Project No. E002101

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# Design Report Addendum

## Old Cross Cut Canal Flood Control Improvements

*(North of McDowell Road to North of Indian School Road)*

**Prepared for**
**Flood Control District of Maricopa County**
**and the City of Phoenix**

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REMARKS

**Prepared by**
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**May 14, 1993**

Project No. E002101

# Errata to the Design Report Addendum

## Old Cross Cut Canal Flood Control Improvements

*(North of McDowell Road to North of Indian School Road)*

**Prepared for**
**Flood Control District of Maricopa County**
**and the City of Phoenix**

**Prepared by**
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ARIZONA, U.S.A.

**June 4, 1993**

Greiner

Project No. E002101

## *Errata to the Design Report Addendum*

### *Old Cross Cut Canal Flood Control Improvements*
**(North of McDowell Road to North of Indian School Road)**

The following is a list of additions and/or changes to the Design Report Addendum for the Old Cross Cut Canal Flood Control Improvements, dated May 14, 1993.

**1. Page 8, Second Paragraph, which begin with "Model 1 (Table 7) . . ."**

Add the following:

It is feasible that the surface feature for Model 1 could be deepened and made narrower from Sta. 23+00 to Sta. 39+50 to avoid impacting 48th Street pavement. This will be investigated during the final design phase if Model 1 is the chosen alternative.

**2. Page 8, Fifth and Sixth Paragraph, which begins with "Model 5 (Table 10) . . ." and "All surface features . . ."**

Delete these paragraphs and substitute the following:

Model 5 (Table 10) is for the 100-year existing condition without LID improvement. The objective of this alternative is to minimize conduit construction while maximizing surface feature conveyance capacity. This alternative requires a 60-foot bottom width surface feature section with a carrying capacity of 1,600 cfs at four feet above the proposed conduit from McDowell Road to Indian School Road. This alternative has a smaller conduit than Models 1 and 3. Due to the smaller conduit and the large surface feature for Model 5, it is estimated that, at Indian School Road, the surface feature will be required to carry runoff for the 1-year storm, and at Earll Drive and Thomas Road, the 10-year storm. Model 5 includes a 60-inch pipe south of Indian School Road while maintaining an open channel north to the Arizona Canal. This may require the construction of a siphon for the future LID detention basin bleed-off and may require reconstruction of the Indian School Road crossing and existing utilities. The depth of the surface feature for Model 5 averages four feet with extremes at two feet and 6.26 feet.

Surface Feature

The modeling logic used for Models 1, 3 and 4 includes conveying the specified flow in the surface feature without exceeding the precondition flow depth or overtopping the bank, whichever is greater at each cross-section (see Figure 1). Model 5 was modeled using the logic that the invert of the surface feature is not deeper than four feet above the top of the box culvert in order to overcome buoyancy as recommended in the Soils Report. The flow capacity for Model 5 is calculated based on the criteria mentioned for Models 1, 3 and 4 above. In general, the invert of the surface feature for Model 5 is deeper than the other models, with the exception of Models 3 and 4 from McDowell Road to approximately Station 25+00, where the invert of the surface feature is lower than the invert for Model 5.

All surface features for these model studies are based on a rectangular shape and are defined by their bottom width. An equivalent trapezoidal shape with 6:1 side slope shall have a top width of 140 feet for the 100-foot rectangular channel and 80 feet for the 60-foot rectangular channel for Models 1, 3 and 4. From approximately Station 25+00 to the north, the depth of the surface feature for Model 5 is greater than the depth of the surface features of the other models. It requires a wider equivalent trapezoidal section at a top width of 140 feet, and 110 feet for the 80-foot and 60-foot rectangular sections.

**3. Page 10, second paragraph, second sentence, which begins with "Water surface profiles . . ."**

Delete this sentence and substitute the following:

Water surface profiles and surface feature depths for Model 3 are shown in Figure 6. The surface feature depths for Models 1, 4 and 5 differ from Model 3 and are not represented in Figure 6. Refer to the Design Report Addendum text and tables for variations in the surface feature depths.

**4. Page 12, after the second paragraph, which begins with, "The minimum undercrossing. . ."**

Add the following:

The basin size will be impacted by the level of protection to be provided for the LID project and by the selected model for the Old Cross Cut Canal project. The LID project will increase the efficiency of collecting the runoff from the Lafayette area and conveying it to the Old Cross Cut Canal project via the undercrossing of the Arizona Canal. The minimum undercrossing for the Arizona Canal (± 650 cfs) will require some type of detention basin.

**5. Page 15, second paragraph, third sentence, which begins "This condition is estimated . . ."**

Delete this sentence and substitute the following:

This condition is estimated to occur at or above the 75-year storm for Model 1 without the LID and at or above the 33-year storm for Models 3 and 4 with the LID.

**6. Page 26, after the second paragraph, which begins with "One item that . . ."**

Add the following paragraph:

The cost estimate for construction of the drop inlets is based on a reasonable but simplified configuration of one large drop inlet located at the concentration points along the corridor. This simplified approach will be refined during the design phase and will require that the simplified single inlet be split into several small groups of inlets spaced at intervals along the corridor to effectively intercept the flows. This will result in a higher anticipated construction cost for the drop inlets.

**7. In the table immediately following Page 27, "Model Summary Description," in the "Culvert Size" column for Model 4.**

Delete the culvert size " 1-10'x10' " and replace it with " 2-10'x10' ."

ERRATA.CRO

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# Design Report Addendum

*Old Cross Cut Canal Flood Control Improvements*
*(North of McDowell Road to North of Indian School Road)*

## *INTRODUCTION*

This addendum summarizes the evaluation of additional covered channel alternatives when considering less storm drainage from the Arcadia area, without worsening flood conditions in the Old Cross Cut Canal corridor (OCCC). The sizes of the concrete box culvert alternatives were developed by determining the existing water carrying capacity of the open earthen canal. In addition, the alternatives were analyzed with and without the 10-year storm drainage from the Arcadia area north of the Arizona Canal. The 10-year storm drainage project in the Arcadia area is not a component of this project, but rather is a future project referred to as the Lafayette Interceptor Drain (LID). The feasibility, impacts and costs of the alternatives were evaluated.

This report is prepared and submitted to the Flood Control District of Maricopa County (FCDMC) and the City of Phoenix for review. Based on the results of this report, a selection of one of the alternatives will be made as the basis for the project, and the final construction plans and specifications will be prepared if the agencies determine that adequate funds are available.

During the course of this study, scheduled weekly meetings involving the FCDMC, City of Phoenix and Greiner were conducted to discuss methodology, approach, assumptions, activities, etc., for each Scope of Work task. Procedures, results, conclusions and recommendations related to these Scope of Work tasks are summarized.

## *DEFINITION OF TERMINOLOGY*

- **Project Study Area –** The Old Cross Cut Canal corridor from 1,000 feet south of McDowell Road to the Arizona Canal.

- **Pre-Project Condition** – The pre-project condition is defined as the Old Cross Cut Canal before 1989. The pre-project condition includes an earthen channel U/S and D/S of McDowell Road, and a drop structure south of the McDowell Road culvert. The McDowell Road Culvert consists of a 96-inch pipe and a 1-10' X 10' box culvert.

- **Existing Condition** – The existing condition is defined as the condition today. The differences between the pre-project and the existing conditions are the improvements completed since 1990 which include a 110-foot extension of the culvert crossing at McDowell Road, the replacement of the 96-inch pipe with a 1-14' X 10' box culvert, the reconstruction of the downstream earth channel to a 16-foot bottom width rectangular channel and the elimination of the drop structure at the outlet of the McDowell Road culvert. The improvements at McDowell Road were conducted by the City of Phoenix. The channel improvements south of McDowell Road are referred to as the ADOT channel.

- **With Project Condition** – The reconstructed Old Cross Cut Canal as a box culvert with the necessary surface improvements.

- **Existing 100-Year Storm (Q100)** – The peak flow rate that will be generated at the OCCC during a 100-year storm event over the existing Old Cross Cut Canal and Arcadia watershed. A 100-year storm event is defined as having the occurrence probability of one percent per year.

- **LID 10-Year Storm Flow Rate** – The peak flow rate generated during a 10-year storm event in the Arcadia watershed with this flow rate discharged directly into the OCCC. (The LID is to be limited to a 10-year flow rate for all frequency storms.)

- **Arcadia Area** – Drainage area bounded by the Arizona Canal to the south, Camelback Mountain to the north, 44th Street to the west and 64th Street to the east.

## TASK 1 - DETERMINATION OF THE EXISTING OLD CROSS CUT CHANNEL CAPACITY

**Objective:**

To determine the drainage capacity of the existing earthen Old Cross Cut Canal with the pre-project condition.

**Procedures:**

The drainage capacity of the present earthen Old Cross Cut Canal with the pre-project culverts at McDowell Road establishes a baseline measure for the proposed concrete culvert capacity.

The water carrying capacity at a canal cross-section is defined as the maximum flow rate confined by the top of the banks. When a channel reach has uniform cross-sections, the channel capacity is the same as that of any section. As a result of erosion, the existing canal cross-sections are not uniform. These sections vary in width and depth and have various carrying capacities.

In order to define the pre-project channel carrying capacity, multiple HEC-2 profile simulations were performed for flows ranging from 1,500 cfs to 6,500 cfs in 300 cfs increments. The HEC-2 is a water surface computer program developed by the U.S. Army Corps of Engineers. Two model conditions were tested, one with existing crossroad culverts and the other assuming no crossroad culverts. In addition, the canal is divided into five reaches by the crossroad culverts, including south of McDowell Road, between McDowell Road and Thomas Road, between Thomas Road and Osborn Road, between Osborn Road and Indian School Road, and north of Indian School Road. Flow at bank-full capacity for each cross-section, excluding the effects of the crossroads, was abstracted from the HEC-2 results and tabulated on Table 1. Existing crossroad culvert capacities at various channel flow rates are summarized in Table 2. It should be noted that the McDowell Road culverts are the pre-project culverts.

**Results:**

Table 1 documents the existing canal capacities as follows: greater than 4,200 cfs south of the McDowell Road culvert; 1,800 cfs at the pre-project McDowell Road culvert; 3,600 cfs from McDowell Road to Oak Street 2,700 cfs from Oak Street to Thomas Road; 2,100 cfs at Thomas Road culvert, 3,900 cfs from Thomas Road to Osborn Road, 1,800 cfs at Osborn Road culvert; 3,600 cfs from Osborn Road to Indian School Road; 1,600 cfs at the Indian School Road culvert; and 3,000 cfs north of Indian School Road.

Table 2 demonstrates that the existing crossroad culverts have limited capacities. Comparison of the two model results in Table 1 indicates that the effect from the limited crossroad culverts is a localized situation and has minimum impact on the existing earthen canal carrying capacities.

**Conclusions:**

Recommended channel capacities for various reaches of the existing Old Cross Cut Canal were developed and are included in Table 3. The recommended channel capacities are 4,000 cfs from McDowell Road to Thomas Road; 3,600 cfs from Thomas Road to Weldon; and 3,000 cfs from Weldon to north of Indian School Road.

## TASK 2 – DEVELOP CULVERT ALTERNATIVES

**Objective:**

To determine the culvert size alternatives (with the existing condition McDowell Road culverts) required to convey the existing capacity as determined in Task 1.

**Procedures:**

By taking into consideration the ADOT channel capacity of 4,100 cfs and the potential channel capacity as defined in Task 1, design capacities for the new culvert are recommended in Table 3. The preliminary culverts were sized by friction slope and existing ground slope comparison, and are compared to the May 24, 1991 report designs in Table 4.

Six storm scenarios were considered, which are a combination of the storm under the existing condition with and without a 10-year LID storm flow. These storm flow conditions include the 1,000 cfs baseline discharge from the SRP Arizona Canal and are shown in Table 3. The preliminary culvert size is to be used as the baseline culvert required for any frequency storm. The culvert size shall be refined to accommodate side inflow drainage for the selected design alternative.

The closed culvert hydraulics performance was investigated using the STORM program. STORM is a modular hydraulic analysis program designed to evaluate existing or proposed storm drain systems. The STORM model computes the hydraulic grade line by evaluating the friction losses and the minor losses throughout the system. Junction losses are evaluated by two methods. For side inlet junctions, the losses are calculated by equating pressure plus momentum for the incoming and outgoing flows through the junction. Drop inlet losses are calculated using procedures from the Maricopa County Drainage Design Manual.

**Results:**

Table 3 documents a recommended baseline culvert capacity as follows: 4,100 cfs from McDowell Road to south of Virginia Avenue, 3,600 cfs from Virginia Avenue to south of Pinchot Avenue, 3,300 cfs from Pinchot Avenue to south of Richardson; 2,500 cfs from Richardson to Indian School Road, and 1,200 cfs north of Indian School Road.

A baseline culvert size to accommodate the recommended capacities was developed and is included in Table 4. These culverts are assumed to be constructed by normal cast-in-place forming procedures and to have a friction loss Manning's number of 0.014. The culvert sizes are double 18' by 10' (two cell box, each cell is 18 feet wide and 10 feet high) from McDowell Road to south of Pinchot Avenue, double 10' by 10' from Pinchot to south of Richardson and double 8' by 10' from Pinchot to north of Indian School Road.

**Conclusions:**

Without the 10-year LID, this proposed closed culvert system is capable of carrying the design flow rates for the 25- and 50-year storms and most of the 100-year storm (north of Oak Street). With the LID, the closed conduit will carry the 25-year storm, most of the

50-year storm (north of Oak Street) and some of the 100-year storm (north of Earll Drive). Excess flows will require a surface feature.

## TASK 3 DETERMINE THE SURFACE FEATURE REQUIREMENTS

**Objective:**

To determine the need for and the type, configuration and location of surface drainage features.

**Procedures:**

Considering the conditions of with and without a 10-year LID improvement in conjunction with various frequency storms (25-, 50- and 100-year) that may occur within the study area watershed, the need for a surface drainage feature was developed. In general, the proposed culvert will accommodate the 25-year and the 50-year existing conditions and will accommodate the 25-year storm with a 10-year LID. A surface feature will be required for the 100-year existing condition and the 50-year and 100-year storms with the 10-year LID alternative. Surface flow rates for these alternatives are included in Table 5. The surface feature configurations are limited to the minimum cross-sections required without worsening the existing flooding conditions.

A two-step procedure was followed to develop the surface feature alternatives. First, three HEC-2 models with the flow rates documented in Table 5 were developed to determine the cross-section configurations required by comparing flows along the surface feature (Profile 2) to corresponding storm flows that would occur in the OCCC (Profile 1). These three models are named Model 1, 2 and 3 for the existing 100-year without 10-year LID; existing 50-year with 10-year LID; and existing 100-year with 10-year LID, respectively. All three models are compared to the pre-project conditions. Nine multiple profiles with various surface feature depths (1', 2' and 3') and bottom widths (60', 80', 100', 120', 140' and 160') were prepared to determine the optimum surface feature that would require minimum earthwork, cut and fill, and would have the least impact to right-of-way, utilities and construction. Flow in the surface features shall have a maximum water surface elevation no higher than the pre-project conditions. Surface feature water surface elevations higher than the pre-project conditions are allowed if the flows can be

completely confined within the surface feature. In other words, the improved project with a surface feature shall not worsen flooding conditions. Schematics showing these conditions for the surface feature are included on Figure 1. Note that Model 2 was not evaluated further. Results of the two models are tabulated in Table 6.

Under the pre-project and existing conditions, flows along the Old Cross Cut Canal will be confined within the canal. The flow eventually will overtop the canal banks if the flow rate is greater than the canal carrying capacity. The overtop flow will continue south and may break out and flow westerly at certain locations such as street intersections. For the purpose of this task, a conservative assumption was made that flows be confined within the corridor for all conditions in the HEC-2 modeling. The Old Cross Cut Canal corridor is defined as the area from private right-of-way from the west to private right-of-way to the east (see Figure 1).

Step two involved cut-and-paste of various profile runs within each model to develop an optimum surface feature for each model which would require minimum cut and fill, and would have the least impact on right-of-way utilities and construction. HEC-2 runs were conducted to assess the flooding impact of these optimum surface feature models. The results are included in Tables 7 and 8. Model 4 was created as a modification to Model 3. The modification includes a larger conduit to minimize surface feature needs to convey the 100-year with 10-year LID flows. Model 5 was developed for the other extreme by maximizing the surface feature to minimize the culvert size for the existing 100-year flow condition without LID. The surface feature invert is set at 4 feet above the culvert top slab at a constant bottom width of 60 feet except near McDowell Road. The 4-foot minimum cover is required to counter the ground water buoyancy force on the culvert. The results of the analyses for Models 4 and 5 are included in Tables 9 and 10, respectively.

**Results:**

Because the final improvement must not worsen the 100-year condition, Model 2, the 50-year existing condition improvement alternative, was deleted from further analysis and consideration.

Four optimum surface feature alternatives that would require minimum cut and fill were developed. Models 1 and 3 have the same conduit size, while Model 4 has a larger conduit and Model 5 has a smaller conduit.

Model 1 (Table 7) is for the 100-year existing condition without LID improvement and will require a surface feature from McDowell Road to south of Virginia Avenue. The surface feature cross-section bottom width varies from 60 feet to 100 feet, with a depth varying from 0.5 foot to two feet.

Model 3 (Table 8) is for the 100-year existing condition with a 10-year LID improvement. This alternative will require a surface feature from McDowell Road to Indian School Road. The surface feature has a uniform 100-foot bottom width cross-section. The surface feature depth varies from 2.5 south of Oak Street to less than 1.5 feet for the remaining reaches.

Model 4 (Table 9) is for the 100-year existing condition with a 10-year LID improvement. This alternative has a larger conduit than Models 1 and 3 and will require a smaller surface feature from McDowell Road to Earll Drive. The surface feature requires 100-foot bottom width cross-sections from McDowell Road to 200 feet north of Virginia Avenue and a 60-foot bottom width for the remaining reaches. The surface feature depth varies from five feet south of Oak Street to less than 1.5 feet for the remaining reaches.

Model 5 (Table 10) is for the 100-year existing condition without LID improvement. This alternative has a smaller conduit than Models 1 and 3. This alternative requires a 60 foot bottom width surface feature section at four feet above the proposed conduit from McDowell Road to Indian School Road.

All surface features for these model studies are based on a rectangular shape and are defined by their bottom width. An equivalent trapezoidal shape shall have top width of 140 feet for the 100-foot rectangular channel and 80 feet for the 60-foot rectangular channel with 6:1 side slopes.

These surface features were evaluated for "n" values at 0.025 and 0.045. An "n" value of 0.025 represents channels lined with concrete, earth and asphalt with little or no vegetation. An "n" value of 0.045 allows some grass and landscaping. Table 7, 8 and 9

document flow conditions at the "n" value of 0.025. The water surface elevation for the "n" value of 0.045 is approximately 0.5-foot higher. A detailed analysis to address applicable channel treatments and landscaping according to each reach and their "n" values will be conducted in the final design. It appears that little opportunity for landscaping is available south of Granada Road.

Impacts of the surface features along the Old Cross Cut Canal corridor vary with each model. See Figure 3, Sheets 1 through 12, Appendix D, for the extent of the top width and the length of the surface feature for each of the models.

The surface features impact various properties and structures, existing utilities, 48th Street pavement and miscellaneous surface features along the Old Cross Cut Canal corridor. Refer to the Figure 3 sheets in Appendix D for a plan view of the Old Cross Cut Canal corridor, along with the surface feature top width boundaries of each of the models. For a detailed discussion of the major impacts, see Task 6.

## TASK 4 – FLOODING IMPACT EVALUATIONS

**Objective:**

To evaluate the impacts of flooding conditions within the Old Cross Cut Canal corridor for the culvert alternatives with surface drainage features.

**Procedure:**

Optimum surface features with and without the 10-year LID under the 100-year storm conditions were developed. HEC-2 models were developed to determine the flooding impacts along the surface feature to a corresponding storm flooding condition that would occur under the pre-project condition.

**Results:**

The surface feature was investigated with three different reach lengths starting at the upstream headwall of the McDowell Road Bridge and extending to Virginia Avenue, Earll Drive and the downstream headwall of Indian School Road. This is reflected in Tables

7, 9 and 8, respectively. Table 10, like Table 8, extends the surface feature to Indian School Road from the McDowell Road headwall. Along the corridor, the existing west bank elevation shall be maintained, and design will ensure that the pre-project flooding condition elevations are not exceeded.

The flooding impacts in comparison to the pre-project conditions are documented in Tables 7, 8, 9 and 10. Water surface profiles and surface feature depths are included in Figure 6. Top widths of surface features are included in Figure 3. In general, surface features south of Granada Road require extensive structural work and are limited to no landscaping (n = 0.025); surface features north of Granada Road will accommodate moderate landscaping (n = 0.045) for various reaches.

The proposed surface features will not cross under any existing crossroads (i.e., Thomas and Osborn Roads). Inlets shall be provided at the upstream end of the crossroads to drain the surface feature flows into the culvert. Excess surface flow shall follow the existing Cross Cut Canal overflow pattern during a high flow situation. Under the existing condition, flows exceeding the crossroad culvert capacities (approximately 1,800 cfs) will overtop the crossroad. The majority will return to the downstream channel and some will leave the Old Cross Cut corridor to the west via crossroads. A flooding improvement is proposed with Models 1, 3, 4 and 5. The improvements proposed in each model will carry most of the flow and will reduce the flows that originally were conveyed to the west.

The ADOT channel was designed to accommodate a peak flow rate of 4,100 cfs. The west overbank area upstream of the McDowell Road culvert was raised approximately two feet during the McDowell Road improvement project. As a result, the HEC-2 program reflects a higher water surface elevation at this location. A short, open-channel section north of McDowell Road is recommended. This open channel is to maintain flow balance of culvert flow and crossroad overflow due to the surface feature. This open channel is approximately 15 feet in length and will require earthwork at the west bank.

## TASK 5 - LAFAYETTE INTERCEPTOR DRAIN CONNECTOR

**Objective:**

To evaluate two undercrossing conditions for the Lafayette Interceptor Drain at the Arizona Canal, including an inverted siphon and a non-siphon (straight grade) culvert or pipe.

**Procedures and Results:**

At present, Salt River Project is replacing the Old Cross Cut headworks at the Arizona Canal. Field investigations, along with a review of the construction plans for this project, have revealed that the invert of the headworks outfall is being lowered approximately 6.5 feet below the existing invert. This lower invert eliminates a straight grade undercrossing centered on the headworks, as shown on the initial Old Cross Cut Canal 30% plans. An inverted siphon system along this alignment would be extremely difficult and expensive to construct and is not a viable option.

In order to achieve a straight-grade undercrossing of the Arizona Canal, the LID undercrossing alignment will have to shift to the east where the existing Arizona Canal invert is higher. This alignment will require new right-of-way from the property south of the Arizona Canal and east of the Old Cross Cut Canal, and from the property north of the Arizona Canal and east of Arcadia Drive. A straight-grade undercrossing along this eastern alignment will not impact the SRP headworks presently under construction.

It is recommended that a non-siphon (straight grade) undercrossing be utilized for the LID at the Arizona Canal.

A detention basin alternative was investigated for this LID undercrossing to determine if there is a possible site north of the Arizona Canal that could provide storage volume for the LID project. Preliminary calculations for a 10-year storm (two inches) over the LID area (2.9 square miles) indicate that it will produce a rainfall volume of approximately 310 acre-feet. A possible site for this detention basin is the vacant property bounded by the Arizona Canal on the south, Arcadia Drive on the west, Lafayette Boulevard on the north and 50th Street on the east.

Based on preliminary area calculations for this property, a detention basin with a minimum depth of 18 feet on the down slope (south) side would be required for the 10-year storm. Since this depth is approximately seven feet above the proposed invert of the Old Cross Cut Canal box culvert at the south side of the Arizona Canal, an outlet pipe could be designed to connect the basin to the box culvert by crossing under the Arizona Canal. This outlet pipe would be designed to drain the basin into the Old Cross Cut Canal box culvert in the time period as required by the City of Phoenix Storm Drain Design Manual. This outlet pipe would be considerably smaller than the box culvert required to directly convey the 10-year storm under the Arizona Canal and the basin would eliminate the need to include the 10-year LID discharge in the design of the Old Cross Cut Canal box culverts, thereby reducing the size of the surface feature required.

The minimum undercrossing of the Arizona Canal that should be considered must convey the amount of flow that presently overtops the Arizona Canal (± 650 CFS). This minimum undercrossing would reduce the size of the basin.

## TASK 6 – CONSTRUCTION IMPACT EVALUATIONS

**Objective:**

To evaluate the impacts of the culvert alternatives and surface features on:

a. Inlet Function and Location
b. Existing Utilities
c. The "Farm" Property and Structures
d. The Need for Shoring
e. Groundwater Effects
f. Subdrain or Weep Hole Requirements

**Impacts:**

### a. Inlet Function and Location

Drainage inlets are needed to collect local drainage. The pre-project condition is an open channel which functions as a side drainage collector. The proposed project is a closed

culvert with or without surface features. If inlets do not have adequate water collection capacity, flow will not be intercepted. This will result in greater flows along the corridor and to the west.

Drainage inlets may be constructed on top of the proposed closed culvert as drop inlets and/or by constructing side inlets. Surface features with drop inlets will function as a collector channel. Minor grading along the east side of the surface feature will be required. This grading will direct flow to the depressed area and spill into the surface feature. Improvement schemes without a surface feature will require comprehensive site grading to collect the existing unconfined local drainage. This can be done by grading along existing 48th Street and/or creating a depressed strip/area between the box culvert and 48th Street. A detailed site grading plan would be required in the final design phase. The landscape and park design shall use the grading plan, in order to not worsen flooding conditions.

Local inflows were determined at cross streets along the Old Cross Cut Canal and provided to Greiner by the FCDMC in a table titled, "Old Cross Cut Canal Hydrology Local Inlet Design Storm," which is included in this addendum as Table 11A. These discharges were used to estimate the size of the inlets required to intercept the contributing local drainage. Inlets will be located within the surface feature, if appropriate to the particular model, and over the box to allow flows to drop into the top of the mainline culvert. Table 13 lists the mainline loss MGL coefficients and EGL for the drop inlets. By orienting the drop inlets as mentioned above, expensive lateral pipes which connect to the mainline structure are eliminated. The cost estimate provided uses this design approach as the basis for the inlet section. Side inlet junction structure losses calculated by the modified City of Los Angeles method and mainline MGL and EGL are summarized in Table 15.

Local flow intercepted by drop inlets creates excessive junction loss and may result in inefficient and/or non-functioning inlets at various locations. Local flow intercepted by side inlets required expensive lateral junction structures. Balanced use of drop and side inlets to intercept local flow shall be optimized during the final design.

The total number of grates and grading requirements vary extensively depending on the reach length of the surface feature. The local inlet storm column in Table 11A represents

the flow that is generated in the contributing subareas. The flow values in the 100-year general column are used to design the grates when there is a surface feature. The surface feature will convey the difference in flow between the local inlet storm flow values and the 100-year general flow values. At locations where there is no surface feature or the surface feature cannot convey the difference mentioned above, the total number of grates will be increased to intercept more flow so that the surface feature does not overtop. This design approach of using the surface feature to convey the flow difference as mentioned above is a more efficient use of drop inlets.

When there is not a surface feature, the discharge used for the design of the number of grates must be the "Local Inlet Storm" in Table 11A. Extensive grading, berming and local depressions will be required to direct the flows to these inlets.

The design discharge at McDowell Road as shown in Table 12 was reduced below the "100-Year General" value in Table 11 because of an existing storm drain. Therefore, the design value at this location is 97 cfs. Table 12 documents the number of grates and discharges used for the grate design. It also lists the surface feature capacities for the different models.

Inherent in all approaches are the understanding and provision for sufficient grates and berming to ensure that the local flow from each contributing subarea will be intercepted and conveyed into the mainline culvert. A part of this approach is the inclusion of a short reach of open concrete channel immediately upstream of the McDowell Road culvert to allow mixing of the surface feature flow and box culvert flow to convey the total flow beyond the McDowell Road structure in the same manner as the pre-project flow regime. This will include weir flow across McDowell Road (similar to pre-project conditions).

The inlet locations and grate sizing assumes that the lateral flows for each contributing subarea will concentrate at one location and inlets will be constructed to intercept this flow. It should be realized that this is a reasonable, simplified approach for large subareas for the study phase and these inlet locations will have to be addressed in greater detail during the final design. It may be more appropriate, at the locations where the larger side inflows occur, to provide several inlets (spillways) to the surface feature with the large inlets broken into small groups of grates. In the areas where there is not a surface

feature, very detailed, intensive grading will be required to direct the lateral inflows to these groups of grates.

For the less frequent occurring storms, flow may back-up out of the inlets into the surface feature. This is a condition which will only occur at locations where box culvert design capacity is less than the storm event and is not a cause for concern. This condition is estimated to occur at or above the 75-year storm only. Typically, this will occur due to differences in travel times between the local subareas and the total contributing area of the mainline and only for lesser frequency storms.

To ensure that all local drainage can be delivered in the surface feature, the relationship between the surface feature invert elevation and the gutter elevation of 48th Street is listed in Table 14. It should be noted that in some cases the surface feature invert is higher than the gutter elevation, however this does not worsen flow elevations when compared to the pre-project condition. Catch basin inlets will be installed at these sump locations if the surface feature invert cannot be lowered as determined in the design phase.

**b. Existing Utilities**

The purpose of this portion of Task 6 is to identify any utility conflicts that were not included in the original study report or the initial 30% plans.

On-site utility locating operations and record drawing information provided by the City of Phoenix have revealed that the 54-inch water line that runs parallel to the canal on the west bank from Hubble Avenue to Virginia Avenue is closer to the canal than originally understood. Excavation cross-sections based on the initial 30% plan construction centerline, show that clearances between the water line and the construction excavation slopes vary from ± six feet (Hubble Avenue) to ± one foot (Virginia Avenue). This 54-inch water line makes a 90-degree bend at Hubble Avenue as it turns and runs north parallel to the canal. There is an existing concrete thrust block at this bend which restrains movement of the water line. Excavation for the box culvert will remove the soil adjacent to this thrust block which will render it ineffective in restraining the pipe. To counter the removal of this restraint, the contractor will be required to retrofit the existing 54-inch concrete cylinder pipe with joint restraint welds for approximately 50 feet in both

directions from the 90 degree bend. The preliminary cost estimate for this retrofit is $10,000.

Due to the close proximity of this 54-inch water line to the excavation slopes, measures must be taken to ensure that this utility is not disturbed during construction. Mitigating measures that were investigated are: shoring during construction, relocating the 54-inch water line and shifting the construction centerline. These options are discussed as follows:

1. **Shoring** – Two types of shoring and associated costs were evaluated. The first type of shoring evaluated is soldier beams with wood lagging, which is the predominate method used in the Phoenix area for this type of wide-trench excavation. The estimated cost for soldier beams with wood lagging, based on excavation depths ranging from 15 to 22 feet is $24/square foot. For the 2,500 feet (Hubble Avenue to Virginia Avenue) of shoring required to protect this 54-inch water line, the estimated cost, based on an average of $430/linear foot, is $1,075,000.

The second type of shoring considered is steel sheet piling. This type of shoring is not generally used due to its higher cost for materials and installation. On the average, costs associated with this type of shoring are 50 percent to 70 percent higher than the soldier beams with wood lagging. Several local contractors familiar with box culvert construction and excavation shoring were contacted and the consensus was that steel sheet piling would not be used due to the high cost. The preferred method of shoring for this situation is the installation of soldier beams with wood lagging as previously discussed.

Other methods of shoring or soil stabilization can be investigated during the final design phase of this project to identify any potential cost saving alternatives.

2. **Relocation** – Preliminary investigations point to a possible relocation corridor from Monte Vista Road to Virginia Avenue at approximately 50 to 55 feet west of the proposed construction centerline. This location is between an existing six-inch water line and 36-inch SRP irrigation pipe along the west bank from Vernon Avenue to Virginia Avenue and will require crossing the 36-inch irrigation pipe at Virginia Avenue. There are approximately 13 to 15 feet between these two utilities which is adequate space for the 54-inch water line relocation. Crossing the 36-inch irrigation pipe at Virginia Avenue will not

present a problem, as it is fairly shallow (three feet of cover) and the 54-inch water line will have to be relocated to cross under the new OCCC box culverts at this location.

Relocation of the 54-inch water line will involve obtaining either right-of-way or a public utility easement from the property adjacent to the south side of Oak Street, west of the canal. Since there are tentative plans to obtain right-of-way or a public utility easement from this property for SRP irrigation and City of Phoenix water, the area required for this 54-inch water line relocation could be included. This 54-inch water line relocation will also involve avoiding an existing irrigation gate structure, a relocated SRP steel power pole and cable TV line.

