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The  
WLB  
Group  
Inc.

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# DYSART DRAIN IMPROVEMENT PROJECT

## CONCEPT DESIGN STUDY

Prepared for:  
**FLOOD CONTROL DISTRICT OF  
MARICOPA COUNTY**

June 2, 1993

Prepared by:  
**THE WLB GROUP, INC.**  
333 East Osborn Road, Suite 380  
Phoenix, Arizona 85012  
(602) 279-1016



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The WLB Group, Inc. was contracted by the Flood Control District of Maricopa County to develop alternative concept designs to improve the Dysart Drain. The existing Dysart Drain channel (see Location Map) has very little stormwater conveyance capacity due to 40 years of land subsidence. The diminished capacity has resulted in frequent, and sometimes severe, flooding on Luke AFB. In response to the flooding problem, the Flood Control District and Luke AFB have agreed to share the cost to improve the conveyance capacity of the Dysart Drain to a 100-year level of service.

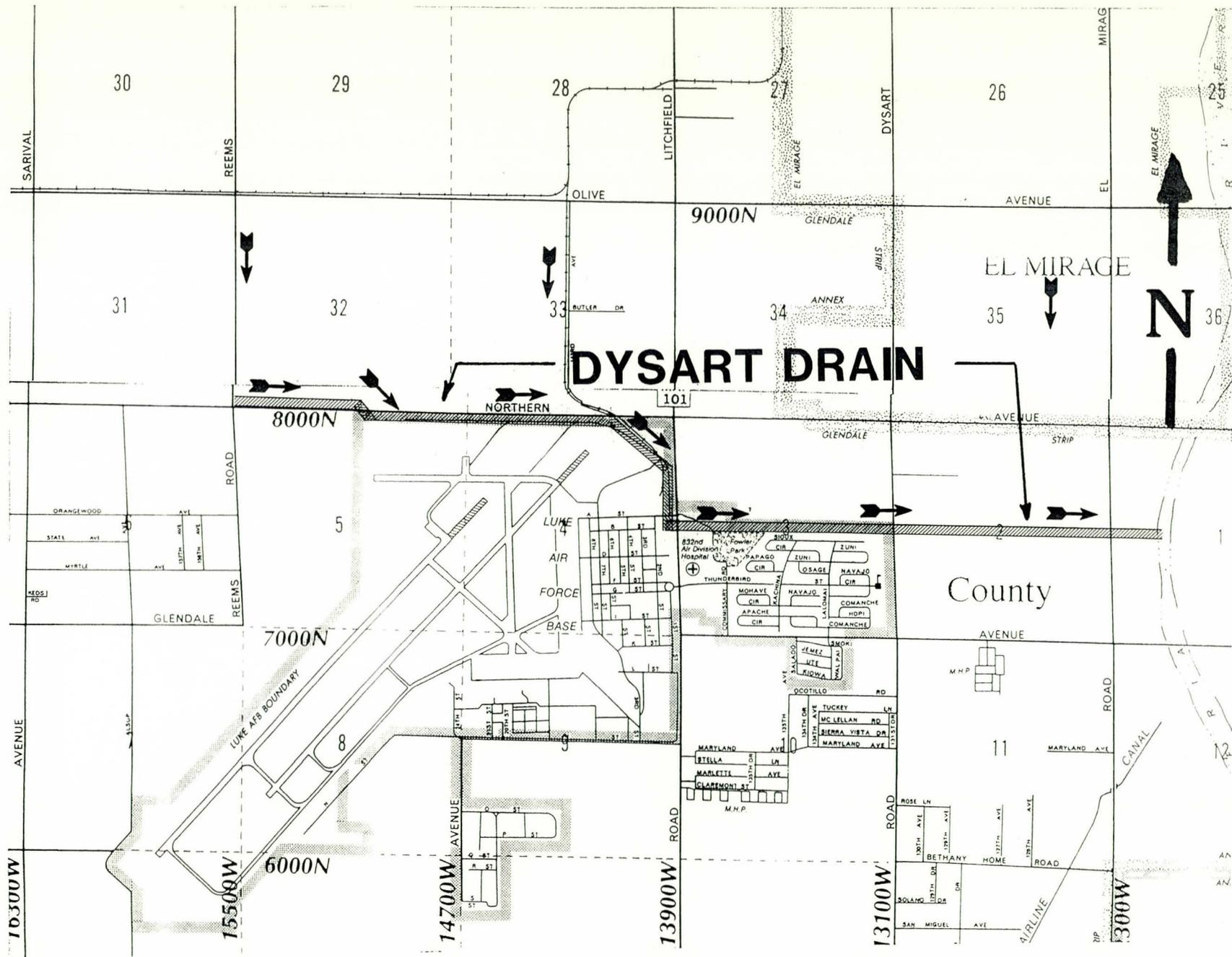
This study provides the Flood Control District and Luke AFB with a variety of alternative concepts and cost estimates in order to determine the most favorable and cost effective plan to improve the flood protection effectiveness of the Dysart Drain. The alternative plans include channel improvement concepts, detention basin schemes and channelization concepts to divert flow away from Dysart Drain.

#### 1.1 PURPOSE OF STUDY

The purpose of this study is to:

1. Investigate alternative concepts for improving the Dysart Drain to a 100-year level of service.
2. Aid in the selection of the preferred alternative concept by providing comparative costs and advantages and disadvantages of each alternative.
3. Provide budgetary costs of the preferred alternative for use by the Flood Control District and Luke AFB.
4. Provide preliminary plans of the preferred alternative to be used as a general guide for the final design.

# LOCATION MAP



## 1.2 HISTORY OF DYSART DRAIN

The Dysart Drain was built by the U.S. Army Corps of Engineers in 1958 to collect off-site stormwater flows and prevent them from entering the Base property. It was constructed in conjunction with McMicken Dam which is located upstream of the Base. McMicken Dam retains flows from a 320 square mile drainage area that would otherwise flood Luke AFB. The floodwaters impounded by the dam are discharged to the Agua Fria River. Dysart Drain's purpose is to collect and convey floodwaters from the contributing drainage area downstream of McMicken Dam. Both McMicken Dam and Dysart Drain were built in response to a large flood that occurred in August of 1951. A subtropical storm system dropped substantial amounts of rainfall in the upstream watershed which resulted in heavy flooding. Luke AFB was inundated which caused extensive damage. In addition to the Base damage, the agricultural fields in the area also experienced substantial damage.

The Dysart Drain has slowly, through time, lost a major amount of its capacity due to land subsidence in the area. The conveyance capacity has decreased from an original design capacity of 1100 cfs down to a current capacity of approximately 300 cfs.

## 1.3 HISTORY OF LAND SUBSIDENCE

Land subsidence in the area around Luke AFB, including Dysart Drain, has been occurring for a number of years. This phenomenon is believed to be a result of groundwater pumping for agricultural purposes. It may also be related to the close proximity of the Luke salt body which is roughly located between Northern Avenue and Camelback Road, east of Litchfield Road to approximately El Mirage Road. The U.S. Geological Survey has, to a limited degree, studied the subsidence in this area, but, at the time of this report, no studies have been published that assess the various elements that may be contributing to the subsidence problem. Therefore, no model exists to predict the rate of future subsidence that may occur.

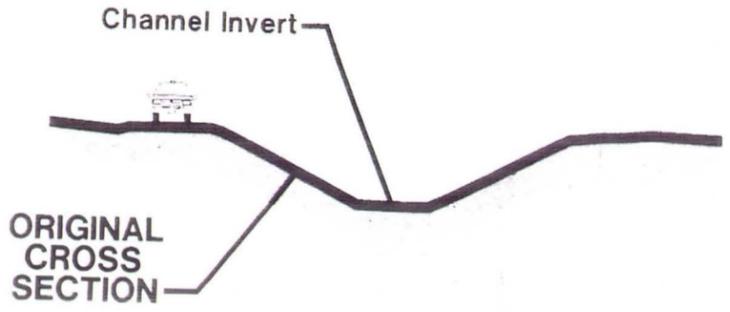
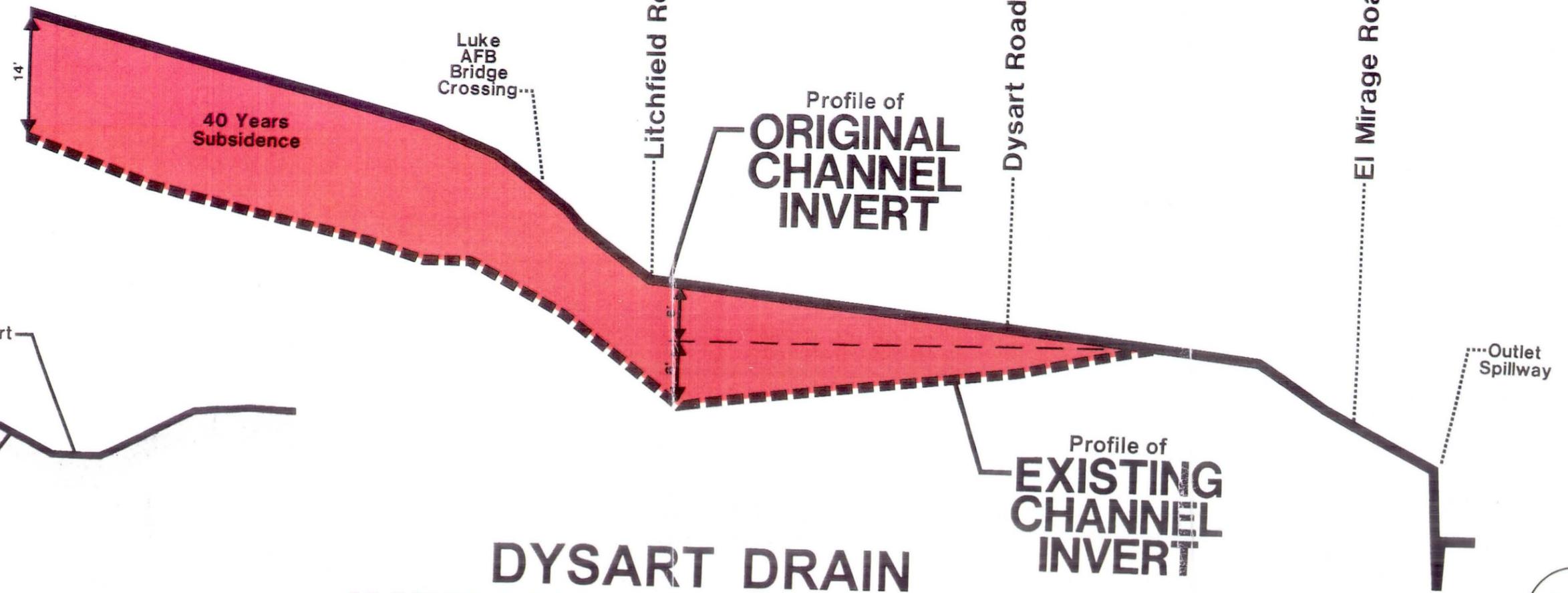
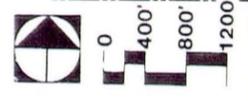
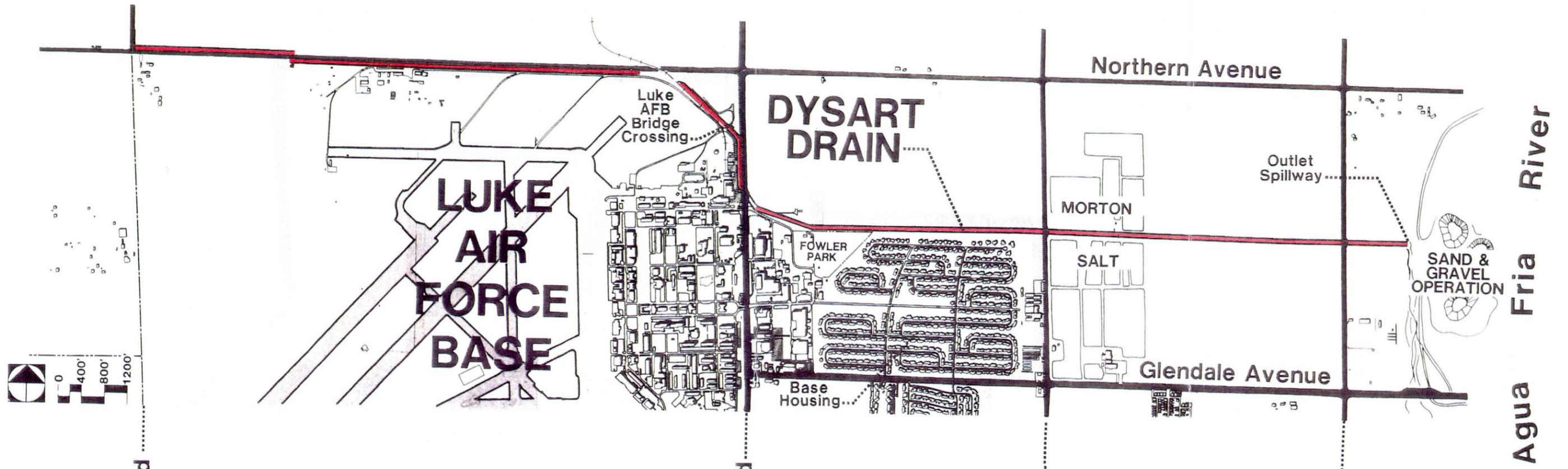


Currently, the Arizona Department of Water Resources regulates the Arizona Groundwater Management Code which is a law that was established to actively manage groundwater withdrawal and replenishment within the state of Arizona. Active Management Areas (AMA's) were set up in regions where severe overdrafts have occurred. The Dysart Drain watershed lies within the Phoenix AMA. A primary management goal of the AMA's is to reach a point where there is no net withdrawal of groundwater by the year 2025. This goal will be obtained by reducing groundwater withdrawal such that the amount of artificial and natural recharge equals the groundwater withdrawals. This program should alleviate the land subsidence problem.

The following table shows the amount of subsidence that has occurred in the general vicinity of Dysart Drain. The 1957 elevations were taken from 7 1/2 minute USGS quadrangle maps and the 1989 elevations were taken from the topographic maps prepared for the White Tanks/Agua Fria ADMS. Both of the mapping sources are based on National Geodetic Vertical Datum.

TABLE OF SUBSIDENCE VALUES IN THE VICINITY OF DYSART DRAIN

LOCATION	1957 ELEVATION	1989 ELEVATION	SUBSIDENCE
Olive Ave. & El Mirage Rd.	1098	1096.8	- 1 Feet
Olive Ave. & Dysart Rd.	1102	1092.5	-10 Feet
Olive Ave. & Litchfield Rd.	1117	1104.3	-13 Feet
Olive Ave. & Reems Rd.	1143	1125.4	-18 Feet
Olive Ave. & Sarival Ave.	1163	1149.4	-14 Feet
Northern Ave. & Litchfield Rd.	1097	1086.8	-10 Feet
Northern Ave. & Sarival Ave.	1140	1126.3	-14 Feet
Glendale Ave. & Dysart Rd.	1084	1082.9	- 1 Feet
Glendale Ave. & Litchfield Rd.	1085	1077.3	- 8 Feet
Glendale Ave. & Sarival Ave.	1113	1101.6	-11 Feet
Bethany Home Rd. & El Mirage Rd.	1037	1036.6	0 Feet
Bethany Home Rd. & Litchfield Rd.	1078	1078.1	0 Feet
Bethany Home Rd. & Sarival Ave.	1089	1080.7	- 8 Feet
Camelback Rd. & Reems Rd.	1054	1053.3	0 Feet



# DYSART DRAIN IMPROVEMENT PROJECT

The WLB Group **WLB**



The problem for the Dysart Drain has been differential land subsidence. No subsidence has occurred at the Luke salt body east of Dysart Road while approximately 12 feet of subsidence has occurred at Litchfield Road and approximately 14 feet has occurred at the upstream end of the drain at Reems Road. This differential subsidence has resulted in very damaging effects on the conveyance capacity of the drain. The exhibit on the previous page demonstrates this subsidence on Dysart Drain.

Differential subsidence of 14 feet has also occurred between the north side and the south side of Luke AFB. The south side of the Base has remained relatively stable with little subsidence.

#### 1.4 DRAINAGE PROBLEMS

Drainage problems along the Dysart Drain are due largely to the land subsidence that has occurred since the channel was built. Currently, three separate areas exist where stormwater flows breakout to the south onto Base property once the capacity of the channel is exceeded.

The first area is located just east of Litchfield Road. This area has subsided approximately 12 feet over the last 40 years which has caused a "low point" or sag in the channel invert. The "low point" is approximately 6 feet lower than the downstream channel invert elevation located at the "hinge point" approximately 1/4 mile east of Dysart Road. This is referred to as the "hinge point" of the channel because little or no subsidence has occurred from this point east to the Agua Fria River. The result is that stormwater flows pond in the channel until the water surface rises to the "hinge point" elevation. At that point, the flows can drain out to the Agua Fria River. When a large storm generates heavy runoff, the channel is not able to handle the discharge conveyed to the "low point" and eventually the water surface elevation reaches a height where flows begin to breakout onto Luke AFB. Under current conditions, 945 cfs will reach this point during the 100-year storm event. 345 cfs is conveyed east in Dysart Drain and the remainder flow of 600 cfs breaks out south over the bank. The breakout flows flood the Base housing area located south of Dysart Drain and east of Litchfield Road.

This problem is compounded by the fact that the Base housing area south of Dysart Drain has also subsided. The subsidence has created a low area where the breakout flows will pond as much as two feet deep before overtopping Litchfield Road. The existing storm drains in this area cannot handle the flows from the breakout and may in fact not be able to handle the flows generated from the local drainage area south of the Dysart Drain. Therefore, this area will still be subject to flooding even after the Dysart Drain is improved.

The second area is located just upstream of the existing 2 - 10' x 5.5' x 640' box culverts located at the north end of the Luke AFB runways. These culverts and the upstream earthen channel are undersized (approximately 500 cfs capacity) to handle the flows that come in from the north along the AT&SF Railroad. The combined flow in Dysart Drain at this point is 2560 cfs. Excess flows (2050 cfs) breakout over the south bank and continue south as sheet flow across the Base runways. This flooding is typically accompanied by large amounts of sediment and debris that is deposited on the runways from the agricultural land upstream. In addition, several buildings adjacent to the runways are normally flooded before the flows exit the Base to the south.

The last area where breakout flows occur is between the west side of Luke AFB and Reems Road. The earthen trapezoidal channel located on the north side of Northern Avenue has insufficient capacity to convey the flows that are collected at Reems Road. Approximately 2350 cfs is carried south on Reems Road to the intersection with Northern Avenue where a grouted riprap inflow spillway collects flows and directs them east in the earthen channel. This channel has capacity for approximately 800 cfs. The remainder of the flow (1550 cfs) will breakout to the south over the top of Northern Avenue. The breakout flow continues south-southeast as sheet flow until it is collected in the channel along the west side of the Base. The west side channel collects flows and conveys them around the south side of the Base and discharges to Bullard Wash. This breakout flow has the least impact on the Base. The 100-year flood is contained in the earthen channel.

## 2.0 EXISTING CONDITIONS

The existing Dysart Drain collects flows from a drainage area of approximately 50 square miles located north and northwest of Luke AFB. The drainage area is composed predominantly of agricultural land. Stormwater travels overland primarily as sheet flow or is collected along roadways and/or farm ditches and heads generally in a southeasterly direction. The average slope of the land is approximately 0.005 ft/ft.

### 2.1 DESCRIPTION OF CURRENT DRAINAGE ELEMENTS

The existing Dysart Drain channel is composed of the following elements:

- A. A concrete-lined trapezoidal channel with a 10 foot bottom width and 2:1 side slopes extends from the Agua Fria River upstream to the outlet of the existing 2 - 10' x 5.5' x 640' box culverts north of the Base runways. The concrete lining height varies from 6.5' to 9.0'.
- B. An earthen trapezoidal channel with a 10 foot bottom width and 4:1 side slopes extends upstream of the 2 - 10' x 5.5' x 640' box culverts to the dip crossing at Northern Avenue.
- C. An earthen trapezoidal channel with an 18 foot bottom width and side slopes that vary from 2:1 to 3:1 extends from the dip section at Northern Avenue to Reems Road along the north side of Northern Avenue.
- D. A large concrete spillway structure is located at the outfall into the Agua Fria River.
- E. Two concrete inflow spillways are located on the north bank of Dysart Drain between Dysart Road and El Mirage Road.
- F. Bridged crossings of the Dysart Drain are located at El Mirage Road, Morton Salt, Dysart Road, Litchfield Road and on Luke AFB just west of Litchfield Road.
- G. A double 10' x 5.5' x 640' box culvert is located under the AT&SF Railroad at the north end of the Luke AFB runways.

- H. A smaller inflow channel directs flows into the Dysart Drain along the west side of Litchfield Road.
- I. Several small pipe culverts bring tailwater flows into the earthen channel between the box culverts and the Northern Avenue dip section.
- J. A 137" x 87" CMPA culvert is located at a driveway on the north side of Luke AFB south of Northern Avenue.
- K. Seven 48" CMP's are located under the Northern Avenue dip section.
- L. Two 66" x 24' CP's are located at a farm access driveway north of Northern Avenue at the west side of Luke AFB.
- M. Four 54" x 24' CP's are located at a farm access driveway north of Northern Avenue approximately 1400 feet east of Reems Road.
- N. A grouted riprap inflow spillway is located at the northeast corner of Reems Road and Northern Avenue and constitutes the beginning of Dysart Drain.

## 2.2 UTILITY CONFLICTS

Utility conflicts were not included as an item to be studied in this concept report, however, the cost estimates include a contingency amount of 20% above the construction cost which should adequately cover utility relocations. Also, a summary of potential utility conflicts was compiled by the Flood Control District of Maricopa County. Please refer to Appendix A for a description of these potential conflicts and a list of utility contacts.

This summary refers to a number of utility maps and plans which are not attached to this report. Please contact Jan Staedicke, Utility Coordinator at the Flood Control District of Maricopa County, for a copy of the maps.

### 3.0 SUMMARY OF ALTERNATIVES

The following sections briefly describe the five alternative concepts which were studied in detail. Descriptions are also provided for other concepts that were considered, but were disregarded after preliminary investigation proved them undesirable or unfeasible. Section 7 provides detailed descriptions and cost estimates for the five alternatives studied.

#### 3.1 ALTERNATIVES STUDIED

*Alternative No. 1* - This alternative was based on the premise that the existing split flow situation at Reems Road and Northern Avenue will remain. The current channel at this location is earthen and has capacity for approximately 800 cfs which is conveyed east in Dysart Drain. The remainder of the flows, approximately 1500 cfs, break out over Northern Avenue and continue south along the west side of the Base. The channel improvements for this alternative begin at the point where Dysart Drain crosses under Northern Avenue. The drain is then rechannelized from this point east to the Agua Fria River to collect and convey the 100-year flood.

*Alternative No. 2* - This alternative is based on the assumption that the entire 100-year storm event will be collected along the Dysart Drain alignment from Reems Road to the Agua Fria River. That is, the breakout at Reems Road will be eliminated with all the flows collected in the Dysart Drain. The new channel is a 20 foot bottom width, concrete lined, trapezoidal section that extends from the Agua Fria River upstream to Reems Road.

*Alternative No. 3* - This alternative consists of collecting the 100-year flow of 2350 cfs at Reems Road and Northern Avenue and diverting it south in a large earthen channel along the west side of Luke AFB to Bullard Wash. The remainder of the flows reaching Dysart Drain are collected and conveyed east in a reconstructed channel to the Agua Fria River.

**Alternative No. 4** - This alternative includes a large detention basin (290 Ac.) located between Reems Road and the AT&SF Railroad immediately north of Northern Avenue. The basin was designed to reduce the peak outflow down to the capacity of the existing 2 - 10' x 5.5' box culverts under the AT&SF Railroad. Therefore, much of the existing Dysart Drain channel will not require any improvements including the box culverts and the entire reach downstream of the box culverts to the low point east of Litchfield Road. However, the channel will need to be reconstructed east of this point to the Agua Fria River due to the existing "hump" in the channel caused by the land subsidence problem.

**Alternative No. 5** - This alternative also utilizes stormwater detention. Two separate basins are proposed. A 125-acre basin is located east of Reems Road and north of Northern Avenue and a 116-acre basin is located north of Northern Avenue and west of the AT&SF Railroad.

The 125-acre basin adjacent to Reems Road detains runoff from the 100-year flood and discharges, at a reduced flow (approximately 550 cfs), into a proposed earthen channel along the west and south sides of the Base that outlets into Bullard Wash.

The 116-acre basin adjacent to the AT&SF Railroad also detains runoff from the 100-year flood. The reduced outflow (approximately 950 cfs) is metered into Dysart Drain and conveyed east to the Agua Fria River. This basin was designed to reduce the peak discharge in the Dysart Drain down to the capacity of the existing 2 - 10' x 5.5' box culverts under the AT&SF Railroad. Therefore, much of the existing Dysart Drain channel will not require any improvement including the entire reach from the box culverts downstream to the low point in the channel east of Litchfield Road. However, due to the subsidence problem, the channel will require reconstruction from the low point out to the Agua Fria River as in Alternative No. 4.

### 3.2 ADDITIONAL CONCEPTS CONSIDERED

In addition to the five alternatives described above, several other options were also considered but were ruled out for the reasons explained in the paragraphs below.

#### A. Diversion Channel North of Dysart Drain

The option of a diversion channel north of Dysart Drain was investigated to reduce peak flows that reach the channel. This alternative did not make economic sense, and in fact would almost double the total cost. The reason is that the majority of the Dysart Drain would have to be rebuilt, regardless of the diversion channel and the corresponding reduced flows, to remove the "hump" in the channel caused by the land subsidence problem.

#### B. Piped Drain Under the Channel

The Flood Control District of Maricopa County is in the process of modifying the channel between Dysart Road and El Mirage Road. The channel invert is being lowered approximately 6 feet at the "hump" as a temporary solution to increase flow capacity.

