SOSSAMAN RD CHANNEL

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# PRELIMINARY SUBMITTAL
# DESIGN REVIEW AND ANALYSIS
# FOR SOSSAMAN ROAD DRAINAGE CHANNEL

Prepared for
FLOOD CONTROL DISTRICT
of Maricopa County
Phoenix, Arizona

by
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May 16, 1980

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REPORT

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## PURPOSE

The purpose of this report is to discuss the findings of the Design Review and Analysis of the Sossaman Road Drainage Channel made by B. R. Jolly, Consulting Engineer, under contract to the Flood Control District of Maricopa County.

## SCOPE

A Scope of proposed work is contained in the Description of Work and Services Required in Exhibit "A" to the above referenced contract. This report covers only the review and analysis of the Sossaman Road Channel, the Guadalupe Road Channel, diversion structure and dip crossing. Upon conveying general findings to the District, it was mutually agreed that detailed plan review, consideration of maintenance and safety hazards and verification of the legal description of the project right-of-way at this time would not be appropriate.

## ANALYSIS AND RESULTS

Design and plan review was terminated upon completion of hydraulic and allowable velocity analyses because of the scope of design changes required. The overall result was a general failure to the hydraulic analysis to meet the conditions specified in the design criteria. The phases of analysis and results are as follows:

Guadalupe Road Channel and Overflow Analysis.

The Channel design consists of a hydraulically continuous reach from which overflows are caused by reductions in Channel area. The analysis is a water-surface profile computation which simultaneously calculates overflow over the south (high) shoulder of Guadalupe Road. Detailed analysis covers only the reach of Guadalupe Road west of the project and the channel between Station 13+00 and 21+00.

Results: The outfall to the existing ditch and the westerly 800 feet of channel do not cause the desired spill in that 800 foot reach and, in turn, affect hydraulics in upstream reaches which depend upon backwater effect from downstream to spill as specified in the design criteria. The excess discharge remaining in the last reach and continuing along Guadalupe Road will cause scour due to excess velocity. Over time, the capacity west will increase and overflow will further decrease.

Division of Flows at Guadalupe and Sossaman Roads.

The design consists of the intersection of three channels, incoming flows from the north and outflows to the west and south. Hydraulic control is assumed at the Sossaman Road dip westbound and at a point where the south channel is 30 feet wide. The analysis analyzes the location of hydraulic control for south and west flows, determines the ratio of outflows and analyzes inlet conditions for flows from the north.

Results: The analysis produces a ratio of 4:1 (west:south) versus a design criterion of 3:1 (approximate). Inlet analysis indicates a lack of hydraulic control on incoming flows which would prove destructive to the south channel for a 10 year storm (1800 cfs) and probably lower flows.

Sossaman Road Channel Hydraulics.

The design consists of a series of short reaches between drop structures in the northerly ½ mile, and a constant grade channel which at one location expands from 30 feet to 50 feet bed width. The maximum allowable velocity for the 3200 cfs design flow is 6.9 feet/second. The analysis is a water surface profile calculation for 3200 cfs.

Results: Each of the drop structures causes a draw-down of the water-surface profile in the reach immediately upstream resulting in velocities of 7.5 to 11.6 feet/second within each reach. The channel expansion likewise causes a drop in the water-surface and excessive velocities within and upstream of the expansion.

Baseline Road Culvert.

The design intent is unclear and no specific calculations were included in the Notes on Design for flow conditions approaching or exiting the culvert under design conditions. The analysis is by inspection.

Results: The approach slope is clearly supercritical for all flows up to the 3200 cfs design flow. With a drop structure 136 feet downstream, the depth of flow clearly does not attain the 7.5 foot depth assumed in the culvert capacity calculation of existing capacity. Under design conditions the flow through the culvert will not be limited to 3200 cfs. For some range of flows (undefined) there is a strong possibility of supercritical flow through the culvert and to the drop structure downstream. Velocities

encountered will exceed non-erosive velocity under this condition (allowable velocity varies with flood frequency and depth of flow.) The culvert will not function as assumed in the calculation of existing capacity.

Design Velocities.

The design is for a predominantly unlined earth channel. Bank protection is provided only at the drop structures. The design uses an allowable velocity of 6.9 feet/second for the 100-year flood without soil property data only recently available. The analysis uses specific properties for the soil developed by the Maricopa County Highway Department Materials Laboratory and penetrometer measurements made by Engineers' Testing Laboratory to evaluate the effect of the native material on allowable velocity. In addition, the 3200 cfs flow was assigned a return period of 50 years because allowable velocity is a function of frequency of occurrence and not of flow capacity.

Results: Allowable velocity for the design configuration should be 4.87 feet/second maximum, being reduced where curvature or depth of flow requires.

## CONCLUSIONS

1. The design is predominantly inadequate and correction of the design is beyond the scope of modification of the current plans.
2. The allowable velocities determined herein require channel lining virtually throughout, additional right-of-way for an earth channel, and some additional right-of-way may be required in either case.
3. Adding lining to the present design will not render the design viable.
4. The design overflows along Guadalupe Road can be assured only by making the identified spill reaches hydraulically independent with some type of channel control structures.
5. The conveyance capacity of Guadalupe Road is significant to the overflow design. It should be considered along with road modifications to assure the design overflows.
6. Future Guadalupe Road improvements encroaching into the channel should be considered and probably avoided by road or channel alignment change.
7. The design flow split at Guadalupe and Sossaman Roads require structural control to assure achievement of design values and stability over time.
8. The design should lend itself to the ultimate function of conveying flows to the RWCD Floodway. A decision on that route is needed to assure availability of future right-of-way. The logical route appears to be west along Guadalupe Road where the majority of design flows are allocated and which requires the shortest channel (to Power Road).
9. The Sossaman Road dip crossing represents a significant hazard which can be mitigated only by a box-culvert or bridge.
10. The scope of redesign can be determined only after major decisions on treatment of the overflows on Guadalupe Road, lining or modified channel design and consideration of the Baseline Road Culvert flows (i.e. design to limit to 3200 cfs or redesign project for the full 100-year flow arriving at Baseline Road).

## RECOMMENDATIONS

1. A complete hydraulic redesign is recommended.
2. A culvert for Sossaman Road at Guadalupe designed to accommodate the 100-year flood under future conditions is recommended. The culvert would also help assure a "desired" split of flows in the interim.
3. I recommend a commitment to convey the 100-year flood to RWCD Floodway along the Guadalupe Road alignment. The attendant recommendation is acquisition of the ultimate right-of-way within the Farnsworth holding prior to development.
4. I recommend consideration of dialog with the Roosevelt Water Conservation District prior to design, to determine the climate for extension of the Guadalupe Channel west under Power Road as part of the current project. A borrow pit now exists at the Guadalupe and Power Road intersection on Flood Control District right-of-way for the future RWCD Project. Minor flows are diverted along that route at present. Elimination of the Guadalupe overflows would also eliminate the need for future redesign and reconstruction.
5. I recommend that a sediment basin be designed for the Guadalupe Channel immediately east of Power Road in order that right-of-way might be reserved from future development. (I believe that the Soil Conservation Service would provide the required sediment data, possibly the total design).
6. I recommend reconsideration of existing capacity of the Baseline Road culvert by re-analysis, and, if warranted, redefinition of the 100-year flow.
7. I recommend no final commitment on right-of-way requirement until completion of redesign and design review.

# PART II

# COMPUTATIONS

# Sossaman Road Channel Design Review



## Item 1. Overflow from Guadalupe Rd. Reach

Design - Overflow for each sub-reach is determined by sizing the next downstream reach to carry a Q reduced by the desired overflow - for the 100-year occurrence. Channel size is determined by using Manning's Equation for each sub-reach. This inherently assumes steady-uniform flow. No check of possible backwater effects is attempted.

Review Routine - For the design configuration, back-water computations will be made to determine if overflow adequately matches those specified for design - 100-year occurrence.
1. Capacity of existing ditch west of proposed channel 2. Backwater calcs. using MCHD X-secs 100-year 3. 10-yr. backwater if 100-yr

## Item 2. Split of flows west and south at Guadalupe Rd. and Sossaman Rd. - 100-year occurrence.

Design - Control sections are assumed at Sta 4+00 (Sossaman) and Sta 51+89.20 (Guadalupe) i.e. road dip.