Preliminary cost estimates for this relocation option are based on an installation price of $250/linear foot. The total estimated cost for this item, which includes 2,000 feet of new 54-inch water line, 500 feet of shoring and incidentals is $715,000. This cost estimate does not include any right-of-way or miscellaneous utility relocations that may be required. It also does not include any salvage value associated with the existing 54-inch pipe that will be removed.

3. **Shifting the Construction Centerline** – As stated in Supplement No. 2 to the Geotechnical Report prepared by Thomas Hartig & Associates (see Appendix C), the excavation slopes in the vicinity of constructed fill or existing utility line backfill zones may not be as stable as undisturbed soils when higher groundwater levels are present, and may not hold at 1:1 as recommended in the Geotechnical Report. In order to protect the existing 54-inch water line during construction, the excavation slopes should not enter the backfill zone of this utility line. This zone is estimated at two feet beyond the outside diameter of the existing pipe at the spring line, extending up to the existing ground surface. It is recommended that in the next phase of the project, additional soil tests should be performed in the proximity of the critical utilities to better determine soil stability within these backfill zones. The 30-percent plan cross-sections were evaluated, incorporating pothole and as-built information to determine if the centerline could be shifted to the east. Existing utilities that limit the extent of the shift are a 48-inch water line and a 15-inch sanitary sewer which also run parallel to the canal along 48th Street on the east bank.

Preliminary geometric layouts based on the estimated backfill zones indicate that shifting the construction centerline the required four to eight feet can be accomplished without adversely impacting the 48-inch water line on the east bank or the hydraulic performance of the box culvert. It should be noted that the recommended additional soils tests should be performed prior to the acceptance of the validity of this alternative to avoid creating a situation where the contractor feels it is necessary to shore for both the 54-inch and the 48-inch water lines (see Figure 2 - Appendix D). Shifting the centerline eight feet at Virginia Avenue will impact an existing 15-inch sanitary sewer beginning at Virginia Avenue and extending to the north for approximately 500 feet. Shoring will be required to protect the 15-inch sewer from damage during construction. The preliminary cost estimate for shoring for the 500 feet along the 15-inch sanitary sewer line is $215,000. Another possible option instead of shoring along the existing 15-inch sanitary sewer line is to construct a temporary bypass line with PVC or other semi-rigid pipe along this 500-foot reach. The preliminary cost estimate for this option is $80,000.

A cost estimate summary for the three options presented is:

1. Shoring - $1,075,000
2. Relocation - $715,000
3. Shifting the CL - ~~$30~~,000 to $215,000 (subject to further field soils testing)
   80

It is recommended that further soils tests be conducted and, if feasible, that the centerline be shifted to resolve this 54-inch water line conflict.

Another location where excavation slopes impact existing utilities is from approximately Sta. 19+00 to Sta. 23+00, where an existing 48-inch water line runs parallel to the canal along 48th Street. In this area, the 48-inch water line is very close to the required excavation limits and shoring will be necessary to prevent any possible damage and unplanned shutdowns during construction. Shifting the centerline to the west is feasible in this area and should be investigated during the design phase in conjunction with the other centerline shifts discussed in this addendum. The preliminary cost estimate for shoring along this 48-inch water line is $172,000.

The impacts of the excavation for the various surface features to existing utilities along the corridor were determined by establishing soil cover reduction zones (see Figure 8, Appendix D). These zones are as follows:

1. Zero to one foot of soil cover reduction - no impact.
2. One to three feet of soil cover reduction - install concrete protection.
3. More than three feet of soil cover reduction - relocate if active, remove if abandoned.

For zero to one foot of soil cover reduction, it is assumed that the minimum required soil cover over the existing utility will be maintained. Therefore, it is assumed that there will be no impact to any utility identified within this zone.

For one to three feet of soil cover reduction, it is assumed that the soil cover over the existing utility will be reduced below the minimum required and, therefore, it is assumed that some type of concrete protection will have to be installed to counter this reduction.

For more the three feet of soil cover reduction, it is assumed that the soil cover over the existing utility will be reduced to a point where the utility is unstable or exposed and concrete protection is no longer a viable solution. Therefore, it is assumed that any existing utility within this zone will have to be removed or relocated, depending on whether it is abandoned or active.

Cost estimates were then prepared by identifying existing utilities within these established impact zones for each of the models. These costs for all utilities other than the 54-inch and 48-inch water lines are listed as line item, "Remove, Protect or Relocate Miscellaneous Utilities" in the cost estimate worksheets specific to the individual models (see Appendix B). The 54-inch and 48-inch water lines are listed separately on these same worksheets.

**c. The "Farm" Property and Structures:**

Both the excavation for the proposed box culvert and the four alternative surface features impact the "farm" property located along the east bank of the canal from the existing

headwall at McDowell Road (Sta. 10+00) to approximately 200 feet south of Granada Road (Sta. 17+70).

Excavation slopes based on the Geotechnical Report will extend to or be within approximately three to five feet of four buildings located on this property. In order to excavate to construct the box culvert, it will be necessary to mitigate the impact to these structures and any associated substructures such as basements.

Two mitigating alternatives were investigated and involved shifting the construction centerline to the west and shoring during construction. A third alternative of obtaining the two parcels of "farm" property is also discussed.

1. **Shifting the Construction Centerline** – The initial 30-percent plan construction centerline location leaves enough area for a top of bank access road for the contractor on the west side. There is no access on the east side along the "farm" property. In order to eliminate the excavation impacts to the existing structures, the construction centerline must shift a minimum of eight feet to the west. This much of a shift will not allow enough room on the west bank for an at-grade construction access road for this reach of the project. This will make construction of the box culvert more time consuming and will increase the cost since it will require more labor and equipment. A temporary construction easement could be obtained from the vacant property adjacent to and west of the canal from McDowell Road to Sta. 11+90. This will provide the contractor with an area in which to grade a ramp into the excavation at this south end. There is a 20-foot public utility easement strip along this property that may be used but a larger area will be required. Even though the centerline shift will alleviate the impact to the structures, the excavation will still be close and the contractor will face a very tight construction corridor with private property on both sides and no at-grade access roads.

A preliminary estimate for the temporary construction easement based on a 40-foot-wide strip along the existing right-of-way on the west side of the Canal, from McDowell Road to approximately Station 12+00, is 11,200 square feet. The increased construction cost for shifting the centerline and eliminating the at-grade access is estimated at $150,000. This is based on the assumption that the per linear foot cost will increase approximately 15 percent ($215/linear foot).

2. **Shoring** – Shoring of the excavation bank along the "farm" property (approximately 700 feet) will significantly increase the cost of construction for this reach. It is feasible to require shoring only for the stretch of excavation that impacts the structures. This could reduce the shoring length from 700 feet to approximately 400 feet.

Cost estimates for shoring along this reach were increased by 10 percent over other shoring cost estimates due to the fact that there is no access on the east bank to perform this shoring operation and it will have to be done by extending operations from the west bank. It is also important to note that, due to the close proximity of the structures to the excavation, vibrations caused by the shoring installation may cause significant damage to these existing structures.

The estimated cost for shoring 700 feet of the east bank along the "farm" property is $336,000. The estimated cost for shoring 400 feet of the east bank along the area of the structures is $192,000.

3. **Obtaining the "Farm" Property** – The surface feature proposed for Models 1 and 5 can be horizontally and vertically adjusted so as not to impact any of the structures on the "farm" property, but will require additional permanent right-of-way inside the existing fence line and very close to the structures (see Figure 3, Sheet 1, Appendix D).

The surface feature for Models 3 and 4 will impact all four structures on the "farm" property and will also require additional right-of-way (see Figure 3, Sheet 1, Appendix D). The four structures will have to be demolished or relocated if possible. Realistically, the entire property will probably have to be obtained to accommodate the surface feature for Models 3 and 4. Also, right-of-way will have to be obtained from properties along the west bank. Consideration should be given to obtaining the two parcels contained in the "farm" property, regardless of which model is selected, if it is determined that it will be cost effective. Purchasing this property will provide an area for surface feature expansion and orientation, eliminate the need for shoring, give the contractor at-grade access on both sides and provide an additional area to incorporate into the overall park scheme planned for this southern reach. Rough calculations based on the City of Phoenix Right-Of-Way Map (Old Cross Cut Canal Upgrade - ST-903450) for the area of these two parcels is approximately 1.89 acres.

A cost estimate summary for the three options presented is:

1. Shifting the CL - $150,000
2. Shoring - $192,000 to $336,000 + DAMAGES
3. Obtaining the "farm" parcels - 1.89 acres to demolish buildings for construction of the surface feature.

**d. The Need for Shoring:**

As previously discussed, shoring is needed along the "farm" property if the centerline is not shifted or the property obtained. Also, as previously discussed, shoring will be required along the existing 54-inch water line from Hubble Avenue to Virginia Avenue and the 48-inch water line from Station 19+00 to 23+00, if other mitigating options are not desirable. The shoring will be required to avoid the risk of damaging these water lines. Since these are major "feeder mains," it is important to ensure that there will not be any unplanned shutdowns caused by damage during construction.

Another possible shoring location is along the existing 15-inch sanitary sewer line from Virginia Avenue to 500 feet north as mentioned previously.

If other mitigating options discussed are not viable and shoring is required, then the total estimated cost for shoring on the project is $1,800,000.

**e. The Effects of Groundwater on Construction:**

Due to high groundwater elevations along the canal as determined by the geotechnical boring and piezometer well monitoring by the FCDMC, the use of a dewatering system will be required during construction to transport the inflowing groundwater out of the excavation area. One such dewatering system recommended in the Geotechnical Report is the placement of two feet of wash gravel in the bottom of the excavation below the proposed box culvert. This layer of wash gravel in conjunction with downstream drainage sumps and portable pumping systems will remove or transport accumulating water within the excavation area. This wash gravel will also be compacted and used as the supporting base for placing the pre-cast box culverts or forming the cast-in-place box culvert.

The Geotechnical Report indicates that groundwater will not affect excavation slope stability in undisturbed soil. As previously discussed, however, Supplement No. 2 to the Geotechnical Report (see Appendix C) indicates that slope stability may be adversely affected by high groundwater permeating into areas other than undisturbed soil such as constructed fill areas and utility backfill zones. Should the groundwater reach these areas, it could create an unstable excavation slope.

**f. The Need for and Type of Subdrain/Weep Hole System:**

Since the existing earthen canal allows inflow of groundwater, it is necessary to maintain this condition after the box culvert construction by implementing either a perforated pipe subdrain system or a weep hole subdrain system. This is necessary to avoid adversely affecting groundwater up-gradient (flooding of basements or other subsurface structures in the area) and avoid floating the box culvert.

The weep hole subdrain system will consist of a series of circular openings in the box culvert walls at or a few inches above the invert. This system will also include a gravel fill zone and filter fabric adjacent to the weep holes and running parallel to the box culvert. The spacing, size and gravel fill zone features will be determined during the final design phase of the project. Construction of this system will not require additional excavation area for installation.

The perforated pipe subdrain system will consist of a small diameter (approximately six-inch), perforated PVC pipe surrounded by a gravel material with filter fabric paralleling the invert of the box culvert on both sides. This perforated pipe will be designed to outfall into the box culvert at spaced intervals determined during the design phase of the project. Installation of the perforated pipe will be very difficult due to the limited area between the box culvert and the excavation slopes and may require additional excavation to install.

A third option is the perforated pipe system as described, but instead of gravity outfalls into the box culvert, the system will incorporate concrete wet pits and pumping stations along the corridor to collect and transport the accumulating groundwater into the box culvert. The difference between this pumped system and the other two systems discussed

is that it will be a "one way" system, meaning that it will provide the means to transport groundwater into the box culvert and not allow storm water out.

An added benefit is that these systems will somewhat relieve buoyancy uplift pressures to the box culvert created by the high groundwater levels. Although the buoyancy pressures are countered when a minimum four feet of cover over the box culvert is maintained and although the buoyancy relief is minimal, either one of these systems will be an added safety measure to help alleviate this problem.

Preliminary cost estimates for the three systems are as follows:

1. Weep hole system - $60,000.
2. Perforated pipe system - $140,000.
3. Perforated pipe system with concrete wet pits and pumping stations - $210,000.

It is recommended that the weep hole system be utilized due to its lower cost and ease of construction.

## TASK 7 POTENTIAL OF ADOT CHANNEL MODIFICATIONS

**Objective:**

Evaluate and/or develop modification alternatives to the ADOT channel transition section immediately downstream of the McDowell Road culverts to improve the hydraulics and/or reduce the size and cost of the culvert alternatives and the need for surface drainage features.

**Procedures:**

Alternatives in improving the ADOT channel and/or the existing McDowell Road culvert hydraulic performance to reduce upstream culvert sizes were identified in the May 1991 Design Report. Those modification alternatives were very costly and were not recommended. Work conducted in this task is limited to modification and/or restoration of a drop structure at the D/S side of the McDowell Road culvert outlet. Two outlet drop schemes were formulated including an original drop (pre-ADOT channel drop) and a

revised ADOT channel with a drop (Figure 7). HEC-2 was modeled for the proposed modifications which were compared to the existing no-drop ADOT channel condition.

**Results:**

Table 16 documents hydraulic performance for all three conditions. The pre-ADOT channel condition has a seven-foot drop and will have an adverse channel slope to daylight to the existing ADOT channel invert. The revised ADOT channel will have a 3.5-foot drop and will match the existing ADOT channel grade. The pre-ADOT drop modification will result in a 0.6-foot lower water surface elevation at the upstream side of the McDowell Road culvert, while the revised ADOT channel drop will only lower the water surface elevation by 0.3 foot.

**Conclusion:**

The modification of the McDowell Road culvert with a drop structure requires reconstruction of 242 feet of ADOT channel at a cost of approximately $300,000. This improvement scheme should be further investigated during final design to determine if cost savings can be achieved by reducing the size of the upstream catch basin inlets, based on the lower water surface elevation.

## TASK 8 COST ESTIMATES

**Objective:**

Develop approximate cost estimates for each model alternative. The estimate will consider all associated structures, surface features, constructibility issues, impacts and relocations.

**Procedures and Results:**

Cost estimates for the four models were developed by calculating quantities for the various individual construction items identified and assigning an estimated unit cost to each based on current market prices averaged from various data sources. This was done to facilitate identification of cost variances between the four models. Appendix B contains the itemized cost estimate worksheets for construction items common to all models and for construction

items specific to each individual model. It should be noted that the cost estimates do not include any right-of-way or temporary construction easement costs associated with the project.

One item that is listed for each model that needs some explanation is "Additional Concrete to Counter Buoyancy." At some locations along the corridor, depth requirements for the surface features of the models reduce the amount of earth cover over the box culvert below the four-foot minimum required to counter groundwater buoyancy pressure. Therefore, additional weight must be added to the box culvert to replace this earth cover. This additional weight was calculated as concrete added to the box culvert by increasing the thickness of box culvert section. This concrete quantity was established to develop estimated cost variances between the four models created by this earth cover reduction.

See the following Summary Section for a cost comparison of the four model alternatives.

## SUMMARY

Four alternative improvement schemes are presented in this addendum. The following two tables summarize culvert sizes with associated surface feature requirements and the estimated construction cost for each model.

All four alternatives are to be designed to meet the existing McDowell Road culvert and ADOT channel design capacities and are not to have adverse impact compared to the pre-project conditions. Major items to consider in comparing the four models are their impacts to the "farm" property and structures, existing utilities, other properties and structures along the corridor, 48th Street pavement and cost to construct.

Model 5 appears to be the least expensive of the four, but the cost estimates do not include construction easement and permanent right-of-way acquisition which could be extensive for this model.

Model 1 has the least impact to the items mentioned above and should be given serious consideration.

Models 3 and 4 will divert more flow to the ADOT corridor than the preproject condition and models 1 and 5.

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## MODEL SUMMARY DESCRIPTION

| PROJECT STATION AT CENTER OF ROAD | STREET NAME | MODEL 1 100-YR. FLOW W/O LID | | MODEL 3 100-YR. FLOW W/ LID | | MODEL 4 100-YR. FLOW W/ LID (MAX. BOX, MIN. S.F.) | | MODEL 5 100-YR. FLOW W/O LID (MIN. BOX, MAX. S.F.) | |
|---|---|---|---|---|---|---|---|---|---|
| | | S.F. SIZE | CULVERT SIZE | S.F. SIZE | CULVERT SIZE | S.F. SIZE | CULVERT SIZE | S.F. SIZE | CULVERT SIZE |
| 8+51 | McDOWELL | 60 | 2-18'x10' | 100 | 2-18'x10' | 100 | 2-18'x10' | 60 | 2-18'x10' |
| 20+10 | GRANADA | 60 | " | " | " | " | " | 60 | " |
| 27+17 | HOLLY | 100 | " | " | " | " | " | 100 | " |
| 37+12 | OAK | 100 | " | " | " | " | " | 100 | " |
| 50+27 | VIRGINIA | N/A | " | " | " | 100 | " | 60 | 2-10'x10' |
| 55+19 | N. OF VIRGINIA | N/A | " | " | " | 60 | " | " | " |
| 56+96 | WINDSOR | N/A | " | " | " | " | " | " | " |
| 63+45 | THOMAS | N/A | " | " | " | " | " | " | " |
| 71+38 | PINCHOT | N/A | 2-16'x10' | " | 2-16'x10' | " | " | " | " |
| 76+64 | EARLL | N/A | " | " | " | 60 | " | " | 2-8'x10' |
| 83+24 | RICHARDSON | N/A | 2-10'x10' | " | 2-10'x10' | N/A | 2-12'x10' | " | " |
| 90+10 | OSBORN | N/A | " | " | " | N/A | " | " | 1-8'x10' |
| 96+63 | WHITTON | N/A | 1-16'x10' | " | 1-16'x10' | N/A | " | " | 1-60" |
| 100+33 | WELDON | N/A | 1-14'x10' | " | 1-14'x10' | N/A | 2-10'x10' | " | " |
| 116+22 | INDIAN SCHOOL | N/A | 1-12'x10' | 100 | 1-12'x10' | N/A | " | 60 | " |

NOTE: LID = 10-YEAR LAFAYETTE INTERCEPTOR DRAIN
S.F. = SURFACE FEATURE
BOX = MAINLINE CULVERT

## COST COMPARISION FOR MODEL ALTERNATIVES

| ITEMS | MODEL 1 | MODEL 3 | MODEL 4 | MODEL 5 |
|---|---|---|---|---|
| 1. COMMON COSTS (SEE ITEMIZED COST ESTIMATE COMMON TO ALL MODELS) | $1,646,170.00 | $1,646,170.00 | $1,646,170.00 | $1,646,170.00 |
| 2. SPECIFIC COSTS (SEE ITEMIZED COST ESTIMATES SPECIFIC TO EACH MODEL) | $15,678,350.00 | $18,056,840.00 | $18,022,630.00 | $13,723,641.00 |
| 3. SHORING (MAY BE REQUIRED IF OTHER OPTIONS ARE NOT VIABLE) | $1,800,000.00 | $1,800,000.00 | $1,800,000.00 | $1,800,000.00 |
| SUBTOTAL | $19,124,520.00 | $21,503,010.00 | $21,468,800.00 | $17,169,811.00 |
| CONTINGENCIES (10%) | $1,912,452.00 | $2,150,301.00 | $2,146,880.00 | $1,716,981.10 |
| DESIGN & CONSTRUCTION MANAGEMENT | $1,500,000.00 | $1,500,000.00 | $1,500,000.00 | $1,500,000.00 |
| TOTAL | $22,536,972.00 | $25,153,311.00 | $25,115,680.00 | $20,386,792.10 |

# APPENDIX A

## *TABLE 1 – Existing Channel Capacity*

*Page 1 of 2*

| *Discharge (cfs)* | *McDowell (8+51)* | *Thomas (63+45)* | *Osborn (90+10)* | *Indian School (116+22)* | |
|---|---|---|---|---|---|
| | S. of McDowell | Between McDowell & Thomas | Between Thomas & Osborn | Between Osborn & Indian School | N. of Indian School |
| 1,500 | | | | | 116+90<br>117+51 |
| 1,800 | | 10+30 | | 90+37<br>91+18 | |
| 2,100 | | | 65+17<br>67+14<br>71+15 | | |
| 2,400 | | | (65+17)(67+14)<br>75+15 (77+15) | | |
| 2,700 | | 55+13<br>59+14 | (75+15)<br>77+15 | | |
| 3,000 | | (55+13)<br>47+13 (59+14)<br>51+13 | (77+15)<br>63+88 | | 119+20 |
| 3,300 | | (47+13)(51+13)<br>43+13 | 63+07 | 93+18<br>107+20 | |
| 3,600 | | (43+13)<br>25+15<br>25+22<br>25+30<br>27+12<br>31+12<br>35+13<br>39+13 | (63+07)<br>79+16<br>(63+88) | 101+19<br>(107+20) | (117+51) |
| 3,900 | | | (79+16)<br>83+17 | | (119+20) |
| 4,200 | | (27+12)(31+12)<br>(25+30)(35+13)<br>11+10<br>61+56 | (83+17) | 103+19<br>114+08 | (116+90) |
| 4,500 | 7+61 | (61+56)<br>(25+22) | | (101+19)<br>(103+19)<br>(114+08)<br>(115+58)<br>(115+58) | |

## *TABLE 1 – Existing Channel Capacity*

*Page 2 of 2*

| *Discharge (cfs)* | *McDowell (8+51)* | *Thomas (63+45)* | *Osborn (90+10)* | *Indian School (116+22)* | |
|---|---|---|---|---|---|
| | S. of McDowell | Between McDowell & Thomas | Between Thomas & Osborn | Between Osborn & Indian School | N. of Indian School |
| 4,800 | 4+84 | 10+30 (39+13) | | | |
| 5,100 | (7+61)<br>6+84<br>(4+84)<br>7+66 | | | ~~(99+19)~~<br>95+18 | |
| 5,400 | (6+84)<br>3+84 | (11+10) | | 99+19 (93+18)<br>(91+18) | |
| 5,700 | (7+66)<br>-16 | (25+15) | | (99+19) | |
| 6,000 | (3+84) | | | (95+18)(111+20)<br>111+20 | |
| 6,300 | | | (89+77)<br>88+59 | (89+77)<br>(90+37) | |
| 6,600 | (-16) | 24+85<br>(24+85) | 87+17 (88+59) | | |
| 6,900 | | | | | |
| 7,200 | | | (87+17) | | |
| 7,800 | 7+10.50 | | | | |
| 8,100 | (7+10.50) | | | | |
| 8,400 | | 15+14 | | | |
| 8,700 | | | | | |
| 9,300 | | (15+14)<br>19+12<br>23+12<br>(23+12)<br>(19+12) | | | |

NOTE: STATIONS IN PARENTHESES ARE MODEL 2 WITHOUT CROSS ROAD CULVERT RESTRICTIONS. STATIONS WITHOUT PARENTHESES ARE MODEL 1 WITH CROSS ROAD CULVERT RESTRICTIONS.
THE STATIONS SHOWN ON THIS TABLE CAME FROM HEC-2 MODELS.
THE STATION LABELED – 16 IS 1,016 FEET SOUTH OF THE NORTH HEADWALL OF THE MCDOWELL ROAD BRIDGE.

## TABLE 1A – CONSTRUCTION CENTERLINE STATIONING

| LOCATION | DESIGN REPORT STATION | INITIAL 30% PLANS & DESIGN REPORT ADDENDUM STATION |
|---|---|---|
| 1. NORTH HEADWALL (FACE) OF THE McDOWELL ROAD BOX CULVERTS – PRESENT CONDITION | 8+90 | 10+00 |
| 2. NORTH HEADWALL (BACK) OF THE McDOWELL ROAD BOX CULVERTS – PRIOR TO THE McDOWELL ROAD IMPROVEMENTS | 8+10 | 9+20 |
| 3. SOUTH HEADWALL (FACE) OF THE McDOWELL ROAD BOX CULVERTS – PRESENT CONDITION | 6+16 | 7+26 |
| 4. SOUTH HEADWALL (BACK) OF THE McDOWELL ROAD BOX CULVERTS – PRIOR TO THE McDOWELL ROAD IMPROVEMENTS | 6+56 | 7+66 |
| 5. END OF SHOTCRETE–LINED CHANNEL– PRESENT CONDITION | 10+00 | 11+10 |

| *TABLE 2 – Existing Culvert Capacity Versus Total Discharge* | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Total Discharge* | *1,500 cfs* | *1,800 cfs* | *3,000 cfs* | *3,300 cfs* | *4,500 cfs* | *5,100 cfs* | *6,300 cfs* |
| BRIDGE | | | | | | | |
| McDowell Road – Qcul: (1) | 1,500 | 1,750 | 2,060 | 2,106 | 2,291 | 2,367 | 2,507 |
| Thomas Road – Qcul: | 1,500 | 1,800 | 2,612 | 2,717 | 2,501 | 2,644 | 2,916 |
| Osborn Road – Qcul: | 1,500 | 1,800 | 1,814 | 1,793 | 1,735 | 1,711 | 1,637 |
| Indian School Road – Qcul: | 1,500 | 1,661 | 1,673 | 1,657 | 1,584 | 1,434 | 1,444 |

(1) THE PRE-PROJECT MCDOWELL ROAD CULVERTS, 1-10' X 10' CBC AND 1-96" RCP, WERE INVESTIGATED TO DETERMINE PRE-PROJECT CULVERT CAPACITY.

| TABLE 3 – Summary of Potential Channel Capacity and Recommended Culvert Capacity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Existing Conditions | | | With 10-Year LID | | | Potential Channel Capacity | Recommended Culvert Capacity | Surface Feature Required Capacity | |
| Cross Street | Project Station at Center of Road | 25-Year | 50-Year | 100-Year [1] | 25-Year | 50-Year [1] | 100-Year [1] | | | 1 [2] | 3 [2] |
| Lafayette Interceptor Drain | | 0 | 0 | 0 | 1190 | 1190 | 1190 | 3000 | 1200 | – | – |
| Indian School | 116+22 | 1370 | 1530 | 1640 | 2310 | 2440 | 2560 | 3000 | 2500 | – | 60 |
| Weldon | 100+33 | 1400 | 1560 | 1700 | 2340 | 2490 | 2610 | 3600 | 2500 | – | 110 |
| Whitton | 96+63 | 1400 | 1570 | 1700 | 2350 | 2500 | 2620 | 3600 | 2500 | – | 120 |
| Osborn | 90+10 | 1760 | 2040 | 2270 | 2520 | 2740 | 2950 | 3600 | 2500 | – | 450 |
| Richardson | 83+24 | 1780 | 2060 | 2300 | 2540 | 2760 | 2980 | 3600 | 2500 | – | 480 |
| Earll | 76+64 | 2300 | 2830 | 3310 | 3080 | 3550 | 4000 | 3600 | 3300 | 10 | 700 |
| Pinchot | 71+38 | 2320 | 2850 | 3330 | 3090 | 3560 | 4020 | 3600 | 3300 | 30 | 720 |
| Thomas | 63+45 | 2410 | 2960 | 3470 | 3180 | 3680 | 4160 | 3600 | 3600 | – | 560 |
| Windsor | 56+96 | 2440 | 3000 | 3530 | 3220 | 3730 | 4220 | 4000 | 3600 | – | 620 |
| North of Virginia | 55+19 | 2450 | 3000 | 3540 | 3220 | 3730 | 4230 | 4000 | 3600 | – | 630 |
| Virginia | 50+27 | 2640 | 3270 | 3850 | 3430 | 4000 | 4540 | 4000 | 3600 | 250 | 940 |
| Oak | 37+12 | 3000 | 3690 | 4350 | 3830 | 4490 | 5110 | 4000 | 4100 | 250 | 1010 |
| Holly | 27+17 | 3050 | 3730 | 4410 | 3880 | 4540 | 5180 | 4000 | 4100 | 310 | 1080 |
| Granada | 20+10 | 3090 | 3790 | 4490 | 3930 | 4590 | 5250 | 4000 | 4100 | 390 | 1150 |
| McDowell | 8+51 | 3250 | 3970 | 4710 | 4080 | 4780 | 5470 | 4000 | 4100 | 610 | 1370 |

(1) THE SHADED AREAS INDICATE THE REACHES WHERE THE CLOSED CONDUIT CANNOT CONVEY THE FLOW AND A SURFACE FEATURE IS REQUIRED.

(2) THE FLOWS IN THESE COLUMNS CANNOT BE CONVEYED WITHIN THE CULVERT AND REQUIRE A SURFACE FEATURE.

BOTH CONDITIONS INCLUDE BASELINE OF 1,000 CFS FOR SRP.

EXISCOND.GEN

| TABLE 4 – Base Model Culvert Size | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *Cross Street* | *Project Station at Center of Road* | *Previous Design (May 1991)* | | | *Addendum Base Model Design (1)* | | | *Existing Ground Slope (%)* |
| | | *Q* | *Size* | *Sf (%)* | *Q* | *Size* | *Sf (%)* | |
| Lafayette Interceptor Drain | | 1600 | 2-10'x10' | 0.589 | 1200 | — | — | 0.88 |
| Indian School | 116+22 | 3000 | 2-10'x10' | 0.589 | 2500 | 2-8'x10' | 0.747 | 0.88 |
| Weldon | 100+33 | 3000 | 2-10'x10' | 0.589 | 2500 | 2-8'x10' | 0.747 | 0.88 |
| Whitton | 96+63 | 3000 | 2-10'x10' | 0.589 | 2500 | 2-8'x10' | 0.747 | 0.625 |
| Osborn | 90+10 | 3600 | 2-12'x10' | 0.524 | 2500 | 2-8'x10' | 0.747 | 0.625 |
| Richardson | 83+24 | 3600 | 2-12'x10' | 0.524 | 2500 | 2-8'x10' | 0.747 | 0.625 |
| Earll | 76+64 | 3600 | 2-12'x10' | 0.524 | 3300 | 2-10'x10' | 0.712 | 0.625 |
| Pinchot | 71+38 | 3600 | 2-18'x10' | 0.187 | 3300 | 2-10'x10' | 0.712 | 0.32 |
| Thomas | 63+45 | 3600 | 2-18'x10' | 0.187 | 3600 | 2-18'x10' | 0.187 | 0.32 |
| Windsor | 56+96 | 3600 | 2-18'x10' | 0.187 | 3600 | 2-18'x10' | 0.187 | 0.32 |
| North of Virginia | 55+19 | 3600 | 2-18'x10' | 0.187 | 3600 | 2-18'x10' | 0.187 | 0.32 |
| Virgina | 50+27 | 4100 | 2-18'x10' | 0.0243 | 3600 | 2-18'x10' | 0.187 | 0.32 |
| Oak | 37+12 | 4100 | 2-18'x10' | 0.0243 | 4100 | 2-18'x10' | 0.243 | 0.32 |
| Holly | 27+17 | 4100 | 2-18'x10' | 0.0243 | 4100 | 2-18'x10' | 0.243 | 0.32 |
| Granada | 20+10 | 4100 | 2-18'x10' | 0.0243 | 4100 | 2-18'x10' | 0.243 | 0.32 |
| McDowell | 8+51 | 4100 | 2-18'x10' | 0.0243 | 4100 | 2-18'x10' | 0.243 | 0.32 |

n = 0.014

(1) THE BASE MODEL CULVERT SIZE WILL REQUIRE REFINEMENT FOR THE SELECTED ALTERNATIVE TO ACCOMMODATE SIDE INFLOWS.

## *TABLE 5 – Comparison of Flow Rates in Surface Features to Total Flows*

| *Cross Street* | *Project Station at Center of Road* | *Model 1* | | *Model 2* | | *Model 3* | |
|---|---|---|---|---|---|---|---|
| | | *Profile 1* | *Profile 2* | *Profile 1* | *Profile 2* | *Profile 1* | *Profile 2* |
| Lafayette Interceptor Drain | | | | | | 0 | |
| Indian School | 116+22 | | | | | 1640 | 60 |
| Weldon | 100+33 | | | | | 1700 | 110 |
| Whitton | 96+63 | | | | | 1700 | 120 |
| Osborn | 90+10 | | | 2040 | 240 | 2270 | 450 |
| Richardson | *83+24 | | | 2060 | 260 | 2300 | 480 |
| Earll | 76+64 | | | 2830 | 250 | 3310 | 700 |
| Pinchot | 71+38 | | | 2850 | 260 | 3330 | 720 |
| Thomas | 63+45 | | | 2960 | 80 | 3470 | 560 |
| Windsor | *56+96 | | | 3000 | 130 | 3530 | 620 |
| North of Virginia | *55+19 | | | 3000 | 130 | 3540 | 630 |
| Virginia | 50+27 | 3850 | 250 | 3270 | 400 | 3850 | 940 |
| Oak | *37+12 | 4350 | 250 | 3690 | 390 | 4350 | 1010 |
| Holly | 27+17 | 4410 | 310 | 3730 | 440 | 4410 | 1080 |
| Granada | 20+10 | 4490 | 390 | 3790 | 490 | 4490 | 1150 |
| McDowell | *8+51 | 4710 | 610 | 3970 | 680 | 4710 | 1370 |

MODEL 1 = 100-YEAR EXISTING WITHOUT 10-YEAR LID
MODEL 2 = 50-YEAR EXISTING WITH 10-YEAR LID
MODEL 3 = 100-YEAR EXISTING WITH 10-YEAR LID

PROFILE 1 IS TOTAL FLOW INTO THE OLD CROSS CUT CANAL
PROFILE 2 IS THE SURFACE FEATURE FLOW FOR THE PROPOSED IMPROVEMENT.