An option was investigated to construct a large 8' diameter pipe under the modified channel to drain the low point east of Litchfield Road and not do any further improvements to the channel. The channel modification reduces the ponding from approximately 6 feet to 4 feet and provides better outfall to the Agua Fria River but only increases the channel capacity to about 900 cfs. At most, the pipe capacity would equal around 400 cfs for a total capacity of 1300 cfs. This improvement would provide adequate conveyance capacity under current conditions for the detention basin schemes in Alternatives 4 and 5. However, if any future subsidence occurs, the capacity would be reduced and the same flooding problems that occur today would reappear.

This option would save on channel lining costs and would save the cost of rebuilding both the Dysart and El Mirage Road bridges. However, because of the need to provide flood protection under future subsidence conditions, this alternative was dropped from further consideration.

C. Preserve Dysart Road Bridge Design

An option was considered to incorporate the future Dysart Road Bridge which has already been designed by the Maricopa County Department of Transportation based on the existing channel configuration. This option would require retaining walls under the bridge with channel transitions on each side to transition back to the trapezoidal section. A cursory investigation of construction costs indicated that there would not be any substantial cost savings by preserving the bridge as designed. In fact, the costs are approximately the same whether the bridge is preserved or lengthened.

D. Detain Entire 100-Year Flood

A detention scheme was also considered to store the entire 100-year peak discharge on the north side of Northern Avenue between Reems Road and the AT&SF Railroad. The purpose of this option was to substantially reduce the peak flow in Dysart Drain so that no channel improvements would be necessary beyond the interim improvements that the Flood Control District is currently constructing.

A cursory look at this scheme indicated that approximately 1800 acre-feet of storage would be required. This translates into a basin that is either very large in area or very deep. The deep basin option would require a lift station to drain the basin. The shallow basin would require a land area of approximately 600 acres. In either case, this alternative would be substantially more expensive than either Alternatives 4 or 5.

In addition, as was the case with option B above, the anticipated future land subsidence would result in inadequate future capacity in the Dysart Drain to collect and convey the local drainage downstream of the basin. This is true even with the proposed Flood Control District interim channel modifications.

The HEC-1 hydrologic model utilized to study the Dysart Drain Channel was taken from the White Tanks/Agua Fria Area Drainage Master Study (ADMS). This ADMS was prepared for the Flood Control District of Maricopa County (FCDMC) by The WLB Group, Inc. The following Drainage Area Map, taken from the ADMS, shows the location of the Dysart Drain and the associated watershed.

#### 4.1 HYDROLOGIC ASSUMPTIONS

The existing White Tanks/Agua Fria ADMS HEC-1 model utilizes the following elements to calculate rainfall runoff:

Rainfall - The 100-year, 24-Hour rainfall amount of approximately 4.0 inches was used as an average for the entire watershed.

Rainfall Distribution - The SCS Type II rainfall distribution pattern was utilized.

Depth-Area Reduction - The NOAA Atlas II, Arizona, provided the depth-area reduction relationships for the 24-hour storm.

Rainfall Losses - The Green and Ampt infiltration equation was used to estimate rainfall losses and requires the classification of soils based on soil texture to compute infiltration.

Unit Hydrograph - The Phoenix Valley S-Graph was utilized for unit hydrograph computation.

Channel Routing - Normal-depth channel routing was used to route the computed hydrographs through each reach of the watershed.

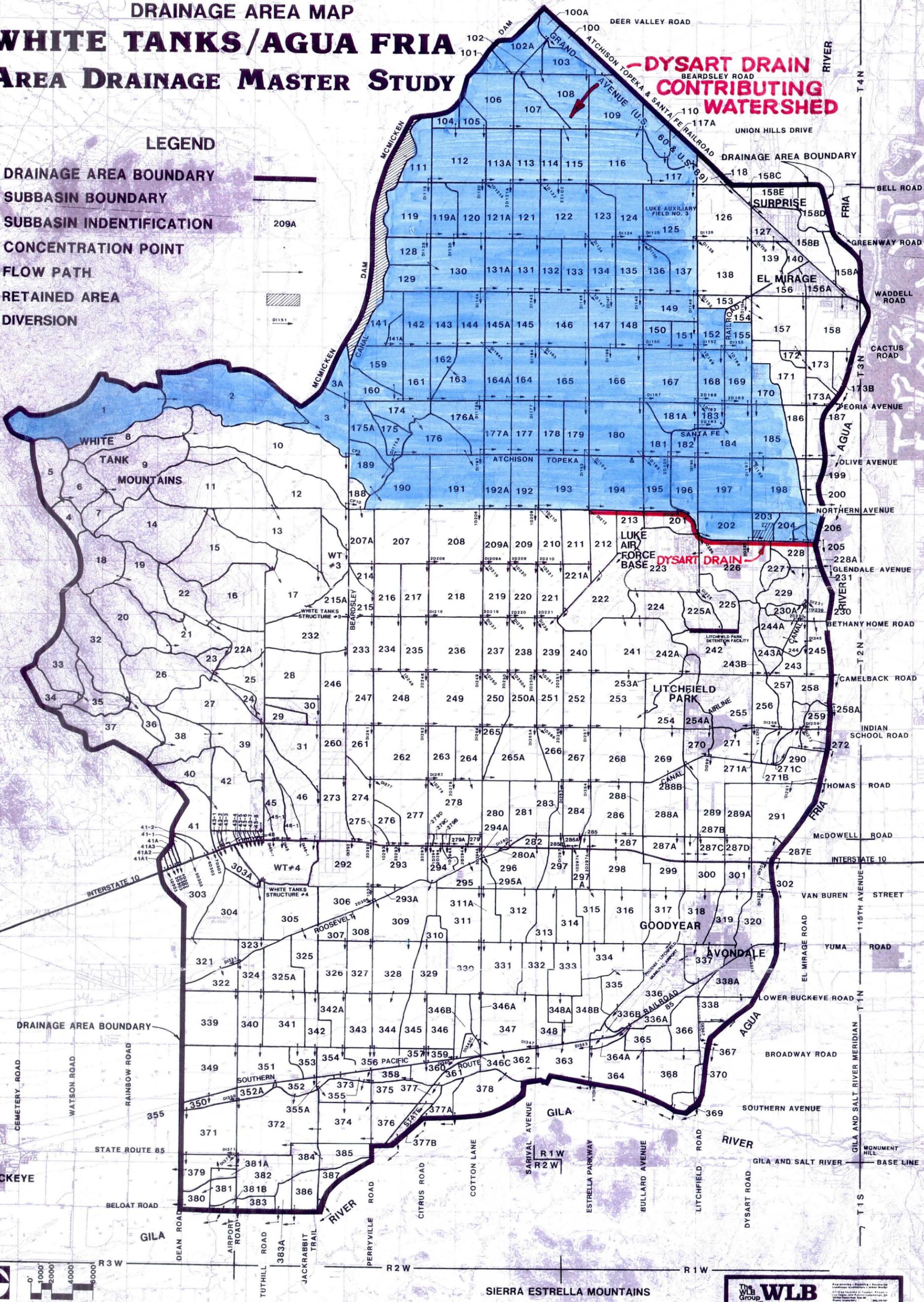
# DRAINAGE AREA MAP

## WHITE TANKS/AGUA FRIA

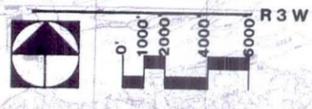
### AREA DRAINAGE MASTER STUDY

#### LEGEND

- DRAINAGE AREA BOUNDARY 
- SUBBASIN BOUNDARY 
- SUBBASIN IDENTIFICATION 
- CONCENTRATION POINT 
- FLOW PATH 
- RETAINED AREA 
- DIVERSION 



**DYSART DRAIN CONTRIBUTING WATERSHED**





For a more complete discussion of the hydrologic parameters, please refer to the White Tanks/Agua Fria Area Drainage Master Study, Part A: Flood Study Technical Data Notebook and to the Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology. These references document the input data to the HEC-1 model and discuss the reasoning and methodology for the chosen parameters.

For each alternative, minor modifications were made to the HEC-1 model to determine peak discharges in the Dysart Drain. These modifications include:

- A. Eliminating the diversions on Dysart Drain.
- B. Recomputation of the way the drainage areas were added together for the concepts that divert part of the runoff south along the west side of the Base.
- C. Stage-Storage-Discharge tables for each detention basin alternative were added to the model. (Backup data is located in Appendix D - Hydraulic Design Data.)

Also, some of the channel routing routines were modified in some of the alternatives to account for increases or decreases in routing reach lengths, changes in slope and changes in channel shape.

Routing reaches along the length of the Dysart Drain were not modified for each alternative as each has approximately the same channel elements, therefore, velocities and travel times would stay approximately the same.

The numbering scheme for each subwatershed stayed the same so that peak discharges could easily be compared at any specific point of interest.

4.2 HYDROLOGIC MODEL DESIGNATIONS

The hydrologic model designations relate to the five alternatives studied in the following manner:

ALTERNATIVE	HYDROLOGIC MODEL DESIGNATION
N/A	DYSEXIST.24
No. 1	DYSPLIT.24
No. 2	DYSEAST.24
No. 3	DYSSOUTH.24
No. 4	DYDTPD1E.24
No. 5	DYDTPD2S.24

Briefly, the hydrologic models refer to the following assumed flow conditions:

*DYSEXIST.24* - This is the existing conditions model with breakout flows along Dysart Drain at Reems Road, at the north end of the Luke AFB runways, and just east of Litchfield Road.

*DYSPLIT.24* - The existing condition split flow continues to occur at Reems Road and Northern Avenue and the remainder of the flow collected along Dysart Drain is conveyed to the Agua Fria River. That is, the breakout flows at the north end of the runways and just east of Litchfield Road are eliminated.

*DYSEAST.24* - All of the stormwater flows are collected along the Dysart Drain alignment starting at Reems Road and are conveyed east to the Agua Fria River without any breakouts.

*DYSSOUTH.24* - Flows collected between Reems Road and the west end of Luke AFB (along Northern Avenue), are conveyed south under Northern Avenue around the west and south side of Luke AFB. The remainder of the flows collected along the Dysart Drain are conveyed east to the Agua Fria River.

DYDTPDIE.24 - One 290-acre detention basin is included in this model on the north side of Northern Avenue, between Reems Road and the AT&SF Railroad. Stormwater outflow is directed into the Dysart Drain and conveyed east to the Agua Fria River.

DYDTPD2S.24 - Two detention basins are included in this model on the north side of Northern Avenue; a 125-acre basin east of Reems Road and a 116-acre basin west of the AT&SF Railroad. The basin adjacent to Reems Road will outflow south under Northern Avenue and around the west side of Luke AFB. The basin adjacent to the AT&SF Railroad will outflow into the Dysart Drain and out to the Agua Fria River.

#### 4.3 SUMMARY OF PEAK DISCHARGES

The following table summarizes the 100-year peak discharges for various concentration points along Dysart Drain and around the west and south side of Luke AFB. Following the table is a schematic diagram showing the location of the concentration points.

It should be mentioned that each hydrologic model includes Bullard Wash all the way downstream to the Gila River. Therefore, each alternative can be evaluated for impacts downstream on Bullard Wash. It should also be mentioned that all five alternatives result in reduced peak flows on Bullard Wash.

The HEC-1 hydrologic models can be found under separate cover in Appendix E, Volumes I, II, III and IV. Input files for each model are also located in the front of Appendix E, Volume I of IV on a 5 1/4" floppy disk.

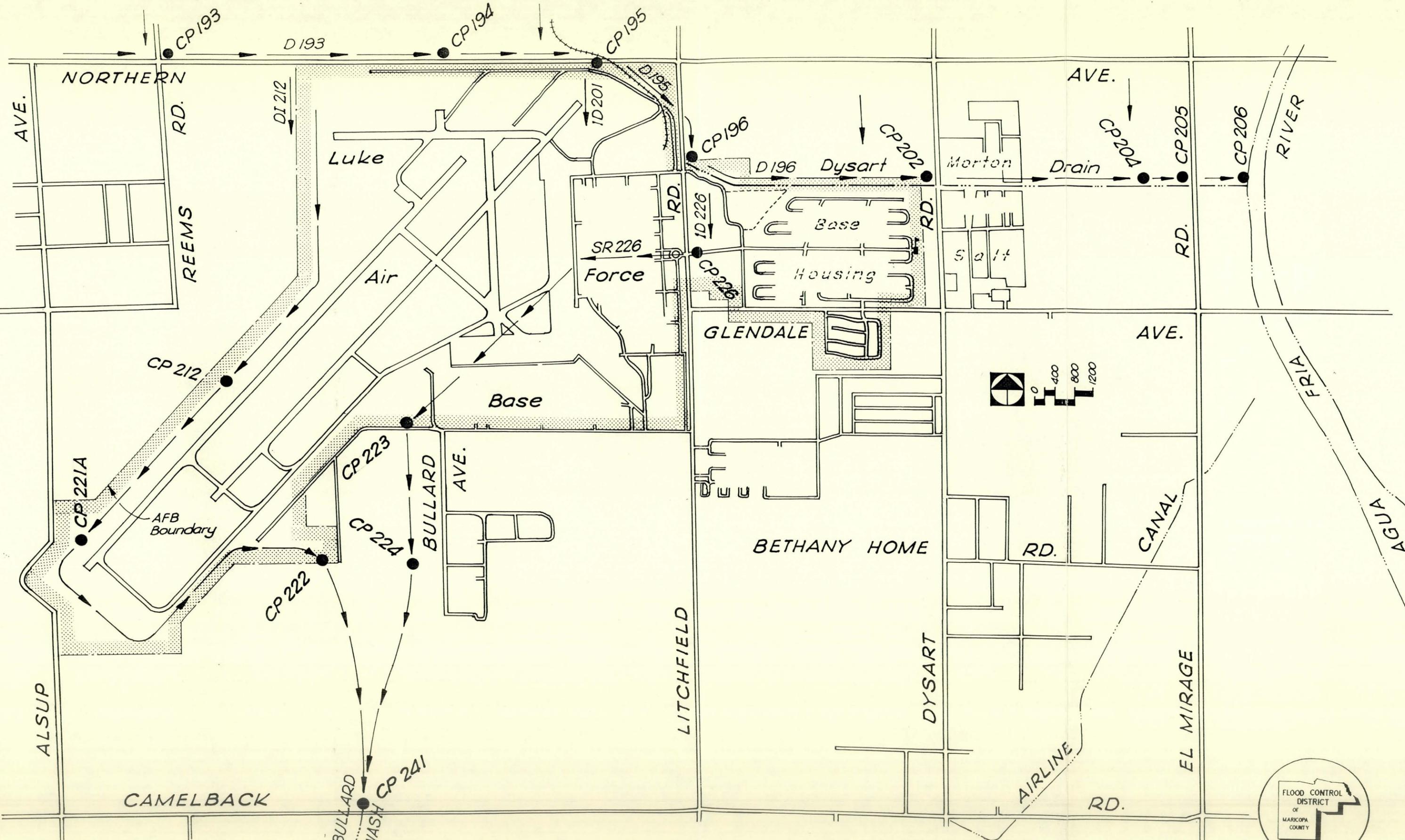


SUMMARY OF 100-YEAR DISCHARGES FOR DYSART DRAIN IMPROVEMENT PROJECT						
CONCENTRATION POINT (LOCATION)	DRAINAGE MODELS DISCHARGE, CFS					
	Existing Condition DYSEXIST.24	Alt. No. 1 DYSPLIT.24	Alt. No. 2 DYSEAST.24	Alt. No. 3 DYSSOUTH.24	Alt. No. 4 DYDTPD1E.24	Alt. No. 5 DYDTPD25.24
CP193 (Reems Road)	2350	2350	2350	2350	2350	2350
DI212 (Diversion south along west side of Luke AFB)	1540	1540	0	2350	0	550
D193 (Remainder Flow East)	810	810	2350	0	500	0
CP194 (Bullard Ave. Extended)	875	970	2410	535	600	535
CP195 (Upstream of Luke AFB R.R. Box Culverts)	2560	2560	3940	1795	2080	1795
1D201 (Diversion south onto Luke AFB)	2050	0	0	0	0	0
D195 (Remainder Flow East)	510	2560	3940	1795	945	980
CP196 (Litchfield Rd.)	945	2835	4190	2070	1220	1385
1D226 (Diversion south - just east of Litchfield Rd.)	600	0	0	0	0	0
D196 (Remainder Flow East)	345	2835	4190	2070	1220	1385
CP202 (Dysart Rd.)	565	2820	4160	2060	1215	1380
CP204 (Upstream of Inflow Spillway)	565	2820	4160	2060	1215	1380

SUMMARY OF 100-YEAR DISCHARGES FOR DYSART DRAIN IMPROVEMENT PROJECT						
CONCENTRATION POINT (LOCATION)	DRAINAGE MODELS DISCHARGE, CFS					
	Existing Condition DYSEXIST.24	Alt. No. 1 DYSPLIT.24	Alt. No. 2 DYSEAST.24	Alt. No. 3 DYSSOUTH.24	Alt. No. 4 DYDTPD1E.24	Alt. No. 5 DYDTPD25.24
CP204 (Downstream of Inflow Spillway)	1720	3880	5110	3140	2565	2680
CP205 (E1 Mirage Rd.)	1720	3880	5110	3140	2565	2680
CP206 (Dysart Drain Outlet Spillway)	1720	3880	5110	3140	2565	2680
CP212 (West of Luke AFB at Approx. Reems Rd. and Glendale Ave.)	1350	1350	380	2415	380	590
CP221A (Southwest Corner of Luke AFB)	1380	1380	590	2580	590	715
CP222 (South Side of Luke AFB)	1380	1380	700	2630	700	900
CP226 (Base Drainage to East of Litchfield Rd.)	1575	1575	1575	1575	1575	1575
SR226 (Outflow After Storage at Litchfield Rd.)	534	503	503	503	503	503
CP223 (Base Drainage - West of Litchfield Rd.)	2525	1775	1775	1775	1775	1775
CP224 (Base Drainage - South Side of Base)	2455	2140	2140	2140	2140	2140



SUMMARY OF 100-YEAR DISCHARGES FOR DYSART DRAIN IMPROVEMENT PROJECT						
CONCENTRATION POINT (LOCATION)	DRAINAGE MODELS DISCHARGE, CFS					
	Existing Condition DYSEXIST.24	Alt. No. 1 DYSPLIT.24	Alt. No. 2 DYSEAST.24	Alt. No. 3 DYSSOUTH.24	Alt. No. 4 DYDTPD1E.24	Alt. No. 5 DYDTPD25.24
CP241 (Combined Flows at Camelback Rd.)	4245	2650	2720	3440	2720	2360



**SCHEMATIC DIAGRAM FOR SUMMARY OF PEAK DISCHARGES**  
**DYSART DRAIN IMPROVEMENT PROJECT**



4.3 DETENTION BASIN DISCHARGES FOR PROBABLE MAXIMUM FLOOD

The detention basins for Alternative No. 4 and Alternative No. 5 are designed with berming to minimize the amount of cut. The berms, as they are now designed, are classified as small dams under current Arizona Department of Water Resources criteria. Under this criteria, certain requirements must be met including the design of overflow spillways to pass the 1/2 Probable Maximum Flood (PMF) with a minimum residual freeboard of approximately 3 feet.

Two storms, the 6-hour Local Storm - Probable Maximum Precipitation (PMP) and the 72-hour General Storm - PMP, were compared to see which would give the higher PMF discharge. The 6-hour Local Storm results in the highest peak discharge for this watershed and was subsequently chosen to design the overflow spillways. Even though the 72-hour General Storm has a larger amount of rainfall, the 6-hour Local Storm has a shorter, more intense rainfall distribution resulting in a higher peak discharge.

Precipitation for each storm was calculated utilizing the Hydrometeorological Report No. 49. Rainfall for each storm event is as follows:

6-Hour Local Storm PMP	72-Hour General Storm PMP
11.7 In	16.0 In

Data computations for each storm event are presented in Appendix B.

Peak discharges and water surface elevations for the 1/2 PMF, along with pertinent detention basin data, are given on the following table for the 6-hour Local Storm.

PEAK DISCHARGES FOR 6-HOUR LOCAL STORM - 1/2 PROBABLE MAXIMUM FLOOD AND CORRESPONDING DETENTION BASIN DESIGN ELEMENTS								
ALTERNATIVE NO. 4								
WEST DETENTION BASIN (CONCENTRATION POINT 193)					EAST DETENTION BASIN (CONCENTRATION POINT 195)			
6-Hour Local Storm 1/2 PMF Outflow	Water Surface Elev.	Spillway Height		Berm Height (Min.)	6-Hour Local Storm 1/2 PMF Outflow	Water Surface Elev.	Spillway Height Primary	Berm Height (Min.)
		Primary	Secondary					
10155 CFS	1103.81	1100.0	1102.0	1110.0	14,510 CFS	1098.84	1095	1102.0
ALTERNATIVE NO. 5								
WEST DETENTION BASIN (CONCENTRATION POINT 193)					EAST DETENTION BASIN (CONCENTRATION POINT 195)			
6-Hour Local Storm 1/2 PMF Outflow	Water Surface Elev.	Spillway Height		Berm Height (Min.)	6-Hour Local Storm 1/2 PMF Outflow	Water Surface Elev.	Spillway Height Primary	Berm Height (Min.)
		Primary	Secondary					
10520 CFS	1105.06	1102.0	1102.0	1110.0	11150 CFS	1098.29	1095	1102.0

The spillway capacities for both alternatives easily pass the computed 1/2 PMF with more than the minimum of three feet of residual freeboard between the top of the berm and the peak water surface elevation.

The 100-year HEC-1 model was used to calculate the PMF without any changes to the upstream routing reaches or diversion schemes. In actuality, the Probable Maximum Flood would result in widespread flooding that would not follow all of the flow paths as defined in the 100-year hydrologic model. Therefore, the computed discharge at the detention basins may be somewhat conservative.

The HEC-1 hydrology models used to determine the 6-hour Local Storm PMF can be found in Appendix E. Backup design data for the detention basins can be found in Appendix D - Hydraulic Design Data.

## 5.0 HYDRAULIC DESIGN

The following sections discuss the hydraulic design assumptions that were incorporated in this concept study.

### 5.1 FUTURE LAND SUBSIDENCE

Due to the problem of land subsidence, it was deemed necessary to incorporate some estimate of probable future subsidence into the channel design. That is, the channel improvements were designed so that 100-year flood protection will be provided in the future, after further subsidence has occurred. To this date, no data exists and no studies have been performed to estimate the rate of future subsidence. Therefore, it was necessary to make an assumption for design purposes.

Conversations with staff at the USGS indicate that the rate of subsidence usually decreases with time as the underlying soil layers become compacted. It is also known that the Arizona Groundwater Management Act will require that there be no net withdrawal of groundwater by the year 2025. Using these generalities as a basis, it was assumed that the rate of subsidence over the next 40 years will continue at a rate of approximately half of what has occurred over the past 40 years. It was also assumed that no significant subsidence will occur beyond 40 years in the future due to the enactment of the Arizona Groundwater Management Act.

The following estimates of future subsidence were assumed for the Dysart Drain and for the channel on the west side of the Base. These values were used to design the various channel alternatives, making sure that each design would continue to function in the future. No appreciable future subsidence is expected east of the "hinge point" in Dysart Drain.

LOCATION	ASSUMED SUBSIDENCE
"Hinge Point" East of Dysart Road	0.0 Feet
Litchfield Road	7.0 Feet
Reems Road	9.0 Feet
South Side of Luke AFB	0.0 Feet

Differential subsidence has occurred throughout this area and the above values take this into consideration. A straight-line interpolation was made between each assumed value to compute subsidence for any given location along the channel.

## 5.2 CHANNEL DESIGN

Channel design for each alternative is based on the premise that a subcritical flow regime will be maintained wherever new construction takes place. In some alternatives however the existing concrete-lined channel is preserved between Litchfield Road and the railroad box culverts where existing slopes are relatively steep. In these alternatives, supercritical flow will occur downstream of the box culverts with a hydraulic jump upstream of Litchfield Road. The height of the existing concrete lining in these alternatives is increased to provide adequate freeboard.

Velocities in the proposed concrete-lined sections are kept below 15 fps and in earthen sections the velocity is kept to 5 fps or less. Erosion protection is provided in earthen channels at bends and at the upstream and downstream end of culverts.

Side slopes for concrete-lined channels are 2H:1V and side slopes for earthen channels are a minimum of 4H:1V.

Concrete lining in the existing channel is 6" on the side slopes and 8" on the invert. Both are reinforced with No. 4 over No. 5 rebar on 12" centers. It was assumed that, at a minimum, the new channel lining should incorporate the same design as the existing channel. However, geotechnical investigations that are done with the final design may require a different lining design.

As part of the final design, the need for under-drainage should be evaluated to prevent damage to the concrete-lining due to hydrostatic back pressure or possible subgrade erosion.

Appendix D (under separate cover) includes the step backwater calculations and culvert design calculations for each alternative.

### 5.3 DETENTION BASIN DESIGN

Detention basin schemes are utilized in Alternatives No. 4 and 5. These basins are designed so that the excavated soil can be spoiled on site. The acquisition of additional basin area is proposed for this purpose as the cost to haul away the spoil is more expensive than the additional right of way costs. Spoil areas in the basins are designed to have an average height of 30 feet above existing grade.

The basins were designed to reduce the peak outflow down to the existing capacity of the existing 2 - 10' x 5.5' box culverts under the AT&SF Railroad at the north end of the Base runways.

Grouted riprap inflow spillways or other adequate erosion protection will be required at a number of inflow locations. Berming was included along the north and west edge of the basins to concentrate flows at the inflow spillways. The purpose of the berms is to minimize the number of spillways required.

The low end of the detention basins were diked with large berms to minimize the amount of soil excavation. These dikes are located around the east and south sides of the basins. Since the berms are higher than 6 feet, they would be considered small dams under current Arizona Department of Water Resources criteria and, therefore, overflow spillways were incorporated to pass 1/2 of the Probable Maximum Flood with a minimum residual freeboard of approximately 3 feet. The 6-hour Local Storm - Probable Maximum Precipitation was used to design these overflow spillways. The spillways are not elevated. Instead they are level with the existing ground elevation which minimizes the need for erosion protection. (Refer to the plan and profile for Alternative No. 4 and 5.)