Review Routine - From Item 1 the assumption of Sta 51+89.20 (Guad.) can be analyzed. This establishes a control elevation for the split. The Sossaman

flow will be analyzed by back-water analysis to verify the required split. (100-year occurrence.) If as specified, repeat for 10-year occurrence.

Evaluation - From the results of Items 1 & 2, the need for any design revisions and their probable scope are to be determined. This evaluation will deal basically with design water-surface profiles, but not allowable velocities as WSE will determine if the specified 100-year overflow and division of flows are satisfied by the design.

Item 3 - Backwater calculation from Guadalupe north along Sossaman for 100-year and 10-year event. For 100-year, the hydraulic gradient and drop structure designs will be evaluated

Item 4 - Allowable velocities will be reviewed using SCS design manual and field soils data.

Review Routine - A single allowable velocity will be determined for a 10-year flow using average allowable velocity, discarding the highest and lowest values. From the backwater analysis a determination of adequacy of design will be made, and if necessary, recommendations for redesign. Allowable velocity for $Q_{100}$ will also be compared to design velocity to determine if those are also adequate

Item 5 - An overall review of hazardous potential will be made based on current design - Recommendations will be made to incorporate hazard mitigation features into the current design specifically by design modifications, or as items for consideration in a redesign, if necessary.

Item 6 - Legal description will be written for existing design, if no r/w changes will be required. Additionally, recommendations will be made for provision of future r/w requirements.

Item 7 - Report of findings and drawing revisions will be provided.

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# Hydraulic Review

## Item 1 - Overflow from Guadalupe Rd. Reach

A. Backwater Calcs. Appendix A indicate that the "desired" flow west on Guadalupe at the beginning station 13+00 Q=470 cfs can occur in a 100-year storm, if the design of the Guadalupe channel spills the excess as intended.

Note: The entire roadway is inundated for the full 1/4 mile - Power Rd to Sta 13+00 - by 470 cfs in a 100-year flow, but also any time 470 cfs is turned west at the Sossaman intersection. This condition increases this hazard & more frequently these conditions will occur because the proposed channel will convey flows which would have attenuated or even may have dissipated as overland flow (existing topography)

B. Backwater Calcs. Appendix B indicate that Overflow Reach I will not function as Desired. An outflow "desired" at Sta 13+00 of 470 cfs will not cause the desired spill of 550 cfs between 13+00 & 21+00, nor will an outflow of 600 cfs.

However an outflow of 700 cfs cannot occur without spilling in excess of 800 cfs (estimate) and creates a critical flow situation at 15+00, possibly elsewhere

Conclusions: (1) The entire Guadalupe Rd channel reach requires redesign to spill as desired as design control is downstream (flow per design is subcritical) - therefore the downstream reach must function per design criteria to cause the entire reach to function.

(2) Redesign should encorporate drop structure to separate the reaches hydraulically (make each reach independent of backwater from the next downstream) and gentler bed slopes to allow better control of the spill in each reach.

(3) The tendency is going to be (in any design) for flows less than 100 year to spill most from the westerly reaches, creating "unnatural" distribution of outflows for these lower Q's. This can be somewhat mitigated in redesign.

(4) A significant additional factor is that Guadalupe Rd itself will carry significant flows <u>west</u>, while design considered a spill any flow above the channel capacity

(1-B Continued Guadalupe Spills)

(ie above design bank el.) However, the South edge of Guadalupe Rd. is generally one foot or more above bank elev. - The additional capacity in that one foot deep flow across the entire road and channel right-of-way must be considered.

- Per Tom Hirsch, the spills were determined based on high elev. of Guadalupe Rd but the channel design does not account for this and resulting spills will not match design spills.

Note: Any appreciable flow under existing, per MCHD design or for any modified spill design will inundate a portion of Guadalupe Rd. to a depth near the Power Rd. intersection sufficient to make the road impassable. The MCHD design should incorporate a method to close the road (stored barracades or a cable gate) plus should have permanent warning signs. "do not enter when flooded."

Item 2 - Split of Flows at Guadalupe & Sossaman

A. Backwater conditions on Guadalupe - Calculated from the Drop Str. at 46+00 - Results of Appendix C indicate that critical condition would occur at the Sossaman Rd dip (proposed) rather than being governed by conditions (backwater) from 46+00 to Sossaman Road

B. Appendix C includes analysis of Q vs H (total head) for the dip section (effective flow area) and for the continuation south along Sossaman. The results indicate a split of flows between 4.25 to 1 and 3.79 to 1 for a design flow range between 1400 cfs and 3260 cfs. Flow of 780 cfs "desired" to the south would not be possible i.e. 680 cfs south @ total Q of 3260.

Item 3 Sossaman

A. Appendix D is flow analysis of the design flow of 3200 cfs from Guadalupe Road vicinity (Sta 7+00) to Baseline Rd. in the proposed Sossaman Road Channel.

1. Analysis of the conditions of flow approaching the flow split (Sossaman

and Guadalupe Channel Intersection) show that Sossaman flows would pass through critical condition and would enter the split area at higher energy than would be required for the split. These flows would spill somewhat over the Sossaman Road dip to the west, but the majority of flow volume would continue across the basin as supercritical flows and impinge on the much smaller outlet channel. The effect would be rapid enlargement of the south channel and ultimately the split flows would in majority favor the south channel along Sossaman. This analysis for the 100-year event would not precisely model the scaled-down 10-year event, but for any significant flow the split flow control would be significantly altered. The physical control under flow conditions is therefore not structurally or hydraulically stable; and the split structure and entrance hydraulics require redesign.

2. <u>Backwater analysis</u> · <u>100-year</u> <u>3200 cfs flows</u>
<u>Sossaman Rd. Channel</u>

a. Transition (expansion) 30' to 50' bed width Sta 24+00 to 25+00 --

80-10
Sheet H6 of 8

Assuming proper control of the split structure entrance conditions, the first situation (going upstream) encountered requiring detailed hydraulic review is the transition.

Generally an open channel constriction indicates a point of control and an expansion indicates need for careful analysis. This expansion is a prime example. Although normal depth (steady-uniform flow) may be acceptable upstream and downstream, providing for continuity of the energy gradient through an expansion from one assumed normal depth to another generally requires an accompanying change in bed elevation (a step-up going downstream.)

The design (100-yr Q) would produce a critical flow near the upstream (30' wide) end, meaning high velocity (11.6+ ft/sec) at the critical station with higher than normal (Manning) velocities for at least 1000' upstream due to drawdown. Redesign is required.

b. Drop Structure Effects. - From the station equation 31+32 BK = 0+00 Ahd. the Sossoman

Channel is a series of short reaches separated by drop structures. Analysis at or similar conditions among each of these drops indicates the expected critical condition at the crest (no backwater effect from downstream influences the upstream reach.) Each reach is hydraulically independent (the analysis is for Q 100-yr, but independence is true for all flows < Q100) and is subject to drawdown effect. Because of the short reaches used, the drawdown produces higher-than-designed velocities throughout each reach. Typically 11.64 ft/sec to a minimum of 7.29 ft/sec. Allowable velocities according to the MCHD design are 6.9 ft/sec.

c. Curve hydraulics - no analysis has been made here, but will be incorporated in allowable velocity analysis, for reduced velocity requirements in the curves. At these high velocities, some hydraulic superelevation is also to be expected. The amount of superelevation would be part of the redesign - assuming that the greater than allowable velocities require modification which is not as yet defined (i.e. realignment, lining, etc.)

d. Culvert exit - Although the culvert capacity of 3200 cfs is a "given," the design of a drop structure immediately downstream (136' downstream) precludes the development of the assumed downstream head ($d_2$=7.5' vs. approximately 6.1' from backwater calculations) and indicates a higher than calculated $Q_{100}$. Also there is a strong potential for supercritical flow for the entire 136' reach. If not, there is probably a hydraulic jump near the culvert exit. None of these possibilities should be designed into this type of channel. Some redesign of culvert entrance and exit conditions is required to match design discharge to computed existing discharge -- or Q100 SHOULD BE RECALCULATED (HIGHER.)