NOTE: FLOWS INCLUDE THE SRP 1,000 CFS

SEE TABLE 3 FOR "Q"

TABLE 6A

## 100–YEAR EXISTING FLOW WITHOUT 10–YEAR LID WITH SURFACE FEATURE ALTERNATIVES

# MODEL 1

| PRE–PROJECT CONDITIONS | | | | | | PROPOSED SURFACE FEATURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION | DISCHARGE (cfs) | INVERT ELEVATION | EAST BANK ELEVATION | WEST BANK ELEVATION | WATER SURFACE ELEVATION | DISCHARGE (cfs) | DEPTH 1' WATER SURFACE | DEPTH 2' WATER SURFACE | DEPTH 3' WATER SURFACE |
| 1110 | 4710 | 181 | 195 | 195 | 195.3 | 610 | 194.30 | 193.30 | 192.30 |
| 1514 | 4710 | 181.1 | 198.6 | 198.6 | 195.89 | 610 | 197.60 | 196.60 | 195.60 |
| 1912 | 4490 | 181.7 | 203 | 202.7 | 196.7 | 390 | 201.70 | 200.70 | 199.70 |
| 2312 | 4490 | 183 | 204 | 203 | 197.05 | 390 | 202.00 | 201.00 | 200.00 |
| 2485 | 4490 | 183.9 | 203 | 203 | 199.78 | 390 | 202.00 | 201.00 | 200.00 |
| 2515 | 4490 | 184 | 203 | 203 | 203.8 | 390 | 202.80 | 201.80 | 200.80 |
| 2530 | 4490 | 188.3 | 203 | 203 | 205.91 | 390 | 202.50 | 202.50 | 200.86 |
| 2712 | 4410 | 188.5 | 204 | 203 | 205.99 | 310 | 202.50 | 202.50 | 201.63 |
| 3112 | 4410 | 189.4 | 205.4 | 204 | 206.33 | 310 | 203.50 | 203.50 | 203.33 |
| 3513 | 4350 | 190.8 | 205 | 205 | 206.44 | 250 | 204.50 | 204.44 | 203.44 |
| 3913 | 4350 | 191.3 | 205.8 | 206 | 206.88 | 250 | 205.30 | 204.88 | 203.88 |
| 4313 | 4350 | 192.6 | 205 | 207 | 207.59 | 250 | 204.50 | 204.50 | 204.59 |
| 4713 | 3850 | 192.8 | 206.6 | 206 | 208.04 | 250 | 205.50 | 205.50 | 205.04 |

STATION 1110 IS THE END OF THE SHOTCRETE–LINED CHANNEL–PRESENT CONDITIONS JUST NORTH OF McDOWELL ROAD.

TABLE 6B

100-YEAR EXISTING FLOW WITH 10-YEAR LID
WITH SURFACE FEATURE ALTERNATIVES

# MODEL 3



| PRE-PROJECT CONDITIONS | | | | | | PROPOSED SURFACE FEATURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION | DISCHARGE (cfs) | INVERT ELEVATION | EAST BANK ELEVATION | WEST BANK ELEVATION | WATER SURFACE ELEVATION | DISCHARGE (cfs) | DEPTH 1' WATER SURFACE | DEPTH 2' WATER SURFACE | DEPTH 3' WATER SURFACE |
| 1110 | 4710 | 181 | 195 | 195 | 195.3 | 1370 | 194.30 | 193.30 | 192.30 |
| 1514 | 4710 | 181.1 | 198.6 | 198.6 | 195.89 | 1370 | 197.60 | 196.60 | 195.60 |
| 1912 | 4490 | 181.7 | 203 | 202.7 | 196.7 | 1150 | 201.70 | 200.70 | 199.70 |
| 2312 | 4490 | 183 | 204 | 203 | 197.05 | 1150 | 202.00 | 201.00 | 200.00 |
| 2485 | 4490 | 183.9 | 203 | 203 | 199.78 | 1150 | 202.00 | 201.00 | 200.00 |
| 2515 | 4490 | 184 | 203 | 203 | 203.8 | 1150 | 202.80 | 201.80 | 200.80 |
| 2530 | 4490 | 188.3 | 203 | 203 | 205.91 | 1150 | 202.50 | 202.50 | 202.50 |
| 2712 | 4410 | 188.5 | 204 | 203 | 205.99 | 1080 | 202.50 | 202.50 | 202.50 |
| 3112 | 4410 | 189.4 | 205.4 | 204 | 206.33 | 1080 | 203.50 | 203.50 | 203.33 |
| 3513 | 4350 | 190.8 | 205 | 205 | 206.44 | 1010 | 204.50 | 204.44 | 203.44 |
| 3913 | 4350 | 191.3 | 205.8 | 206 | 206.88 | 1010 | 205.30 | 204.88 | 203.88 |
| 4313 | 4350 | 192.6 | 205 | 207 | 207.59 | 1010 | 204.50 | 204.50 | 204.50 |
| 4713 | 3850 | 192.8 | 206.6 | 206 | 208.04 | 940 | 205.50 | 205.50 | 205.04 |
| 5113 | 3540 | 194.5 | 207.2 | 207 | 208.39 | 630 | 206.50 | 206.39 | 205.39 |

TABLE 6B

100-YEAR EXISTING FLOW WITH 10-YEAR LID
WITH SURFACE FEATURE ALTERNATIVES

# MODEL 3



| PRE-PROJECT CONDITIONS | | | | | | PROPOSED SURFACE FEATURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | DEPTH 1' | DEPTH 2' | DEPTH 3' |
| STATION | DISCHARGE (cfs) | INVERT ELEVATION | EAST BANK ELEVATION | WEST BANK ELEVATION | WATER SURFACE ELEVATION | DISCHARGE (cfs) | WATER SURFACE | WATER SURFACE | WATER SURFACE |
| 5513 | 3530 | 195.6 | 207 | 207 | 208.56 | 620 | 206.50 | 206.50 | 205.56 |
| 5914 | 3530 | 196.6 | 208 | 208 | 209.18 | 620 | 207.50 | 207.18 | 206.18 |
| 6156 | 3530 | 197.8 | 210 | 209.8 | 209.36 | 620 | 208.80 | 207.80 | 206.80 |
| 6307 | 3530 | 198.75 | 209.75 | 210.1 | 211.57 | 620 | 209.25 | 209.25 | 208.57 |
| 6388 | 3470 | 199.61 | 210.61 | 210.61 | 214.46 | 560 | 210.11 | 210.11 | 210.11 |
| 6517 | 3470 | 200 | 211.3 | 211.5 | 214.85 | 560 | 210.80 | 210.80 | 210.80 |
| 6714 | 3470 | 200.3 | 211 | 211 | 214.9 | 560 | 210.50 | 210.50 | 210.50 |
| 7115 | 3330 | 200.6 | 213 | 212 | 215.05 | 720 | 211.50 | 211.50 | 211.50 |
| 7515 | 3310 | 200.9 | 213 | 213 | 215.26 | 700 | 212.50 | 212.50 | 212.26 |
| 7715 | 3310 | 201.5 | 214 | 214 | 215.21 | 700 | 213.50 | 213.21 | 212.21 |
| 7916 | 3310 | 202.1 | 216 | 215 | 214.9 | 700 | 214.00 | 213.00 | 212.00 |
| 8317 | 2300 | 203 | 219 | 217 | 216.95 | 480 | 216.00 | 215.00 | 214.00 |
| 8717 | 2300 | 204 | 221 | 221 | 217.41 | 480 | 220.00 | 219.00 | 218.00 |
| 8859 | 2300 | 204.6 | 221 | 222 | 217.51 | 480 | 220.00 | 219.00 | 218.00 |

TABLE 6B

100-YEAR EXISTING FLOW WITH 10-YEAR LID
WITH SURFACE FEATURE ALTERNATIVES

# MODEL 3



| PRE-PROJECT CONDITIONS | | | | | | PROPOSED SURFACE FEATURE | | | |
|---|---|---|---|---|---|---|---|---|---|
| STATION | DISCHARGE (cfs) | INVERT ELEVATION | EAST BANK ELEVATION | WEST BANK ELEVATION | WATER SURFACE ELEVATION | DISCHARGE (cfs) | DEPTH 1' WATER SURFACE | DEPTH 2' WATER SURFACE | DEPTH 3' WATER SURFACE |
| 9037 | 2270 | 206.49 | 222.6 | 222.5 | 223.86 | 450 | 222.00 | 221.86 | 220.86 |
| 9118 | 2270 | 205.6 | 224 | 223 | 223.92 | 450 | 222.92 | 221.92 | 220.92 |
| 9318 | 2270 | 206.4 | 225 | 225 | 223.77 | 450 | 224.00 | 223.00 | 222.00 |
| 9518 | 1700 | 207.2 | 227 | 227 | 224.18 | 120 | 226.00 | 225.00 | 224.00 |
| 9919 | 1700 | 212.2 | 228 | 230 | 224.46 | 110 | 227.00 | 226.00 | 225.00 |
| 10119 | 1700 | 215 | 230 | 230 | 224.37 | 110 | 229.00 | 228.00 | 227.00 |
| 10319 | 1700 | 217.8 | 232 | 232.8 | 227.27 | 110 | 231.00 | 230.00 | 229.00 |
| 10720 | 1700 | 220.5 | 237.1 | 236 | 231.19 | 110 | 235.00 | 234.00 | 233.00 |
| 11120 | 1700 | 222 | 241 | 240 | 235.38 | 110 | 239.00 | 238.00 | 237.00 |
| 11408 | 1700 | 226 | 241 | 241 | 235.42 | 110 | 240.00 | 239.00 | 238.00 |
| 11558 | 1700 | 229.22 | 243 | 243 | 237.65 | 110 | 242.00 | 241.00 | 240.00 |
| 11690 | 1640 | 229.7 | 243.6 | 243.8 | 243.35 | 60 | 242.60 | 241.60 | 240.60 |

STATION 1110 IS THE END OF THE SHOTCRETE LINED CHANNEL-PRESENT CONDITIONS JUST NORTH OF McDOWELL ROAD.

TABLE 7

SURFACE FEATURE IMPACT SUMMARY
FOR 100–YEAR EXISTING ALTERNATIVE WITHOUT 10–YEAR LID
AND WITH DESIGN CULVERT

# MODEL 1

| STATION NUMBER | EXISTING TOP WIDTH | (1) FLOW WIDTH WITH PROJECT | LEFT BANK ELEVATION | RIGHT BANK ELEVATION | EXISTING INVERT ELEVATION | SURFACE FEATURE INVERT ELEVATION | EXISTING WATER SURFACE ELEVATION | SURFACE FEATURE WATER SURFACE ELEVATION | SURFACE FEATURE DISCHARGE | SURFACE FEATURE VELOCITY | SURFACE FEATURE BOTTOM WIDTH | RECOMMENDED CULVERT SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+00 | 104.00 | N/A | 193.87 | 193.87 | 179.85 | N/A | 195.24 | 196.68 | N/A | N/A | N/A | |
| 11+10 | 80.19 | 85.00 | 195.00 | 195.00 | 181.00 | 193.30 | 195.30 | 198.27 | 610 | 1.86 | 60 | 2–18'X 10' |
| 15+14 | 48.47 | 58.01 | 198.60 | 198.60 | 181.10 | 196.60 | 195.89 | 198.10 | 610 | 7.00 | 60 | ▪ |
| 19+12 | 47.45 | 60.00 | 203.00 | 202.70 | 181.70 | 200.70 | 196.70 | 201.81 | 390 | 5.85 | 60 | ▪ |
| 23+12 | 44.22 | 84.27 | 204.00 | 203.00 | 183.00 | 201.00 | 197.05 | 203.09 | 390 | 2.74 | 60 | ▪ |
| 24+85 | 39.81 | 105.40 | 203.00 | 203.00 | 183.90 | 201.00 | 199.78 | 203.25 | 390 | 2.09 | 80 | ▪ |
| 25+15 | 119.20 | 104.50 | 203.00 | 203.00 | 184.00 | 201.80 | 203.80 | 203.23 | 390 | 3.18 | 80 | ▪ |
| 25+30 | 158.00 | 116.60 | 203.00 | 203.00 | 188.30 | 202.50 | 205.91 | 203.20 | 390 | 4.53 | 100 | ▪ |
| 27+12 | 158.00 | 108.10 | 204.00 | 203.00 | 188.50 | 202.50 | 205.99 | 203.90 | 310 | 2.05 | 100 | ▪ |
| 31+12 | 166.50 | 166.49 | 205.40 | 204.00 | 189.40 | 203.50 | 206.33 | 204.29 | 310 | 1.71 | 100 | ▪ |
| 35+13 | 184.00 | 163.65 | 205.00 | 205.00 | 190.80 | 204.44 | 206.44 | 204.98 | 250 | 2.44 | 100 | ▪ |
| 39+13 | 183.99 | 183.98 | 205.80 | 206.00 | 191.30 | 204.88 | 206.88 | 205.67 | 250 | 1.45 | 100 | ▪ |
| 43+13 | 189.00 | 131.74 | 205.00 | 207.00 | 192.60 | 204.50 | 207.59 | 205.96 | 250 | 1.98 | 60 | ▪ |
| 47+13 | 169.98 | 169.98 | 206.60 | 206.00 | 192.80 | 205.50 | 208.04 | 206.87 | 250 | 1.01 | 60 | ▪ |
| 51+13 | NO SURFACE FEATURES REQUIRED | | | | | | | | | | | ▪ |
| 55+13 | | | | | | | | | | | | ▪ |
| 59+14 | | | | | | | | | | | | ▪ |
| 61+56 | | | | | | | | | | | | ▪ |
| 63+07 | | | | | | | | | | | | ▪ |
| 63+88 | | | | | | | | | | | | ▪ |
| 65+17 | | | | | | | | | | | | ▪ |
| 67+14 | | | | | | | | | | | | 2–16' X 10' |
| 71+15 | | | | | | | | | | | | ▪ |
| 75+15 | | | | | | | | | | | | ▪ |
| 77+15 | | | | | | | | | | | | 2–12' X 10' |
| 79+16 | | | | | | | | | | | | ▪ |
| 83+17 | | | | | | | | | | | | 2–10' X 10' |
| 87+17 | | | | | | | | | | | | ▪ |
| 88+59 | | | | | | | | | | | | ▪ |
| 89+77 | | | | | | | | | | | | 1–16' X 10' |
| 90+37 | | | | | | | | | | | | ▪ |
| 91+18 | | | | | | | | | | | | ▪ |
| 93+18 | | | | | | | | | | | | ▪ |
| 95+18 | | | | | | | | | | | | ▪ |
| 99+19 | | | | | | | | | | | | 1–14'X 10' |
| 101+19 | | | | | | | | | | | | ▪ |
| 103+19 | | | | | | | | | | | | ▪ |
| 107+20 | | | | | | | | | | | | ▪ |
| 111+20 | | | | | | | | | | | | ▪ |
| 114+08 | | | | | | | | | | | | ▪ |
| 115+58 | | | | | | | | | | | | 1– 12' X 10' |
| 116+90 | | | | | | | | | | | | ▪ |

NOTE: MANNING'S 'n' = 0.025 FOR SURFACE FEATURE
SEC No. 4713 IS AT VIRGINIA
(1) THE FLOW WIDTH ALONG THE CORRIDOR WITH PROJECT.

TABLE 8
SURFACE FEATURE IMPACT SUMMARY
FOR 100–YEAR EXISTING ALTERNATIVE
WITH THE 10–YEAR LID AND WITH
DESIGN CULVERT

# MODEL 3

| STATION NUMBER | EXISTING TOP WIDTH | (1) FLOW WIDTH WITH PROJECT | LEFT BANK ELEVATION | RIGHT BANK ELEVATION | EXISTING INVERT ELEVATION | SURFACE FEATURE INVERT ELEVATION | EXISTING WATER SURFACE ELEVATION | SURFACE FEATURE WATER SURFACE ELEVATION | SURFACE FEATURE DISCHARGE | SURFACE FEATURE VELOCITY | SURFACE FEATURE BOTTOM WIDTH | RECOMMENDED CULVERT SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+00 | 104.00 | N/A | 193.87 | 193.87 | 179.85 | N/A | 195.24 | N/A | N/A | N/A | N/A | |
| 11+10 | 80.19 | 85.01 | 195.00 | 195.00 | 181.00 | 191.44 | 195.30 | 198.96 | 1370 | 2.34 | 100.0 | 2–18' X 10' |
| 15+14 | 47.47 | 83.00 | 198.60 | 198.60 | 181.10 | 194.39 | 195.89 | 198.96 | 1370 | 3.81 | 100.0 | " |
| 19+12 | 47.45 | 100.00 | 203.00 | 202.70 | 181.70 | 195.51 | 196.70 | 199.27 | 1150 | 3.06 | 100.0 | " |
| 23+12 | 44.22 | 100.00 | 204.00 | 203.00 | 183.00 | 194.74 | 197.05 | 199.46 | 1150 | 2.43 | 100.0 | " |
| 24+85 | 39.81 | 100.00 | 203.00 | 203.00 | 183.90 | 197.14 | 199.78 | 199.41 | 1150 | 5.07 | 100.0 | " |
| 25+15 | 119.20 | 100.00 | 203.00 | 203.00 | 184.00 | 197.96 | 203.80 | 199.56 | 1150 | 7.21 | 100.0 | " |
| 25+30 | 158.00 | 100.00 | 203.00 | 203.00 | 188.30 | 198.91 | 205.91 | 200.51 | 1150 | 7.20 | 100.0 | " |
| 27+12 | 158.00 | 108.10 | 204.00 | 203.00 | 188.50 | 201.20 | 205.99 | 202.72 | 1080 | 6.96 | 100.0 | " |
| 31+12 | 166.50 | 166.49 | 205.40 | 204.00 | 189.40 | 202.26 | 206.33 | 204.51 | 1080 | 3.93 | 100.0 | " |
| 35+13 | 184.00 | 183.99 | 205.00 | 205.00 | 190.80 | 203.35 | 206.44 | 205.23 | 1010 | 4.59 | 100.0 | " |
| 39+13 | 183.99 | 183.99 | 205.80 | 206.00 | 191.30 | 204.04 | 206.88 | 206.11 | 1010 | 3.51 | 100.0 | " |
| 43+13 | 189.00 | 189.00 | 205.00 | 207.00 | 192.60 | 204.50 | 207.59 | 206.59 | 1010 | 2.75 | 100.0 | " |
| 47+13 | 169.98 | 169.98 | 206.60 | 206.00 | 192.80 | 205.50 | 208.04 | 207.00 | 940 | 3.23 | 100.0 | " |
| 51+13 | 181.48 | 181.47 | 207.20 | 207.00 | 194.50 | 206.50 | 208.39 | 207.69 | 630 | 2.49 | 100.0 | " |
| 55+13 | 172.99 | 172.99 | 207.00 | 207.00 | 195.60 | 206.50 | 208.56 | 208.21 | 620 | 3.08 | 100.0 | " |
| 59+14 | 154.79 | 137.45 | 208.00 | 208.00 | 196.60 | 207.50 | 209.18 | 208.92 | 620 | 4.05 | 100.0 | " |
| 61+56 | 42.04 | 124.00 | 210.00 | 209.80 | 197.80 | 208.27 | 209.36 | 209.67 | 620 | 4.20 | 100.0 | " |
| 63+07 | 154.99 | 133.18 | 209.75 | 210.10 | 198.75 | 209.25 | 211.57 | 210.36 | 620 | 5.52 | 100.0 | " |
| 63+88 | 169.00 | 168.99 | 210.61 | 210.61 | 199.61 | 210.11 | 214.46 | 210.87 | 560 | 5.72 | 100.0 | " |
| 65+17 | 172.00 | 171.99 | 211.30 | 211.50 | 200.00 | 210.80 | 214.85 | 211.81 | 560 | 2.88 | 100.0 | " |
| 67+14 | 198.50 | 187.40 | 211.00 | 211.00 | 200.30 | 210.50 | 214.90 | 212.12 | 560 | 2.62 | 100.0 | 2– 16' X 10' |
| 71+15 | 195.50 | 167.05 | 213.00 | 212.00 | 200.60 | 211.50 | 215.05 | 212.76 | 720 | 4.01 | 100.0 | " |
| 75+15 | 197.99 | 188.90 | 213.00 | 213.00 | 200.90 | 212.50 | 215.26 | 213.85 | 700 | 3.14 | 100.0 | " |
| 77+15 | 222.99 | 146.43 | 214.00 | 214.00 | 201.50 | 213.50 | 215.21 | 214.39 | 700 | 4.50 | 100.0 | 2– 12' X 10' |
| 79+16 | 38.75 | 140.25 | 216.00 | 215.00 | 202.10 | 214.00 | 214.90 | 215.44 | 700 | 4.80 | 100.0 | " |
| 83+17 | 41.86 | 100.00 | 219.00 | 217.00 | 203.00 | 216.00 | 216.95 | 217.17 | 480 | 4.08 | 100.0 | 2– 10' X 10' |
| 87+17 | 39.07 | 100.00 | 221.00 | 221.00 | 204.00 | 218.75 | 217.41 | 219.64 | 480 | 5.39 | 100.0 | " |
| 88+59 | 38.61 | 100.00 | 221.00 | 222.00 | 204.60 | 219.72 | 217.51 | 220.79 | 480 | 4.47 | 100.0 | " |
| 89+77 | 37.67 | 100.00 | 222.00 | 222.00 | 205.90 | 220.53 | 217.49 | 221.50 | 480 | 4.96 | 100.0 | 1– 16' X 10' |
| 90+37 | 137.99 | 100.00 | 222.60 | 222.50 | 206.49 | 220.94 | 223.86 | 221.81 | 450 | 5.16 | 100.0 | " |
| 91+18 | 110.84 | 100.00 | 224.00 | 223.00 | 205.60 | 221.50 | 223.92 | 222.52 | 450 | 4.40 | 100.0 | " |
| 93+18 | 38.99 | 100.00 | 225.00 | 225.00 | 206.40 | 222.87 | 223.77 | 223.78 | 450 | 4.94 | 100.0 | " |
| 95+18 | 36.94 | 100.00 | 227.00 | 227.00 | 207.20 | 224.25 | 224.18 | 225.01 | 120 | 1.58 | 100.0 | " |
| 99+19 | 41.09 | 100.00 | 228.00 | 230.00 | 212.20 | 227.00 | 224.46 | 227.33 | 110 | 3.30 | 100.0 | 1– 14' X 10' |
| 101+19 | 26.52 | 126.50 | 230.00 | 230.00 | 215.00 | 229.00 | 224.37 | 229.26 | 110 | 0.55 | 100.0 | " |
| 103+19 | 29.55 | 100.00 | 232.00 | 232.80 | 217.80 | 231.00 | 227.27 | 231.33 | 110 | 3.30 | 100.0 | " |
| 107+20 | 20.45 | 95.25 | 237.10 | 236.00 | 220.50 | 235.00 | 231.19 | 235.40 | 110 | 2.85 | 100.0 | " |
| 111+20 | 33.33 | 97.01 | 241.00 | 240.00 | 222.00 | 239.00 | 235.38 | 239.35 | 110 | 3.32 | 100.0 | " |
| 114+08 | 22.30 | 98.86 | 241.00 | 241.00 | 226.00 | 240.00 | 235.42 | 240.61 | 110 | 1.82 | 100.0 | " |
| 115+58 | 20.00 | 95.01 | 243.00 | 243.00 | 229.22 | 242.00 | 237.65 | 242.35 | 110 | 3.35 | 100.0 | 1– 12' X 10' |
| 116+90 | 48.91 | 100.00 | 243.60 | 243.80 | 229.70 | 242.60 | 243.35 | 242.83 | 60 | 2.66 | 100.0 | " |

NOTE: MANNING'S 'n' = 0.025 FOR SURFACE FEATURE
(1) THE FLOW WIDTH ALONG THE CORRIDOR WITH PROJECT.

TABLE 9

SURFACE FEATURE IMPACT SUMMARY
FOR 100–YEAR EXISTING ALTERNATIVE
WITH THE 10–YEAR LID AND WITH
MAXIMIZATION OF CULVERT CAPACITY AND
MINIMIZATION OF SURFACE FEATURE CAPACITY

# MODEL 4

| STATION NUMBER | EXISTING TOP WIDTH | (1) FLOW WIDTH WITH PROJECT | LEFT BANK ELEVATION | RIGHT BANK ELEVATION | EXISTING INVERT ELEVATION | SURFACE FEATURE INVERT ELEVATION | EXISTING WATER SURFACE ELEVATION | SURFACE FEATURE WATER SURFACE ELEVATION | SURFACE FEATURE DISCHARGE | SURFACE FEATURE VELOCITY | SURFACE FEATURE BOTTOM WIDTH | RECOMMENDED CULVERT SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+00 | 104.00 | N/A | 193.87 | 193.87 | 179.85 | N/A | 195.24 | N/A | N/A | N/A | N/A | |
| 11+10 | 80.19 | 85.01 | 195.00 | 195.00 | 181.00 | 191.44 | 195.3 | 198.96 | 1370 | 2.34 | 100 | 2–18' X 10' |
| 15+14 | 48.47 | 83.00 | 198.60 | 198.60 | 181.10 | 194.39 | 195.89 | 198.96 | 1370 | 3.81 | 100 | " |
| 19+12 | 47.45 | 100.00 | 203.00 | 202.70 | 181.70 | 195.51 | 196.7 | 199.27 | 1150 | 3.06 | 100 | " |
| 23+12 | 44.22 | 100.00 | 204.00 | 203.00 | 183.00 | 194.74 | 197.05 | 199.46 | 1150 | 2.43 | 100 | " |
| 24+85 | 39.81 | 100.00 | 203.00 | 203.00 | 183.90 | 197.14 | 199.78 | 199.41 | 1150 | 5.07 | 100 | " |
| 25+15 | 119.20 | 100.00 | 203.00 | 203.00 | 184.00 | 197.96 | 203.8 | 199.56 | 1150 | 7.21 | 100 | " |
| 25+30 | 158.00 | 100.00 | 203.00 | 203.00 | 188.30 | 198.91 | 205.91 | 200.51 | 1150 | 7.20 | 100 | " |
| 27+12 | 158.00 | 108.10 | 204.00 | 203.00 | 188.50 | 201.20 | 205.99 | 202.72 | 1080 | 6.96 | 100 | " |
| 31+12 | 166.50 | 166.49 | 205.40 | 204.00 | 189.40 | 202.26 | 206.33 | 204.51 | 1080 | 3.93 | 100 | " |
| 35+13 | 184.00 | 183.99 | 205.00 | 205.00 | 190.80 | 203.35 | 206.44 | 205.23 | 1010 | 4.59 | 100 | " |
| 39+13 | 183.99 | 183.99 | 205.80 | 206.00 | 191.30 | 204.04 | 206.88 | 206.11 | 1010 | 3.51 | 100 | " |
| 43+13 | 189.00 | 189.00 | 205.00 | 207.00 | 192.60 | 204.50 | 207.59 | 206.59 | 1010 | 2.75 | 100 | " |
| 47+13 | 169.98 | 169.98 | 206.60 | 206.00 | 192.80 | 205.50 | 208.04 | 207.00 | 940 | 3.23 | 100 | " |
| 51+13 | 181.48 | 181.47 | 207.20 | 207.00 | 194.50 | 206.50 | 208.39 | 207.53 | 130 | 0.62 | 60 | " |
| 55+13 | 172.99 | 79.88 | 207.00 | 207.00 | 195.60 | 206.50 | 208.56 | 207.59 | 120 | 1.81 | 60 | " |
| 59+14 | 154.79 | 60.00 | 208.00 | 208.00 | 196.60 | 207.50 | 209.18 | 208.18 | 120 | 2.90 | 60 | " |
| 61+56 | 42.04 | 60.00 | 210.00 | 209.80 | 197.80 | 208.27 | 209.36 | 209.03 | 120 | 2.63 | 60 | " |
| 63+07 | 154.99 | 60.00 | 209.75 | 210.10 | 198.75 | 209.25 | 211.57 | 209.75 | 120 | 4.02 | 60 | " |
| 63+88 | 169.00 | 166.33 | 210.61 | 210.61 | 199.61 | 210.11 | 214.46 | 210.30 | 60 | 2.79 | 60 | " |
| 65+17 | 172.00 | 110.00 | 211.30 | 211.50 | 200.00 | 210.80 | 214.85 | 210.87 | 60 | 0.39 | 60 | " |
| 67+14 | 198.50 | 60.00 | 211.00 | 211.00 | 200.30 | 210.50 | 214.9 | 211.14 | 60 | 1.57 | 60 | " |
| 71+15 | 195.50 | 60.00 | 213.00 | 212.00 | 200.60 | 211.50 | 215.05 | 211.77 | 20 | 1.26 | 60 | " |
| 75+15 | 197.99 | 60.00 | 213.00 | 213.00 | 200.90 | 212.50 | 215.26 | 212.78 | 20 | 1.22 | 60 | " |
| 77+15 | NO SURFACE FEATURES REQUIRED | | | | | | | | | | | 2– 12' X 10' |
| 79+16 | | | | | | | | | | | | " |
| 83+17 | | | | | | | | | | | | " |
| 87+17 | | | | | | | | | | | | " |
| 88+59 | | | | | | | | | | | | " |
| 89+17 | | | | | | | | | | | | " |
| 90+37 | | | | | | | | | | | | " |
| 91+18 | | | | | | | | | | | | " |
| 93+18 | | | | | | | | | | | | " |
| 95+18 | | | | | | | | | | | | " |
| 99+19 | | | | | | | | | | | | 2– 10' X 10' |
| 101+19 | | | | | | | | | | | | " |
| 103+19 | | | | | | | | | | | | " |
| 107+20 | | | | | | | | | | | | " |
| 111+20 | | | | | | | | | | | | " |
| 114+08 | | | | | | | | | | | | " |
| 115+58 | | | | | | | | | | | | " |
| 116+90 | | | | | | | | | | | | " |

NOTES: MANNING'S 'n' = 0.025 FOR SURFACE FEATURE.
SEC NO. 7515 IS AT EARLL DR.
(1) THE FLOW WIDTH ALONG THE CORRIDOR WITH PROJECT.