The west basin in alternative No. 4 has a primary spillway located between the two basins at an elevation below the existing ground. This spillway allows excess flows to enter the eastern basin once the western basin is filled to capacity. This entire spillway will need to be protected to prevent failure in case of a large flood event. Design data for these basins is located in Appendices D and E.

Minimum side slopes for the detention basins were set at 6:1. No attempt was made to shape the basin for aesthetic purposes, however, undulation of the side slopes and the strategic mounding of the spoil areas could enhance the overall visual impact of the basin. This should be considered during final design.

#### 5.4 SECTION 404 PERMIT

The Flood Control District of Maricopa County has contacted the Corps of Engineers to ascertain whether a 404 permit will be required for this project. A letter was received from the Corps indicating that indeed the project would impact the Agua Fria River at the spillway outlet of the Dysart Drain. The letter and maps (see Appendix C) from the Corps of Engineers delineates the jurisdictional limits of the Clean Water Act for the Agua Fria River. The Corps should be contacted during final design to determine permit requirements for the reconstruction of the Dysart Drain.



## 6.0 ASSUMPTIONS FOR COST ESTIMATES

Cost estimates for this concept study were based on information obtained from a number of sources including area contractors; Means Site Work and Landscape Cost Data, 1992; and ADOT Construction Cost Data, 1990.

Cost estimates were separated into Off-Base Costs and On-Base Costs. Off-Base Costs include demolition and replacement of existing bridges off the Base, all right of way acquisitions, channel costs located outside of Base property, and detention basin costs.

On-Base Costs include demolition, excavation, and replacement of the Dysart Drain channel and demolition and replacement of bridges and culverts which are located on the Base.

Cost estimates for each alternative design include a contingency cost equal to 20% of the construction cost to cover utility relocations any other unforeseen costs. Another 20% is added to the total construction cost to account for engineering and construction management.

The following unit prices were utilized to estimate the cost of construction.

<u>Description</u>	<u>Unit Cost</u>
New Concrete Channel Lining	\$22/S.Y.
Demolish Concrete Channel Lining	\$.75/S.F.
Demolish and Remove Bridges	\$15,000 - \$35,000 Ea.
Replace Bridges	\$45/S.F.
Grouted Riprap Protection	\$22/S.Y.
Remove and Replace Asphalt Pavement	\$15/S.Y.
Channel Excavation (Truck Haul)	\$3.00/C.Y.
Channel and Detention Basin Excavation (Scraper Haul)	\$1.00/C.Y.
Concrete Transition/Retaining Walls	\$30/S.F.
Remove and Replace Railroad Track	\$50/L.F.
Concrete Drop Structures	\$5,000 - \$15,000 Ea.
Rock Riprap Protection	\$50/C.Y.
3 - 10' x 4' Box Culverts	\$790/L.F.
1 - 8' x 5' Box Culvert	\$250/L.F.
2 - 8' x 5' Box Culverts	\$410/L.F.



2 - 8' x 6' Box Culverts	\$435/L.F.
2 - 10' x 6' Box Culverts	\$600/L.F.
1 - 10' x 7' Box Culvert	\$370/L.F.
3 - 10' x 7' Box Culverts	\$900/L.F.
4 - 10' x 7' Box Culverts	\$1,200/L.F.
Right of Way (Channel)	\$.15/S.F.
Right of Way (Detention Basin)	\$5,000/Ac.
20% Contingencies (Includes Utility Relocation)	% of Construction Cost
20% Engineering and Construction Management	% of Total Construction Cost

Cost estimates for each Alternative can be found in Section 7.0 of this report.

## 7.0 DESCRIPTION OF ALTERNATIVES AND COST ESTIMATES

This section provides descriptions of each alternative including a discussion of advantages and disadvantages, cost estimates, right of way requirements, and preliminary plan and profile sheets.

### 7.1 ALTERNATIVE NO. 1

This alternative is based on allowing the existing split flow at Reems Road and Northern Avenue to remain. Under current conditions, the Dysart Drain has insufficient capacity at Reems Road which is the upstream end of the channel. The result is a split flow with approximately 800 cfs flowing easterly in Dysart Drain and 1500 cfs flowing southerly over Northern Avenue and along the west side of Luke AFB.

The effects on Luke AFB caused by the split flow appear to be minimal. Except for the area at the extreme south end of the runway; the flow is contained in the existing earthen channel along the west side of the base.

#### 7.1.1 DESCRIPTION OF IMPROVEMENTS AND R/W REQUIREMENTS (Refer to Plan Sheets)

##### *Sta. 10+40 to 113+15 (Agua Fria River Upstream to West Side of the Base Housing Area)*

##### Channel Improvements:

This portion of the channel requires complete reconstruction in order to remove the sag in the existing channel east of Litchfield Road. The work includes: removing the existing concrete channel lining and the existing farm bridge east of Dysart Road; excavation to lower the channel invert; removal and replacement of the El Mirage Road and Dysart Road bridges; and new concrete channel lining.

Right of Way Requirements:

An additional 30 feet of right of way is required on the south side of the channel from the Agua Fria River to Dysart Road. The existing right of way in this reach is 130 feet. The required right of way is 160 feet.

In addition to the above requirement, 60 feet of additional right of way is required between Dysart Road and the Base (Sta. 72+29 to Sta. 77+05). In this area, the existing right of way is 100 feet and the required right of way is 160 feet.

These right of way requirements were determined for the widest channel section which occurs at the location with the deepest cut (28 foot cut at Sta. 54+00). The right of way is also based on having a maintenance road on each side of the channel. Therefore, the right of way requirement could be reduced by 1) eliminating one maintenance road or 2) narrowing the right of way in areas of shallower cuts. A critical area is where Morton Salt is located, as some of their drying beds may have to be reconfigured to accommodate the proposed channel. This is also where some of the deepest cuts occur.

***Sta. 113+15 to 146+00 (West Side of Base Housing to the Railroad)***

Channel Improvements:

The existing concrete lined channel in this reach is to remain and the channel lining is extended to the top of bank. In addition, the south bank is raised east of Litchfield Road to prevent breakout of flows onto the Base housing area. The Base bridge west of Litchfield Road also remains.

Right of Way Requirements:

No right of way is required for this reach. The channel is located on Base property.

***Sta. 146+00 to 157+78 (Railroad Box Culverts)***

**Channel Improvements:**

The improvements for this section of the channel involve the construction of three new 10' x 7' x 640' box culverts that will abut the south edge of the existing box culverts at the north end of the runway. The improvements also include the channel transitions on both ends of the new box culverts and removing and replacing the railroad.

There is an option (Option 1) in the cost estimate to reduce the length of the box culverts. The existing box culverts are much longer than what is necessary for the railroad crossing. If Luke AFB can accept an open channel at the end of the runway, there are substantial cost savings in reducing the length of the box culvert. The length required for the railroad is approximately 150 feet which results in a length reduction of 490 feet.

**Right of Way Requirements:**

No right of way is required in this reach. The channel is located on Base property.

***Sta. 157+78 to 215+00 (Railroad Box Culverts to the Northern Avenue Culvert Crossing)***

**Channel Improvements:**

The existing earthen channel in this section is to be enlarged. Other improvements include: a long spillway (approximately 1700 feet) to collect flows that concentrate along the AT&SF Railroad; relocation of the Base road that parallels the channel; raising the south bank of the channel upstream of the box culverts to increase the capacity of the culverts; and constructing 2 - 10' x 6' box culverts at the north driveway entrance onto the Base.

An option (Option 2) is included in the cost estimate to concrete-line the channel in this section.



Right of Way Requirements:

No right of way is required in this reach. The channel is located on Base property.

*Sta. 215+00 to 219+40 (Northern Avenue Culvert Crossing)*

Channel Improvements:

The existing Northern Avenue "Dip Section" and culvert crossing are reconstructed in order to provide for the 100-year flood with no more than 0.5 foot of floodwater over the roadway. The existing earthen channel, west of this location, is not improved.

Right of Way Requirements:

No right of way is required at this location. The improvements are within the existing Northern Avenue R/W.

7.1.2 ADVANTAGES AND DISADVANTAGES

Advantages:

1. Cost

This is the lowest cost alternative.

2. Maintenance

Since most of the channel will be concrete-lined, this alternative has one of the lowest maintenance requirements. Only the portion on the north side of the Base will be earthen lined. The rest of the channel improvements are concrete lined.



3. Litchfield Road Bridge

In this alternative the Litchfield Road bridge remains. This is an advantage, not only because of the cost of the bridge, but also because of the problem of maintaining adequate traffic flow on Litchfield Road during construction.

Disadvantages:

1. Split Flow at Reems Road

As stated previously, this alternative does not collect all of the runoff at Reems Road and the existing condition split flow will continue to occur.

7.1.3 COST ESTIMATE (Refer to the Itemized Estimates)

SUMMARY OF COST ESTIMATES FOR ALTERNATIVE 1			
DESCRIPTION	ALTERNATIVE 1	W/OPTION 1	W/OPTION 2
Cost Reduction (-) / Increase (+)		- \$545,200 (ON-BASE)	+ \$728,900 (ON-BASE)
Total On-Base Cost	\$5,871,000	\$5,325,800	\$6,599,900
Total Off-Base Cost	\$1,480,800	\$1,480,800	\$1,480,800
<b>TOTAL COST</b>	<b>\$7,351,800</b>	<b>\$6,806,600</b>	<b>\$8,080,700</b>

Option 1: Reduce length of box culverts at north end of runway to 150 feet.

Option 2: Provide concrete channel lining along north edge of Luke AFB between Northern Avenue dip section and entrance to box culverts at the end of the runway.

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 1  
COST ESTIMATE

(OFF-BASE PORTION)

Page 1 of 4

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove El Mirage Road Bridge	1 Ea.	\$35,000	\$35,000
Demolish and Remove Dysart Road Bridge	1 Ea.	\$25,000	\$25,000
Demolish and Remove Farm Bridge	1 Ea.	\$15,000	\$15,000
Replace El Mirage Road Bridge (105' x 84')	8820 S.F.	\$45/S.F.	\$396,900
Replace Dysart Road Bridge (110' x 84')	9240 S.F.	\$45/S.F.	\$415,800
3 - 10' x 4' x 120' Box Culverts	120 L.F.	\$790/L.F.	\$94,800
Grouted Riprap Inlet Protection (Northern Ave. Culverts)	330 S.Y.	\$22/S.Y.	\$7,300
Rebuild and Replace Asphalt Pavement (Northern Ave. Dip Section)	1100 S.Y.	\$15/S.Y.	\$16,500
SUBTOTAL			\$1,006,300
+ 20% Contingencies			\$201,300
TOTAL CONSTRUCTION COST			\$1,207,600
+ 20% Engineering and Construction Management			\$241,500
Right of Way 60' x 430' = 25,800 S.F. 30' x 6190' = <u>185,700</u> S.F. 211,500 S.F.	211,500 S.F.	\$.15/S.F.	\$31,700
TOTAL OFF-BASE COST			\$1,480,800

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 1  
COST ESTIMATE

(ON-BASE PORTION)

Page 2 of 4

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove 6" Concrete Lining w/Rebar (East of Litchfield Road)	500,000 S.F.	\$.75/S.F.	\$375,000
New 6" Concrete Lining w/Rebar (Includes Extended Lining on Existing Channel)	83,000 S.Y.	\$22/S.Y.	\$1,826,000
Channel Excavation (East of Litchfield Road)	289,000 C.Y.	\$3/C.Y.	\$867,000
Demolish and Remove 6" Concrete Lining w/Rebar (North of Runway)	21,500 S.F.	\$.75/S.F.	\$16,100
Replace Transition/Retaining Walls Downstream and Upstream of 2 - 10' x 5.5' B.C.'s	2,000 S.F.	\$30/S.F.	\$60,000
Grouted Riprap Bank Protection Upstream of 2 - 10' x 5.5' B.C.'s (North Side of Channel Only)	4,700 S.Y.	\$22/S.Y.	\$103,400
Channel Excavation (10' x 5.5' Box Culverts to the West)	22,300 C.Y.	\$2/C.Y.	\$44,600
3 - 10' x 7' x 640' Box Culverts (Adjacent to Existing 10' x 5.5' B.C.'s)	640 L.F.	\$900/L.F.	\$576,000
2 - 10' x 6' x 40' Box Culverts	40 L.F.	\$600/L.F.	\$24,000
Remove and Replace RR Track	600 L.F.	\$50/L.F.	\$30,000
Remove and Replace Access Road on North Side of Luke A.F.B. (3,600 L.F. x 24 F.T. = 9,600 S.Y.)	9,600 S.Y.	\$15/S.Y.	\$144,000
Grouted Riprap Outlet Protection for 3 - 10' x 4' x 120' Box Culverts 60' x 75' = 500 S.Y.	500 S.Y.	\$22/S.Y.	\$11,000
SUBTOTAL			\$4,077,100
+ 20% Contingencies			\$815,400
TOTAL CONSTRUCTION COST			\$4,892,500
+ 20% Engineering and Construction Management			\$978,500
TOTAL ON-BASE COST			\$5,871,000

DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 1  
 COST ESTIMATE

<u>OPTION 1</u>			
Reduce Length of Box Culverts At North End of Runway to 150 Feet			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Reduce Length of 3 - 10' x 7' Box Culvert	- 490 L.F.	\$900/L.F.	- \$441,000
Remove 2 - 10' x 5.5' Box Culverts (490' Length)	+ 28,700 S.F.	\$1/S.F.	+ \$28,700
Channel Excavation	+ 2,000 C.Y.	\$2/C.Y.	+ \$4,000
Grouted Riprap Bank Protection Upstream of Box Culverts (North Side Only)	+ 1,350 S.Y.	\$22/S.Y.	+ \$29,700
CONSTRUCTION COST ADJUSTMENT			- \$378,600
+ 20% Contingencies			- \$75,700
TOTAL CONSTRUCTION COST ADJUSTMENT			- \$454,300
+ 20% Engineering and Construction Management			- \$90,900
TOTAL COST ADJUSTMENT			- \$545,200

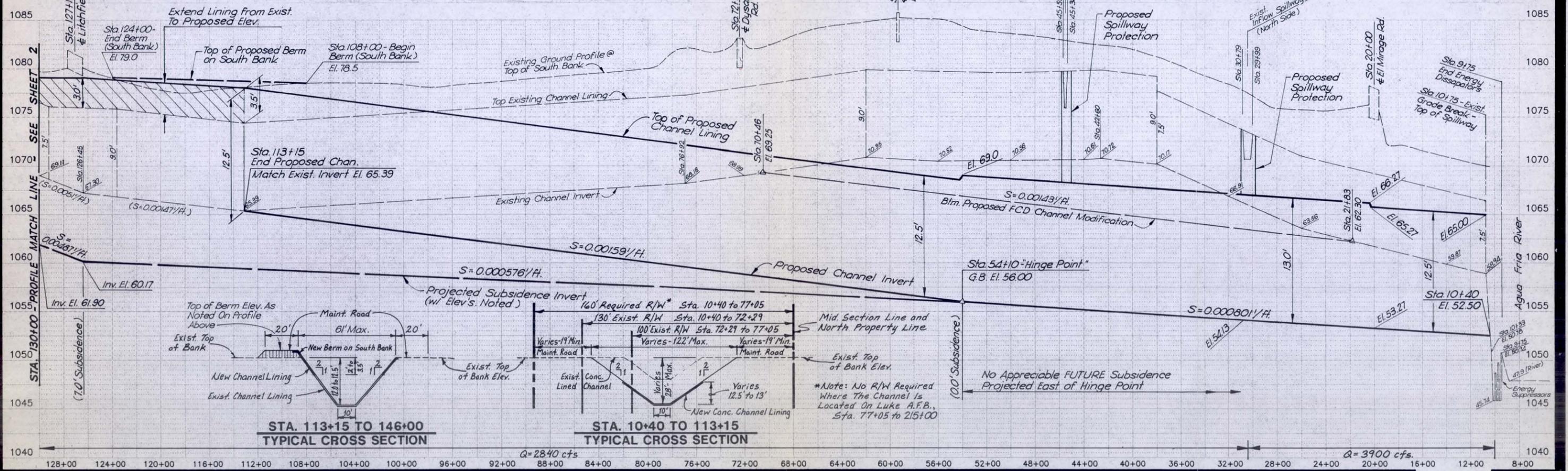
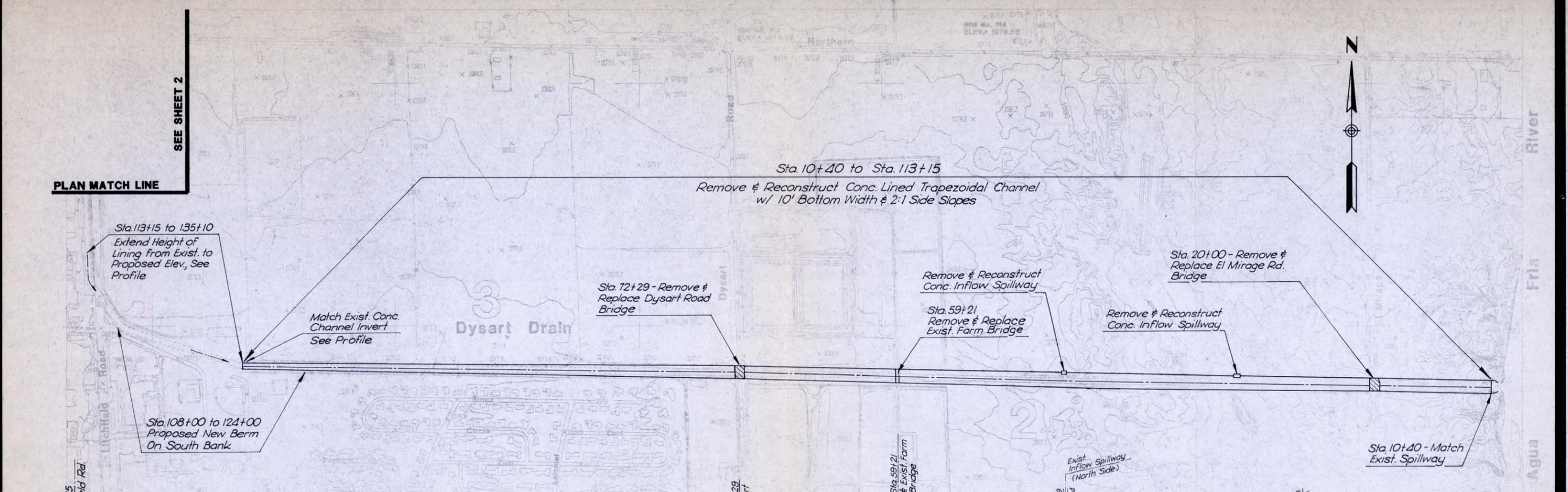
DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 1  
COST ESTIMATE

Page 4 of 4

<u>OPTION 2</u>			
Provide Concrete Channel Lining Along North Edge of Luke AFB Between Northern Avenue Dip Section and Entrance to Box Culverts at the End of the Runway			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Concrete Channel Lining	+ 34,255 S.Y.	\$22/S.Y.	+ \$753,600
Grouted Riprap Bank Protection Upstream of 2 - 10'x5.5' B.C.'s (North Side of Channel Only)	- 4,700 S.Y.	\$22/S.Y.	- \$103,400
Remove and Replace Access Road on North Side of Luke AFB	- 9,600 S.Y.	\$15/S.Y.	- \$144,000
CONSTRUCTION COST ADJUSTMENT			+ \$506,200
+ 20% Contingencies			+ \$101,200
TOTAL CONSTRUCTION COST ADJUSTMENT			+ \$607,400
+ 20% Engineering and Construction Management			+ \$121,500
TOTAL COST ADJUSTMENT			+ \$728,900

PLAN MATCH LINE

SEE SHEET 2



STA. 113+15 TO 146+00  
TYPICAL CROSS SECTION

STA. 10+40 TO 113+15  
TYPICAL CROSS SECTION



Engineering • Planning • Surveying  
Landscape Architecture • Urban Design  
Offices located in Tucson, Phoenix  
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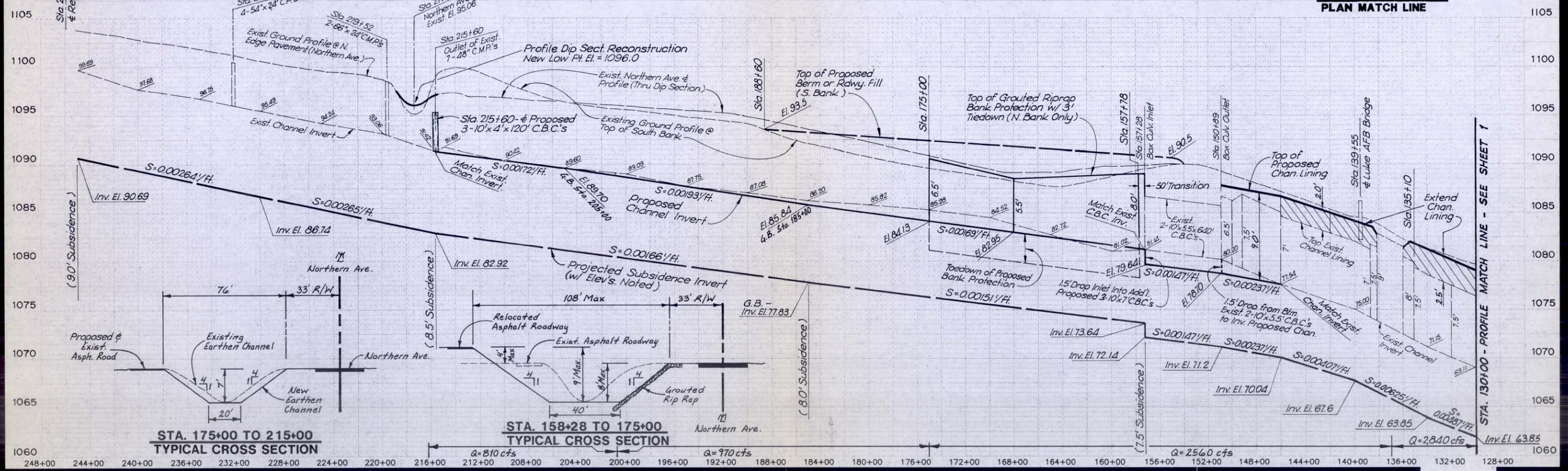
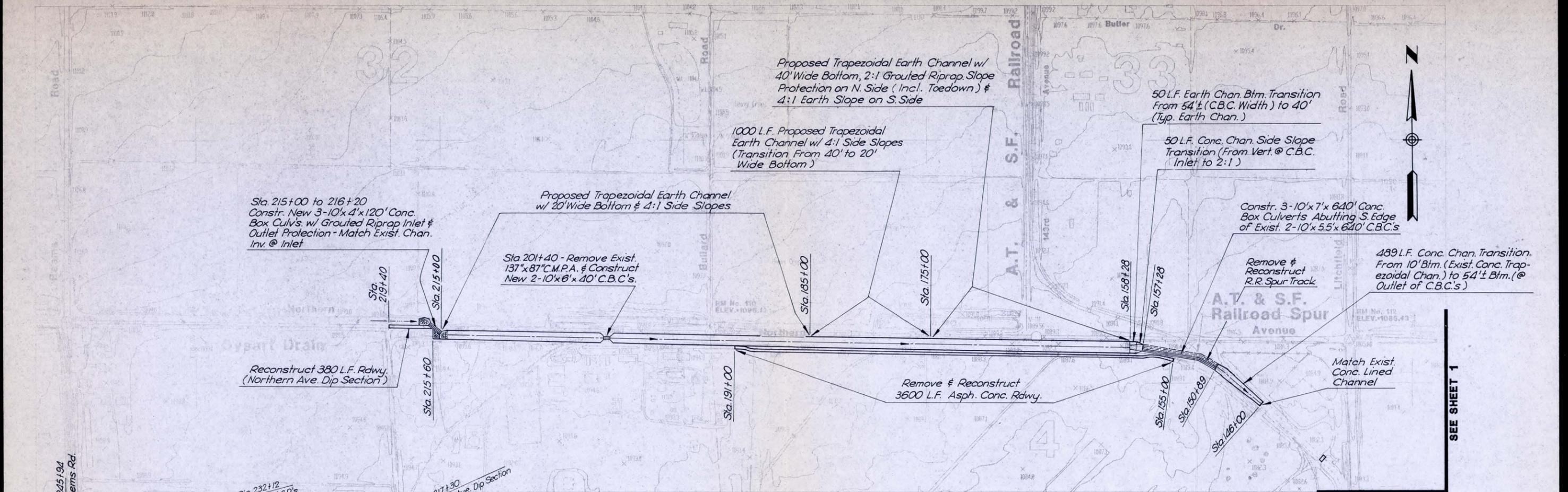
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
Dysart Drain Improvement Project  
Preliminary Design

ALTERNATIVE NO. 1

No.	Date	Item

Scale 1"=400' H. 1"=5' V.  
Job No. 289036-4  
Date 4-20-93  
Drawn By BKF  
Checked By MTG

Sheet 1  
Of 2



7.2 ALTERNATIVE NO. 2

This alternative is based on constructing a new channel along the Dysart Drain alignment from Reems Road to the Agua Fria River. In contrast to the channel proposed in Alternative No. 1, this channel will collect all of the runoff and eliminate the split flow at Reems Road and Northern Avenue.

7.2.1 DESCRIPTION OF IMPROVEMENTS AND R/W REQUIREMENTS  
(Refer to Plan Sheets)

*Sta. 10+33 to 127+85 (Agua Fria River Upstream to Litchfield Road)*

Channel Improvements:

This portion of the channel requires complete reconstruction in order to widen the existing channel bottom width and to remove the sag in the existing channel just east of Litchfield Road. The work includes: removing the existing concrete channel lining and existing farm bridge east of Dysart Road; excavation to lower and widen the channel invert; removal and replacement of El Mirage Road, Dysart Road and Litchfield Road Bridges; new concrete channel lining; and the south bank is raised on the east side of Litchfield Road to prevent breakout of flows onto the Base housing area.

Right of Way Requirements:

An additional 40 feet of right of way is required on the south side of the channel from the Agua Fria River to Dysart Road. The existing right of way in this reach is 130 feet and the required right of way is 170 feet.