B. Backwater analysis 10-year flow Sossoman Rd.

None required - 100-year will not function as designed

C. Summary & Conclusions - In all aspects, the hydraulic design is inadequate.

# Analysis of Design Velocities



Both "design" velocities and calculated velocities of 100-year flow are significantly to dangerously in excess of Allowable Velocity Analysis in Appendix E. Allowable velocities ranged between 4.48 and 4.87 ft/sec vs 6.9 fps design allowable and up to 11.6 ft/sec calculated.

Redesign is recommended using acceptable allowable velocities or channel protection virtually throughout.

Significantly the 100-year flow has approximately a 50-year recurrence interval - and allowable velocity for redesign should treat it as 50-year frequency.

The SCS method uses a 10-year storm for design of channels without significant scour. Any earth channel in redesign should be evaluated to preclude exceedence of 10-year allowable velocity at Q=1800 cfs for control of scour.

# APPENDIX A

Backwater Guadalupe - Power to Sossaman

Set Intial conditions @ start of proj

Begin Q per 100 yr design - 401 Assume levels shown @ 1+00 and work back to start of project Sta 13+00

| Sta | Z | A | P | R | $R^{2/3}$ | n | | V | V²/2g | H | Sf | $\bar{Sf}$ | Δx | h | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1+00 | 37.2 | 99 | 65 | 1.52 | 1.32 | 0.025 | | 4.05 | 0.25 | 37.45 | 0.00266 | | | | 37.45 | |
| ~~2+00~~ | ~~37.6~~ | ~~108~~ | ~~69~~ | ~~1.57~~ | ~~1.35~~ | ~~0.025~~ | | ~~3.71~~ | ~~0.21~~ | ~~37.81~~ | ~~0.00214~~ | ~~0.00240~~ | ~~100~~ | ~~.24~~ | ~~37.69~~ | |
| | | | | | | | | | | | | 0.00265 | 100 | .26 | | |
| 2+00 | 37.5 | 101 | 68 | 1.49 | 1.30 | 0.025 | | 3.97 | 0.24 | 37.74 | 0.00264 | | | | 37.71 | |
| 3+00 | 38.4 | 18 | 13 | 1.38 | 1.24 | 0.035 | 948 | | | | | | | | | |
| ditch RD | | 35 | 60 | 0.58 | 0.70 | 0.025 | 1456 | | | | | 0.0152 | 100 | 1.52 | | |
| | | 53 | | | | Σ | 2404 | 7.57 | 0.89 | 39.29 | 0.02782 | | | | 39.23 | |
| ~~4+00~~ | ~~39.8~~ | ~~97~~ | ~~73~~ | ~~1.33~~ | ~~1.21~~ | ~~0.030~~ | | ~~4.13~~ | ~~0.27~~ | ~~40.07~~ | ~~0.00476~~ | ~~0.0163~~ | ~~100~~ | ~~1.63~~ | ~~40.86~~ | |
| | | | | | | | | | | | | 0.0144 | 100 | 1.44 | | |
| 4+00 | 40.6 | 154 | 73 | 2.10 | 1.64 | 0.030 | | 2.60 | 0.11 | 40.71 | 0.00103 | | | | 40.76 | |

But Spill to South occurs @ Z = 39.9 - Recalculate beginning @ Sec 4+00 using Sf = 0.00103 Z = 39.8

$$Q = \frac{1.486}{0.03} \times 97 \times 1.21 \times (0.00103)^{1/2} = 187 \text{ cfs}$$ (say 200 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | | V | V²/2g | H | Sf | $\bar{Sf}$ | Δx | h | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4+00 | 39.8 | 97 | 73 | 1.33 | 1.21 | 0.030 | | 2.06 | 0.07 | 39.87 | 0.00118 | | | | 39.87 | |
| ~~5+00~~ | ~~40.0~~ | ~~108~~ | ~~72~~ | ~~1.50~~ | ~~1.31~~ | ~~0.030~~ | ΔQ = 0.2 | ~~1.85~~ | ~~0.05~~ | ~~40.05~~ | ~~0.00081~~ | ~~0.000997~~ | | | ~~39.97~~ | |
| | | | | | | | | | | | | 0.00109 | 0.11 | | | |
| 5+00 | 39.9 (40.3) | 101 | 71 | 1.42 | 1.26 | 0.030 | 26.8 | 1.98 | 0.06 | 39.96 | 0.00101 | | | | 39.98 | |
| | | | | | | | | | | | | 0.00156 | 0.16 | | | |
| 6+00 | 40.1 | 77 | 63 | 1.22 | 1.14 | 0.030 | | 2.50 | 0.10 | 40.20 | 0.00212 | | | | 40.14 | |
| | | | | | | | | | | | | 0.00432 | 0.43 | | | |
| 7+00 | 40.4 | 55 | 63 | 0.87 | 0.91 | 0.030 | | 3.64 | 0.21 | 40.61 | 0.00651 | | | | 40.57 | |
| | | | | | | | | | | | | 0.00402 | 0.41 | | | |
| 8+00 | 40.9 | 81 | 59 | 1.37 | 1.23 | 0.030 | | 2.47 | 0.09 | 40.99 | 0.00164 | | | | 40.98 | |

No further spills indicated @ Q = 200 cfs - Return to Design Calc flows of 410 cfs @ Sta 6+00 & determine if additional spills occur

Q = 410

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | $S_f$ | $\bar{S}_f$ | $\Delta x$ | h | Z | $\Delta$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6+00 | 40.5 | 102 | 65 | 1.57 | 1.35 | 0.03 | 4.02 | 0.25 | 40.75 | 0.00361 | | | | 40.75 | | |
| | | | | | | | | | | | 0.00513 | .52 | | | | |
| 7+00 | 40.8 | 80 | 64 | 1.25 | 1.16 | 0.03 | 5.13 | 0.41 | 41.21 | 0.00685 | | | | 41.27 | 0.06 | |
| | | | | | | | | | | | 0.00521 | 0.52 | | | | |
| ~~8+00~~ | ~~41.2~~ | ~~99~~ | ~~60~~ | ~~1.65~~ | ~~1.40~~ | ~~0.03~~ | ~~4.14~~ | ~~0.27~~ | ~~41.47~~ | ~~0.00357~~ | ~~0.00464~~ | | | ~~41.74~~ | ~~0.32~~ | |
| 8+00 | 41.4 | 111 | 60 | 1.85 | 1.51 | | 3.69 | 0.21 | 41.61 | 0.00244 | 0.00445 | 0.96 | | 41.73 | 0.12 | → Z 41.5 |
| 8+00 | 41.5 | 117 | 60 | 1.95 | 1.56 | | 3.51 | 0.19 | 41.69 | 0.00205 | | 0.45 | | 41.72 | 0.03 | SPILL b, 0.5 @ x sec |
| Q = 427 | | | | | | | | | | | ~~0.00284~~ | ~~0.22~~ | | | | |
| ~~9+00~~ | ~~41.8~~ | ~~115~~ | ~~60~~ | ~~1.92~~ | ~~1.55~~ | | ~~3.71~~ | ~~0.21~~ | ~~42.01~~ | ~~0.00234~~ | 0.00243 | 0.24 | | 41.94 | 0.07 | Appx 17 cfs per 100' |
| 9+00 | 41.7 | 109 | 60 | 1.82 | 1.49 | | 3.92 | 0.24 | 41.94 | 0.00282 | | | | 41.96 | 0.02 | → Z 41.7 |
| Q = 475 | | | | | | | | | | | | | | | | spill b, 1.2' |
| | | | | | | | | | | | 0.00276 | .24 | | | | Appx 38 cfs per 100' |
| ~~10+00~~ | ~~42.1~~ | ~~117~~ | ~~59~~ | ~~1.98~~ | ~~1.58~~ | | ~~4.06~~ | ~~0.26~~ | ~~42.36~~ | ~~0.00269~~ | 0.00334 | .39 | | ~~42.24~~ | 0.12 | |
| 10+00 | 42.0 | 105 | 59 | 1.78 | 1.47 | | 4.52 | 0.32 | 42.32 | 0.00386 | | | | 42.29 | 0.03 | → No spill @ x sec |
| | | | | | | | | | | | 0.00393 | .39 | | | | |
| 11+00 | 42.4 | 104 | 59 | 1.76 | 1.46 | | 4.57 | 0.32 | 42.72 | 0.00399 | | | | 42.68 | 0.04 | no spill |
| | | | | | | | | | | | 0.00664 | .66 | | | | |
| 12+00 | 42.8 | 80 | 58 | 1.39 | 1.24 | | 5.94 | 0.55 | 43.35 | 0.00935 | | | | 43.34 | 0.01 | |
| | | | | | | | | | | | 0.00621 | .62 | | | | |
| ~~13+00~~ | ~~43.5~~ | ~~114~~ | ~~61~~ | ~~1.87~~ | ~~1.58~~ | | ~~4.17~~ | ~~0.27~~ | ~~43.77~~ | ~~0.00306~~ | ~~0.00574~~ | ~~.58~~ | | ~~43.96~~ | ~~0.19~~ | |
| 13+00 | 43.7 | 126 | 61 | 2.07 | 1.61 | | 3.77 | 0.22 | 43.92 | 0.00224 | | | | 43.92 | 0.00 | → 0.2' spill x-sec Appx 9 cfs /100' |