TABLE 10
SURFACE FEATURE IMPACT SUMMARY
FOR 100–YEAR EXISTING CONDITION WITHOUT
THE 10–YEAR LID AND WITH MAXIMIZATION OF SURFACE FEATURE
AND MINIMIZATION OF CULVERT CAPACITY

# MODEL 5

| STATION NUMBER | EXISTING TOP WIDTH | FLOW WIDTH WITH PROJECT | LEFT BANK ELEVATION | RIGHT BANK ELEVATION | EXISTING INVERT ELEVATION | SURFACE FEATURE INVERT ELEVATION | EXISTING WATER SURFACE ELEVATION | SURFACE FEATURE WATER SURFACE ELEVATION | SURFACE FEATURE DISCHARGE | SURFACE FEATURE VELOCITY | SURFACE FEATURE BOTTOM WIDTH | RECOMMENDED CULVERT SIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+00 | 104.00 | N/A | 193.87 | 193.87 | 179.85 | N/A | 195.24 | N/A | N/A | N/A | N/A | |
| 11+10 | 80.19 | 85.00 | 195.00 | 195.00 | 181.00 | 195.11 | 195.30 | 199.07 | 100 | N/A | 60.0 | 2–18' X 10' |
| 15+14 | 48.47 | 83.00 | 198.60 | 198.60 | 181.10 | 196.05 | 195.89 | 198.44 | 100 | N/A | 60.0 | " |
| 19+12 | 47.45 | 100.00 | 203.00 | 202.70 | 181.70 | 196.99 | 197.70 | 200.65 | 1600 | N/A | 60.0 | " |
| 23+12 | 44.22 | 60.00 | 204.00 | 203.00 | 183.00 | 197.92 | 197.05 | 201.87 | 1600 | N/A | 60.0 | " |
| 24+85 | 39.81 | 60.00 | 203.00 | 203.00 | 183.90 | 198.33 | 199.78 | 202.30 | 1600 | N/A | 80.0 | " |
| 25+15 | 119.20 | 70.08 | 203.00 | 203.00 | 184.00 | 198.40 | 203.80 | 202.38 | 1600 | N/A | 80.0 | " |
| 25+30 | 158.00 | 72.32 | 203.00 | 203.00 | 188.30 | 198.44 | 205.91 | 202.42 | 1600 | N/A | 100.0 | " |
| 27+12 | 158.00 | 60.00 | 204.00 | 203.00 | 188.50 | 198.86 | 205.99 | 202.85 | 1600 | N/A | 100.0 | " |
| 31+12 | 166.50 | 60.00 | 205.40 | 204.00 | 189.40 | 199.80 | 206.33 | 203.79 | 1600 | N/A | 100.0 | " |
| 35+13 | 184.00 | 60.00 | 205.00 | 205.00 | 190.80 | 200.74 | 206.44 | 204.73 | 1600 | N/A | 100.0 | " |
| 39+13 | 183.99 | 130.98 | 205.80 | 206.00 | 191.30 | 201.68 | 206.88 | 205.74 | 1600 | N/A | 100.0 | " |
| 43+13 | 189.00 | 131.74 | 205.00 | 207.00 | 192.60 | 202.61 | 207.59 | 206.59 | 1600 | N/A | 60.0 | " |
| 47+13 | 169.98 | 169.98 | 206.60 | 206.00 | 192.80 | 203.55 | 208.04 | 207.33 | 1600 | N/A | 60.0 | " |
| 51+13 | 181.48 | 181.47 | 207.20 | 207.00 | 194.50 | 204.49 | 208.39 | 207.84 | 1600 | N/A | 60.0 | 2–10' X 10' |
| 55+13 | 172.99 | 172.99 | 207.00 | 207.00 | 195.60 | 205.43 | 208.56 | 208.51 | 1500 | N/A | 60.0 | " |
| 59+14 | 154.75 | 140.90 | 208.00 | 208.00 | 196.60 | 206.36 | 209.18 | 209.06 | 1000 | N/A | 60.0 | " |
| 61+56 | 42.04 | 60.00 | 210.00 | 209.80 | 197.80 | 206.93 | 209.36 | 209.67 | 1000 | N/A | 60.0 | " |
| 63+07 | 154.99 | 154.99 | 209.75 | 210.10 | 198.75 | 207.29 | 211.57 | 210.80 | 1600 | N/A | 60.0 | " |
| 63+88 | 169.00 | 168.99 | 210.61 | 210.61 | 199.61 | 207.48 | 214.46 | 211.84 | 1600 | N/A | 60.0 | " |
| 65+17 | 172.00 | 171.99 | 211.30 | 211.50 | 200.00 | 207.78 | 214.85 | 211.97 | 1600 | N/A | 60.0 | " |
| 67+14 | 198.50 | 188.32 | 211.00 | 211.00 | 200.30 | 208.24 | 214.90 | 212.20 | 1600 | N/A | 60.0 | " |
| 71+15 | 195.50 | 172.30 | 213.00 | 212.00 | 200.60 | 209.18 | 215.05 | 212.88 | 1600 | N/A | 60.0 | " |
| 75+15 | 197.99 | 186.35 | 213.00 | 213.00 | 200.90 | 210.12 | 215.26 | 213.79 | 1600 | N/A | 60.0 | 2–8' X 10' |
| 77+15 | 222.99 | 60.00 | 214.00 | 214.00 | 201.50 | 210.97 | 215.21 | 213.91 | 1600 | N/A | 60.0 | " |
| 79+16 | 38.75 | 60.00 | 216.00 | 215.00 | 202.10 | 211.91 | 214.90 | 214.78 | 1300 | N/A | 60.0 | " |
| 83+17 | 41.86 | 60.00 | 219.00 | 217.00 | 203.00 | 213.79 | 216.95 | 216.98 | 1600 | N/A | 60.0 | 1–8' X 10' |
| 87+17 | 39.07 | 60.00 | 221.00 | 221.00 | 204.00 | 215.66 | 217.41 | 218.90 | 1600 | N/A | 60.0 | " |
| 88+59 | 38.61 | 60.00 | 221.00 | 222.00 | 204.60 | 216.33 | 217.51 | 219.56 | 1600 | N/A | 60.0 | " |
| 89+77 | 37.67 | 60.00 | 222.00 | 222.00 | 205.90 | 216.88 | 217.49 | 220.10 | 1600 | N/A | 60.0 | " |
| 90+37 | 137.99 | 137.99 | 222.60 | 222.50 | 206.49 | 217.16 | 223.86 | 223.42 | 1600 | N/A | 60.0 | " |
| 91+18 | 110.84 | 108.26 | 224.00 | 223.00 | 205.60 | 217.54 | 223.92 | 223.46 | 1600 | N/A | 60.0 | " |
| 93+18 | 38.99 | 60.00 | 225.00 | 225.00 | 206.40 | 218.48 | 223.77 | 223.51 | 1600 | N/A | 60.0 | " |
| 95+18 | 36.94 | 60.00 | 227.00 | 227.00 | 207.20 | 219.41 | 224.18 | 223.69 | 1600 | N/A | 60.0 | 1–60" |
| 99+19 | 41.09 | 60.00 | 228.00 | 230.00 | 212.20 | 221.96 | 224.46 | 224.76 | 1600 | N/A | 60.0 | " |
| 101+19 | 26.52 | 60.00 | 230.00 | 230.00 | 215.00 | 223.70 | 224.37 | 226.50 | 1600 | N/A | 60.0 | " |
| 103+19 | 29.55 | 60.00 | 232.00 | 232.80 | 217.80 | 225.43 | 227.27 | 228.23 | 1600 | N/A | 60.0 | " |
| 107+20 | 20.45 | 60.00 | 237.10 | 236.00 | 220.50 | 228.91 | 231.19 | 231.71 | 1600 | N/A | 60.0 | " |
| 111+20 | 33.33 | 60.00 | 241.00 | 240.00 | 222.00 | 232.37 | 235.38 | 235.17 | 1600 | N/A | 60.0 | " |
| 114+08 | 22.30 | 60.00 | 241.00 | 241.00 | 226.00 | 234.87 | 235.42 | 237.67 | 1600 | N/A | 60.0 | " |
| 115+58 | 20.00 | 60.00 | 243.00 | 243.00 | 229.22 | 236.17 | 237.65 | 238.97 | 1600 | N/A | 60.0 | " |
| 116+90 | 48.91 | 89.43 | 243.60 | 243.80 | 229.70 | 237.31 | 243.35 | 243.07 | 1400 | N/A | 60.0 | 1–54" |

NOTE: MANNING'S 'n' = 0.025 FOR SURFACE FEATURE.
PROPOSED SURFACE FEATURE INVERT IS APPROXIMATELY 4 FEET ABOVE THE TOP OF CULVERT SLAB.
(1) THE FLOW WIDTH ALONG THE CORRIDOR WITH PROJECT.

| *TABLE 11A – Old Cross Cut Canal Hydrology, Side Inlet Design Storm* | | | |
|---|---|---|---|
| *Location* | *100-Year General* | *Local Side Inlet Storm* | *% Difference* |
| Indian School Road | 21 | 41 | 95 |
| Weldon | 74 | 149 | 101 |
| Whitton | 9 | 18 | 100 |
| Osborn | 235 | 431 | 83 |
| Richardson | 35 | 66 | 89 |
| Earll | 1,055 | 1,509 | 43 |
| Pinchot | 20 | 38 | 90 |
| Thomas | 156 | 267 | 71 |
| Windsor | 60 | 108 | 80 |
| North of Virginia | 7 | 15 | 114 |
| Virginia | 333 | 570 | 71 |
| Oak | 806 | 1,540 | 91 |
| Holly | 81 | 142 | 75 |
| Granada | 80 | 145 | 81 |
| McDowell | 281 | 528 | 88 |

Note: Revised March 17, 1993 by FCDMC.

| *TABLE 11B – Old Cross Cut Canal Hydrology, Side Inlet Design Storm – 100-Year Analysis* | | | |
|---|---|---|---|
| *Location* | *Main* | *Time* | *Corresponding Side Drain* [1] |
| Indian School Road | 1,640 | 4.42 | 7 |
| Weldon | 1,700 | – | 38 |
| Whitton | 1,700 | – | 5 |
| Osborn | 2,270 | – | 236 |
| Richardson | 2,300 | – | 27 |
| Earll | 3,310 | – | 1,145 |
| Pinchot | 3,330 | – | 17 |
| Thomas | 3,470 | – | 180 |
| Windsor | 3,530 | – | 54 |
| North of Virginia | 3,540 | – | 2 |
| Virginia | 3,850 | – | 329 |
| Oak | 4,350 | 4.33 | 361 |
| Holly | 4,410 | – | 55 |
| Granada | 4,490 | – | 62 |
| McDowell | 4,710 | – | 148 |

1. These flows in cfs are the flows from the "Side Drainage Storm Design" HEC-1 analysis. Based on the peak time for Main Trunk in Column 3, corresponding flow for side drain (closest time increment) was reported in Column 4.

2. Revised April 20, 1993 by FCDMC.

TABLE 12

## GRATE DESIGN AND SURFACE FEATURE CAPACITY

| STATION OF GRATE | STREET NAME | 100-YEAR GENERAL STORM (cfs) [3] | LOCAL STORM (cfs) [3] [5] | DESIGN DISCHARGE (cfs) [6] | NUMBER OF GRATES [1] | SURFACE FEATURE (CHIMP) MODEL 1 (width-ft) | CAPACITY cfs (cfs)/ no. [2] [3] [4] | MODEL 3 (width-ft) | CAPACITY (cfs) [4] | MODEL 4 (width-ft) | CAPACITY cfs (cfs)/ no. [2] [3] [4] | MODEL 5 (width-ft) | CAPACITY (cfs) [4] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+67 | McDOWELL | 281 | 528 | 97 | 3 | 60 | 610 | 100 | 1370 | 100 | 1370 | 60 | 610 |
| 19+60 | GRANADA | 80 | 145 | 80 | 4 | 60 | 390 | " | 1150 | " | 1150 | 60 | 1600 |
| 26+50 | HOLLY | 81 | 142 | 81 | 3 | 100 | 310 | " | 1080 | " | 1080 | 100 | " |
| 36+25 | OAK | 806 | 1540 | 806 | 22 | 100 | 250 (484) /19 | " | 1010 | " | 1010 | 100 | " |
| 49+75 | VIRGINIA | 333 | 570 | 333 | 13 | N/A | 0 (570) /22 | " | 630 | 100 | 130 (107) /4 | 60 | 1600 |
| 54+70 | N. OF VIRGINIA | 7 | 15 | 7 | 1 | N/A | 0 (15) /1 | " | 620 | 60 | 120 | " | 1500 |
| 56+50 | WINDSOR | 60 | 108 | 60 | 3 | N/A | 0 (108) /5 | " | 620 | " | 120 | " | 1000 |
| 62+50 | THOMAS | 156 | 267 | 156 | 7 | N/A | 0 (267) /7 | " | 560 | " | 60 (51) /2 | " | 1600 |
| 71+00 | PINCHOT | 20 | 38 | 20 | 1 | N/A | 0 (38) /2 | " | 720 | " | 20 | " | " |
| 75+00 | EARLL | 1055 | 1509 | 1055 | 33 | N/A | 0 (1509) /47 | " | 700 | 60 | 20 (434) /14 | " | " |
| 82+50 | RICHARDSON | 35 | 66 | 35 | 1 | N/A | 0 (66) /2 | " | 480 | N/A | 0 (66) /2 | " | 1600 |
| 89+40 | OSBORN | 235 | 431 | 235 | 6 | N/A | 0 (431) /11 | " | 480 | N/A | 0 (431) /11 | " | 1600 |
| 95+80 | WHITTON | 9 | 18 | 9 | 1 | N/A | 0 (18) /2 | " | 120 | N/A | 0 (18) /2 | " | " |
| 99+70 | WELDON | 74 | 149 | 74 | 3 | N/A | 0 (149) /6 | " | 110 | N/A | 0 (149) /6 | " | " |
| 115+50 | INDIAN SCHOOL | 21 | 41 | 21 | 1 | N/A | 0 (41) /2 | 100 | 60 | N/A | 0 (41) /2 | 60 | 1400 |

NOTE: [1] THIS COLUMN IS BASED ON THE COLUMN LABELED "DESIGN DISCHARGE" AND ASSUMES A SURFACE FEATURE (CHIMP) EXTENDING TO INDIAN SCHOOL.

[2] FOR THE MODELS WHERE THE CHIMP DOES NOT EXTEND TO INDIAN SCHOOL, THE DESIGN DISCHARGE MUST BE TAKEN FROM THE COLUMN LABELED "LOCAL STORM" WITH ADDITIONAL AREA PROVIDED TO ACCOMMODATE MORE GRATES; SEE NOTE 3.

[3] THE FIRST NUMBER IS THE FLOW CAPACITY, CFS, OF THE SURFACE FEATURE. THE NUMBER IN PARENTHESIS IS THE DIFFERENCE IN FLOW BETWEEN THE "LOCAL STORM" AND THE "100-YEAR GENERAL STORM" AND IS IN EXCESS OF THE SURFACE FEATURE'S CAPACITY.
WHEN THERE IS NO SURFACE FEATURE, THE NUMBER IN PARENTHESIS EQUALS THE LOCAL STORM.
THE NUMBER WHICH FOLLOWS THE SLASH IS THE ADDITIONAL NUMBER OF GRATES NEEDED TO INTERCEPT THE FLOW IN PARENTHESIS.
IN INSTANCES WHERE THE SURFACE FEATURE DOES NOT EXIST (CAPACITY EQUALS 0) , THE NUMBER FOLLOWING THE SLASH IS THE TOTAL NUMBER OF GRATES NEEDED TO INTERCEPT THE FLOW IN PARENTHESIS.

[4] MODEL 1 REPRESENTS FLOW CONDITIONS WITHOUT THE 10-YEAR LAFAYETTE INTERCEPTOR DRAIN (LID). THE SURFACE FEATURE ENDS AT VIRGINA.
MODEL 3 REPRESENTS FLOW CONDITIONS WITH THE 10-YEAR LID. THE SURFACE FEATURE ENDS AT INDIAN SCHOOL.
MODEL 4 REPRESENTS MAXIMIZATION OF THE CULVERT AND MINIMIZATION OF THE CHIMP.
THIS MODEL ALSO REPRESENTS FLOW CONDITIONS WITH THE 10-YR. LID. THE SURFACE FEATURE ENDS AT EARLL.
MODEL 5 REPRESENTS A MINIMIZATION OF THE CULVERT AND MAXIMIZATION OF THE CHIMP.
THIS MODEL ALSO REPRESENTS FLOW CONDITIONS WITHOUT THE 10-YR. LID. THE SURFACE FEATURE ENDS AT INDIAN SCHOOL ROAD.

[5] THE VALUES IN THIS COLUMN WERE PROVIDED BY THE FCDMC AND APPEAR IN TABLE 11A.

[6] THE "DESIGN DISCHARGE" VALUE FOR McDOWELL ROAD HAS BEEN REDUCED DUE TO AN EXISTING STORM DRAIN , WHICH INTERCEPTS A PORTION OF THE 281 CFS.

TABLE 13

# STORM INPUT TABLE FOR DROP INLETS



| STREET NAME/ STRUCTURE NAME | MAINLINE LINE NUMBER | 2 MAINLINE DISCHARGE | MAINLINE REACH LENGTH | DOWNSTREAM GRATE STATION | UPSTREAM GRATE STATION | DOWNSTREAM INVERT ELEVATION | UPSTREAM INVERT ELEVATION | MAINLINE TOP OF GROUND AT GRATE | MAINLINE STRUCTURE SIZE |
|---|---|---|---|---|---|---|---|---|---|
| McDOWELL | 2 | 4100 | 37.0 | 10+30.0 | 10+67.0 | 179.87 | 179.96 | 193.00 | 2–18'x10' |
| McDOWELL | 2 | 4100 | 37.0 | 10+30.0 | 10+67.0 | 179.87 | 179.96 | 193.00 | 2–18'x10' |
| GRANADA | 3 | 4100 | 893.0 | 10+67.0 | 19+60.0 | 179.96 | 182.10 | 203.48 | " |
| HOLLY | 4 | 4100 | 690.0 | 19+60.0 | 26+50.0 | 182.10 | 183.76 | 203.97 | " |
| OAK | 5 | 4100 | 975.0 | 26+50.0 | 36+25.0 | 183.76 | 186.10 | 205.49 | " |
| VIRGINIA | 6 | 4100 | 1350.0 | 36+25.0 | 49+75.0 | 186.10 | 189.34 | 207.06 | " |
| N. of VIRGINIA | 7 | 3600 | 495.0 | 49+75.0 | 54+70.0 | 189.34 | 190.53 | 207.00 | " |
| WINDSOR | 8 | 3600 | 180.0 | 54+70.0 | 56+50.0 | 190.53 | 190.96 | 207.41 | " |
| THOMAS | 9 | 3600 | 600.0 | 56+50.0 | 62+50.0 | 190.96 | 192.40 | 210.74 | " |
| BEGIN TRANSITION STR. | 10 | 3300 | 150.0 | 62+50.0 | 64+00.0 | 192.40 | 192.76 | 210.70 | " |
| END TRANSITION STR. | 11 | 3300 | 20.0 | 64+00.0 | 64+20.0 | 192.76 | 192.81 | 210.70 | 2– 16' x 10' |
| PINCHOT | 12 | 3300 | 680.0 | 64+20.0 | 71+00.0 | 192.81 | 194.44 | 213.00 | " |
| EARLL / GRADE BREAK | 13 | 3300 | 400.0 | 71+00.0 | 75+00.0 | 194.44 | 195.40 | 213.68 | " |
| BEGIN TRANSITION STR. | 14 | 2500 | 50.0 | 75+00.0 | 75+50.0 | 195.40 | 195.63 | 213.60 | " |
| END TRANSITION STR. | 15 | 2500 | 40.0 | 75+50.0 | 75+90.0 | 195.63 | 195.81 | 213.70 | 2– 12' x 10' |
| BEGIN TRANSITION STR. | 16 | 2500 | 50.0 | 75+90.0 | 76+40.0 | 195.81 | 196.04 | 213.70 | " |
| END TRANSITION STR. | 17 | 2500 | 20.0 | 76+40.0 | 76+60.0 | 196.04 | 196.14 | 213.70 | 2– 10' x 10' |
| RICHARDSON | 18 | 2500 | 590.0 | 76+60.0 | 82+50.0 | 196.14 | 198.85 | 218.72 | " |
| OSBORN | 19 | 2300 | 690.0 | 82+50.0 | 89+40.0 | 198.85 | 202.02 | 222.05 | " |
| BEGIN TRANSITION STR. | 20 | 2300 | 10.0 | 89+40.0 | 89+50.0 | 202.02 | 202.07 | 222.05 | " |
| END TRANSITION STR. | 21 | 2300 | 25.0 | 89+50.0 | 89+75.0 | 202.07 | 202.19 | 222.05 | 1–16' x 10' |
| WHITTON | 22 | 2270 | 605.0 | 89+75.0 | 95+80.0 | 202.19 | 204.97 | 227.17 | " |
| BEGIN TRANSITION STR. | 23 | 2270 | 20.0 | 95+80.0 | 96+00.0 | 204.97 | 205.06 | 227.17 | " |
| END TRANSITION STR. | 24 | 2270 | 10.0 | 96+00.0 | 96+10.0 | 205.06 | 205.11 | 227.17 | 1–14' x 10' |
| GRADE BREAK | 25 | 2270 | 90.0 | 96+10.0 | 97+00.0 | 205.11 | 205.52 | 228.30 | " |
| WELDON | 26 | 1700 | 270.0 | 97+00.0 | 99+70.0 | 205.52 | 207.84 | 230.00 | " |
| BEGIN TRANSITION STR. | 27 | 1700 | 30.0 | 99+70.0 | 100+00.0 | 207.84 | 208.10 | 230.00 | " |
| END TRANSITION STR. | 28 | 1700 | 10.0 | 100+00.0 | 100+10.0 | 208.10 | 208.19 | 230.00 | 1–12' x 10' |
| INDIAN SCHOOL | 29 | 1700 | 1540.0 | 100+10.0 | 115+50.0 | 208.19 | 221.43 | 243.31 | " |
| ARIZONA CANAL | 30 | 1700 | 680.0 | 115+50.0 | 122+30.0 | 221.43 | 227.28 | 252.50 | " |

NOTE: 1. THE DISCHARGES ARE 100–YEAR EXISTING WITHOUT 10–YEAR LID.
2. CULVERT SIZES ARE MODIFIED FROM TABLE 4 TO ACCOMMODATE LOCAL INFLOWS FOR THIS STORM.

TABLE 13

# STORM INPUT TABLE FOR DROP INLETS



| STREET NAME/ STRUCTURE NAME | MAINLINE LINE NO. | DOWNSTREAM INLET STATION | UPSTREAM INLET STATION | INLET LOSS COEFFICENT | TRANSITION LOSS COEFFICENT | GRATE INLET DISCHARGE | UPSTREAM HYDRAULIC GRADE LINE | UPSTREAM ENERGY GRADE LINE | MAINLINE TOP OF GROUND AT UPSTREAM |
|---|---|---|---|---|---|---|---|---|---|
| McDOWELL | 2 | 10+30.0 | 10+67.0 | 0.13 | N/A | 97 | 195.63 | 197.65 | 193.00 |
| GRANADA | 3 | 10+67.0 | 19+60.0 | 0.13 | " | 80 | 198.06 | 200.05 | 203.48 |
| HOLLY | 4 | 19+60.0 | 26+50.0 | 0.13 | " | 81 | 200.00 | 202.02 | 203.97 |
| OAK | 5 | 26+50.0 | 36+25.0 | 0.55 | " | 806 | 202.62 | 204.64 | 205.49 |
| VIRGINIA | 6 | 36+25.0 | 49+75.0 | 0.55 | " | 333 | 207.01 | 209.03 | 207.06 |
| N. of VIRGINIA | 7 | 49+75.0 | 54+70.0 | 0.13 | " | 7 | 209.38 | 210.93 | 207.00 |
| WINDSOR | 8 | 54+70.0 | 56+50.0 | 0.13 | " | 60 | 209.92 | 211.47 | 207.41 |
| THOMAS | 9 | 56+50.0 | 62+50.0 | 0.13 | " | 156 | 211.23 | 212.78 | 210.74 |
| BEGIN TRANSITION STR. | 10 | 62+50.0 | 64+00.0 | N/A | 0.01 | N/A | 211.91 | 213.22 | 210.70 |
| END TRANSITION STR. | 11 | 64+00.0 | 64+20.0 | " | N/A | N/A | 211.61 | 213.26 | 210.70 |
| PINCHOT | 12 | 64+20.0 | 71+00.0 | 0.13 | " | 20 | 213.04 | 214.69 | 213.00 |
| EARLL / GRADE BREAK | 13 | 71+00.0 | 75+00.0 | 1.56 | " | 1055 | 214.10 | 215.75 | 213.68 |
| BEGIN TRANSITION STR. | 14 | 75+00.0 | 75+50.0 | N/A | 0.02 | N/A | 216.47 | 217.41 | 213.60 |
| END TRANSITION STR. | 15 | 75+50.0 | 75+90.0 | " | N/A | N/A | 215.85 | 217.53 | 213.70 |
| BEGIN TRANSITION STR. | 16 | 75+90.0 | 76+40.0 | " | 0.01 | N/A | 215.99 | 217.67 | 213.70 |
| END TRANSITION STR. | 17 | 76+40.0 | 76+60.0 | " | N/A | N/A | 215.34 | 217.77 | 213.70 |
| RICHARDSON | 18 | 76+60.0 | 82+50.0 | 0.13 | " | 35 | 217.75 | 220.18 | 218.72 |
| OSBORN | 19 | 82+50.0 | 89+40.0 | 0.48 | " | 235 | 220.78 | 222.83 | 222.05 |
| BEGIN TRANSITION STR. | 20 | 89+40.0 | 89+50.0 | N/A | 0.01 | N/A | 221.80 | 223.85 | 222.05 |
| END TRANSITION STR. | 21 | 89+50.0 | 89+75.0 | " | N/A | N/A | 220.82 | 224.04 | 222.05 |
| WHITTON | 22 | 89+75.0 | 95+80.0 | 0.13 | " | 9 | 224.71 | 227.84 | 227.17 |
| BEGIN TRANSITION STR. | 23 | 95+80.0 | 96+00.0 | N/A | 0.01 | N/A | 225.21 | 228.34 | 227.17 |
| END TRANSITION STR. | 24 | 96+00.0 | 96+10.0 | " | N/A | N/A | 224.34 | 228.42 | 227.17 |
| GRADE BREAK | 25 | 96+10.0 | 97+00.0 | " | " | N/A | 225.15 | 229.23 | 228.30 |
| WELDON | 26 | 97+00.0 | 99+70.0 | 0.13 | " | 74 | 230.08 | 232.35 | 230.00 |
| BEGIN TRANSITION STR. | 27 | 99+70.0 | 100+00.0 | N/A | 0.01 | N/A | 230.55 | 232.82 | 230.00 |
| END TRANSITION STR. | 28 | 100+00.0 | 100+10.0 | " | N/A | N/A | 229.81 | 232.94 | 230.00 |
| INDIAN SCHOOL | 29 | 100+10.0 | 115+50.0 | 0.13 | " | 21 | 241.67 | 244.80 | 243.31 |
| ARIZONA CANAL | 30 | 115+50.0 | 122+30.0 | N/A | " | N/A | 247.28 | 250.41 | 252.50 |

TABLE 14

48TH STREET WEST GUTTER ELEVATION TO SURFACE FEATURE INVERT ELEVATION & EAST BANK TOP ELEVATION

| STATION | 48TH STREET WEST GUTTER ELEVATION | MODEL 1 EAST BANK ELEVATION | MODEL 1 SURFACE FEATURE INVERT ELEVATION | MODEL 3 EAST BANK ELEVATION | MODEL 3 SURFACE FEATURE INVERT ELEVATION | MODEL 4 EAST BANK ELEVATION | MODEL 4 SURFACE FEATURE INVERT ELEVATION | MODEL 5 EAST BANK ELEVATION | MODEL 5 SURFACE FEATURE INVERT ELEVATION |
|---|---|---|---|---|---|---|---|---|---|
| 19+12 | 203.23 | 203.00 | 200.70 | 203.00 | 195.51 | 203.00 | 195.51 | 203.00 | 196.99 |
| 23+12 | 204.41 | 204.00 | 201.00 | 204.00 | 194.74 | 204.00 | 194.74 | 204.00 | 197.72 |
| 27+12 | 203.88 | 204.00 | 202.50 | 204.00 | 201.20 | 204.00 | 201.20 | 204.00 | 198.86 |
| 31+12 | 204.10 | 205.40 | 203.50 | 205.40 | 202.26 | 205.40 | 202.26 | 205.40 | 199.80 |
| 35+13 | 204.62 | 205.00 | 204.44 | 205.00 | 203.35 | 205.00 | 203.35 | 205.00 | 200.74 |
| 39+13 | 204.82 | 205.80 | 204.88 | 205.80 | 204.04 | 205.80 | 204.04 | 205.80 | 201.68 |
| 43+13 | 204.46 | 205.00 | 204.50 | 205.00 | 204.50 | 205.00 | 204.50 | 205.00 | 202.61 |
| 47+13 | 205.37 | 206.60 | 205.50 | 206.60 | 205.50 | 206.60 | 205.50 | 206.60 | 203.55 |
| 51+13 | 206.38 | | | 207.20 | 206.50 | 207.20 | 206.50 | 207.20 | 204.49 |
| 55+13 | 207.84 | | | 207.00 | 206.50 | 207.00 | 206.50 | 207.00 | 205.43 |
| 59+14 | 208.00 | | | 208.00 | 207.50 | 208.00 | 207.50 | 208.00 | 206.36 |
| 63+07 | 210.14 | | | 209.75 | 209.25 | 209.75 | 209.25 | 209.75 | 207.29 |
| 67+14 | 210.99 | | | 211.00 | 210.50 | 211.00 | 210.50 | 211.00 | 208.24 |
| 75+15 | 213.00 | | | 213.00 | 212.50 | 213.00 | 212.50 | 213.00 | 210.12 |
| 79+16 | 214.91 | | | 216.00 | 214.00 | | | 216.00 | 211.91 |
| 83+17 | 217.85 | | | 219.00 | 216.00 | | | 219.00 | 213.79 |
| 87+17 | 220.13 | | | 221.00 | 218.75 | | | 221.00 | 215.66 |
| 91+18 | 222.88 | | | 224.00 | 221.50 | | | 224.00 | 217.54 |
| 95+18 | 225.00 | | | 227.00 | 224.25 | | | 227.00 | 219.41 |
| 99+19 | 228.39 | | | 228.00 | 227.00 | | | 228.00 | 221.96 |
| 101+19 | 230.29 | | | 230.00 | 229.00 | | | 230.00 | 223.70 |
| 103+19 | 232.00 | | | 232.00 | 231.00 | | | 232.00 | 225.43 |
| 107+20 | 235.94 | | | 237.10 | 235.00 | | | 237.10 | 228.91 |
| 111+20 | 240.48 | | | 241.00 | 239.00 | | | 241.00 | 232.37 |
| 114+08 | 240.96 | | | 241.00 | 240.00 | | | 241.00 | 234.87 |
| 115+58 | 242.10 | | | 243.00 | 242.00 | | | 243.00 | 236.17 |
| 116+90 | 244.20 | | | 243.60 | 242.60 | | | 243.60 | 237.31 |

TABLE 15

# STORM INPUT TABLE FOR SIDE INLETS



| STREET NAME/ STRUCTURE NAME | MAINLINE LINE NUMBER | MAINLINE 2 DISCHARGE | MAINLINE REACH LENGTH | DOWNSTREAM GRATE STATION | UPSTREAM GRATE STATION | DOWNSTREAM INVERT ELEVATION | UPSTREAM INVERT ELEVATION | MAINLINE TOP OF GROUND AT UPSTREAM GRATE | MAINLINE STRUCTURE SIZE |
|---|---|---|---|---|---|---|---|---|---|
| McDOWELL | 2 | 4100 | 37.0 | 10+30 | 10+67 | 179.92 | 179.96 | 193.00 | 2–18'x10' |
| GRANADA | 3 | 4100 | 893.0 | 10+67 | 19+60 | 179.96 | 182.10 | 203.48 | " |
| HOLLY | 4 | 4100 | 690.0 | 19+60 | 26+50 | 182.10 | 183.76 | 203.97 | " |
| OAK | 5 | 4100 | 975.0 | 26+50 | 36+25 | 183.76 | 186.10 | 205.49 | " |
| VIRGINIA | 6 | 4100 | 1350.0 | 36+25 | 49+75 | 186.10 | 189.34 | 207.06 | " |
| N. of VIRGINIA | 7 | 3600 | 495.0 | 49+75 | 54+70 | 189.34 | 190.53 | 207.00 | " |
| WINDSOR | 8 | 3600 | 180.0 | 54+70 | 56+50 | 190.53 | 190.96 | 207.41 | " |
| THOMAS | 9 | 3600 | 600.0 | 56+50 | 62+50 | 190.96 | 192.40 | 210.74 | " |
| BEGIN TRANSITION STR. | 10 | 3300 | 150.0 | 62+50 | 64+00 | 192.40 | 192.76 | 210.70 | " |
| END TRANSITION STR. | 11 | 3300 | 20.0 | 64+00 | 64+20 | 192.76 | 192.81 | 210.70 | 2– 16' x 10' |
| PINCHOT | 12 | 3300 | 690.0 | 64+20 | 71+00 | 192.81 | 194.44 | 213.00 | " |
| EARLL / GRADE BREAK | 13 | 3300 | 400.0 | 71+00 | 75+00 | 194.44 | 195.40 | 213.68 | " |
| BEGIN TRANSITION STR. | 14 | 2500 | 50.0 | 75+00 | 75+50 | 195.40 | 195.63 | 213.60 | " |
| END TRANSITION STR. | 15 | 2500 | 40.0 | 75+50 | 75+90 | 195.63 | 195.81 | 213.70 | 2– 12' x 10' |
| BEGIN TRANSITION STR. | 16 | 2500 | 50.0 | 75+90 | 76+40 | 195.81 | 196.04 | 213.70 | " |
| END TRANSITION STR. | 17 | 2500 | 20.0 | 76+40 | 76+60 | 196.04 | 196.14 | 213.70 | 2– 10' x 10' |
| RICHARDSON | 18 | 2500 | 590.0 | 76+60 | 82+50 | 196.14 | 198.85 | 218.72 | " |
| OSBORN | 19 | 2300 | 690.0 | 82+50 | 89+40 | 198.85 | 202.02 | 222.05 | " |
| BEGIN TRANSITION STR. | 20 | 2300 | 10.0 | 89+40 | 89+50 | 202.02 | 202.07 | 222.05 | " |
| END TRANSITION STR. | 21 | 2300 | 25.0 | 89+50 | 89+75 | 202.07 | 202.19 | 222.05 | 1–16' x 10' |
| WHITTON | 22 | 2270 | 605.0 | 89+75 | 95+80 | 202.19 | 204.97 | 227.17 | " |
| BEGIN TRANSITION STR. | 23 | 2270 | 20.0 | 95+80 | 96+00 | 204.97 | 205.06 | 227.17 | " |
| END TRANSITION STR. | 24 | 2270 | 10.0 | 96+00 | 96+10 | 205.06 | 205.11 | 227.17 | 1–14' x 10' |
| GRADE BREAK | 25 | 2270 | 90.0 | 96+10 | 97+00 | 205.11 | 205.52 | 228.30 | " |
| WELDON | 26 | 1700 | 270.0 | 97+00 | 99+70 | 205.52 | 207.84 | 230.00 | " |
| BEGIN TRANSITION STR. | 27 | 1700 | 30.0 | 99+70 | 100+00 | 207.84 | 208.10 | 230.00 | " |
| END TRANSITION STR. | 28 | 1700 | 10.0 | 100+00 | 100+10 | 208.10 | 208.19 | 230.00 | 1–12' x 10' |
| INDIAN SCHOOL | 29 | 1700 | 1540.0 | 100+10 | 115+50 | 208.19 | 221.43 | 243.31 | " |
| ARIZONA CANAL | 30 | 1700 | 680.0 | 115+50 | 122+30 | 221.43 | 227.28 | 252.50 | " |

NOTE: 1. MAINLINE SIZE ADJUSTED FROM TABLE 4, "ADDENDUM BASE MODEL DESIGN," TO ACCOMMODATE THE HYDRAULIC GRADE LINE REQUIREMENTS (MODELS 1 & 3).
2: THE DISCHARGES ARE 100–YEAR EXISTING WITHOUT 10–YEAR LID.
3: THE LOSS COEFFICENTS WERE COMPUTED BASED ON HYDROLOGY TABLE 11B, THE CAPACITY OF THE PROPOSED CULVERT AND THE INLET'S DESIGN CAPACITY.