In addition, 70 feet of additional right of way is required on the south side of the channel between Dysart Road and the Base (Sta. 72+29 to Sta. 77+05). In this area, the existing right of way is 100 feet and the required right of way is 170 feet.

These right of way requirements were determined for the widest channel section which occurs at the location with the deepest cut (28 foot cut at Sta. 54+00). The right of way is also based on requiring a maintenance road on each side of the channel. Therefore, the right of way requirement could be reduced by 1) eliminating one maintenance road or 2) narrowing the right of way in areas of shallower cuts. A critical area is where Morton Salt is located, as some of their drying beds may have to be reconfigured to accommodate the proposed channel. This is also where some of the deepest cut occurs.

***Sta. 127+85 to 149+89 (Litchfield Road to the Railroad Box Culverts)***

Channel Improvements:

This portion of the channel also requires complete reconstruction to increase the channel bottom width and depth. The work includes: removing the existing concrete lining; excavation to lower and widen the existing channel; removal and replacement of existing Luke AFB bridge; raising the south/west bank from Litchfield Road to Sta. 133+00 to prevent breakout flows; construction of two drop structures; removal and replacement of existing railroad spur track; and new concrete channel lining.

Right of Way Requirements:

No right of way is required for this reach. The channel is located on Base property.

***Sta. 149+89 to 158+28 (Railroad Box Culverts and Transitions)***

Channel Improvements:

The improvements for this section of the channel involve the construction of four new 10' x 10' x 640' box culverts and removing the existing 2 - 10' x 5.5' x 640' box culverts. The improvements also include the channel transitions on both ends of the box culverts, excavation of proposed channel configuration, and removal and replacement of the railroad over the box culverts.

There is an option (Option 1) in the cost estimate to reduce the length of the box culverts. The existing box culverts are much longer than what is necessary for the railroad crossing. If Luke AFB can accept an open channel at the end of the runway, there are substantial cost savings in reducing the length of the box culverts. The length required for the railroad is approximately 150 feet which results in a length reduction of 490 feet.

Right of Way Requirements:

No right of way is required in this reach. The improvements are located on Base property.

***Sta. 158+28 to 214+40 (Upstream of Railroad Box Culverts to Culvert Outlet Under Northern Avenue)***

Channel Improvements:

The improvements in this channel reach include the following: excavation to deepen and widen existing channel; new channel lining; construction of berm along south bank from Sta. 154+00 to Sta. 182+00 to prevent breakout flows; construction of a 1 foot drop structure; and removal of the existing 10' x 6' box culvert at the Northern Avenue driveway entrance to the base and replacing it with a bridge.

Right of Way Requirements:

No right of way is required for this reach. The channel improvements are located on the Base.

***Sta. 214+40 to 248+50 (Box Culverts at Northern Avenue Dip Section to the Inflow Spillway at Reems Road)***

Channel Improvements:

The existing Northern Avenue "Dip Section" and culvert crossing shall be reconstructed in order to provide for the 100-year flood with no more than 0.5 foot of floodwater over the roadway. Four new 10' x 7' x 120' box culverts will be built and the existing 7 - 48" CMP's will be removed.

The channel will be excavated for additional depth and width and will be concrete lined from the Northern Avenue culvert entrance to Reems Road. There are two existing culverts at driveway entrances into the farm fields that will be removed. It was assumed that these will not need to be replaced.

A grouted riprap spillway is required along Reems Road for stormwater inflows.

Right of Way Requirements:

Currently, there is 75 feet of right of way on the north side of Northern Avenue and on the east side of Reems Road. The existing channel lies inside this right of way.

To provide for the new channel, 25 feet of additional right of way will be required along the north side of Northern Avenue for a total of 100 feet, and 85 feet of additional right of way will be required along the east side of Reems Road for a total of 165 feet.

#### 7.2.2 ADVANTAGES AND DISADVANTAGES

Advantages:

1. Collects all Runoff

All runoff will be collected in this channel from Reems Road to the Agua Fria River. Therefore, unlike Alternative No. 1, the split flow at Reems Road is eliminated which prevents the current flooding condition on the west side of the Base.

2. Maintenance

The entire channel is concrete lined, therefore, very little maintenance will be required.

Disadvantages:

1. Cost

This alternative and Alternative No. 4 are the costliest. The costs are high because the entire channel is concrete lined and all of the structures have to be replaced.

2. Litchfield Road Bridge

Litchfield Road Bridge will have to be replaced which would disrupt traffic. This alternative also requires replacement of the bridge on Luke AFB.

3. Utility Impacts

Since this alternative requires the largest and deepest channel section it is likely that it will have the greatest impact on existing utilities.

4. Most Disruption Through Base

The channel is totally reconstructed through the Base, therefore this alternative will cause the greatest disruption of normal AFB activities.

7.2.3 COST ESTIMATE

SUMMARY OF COST ESTIMATES FOR ALTERNATIVE 2		
DESCRIPTION	ALTERNATIVE 2	W/ <del>O</del> OPTION 1
Cost Reduction (-) / Increase (+)		- \$991,200 (ON-BASE)
Total On-Base Cost	\$9,614,800	\$8,623,600
Total Off-Base Cost	\$3,223,500	\$3,223,500
<b>TOTAL COST</b>	<b>\$12,838,300</b>	<b>\$11,847,100</b>

Option 1: Reduce length of box culverts at north end of runway to 150 feet.

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 2  
COST ESTIMATE

Page 1 of 3

(OFF-BASE PORTION)

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove El Mirage Road Bridge	1 Ea.	\$35,000	\$35,000
Demolish and Remove Farm Bridge	1 Ea.	\$15,000	\$15,000
Demolish and Remove Dysart Road Bridge	1 Ea.	\$25,000	\$25,000
Demolish and Remove Litchfield Road Bridge	1 Ea.	\$35,000	\$35,000
Replace El Mirage Road Bridge (117' x 84')	9,828 S.F.	\$45/S.F.	\$442,300
Replace Dysart Road Bridge (124' x 84')	10,416 S.F.	\$45/S.F.	\$468,700
Replace Litchfield Road Bridge ( 71' x 120')	9,230 S.F.	\$45/S.F.	\$415,400
Construct 4 - 10' x 7' x 120' B.C. at Dip Section (Sta. 214+40 to Sta. 215+60)	120 L.F.	\$1,200/L.F.	\$144,000
Rebuild and Raise Dip Section on Northern Avenue, Remove and Replace Pavement	1,560 S.Y.	\$15/S.Y.	\$23,400
Channel Excavation (North of Northern Avenue)	29,360 C.Y.	\$3/C.Y.	\$88,100
New 6" Concrete Channel Lining (North of Northern Avenue)	17,983 S.Y.	\$22/S.Y.	\$395,600
Grouted Riprap Erosion Protection	4,995 S.Y.	\$22/S.Y.	\$109,900
SUBTOTAL			\$2,197,400
+ 20% Contingencies			\$439,500
TOTAL CONSTRUCTION COST			\$2,636,900
+ 20% Engineering and Construction Management			\$527,400
Right of Way East of Dysart 6190' x 40' = 247,600 S.F. West of Dysart 430' x 70' = 30,100 S.F. North of Northern = 116,600 S.F.	394,300 S.F.	\$.15/S.F.	\$59,200
TOTAL OFF-BASE COST			\$3,223,500

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 2  
COST ESTIMATE

Page 2 of 3

(ON-BASE PORTION)

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove 6" Concrete Lining w/Rebar	681,403 S.F.	\$.75/S.F.	\$511,000
Demolish and Remove Luke A.F.B. Bridge	1 Ea.	\$15,000	\$15,000
Demolish and Remove 2 - 10' x 5.5' x 640' B.C.	37,440 S.F.	\$1/S.F.	\$37,400
Channel Excavation	452,602 C.Y.	\$3/C.Y.	\$1,357,800
Replace Luke A.F.B. Bridge (102' x 26')	2,652 S.F.	\$45/S.F.	\$119,300
Demolish and Remove 10' x 6' x 40' Box Culvert	1,280 S.F.	\$1/S.F.	\$1,300
New Bridge at Driveway Entrance off Northern Avenue (60' x 40')	2,400 S.F.	\$45/S.F.	\$108,000
Remove and Replace RR Track	1,200 L.F.	\$50/L.F.	\$60,000
Construct 4 - 10' x 10' x 640' B.C.	640 L.F.	\$1,600/L.F.	\$1,024,000
New 6" Concrete Lining w/Rebar	155,139 S.Y.	\$22/S.Y.	\$3,413,100
2' Drop Structure at Sta. 134+00	1 Ea.	\$15,000/Ea.	\$15,000
3' Drop Structure at Sta. 139+42	1 Ea.	\$10,000/Ea.	\$10,000
1' Drop Structure at Sta. 187+00	1 Ea.	\$5,000/Ea.	\$5,000
SUBTOTAL			\$6,676,900
+ 20% Contingencies			\$1,335,400
TOTAL CONSTRUCTION COST			\$8,012,300
+20% Engineering and Construction Management			\$1,602,500
TOTAL ON-BASE COST			\$9,614,800

DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 2  
 COST ESTIMATE

<u>OPTION 1</u>			
Reduce Length of Box Culverts At North End of Runway to 150 Feet			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Reduce Length of 4 - 10' x 10' Box Culverts	- 490 L.F.	\$1600/L.F.	- \$784,000
Channel Excavation	+ 2,500 S.F.	\$2/C.Y.	+ \$5,000
Channel Lining	+ 4,125 C.Y.	\$22/S.Y.	+ \$90,800
CONSTRUCTION COST ADJUSTMENT			- \$688,300
+ 20% Contingencies			- \$137,700
TOTAL CONSTRUCTION COST ADJUSTMENT			- \$826,300
+ 20% Engineering and Construction Management			- \$165,200
TOTAL COST ADJUSTMENT			- \$991,200

SEE SHEET 2

PLAN MATCH LINE

Sta. 10+33 to Sta. 134+85

Remove & Reconstruct Conc. Lined Trapezoidal Channel w/ 20' Bottom Width & 2:1 Side Slopes

Sta. 127+15 - Remove & Replace Litchfield Rd. Bridge

Sta. 72+29 - Remove & Replace Dysart Road Bridge

Remove & Reconstruct Conc. Inflow Spillway

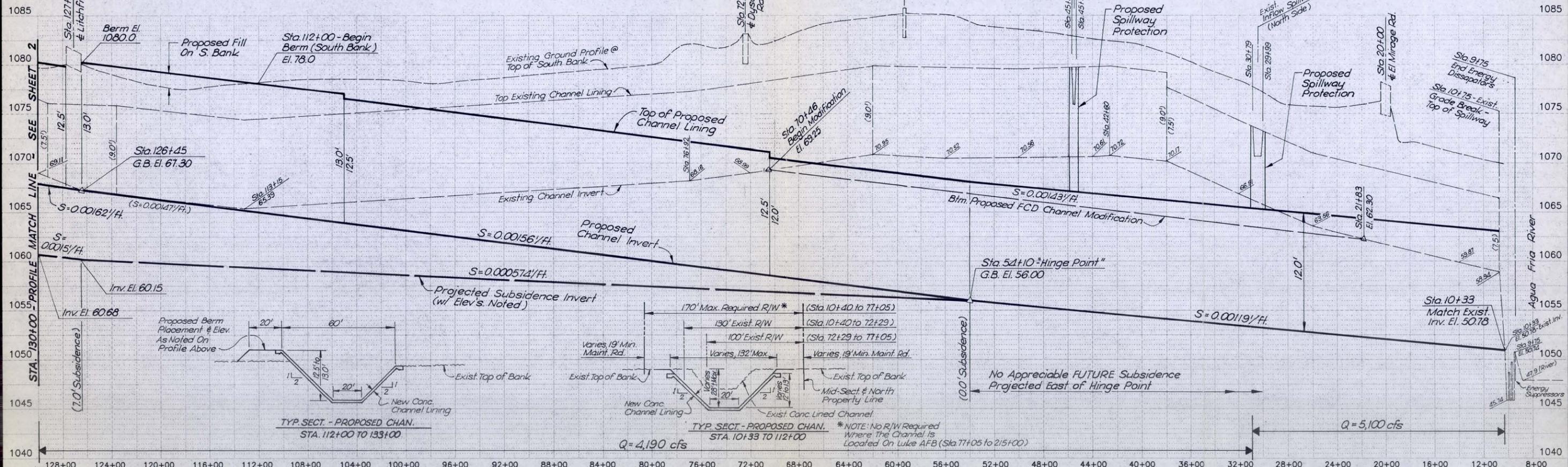
Sta. 20+00 - Remove & Replace El Mirage Rd. Bridge

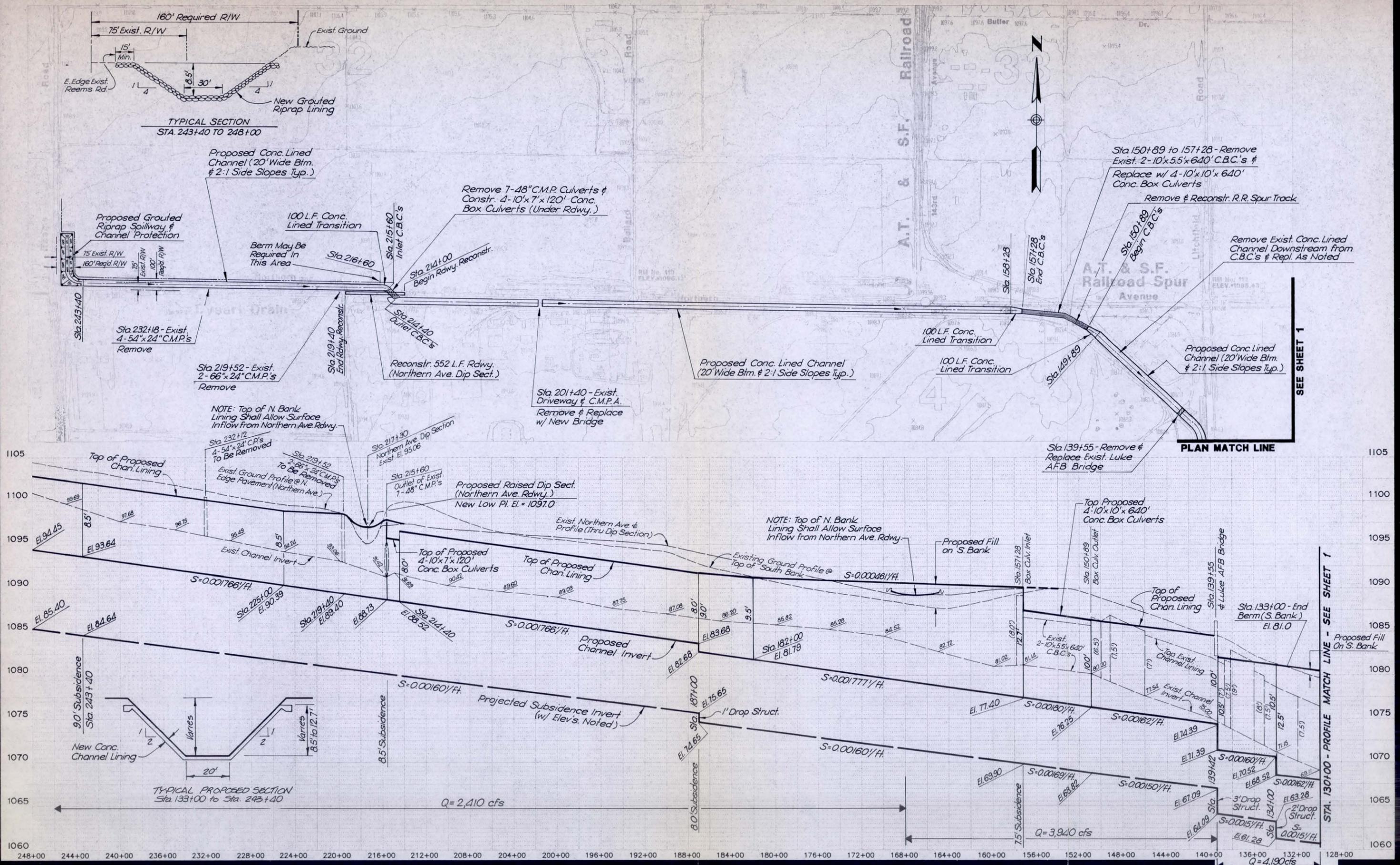
Sta. 59+21 - Remove & Replace Exist. Farm Bridge

Remove & Reconstruct Conc. Inflow Spillway

Sta. 112+00 to 133+00 Proposed Berm On South Bank

Sta. 10+33 - Match Exist. Spillway





No.	Date	Item

7.3 ALTERNATIVE NO. 3

This alternative consists of collecting the runoff at Reems Road and Northern Avenue and conveying it south, under Northern Avenue, and around the west side of the Base to Bullard Wash. The remainder of the flows are collected in Dysart Drain and conveyed east to the Agua Fria River. The effect of constructing the channel on the west side of the Base is a significantly reduced flow in the Dysart Drain. This minimizes the channel improvements necessary for the Dysart Drain.

7.3.1 DESCRIPTION OF IMPROVEMENTS AND R/W REQUIREMENTS  
(Refer to Plan Sheets)

7.3.1.1 Dysart Drain

*Sta. 10+40 to 113+15 (Agua Fria River Upstream to West Side of Base Housing Area)*

Channel Improvements:

This portion of the channel again requires complete reconstruction in order to remove the sag in the existing channel just east of Litchfield Road. The channel will still have to be excavated considerably east of Dysart Road to accommodate the anticipated future subsidence even though the flows are reduced compared to Alternative 1 and Alternative 2.

The work includes: removal of the existing concrete channel lining and farm bridge east of Dysart Road; removal and replacement of El Mirage Road and Dysart Road bridges; excavation to lower the channel invert; and new concrete channel lining.

Right of Way Requirements:

An additional 20 feet of right of way is required on the south side of the channel from the Agua Fria River to Dysart Road. The existing right of way in this reach is 130 feet. The required right of way is 150 feet.

In addition to the above requirement, 50 feet of additional right of way, south of the channel, is required from Dysart Road west to the Base (Sta. 72+29 to Sta. 77+05). In this area, the existing right of way is 100 feet and the required right of way is 150 feet.

These right of way requirements were determined for the widest channel section which occurs at the location with the deepest cut (26 foot cut at Sta. 54+00). The right of way is also based on having a maintenance road on each side of the channel. Therefore, the right of way requirement could be reduced by 1) eliminating one maintenance road or 2) narrowing the right of way in areas of shallower cuts. A critical area is where Morton Salt is located, as some of their drying beds may have to be reconfigured to accommodate the proposed channel. This is also where some of the deepest cuts occur.

***Sta. 113+15 to 135+00 (West Side of Base Housing to West of Litchfield Road)***

**Channel Improvements:**

The existing concrete lined channel in this reach is to remain and the channel lining is extended to the top of bank. In addition, the south bank is raised east of Litchfield Road to prevent breakout of flows onto the Base housing area. The Base bridge west of Litchfield Road and Litchfield Road bridge both remain.

**Right of Way Requirements:**

No right of way is required for this reach. The channel is located on Base property.

***Sta. 135+00 to 146+00 (West of Litchfield Road to Railroad Box Culverts)***

Channel Improvements:

No channel improvements are required in this reach.

Right of Way Requirements:

No right of way is required for this reach.

***Sta. 146+00 to 157+78 (Railroad Box Culverts and Upstream and Downstream Transitions)***

Channel Improvements:

The improvements for this section of the channel involve the construction of one new 10' x 7' x 640' box culvert that will abut the south edge of the existing box culverts under the railroad at the north end of the runway. The improvements also include new channel transitions on both ends of the new box culvert and removing and replacing the railroad.

There is an option (Option 1) in the cost estimate to reduce the length of the box culverts. The existing box culverts are much longer than what is necessary for the railroad crossing. If Luke AFB can accept an open channel at the end of the runway, there are substantial cost savings in reducing the length of the box culvert. The length required for the railroad is approximately 150 feet which results in a length reduction of 490 feet.

Right of Way Requirements:

No right of way is required in this reach. The improvements are located on Base property.

***Sta. 157+78 to 215+60 (Railroad Box Culverts to the Northern Avenue Culvert Crossing)***

Channel Improvements:

The existing earthen channel in this section is to be enlarged from Sta. 157+78 to Sta. 185+00 and regraded from Sta. 185+00 to Sta. 215+60. Other improvements include: a long spillway (approximately 1700 feet) to collect flows that concentrate along the AT&SF Railroad; relocation of the Base road that parallels the channel; and raising the south bank of the channel upstream of the railroad box culverts to increase the capacity of the culverts. The existing 10' x 6' box culvert at the Northern Avenue driveway entrance will remain. The culverts at the Northern Avenue dip section will also remain.

An option (Option 2) is included in the cost estimate to concrete-line the channel in this section.

Right of Way Requirements:

No right of way is required in this reach. The channel is located on Base property.

7.3.1.2 Channel Along the West Side of Luke AFB

***Sta. 16+85 to 56+00 (Outlet of South Channel to the End of the Proposed Dikes)***

Channel Improvements:

The improvements for this portion of the channel include widening the existing channel bottom width to 150 feet and providing dikes on the south and north side of the channel where shown on the plans. Rock riprap protection at the outlet into Bullard Wash would be required to disperse the flows and reduce the velocity. Also, rock riprap protection would be required on the inside and outside edges of the channel bends.

Right of Way Requirements:

Currently, the existing channel at the south outlet is located in a drainage easement. New right of way or additional drainage easement would be required with an approximate width of 400 feet. The existing easement width is 100 feet. The cost estimate is based on acquiring new right of way.

***Sta. 56+00 to 233+60 (End of Dikes on South End to Northern Avenue)***

Channel Improvements:

The improvements in this reach consist of an earthen channel with a 150 foot bottom width. Rock riprap is included for the channel bends at the inside and outside edges of the channel. Two drop structures will also be required in this reach along with grouted riprap outlet protection downstream of the box culverts under Northern Avenue.

Right of Way Requirements:

An additional 250 feet of right of way will be required along the west side of Luke AFB from Northern Avenue south, approximately 4500 feet. The new right of way is located west of the existing Luke AFB property line. No right of way is required for the remainder of the channel to the south where it is located on Base property.

***Sta. 233+60 to 262+00 (Northern Avenue Box Culverts to Reems Road)***

Channel Improvements:

Channel improvements in this reach consist of 4 - 10' x 7' x 150' box culverts under Northern Avenue, channel excavation for a 70 foot bottom width earthen channel, and grouted riprap inflow spillway/channel protection at Reems Road.

Right of Way Requirements:

Currently, there is 75 feet of right of way on the north side of Northern Avenue and on the east side of Reems Road. The existing channel lies inside this right of way.

Additional right of way of 130 feet will be required along the north side of Northern Avenue for a total of 205 feet, and 140 feet of additional right of way will be required along the east side of Reems Road for a total of 215 feet.

7.3.2 ADVANTAGES AND DISADVANTAGES

Advantages:

1. Collects all Runoff

All flows are collected in channels so that the Base is not impacted by any off-site stormwater flows.

2. Reduced Flow In Dysart Drain

This alternative reduces the amount of flow that reaches the Dysart Drain channel, therefore, it minimizes the reconstruction of Dysart Drain.

3. Cost

This is the second lowest cost of all five alternatives, but very close to the cost of the detention scheme in Alternative 5.

Disadvantages:

1. Channel Outlet

Flow in the west channel is difficult to outlet at the south end of the Base because the channel slope is very flat. In addition, Bullard Wash is not well defined and has no channel banks. Therefore, the west side channel is constructed with dikes on each side where it outlets into Bullard Wash.

2. Additional Right of Way

Additional right of way is required around the west and south side of Luke AFB.

3. Increased Maintenance

The west channel will require a significant amount of maintenance since it is not lined.

4. Channelized Flows South Including Low Flows

This alternative, as well as the other 4 alternatives, reduces the 100-year peak discharge in Bullard Wash with the improvement of Dysart Drain. However, the addition of the west side channel will result in higher flows during the more frequent storms. Currently, the stormwater runoff from small floods is all collected in the Dysart Drain and conveyed to the Agua Fria River. In the case of Alternative 3, these low flows will be conveyed to Bullard Wash. The result will be more frequent flooding along Bullard Wash which includes several roadway crossings to the south. In addition, crop damage along Bullard Wash may increase as a result of the more frequent flooding.

7.3.3 COST ESTIMATE (Refer to the Itemized Estimates)

SUMMARY OF COST ESTIMATES FOR ALTERNATIVE 3				
DESCRIPTION	ALT NO. 3	W/OPTION 1	W/OPTION 2	W/OPTION 3
Cost Reduction (-) / Increase (+)		-\$171,200 (ON-BASE)	+\$527,600 (ON-BASE)	+\$4,176,400 (ON-BASE) +\$359,700 (OFF-BASE)
Total On-Base Cost	\$6,405,800	\$6,234,600	\$6,933,400	\$10,582,200
Total Off-Base Cost	\$3,698,900	\$3,698,900	\$3,698,900	\$4,058,600
<b>TOTAL COST</b>	<b>\$10,104,700</b>	<b>\$9,933,500</b>	<b>\$10,632,300</b>	<b>\$14,640,800</b>

Option 1: Reduce length of box culverts at north end of runway to 150 feet.

Option 2: Provide concrete channel lining along north edge of Luke AFB between Northern Avenue dip section and entrance to box culverts at the end of the runway.

Option 3: Provide concrete channel lining along west side of Luke AFB.