Q = 484 Begin Q for Designed Channel – Conditions at start of project per Sta 13+00

z = 43.7 $S_f$ = 0.00224 ~~Q = 484 cfs~~ use "desired" Q = 470 cfs

# Guadalupe X-Secs

## Flow Area, Perimeter vs Elev

### 1+00

| | Z | T | A | P |
|---|---|---|---|---|
| | 35.6 | 50 | 0 | 50 |
| | 36.0 | 57 | 23 | 57 |
| | 36.4 | 63 | 47 | 63 |
| Spills @ 36.7 | 36.8 | 65 | 73 | 65 |
| | 37.2 | 65 | 99 | 65 |

### 2+00

| | | | |
|---|---|---|---|
| 35.5 | 0 | 0 | 0 |
| 35.7 | 30 | 3 | 35.7 |
| 36.0 | 41 | 17 | 41 |
| 36.4 | 50 | 35 | 50 |
| 36.8 | 58 | 57 | 68 |
| 37.2 | 64 | 81 | 64 |
| 37.6 | 69 | 108 | 69 |
| 38.0 | 73 | 136 | 73 |

### 3+00

| | | | |
|---|---|---|---|
| 35.3 | 6 | 0 | 6 |
| 36.0 | 8 | 5 | 8 |
| 36.8 | 10 | 12 | 11 |
| 38.0 | 12 | 25 | 15 |
| 39.2 | 20 | 44 | 24 |
| 39.5 | 24 | 51 | 27 |

3+00 Roadway

| Z | T=P | A |
|---|---|---|
| 37.6 | 0 | 0 |
| 37.9 | 46 | 7 |
| 38.1 | 57 | 17 |
| 38.4 | 60 | 35 |
| 38.8 | 65 | 60 |
| 39.3 | 74 | 95 |

### 4+00

| | | | |
|---|---|---|---|
| 35.6 | 0 | 0 | 0 |
| 35.7 | 5 | 0 | 5 |
| 36.4 | 7 | 4 | 7 |
| 37.6 | 10 | 15 | 11 |
| 38.4 | 12 | 23 | 14 |
| 39.2 | 20 | 36 | 22 |
| 39.6 | 24 | 45 | 26 |

3+00 Roadway

| | | |
|---|---|---|
| 38.4 | 0 | 0 |
| 38.6 | 20 | 2 |
| 39.1 | 40 | 17 |
| 39.6 | 44 | 38 |

| | | | | |
|---|---|---|---|---|
| | (37.6) | (69) | | |
| Combined | 39.8 | 71 | 97 | 73 |

## 5+00

| Z | T | A | | P | |
|---|---|---|---|---|---|
| 35.8 | 3 | 0 | | 3 | |
| 36.8 | 9 | 6 | 4 | 9 | 2 |
| 38.0 | 16 | 21 | [illegible] | 16 | 5 |
| 39.0 | 23 | 41 | 12.4 | 23 | 8 |
| 39.2 | 28 | 46 | [illegible] | 28 | 5.9 |
| Combined (39.2)(42) | | | | 42 | |
| 39.6 | 66 | 80 | | 66 | |
| 40.0 | 72 | 108 | | 72 | |
| 40.3 | 73 | 130 | | 73 | |

Spill N @39.5

500 Road

| Z | T=P | A |
|---|---|---|
| 38.7 | 0 | 0 |
| 39.2 | 13 | 3 |

## 6+00

| | | | | | |
|---|---|---|---|---|---|
| 36.0 | 3 | 0 | | 3 | |
| 37.6 | 10 | 9 | 4.4 | 12 | 4.1 |
| 38.5 | 14 | 20 | [illegible] | 16 | 6.5 |
| 38.7 | 18 | 23 | 22.2 7.5 | 20 | 9.5 |
| 38.8 | 25 | 25 | | 27 | |
| 39.4 | 36 | 43 | | 38 | |
| 40.1 | 61 | 77 | | 63 | |
| 40.5 | 63 | 102 | | 65 | |

Spill N

## 7+00

| | | | | | |
|---|---|---|---|---|---|
| 37.4 | 3 | 0 | | 3 | |
| 38.4 | 8 | 6 | 2.8 | 9 | 3.5 |
| 39.5 | 14 | 18 | 5.9 | 16 | 7.3 |
| 39.7 | 29 | 22 | 6.46 | 31 | |
| 40.3 | 61 | 49 | | 63 | |
| 40.8 | 62 | 80 | | 64 | |

## 8+00

| | | | |
|---|---|---|---|
| 37.6 | 2 | 0 | 2 |
| 39.1 | 16 | 14 | 16 |
| 39.9 | 29 | 32 | 29 |
| 40.5 | 58 | 58 | 58 |
| 41.2 | 60 | 99 | 60 |

## 9+00

| | | | |
|---|---|---|---|
| 37.8 | 3 | 0 | 3 |
| 39.3 | 15 | 14 | 15 |
| 39.6 | 24 | 19 | 24 |
| 40.4 | 28 | 40 | 28 |
| 40.9 | 57 | 61 | 57 |
| 41.5 | 60 | 97 | 60 |

10+00

| Z | T | A | P |
|---|---|---|---|
| 38.4 | 5 | 0 | 5 |
| 40.0 | 23 | 22 | 23 |
| 40.7 | 28 | 40 | 28 |
| 41.3 | 57 | 66 | 57 |
| 42.1 | 59 | 112 | 59 |

11+00

| | | | |
|---|---|---|---|
| 38.6 | 2 | 0 | 2 |
| 40.6 | 25 | 27 | 25 |
| 41.1 | 30 | 41 | 30 |
| 41.9 | 57 | 76 | 57 |
| 42.5 | 59 | 110 | 59 |

12+00

| | | | |
|---|---|---|---|
| 38.9 | 5 | 0 | 5 |
| 41.6 | 28 | 28 | 28 |
| 42.0 | 39 | 41 | 39 |
| 42.8 | 58 | 80 | 58 |
| 43.3 | 60 | 110 | 60 |

13+00

| | | | |
|---|---|---|---|
| 39.3 | 6 | 0 | 6 |
| 40.8 | 19 | 19 | 19 |
| 42.0 | 28 | 47 | 28 |
| 43.5 | 61 | 114 | 61 |

# APPENDIX B

80-10

# Backwater - Guadalupe Spills for 100-year Q

## Hydraulic Analysis of MCHD Design

Overflow Reach I 11+00 (13+00) to 21+00 Q final - 470 cfs, Q initial = 1020 cfs
Total overflow 550 cfs
Avg overflow 550 cfs