TABLE 15

# STORM INPUT TABLE FOR SIDE INLETS



| STREET NAME/ STRUCTURE NAME | MAINLINE LINE NUMBER | DOWNSTREAM MAINLINE GRATE STATION | UPSTREAM MAINLINE GRATE STATION | JUNCTION LOSS COEFFICIENT | TRANSITION LOSS COEFFICIENT | MAINLINE LINE NUMBER | LATERAL JUNCTION ANGLE TO MAINLINE | JUNCTION STRUCTURE LENGTH |
|---|---|---|---|---|---|---|---|---|
| McDOWELL | 2 | 10+30 | 10+67 | 0.04 | N/A | 3 | 68 | 4.9 |
| GRANADA | 3 | 10+67 | 19+60 | 0.03 | " | 4 | 90 | 4.0 |
| HOLLY | 4 | 19+60 | 26+50 | 0.03 | " | 5 | 90 | 4.0 |
| OAK | 5 | 26+50 | 36+25 | 0.17 | " | 6 | 45 | 28.3 |
| VIRGINIA | 6 | 36+25 | 49+75 | 0.10 | " | 7 | 45 | 14.1 |
| N. of VIRGINIA | 7 | 49+75 | 54+70 | 0.01 | " | 8 | 90 | 2.0 |
| WINDSOR | 8 | 54+70 | 56+50 | 0.02 | " | 9 | 45 | 5.0 |
| THOMAS | 9 | 56+50 | 62+50 | 0.04 | " | 10 | 45 | 7.1 |
| BEGIN TRANSITION STR. | 10 | 62+50 | 64+00 | N/A | 0.01 | 11 | N/A | N/A |
| END TRANSITION STR. | 11 | 64+00 | 64+20 | " | N/A | 12 | " | " |
| PINCHOT | 12 | 64+20 | 71+00 | 0.01 | " | 13 | 90 | 2.0 |
| EARLL / GRADE BREAK | 13 | 71+00 | 75+00 | 0.15 | " | 14 | 45 | 22.6 |
| BEGIN TRANSITION STR. | 14 | 75+00 | 75+50 | N/A | 0.02 | 15 | N/A | N/A |
| END TRANSITION STR. | 15 | 75+50 | 75+90 | " | N/A | 16 | " | " |
| BEGIN TRANSITION STR. | 16 | 75+90 | 76+40 | " | 0.01 | 17 | " | " |
| END TRANSITION STR. | 17 | 76+40 | 76+60 | " | N/A | 18 | " | " |
| RICHARDSON | 18 | 76+60 | 82+50 | 0.02 | " | 19 | 90 | 2.5 |
| OSBORN | 19 | 82+50 | 89+40 | 0.07 | " | 20 | 68 | 4.3 |
| BEGIN TRANSITION STR. | 20 | 89+40 | 89+50 | N/A | 0.01 | 21 | N/A | N/A |
| END TRANSITION STR. | 21 | 89+50 | 89+75 | " | N/A | 22 | " | " |
| WHITTON | 22 | 89+75 | 95+80 | 0.01 | " | 23 | 90 | 2.0 |
| BEGIN TRANSITION STR. | 23 | 95+80 | 96+00 | N/A | 0.01 | 24 | N/A | N/A |
| END TRANSITION STR. | 24 | 96+00 | 96+10 | " | N/A | 25 | " | " |
| GRADE BREAK | 25 | 96+10 | 97+00 | " | " | 26 | " | " |
| WELDON | 26 | 97+00 | 99+70 | 0.04 | " | 27 | 45 | 5.7 |
| BEGIN TRANSITION STR. | 27 | 99+70 | 100+00 | N/A | 0.01 | 28 | N/A | N/A |
| END TRANSITION STR. | 28 | 100+00 | 100+10 | " | N/A | 29 | " | " |
| INDIAN SCHOOL | 29 | 100+10 | 115+50 | 0.01 | " | 30 | 90 | 2.0 |
| ARIZONA CANAL | 30 | 115+50 | 122+30 | N/A | " | N/A | N/A | N/A |

TABLE 15

# STORM INPUT TABLE FOR SIDE INLETS



| STREET NAME/ STRUCTURE NAME | MAINLINE LINE NUMBER | LATERAL DISCHARGE | LATERAL REACH LENGTH | DOWNSTREAM LATERAL INVERT ELEVATION | UPSTREAM LATERAL INVERT ELEVATION | UPSTREAM MAINLINE HYDRAULIC GRADE LINE | UPSTREAM MAINLINE ENERGY GRADE LINE | LATERAL TOP OF GROUND AT UPSTREAM GRATE | LATERAL STRUCTURE |
|---|---|---|---|---|---|---|---|---|---|
| McDOWELL | 2 | 97 | 10.8 | 180.97 | 181.00 | 195.62 | 197.64 | 193.00 | 1-54" |
| GRANADA | 3 | 80 | 10.0 | 183.11 | 183.14 | 197.86 | 199.88 | 203.48 | 1-48" |
| HOLLY | 4 | 81 | 10.0 | 184.77 | 184.80 | 199.59 | 201.61 | 203.97 | 1-48" |
| OAK | 5 | 806 | 14.1 | 187.12 | 187.16 | 201.99 | 204.01 | 205.49 | 2-10'x7' |
| VIRGINIA | 6 | 333 | 14.1 | 190.35 | 190.39 | 205.57 | 207.59 | 207.06 | 1-10'x6' |
| N. of VIRGINIA | 7 | 7 | 10.0 | 191.16 | 191.19 | 207.14 | 208.69 | 207.00 | 1-24" |
| WINDSOR | 8 | 60 | 14.1 | 191.96 | 192.00 | 207.49 | 209.04 | 207.41 | 1-42" |
| THOMAS | 9 | 156 | 14.1 | 193.41 | 193.45 | 208.64 | 210.19 | 210.74 | 1-60" |
| BEGIN TRANSITION STR. | 10 | N/A | N/A | N/A | N/A | 209.19 | 210.50 | 210.70 | N/A |
| END TRANSITION STR. | 11 | N/A | N/A | N/A | N/A | 208.89 | 210.54 | 210.70 | N/A |
| PINCHOT | 12 | 20 | 10.0 | 195.44 | 195.47 | 210.32 | 211.97 | 213.00 | 1-24" |
| EARLL / GRADE BREAK | 13 | 1055 | 14.1 | 196.44 | 196.48 | 211.16 | 212.81 | 213.68 | 2-8'x7' |
| BEGIN TRANSITION STR. | 14 | N/A | N/A | N/A | N/A | 212.18 | 213.12 | 213.60 | N/A |
| END TRANSITION STR. | 15 | N/A | N/A | N/A | N/A | 211.56 | 213.24 | 213.70 | N/A |
| BEGIN TRANSITION STR. | 16 | N/A | N/A | N/A | N/A | 211.70 | 213.38 | 213.70 | N/A |
| END TRANSITION STR. | 17 | N/A | N/A | N/A | N/A | 211.05 | 213.48 | 213.70 | N/A |
| RICHARDSON | 18 | 35 | 10.0 | 199.86 | 199.89 | 213.46 | 215.89 | 218.72 | 1-30" |
| OSBORN | 19 | 235 | 10.8 | 203.03 | 203.06 | 216.25 | 218.30 | 222.05 | 1-48" |
| BEGIN TRANSITION STR. | 20 | N/A | N/A | N/A | N/A | 216.45 | 218.50 | 222.05 | N/A |
| END TRANSITION STR. | 21 | N/A | N/A | N/A | N/A | 215.46 | 218.68 | 222.05 | N/A |
| WHITTON | 22 | 9 | 10.0 | 205.97 | 206.00 | 219.35 | 222.48 | 227.17 | 1-24" |
| BEGIN TRANSITION STR. | 23 | N/A | N/A | N/A | N/A | 219.53 | 222.66 | 227.17 | N/A |
| END TRANSITION STR. | 24 | N/A | N/A | N/A | N/A | 218.67 | 222.75 | 227.17 | N/A |
| GRADE BREAK | 25 | N/A | N/A | N/A | N/A | 219.47 | 223.55 | 228.30 | N/A |
| WELDON | 26 | 74 | 14.1 | 208.88 | 208.92 | 224.39 | 226.66 | 230.00 | 1-48" |
| BEGIN TRANSITION STR. | 27 | N/A | N/A | N/A | N/A | 224.65 | 226.92 | 230.00 | N/A |
| END TRANSITION STR. | 28 | N/A | N/A | N/A | N/A | 223.90 | 227.03 | 230.00 | N/A |
| INDIAN SCHOOL | 29 | 21 | 10.0 | 222.44 | 222.47 | 235.76 | 238.89 | 243.31 | 1-24" |
| ARIZONA CANAL | 30 | N/A | N/A | N/A | N/A | 241.02 | 244.15 | 252.50 | N/A |

TABLE 16

MCDOWELL RD. CULVERT OUTLET DROP ANALYSIS

| STATION | PRE–ADOT DROP CWSEL | REV. ADOT DROP CWSEL | ADOT NO–DROP CWSEL |
|---|---|---|---|
| 0 | 183.7 | 183.7 | 183.7 |
| 384 | 185.56 | 185.56 | 185.56 |
| 434 | 186.04 | 186.04 | 186.04 |
| 484 | 187.88 | 186.34 | 186.83 |
| 534 | 193.71 | 194.47 | N/A |
| 584 | 193.83 | 194.54 | N/A |
| 634 | 193.93 | 194.61 | N/A |
| 684 | 194.11 | 194.66 | 195.19 |
| 725 | 194.18 | 194.67 | N/A |
| 726 | 193.79 | 194.41 | 195.03 |
| 1000 | 196.01 | 196.26 | 196.64 |
| 1110 | 196.6 | 196.82 | 197.16 |

NOTE: 1. DISCHARGE IS 4,710 cfs

2. ADDITONAL SECTIONS WERE PUT INTO THE TWO HEC–2 FILES WHICH MODEL THE DROPS. THE FILE, "ADOT NO–DROP", WHICH DOES NOT MODEL A DROP, DOES NOT HAVE THESE CROSS–SECTIONS. THE TABLE SHOWS AN "N/A" ENTRY FOR THE CWSEL FOR THESE CROSS SECTIONS.

3. THE COLUMN TITLED "PRE–ADOT DROP" HAS A 7' DROP AT THE OUTLET OF THE McDOWELL ROAD BRIDGE. THIS DROP REPRESENTS THE DROP FOR THE PRE – McDOWELL ROAD CULVERT CONDITIONS.

4. THE COLUMN TITLED "REV. ADOT DROP" HAS A 3.5' DROP AT THE OUTLET OF THE McDOWELL ROAD BRIDGE. THIS DROP REPRESENTS WHAT COULD BE CONSTRUCTED AT THE OUTLET OF THE McDOWELL ROAD BRIDGE AND STILL PROVIDE A UNIFORM GRADIENT IN THE DOWNSTREAM DIRECTION.

# APPENDIX B

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS COMMON TO ALL MODELS**

MAY 14, 1993

FN: COMNCOST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | COST |
|---|---|---|---|---|---|
| 201 | REMOVE TREES (12" OR LARGER) | EA. | 23 | $250.00 | $5,750 |
| 301 | SUBGRADE PREPARATION UNDER PAVEMENT *1 | S.Y. | 1,486 | $4.00 | $5,944 |
| 310–1 | AGGREGATE BASE COURSE *1 | TON | 271 | $15.00 | $4,065 |
| 310–2 | SELECT MATERIAL *1 | TON | 84 | $15.00 | $1,260 |
| 316 | NEW SHOTCRETE LINING (6") | S.Y. | 185 | $25.00 | $4,625 |
| 321–1 | ASPHALT CONCRETE PAVEMENT D (1/2) *1 | TON | 83 | $30.00 | $2,490 |
| 321–2 | ASPHALT CONCRETE PAVEMENT C (3/4) *1 | TON | 535 | $25.00 | $13,375 |
| 321–3 | A.C. SINGLE CURB | L.F. | 2,338 | $4.00 | $9,352 |
| 340–1 | CONC. CURB & GUTTER STD. DET. 220, TYPE A | L.F. | 359 | $8.00 | $2,872 |
| 340–2 | CONC. SIDEWALK C.O.P. DET. P–1230 | S.F. | 1,173 | $2.00 | $2,346 |
| 340–3 | CONC. DRIVEWAY C.O.P. DET P–1255 | S.F. | 80 | $3.00 | $240 |
| 340–4 | CONC. SIDEWALK RAMP C.O.P. DET P–1233, TYPE A | EA. | 1 | $300.00 | $300 |
| 340–5 | CONC. SIDEWALK RAMP C.O.P. DET P–1234, TYPE B | EA. | 1 | $300.00 | $300 |
| 350–1 | REMOVE WINGWALL @ MCDOWELL RD. | L.S. | 1 | $2,000.00 | $2,000 |
| 350–2 | REMOVE SHOTCRETE | S.Y. | 3,663 | $1.00 | $3,663 |
| 350–3 | REMOVE CONCRETE | S.F. | 840 | $4.00 | $3,360 |
| 350–4 | REMOVE GUARDRAIL | L.F. | 790 | $5.00 | $3,950 |
| 350–5 | REMOVE HANDRAIL | L.F. | 35 | $5.00 | $175 |
| 350–6 | REMOVE SIGNS, ROAD MARKERS, GUARD POSTS, AND BARRICADES | L.S. | 1 | $2,000.00 | $2,000 |
| 350–7 | REMOVE & REPLACE EXIST. WOOD FENCE | L.F. | 729 | $8.00 | $5,832 |
| 350–8 | REMOVE IRR. STAND PIPE | EA. | 1 | $50.00 | $50 |
| 350–9 | REMOVE DROP STRUCTURE, HDWALLS, & PED. CROSSING | L.S. | 1 | $20,000.00 | $20,000 |
| 350–10 | REMOVE CHAIN LINK FENCE | L.F. | 551 | $5.00 | $2,755 |
| 350–11 | REMOVE PIPE | L.F. | 510 | $6.00 | $3,060 |
| 350–12 | REMOVE A.C. BIKE PATH | S.Y. | 156 | $1.00 | $156 |
| 350–13 | REMOVE BOX CULVERTS, HDWALLS, WINGWALLS,& RETAINING STR. | | | | |
| | INDIAN SCHOOL | L.S. | 1 | $20,000.00 | $20,000 |
| | THOMAS ROAD | L.S. | 1 | $20,000.00 | $20,000 |
| | OSBORN ROAD | L.S. | 1 | $20,000.00 | $20,000 |
| 350–14 | REMOVE CURB & GUTTER | L.F. | 359 | $2.00 | $718 |

*1 PAVEMENT RECONSTRUCTION ITEMS AT INTERSECTIONS.

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS COMMON TO ALL MODELS**

MAY 14, 1993

FN: COMNCOST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | COST |
|---|---|---|---|---|---|
| 350–15 | REMOVE CONC. SIDEWALK, DRIVEWAY, VALLEY GUTTER, AND SLAB | S.F. | 1,520 | $1.00 | $1,520 |
| 350–16 | REMOVE A.C. PAVEMENT | S.Y. | 2,284 | $2.00 | $4,568 |
| 350–17 | REMOVE ELECTRIC J–BOX | EA. | 4 | $50.00 | $200 |
| 350–18 | REMOVE ELECT. CONDUIT & WIRE | L.F. | 217 | $1.00 | $217 |
| 350–19 | REMOVE AND REPLACE CHAIN LINK FENCE | L.F. | 76 | $9.00 | $684 |
| 350–20 | REMOVE SD OUTLET STRUCT. @ EARLL ST. (54" ENERGY DISSAPATOR HDWALL) | EA. | 1 | $500.00 | $500 |
| 350–21 | REMOVE HDWALL (10" IRR.) | EA. | 1 | $100.00 | $100 |
| 350–23 | REMOVE A.C. CURB | L.F. | 2,339 | $1.00 | $2,339 |
| 350–24 | REMOVE AND REPLACE DETECTOR LOOPS | EA. | 1 | $100.00 | $100 |
| 401–1 | RELOCATE TRAFFIC SIGNAL POLES | EA. | 6 | $3,000.00 | $18,000 |
| 401–2 | RELOCATE JOINT USE POLES (12kv AND TRAFFIC SIGNAL) | EA. | 1 | $10,000.00 | $10,000 |
| 405 | SURVEY MONUMENT STD. DET. 120–1, TYPE A | EA. | 4 | $250.00 | $1,000 |
| 401–3 | TRAFFIC CONTROL | L.S. | 1 | $60,000.00 | $60,000 |
| 410–3 | RELOCATE SAFETY CURBS | EA. | 9 | $5.00 | $45 |
| 505–1 | ACCESS RAMP | L.S. | 1 | $140,000.00 | $140,000 |
| 601–1 | RELOCATE/PROTECT–IN–PLACE 8" W | L.F. | 60 | $60.00 | $3,600 |
| 601–2 | RELOCATE/PROTECT–IN–PLACE 12" W | L.F. | 60 | $80.00 | $4,800 |
| 601–3 | PROTECT–IN–PLACE TELE. DUCT BANK CANTENARY SUPPORT TYPE SYSTEM | EA. | 2 | $50,000.00 | $100,000 |
| 610–1 | RELOCATE 6" WATER | L.F. | 141 | $30.00 | $4,230 |
| 610–2 | RELOCATE 8" WATER D.I.P. | L.F. | 325 | $40.00 | $13,000 |
| 610–3 | RELOCATE WATER SERVICE | L.F. | 220 | $15.00 | $3,300 |
| 610–4 | RELOCATE 12" WATER | L.S. | 1 | $12,000.00 | $12,000 |
| 610–5 | RELOCATE 24" IRR. SIPHON CROSSING | L.S. | 1 | $16,000.00 | $16,000 |
| 610–6 | RELOCATE 45" WATER | L.S. | 1 | $70,000.00 | $70,000 |
| 610–7 | RELOCATE 54" WATER | L.S. | 1 | $80,000.00 | $80,000 |
| 610–8 | RELOCATE FIRE HYDRANT | EA. | 1 | $900.00 | $900 |
| 610–9 | RETROFIT JOINT RESTRAINT–54" WATER | L.S. | 1 | $10,000.00 | $10,000 |
| 618–1 | INSTALL 12" RGRCP | L.F. | 115 | $35.00 | $4,025 |
| 618–2 | INSTALL 15" RGRCP | L.F. | 24 | $38.00 | $912 |

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS COMMON TO ALL MODELS**

MAY 14, 1993

FN: COMNCOST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | COST |
|---|---|---|---|---|---|
| 618–3 | INSTALL 24" RGRCP | L.F. | 84 | $50.00 | $4,200 |
| 618–4 | INSTALL 33" RGRCP | L.F. | 10 | $73.00 | $730 |
| 619 | PIPE PLUG STD. DET. 427 | EA. | 5 | $160.00 | $800 |
| 622 | 33" FLAP GATE | EA. | 1 | $1,500.00 | $1,500 |
| 625–1 | ACCESS MANHOLE | EA. | 21 | $5,000.00 | $105,000 |
| 625–2 | NEW IRR. STAND PIPE (STD. DET. 503, TYPE A) | EA. | 1 | $600.00 | $600 |
| | INSTALL NEW ELECTRIC J–BOX | EA. | 4 | $500.00 | $2,000 |
| | NEW 2" CONDUIT FOR TRAFFIC SIGNAL | L.F. | 217 | $6.00 | $1,302 |
| | NEW GUARD RAIL –ADOT STD DET. C–10 SERIES | L.F. | 30 | $12.00 | $360 |
| | NEW CONCRETE HEADWALL (NORTH OF INDIAN SCHOOL ROAD) | EA. | 1 | $7,000.00 | $7,000 |
| | UTILITY RELOCATIONS – S.W. GAS, CATV, SRP POWER & U.S. WEST | L.S. | 1 | $500,000.00 | $500,000 |
| | CITY OF PHOENIX – SEWER & MISC. WATER RELOCATIONS | L.S. | 1 | $300,000.00 | $300,000 |
| | | | | TOTAL = | $1,646,170.00 |
| | SHORING (REQUIRED IF OTHER OPTIONS ARE NOT VIABLE) | L.F. | 4100 | $439.00 (AVE.) | $1,800,000 |

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS SPECIFIC TO MODEL – 1**

MAY 14, 1993

FN: MDL1COST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | | COST | |
|---|---|---|---|---|---|---|---|
| 206-1 | EXCAVATION FOR SURFACE FEATURE *1 | C.Y. | 980 | $3.00 | | $2,940 | |
| 206-2 | STRUCTURAL EXCAVATION | C.Y. | 183,000 | $3.50 | | $640,500 | |
| 206-3 | STRUCTURAL EXCAVATION-EXPORT | C.Y. | 31,400 | $8.00 | | $251,200 | |
| 206-4 | STRUCTURAL BACKFILL | C.Y. | 48,200 | $10.00 | | $482,000 | |
| 211 | FILL CONSTRUCTION | C.Y. | 174,400 | $3.50 | | $610,400 | |
| 215 | SURFACE GRADING FOR INLETS (NO SURFACE FEATURE 47+13 TO 115+50) | L.S. | 1 | $50,000.00 | | $50,000 | ? |
| 321 | A.C. PAVEMENT REPLACEMENT | S.Y. | 3,620 | $20.00 | | $72,400 | |
| 340 | CONC. BIKE PATH REPLACEMENT | S.F. | 9,330 | $2.00 | | $18,660 | |
| 601-4 | BEDDING MATERIAL FOR BOX CULVERT | TON | 34,500 | $12.00 | | $414,000 | |
| 610-1 | RELOCATE 48" WATERLINE *2 | L.F. | 1650 | $230.00 | | $379,500 | |
| 610-2 | RELOCATE 54" WATERLINE *2 | L.F. | 1320 | $250.00 | | $330,000 | |
| 610-3 | REMOVE, PROTECT, OR RELOCATE *2 MISCELLANEOUS UTILITIES | L.S. | 1 | $130,000.00 | | $130,000 | |
| 618-1 | DROP INLETS *3 | L.S. | 1 | $115,000.00 | | $115,000 | |
| 618-2 | DOUBLE 18'x 10' CONC. BOX CULVERT *4 | L.F. | 5,400 | $1,500.00 | ($1480.00) | $8,100,000 | ($7,992,000) |
| 618-3 | DOUBLE 16'x 10' CONC. BOX CULVERT *4 | L.F. | 1,200 | $1,270.00 | ($1220.00) | $1,524,000 | ($1,464,000) |
| 618-4 | DOUBLE 12'x 10' CONC. BOX CULVERT *4 | L.F. | 650 | $800.00 | ($810.00) | $520,000 | ($562,000) |
| 618-5 | DOUBLE 10'x 10' CONC. BOX CULVERT *4 | L.F. | 700 | $630.00 | ($610.00) | $441,000 | ($427,000) |
| 618-6 | SINGLE 16'x 10' CONC. BOX CULVERT *4 | L.F. | 750 | $570.00 | ($600.00) | $427,500 | ($450,000) |
| 618-7 | SINGLE 14'x 10' CONC. BOX CULVERT *4 | L.F. | 1,850 | $535.00 | ($510.00) | $989,750 | ($943,500) |
| 618-8 | SINGLE 12'x 10' CONC. BOX CULVERT *4 | L.F. | 200 | $470.00 | ($410.00) | $94,000 | ($82,000) |
| 618-9 | ADDITIONAL CONC. TO COUNTER BOUYANCY | C.Y. | 475 | $180.00 | | $85,500 | |
| | | | | TOTAL = | | $15,678,350 | ($15,509,700) |

*1 EXCAVATION BEYOND WHAT IS REQUIRED FOR THE BOX CULVERT CONSTRUCTION.
*2 SURFACE FEATURE IMPACTS TO UTILITIES BASED ON COVER REDUCTION ZONES.
*3 IF SIDE INLETS WITH CONNECTOR PIPES ARE USED, THE ESTIMATED COST IS $355,000.
*4 ESTIMATES ARE BASED ON CAST-IN-PLACE CONSTRUCTION. ESTIMATES SHOWN IN PARENTHESIS ARE FOR PRECAST CULVERTS.

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS SPECIFIC TO MODEL – 3**

MAY 14, 1993

FN: MDL3COST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | | COST | |
|---|---|---|---|---|---|---|---|
| 206–1 | EXCAVATION FOR SURFACE FEATURE *1 | C.Y. | 24,770 | $3.00 | | $74,310 | |
| 206–2 | STRUCTURAL EXCAVATION | C.Y. | 183,000 | $3.50 | | $640,500 | |
| 206–3 | STRUCTURAL EXCAVATION–EXPORT | C.Y. | 31,400 | $8.00 | | $251,200 | |
| 206–4 | STRUCTURAL BACKFILL | C.Y. | 48,200 | $10.00 | | $482,000 | |
| 211 | FILL CONSTRUCTION | C.Y. | 128,000 | $3.50 | | $448,000 | |
| 321 | A.C. PAVEMENT REPLACEMENT | S.Y. | 24,950 | $20.00 | | $499,000 | |
| 340 | CONC BIKE PATH REPLACEMENT | S.F. | 37,650 | $2.00 | | $75,300 | |
| 601–4 | BEDDING MATERIAL FOR BOX CULVERT | TON | 34,500 | $12.00 | | $414,000 | |
| 610–1 | RELOCATE 48" WATERLINE *2 | L.F. | 4,250 | $230.00 | | $977,500 | |
| 610–2 | RELOCATE 54" WATERLINE *2 | L.F. | 2560 | $250.00 | | $640,000 | |
| 610–3 | RELOCATE 8" H.P. GAS *2 | L.F. | 2170 | $40.00 | | $86,800 | |
| 610–4 | REMOVE, PROTECT, OR RELOCATE *2 MISCELLANEOUS UTILITIES | L.S. | 1 | $760,000.00 | | $760,000 | |
| 618–1 | DROP INLETS *3 | L.S. | 1 | $70,000.00 | | $70,000 | |
| 618–2 | DOUBLE 18'x 10' CONC. BOX CULVERT *4 | L.F. | 5,400 | $1,500.00 | ($1480.00) | $8,100,000 | ($7,992,000) |
| 618–3 | DOUBLE 16'x 10' CONC. BOX CULVERT *4 | L.F. | 1,200 | $1,270.00 | ($1220.00) | $1,524,000 | ($1,464,000) |
| 618–4 | DOUBLE 12'x 10' CONC. BOX CULVERT *4 | L.F. | 650 | $800.00 | ($810.00) | $520,000 | ($526,500) |
| 618–5 | DOUBLE 10'x 10' CONC. BOX CULVERT *4 | L.F. | 700 | $630.00 | ($610.00) | $441,000 | ($427,000) |
| 618–6 | SINGLE 16'x 10' CONC. BOX CULVERT *4 | L.F. | 750 | $570.00 | ($600.00) | $427,500 | ($450,000) |
| 618–7 | SINGLE 14'x 10' CONC. BOX CULVERT *4 | L.F. | 1,850 | $535.00 | ($510.00) | $989,750 | ($943,500) |
| 618–8 | SINGLE 12'x 10' CONC. BOX CULVERT *4 | L.F. | 200 | $470.00 | ($410.00) | $94,000 | ($82,000) |
| 618–9 | ADDITIONAL CONCRETE TO COUNTER BOUYANCY | C.Y. | 3011 | $180.00 | | $541,980 | |
| | | | | TOTAL = | | $18,056,840 | ($17,845,590) |

$12,096,500

*1 EXCAVATION BEYOND WHAT IS REQUIRED FOR THE BOX CULVERT CONSTRUCTION.
*2 SURFACE FEATURE IMPACTS TO UTILITIES BASED ON COVER REDUCTION ZONES.

OLD CROSS CUT CANAL – DESIGN REPORT ADDENDUM COST ESTIMATE

**CONSTRUCTION ITEMS SPECIFIC TO MODEL – 4**

MAY 14, 1993

FN: MDL4COST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | | COST | |
|---|---|---|---|---|---|---|---|
| 206–1 | EXCAVATION FOR SURFACE FEATURE *1 | C.Y. | 14,190 | $3.00 | | $42,570 | |
| 206–2 | STRUCTURAL EXCAVATION | C.Y. | 183,000 | $3.50 | | $640,500 | |
| 206–3 | STRUCTURAL EXCAVATION–EXPORT | C.Y. | 54,700 | $8.00 | | $437,600 | |
| 206–4 | STRUCTURAL BACKFILL | C.Y. | 48,200 | $10.00 | | $482,000 | |
| 211 | FILL CONSTRUCTION | C.Y. | 183,000 | $3.50 | | $640,500 | |
| 215 | SURFACE GRADING FOR INLETS (NO SURFACE FEATURE 75+15 TO 115+50) | L.S. | 1 | $30,000.00 | | $30,000 | |
| 321 | A.C. PAVEMENT REPLACEMENT | S.Y. | 9,200 | $20.00 | | $184,000 | |
| 340 | CONC. BIKE PATH REPLACEMENT | S.F. | 23,900 | $2.00 | | $47,800 | |
| 601–4 | BEDDING MATERIAL FOR BOX CULVERT | TON | 37,400 | $12.00 | | $448,800 | |
| 610–1 | RELOCATE 48" WATERLINE *2 | L.F. | 2,650 | $230.00 | | $609,500 | |
| 610–2 | RELOCATE 54" WATERLINE *2 | L.F. | 2320 | $250.00 | | $580,000 | |
| 610–3 | REMOVE, PROTECT, OR RELOCATE *2 MISCELLANEOUS UTILITIES | L.S. | 1 | $295,000.00 | | $295,000 | |
| 618–1 | DROP INLETS *3 | L.S. | 1 | $100,000.00 | | $100,000 | |
| 618–2 | DOUBLE 18'x 10' CONC. BOX CULVERT *4 | L.F. | 6,500 | $1,500.00 | ($1480.00) | $9,750,000 | ($9,620,000) |
| 618–3 | DOUBLE 12'x 10' CONC. BOX CULVERT *4 | L.F. | 3,700 | $800.00 | ($810.00) | $2,960,000 | ($2,997,000) |
| 618–4 | DOUBLE 10'x 10' CONC. BOX CULVERT *4 | L.F. | 550 | $630.00 | ($610.00) | $346,500 | ($335,500) |
| 618–5 | ADDITIONAL CONCRETE TO COUNTER BOUYANCY | C.Y. | 2,377 | $180.00 | | $427,860 | |
| | | | | TOTAL = | | $18,022,630 | ($17,918,630) |

$13,056,500

*1 EXCAVATION BEYOND WHAT IS REQUIRED FOR THE BOX CULVERT CONSTRUCTION.
*2 SURFACE FEATURE IMPACTS TO UTILITIES BASED ON COVER REDUCTION ZONES.
*3 IF SIDE INLETS WITH CONNECTOR PIPES ARE USED, THE ESTIMATED COST IS $355,000.