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 3  
COST ESTIMATE

(OFF-BASE PORTION)

Page 1 of 5

DYSART DRAIN EAST OF LITCHFIELD ROAD			
DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove El Mirage Road Bridge	1 Ea.	\$35,000	\$35,000
Demolish and Remove Dysart Road Bridge	1 Ea.	\$25,000	\$25,000
Demolish and Remove Farm Bridge	1 Ea.	\$15,000	\$15,000
Replace El Mirage Road Bridge (92' x 84')	7728 S.F.	\$45/S.F.	\$347,800
Replace Dysart Road Bridge (98' x 84')	8232 S.F.	\$45/S.F.	\$370,400
CONSTRUCTION COST SUBTOTAL (Dysart Drain)			\$793,200
Right of Way : 50' x 430' = 21,500 S.F. 20' x 6190 = <u>123,800</u> S.F. 145,300 S.F.	145,300 S.F.	\$.15/S.F.	\$21,800
CHANNEL ALONG WEST SIDE OF BASE (OFF-BASE PROPERTY) AND NORTH OF NORTHERN AVENUE TO REEMS ROAD			
Grouted Riprap Spillway and Channel Protection at Reems Road	8745 S.Y.	\$22/S.Y.	\$192,400
Inlet/Outlet Protection of 4-10'x7'x150'B.C.'s	3160 S.Y.	\$22/S.Y.	\$69,500
4 - 10' x 7' x 150' B.C.'s	150 L.F.	\$1200/L.F.	\$180,000
Channel Excavation	297085 C.Y.	\$3/C.Y.	\$891,300
3' Drop Structure (Grouted Riprap 2018 S.Y. @ \$22/S.Y.) (Concrete Retaining Wall 1548 S.F. @ \$30/S.F.)	1 Ea.	\$90,800	\$90,800
2' Drop Structure (Grouted Riprap 1995 S.Y. @ \$22/S.Y.) (Concrete Retaining Wall 1215 S.F. @ \$30/S.F.)	1 Ea.	\$80,300	\$80,300
CONSTRUCTION COST SUBTOTAL (N. and S. of Northern Ave.)			\$1,504,300
Right of Way: North Northern - 385,270 S.F. W. Side of Base- 250' x 4450' = 1,112,500 S.F. S. Side of Base- 400' x 2400' = 960,000 S.F.	2,457,770 S.F.	\$.15/S.F.	\$368,700
TOTAL CONSTRUCTION COST (W/O Contingencies)			\$2,297,500
+ 20% Contingencies			\$459,500
TOTAL CONSTRUCTION COST			\$2,757,000
+ 20% Engineering and Construction Management			\$551,400
TOTAL RIGHT OF WAY COST			\$390,500
TOTAL OFF-BASE COST			\$3,698,900

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 3  
COST ESTIMATE

(ON-BASE PORTION)

DYSART DRAIN			
DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove 6" Concrete Lining w/Rebar (East of Litchfield Road)	500,050 S.F.	\$.75/S.F.	\$375,000
New 6" Concrete Lining w/Rebar (Incl. Extending Lining STA. 113+15-STA. 135+00)	78,166 S.Y.	\$22/S.Y.	\$1,719,700
Channel Excavation (East of Litchfield Road)	255,000 C.Y.	\$3.00/C.Y.	\$765,000
Demolish and Remove 6" Concrete Lining w/Rebar (North of Runway)	21,519 S.F.	\$.75/S.F.	\$16,100
Replace Transition/Retaining Walls Downstream and Upstream of 2 - 10' x 5.5' and 1 - 10' x 7' B.C.	2000 S.F.	\$30/S.F.	\$60,000
Channel Excavation (B.C.'s West to Ex. 7 - 48" CMP's at Northern Avenue Dip Section)	12,450 C.Y.	\$2.00/C.Y.	\$24,900
1 - 10' x 7' x 640' Box Culvert	640 L.F.	\$370/L.F.	\$236,800
2-8'x6'x40'Box Culvert (Northern Ave. Driveway)	40 L.F.	\$435/L.F.	\$17,400
Grouted Riprap Bank Protection Upstream of 2-10'x5.5'B.C.'s (North Side of Channel Only)	4,700 S.Y.	\$22/S.Y.	\$103,400
Remove and Reconstruct Base Roadway on N. Side of Luke AFB 3360 L.F.x24 Ft.=8960 S.Y.	8960 S.Y.	\$15/S.Y.	\$134,400
Remove and Replace RR Track	600 L.F.	\$50/L.F.	\$30,000
CONSTRUCTION COST SUBTOTAL (Dysart Drain)			\$3,482,700
CHANNEL ALONG WEST SIDE OF BASE (ON-BASE PROPERTY)			
Channel Excavation on West and South Side of Base	383,995 C.Y.	\$1/C.Y. (Place Fill On-Site)	\$384,000
Riprap Bank Protection	11,635 C.Y.	\$50/C.Y.	\$581,800
CONSTRUCTION COST SUBTOTAL			\$965,800
TOTAL CONSTRUCTION COST (W/O Contingencies)			\$4,448,500
+ 20% Contingencies			\$889,700
TOTAL CONSTRUCTION COST			\$5,338,200
+ 20% Engineering and Construction Management			\$1,067,600
TOTAL ON-BASE COST			\$6,405,800

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 3  
COST ESTIMATE

<u>OPTION 1</u>			
Reduce Length of Box Culverts At North End of Runway to 150 Feet			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Reduce Length of 1 - 10' x 7' Box Culvert	- 490 L.F.	\$370/L.F.	- \$181,300
Remove 2 - 10' x 5.5' Box Culverts (490' Length)	+ 28,700 S.F.	\$1/S.F.	+ \$28,700
Channel Excavation	+ 2,000 C.Y.	\$2/C.Y.	+ \$4,000
Grouted Riprap Bank Protection Upstream of Box Culverts (North Side Only)	+ 1,350 S.Y.	\$22/S.Y.	+ \$29,700
CONSTRUCTION COST ADJUSTMENT			- \$118,900
+ 20% Contingencies			- \$23,800
TOTAL CONSTRUCTION COST ADJUSTMENT			- \$142,700
+ 20% Engineering and Construction Management			- \$28,500
TOTAL COST ADJUSTMENT			- \$171,200

DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 3  
 COST ESTIMATE

<u>OPTION 2</u>			
Provide Concrete Channel Lining Along North Edge of Luke AFB Between Northern Avenue Dip Section and Entrance to Box Culverts at the End of the Runway			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Concrete Channel Lining	+ 27,900 S.Y.	\$22/S.Y.	+ \$613,800
Grouted Riprap Bank Protection Upstream of 2 - 10'x5.5' B.C.'s (North Side of Channel Only)	- 4,700 S.Y.	\$22/S.Y.	- \$103,400
Remove and Replace Access Road on North Side of Luke AFB	- 9,600 S.Y.	\$15/S.Y.	- \$144,000
CONSTRUCTION COST ADJUSTMENT			+ \$366,400
+ 20% Contingencies			+ \$73,300
TOTAL CONSTRUCTION COST ADJUSTMENT			+ \$439,700
+ 20% Engineering and Construction Management			+ \$87,900
TOTAL COST ADJUSTMENT			+ \$527,600

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 3  
COST ESTIMATE

<u>OPTION 3</u>			
Provide Concrete Channel Lining Along West Side of Luke AFB			
OFF-BASE COST ADJUSTMENT			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Concrete Channel Lining	+ 29,450 S.Y.	\$22/S.Y.	+ \$647,900
Grouted Riprap Outlet Protection Downstream of 4 - 10' x 7' B.C.'s	- 1,600 S.Y.	\$22/S.Y.	- \$35,200
Drop Structures (2 Drops)	Job	\$171,100/Job	- \$171,100
Channel Excavation	- 40,500 C.Y.	\$3/C.Y.	- \$121,500
CONSTRUCTION COST ADJUSTMENT			+ \$320,100
+ 20% Contingencies			+ \$64,000
TOTAL CONSTRUCTION COST ADJUSTMENT			+ \$384,100
Right of Way 150' Width Reduction (150' x 4500')	-675,000 S.F.	\$.15/S.F.	- \$101,200
+ 20% Engineering and Construction Management			+ \$76,800
TOTAL OFF-BASE COST ADJUSTMENT			+ \$359,700
ON-BASE COST ADJUSTMENT			
Concrete Channel Lining	+161,700 S.Y.	\$22/S.Y.	+ \$3,557,400
Channel Excavation	-192,000 C.Y.	\$1/C.Y.	- \$192,000
Bank Protection	- 9,300 C.Y.	\$50/C.Y.	- \$465,000
CONSTRUCTION COST ADJUSTMENT			+ \$2,900,400
+ 20% Contingencies			+ \$580,000
TOTAL CONSTRUCTION COST ADJUSTMENT			+ \$3,480,400
+ 20% Engineering and Construction Management			+ \$696,000
TOTAL ON-BASE COST ADJUSTMENT			+ \$4,176,400

PLAN MATCH LINE

SEE SHEET 2

Sta. 10+40 to Sta. 113+15

Remove & Reconstruct Conc. Lined Trapezoidal Channel w/ 10' Bottom Width & 2:1 Side Slopes

Sta. 113+15 to 135+00  
Extend Height of Lining from Exist. to Proposed Elev. See Profile

Match Exist. Conc. Channel Invert See Profile

Sta. 72+29 - Remove & Replace Dysart Road Bridge

Remove & Reconstruct Conc. Inflow Spillway

Sta. 59+21  
Remove & Replace Exist. Farm Bridge

Sta. 20+00 - Remove & Replace El Mirage Rd. Bridge

Remove & Reconstruct Conc. Inflow Spillway

Sta. 108+00 to 124+00  
Proposed New Berm On South Bank

Extend Lining from Exist. To Proposed Elev.

Sta. 124+00 - End Berm (South Bank) El. 79.0

Sta. 108+00 - Begin Berm (South Bank) El. 78.5

Existing Ground Profile @ Top of South Bank

Top Existing Channel Lining

Sta. 72+29 & Dysart Rd.

Sta. 59+21 & Exist. Farm Bridge

Exist. Inflow Spillway (North Side)

Proposed Spillway Protection

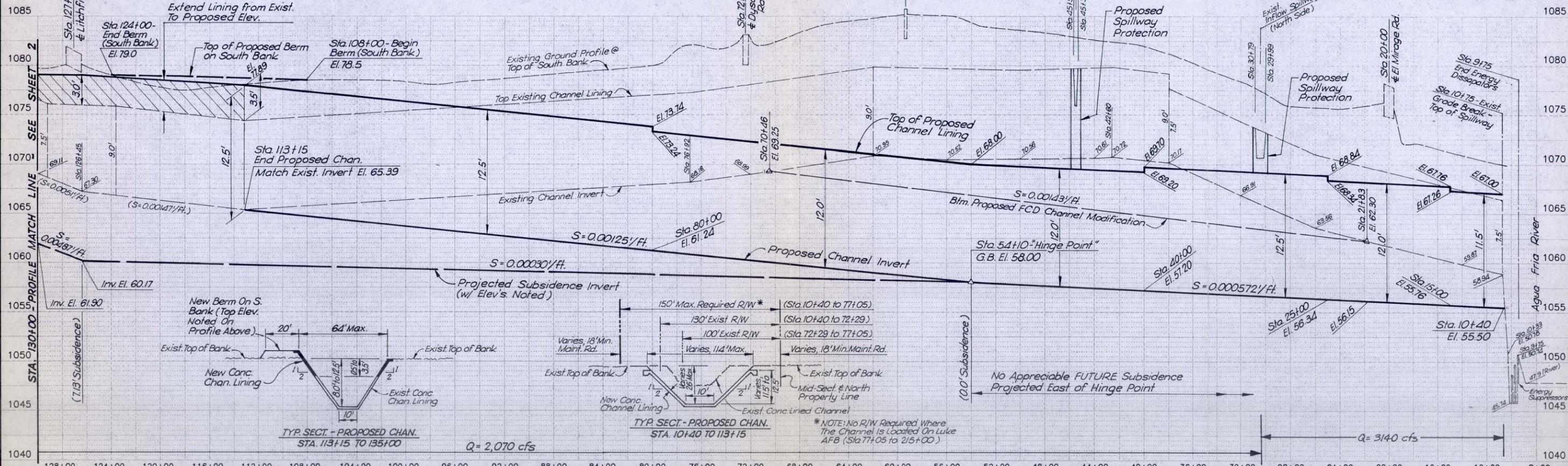
Exist. Inflow Spillway (North Side)

Proposed Spillway Protection

Sta. 10+40 - Match Exist. Spillway

Sta. 9+75 End Energy Dissipators

Sta. 10+75 - Exist. Grade Break - Top of Spillway



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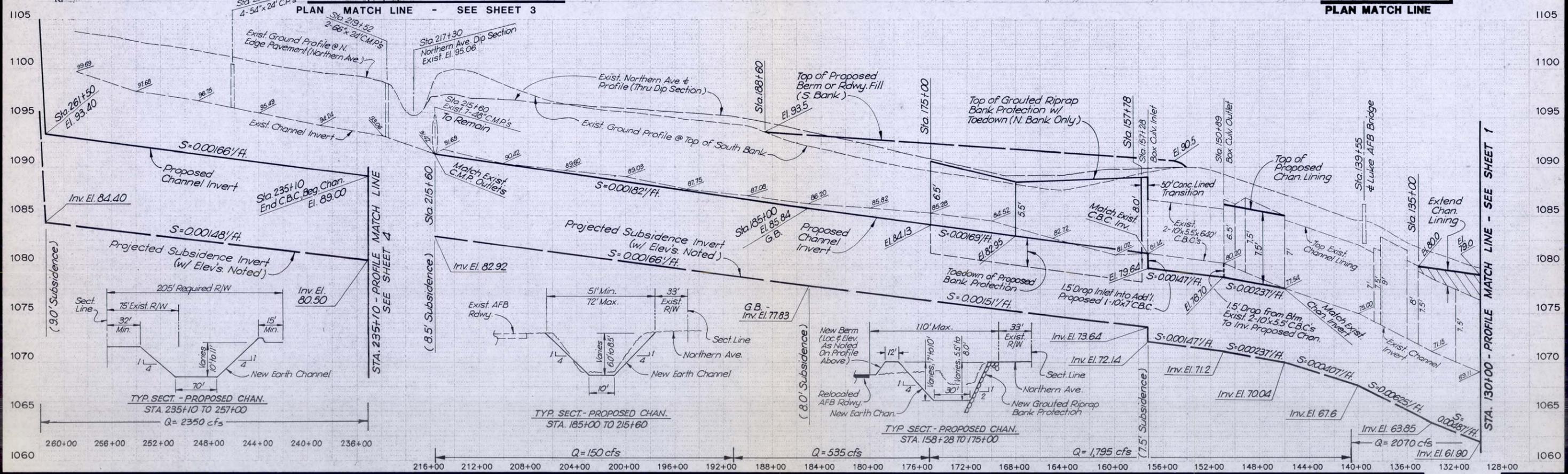
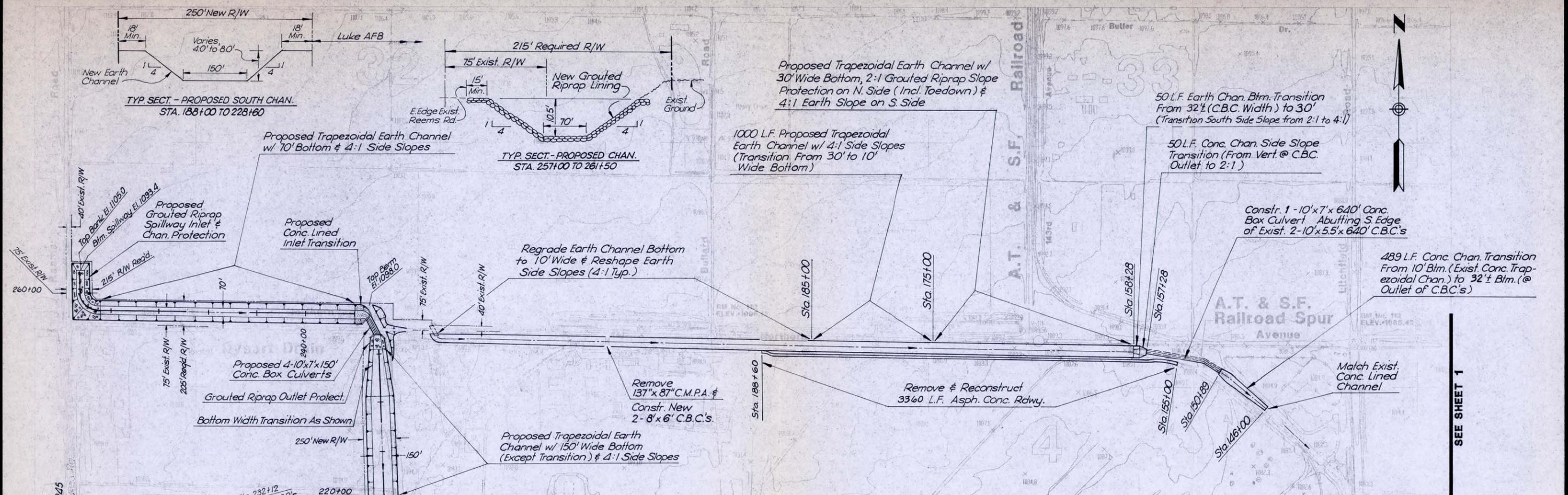
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
Dysart Drain Improvement Project  
Preliminary Design

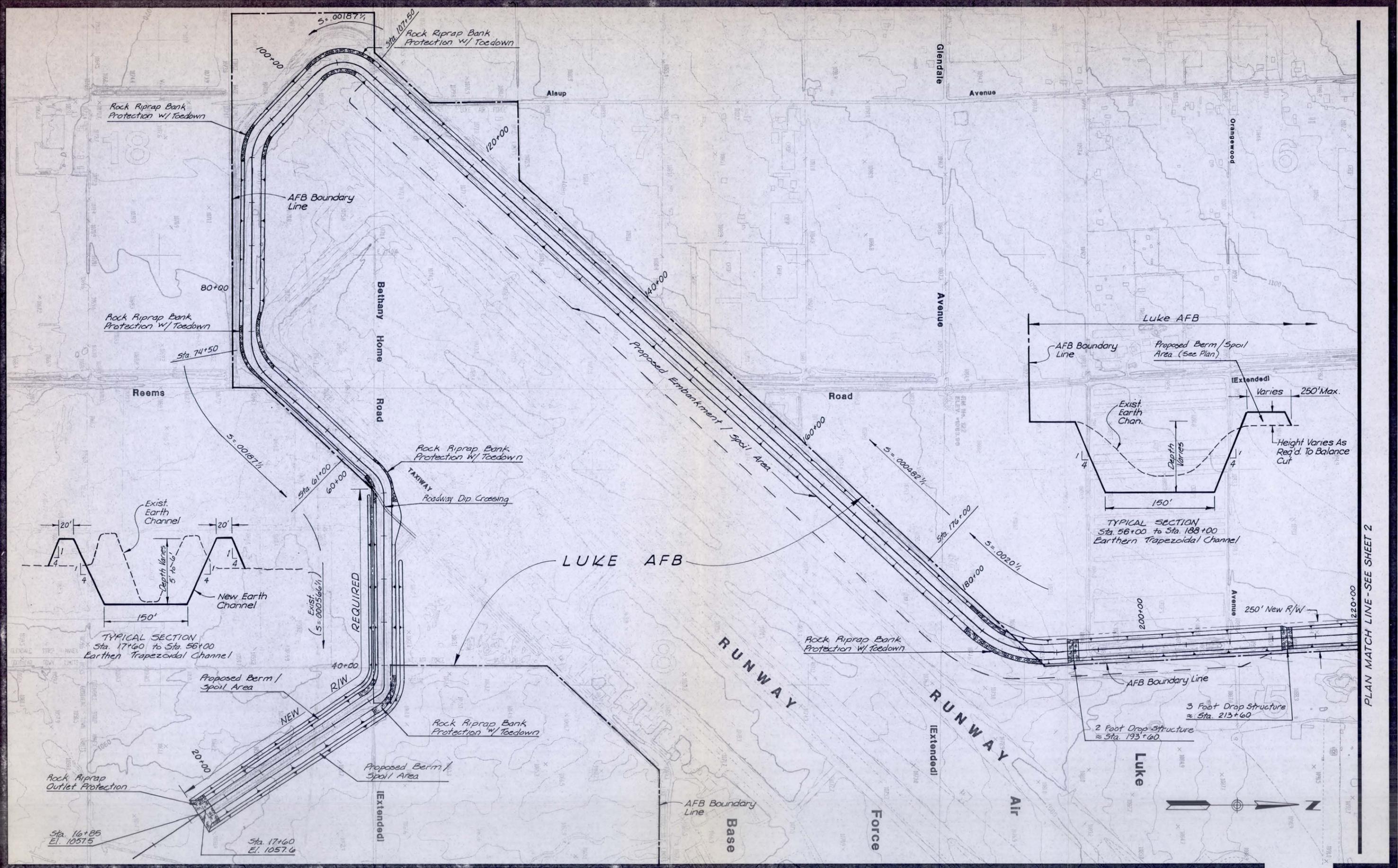
ALTERNATIVE NO. 3

No.	Date	Item

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Date 4-20-93  
Drawn By BKF  
Checked By MTG

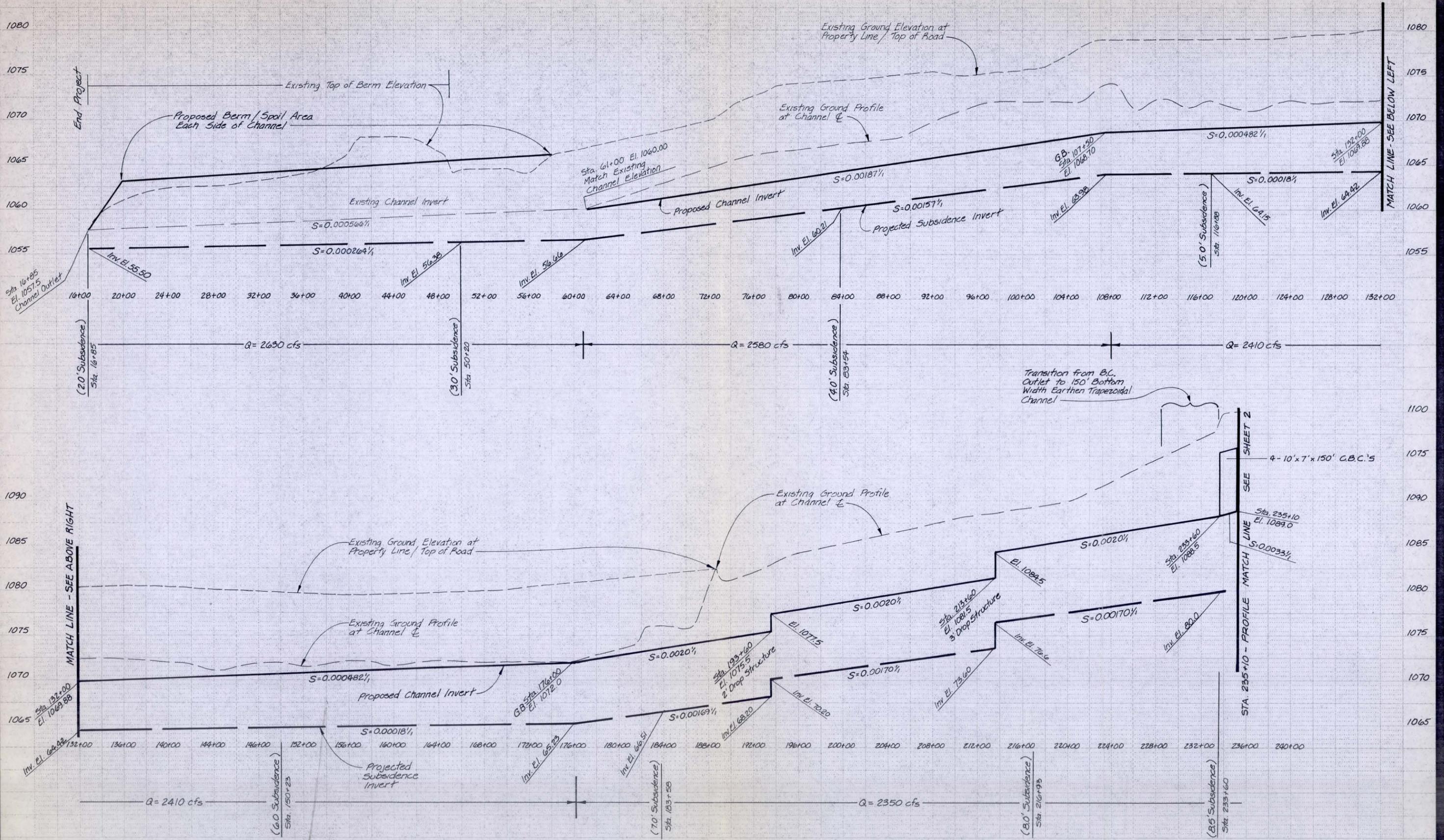
Sheet 1  
Of 4





PLAN MATCH LINE - SEE SHEET 2

No.	Date	Item



7.4 ALTERNATIVE NO. 4

This alternative includes a large detention basin (290 ac.) which collects and detains all of the runoff from the 100-year flood that currently reaches the Dysart Drain between Reems Road and the AT&SF Railroad. The outflow from the basin is conveyed to the Agua Fria River in the Dysart Drain.

The basin was designed to reduce the peak discharge in the Dysart Drain down to the capacity of the existing culverts under the railroad. Therefore, much of the existing Dysart Drain Channel will not require any improvement including the entire reach from the railroad downstream to the sag point in the channel east of Litchfield Road. However, due to the subsidence problem, the channel will require reconstruction from the sag point out to the Agua Fria River.

7.4.1 DESCRIPTION OF IMPROVEMENTS AND R/W REQUIREMENTS  
(Refer to Plan Sheets)

***Sta. 10+40 to 113+15 (Agua Fria River Upstream to West Side of the Base Housing Area)***

Channel Improvements:

This portion of the channel requires complete reconstruction in order to remove the sag in the existing channel east of Litchfield Road. The work includes: removing the existing concrete channel lining and existing farm bridge east of Dysart Road; excavation to lower the channel invert; removal and replacement of the El Mirage Road and Dysart Road bridges; and new concrete channel lining.

Right of Way Requirements:

An additional 20 feet of right of way is required on the south side of the channel from the Agua Fria River to Dysart Road. The existing right of way in this reach is 130 feet. The required right of way is 150 feet.

In addition to the above requirement, 50 feet of additional right of way is required between Dysart Road and the Base (Sta. 72+29 to Sta. 77+05). In this area, the existing right of way is 100 feet and the required right of way is 150 feet.