A. Sta 13+00 to Sta 18+00

Channel transitions from b=10' to b=20' (2'/Sta)
& Channel-M offset varies linearly from 18' to 70' (10.4'/Sta)

B. Sta 18+00 to Sta 21+00 b = 20' M offset = 70'

Bed Slope 13+00 to 21+00 constant $S_o = 0.0025$

Invert Sta 13+00 = EL 38.85
ROUGHNESS CHANNEL 0.027 Road 0.025 Composite 0.026

Initial Conds. (Appendix A Sheet 4 of 4
Sta 13+00 $z = 43.7$ $S_f = 0.00224$

$Q = 470$ cfs

$A = 3y^2 + by$ Trapezoid

$P = b + 6.3y$ Trapezoid

13+00 $A = 3\times(3.3)^2 + 10\times 3.3 + 1.7\times\frac{(30+66)}{2} = 147$

$z = 43.7$ $P = 10 + 6.3(3.3) + \frac{6.3}{2}\times 1.7 + 31 = 67$

14+00 $A = 3\times(3.4)^2 + 12\times 3.4 + 1.4\times\frac{(32+74)}{2} = 150$

$z = 43.9$ $P = 12 + 6.3(3.4) + \frac{6.3}{2}\times 1.4 + 37 = 75$

$z = 43.8$ $A = 145$
$P = 74$

15+00
z 44.0

$A = 3 \cdot (3.7)^2 + 14 \cdot 3.7 + 0.9 \times \left(\frac{37+83}{2}\right) = 147$

$P = 14 + 6.3(3.7) + \frac{6.3}{2} \times 0.9 + 43 = 83$

16+00
z 44.1

$A = 3 \times (3.6)^2 + 16 \times 3.6 + 0.9 \times \frac{(38+88)}{2} = 153$

$P = 16 + 6.3(3.6) + \frac{6.3}{2} \times 0.9 + 47 = 86$

17+00
z=44.3

$A = 3(3.8)^2 + 18 \times 3.8 + 0.6 \times \frac{(41+94)}{2} = 152$

$P = 18 + 6.3(3.8) + \frac{6.3}{2} \times 0.6 + 51 = 95$

18+00
z=44.5

$A = 3(3.9)^2 + 20 \times 3.9 + 0.5 \frac{(43+98)}{2} = 159$

$P = 20 + 6.3(3.9) + \frac{6.3}{2} \times 0.5 + 53 = 99$

z=44.4

$A = 149$

$P = .97$

21+00
z=44.8

$A = 3(3.9)^2 + 20 \times 3.9 = 124$

$P = 20 + 6.3(3.9) = 45$

z=44.9

$A = 128$
$P = 45$

NATIONAL 42 181 50 SHEETS 5 SQUARE 42 182 100 SHEETS 5 SQUARE 42 389 200 SHEETS 5 SQUARE

# Overflow Reach I Backwater Guadalupe Rd

| Sta | Z | A | P | R | $R^{2/3}$ | n | h | $\bar{h}$ | Q / ΔQ | V | $V^2/2g$ | H | $S_f$ | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13+00 | 43.7 Bk / 43.7 Ahd | 126 / 147 | 61 / 67 | 2.19 | 1.69 | 0.026 | 0.2 | | 470 | 3.20 | 0.16 | 43.86 | 0.00224 Bk / 0.00110 AHD | | | | 43.86 | |
| $\bar{Q}$=474 | | 148.5 | 71 | 2.09 | 1.63 | 0.026 | | 0.1 | 9 | | | | | 0.00118 | 100 | .12 | | |
| 14+00 | 43.9 | 150 | 75 | | | 0.026 | 0 | | 479 | 3.19 | 0.16 | 44.06 | | | | | 43.98 | 0.08 |
| $\bar{Q}$=474 | | 146 | 70.5 | 2.07 | 1.62 | 0.026 | | 0.1 | 9 | | | | | 0.00123 | 100 | .12 | | |
| 14+00 | 43.8 | 145 | 74 | | | 0.026 | 0 | | 479 | 3.30 | 0.17 | 43.97 | | | | | 43.98 | 0.01 |
| $\bar{Q}$ 479 | | 146 | 78.5 | 1.77 | 1.46 | 0.026 | | | 0 | 3.28 | 0.17 | | | 0.00154 | 100 | .15 | | |
| 15+00 | 44.0 | 147 | 83 | | | 0.026 | 0 | | 479 | | | 44.17 | | | | | 44.13 | 0.04 |
| $\bar{Q}$ 479 | | 150 | 84.5 | 1.78 | 1.46 | 0.026 | | | | 3.19 | 0.16 | | | 0.00146 | 100 | .15 | | |
| 16+00 | 44.1 | 153 | 86 | | | 0.026 | 0 | | 479 | | | 44.26 | | | | | 44.28 | 0.02 |
| $\bar{Q}$ 479 | | 152.5 | 90.5 | 1.69 | 1.42 | | | | | 3.14 | 0.15 | | | 0.00150 | 100 | .15 | | |
| 17+00 | 44.3 | 152 | 95 | | | | 0 | | 479 | | | 44.45 | | | | | 44.43 | 0.02 |
| $\bar{Q}$ 479 | | 155.5 | 97 | 1.60 | 1.37 | | | | | 3.08 | 0.15 | | | 0.00154 | 100 | .15 | | |
| ~~18+00~~ | ~~44.5~~ | ~~159~~ | ~~99~~ | | | | | | | | | ~~44.65~~ | | | | | ~~44.58~~ | ~~0.07~~ |
| | | 150.5 | 96 | 1.57 | 1.35 | | 0 | | 479 | 3.18 | 0.16 | | | 0.00170 | 100 | .17 | 44.60 | 0.04 |
| 18+00 | 44.4 | 149 | 97 | | | | | | | | | 44.56 | | | | | | |
| $\bar{Q}$=479 | | 136.5 | 71.5 | 1.91 | 1.54 | | | | | | | | | ~~0.00159~~ | ~~300~~ | ~~0.48~~ | | |
| | | | | | | | | | | 3.51 | 0.19 | | | | | | 45.08 | 0.9 |
| ~~21+00~~ | ~~44.8~~ | ~~124~~ | ~~46~~ | | | | ~~0~~ | | ~~479~~ | | | 44.99 | | | | | | |
| $\bar{Q}$=479 | | 138.5 | 71 | 1.95 | 1.56 | | | | | | | | 6 | 0.00151 | 300 | 45 | | |
| 21+00 | 44.9 | 128 | 45 | | | | 0 | | 479 | 3.46 | 0.19 | 45.09 | | | | | 45.05 | 0.04 |

WITH OUTFLOW Q-470 Overflow Reach I will spill 9cfs vs 550 Desired

Overflow Reach I should have Q = 1020 cfs initially - Sta 21+00 -

Determine outflow & spills which cause Q = 1020 @ 21+00

Q = 470 @ Sta 13+00 is too low to force 550 cfs of spill - Adjust outflow conditions to approximate 1020 @ 21+00