OLD CROSS CUT CANAL – PRELIMINARY STUDY PHASE COST ESTIMATE

**CONSTRUCTION ITEMS SPECIFIC TO MODEL – 5**

MAY 14, 1993

FN: MDL5COST.WK1

| ITEM # | BID ITEM | UNIT | QUANTITY | UNIT COST | | COST | |
|---|---|---|---|---|---|---|---|
| 206–1 | EXCAVATION FOR SURFACE FEATURE *1 | C.Y. | 16,288 | $3.00 | | $48,864 | |
| 206–2 | STRUCTURAL EXCAVATION | C.Y. | 153,700 | $3.50 | | $537,950 | |
| 206–4 | STRUCTURAL BACKFILL | C.Y. | 48,200 | $10.00 | | $482,000 | |
| 211 | FILL CONSTRUCTION | C.Y. | 136,600 | $3.50 | | $478,100 | |
| 321 | A.C. PAVEMENT REPLACEMENT | S.Y. | 20,850 | $20.00 | | $417,000 | |
| 340 | CONC. BIKE PATH REPLACEMENT | S.F. | 14,200 | $2.00 | | $28,400 | |
| 601–4 | BEDDING MATERIAL FOR BOX CULVERT | TON | 25,850 | $12.00 | | $310,200 | |
| 610–1 | RELOCATE 48" WATERLINE *2 | L.F. | 1800 | $230.00 | | $414,000 | |
| 610–2 | RELOCATE 54" WATERLINE *2 | L.F. | 2500 | $250.00 | | $625,000 | |
| 610–3 | REMOVE, PROTECT, OR RELOCATE *2 MISCELLANEOUS UTILITIES | L.S. | 1 | $1,413,667.00 | | $1,413,667 | |
| 618–1 | DROP INLETS *3 | L.S. | 1 | $72,000.00 | | $72,000 | |
| 618–2 | DOUBLE 18'x 10' CONC. BOX CULVERT *4 | L.F. | 4,100 | $1,500.00 | ($1,480.00) | $6,150,000 | ($6,068,000) |
| 618–3 | DOUBLE 10'x 10' CONC. BOX CULVERT *4 | L.F. | 2,400 | $630.00 | ($610.00) | $1,512,000 | ($1,464,000) |
| 618–4 | DOUBLE 8'x 10' CONC. BOX CULVERT *4 | L.F. | 800 | $580.00 | ($500.00) | $464,000 | ($400,000) |
| 618–5 | SINGLE 8'x 10' CONC. BOX CULVERT *4 | L.F. | 1,200 | $340.00 | ($300.00) | $408,000 | ($360,000) |
| 618–7 | 60" R.G.R.C.P. | L.F. | 2,250 | $130.00 | | $292,500 | |
| 618–6 | ADDITIONAL CONCRETE TO CONTER BOUYANCY | C.Y. | 392 | $180.00 | | $70,560 | |
| | | | | TOTAL = | | $13,724,241.00 | ($13,481,641) |

*1 EXCAVATION BEYOND WHAT IS REQUIRED TO CONSTRUCT THE BOX CULVERT.
*2 SURFACE FEATURE IMPACTS TO UTILITIES BASED ON THE COVER REDUCTION ZONES.
*3 IF THE SIDE INLETS WITH CONNECTOR PIPES ARE USED, THE ESTIMATED COST IS $355,000.
*4 ESTIMATES ARE BASED ON CAST–IN–PLACE CONSTRUCTION. ESTIMATES SHOWN IN PARENTHESIS ARE FOR PRECAST CULVERTS.

# APPENDIX C

# THOMAS-HARTIG & ASSOCIATES, INC.

**Geotechnical, Materials Testing, and Environmental Consultants**

7031 West Oakland Street • Chandler, Arizona 85226

Chandler: Phone (602) 961-1169, Fax (602) 940-0952 • Phoenix: Phone (602) 437-5450

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5 April 1993

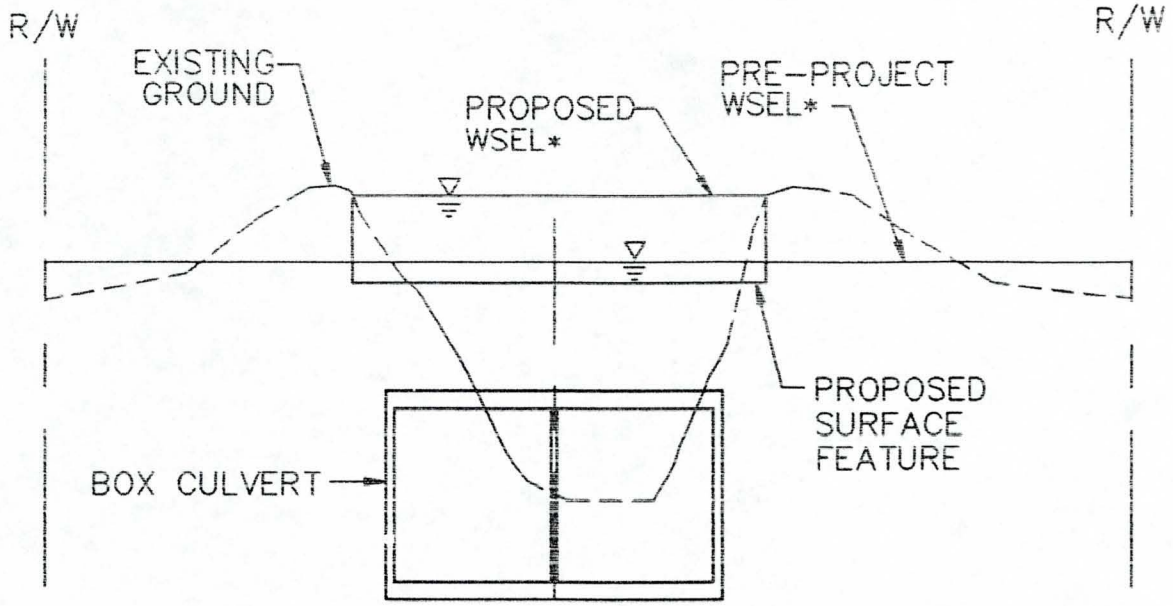
Greiner, Incorporated
7310 North 16th Street, Suite 160
Phoenix, Arizona 85020-2408

Attention: Shi-en Shiau, P.E.

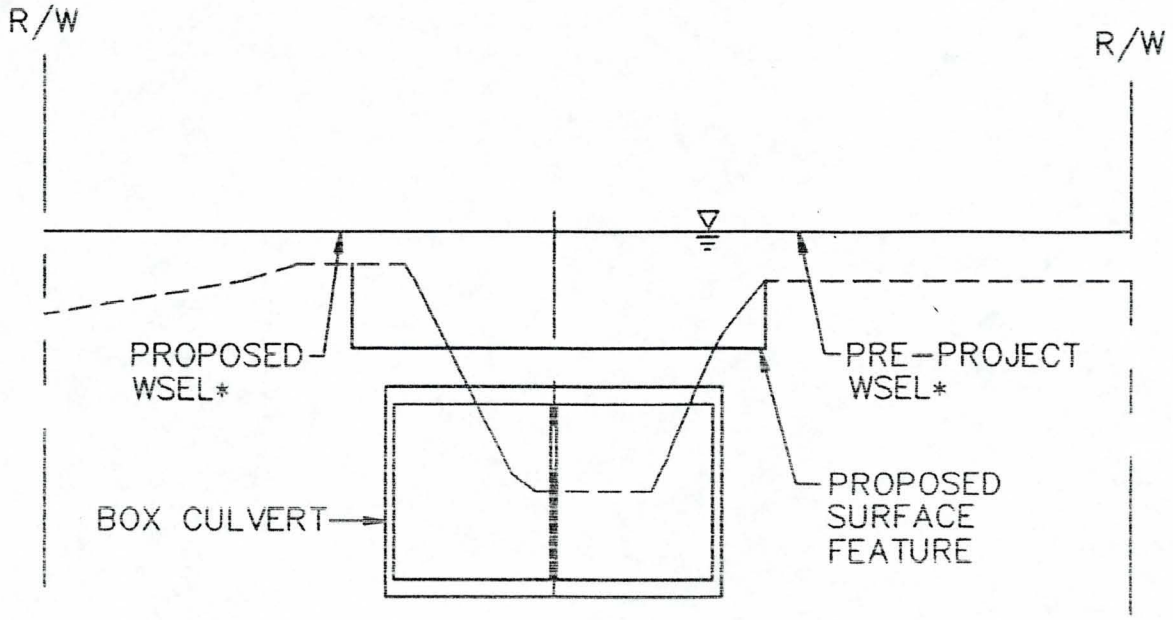
Subject: Report for Geotechnical Engineering Services
[illegible] School Road to McDowell Road

Project No. 90-0863
Supplement No. 2

# APPENDIX D



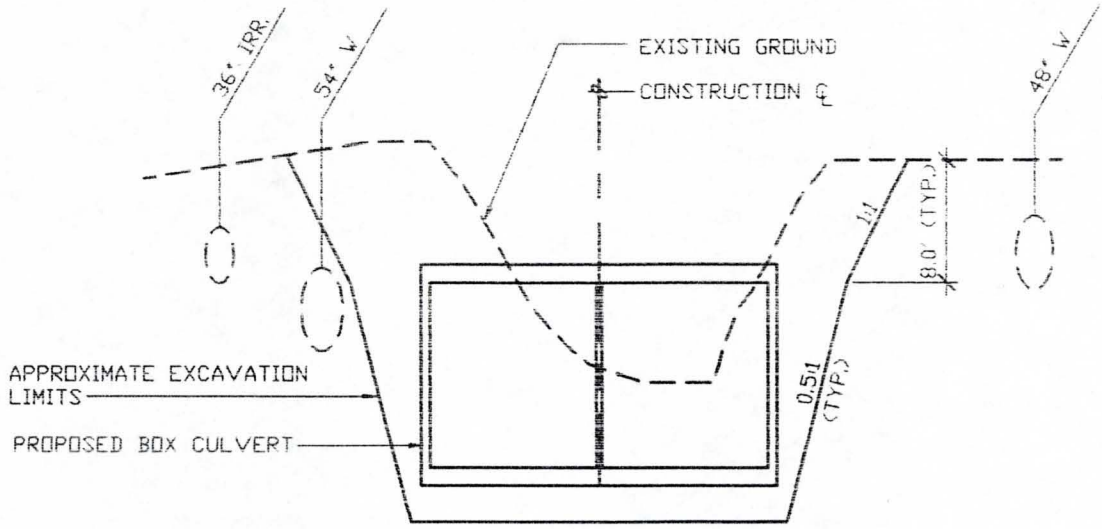

PROPOSED WATER SURFACE ELEVATION
GREATER THAN OR EQUAL TO
PRE-PROJECT WATER SURFACE ELEVATION



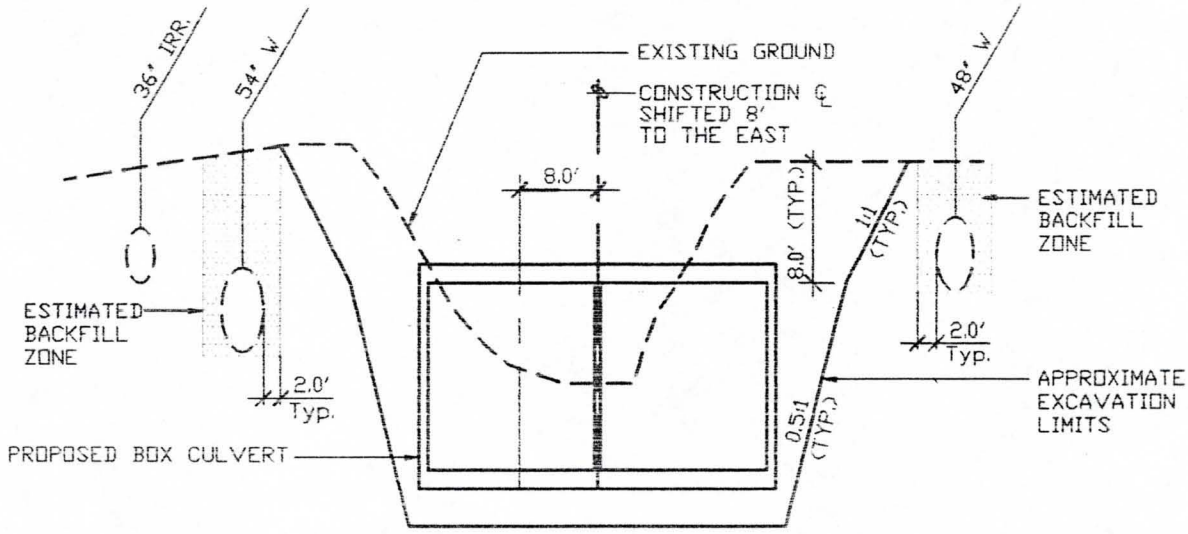

PROPOSED WATER SURFACE ELEVATION
LESS THAN OR EQUAL TO
PRE-PROJECT WATER SURFACE ELEVATION

*WSEL = WATER SURFACE ELEVATION

FIGURE 1 N.T.S.
DESIGN REPORT ADDENDUM
GREINER INC.




INITIAL 30% PLAN LOCATION




SHIFTED CENTERLINE LOCATION

FIGURE 2 N.T.S.

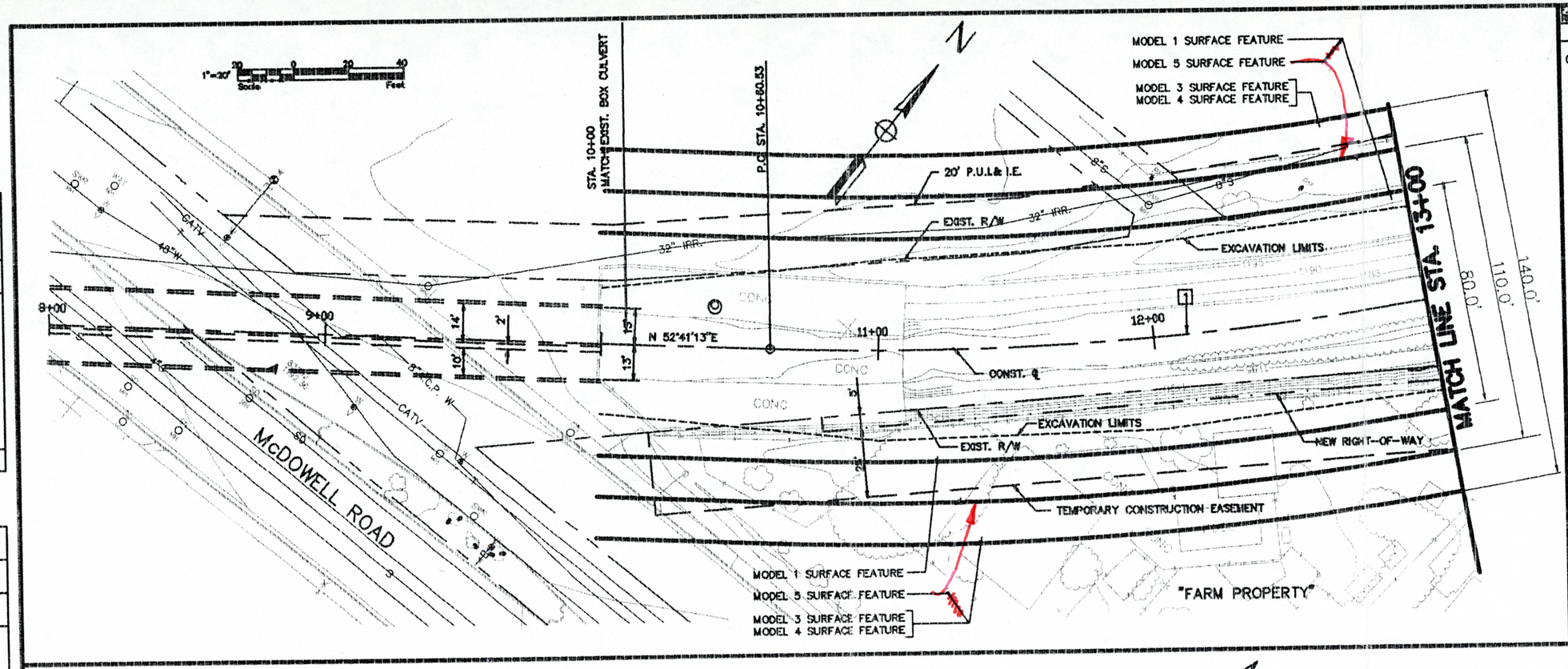
DESIGN REPORT ADDENDUM

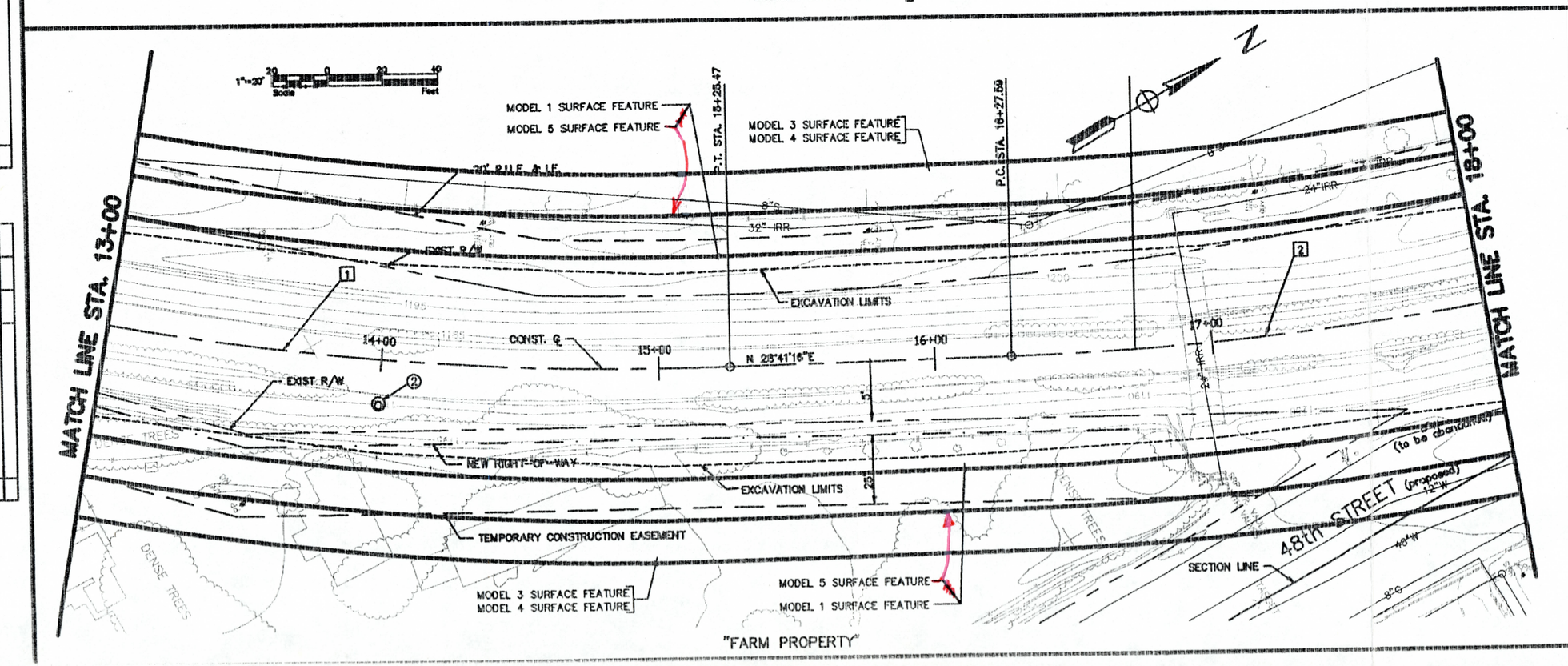
GREINER INC.

| COUNTY | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

## CONST. ℄ CURVE DATA

| Curve | Δ | R | T | L |
|---|---|---|---|---|
| 1 | 23°59'57" | 1110' | 235.93' | 464.94' |

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

RECOMMENDED BY: DATE:
APPROVED BY: DATE:
FLOOD CONTROL DISTRICT ENGINEER

SHEET 1 OF

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

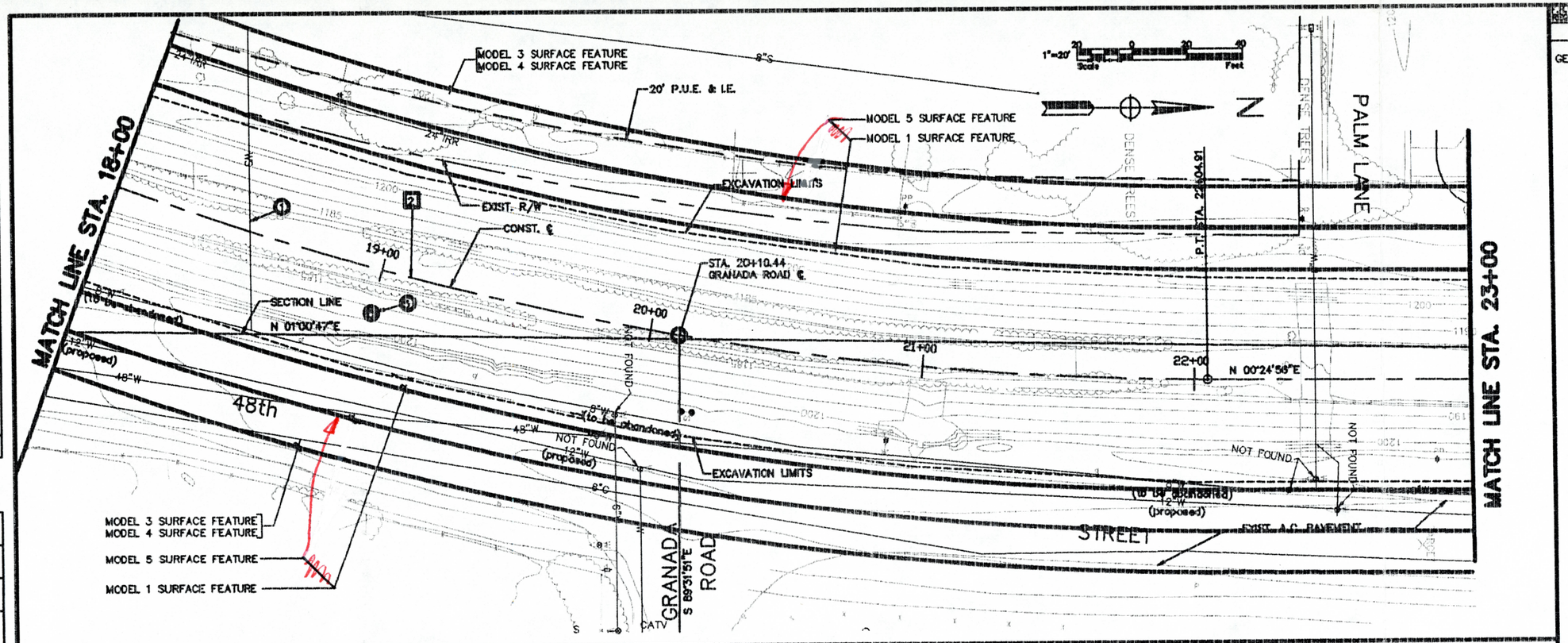
REVISIONS

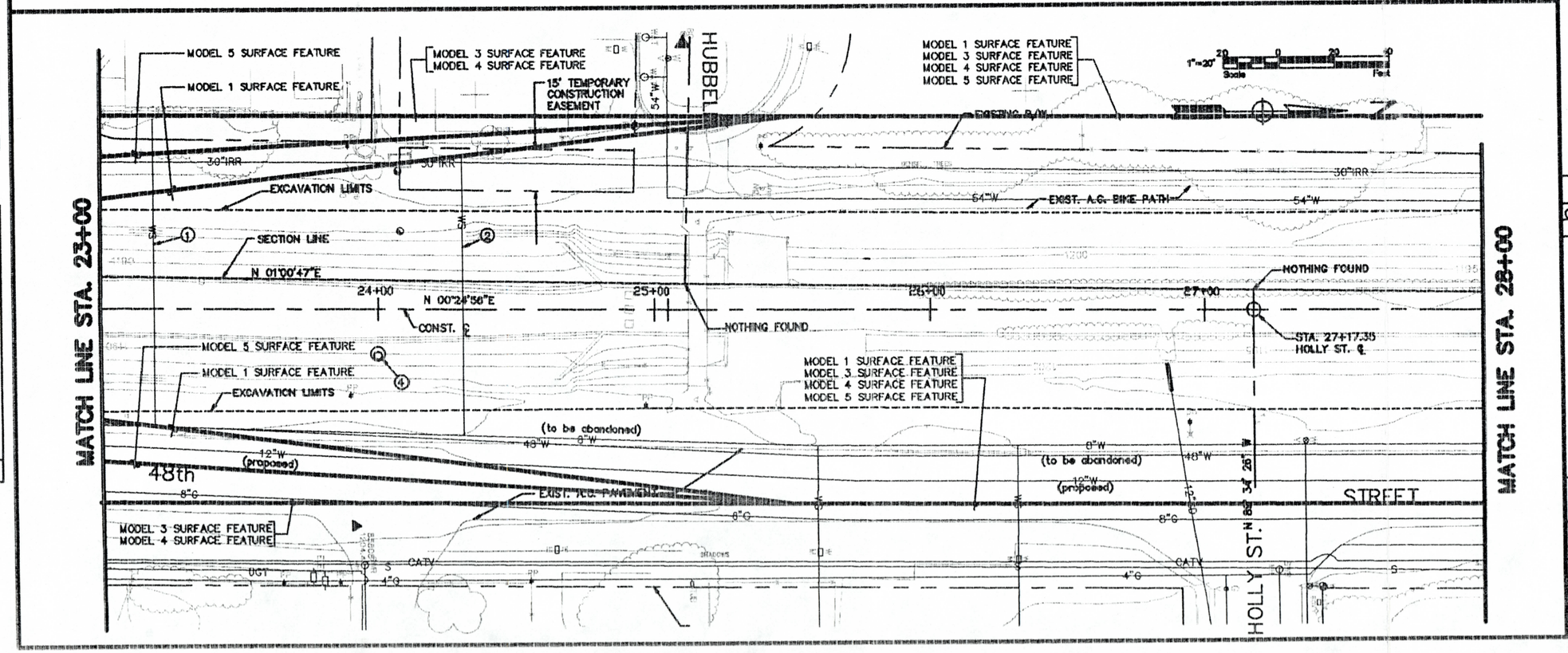
| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

| FEDERAL AID PROJECT | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

CONST. ℄ CURVE DATA

| Curve # | Δ | R | T | L |
|---|---|---|---|---|
| 2 | 28°16'20" | 1170.00 | 294.67 | 577.33 |

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

DESIGNED BY: DATE:
DRAWN BY: DATE:
REVIEWED BY: DATE:
SHEETS: 2

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

REVISIONS

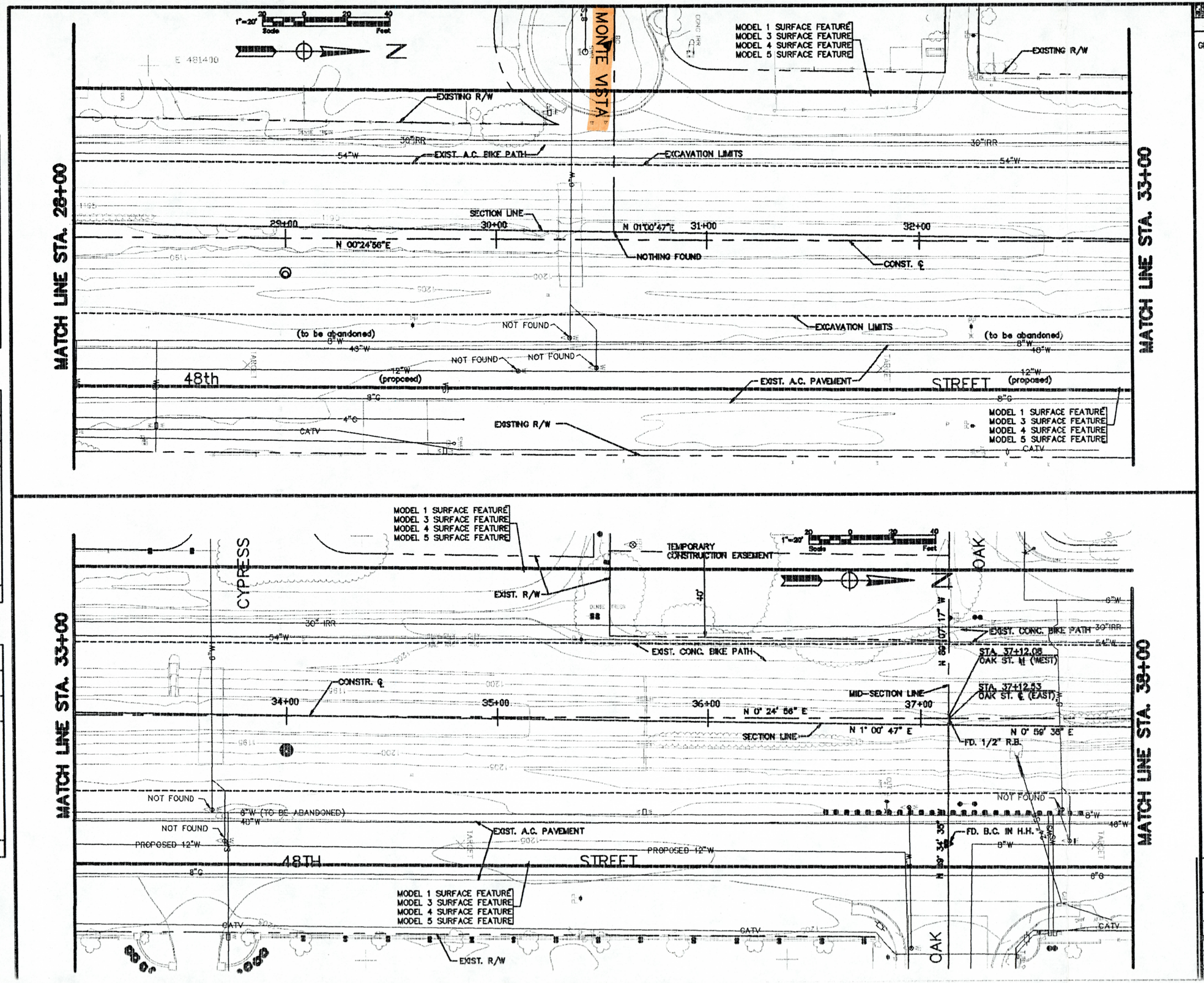
| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
| | | | |

CADD FILE NAME:
SCALE:
PLOT DATE:

| FED. AID PROJ. NO. | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

NOTES :

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT--OF--WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

SHEETS 3 OF

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
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REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
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REVISIONS

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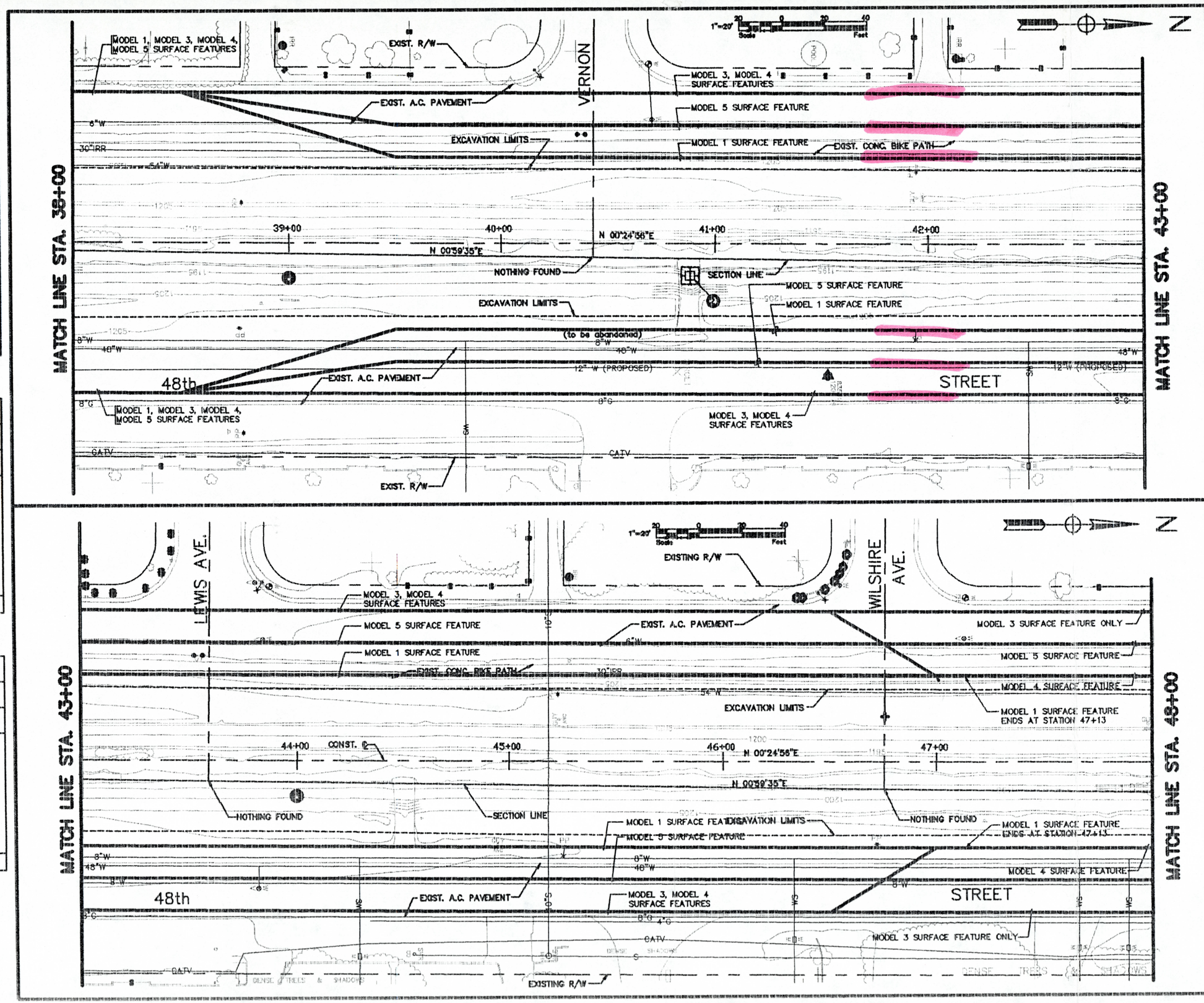
CADD FILE NAME:
SCALE: PLOT DATE:




| F.C.D.M.C. REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.

# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

SHEETS 4 OF

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
|---|---|---|---|
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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REVISIONS

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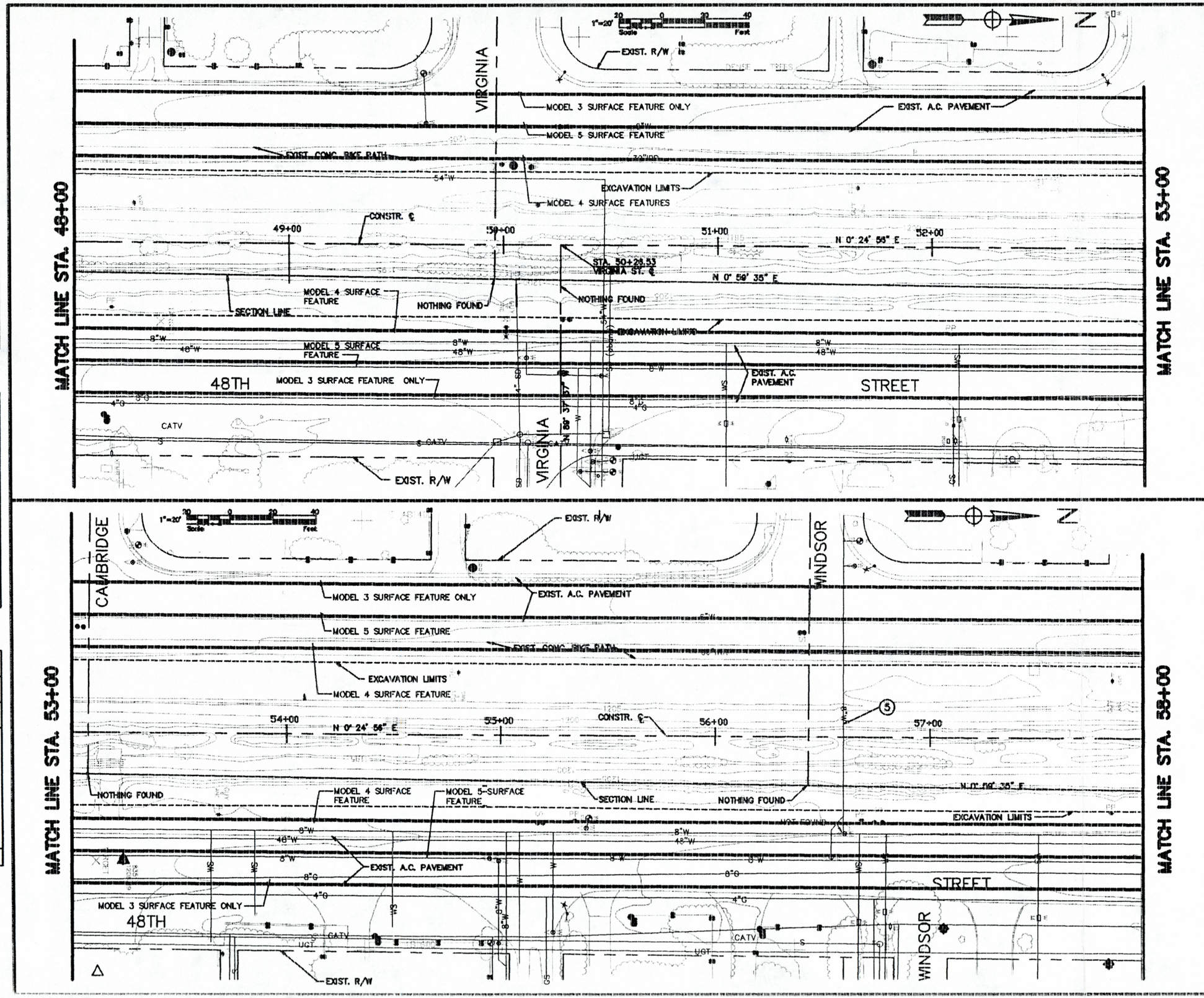
SCALE:
PLOT DATE:




| C.R.M.A. REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.

# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT--OF--WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

RECOMMENDED BY: DATE:
APPROVED BY: DATE:
FOR DIRECTOR, FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SHEET 5 OF

CADD FILE NAME:
SCALE:
PLOT DATE:

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
|---|---|---|---|
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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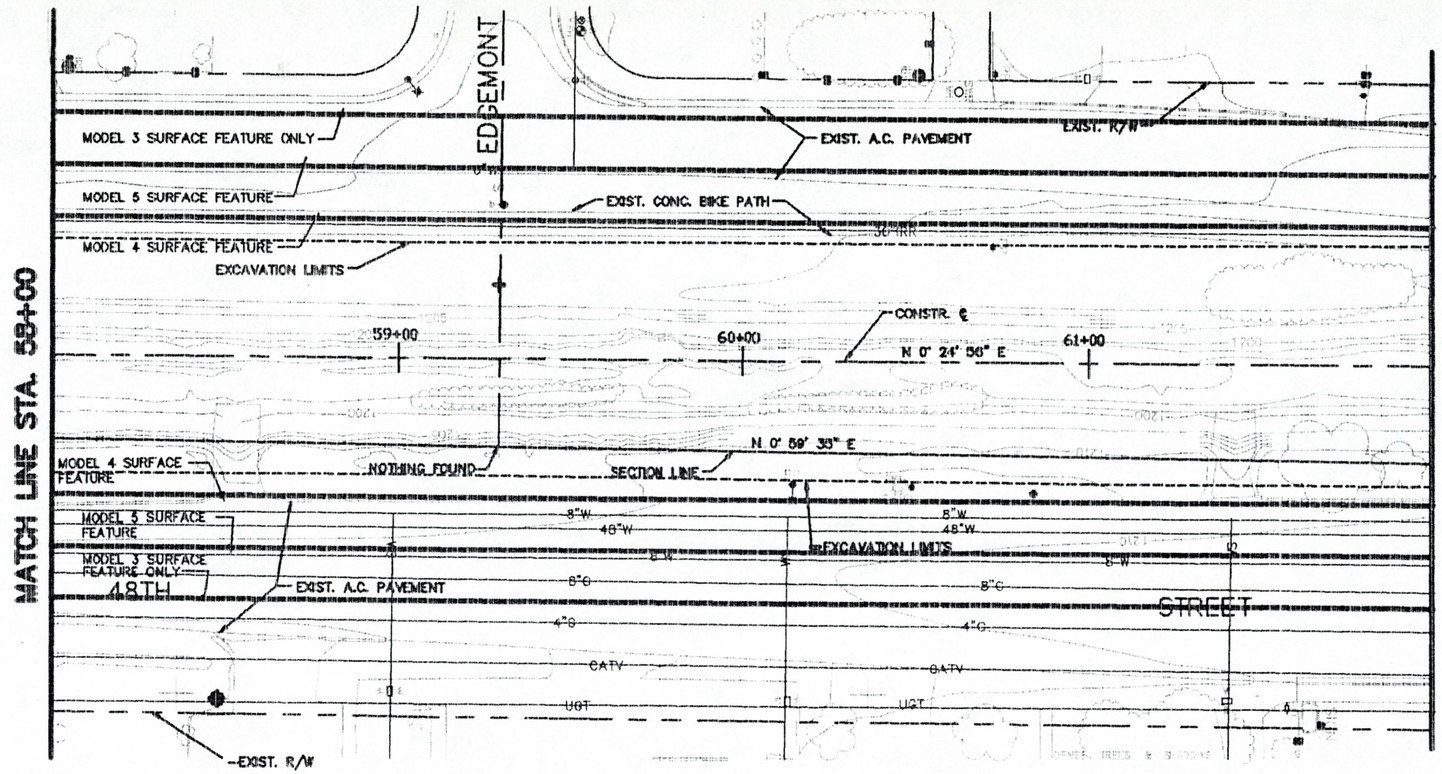
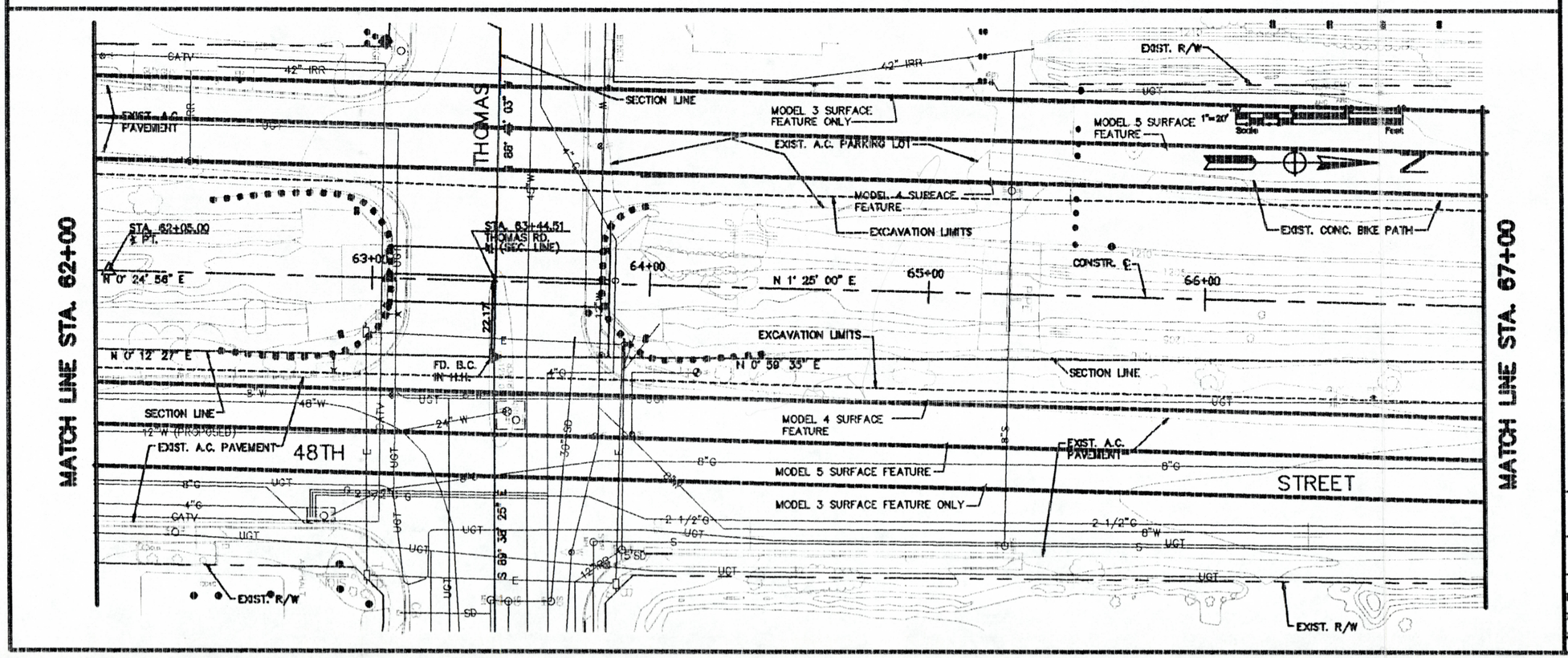
| FEDERAL REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

SHEET 6 OF

REVISIONS

| NO. | DESCRIPTION | BY | CHKD | APPD | DATE |
|---|---|---|---|---|---|
| | | | | | |

REVISIONS

| NO. | DESCRIPTION | BY | CHKD | APPD | DATE |
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REVISIONS

| NO. | DESCRIPTION | BY | CHKD | APPD | DATE |
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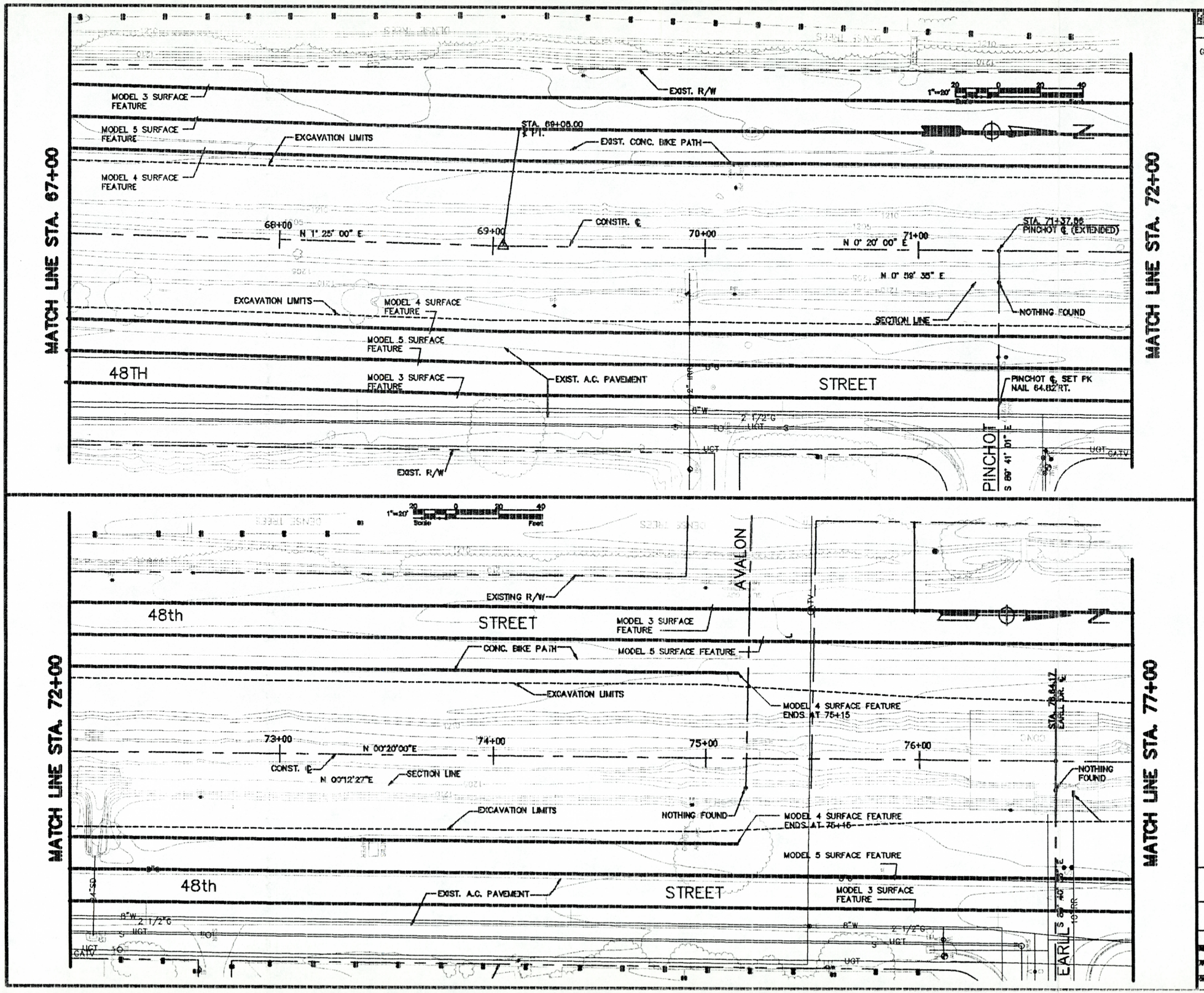
CADD FILE NAME:
SCALE:
PLOT DATE:

| FEDERAL REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




REVISIONS

| NO. | DESCRIPTION | REVISED BY | CKD BY | DATE |
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REVISIONS

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REVISIONS

| NO. | DESCRIPTION | REVISED BY | CKD BY | DATE |
|---|---|---|---|---|
| | | | | |

# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

RECOMMENDED BY: DATE

APPROVED BY: DATE

DIST. ENGINEER AND GENERAL MANAGER

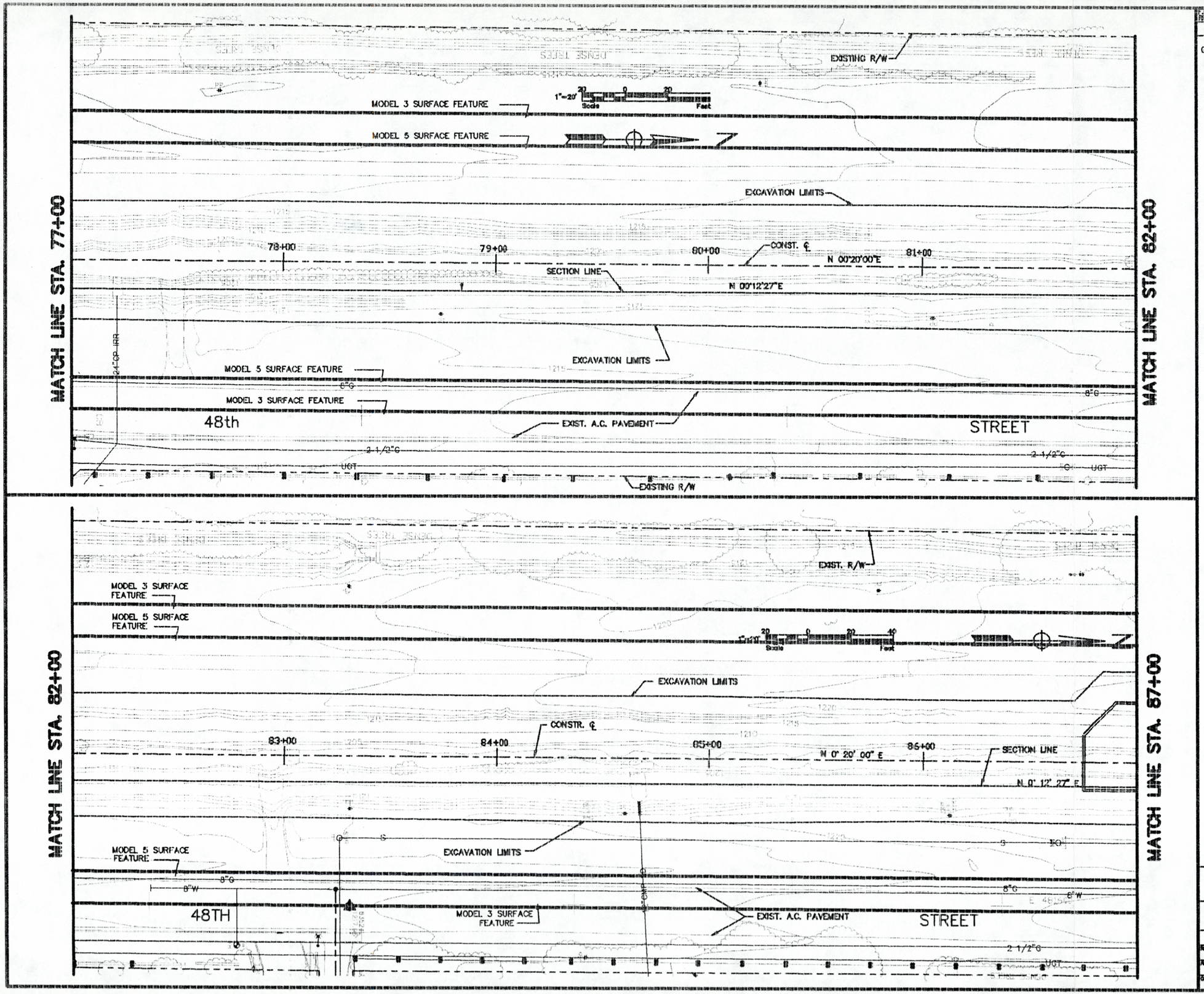
SHEET 7 OF

CADD FILE NAME:
SCALE:
PLOT DATE:

| FEDERAL ROUTE NUMBER | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90--23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

NOTES:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT--OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURES MODELS

RECOMMENDED BY: DATE:

APPROVED BY: DATE:

FCDMC ENGINEER AND GENERAL MANAGER

SHEET 8 OF

CADD FILE NAME: SCALE: PLOT DATE:

REVISIONS

| NO. | DESCRIPTION | REVISION BY | DATE |
|---|---|---|---|
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REVISIONS

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REVISIONS

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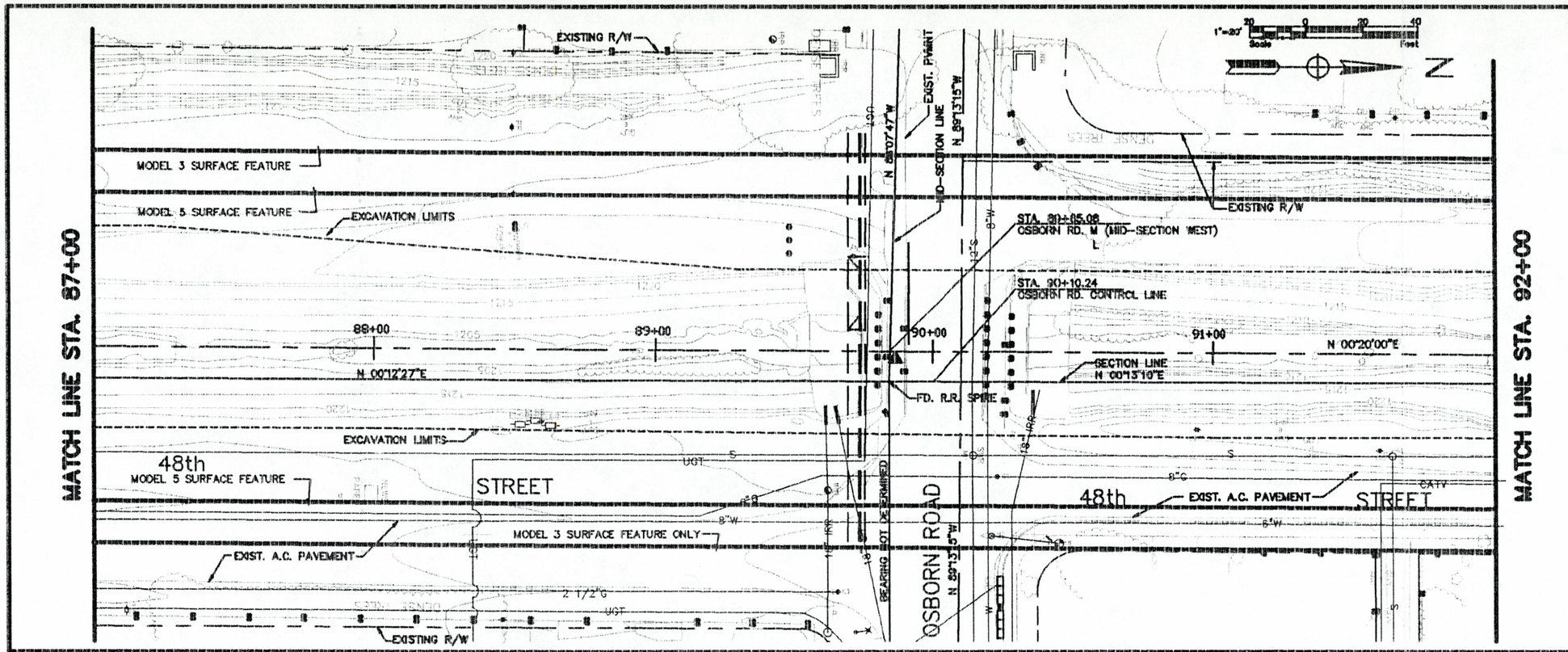
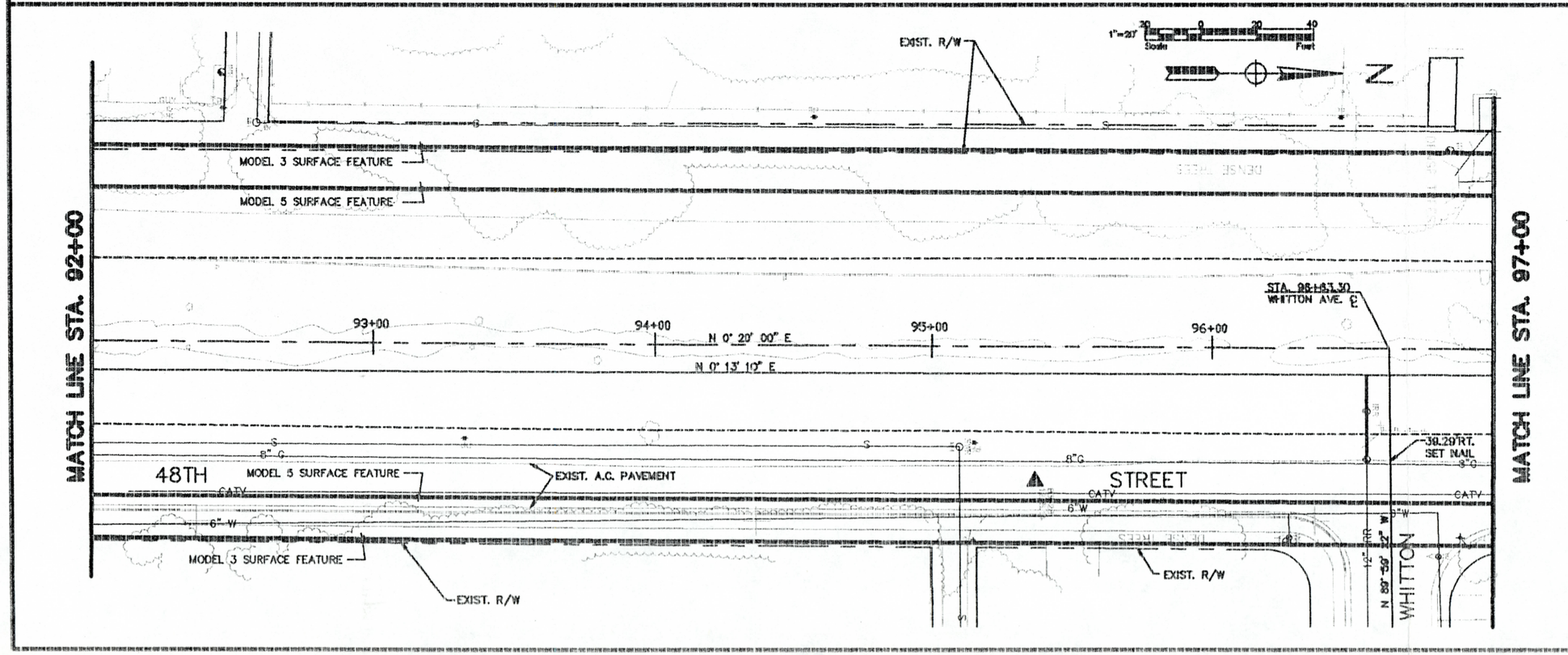
| STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|
| ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO WORK WAS PERFORMED TO TIE DOWN ANY RIGHT OF WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

DATE

DATE

SHEET 9 OF

CADD FILE NAME:
SCALE:
PLOT DATE:

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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REVISIONS

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REVISIONS

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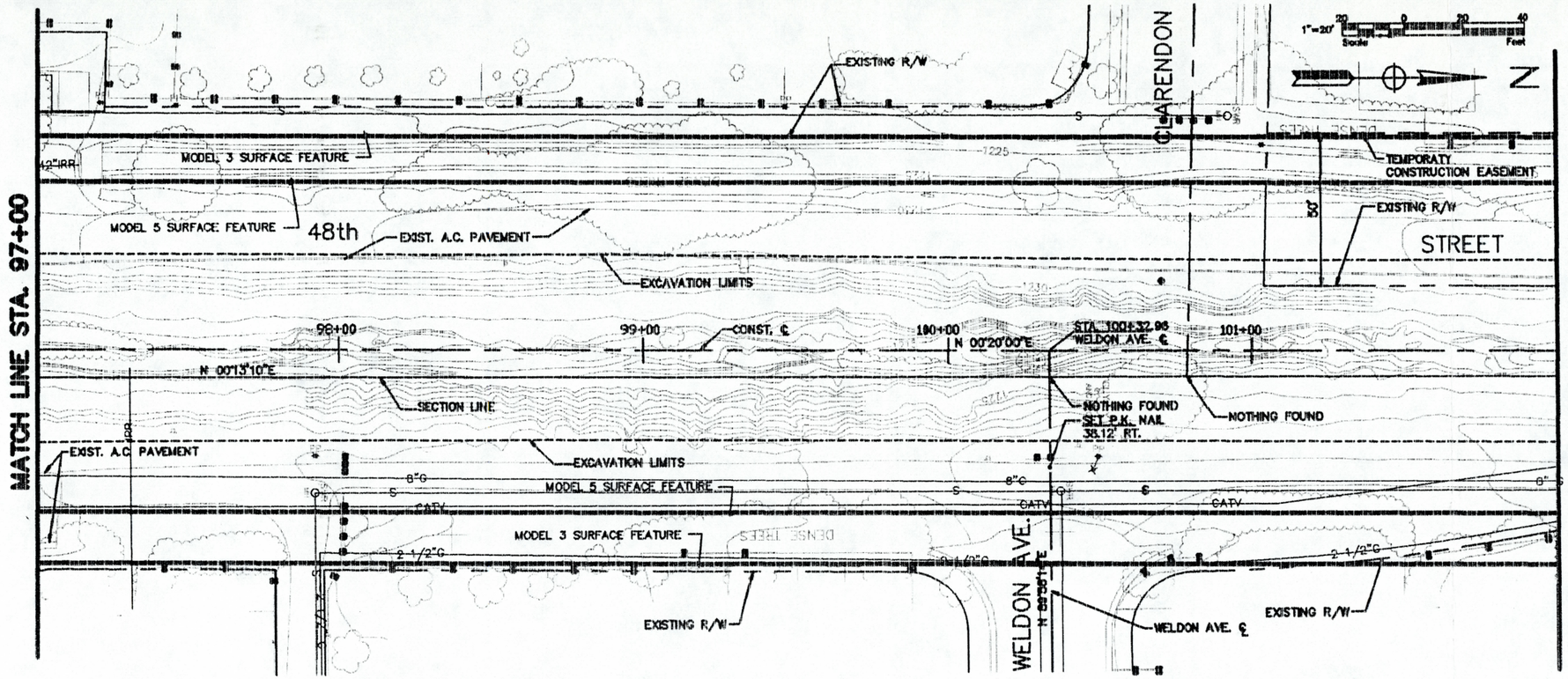


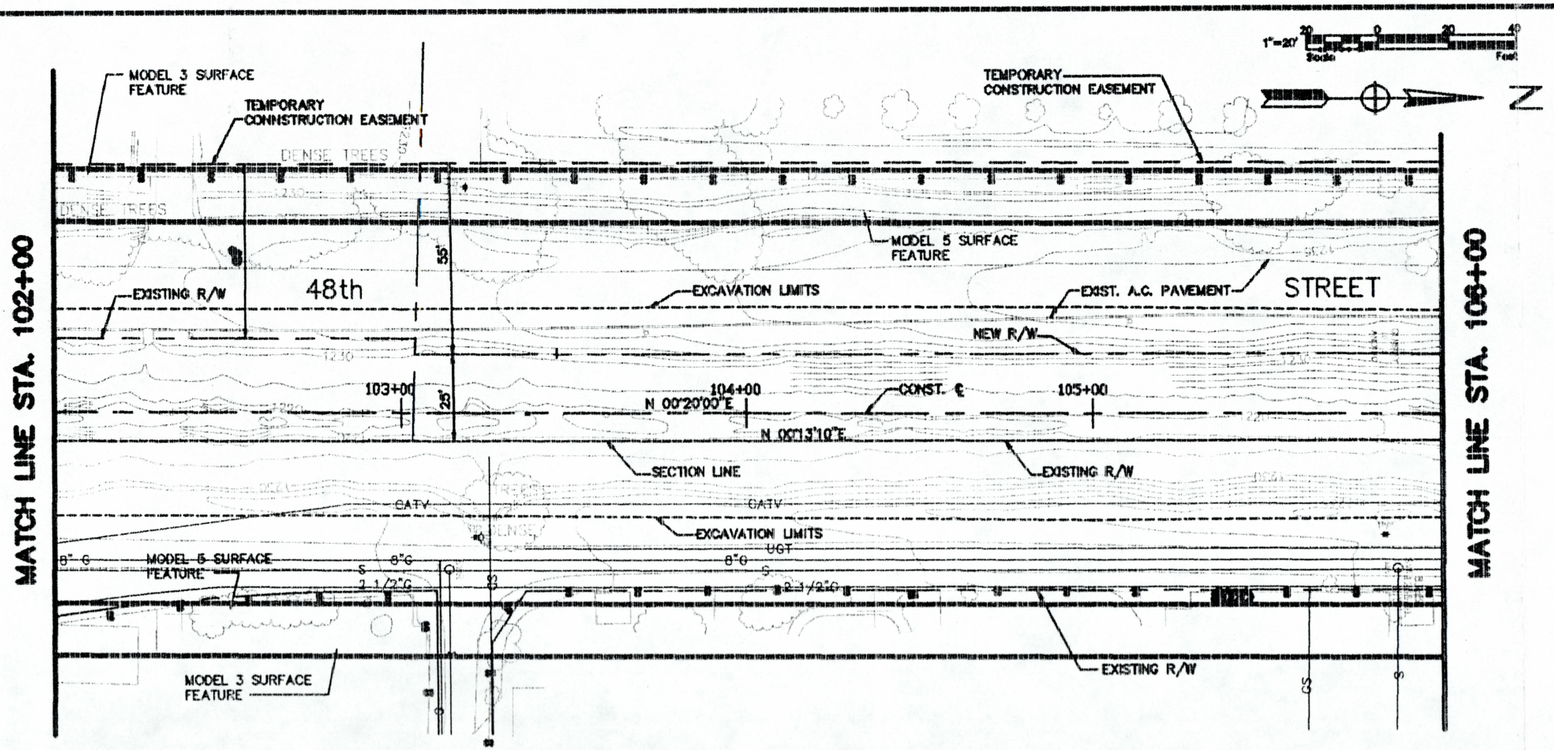


GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.