These right of way requirements were determined for the widest channel section which occurs at the location with the deepest cut (26 foot cut at Sta. 54+00). The right of way is also based on having a maintenance road on each side of the channel. Therefore, the right of way requirement could be reduced by 1) eliminating one maintenance road or 2) narrowing the right of way in areas of shallower cuts. A critical area is where Morton Salt is located, as some of their drying beds may have to be reconfigured to accommodate the proposed channel. This is also where some of the deepest cuts occur.

***Sta. 113+15 to 157+28 (West Side of Base Housing to the Railroad)***

Channel Improvements:

The existing concrete lined channel in this reach is to remain. The channel lining is extended to the top of bank from Sta. 113+15 to Sta. 134+00. The bridge at Litchfield Road, the Base bridge west of Litchfield and the long culverts under the railroad all remain as is.

Right of Way Requirements:

No right of way is required for this reach.

***Sta. 157+28 to 166+50 (Railroad Box Culverts to the Detention Basin Outlet)***

Channel Improvements:

The existing earthen channel in this section is to be concrete lined from the detention basin outlet downstream to the inlet of the box culverts under the railroad. The channel construction includes raising the existing top of the south bank in order to increase the capacity of the box culverts.

Right of Way Requirements:

No right of way is required in this reach. The improvements are located on Base property.

*Sta. 166+50 to Detention Basin (Detention Basin and Outlet Structure)*

Basin Construction:

A new 290-acre detention basin is to be constructed on the north side of Northern Avenue from Reems Road east to the AT&SF Railroad (about 1.5 miles in length). To compensate for the slope of the land, the basin is terraced. The result is two basins, one on the west side and one on the east side, that are interconnected with an 8' x 5' box culvert. The outlet for both basins is a double 8' x 5' box culvert under Northern Avenue that discharges to the Dysart Drain. These basins and outlet box culverts are designed to reduce the 100-year peak outflow to Dysart Drain so that the existing channel elements from the existing 2- 10' x 5.5' x 640' box culvert to the sag east of Litchfield Road can contain the outflow without any modifications.

The basins are designed to incorporate spoil areas so that the cut from the basin can be balanced on-site.

Other basin elements include the use of small berms along the north side of the basin to direct flows to grouted riprap inflow spillways. Bank protection will also be required at the major inflow points along Reems Road and along the AT&SF Railroad.

Emergency overflow spillways, which are located at existing ground elevation on the southwest, south, and northeast side of the basin, have been sized to allow the Probable Maximum Flood to pass without breaching the proposed berms around the south and east side of the basin. Another spillway is located at the "terrace" of the interconnected basins to allow overflow into the eastern basin in case of large inflows to the west basin.

Right of Way Requirements:

The detention basin requires the acquisition of 290 acres of agricultural land north of Northern Avenue.

#### 7.4.2 ADVANTAGES AND DISADVANTAGES

##### Advantages:

1. Minimizes Channel Construction

The detention basin significantly reduces the peak discharge in Dysart Drain. Consequently, much of the existing channel improvements remain as is; including: the Railroad box culverts, the Base bridge and Litchfield Road bridge.

2. Collects all Runoff

This alternative collects all the runoff from Reems Road to the Agua Fria River. Therefore, the current split flow that occurs at Reems Road and Northern Avenue will be eliminated.

3. Protection from Future Land Subsidence

Although each alternative presented in this study has been designed to accommodate future land subsidence; the detention basin provides added protection. If more subsidence occurs than what is anticipated, the channel alternatives (Alternative Nos. 1, 2, and 3) could lose significant capacity. This could greatly reduce the level of flood protection provided by the channel, whereas, the detention basin would continue to function even if more than the expected amount of subsidence occurs. Under these circumstances, the outflow from the basin may cause flooding but the frequency and severity of the flooding would be substantially less than with the channel alternatives.

##### Disadvantages:

1. Most Costly

This alternative and Alternative No. 2, where all the flow is conveyed to the Agua Fria River, are the two most costly solutions.

2. Maintenance

The detention basin presents a large maintenance requirement.

3. Right of Way Acquisition

This alternative requires a 290 acre acquisition for the detention basin.

7.4.3 COST ESTIMATE (Refer to the Itemized Estimates)

SUMMARY OF COST ESTIMATES FOR ALTERNATIVE 4	
DESCRIPTION	ALTERNATIVE 4
Total On-Base Cost	\$4,023,800
Total Off-Base Cost	\$8,580,500
<b>TOTAL COST</b>	<b>\$12,604,300</b>

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 4  
COST ESTIMATE

Page 1 of 2



(OFF-BASE PORTION)

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove El Mirage Road Bridge	1 Ea.	\$35,000	\$35,000
Demolish and Remove Farm Bridge	1 Ea.	\$15,000	\$15,000
Demolish and Remove Dysart Road Bridge	1 Ea.	\$25,000	\$25,000
Replace El Mirage Road Bridge (85' x 84')	7,140 S.F.	\$45/S.F.	\$321,300
Replace Dysart Road Bridge (100' x 84')	8,400 S.F.	\$45/S.F.	\$378,000
Detention Basin Cut Volumes	3,263,935 C.Y.	\$1/C.Y.	\$3,263,900
Construct 2 - 8' x 5' x 270' C.B.C.'s at Southeast Corner of Detention Basin #2	270 L.F.	\$410/L.F.	\$110,700
Construct 1 - 8' x 5' x 100' C.B.C. that Connects Detention Basins #1 and #2	100 L.F.	\$250/L.F.	\$25,000
Grouted Riprap Bank Protection at Detention Basins' Spillways and Culverts	34,670 S.Y.	\$22/S.Y.	\$762,700
SUBTOTAL			\$4,936,600
+ 20% Contingencies			\$987,300
TOTAL CONSTRUCTION COST			\$5,923,900
+ 20% Engineering and Construction Management			\$1,184,800
Right of Way (Channel) 50' x 430' = 21,500 S.F. 20' x 6190' = <u>123,800</u> S.F. 145,300 S.F.	145,300 S.F.	\$.15/S.F.	\$21,800
Right of Way (Detention Basin)	290 Ac.	\$5,000/Ac.	\$1,450,000
TOTAL OFF-BASE COST			\$8,580,500

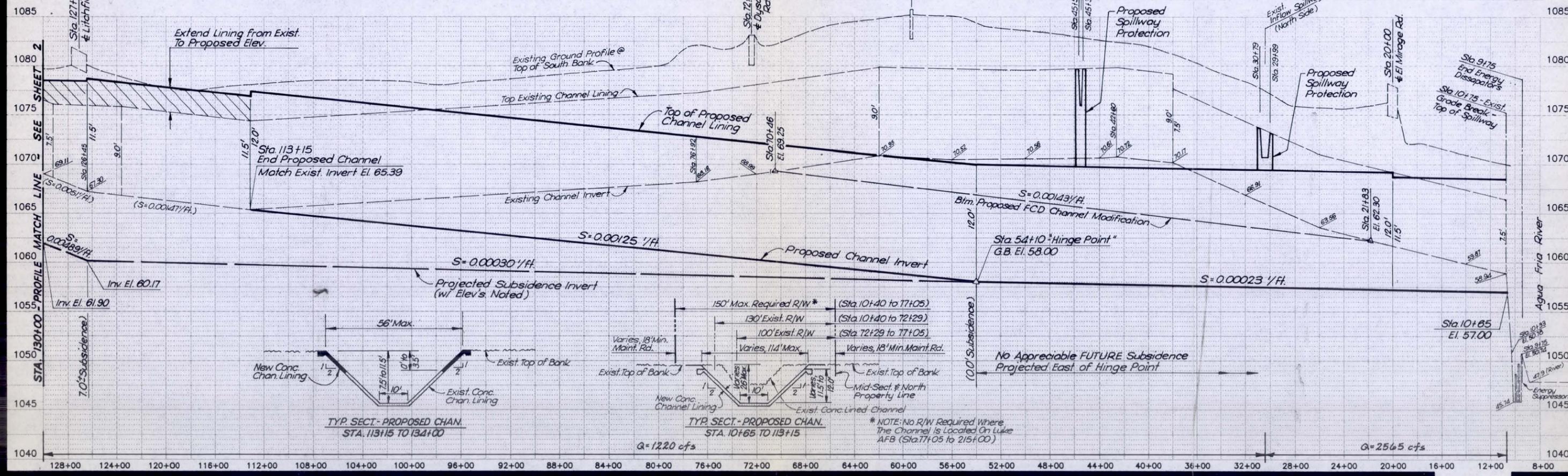
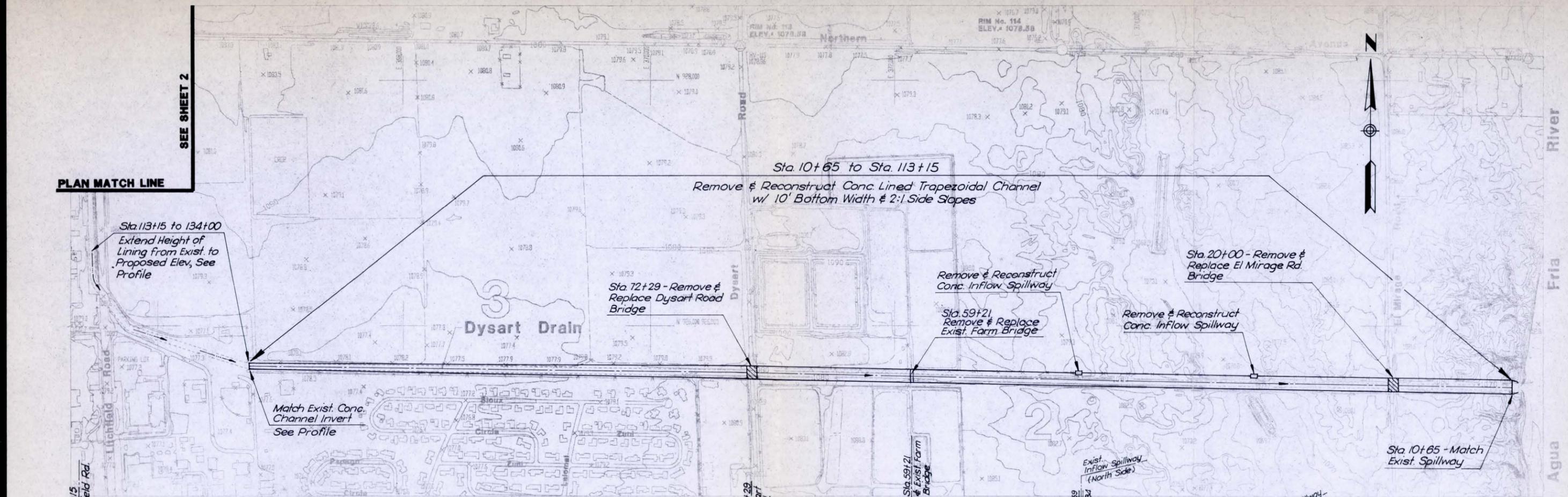
DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 4  
 COST ESTIMATE

Page 2 of 2

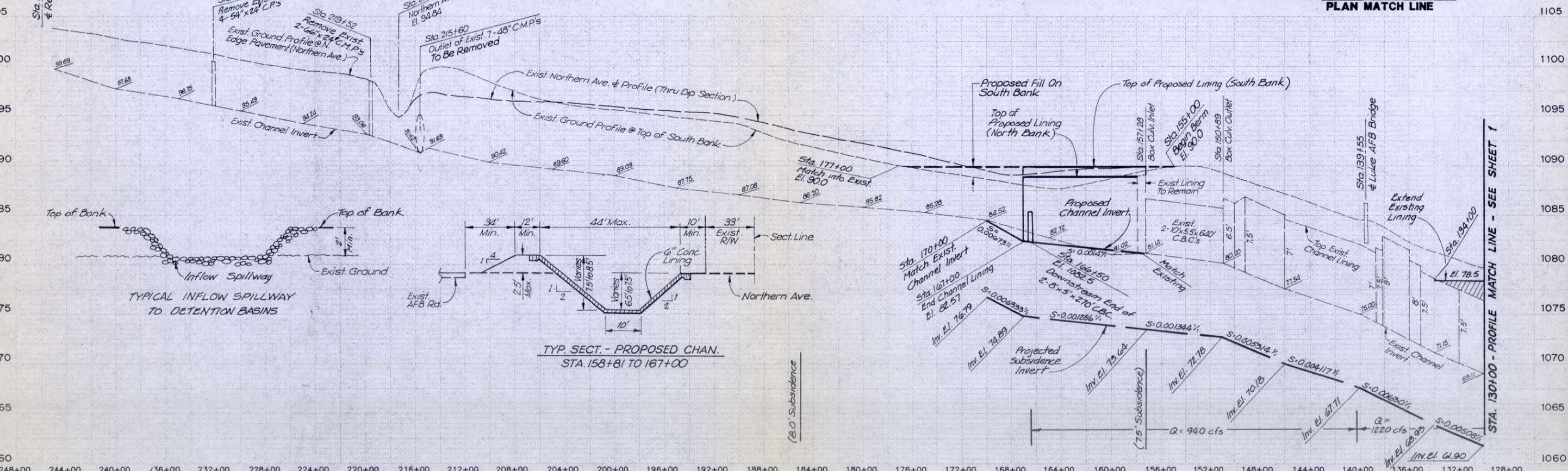
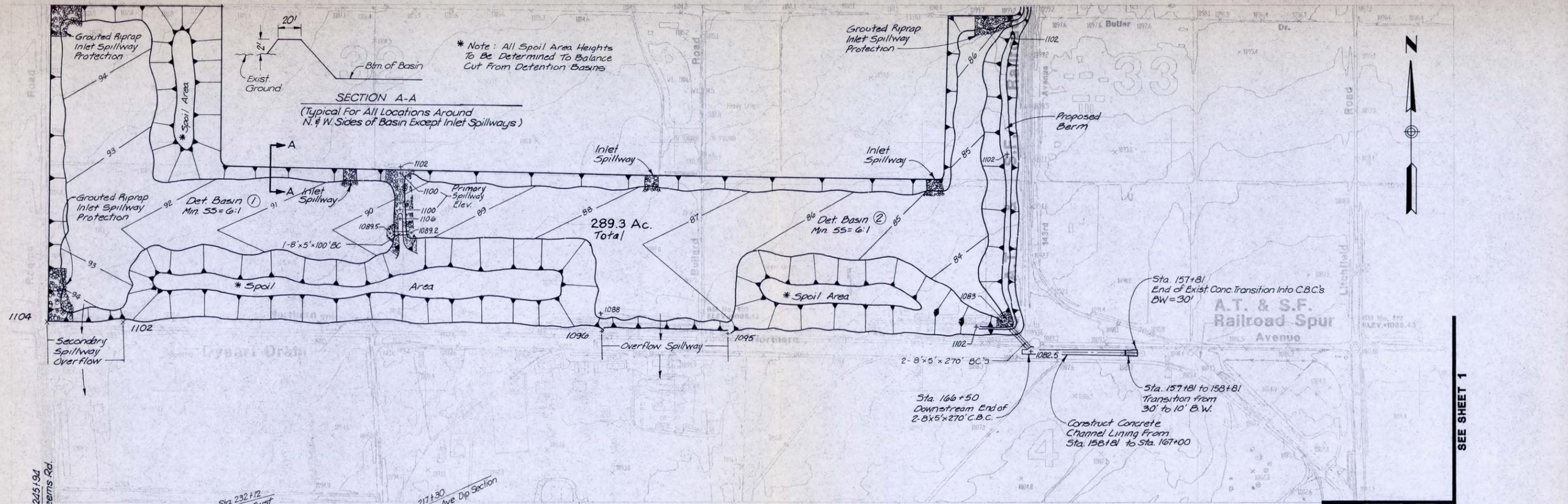


(ON-BASE PORTION)

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove 6" Concrete Lining w/Rebar	496,226 S.F.	\$.75/S.F.	\$372,200
Channel Excavation	216,071 C.Y.	\$3/C.Y.	\$648,200
New 6" Concrete Lining w/Rebar	80,633 S.Y.	\$22/S.Y.	\$1,773,900
SUBTOTAL			\$2,794,300
+ 20% Contingencies			\$558,900
TOTAL CONSTRUCTION COST			\$3,353,200
+ 20% Engineering and Construction Management			\$670,600
TOTAL ON-BASE COST			\$4,023,800



No.	Date	Item



No.	Date	Item

7.5 ALTERNATIVE NO. 5

This alternative includes two separate detention basins. A 125-acre basin is located at Reems Road and Northern Avenue and a 116-acre basin is located at Northern Avenue and the Atchison, Topeka and Santa Fe Railroad.

The 125-acre basin adjacent to Reems Road detains runoff from the 100-year flood and discharges at a reduced flow (approximately 550 cfs) into a proposed channel to Bullard Wash. The channel is located on Luke AFB property along the west and south sides of the Base.

The 116-acre basin adjacent to the AT&SF Railroad also detains runoff from the 100-year flood. The reduced outflow (approximately 950 cfs) is metered into Dysart Drain and conveyed east to the Agua Fria River.

The 116-acre basin was designed to reduce the peak discharge in the Dysart Drain down to the capacity of the existing culverts under the railroad. Therefore, much of the existing Dysart Drain Channel will not require any improvement including the entire reach from the railroad box culvert downstream to the sag point in the channel east of Litchfield Road. However, due to the subsidence problem, the channel will require reconstruction from the sag point out to the Agua Fria River.

7.5.1 DESCRIPTION OF IMPROVEMENTS AND R/W REQUIREMENTS  
(Refer to Plan Sheets)

7.5.1.1 Dysart Drain

*Sta. 10+40 to 113+15 (Agua Fria River Upstream to West Side of Base Housing Area)*

Channel Improvements:

As with the other alternatives, this portion of the channel requires complete reconstruction in order to remove the sag in the existing channel just east of Litchfield Road. The channel will still have to be excavated considerably east of Dysart Road to account for projected future subsidence even though the flows are considerably reduced compared to Alternatives 1, 2, and 3.

The work includes: removal of the existing concrete channel lining and farm bridge east of Dysart Road; removal and replacement of El Mirage Road and Dysart Road bridges; excavation to lower the channel invert; and new concrete channel lining.

Right of Way Requirements:

An additional 20 feet of right of way is required on the south side of the channel from the Agua Fria River to Dysart Road. The existing right of way in this reach is 130 feet. The required right of way is 150 feet.

In addition to the above requirement, 50 feet of additional right of way is required between Dysart Road and the Base (Sta. 72+29 to Sta. 77+05). In this area, the existing right of way is 100 feet and the required right of way is 150 feet.

These right of way requirements were determined for the widest channel section which occurs at the location with the deepest cut (26 foot cut at Sta. 54+00). The right of way is also based on having a maintenance road on each side of the channel. Therefore, the right of way requirement could be reduced by 1) eliminating one maintenance road or 2) narrowing the right of way in areas of shallower cuts. A critical area is where Morton Salt is located, as some of their drying beds may have to be reconfigured to accommodate the proposed channel. This is also where some of the deepest cuts occur.

***Sta. 113+15 to 157+28 (West Side of Base Housing to the Railroad)***

Channel Improvements:

The existing concrete lined channel in this reach is to remain and the channel lining is extended to the top of bank. The Base bridge west of Litchfield Road, the Litchfield Road bridge and the culvert under the railroad all remain as is.

Right of Way Requirements:

No right of way is required for this reach.

***Sta. 157+28 to 166+50 (Railroad Box Culverts to the Detention Basin Outlet)***

Channel Improvements:

Channel improvements in this reach consist of channel excavation to lower the channel invert, new concrete channel lining from Sta. 157+81 to Sta. 167+00, and elevating the south bank to prevent breakout flows to the south.

Right of Way Requirements:

No right of way is required for this reach. The improvements are located on the Base property.

***116-Acre Detention Basin West of AT&SF Railroad***

Basin Construction:

A new 116-acre detention basin is to be constructed on the north side of Northern Avenue, west of the AT&SF Railroad. The basin and outlet culverts are sized to reduce the peak outflow into Dysart Drain so that the existing 2 - 10' x 5.5' box culverts at the north end of the runway have adequate capacity to pass the 100-year flow.

The channel downstream to the sag east of Litchfield Road would also remain as the existing capacity is adequate to convey this flow.

Two - 8' x 5' x 270' box culverts under Northern Avenue would connect the detention basin to Dysart Drain.

The basin is designed to incorporate spoil areas so that the cut from the basin can be balanced on-site.

A small berm will be required along the north side of the basin to direct flows to two grouted riprap inflow spillways. A grouted riprap spillway will also need to be located where a majority of the flows enter the basin along the AT&SF railroad. Emergency overflow spillways, which are located at existing ground elevation on the southeast and northeast corner of the basin, have been sized to pass the Probable Maximum Flood without breaching the berms on the south and east side of the basin.

Right of Way Requirement:

The detention basin requires the acquisition of 116 acres of agricultural land north of Northern Avenue.

7.5.1.2 Channel Around West and South Side of Luke Air Force Base

*Sta. 18+75 to 233+60 (Bullard Wash to Northern Avenue)*

Channel Improvements:

The channel in this reach consists of utilizing the existing earthen channel from the outlet at Sta. 18+75 to Sta. 61+00. From Sta. 61+00 to Sta. 188+90 it will be deepened and widened to a 50 foot bottom width and the side slopes will vary to match the existing channel sides. From Sta. 190+40 to Sta. 233+60, a new earthen channel is constructed with a 10 foot bottom width and 4:1 side slopes. Rock riprap erosion protection will be required at the transition from 50 foot bottom width to the 10 foot bottom width. Discharges vary from 900 cfs at the south end of the Base to 550 cfs from the detention basin outlet at Northern Avenue.

Grouted riprap channel protection will be required at the outlet of the box culvert. An option is provided in the cost estimate (Option 1) to concrete-line the entire channel reach south of Northern Avenue. This would reduce the maintenance requirement.

Right of Way Requirement:

No right of way is required in this reach. The entire channel is located on the Base.

*125-Acre Detention Basin East of Reems Road*

Basin Construction:

A new 125-acre detention basin is to be constructed north of Northern Avenue and east of Reems Road. The basin and the 8' x 5' x 150' box culvert outlet are sized to reduce the 100-year peak outflow to 550 cfs from the existing 2350 cfs that enters the basin. This outflow is conveyed around the west side of Luke AFB in an earthen channel.

This basin is also designed to incorporate spoil areas so that the cut from the basin can be balanced on site.

Other elements of the basin include a grouted riprap inflow spillway north of Northern Avenue along Reems Road to allow the stormwater flows along Reems Road into the basin. A small berm will be required along the north side of the basin to direct flows to another spillway on the north end of the basin. Emergency overflow spillways, which are located at existing ground elevation at the southwest and northeast corners of the basin, have been sized to allow the Probable Maximum Flood to pass without breaching the proposed berms around the south and east side of the basin.

Right of Way Requirements:

The detention basin requires the acquisition of 125 acres of farmland located north of Northern Avenue and east of Reems Road.

## 7.5.2 ADVANTAGES AND DISADVANTAGES

### Advantages:

#### 1. Minimizes Channel Construction

The detention basins significantly reduce the peak discharge in both Dysart Drain and the channel around the west side of the Base. Much of the existing Dysart Drain channel improvements remain as is, including: the Railroad box culverts, the Base bridge and Litchfield Road bridge. The channel along the west and south side of the Base would be located entirely on Base property and would utilize much of the existing earthen channel.

#### 2. Collects all Runoff

This alternative collects all the runoff from Reems Road to the Agua Fria River. The current split flow that occurs at Reems Road and Northern Avenue will be contained in the detention basin and the west side channel.

#### 3. Protection from Future Land Subsidence

Although each alternative presented in this study has been designed to accommodate future land subsidence; the detention basin provides added protection. If more subsidence occurs than what is anticipated, the channel alternatives (Alternative Nos. 1, 2, and 3) could lose significant capacity. This could greatly reduce the level of flood protection provided by the channel, whereas, the detention basins would continue to function even if more than the expected amount of subsidence occurs. Under these circumstances, the outflow from the basins may cause flooding but the frequency and severity of the flooding would be substantially less than with the channel alternatives.

4. Cost

This basin alternative is less costly than Alternative 2 and Alternative 4 and is about the same cost as Alternative 3 where flows at Reems Road and Northern Avenue are conveyed south in a channel without detention.

Disadvantages:

1. Maintenance

The detention basins present a large maintenance requirement.

2. Right of Way Acquisition

This alternative requires the acquisition of 241 acres of farmland for the two detention basins.

3. Increased Stormwater Flows

This alternative, as well as the other 4 alternatives, reduces the 100-year peak discharge in Bullard Wash with the improvement of Dysart Drain. However, the addition of the west side channel will result in higher flows during the more frequent storms. Currently, the stormwater runoff from small floods is all collected in the Dysart Drain and conveyed to the Agua Fria River. In the case of alternative 5 and alternative 3, these low flows will be conveyed to Bullard Wash. The result will be more frequent flooding along Bullard Wash which affects several roadway crossings to the south. Moreover, in the case of this alternative, the duration of flooding will be increased as a result of metering the flows from the detention basin. The result could be longer roadway closures downstream and longer inundation periods for crops along Bullard Wash.

7.5.3 COST ESTIMATE (Refer to the Itemized Estimates)

SUMMARY OF COST ESTIMATES FOR ALTERNATIVE 5		
DESCRIPTION	ALTERNATIVE 5	W/OPTION 1
Cost Reduction (-) / Increase (+)		+ \$2,665,300 (On-Base)
Total On-Base Cost	\$4,325,300	\$6,990,600
Total Off-Base Cost	\$6,318,900	\$6,318,900
<b>TOTAL COST</b>	<b>\$10,644,200</b>	<b>\$13,309,500</b>

Option 1: Provide concrete channel lining along west side of Luke AFB.