TRY 700 cfs @ Sta 10+00

Assume n = 0.030 z = 42.4 -

A = 130 P = 59 R = 2.20 $R^{2/3} = 1.69$

$S_f = 0.00414$

Rerun Overflow Reach I  Q-700 cfs  Sta 10+00

| Sta | Z | A | P | R | $R^{2/3}$ | n | bkel | h | Q/ΔQ | V | $V^2/2g$ | H | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+00 | 42.4 | 130 | 59 | | | 0.030 | 42.1 | 0.52 | 700 | 5.38 | 0.45 | 42.85 | | | | 42.85 | |
| 748 $\bar{Q}$ | | 126 | 59 | 2.14 | 1.66 | 0.030 | | | 97 | | | | 0.00556 | 100 | 0.56 | | |
| 11+00 | 42.7 | 122 | 59 | | | 0.030 | 43.03 42.6 | 0.43 | 797 | 6.53 | 0.66 | 43.36 | | | | 43.41 | 0.05 |
| $\bar{Q}$ = 756 | | 129 | 59 | 2.19 | 1.68 | | | 0.52 | 113 | | | | 0.00496 | 100 | 0.50 | | |
| 11+00 | 42.8 | 128 | 59 | | | | 42.11 42.6 | 0.51 | 813 | 6.35 | 0.63 | 42.43 | | | | 43.35 | 0.08 |
| 11+00 | 42.7 | 122 | 59 | | | 0.030 | 42.6 | 0.43 | 797 | 6.53 | 0.66 | 43.36 | | | | 43.41 | 0.05 |
| $\bar{Q}$=850 | | 119 | 59.5 | 2.00 | 1.59 | 0.030 | | 0.50 | 106 | | | | 0.00823 | 100 | 0.82 | | |
| 12+00 | 43.4 | 116 | 60 | | | 0.030 | 43.3 | 0.57 | 903 | 7.78 | 0.94 | 44.34 | | | | 44.23 | 0.11 |
| $\bar{Q}$=845 | | 116 | 59.5 | 1.95 | 1.56 | 0.030 | | 0.47 | 96 | | | | 0.00888 | 100 | 0.89 | | |
| 12+00 | 43.3 | 110 | 60 | | | 0.030 | 43.3 | 0.51 | 893 | 8.12 | 1.02 | 44.32 | | | | 44.30 | 0.02 |
| | | 117 | 60.5 | 1.93 | 1.55 | 0.030 | | 0.63 | 150 | | | | 0.01201 | 100 | 1.20 | | |
| 13+00 | 43.7 | 124 | 61 | | | 0.030 | 43.5 | 0.75 | 1093 | 8.80 | 1.10 | 44.80 | | | | 45.50 | |
| $\bar{Q}$=989 | | 131 | 60.5 | 1.68 | | | | 0.75 | 192 | | | | 0.00822 | 100 | .82 | | |
| 13+00 | 44.1 | 151 | 61 | 2.17 | | 0.030 | 43.5 | 1.00 | 1085 | 7.19 | 0.80 | 44.90 | | | | 45.12 | 0.22 |
| $\bar{Q}$=1006 | | 137 | 60.5 | 2.26 | 1.72 | 0.030 | | 0.83 | 227 | | | | 0.00743 | 100 | .74 | | |
| 13+00 | 44.3 | 163 | 61 | | | 0.030 | 44.66 43.5 | 1.16 | 1120 | 6.87 | 0.73 | 45.03 | | | | 45.04 | 0.01 |

Overflow Reach I Backwater Guadalupe Rd. Q 1000 - 1000 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | bk el | $h_c$ | Q/ΔQ | V | $V^2/2g$ | H | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.8t | 11 Fk | | | 0.059 BK | 44.50 | | | 6.87 | 0.73 | | | | | | |
| 13+00 | 44.3 | 187 AH | 69 | | | 0.026 AH | 43.5 | 1.03 | 1120 | 5.99 | 0.56 | 44.86 | | | | 44.86 | |
| $\bar{Q}$=1268 | | 187 | 73 | 2.56 | 1.87 | 0.026 | | 0.99 | 296 | | | | 0.00402 | 100 | .40 | | |
| 14+00 | 44.4 | 187 | 77 | | | 0.026 | 44.4 43.9 | 0.94 | 1416 | 7.57 | 0.89 | 45.29 | | | | 45.26 | 0.03 |
| $\bar{Q}$=1552 | | 187.5 | 82.5 | 2.27 | 1.73 | | | 0.94 | 273 | | | | 0.00701 | | .70 | | |
| 15+00 | 44.6 | 186 | 88 | | | 0.026 | 44.3 | 0.94 0.3+ | 1689 | 8.08 | 1.28 | 45.88 | | | | 45.96 | 0.08 |
| | | CHECK | CRITICAL | | | $\frac{Q^2}{g} = \frac{A^3}{T}$ | | ~~0.72~~ | | Super critical | | | | | | | |
| $\bar{Q}$=1762 | | 197 | 92.5 | 2.13 | 1.66 | | | | 147 | | | | 0.00889 | | .89 | | |
| | | | | | | | | 90' -0.1 | | | | | | | | 46.85 | |
| 16+00 | 44.7 | 208 | 97 | | | 0.026 | 44.8 | 0.50 | 1836 | 8.83 | 1.21 | 45.91 | | | | | |

16+00 44.

0.94

13+00
z=44.3

$A = 147 + 0.6 \times 66 = 187$

$P = 67 + \frac{6.3}{2} \times 3.7 = 69$

14+00
z=44.4

$A = 150 + .5 \times 74 = 187$

$P = 75 + \frac{6.3}{2} \times .5 = 77$

15+00
z=44.6

$A = 3 \times (3.7)^2 + 14(3.7) + 1.5 \frac{(37+87)}{2} = 186$

$P = 83 + \frac{6.3}{2} \times 0.6 + 3 = 88$

16+00
z=44.7

$A = 153 + \frac{(88+96)}{2} \times 0.6 = 208$

$P = 88 + \frac{6.3}{2} \times 0.6 + 7 = 97$

NATIONAL 42 381 50 SHEETS 5 SQUARE 42 382 100 SHEETS 5 SQUARE 42 389 200 SHEETS 5 SQUARE

Overflow Reach I Backwater Guadalupe Rd.

Q 13+00 = 600 cfs $S_f$ = 0.00110

| Sta | Z | A | P | R | $R^{2/3}$ | n | Tow bank | h | $\Delta Q$ | V | $V^2/2g$ | H | $\bar{S}_f$ | $\Delta x$ | $h_f$ | H | $\Delta$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13+00 | 44.0 | 167 | 68 | 2.46 | 1.82 | 0.0026 | 43.5 | 0.6 | | 3.6 | 0.20 | 44.20 | 0.00119 | | | 44.20 | ok |
| $\bar{Q}$=667 | | 170 | 77.5 | 2.19 | 1.69 | 0.026 | | 0.37 | 135 | | | | 0.00165 | 200 | 0.33 | | |
| 15+00 | 44.3 | 173 | 87 | | | 0.026 | 44.3 | 0.14 ↑ ↓ | 735 | 4.25 | 0.28 | 44.58 | | | | 44.53 | 0.05 |
| $\bar{Q}$=735 | | 177 | 95.5 | 1.85 | 1.51 | 0.026 | 0 | | | | | | 0.00232 | 200 | 0.46 | | |
| 17+00 | 44.6 | 181 | 102 | | | 0.026 | 45.2 | 0 | 735 | 4.06 | 0.26 | 44.86 | | | | 44.99 | 0.13 |
| $\bar{Q}$=735 | | 186 | 96 | 1.94 | 1.55 | | | | | | | | 0.00198 | 200 | 0.40 | ~~44.93~~ | |
| 17+00 | 44.7 | 191 | 103 | | | 0.026 | 45.2 | 0 | 735 | 3.84 | 0.23 | 44.93 | | | | 44.93 | 0.00 |
| $\bar{Q}$=735 | | 166 | 74 | 2.24 | 1.71 | 0.026 | | | | | | | 0.00205 | 400 | 0.82 | | |
| 21+00 | 45.2 | 141 | 45 | | | | 46.5 | | 735 | 5.21 | 0.42 | 45.62 | | | | 45.75 | 0.13 |
| $\bar{Q}$=735 | | 168.5 | 74 | 2.28 | 1.73 | 0.0026 | | | | | | | 0.00194 | 400 | 0.78 | | |
| 21+00 | 45.3 | 146 | 45 | | | 0.0026 | | | 735 | 5.03 | 0.39 | 45.69 | | | | 45.71 | 0.02 |

At initial Q 600 total Spill in reach 1 is 135 vs 550 "desired"

Conclusion: Designed spill for Reach 1 requires in excess of 600 cfs outflow and is very sensitive to change - controlled spill is highly questionable in a designed channel