# FIGURE 3

NOTE:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT--OF--WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

SHEET 10 OF

| ARIZ. | FCD 90--23 | | | |
|---|---|---|---|---|
| STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |

REVISIONS

| NO. | DESCRIPTION | REVISION DATE | DRAWN BY | DATE |
|---|---|---|---|---|
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REVISIONS

| NO. | DESCRIPTION | REVISION DATE | DRAWN BY | DATE |
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REVISIONS

| NO. | DESCRIPTION | REVISION DATE | DRAWN BY | DATE |
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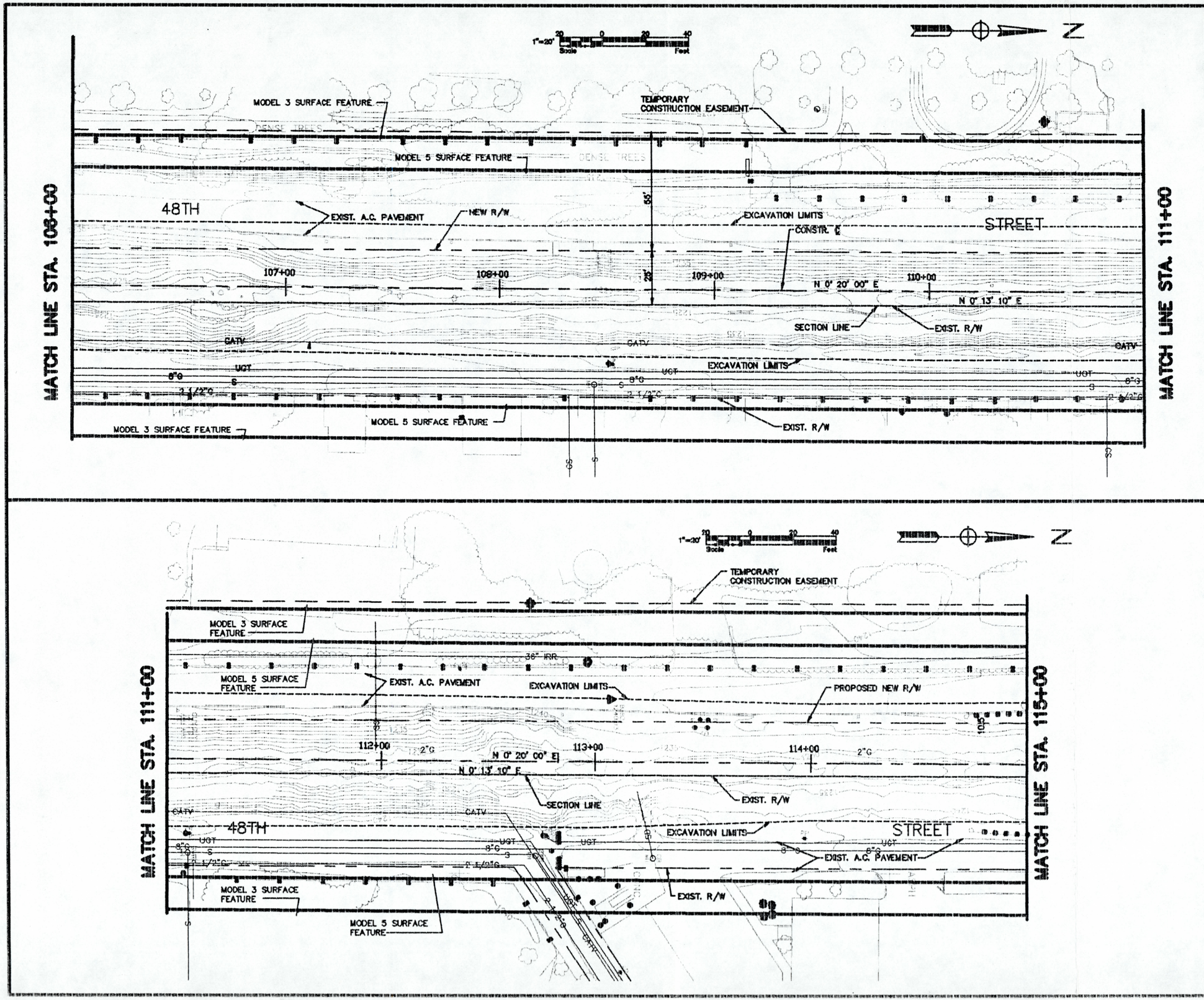
CADD FILE NAME
SCALE
PLOT DATE

| F.C.D.M.C. REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.




# FIGURE 3

NOTES :

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

SHEET 11 OF

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
|---|---|---|---|
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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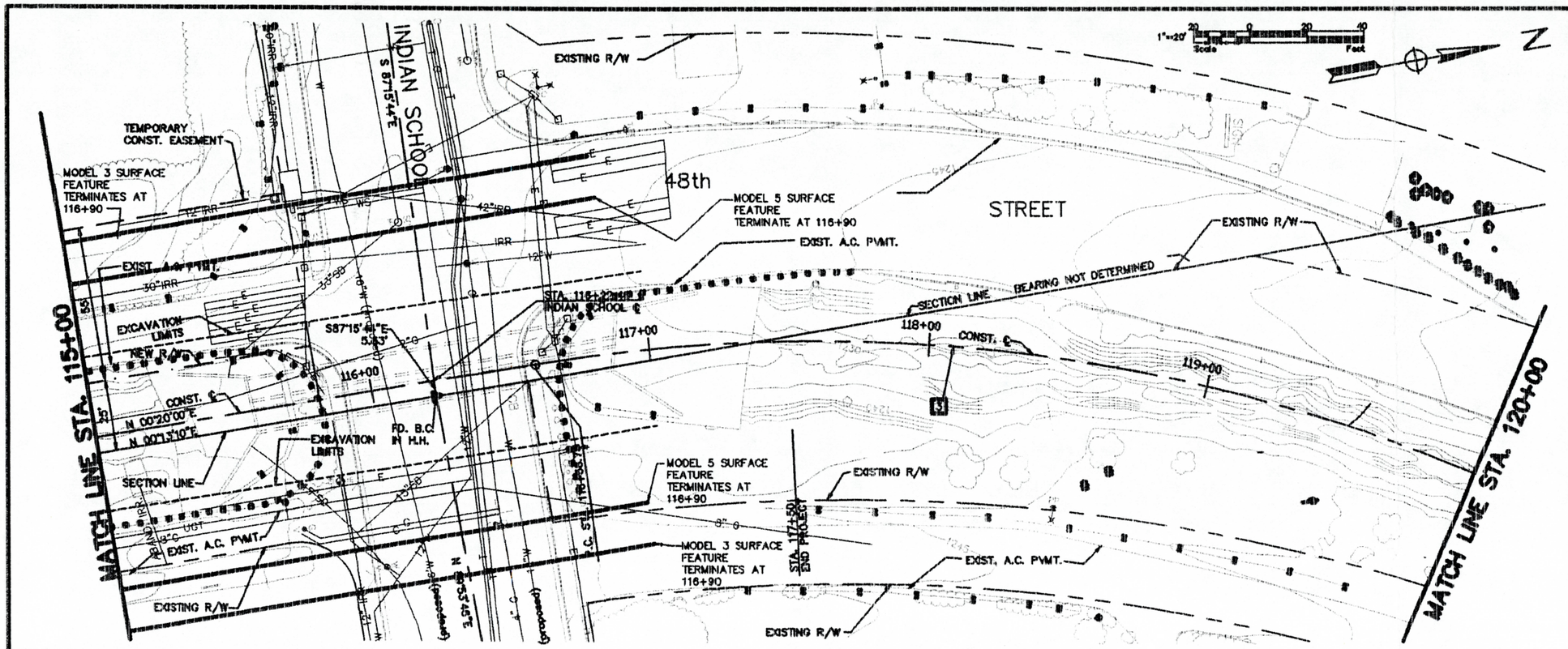
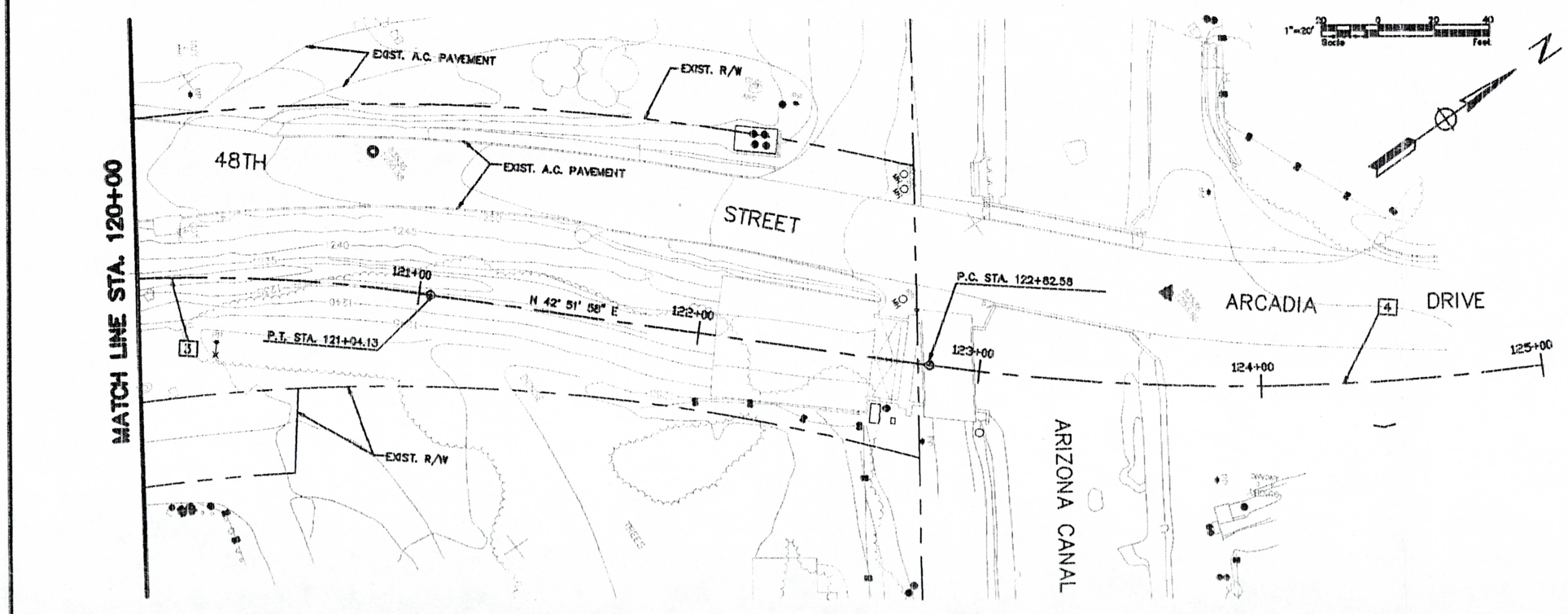
CADD FILE NAME:
SCALE:
PLOT DATE:




| F.C.D.M.C. REGION | STATE | PROJ. NO. | SHEET NO. | TOTAL SHEETS | AS BUILT |
|---|---|---|---|---|---|
| | ARIZ. | FCD 90-23 | | | |

GENERAL NOTES:

THE LINES REPRESENTED IN THE DRAWING FOR MODEL SURFACE FEATURES INDICATE THE TOP WIDTH OF THE SURFACE FEATURE.

# FIGURE 3

CONST. ℄ CURVE DATA

| Curve# | Δ | R | T | L |
|---|---|---|---|---|
| 3 | 42°31'58" | 600.00' | 233.53' | 445.40 |

NOTES:

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS. NO SURVEY WORK WAS PERFORMED TO TIE DOWN ANY RIGHT-OF-WAY CONTROL POINTS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OLD CROSS CUT CANAL FLOOD CONTROL IMPROVEMENTS

SURFACE FEATURE MODELS

DATE:

DATE:

SHEET 12 OF

CADD FILE NAME:
SCALE:
PLOT DATE:

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
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| | | | |

REVISIONS

| NO. | DESCRIPTION | REVISED BY | DATE |
|---|---|---|---|
| | | | |

# OLD CROSS CUT CANAL
# STORM PROGRAM DATA FOR DROP INLETS

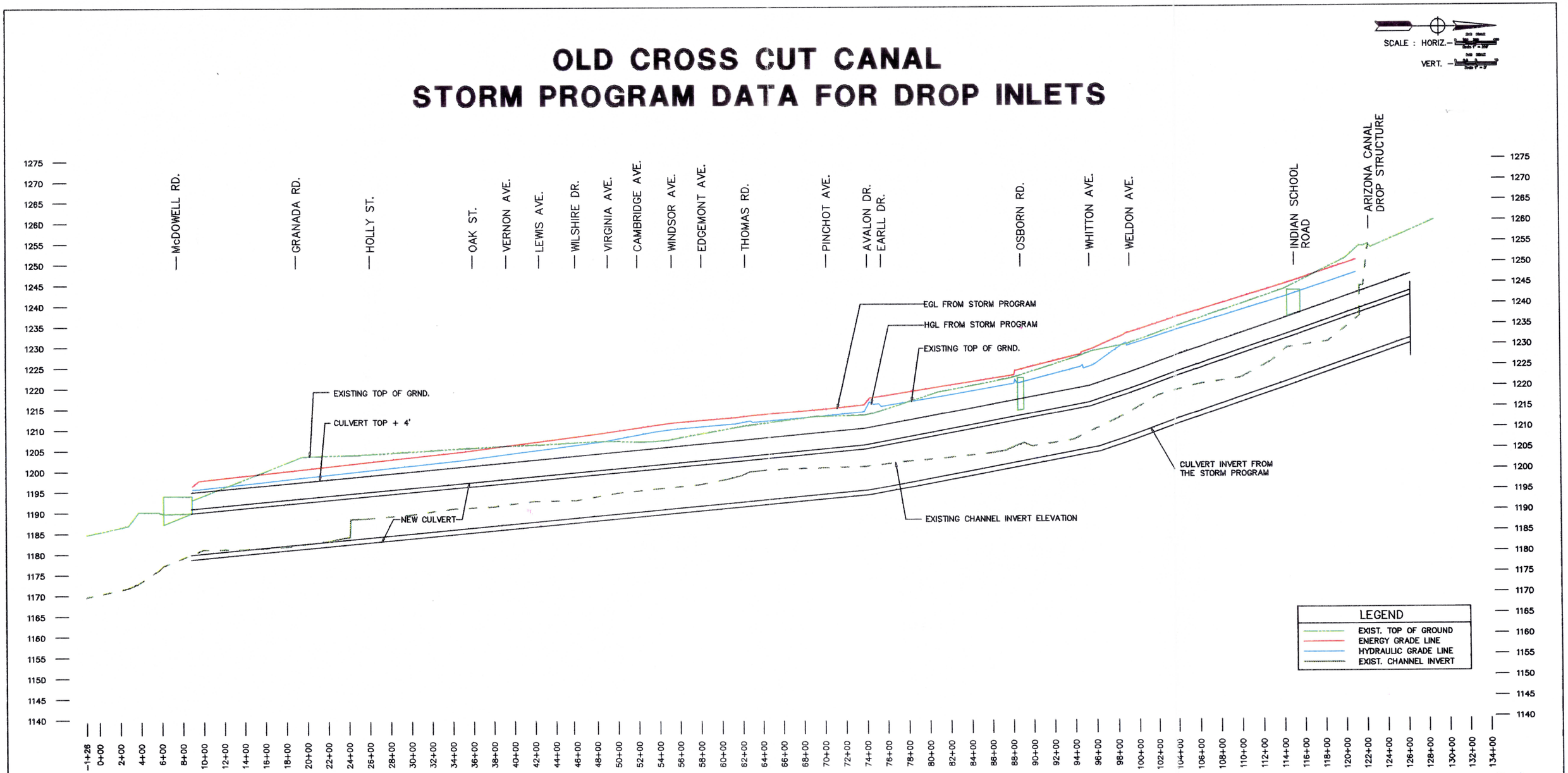



FIGURE 4 Greiner

# OLD CROSS CUT CANAL
# STORM PROGRAM DATA FOR SIDE INLETS

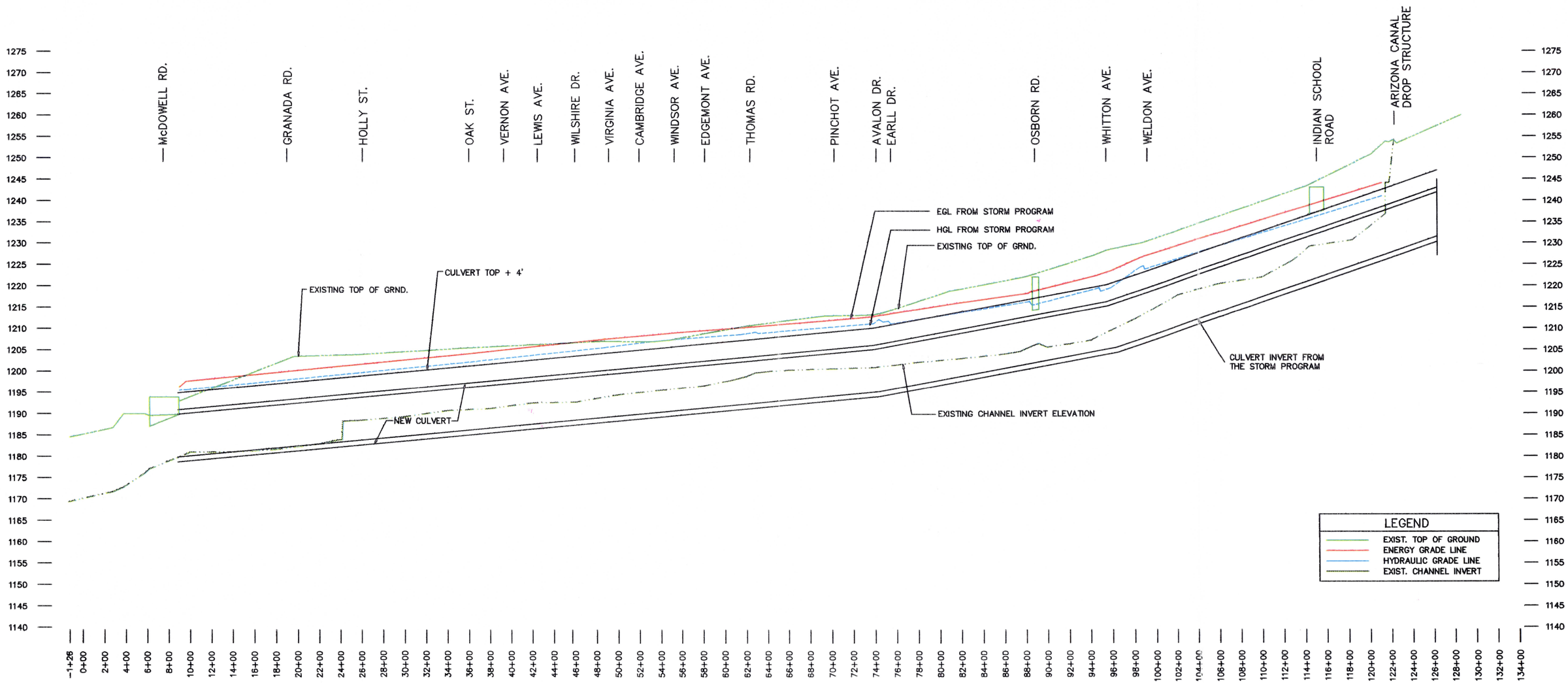
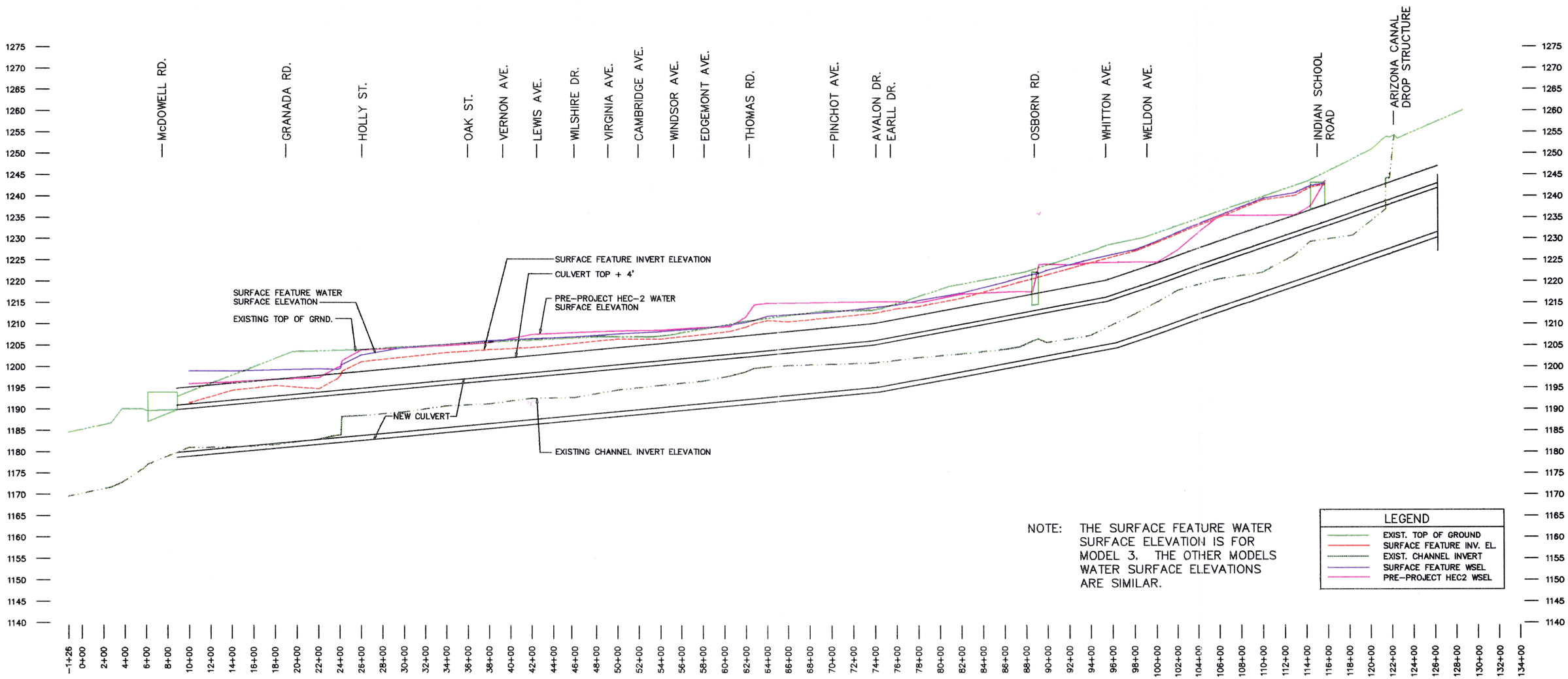



FIGURE 5

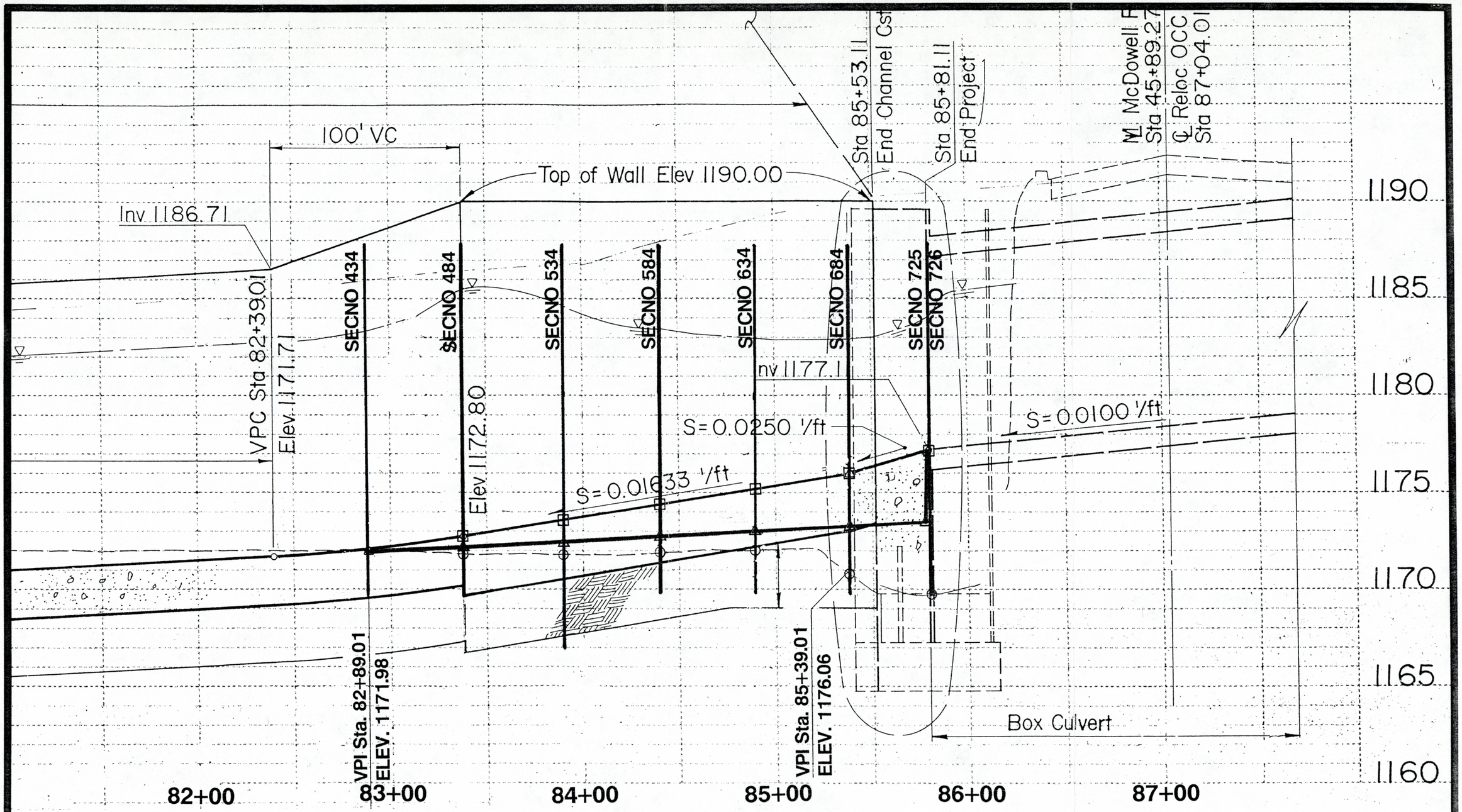
Greiner

# OLD CROSS CUT CANAL
# HEC-2 DATA W/SURFACE FEATURE




NOTE: THE SURFACE FEATURE WATER SURFACE ELEVATION IS FOR MODEL 3. THE OTHER MODELS WATER SURFACE ELEVATIONS ARE SIMILAR.

FIGURE 6 Greiner



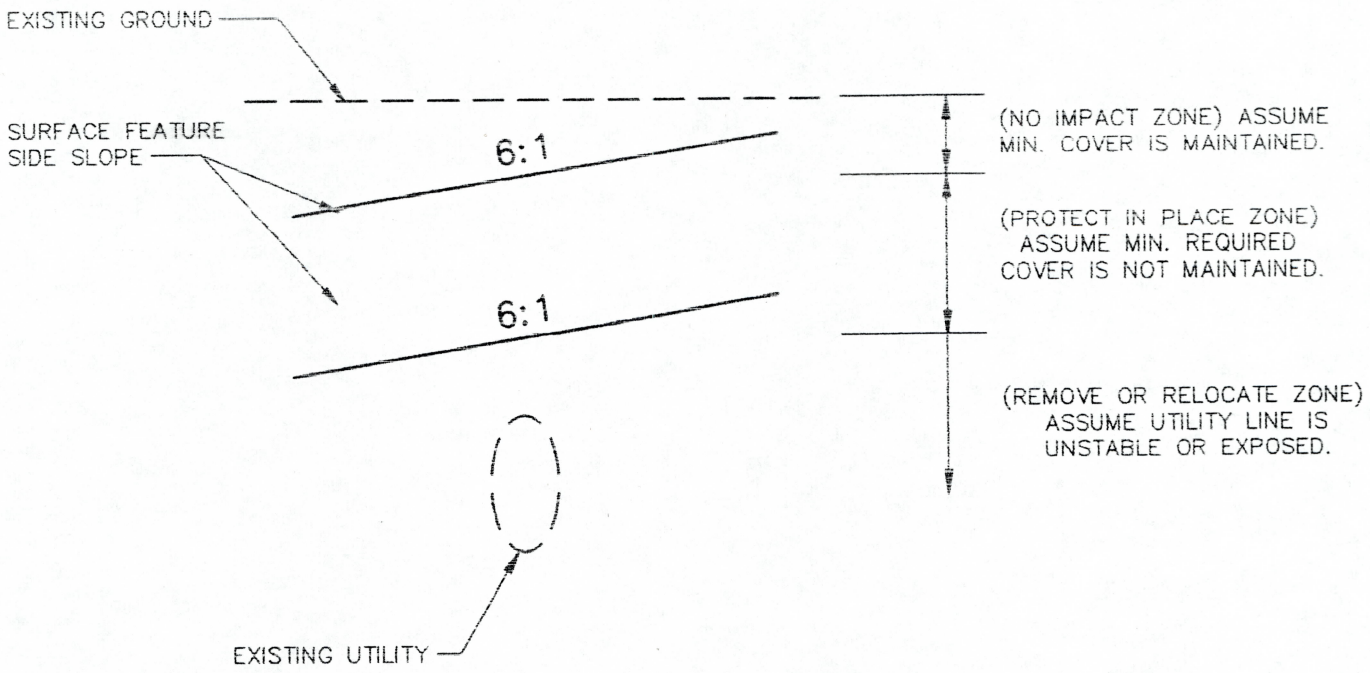

## LEGEND

1. PRE-PROJECT (With Drop)
2. EXISTING CONDITION (ADOT Channel)
3. MODIFIED ADOT (With Drop)

# McDOWELL ROAD OUTLET MODIFICATIONS

FIGURE 7

**Greiner, Inc.**




# SURFACE FEATURE IMPACTS TO EXISTING UTILITIES

FIGURE 8 N.T.S.

DESIGN REPORT ADDENDUM

GREINER INC.