DYSART DRAIN IMPROVEMENT PROJECT  
ALTERNATIVE NO. 5  
COST ESTIMATE



(OFF-BASE PORTION)

DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove El Mirage Road Bridge	1 Ea.	\$35,000	\$35,000
Demolish and Remove Farm Bridge	1 Ea.	\$15,000	\$15,000
Demolish and Remove Dysart Road Bridge	1 Ea.	\$25,000	\$25,000
Replace El Mirage Road Bridge (85' x 84')	7,140 S.F.	\$45/S.F.	\$321,300
Replace Dysart Road Bridge (100' x 84')	8,400 S.F.	\$45/S.F.	\$378,000
Detention Basin Cut Volumes	2,050,070 C.Y.	\$1/C.Y.	\$2,050,100
Construct 2 - 8' x 5' x 270' C.B.C. at Southeast Corner of Detention Basin #2	270 L.F.	\$410/L.F.	\$110,700
Construct 1 - 8' x 5' x 150' that Connects Detention Basin #1 to the South Channel	150 L.F.	\$250/L.F.	\$37,500
Grouted Riprap Bank Protection at Detention Basin Spillways and Culverts	25,693 S.Y.	\$22/S.Y.	\$565,300
SUBTOTAL			\$3,537,900
+ 20% Contingencies			\$707,600
TOTAL CONSTRUCTION COST			\$4,245,500
+ 20% Engineering and Construction Management			\$849,100
Right of Way (Channel) 50' x 430' = 21,500 S.F. 20' x 6190' = <u>123,800</u> S.F. 145,300 S.F.	145,300 S.F.	\$.15/S.F.	\$21,800
Right of Way (Detention Basin)	240.5 Ac.	\$5000/Ac.	\$1,202,500
TOTAL OFF-BASE COST			\$6,318,900

DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 5  
 COST ESTIMATE  
 (ON-BASE PORTION)



DESCRIPTION	QUANTITY	UNIT COST	COST
Demolish and Remove 6" Concrete Lining w/Rebar	496,226 S.F.	\$.75/S.F.	\$372,200
Excavation Along Dysart Drain	216,071 C.Y.	\$3/C.Y.	\$648,200
New 6" Concrete Lining w/Rebar	80,633 S.Y.	\$22/S.Y.	\$1,773,900
Excavation Along Channel West and South of Luke AFB	141,592 C.Y.	\$1/C.Y.	\$141,600
Grouted Riprap Bank Protection in Channel West and South of Luke AFB	3080 S.Y.	\$22/S.Y.	\$67,800
SUBTOTAL			\$3,003,700
+ 20% Contingencies			\$600,700
TOTAL CONSTRUCTION COST			\$3,604,400
+ 20% Engineering and Construction Management			\$720,900
TOTAL ON-BASE COST			\$4,325,300

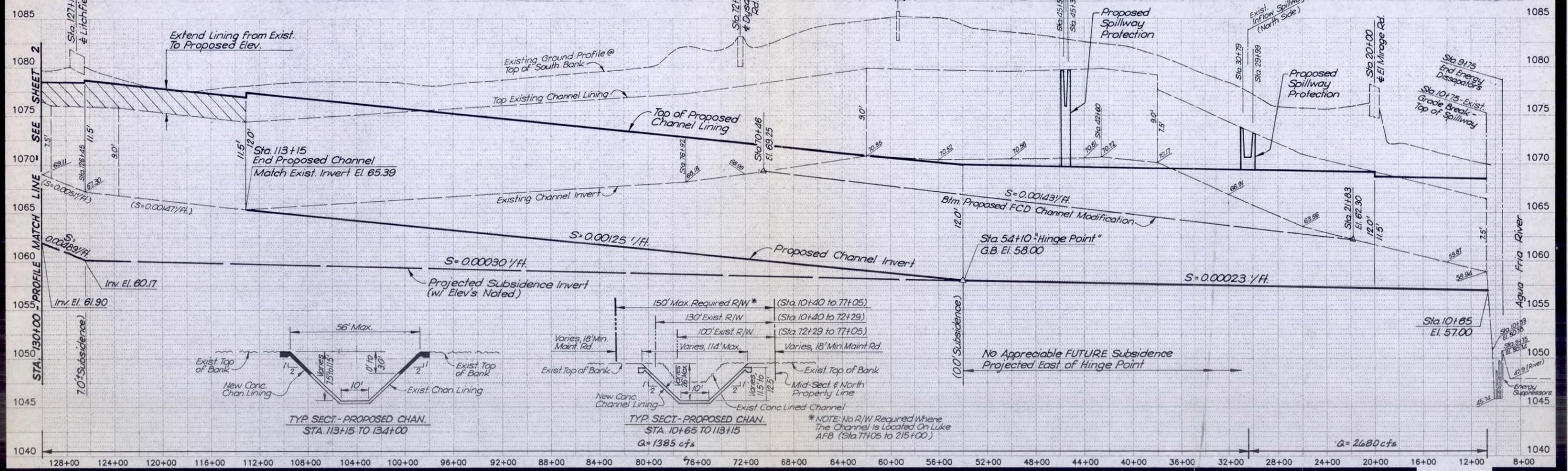
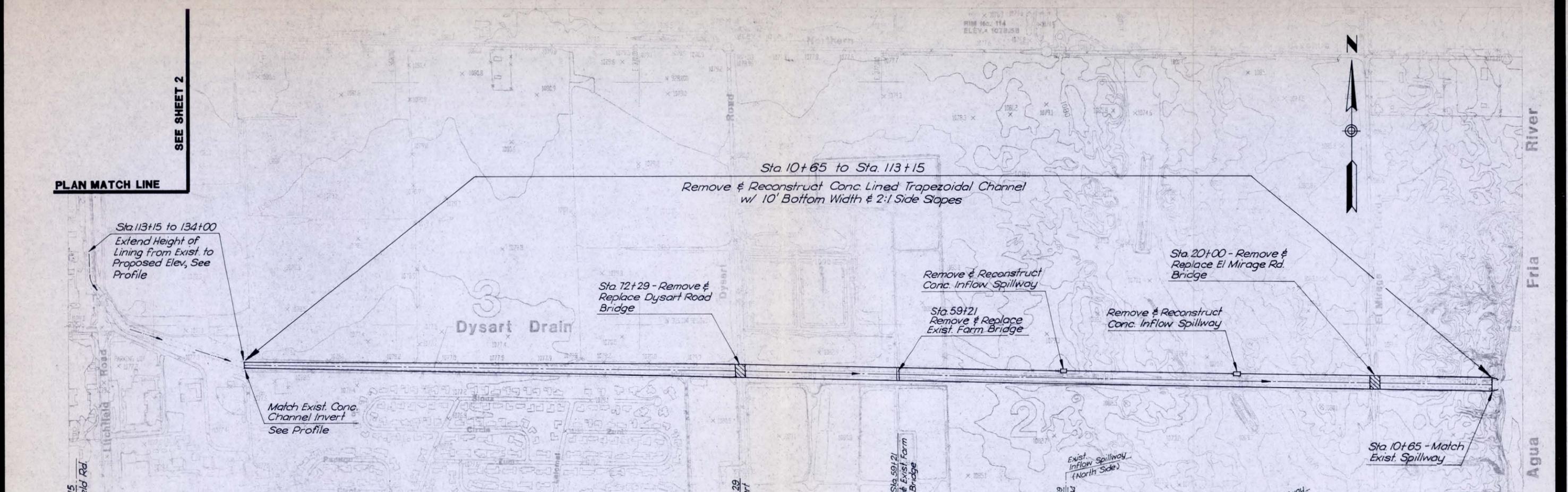
DYSART DRAIN IMPROVEMENT PROJECT  
 ALTERNATIVE NO. 5  
 COST ESTIMATE



<u>OPTION 1</u>			
Provide Concrete Channel Lining Along West Side of Luke AFB			
DESCRIPTION	QUANTITY	UNIT COST	COST ADJUSTMENT
Concrete Channel Lining	+ 92,350 S.Y.	\$22/S.Y.	+ \$2,031,700
Grouted Riprap Bank Protection	- 3,080 S.Y.	\$22/S.Y.	- \$67,800
Channel Excavation	-113,000 S.Y.	\$1/C.Y.	- \$113,000
CONSTRUCTION COST ADJUSTMENT			+ \$1,850,900
+ 20% Contingencies			+ \$370,200
TOTAL CONSTRUCTION COST ADJUSTMENT			+ \$2,221,100
+ 20% Engineering and Construction Management			+ \$444,200
TOTAL COST ADJUSTMENT			+ \$2,665,300

PLAN MATCH LINE

SEE SHEET 2



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Phoenix, Arizona 85012 (602) 279-1016

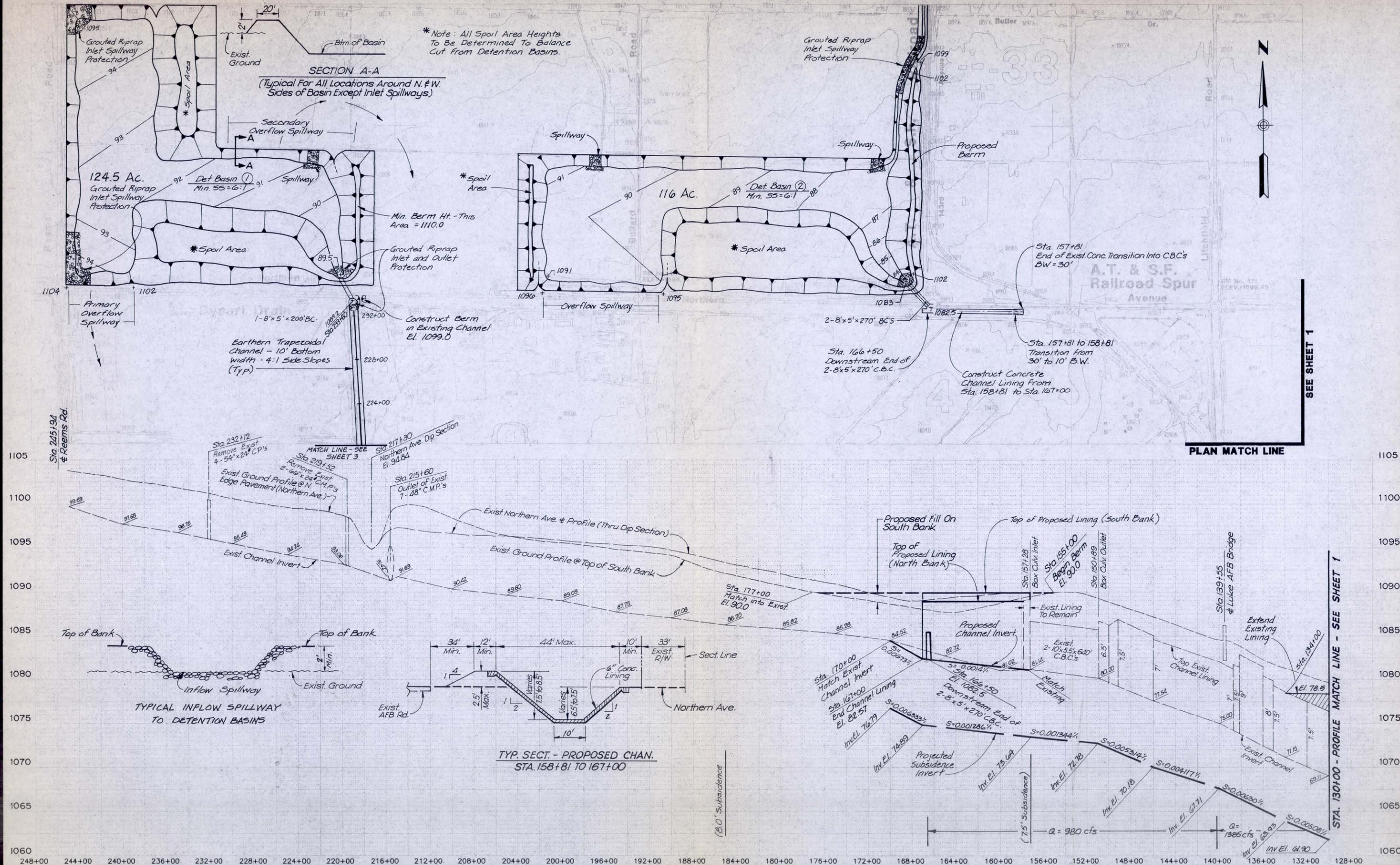
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
**Dysart Drain Improvement Project**  
Preliminary Design

**ALTERNATIVE NO. 5**

No.	Date	Item

Scale 1" = 400' H. 1" = 5' V.  
Job No. 289036-4  
Date 4-20-93  
Drawn By BKF  
Checked By MTG

Sheet 1  
of 4



\* Note: All Spoil Area Heights To Be Determined To Balance Cut From Detention Basins.

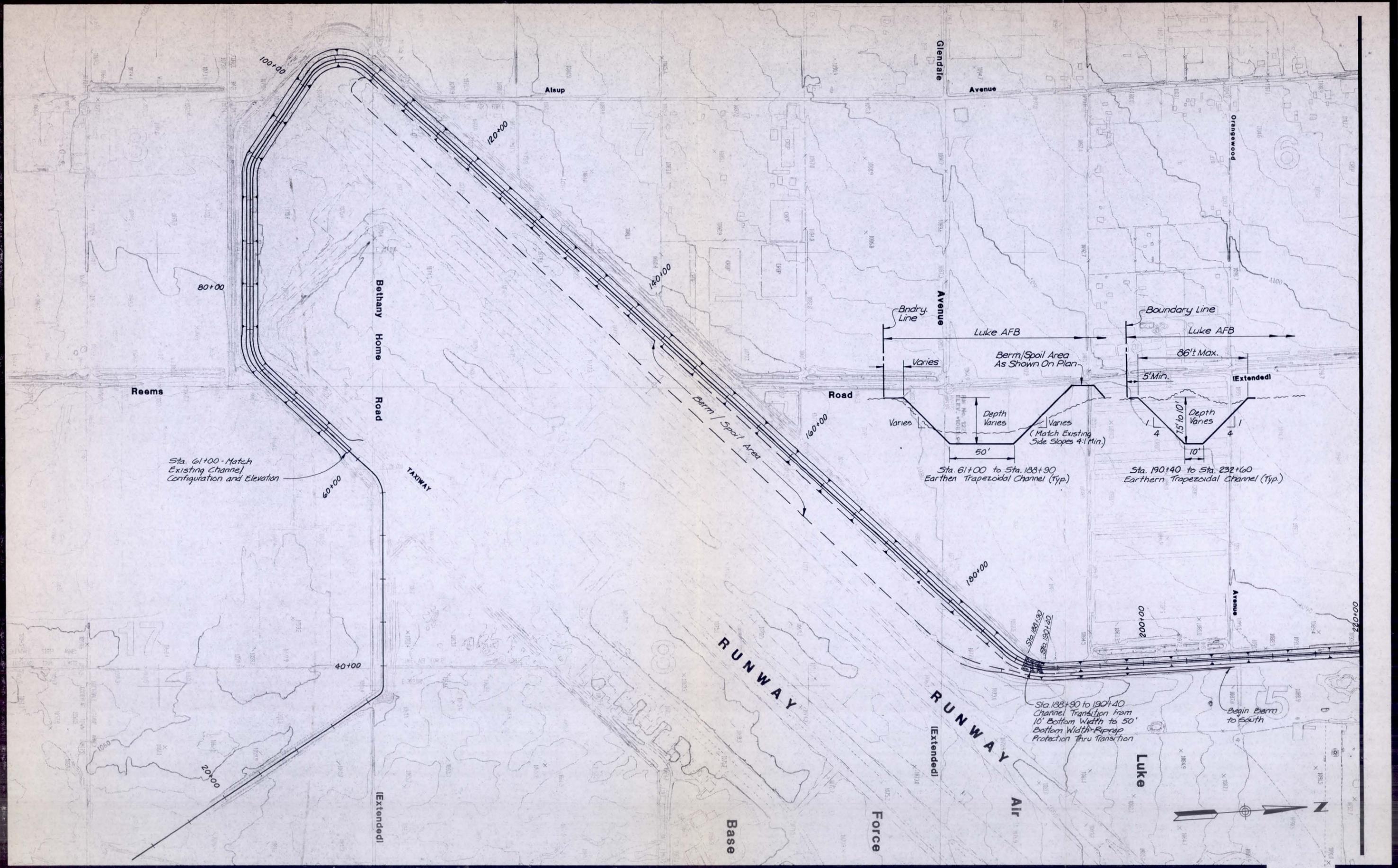
SECTION A-A  
(Typical For All Locations Around N. & W. Sides of Basin Except Inlet Spillways)

PLAN MATCH LINE

SEE SHEET 1

STA. 130+00 - PROFILE MATCH LINE - SEE SHEET 1

No.	Date	Item



Sta. 61+00 - Match Existing Channel Configuration and Elevation

Sta. 61+00 to Sta. 188+90 Earthen Trapezoidal Channel (Typ.)

Sta. 190+40 to Sta. 232+60 Earthen Trapezoidal Channel (Typ.)

Sta. 188+90 to 190+40 Channel Transition from 10' Bottom Width to 50' Bottom Width Riprap Protection thru Transition

Begin Berm to South



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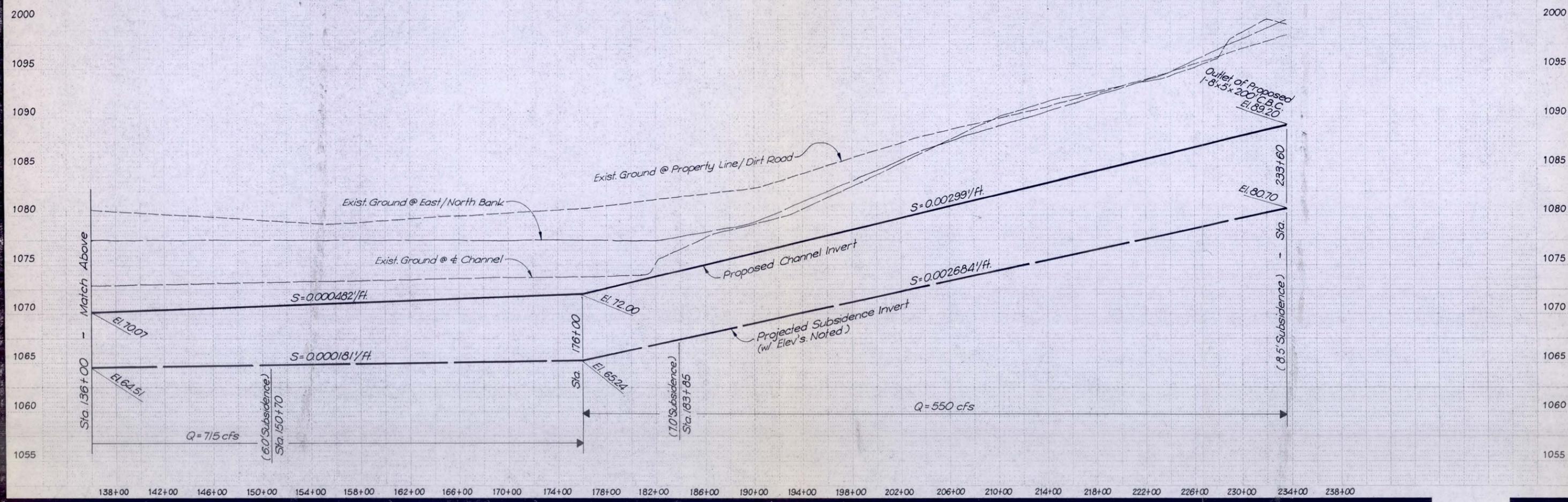
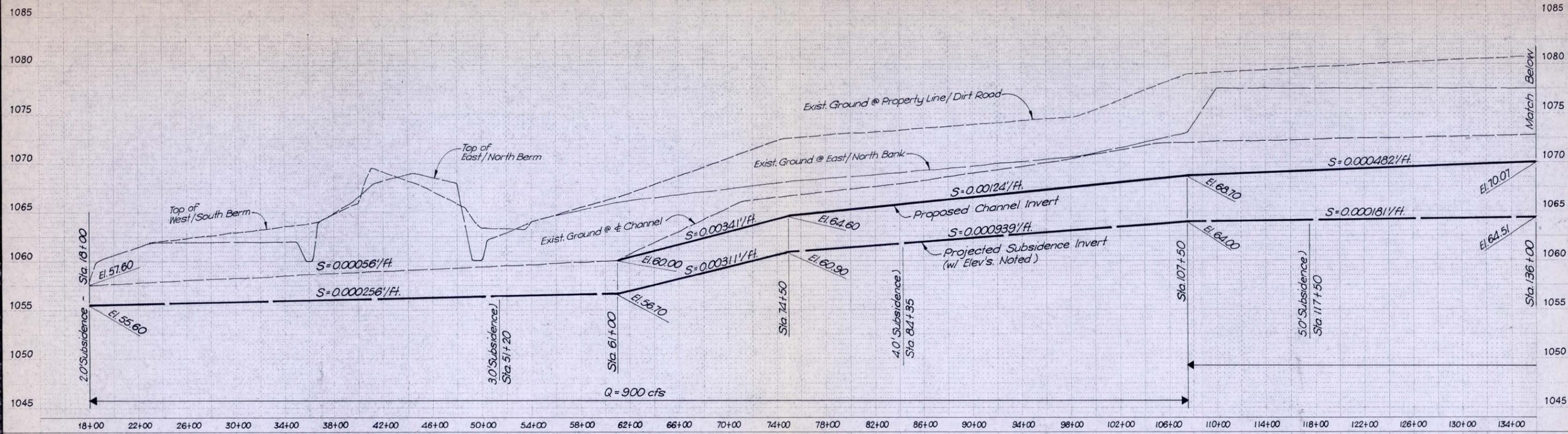
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
Dysart Drain Improvement Project  
Preliminary Design  
Project

ALTERNATIVE NO. 5  
Channel Around West Side Of Luke A.F.B.  
Sheet Title

No.	Date	Item

Scale 1"=400' H. 1"=5' V.  
Job No. 289036-4  
Date 4-20-93  
Drawn By BKF  
Checked By MTG

Sheet 3  
Of 4



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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY  
Dysart Drain Improvement Project  
Preliminary Design

ALTERNATIVE NO. 5

Channel Profile Around West Side Of Luke A.F.B.  
Sheet Title

No.	Date	Item

Scale 1" = 400' H. 1" = 5' V.  
Job No. 289036-4  
Date 4-20-93  
Drawn By BKF  
Checked By MTG

APPENDIX A

**SUMMARY OF  
POTENTIAL UTILITY CONFLICTS**

**DYSART DRAIN**  
**POTENTIAL UTILITY CONFLICTS**  
3/1/93

1) **Santa Fe Pacific Pipeline Partners, L.P. (SFPP)** 6" high pressure refined petroleum products pipeline, 3 crossings.

- a) Dysart Road, 29.5' east of section line, MCDOT permit # C-0099, dated 1-6-56.
- b) Litchfield road, 25' east of section line, MCDOT permit # C-0099, dated 1/6/56.
- c) Litchfield road, approximately 1780' south of Northern Avenue, line crosses Litchfield road and extends west into Luke Air Force Base (LAFB). Crosses channel again at this location. Also see LAFB map for area 8.

According to LAFB, line remains property of SFPP until it reaches the fuel receiving terminal. Therefore, all refined petroleum products pipelines affected by Dysart Drain are owned by SFPP.

Also, according to LAFB the usage of the pipeline is nearly constant, so any downtime for relocation would have to be minimal. Both answers from LAFB were "from the top of their head" so this may need to be researched further as the design progresses. Lines a & b are within road R/W by permit, so this would be at SPPL's cost. Unsure who would bear relocation cost for item c.

2) **Southwest Gas Corporation (SWG)**

- a) Litchfield Road, 20' west of section line, 6" high pressure gas main. Installed in 1954, with relocation @ bridge in 1983. Line is attached to west side of bridge.

*21' PER PHONE CALL 4/22/93  
Quote PER JERRY HUGHES*

3) **Amerigas Terminal** 6" high pressure LP Gas pipe.

- a) Dysart Road, west side, crosses roadway and enters "CalGas" property. Approximately 35' north of existing North R/W line. Does not appear to conflict with channel. May impact other utility relocations, such as SFPP. Per David Harbushka of Amerigas, pothole data from previous job should be available from Roger Miles of MCDOT.

4) **USWest**

- a) Litchfield Road, 40' east of section line, 3-3" black iron pipes (BIP). These appear to be the 3 pipes attached to the east side of the bridge, stacked vertically. The lines extend north of the bridge where they consist of 2-4" conduits & 1 direct bury cable.
- b) Dysart Road, 25' east of section line, underground telco. Goes overhead at south channel R/W line, extending eastward overhead at south R/W line. Does not appear to be in conflict.

c) Northern Avenue, from Bullard to Litchfield Rd, varying from 17' to 38' north of section line, underground telephone cable. Does not appear to conflict with the channel.

d) El Mirage Road, 30' west of section line, underground telco. Telco map shows line at channel was abandoned in 1987, but an overhead line is present across the channel at this location, which appears to be a telephone line.

**5) Arizona Public Service Company (APS)**

a) Along north side of channel, from Litchfield road to Dysart road, there are overhead 12kv and 69kv lines.

b) Dysart Road, east side, overhead transmission and distribution lines. Cable TV line is also attached to these poles.

c) Along south side of channel, from Dysart to 1/4 mile east, there are overhead power lines that cross the channel 1/4 mile east of Dysart. (Service to CalGas and Morton Salt.)

d) El Mirage Road, East Side, overhead power lines.

e) 1/4 mile east of El Mirage Road there are services to "United Metro", but these appear to be beyond the limits of the project.

f) APS power poles, 1/2 mile east of Reems Rd, South of Northern Avenue, along LAFB fence line.

g) APS power poles along the North side of Northern Avenue, from west boundary of base to east of Bullard .

See also, LAFB power lines, section 11. According to LAFB, APS owns the transmission lines within the base, but LAFB owns the distribution lines.

**6) Insight Cablevision**

a) Dysart Road, East side, overhead cable (on APS poles) crosses Dysart Drain. See item 5b above.

**7) Morton Salt Company (east of Dysart Road)**

a) Halfway between Dysart Road and the farm bridge, the following lines are within the 24" steel pipeline which crosses Dysart Drain: 2" PVC electrical conduit, 6" steel salt brine line, and 6" polyethylene fresh water line.

b) 15' west of the farm bridge, the following lines are within the 24" steel pipeline which crosses Dysart Drain: 6" polyethylene fresh water line, 8" polyethylene salt slurry line, 8" polyethylene salt brine line, and 2" polyethylene water line.

c) Concrete Bridge over Dysart Drain.