13+00
z=44.0

$A = 147 + 0.3 \frac{(66+67)}{2} = 167$

$P = 67 + \frac{6.3}{2} \cdot 0.3 = 68$

15+00
z=44.3

$A = 147 + 0.3 \frac{(83+87)}{2} = 173$

$P = 83 + \frac{6.3}{2} \times 0.3 + 3 = 87$

17+00
z=44.6

$A = 152 + 0.3 \frac{(94+101)}{2} = 181$

$P = 95 + \frac{6.3}{2} \times 0.3 + 6 = 102$

17+00
z=44.7

$A = 181 + 0.1 \times 101 = 191$

$P = 103$

21+00
z=45.2

$A = 20 \times 4.0 + (4.0)^2 \times 3 + 0.3(43)$ 141

$P = 20 + 6.3(4.0) + \frac{6.3}{2} \times 0.3 = 45.2$

# APPENDIX C

# Appendix C

Backwater Curves Sta 46+00 to 52+60 Guadalupe

Item 2

Begin By Checking the drop structure for critical flow at various Q

Q = 2420 cfs (100-year design)
(Assume no spill above drop str ($n = 0.027$ $Q = 2600+$)

Downstream of drop assume steady, uniform
- will produce slightly higher z than actual, but if critical conditions are indicated, upstream will be independent of downstream $S_o = 0.0025$

$Q = 2420$ cfs, $n = 0.027$ (anticipate a few short weeds) $b = 50'$ $z = 3$ $A = 50y + 3y^2$ $P = 50 + 6.3y$

$AR^{2/3} = \frac{2420 \times 0.027}{1.486 S_o^{1/2}} = 879.4$

| y | A | P | R | $R^{2/3}$ | $AR^{2/3}$ |
|---|---|---|---|---|---|
| 5 | 325 | 81.6 | 3.98 | 2.51 | 816.5 |
| 5.3 | 349.3 | 83.4 | 4.19 | 2.60 | 907.5 |
| 5.2 | 341.1 | 82.8 | 4.12 | 2.57 | 876.9 ok |

WSE @ Downstr. edge of basin = 5.2 + 46.95 = 52.15

Check critical $\frac{Q^2}{g} = \frac{A^3}{T}$ $T = 50 + 6y$ $\frac{Q^2}{g} = 181876$

| y | A | $A^3$ | T | $A^3/T$ | Δ |
|---|---|---|---|---|---|
| 3 | 177 | $5.595 \times 10^6$ | 68 | 87000 | -94000 |
| 4 | 248 | $1.525 \times 10^7$ | 74 | 206,122 | +24246 |
| 3.8 | 233.3 | $1.270 \times 10^7$ | 72.8 | 174,472 | -7404 use 3.8 |

WSE @ Crit. above crest = 3.8 + 49.02 = 52.82

∴ @ $y_c$ El. of crit flow is above Downstream WS 52.82 > 52.15. Critical flow does occur.

Begin Backwater 20' upstr from drop at Critical Sta 45+90 $z = 49.10 + 3.8 = 52.9$ $V_c = \frac{2420}{233.3} = 10.37$ $\frac{V^2}{2g} = 1.67$

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE

# Backwater Sta 45+90 to 52+60 Guadalupe

$Q_{100} = 2420$ cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45+90 | 52.9 | 233.3 | 73.9 | 3.16 | 2.15 | 0.027 | 10.37 | 1.67 | 54.57 | 0.00767 | | | | 54.57 | |
| | | | | | | | | | | | 0.00677 | 60 | 0.41 | | |
| 46+50 | 53.35 | 255.4 | 75.8 | 3.39 | 2.25 | 0.027 | 9.48 | 1.39 | 54.74 | 0.00587 | | | | 54.98 | 0.24 |
| | | | | | | | | | | | 0.00631 | 60 | 0.38 | | |
| 46+50 | 53.55 | 270.5 | 77.1 | 3.51 | 2.31 | 0.027 | 8.95 | 1.24 | 54.79 | 0.00496 | | | | 54.95 | 0.16 |
| | | | | | | | | | | | 0.00579 | 60 | 0.35 | | |
| 46+50 | 53.85 | 293.5 | 79.0 | 3.72 | 2.40 | 0.027 | 8.25 | 1.06 | 54.91 | 0.00390 | | | | 54.92 | 0.01 |
| | | | | | | | | | | | 0.00340 | 100 | 0.34 | | |
| 47+50 | 54.50 | 325.0 | 81.6 | 3.98 | 2.51 | 0.027 | 7.45 | 0.86 | 55.36 | 0.00290 | | | | 55.26 | 0.10 |
| | | | | | | | | | | | 0.00351 | 100 | 0.35 | | |
| 47+50 | 54.40 | 317.0 | 80.9 | 3.92 | 2.49 | 0.027 | 7.63 | 0.90 | 55.30 | 0.00311 | | | | 55.27 | 0.03 |
| | | | | | | | | | | | 0.00290 | 350 | 1.02 | | |
| 51+00 | 55.45 | 333.0 | 82.1 | 4.05 | 2.54 | 0.027 | 7.27 | 0.82 | 56.27 | 0.00270 | | | | 56.29 | 0.02 |

use Z = 55.45 to determine if critical flow occurs at Road dip

| | | | | | |
|---|---|---|---|---|---|
| Z = 53.35 | 53.55 | 53.85 | 54.50 | 54.40 | |
| 46+50 | 46+50 | 46+50 | 47+50 | 47+50 | 51+00 |
| Bed = 49.25 | | | Bed = 49.50 | | Bed 50.35 |
| y = 4.1 | y = 4.3 | y = 4.6 | 5.0 | 4.9 | 5.1 |
| A = 255.4 | A = 270.5 | A = 293.5 | A = 325 | A = 317.0 | A = 333.0 |
| P = 75.8 | P = 77.1 | P = 79.0 | P = 81.6 | P = 80.9 | P = 82.1 |

Sossaman Rd Dip - Calculated Area - El Curve

$g_1 = 2.71\%$ $\quad g_2 = 4.72\%$ $\quad r = \frac{g_2 - g_1}{L} = \frac{7.43}{2} = 3.715$

$y = 1.8575x^2 - 2.71x + 1355.11$ $\quad$ Low pt $x = \frac{2.71}{3.715} = 0.729$

(sta 5+73)

$y = 54.12$

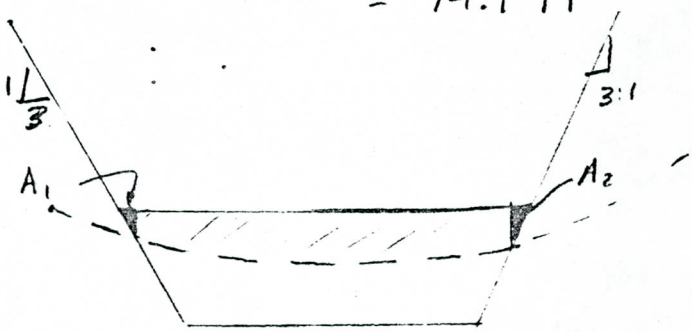
EVALUATE AREA of VERT CURVE
STA 5+15 TO 6+05 (Base width of effective flow)
Below EL 55.11 (VPC EL)

$$A = \int_{0.15}^{1.05} dx \int_{1.8575x^2 - 2.71x + 55.11}^{55.11} dy = \int_{0.15}^{1.05} (\cancel{55.11} - 1.8575x^2 + 2.71x - \cancel{55.11})\,dx$$

$$= \left[-\frac{1.8575}{3}x^3 + \frac{2.71}{2}x^2\right]_{0.15}^{1.05}$$

$$= -.717 + 1.494 + 0.002 - 0.030 = 0.749 \text{ (sta ft)}$$

$$= 74.9 \text{ ft}^2 \quad \text{(Shaded Area)}$$




$y_{0.15} = 54.75$

$A_1 = \frac{3}{2}(55.11 - 54.75)^2 = 0.19 \text{ ft}^2$

$y_{1.05} = 54.31$

$A_2 = \frac{3}{2}(55.11 - 54.31)^2 = 0.96 \text{ ft}^2$

EL 55.11 Topwidth $= (1.05 - 0.15) \times 100 + 3 \times (0.36 + 0.80)$

$= 90 + 3.5 = 93.5'$

Add $1.1 \text{ ft}^2$ - Total Area Below 55.11 = $\underline{76.0 \text{ ft}^2}$