The lines are inside irrigation crossings installed as part of the original Dysart Drain project. Morton may not have prior rights for these utilities. Per Ken Johnson of FCD Land Management, he has researched the ownership of the concrete bridge because it has become a hazard. He could not find any record of Morton's ownership of the bridge, therefore he had it barricaded. Will research this further as the project progresses.

Morton leases this property from Roach & Baker Ranches, who may have some irrigation lines which cross the channel. In general, irrigation lines are not included in this document, as they are most easily discovered by field survey.

---

## **Luke Air Force Base (LAFB)**

### **8) Waste Water Effluent Line**

a) From approximately 1/4 mile east of Litchfield road to 40' west of El Mirage Road, there is a 16" effluent supply pipeline within the channel R/W, near the south R/W line.

b) This line, and an associated 16" PVC irrigation distribution line, cross the channel 1/4 mile east of Litchfield Road.

### **9) Sanitary Sewer**

a) 8" sewer at east bridge. Existing line is approximately 3' above channel invert. Per LAFB plans, elevation of MH invert to North =90.6, to south =88.4. See LAFB area 8 map.

b) 1/4 mile east of Litchfield Road, 4" sewer line (& 2-1/2" water line) are suspended above the channel by cable supported from I-beams. There is a 5' diameter manhole (containing a sewer lift station) approximately 10' north of the north channel bank. These appear to be services for the K9 facility & vet clinic. The overhead electrical service (to the lift station) also crosses Dysart Drain at this location.

### **10) Water Lines**

a) 6" water line crosses above channel invert in LAFB area 9.

b) 1/4 mile east of Litchfield Road, 2-1/2" water line suspended above channel. See item 9b above.

c) West bank of channel, north of LAFB "north gate, there is evidence of a water line (Water valves, hydrants, & pavement cuts). Not shown on LAFB plan. Line appears to parallel the west bank of the channel.

### **11) Power Lines**

- a) Power poles along west side of channel, west of Litchfield Road, LAFB owned.
- b) Power Poles along the south side of the channel from Litchfield Road to 1/4 mile east. LAFB owned.
- c) East of Litchfield Road, electrical service to sewer lift station crosses overhead above channel. See item 9b above.
- d) East of Litchfield Road, electrical service to the vet clinic & K9 facility cross overhead above channel.

#### **12) Communications Lines**

- a) Direct Buried Communication cable, along south side of channel, starting from area 44 map to Litchfield Road. Also called EMCS cable.

#### **13) Gas lines**

- a) 2" PE line, west side of channel, from base entrance road to east bridge. Goes to JP-4 incinerator facility. Per LAFB, this is a gas vapor line which conveys vapors from the gas tanks to the incinerator so that the vapors are not released to the atmosphere. Concrete patch visible in bottom of drain, east of east bridge.

#### **14) Storm Drains**

- a) 12" RCP Storm Drain, shown on area 44 map.
- b) 4-24" CMP's. See area 8 map.
- c) Storm Drain from near building #353, area 8 map.
- d) 24" Storm Drain, area 2 map.
- e) 30" SD, area 2 map.
- f) 30" SD, 1/4 mile east of Litchfield Road, area 2 map.

#### **15) Miscellaneous**

- a) groundwater monitoring well, LAFB area 44, east of bridge, on south side of channel.
- b) 1/4 mile east of Litchfield Road, 12" RCP pipe outlets into channel. Appears to be an irrigation tail water line.
- c) 1/4 mile east of Litchfield Road, irrigation flap gate in south bank of channel.
- d) 1/8 mile west of Dysart Road, 18" irrigation pipe crosses channel. Concrete irrigation structure from pipe to concrete v-ditch to the west. Direction of flow appears to be from south to north. Does not appear to be in service (electrical box

wiring gutted).

NOTES:

This document does not contain an exhaustive list of storm drains or irrigation facilities, as these items are most easily found by field survey.

Contact persons are listed on the next page.

**DYSART DRAIN IMPROVEMENTS  
CONTACT PERSONS**

3/1/93

<u>Name &amp; address</u>	<u>Phone Number</u>
Mr. G. T. Reed Santa Fe Pacific Pipeline Partners, L.P. 888 South Figueroa Street Los Angeles, CA 90017	213-486-7736
Mr. John Herrera Arizona Public Service Company P. O. Box 53999 M.S. 3260 Phoenix, AZ 85072-3999	371-6942
Mr. Roland Faucett Insight Communications 21200 N. Black Canyon Hwy Phoenix, Arizona 85027	780-2222
Mr. Bill Meloche 58th Civil Engineers-CEOI Luke Air Force Base Phoenix, Arizona 85309	856-6394
Mr. Terry Hughes Southwest Gas Corporation 9 South 43rd Avenue Phoenix, AZ 85009	484-5257
Mr. Bob Friess USWest Communications 2236 W. Dunlap Avenue Suite 205 Phoenix, AZ 85021	395-2550
Mr. David Harbushka Amerigas 14702 West Olive Wadell, Arizona 85355	935-2661
Mr. Gary McFarland Morton Salt Company 13000 West Glendale Avenue Glendale, AZ 85307-2408	247-3000

Mr. John Roach (Lessor for Morton Salt)  
Roach & Baker Ranches  
7033 N. Dastard Road  
Glendale, AZ 85307

935-9018

**Others Contacted who had no facilities w/in project corridor:**

Mr. Bob Prince  
Valley Utilities (Water)  
12540 West Bethany Home Road  
Litchfield Park, Arizona 85072-3999

247-2570

APPENDIX B

**PROBABLE MAXIMUM  
PRECIPITATION CALCULATIONS**

HMR-49

Table 6.1.--General-storm PMP computations for the Colorado River and Great basin (72-Hour)

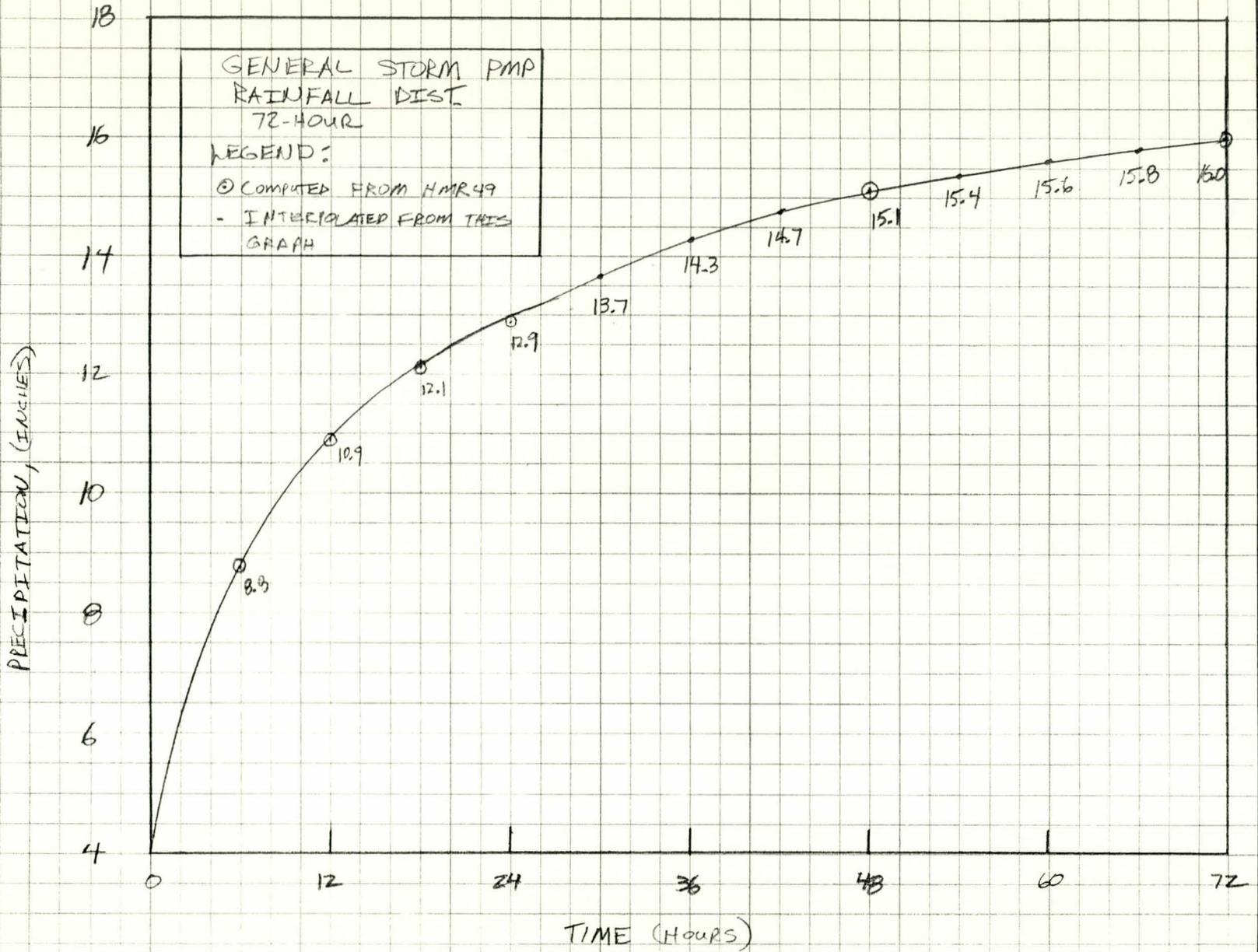
Drainage DYSART DRAIN DRAINAGE, Area 43 mi<sup>2</sup> (km<sup>2</sup>)  
 Latitude 33°27'00", Longitude 112°25' of basin center

Month AUGUST

Step	Duration (hrs)					
	6	12	18	24	48	(72)
<b>A. Convergence PMP</b>						
1. Drainage average value from one of figures 2.5 to 2.16	<u>13.9</u> in. (mm) Fig 2.12					
2. Reduction for barrier-elevation [fig. 2.18]	<u>87</u> %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	<u>12.1</u> in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	<u>75 89 96 100 112 116</u> %					
5. Convergence PMP for indicated durations [steps 3 X 4]	<u>9.1 10.8 11.6 12.1 13.5 14.0</u> in. (mm)					
6. Incremental 10 mi <sup>2</sup> (26 km <sup>2</sup> ) PMP [successive subtraction in step 5]	<u>9.1 1.7 0.8 0.5 1.4 0.5</u> in. (mm)					
7. Areal reduction [select from figs. 2.28 and 2.29]	<u>89 97 98 99 100 100</u> %					
8. Areal reduction PMP [step 6 X step 7]	<u>8.1 1.6 0.9 0.5 1.4 0.5</u> in. (mm)					
9. Drainage average PMP [accumulated values of step 8]	<u>8.1 9.7 10.5 11.0 12.4 12.9</u> in. (mm)					
<b>B. Orographic PMP</b>						
1. Drainage average orographic index from figure 3.11a to d.	<u>2.0</u> in. (mm)					
2. Areal reduction [figure 3.20]	<u>77</u> %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	<u>100</u> %					
4. Areal and seasonally adjusted PMP [steps 1 X 2 X 3]	<u>1.94</u> in. (mm)					
5. Durational variation [table 3.6] 3.9	<u>36 63 84 100 141 159</u> %					
6. Orographic PMP for given durations [steps 4 X 5]	<u>0.7 1.2 1.6 1.9 2.7 3.1</u> in. (mm)					
<b>C. Total PMP</b>						
1. Add steps A9 and B6	<u>8.8 10.9 12.1 12.9 15.1 16.0</u> in. (mm)					
2. PMP for other durations from smooth curve fitted to plot of computed data.						
3. Comparison with local-storm PMP (see sec. 6.3).						

Subject: DISART DRAIN PMP - GENERAL STORM Prepared by JSE Date 2-11-93

72-HOUR



Subject DYSART DRAIN PMP - GENERAL STORM Prepared by JSE Date 2-11-93  
72-HOUR

72-HOUR GENERAL STORM PMP - TIME SEQUENCE

TIME (HOURS)	6	12	18	24	30	36	42	48	54	60	66	72
-----------------	---	----	----	----	----	----	----	----	----	----	----	----

RAINFALL DEPTH (IN.) (ACCUMULATED)	8.8	10.9	12.1	12.9	13.7	14.3	14.7	15.1	15.4	15.6	15.8	16.0
---------------------------------------	-----	------	------	------	------	------	------	------	------	------	------	------

RAINFALL DEPTH (IN.) (INCREMENTAL)	8.8	2.1	1.2	0.8	0.8	0.6	0.4	0.4	0.3	0.2	0.2	0.2
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

RAINFALL DIST. (IN.)	0.2	0.2	0.4	0.6	0.8	2.1	8.8	1.2	0.8	0.4	0.3	0.2
-------------------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(SEE HEL-1 PG. 10 OR HM/R49 PG. 126)

HMR-49

Table 6.3A.--Local-storm PMP computation, Colorado River, Great Basin and California drainages. For drainage average depth PMP. Go to table 6.3B if areal variation is required. (6-HOUR)

Drainage DYSART DRAIN DRAINAGE Area 43 mi<sup>2</sup> (km<sup>2</sup>)  
 Latitude 33° 27' Longitude 112° 25' Minimum Elevation 1090 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi<sup>2</sup> (2.6-km<sup>2</sup>) PMP for drainage [fig. 4.5]. 11.7 in. (mm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

b. Multiply step 1 by step 2a. 11.7 in. (mm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.33

	Duration (hr)									
	1/4	1/2	3/4	1	2	3	4	5	6	
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	<u>71</u>	<u>87</u>	<u>94</u>	<u>100</u>	<u>115</u>	<u>122</u>	<u>127</u>	<u>131</u>	<u>133</u>	%

5. 1-mi <sup>2</sup> (2.6-km <sup>2</sup> ) PMP for indicated durations [step 2b X step 4].	<u>8.3</u>	<u>10.2</u>	<u>11.0</u>	<u>11.7</u>	<u>13.5</u>	<u>14.3</u>	<u>14.9</u>	<u>15.3</u>	<u>15.6</u>	in. (mm)
---	------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	-------------	----------

6. Areal reduction [fig. 4.9].	<u>50</u>	<u>57</u>	<u>61</u>	<u>64</u>	<u>67</u>	<u>70</u>	<u>72</u>	<u>74</u>	<u>75</u>	%
--------------------------------	-----------	-----------	-----------	-----------	-----------	-----------	-----------	-----------	-----------	---

7. Areal reduced PMP [steps 5 X 6].	<u>4.2</u>	<u>5.8</u>	<u>6.7</u>	<u>7.5</u>	<u>9.0</u>	<u>10.0</u>	<u>10.7</u>	<u>11.3</u>	<u>11.7</u>	in. (mm)
-------------------------------------	------------	------------	------------	------------	------------	-------------	-------------	-------------	-------------	----------

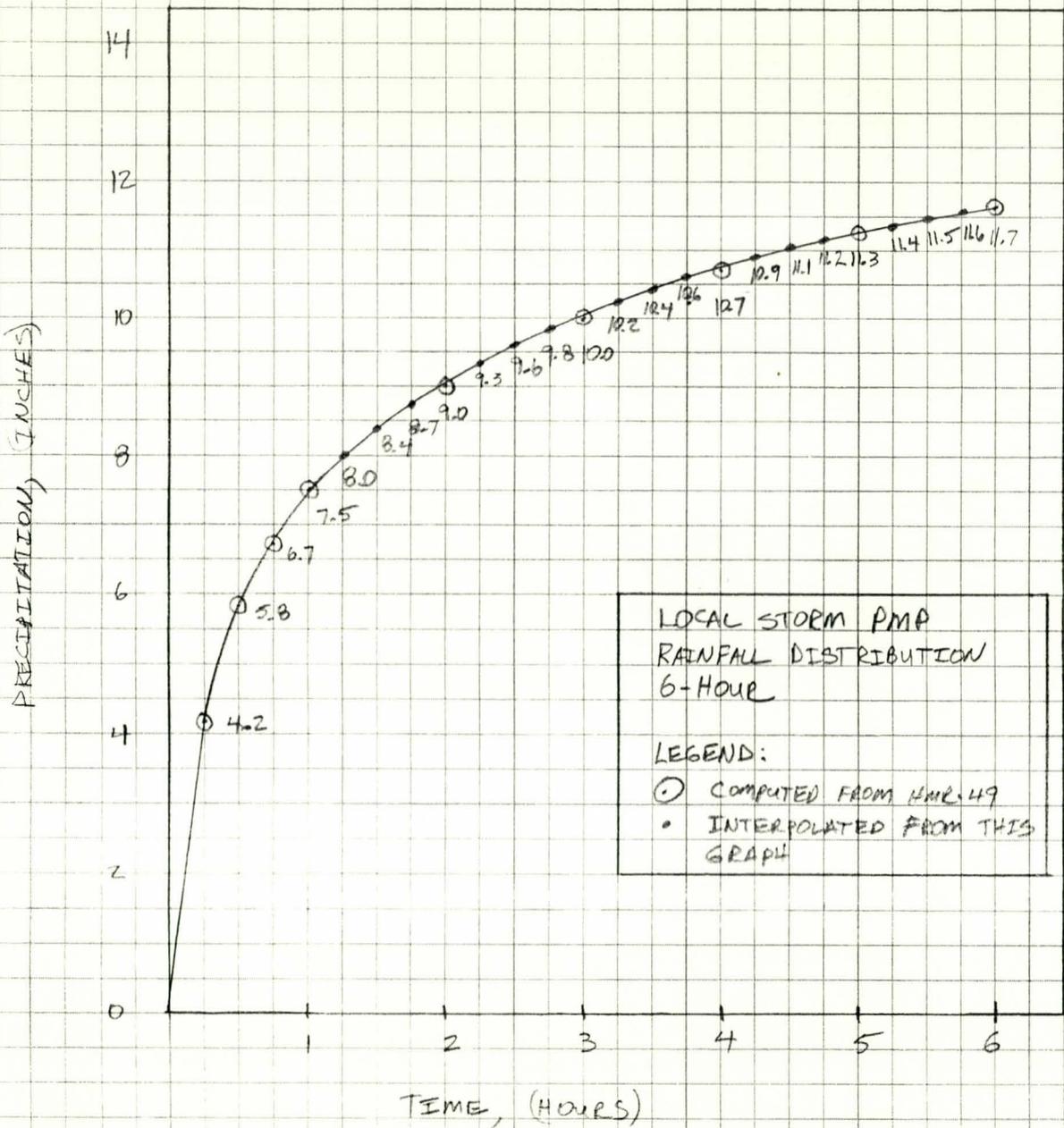
8. Incremental PMP [successive subtraction in step 7].		<u>7.5</u>	<u>1.5</u>	<u>1.0</u>	<u>0.7</u>	<u>0.6</u>	<u>0.4</u>	in. (mm)
	<u>4.2</u>	<u>1.6</u>	<u>0.9</u>	<u>0.8</u>	} 15-min. increments			

9. Time sequence of incremental PMP according to:

Hourly increments [table 4.7].	<u>0.4</u>	<u>0.7</u>	<u>1.5</u>	<u>7.5</u>	<u>1.0</u>	<u>0.6</u>	in. (mm)
--------------------------------	------------	------------	------------	------------	------------	------------	----------

Four largest 15-min. increments [table 4.8].	<u>4.2</u>	<u>1.6</u>	<u>0.9</u>	<u>0.8</u>	in. (mm)
--	------------	------------	------------	------------	----------

Subject DISAST DRAIN PMP - LOCAL STORM Prepared by JSE Date 2-11-73  
6-HOUR



Subject DISAST DRAIN PMP - LOCAL STORM Prepared by JSE Date 2-11-93

6-1 HOUR

6-HOUR LOCAL STORM PMP - TIME SEQUENCE

	1HR			2HR			3HR			4HR			5HR			6HR								
TIME (MIN.)	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345	360
RAINFALL DEPTH (IN.)	4.2	5.8	6.7	7.5	8.0	8.4	8.7	9.0	9.3	9.6	9.8	10.0	10.2	10.4	10.6	10.7	10.9	11.1	11.2	11.3	11.4	11.5	11.6	11.7
(ACCUMULATED)																								
RAINFALL DEPTH (IN.)	4.2	1.6	0.9	0.8	0.5	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
(INCREMENTAL)																								
RAINFALL DEPT. (IN.)	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.8	1.6	4.2	0.9	0.5	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1

(SEE HEC-1 PG. 10 OR HMR-49 PG. 126)

APPENDIX C

**CORRESPONDENCE ON 404  
PERMIT REQUIREMENTS**

DJR



DEPARTMENT OF THE ARMY  
LOS ANGELES DISTRICT, CORPS OF ENGINEERS  
ARIZONA-NEVADA AREA OFFICE  
3636 NORTH CENTRAL AVENUE  
PHOENIX, ARIZONA 85012-1936

REPLY TO  
ATTENTION OF:

MAR - 2 1993

Office of the Chief  
Regulatory Branch

Flood Control District of Maricopa County  
ATTN: Olin S. Sutton, Jr.  
2801 West Durango Street  
Phoenix, Arizona 85009

File Number: 93-324-CL

Dear Mr. Sutton,

Reference is made to your letter of January 25, 1993, in which you inquired as to the jurisdictional limits of the Clean Water Act, ordinary high water mark and/or wetland boundary, of the Agua Fria River at the intersection of the Agua Fria River and the Dysart Drain (Section 1, Township 2 North, and Range 1 West) in the City of Glendale, Maricopa County, Arizona.

The Corps of Engineers has no permit authority under Section 404 of the Clean Water Act in the area(s) outside of the ordinary high water mark or outside wetlands designated on the enclosed aerial photograph or map. However, any activity that discharges dredged or fill material into the designated jurisdictional area(s) requires a Section 404 permit. This jurisdictional determination will remain in effect for three years from the date of this letter unless an unusual flood event occurs. After this three year period or after an unusual flood event alters stream conditions, the Corps of Engineers reserves the authority to retain the original jurisdictional limits or to establish new jurisdictional limits as conditions warrant.

Please include a copy of this letter and the corresponding jurisdictional delineation with any application to the Corps of Engineers for a Section 404 permit.

FLOOD CONTROL DISTRICT	
RECEIVED	
MAR 04 1993	
CHENG	P & PM
DEP	HYDRO
ADMIN	LMGT
FINANCE	FILE
C & O	LOSS
ENGR	
REMARKS	

The receipt of your letter is appreciated. If you have any questions please contact me at (602) 640-5385.

Sincerely,

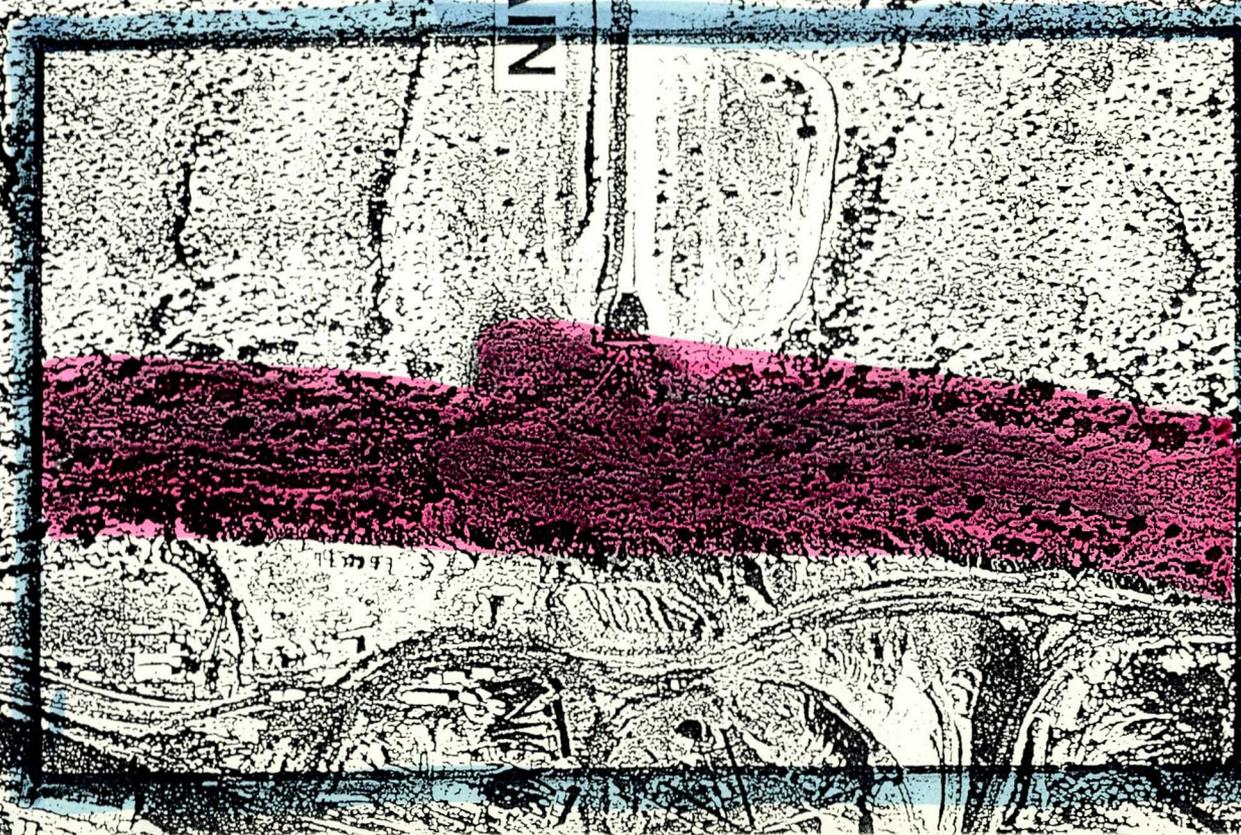
*Cindy J. Lester*

Cindy J. Lester  
Acting Chief, Arizona Field Office  
Regulatory Branch

Enclosure(s)

EL MIRAGE RD

DYSART DRAIN



93-324-CL

 Boundary of Area Surveyed  
for Section 404 Jurisdiction

 Section 404 Jurisdictional  
Area

Jurisdictional Determination  
performed by DS and RF on  
26 FEB 93

**N**

**SCALE : 1" = 200'**

**PHOTO DATE : 1-28-92**