To calculate Additional Area Above 55.11

$\Delta A = 93.5 \times (EL - 55.11) + 3(EL - 55.11)^2$ $\quad$ Total Area = $76.0 + \Delta A$

Additional top width above 55.11

$\Delta T = 6 \times (EL - 55.11)$ $\quad$ Total Topwidth = $93.5 + \Delta T$

For critical condition at Sossaman Rd Dip

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

$$A^3/T = \frac{2420^2}{32.2} = 181876$$

| EL | A | $A^3$ | T | $A^3/T$ | Δ |
|---|---|---|---|---|---|
| 55.11 | 76.0 | 438,976 | 93.5 | 4695 | -177000 |
| 57.11 | 275 | | 105.5 | 197126 | +15,250 |
| 57.01 | 264.5 | $1.85 \times 10^7$ | 104.9 | 176361 | -5515 |

Use Crit. Z @ RD = 57.01

(> 55.45 ∴ no submergence)

Because of critical condition (for all $Q \leq 2420$) Rating of Dip x-ing can be calculated using total head ($H = z + \frac{V^2}{2g}$) at critical condition at the point of flow split

Table of Values ($Q^2 = \frac{gA^3}{T}$)
Critical Flow

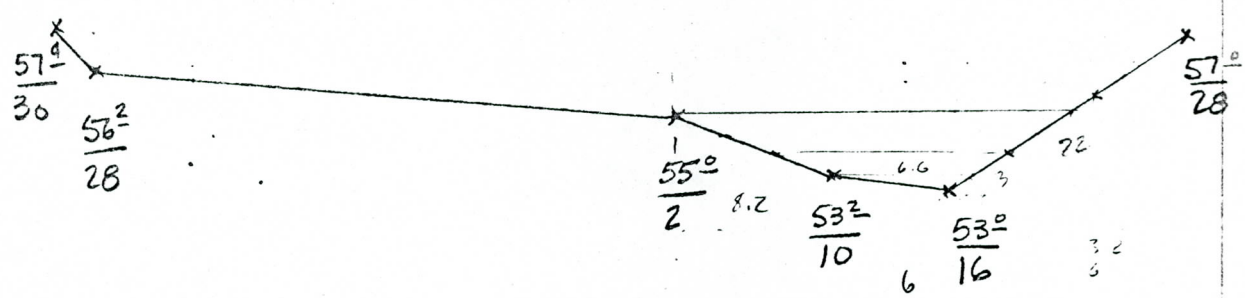
| Z | A | T | Q | V | $V^2/2g$ | H |
|---|---|---|---|---|---|---|
| 55.11 | 76 | 93.5 | 389 | 5.16 | 0.41 | 55.52 |
| 55.61 | 123.5 | 96.5 | 793 | 6.42 | 0.64 | 56.25 |
| 56.11 | 172.5 | 99.5 | 1289 | 7.47 | 0.87 | 56.98 |
| 56.61 | 223.0 | 102.5 | 1866 | 8.37 | 1.09 | 57.70 |
| 57.01 | 264.5 | 104.9 | 2383 | 9.01 | 1.26 | 58.27 |
| 57.11 | 275 | 105.5 | 2519 | 9.16 | 1.30 | 58.41 |
| 57.51 | 328.5 | 108.5 | 3294 | 9.87 | 1.51 | 59.02 |

# Sossaman Road South of Guadalupe

Establish by backwater calcs, EL vs discharge Curve for ditch and roadway.

Assume Road & ditch follow general land grade south of $S_o = 0.003$ & $n = 0.030$ ditch 0.02 road

use existing ground at x-sec 0+00 as typical to South, assume steady-uniform flow to south




Sta 0+00
Sossaman

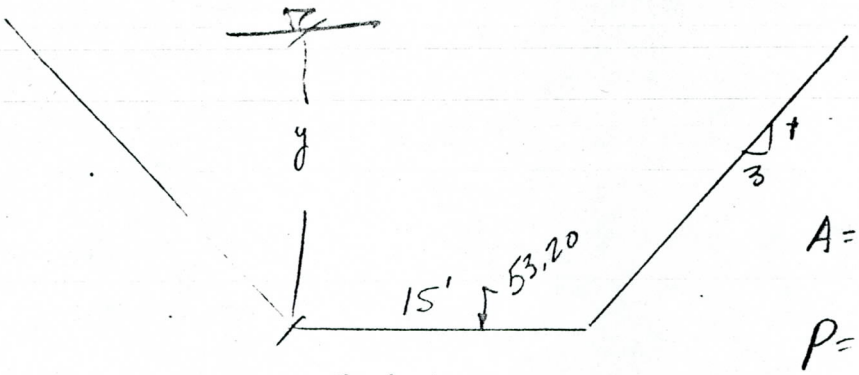
| $y_o$ | EL | DITCH T | DITCH P | DITCH A | ROAD T | ROAD P | ROAD A |
|---|---|---|---|---|---|---|---|
| 0.2 | 53 2 | 6.6 | 6.6 | 0.7 | – | | |
| 1.0 | 54 0 | 12.6 | 12.8 | 8.3 | – | | |
| 1.5 | 54 5 | 16.3 | 16.6 | 15.6 | – | | |
| 2.0 | 55 0 | 20.0 | 20.5 | 24.6 | – | – | – |
| 2.5 | 55 5 | 21.5 | 22.1 | 35.0 | 12.5 | 12.5 | 3.1 |
| 3.0 | 56 0 | 23.0 | 23.7 | 46.1 | 25.0 | 25.0 | 12.5 |
| 3.2 | 56 2 | 23.6 | 24.3 | 50.8 | 30.0 | 30.0 | 18.0 |
| 3.5 | 56 5 | 24.5 | 25.2 | 58.0 | 30.5 | 30.9 | 27.1 |
| 4.0 | 57 0 | 26.0 | 26.8 | 70.6 | 31.3 | 31.5 | 42.5 |
| 4.4 | 57 4 | 26.0 | 26.8 | 81.0 | 31.3 | 31.5 | 55.0 |
| 4.5 | 57 5 | 26.0 | 26.8 | 83.6 | 31.3 | 31.5 | 58.2 |

# Calculate Conditions @ Sta 0+00

## Various flow RATES

$n = 0.030$ Ditch $\quad n = 0.022$ Road $\quad S_o = 0.003$

| y | Z | | A | P | R | $R^{2/3}$ | K $\frac{1.486 A R^{2/3}}{n}$ | Q | V | $V^2/2g$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.0 | 55.0 | | 24.6 | 20.5 | 1.20 | 1.13 | | 75.4 | 3.06 | 0.15 | 55. |
| 2.5 | 55.5 | DITCH | 35.0 | 22.1 | 1.58 | 1.36 | 2355.5 | | | | |
| | | RD. | 3.1 | 12.5 | 0.25 | 0.39 | 82.7 | | | | |
| | | Σ | 38.1 | | | | 2438.2 | 133.5 | 3.51 | 0.19 | 55. |
| 3.0 | 56.0 | DITCH | 46.1 | 23.7 | 1.95 | 1.56 | 3558.2 | | | | |
| | | RD | 12.5 | 25.0 | 0.50 | 0.63 | 531.9 | | | | |
| | | | 58.6 | | | | 4090.1 | 224.0 | 3.82 | 0.23 | 56. |
| 3.5 | 56.5 | DITCH | 58.0 | 25.2 | 2.30 | 1.74 | 5008.1 | | | | |
| | | RD | 27.1 | 30.9 | 0.88 | 0.92 | 1677.2 | | | | |
| | | | 85.1 | | | | 6685.3 | 366.2 | 4.30 | 0.29 | 56. |
| 4.0 | 57.0 | DITCH | 70.6 | 26.8 | 2.63 | 1.91 | 6670.4 | | | | |
| | | Rd | 42.5 | 31.5 | 1.35 | 1.22 | 3505.1 | | | | |
| | | | 113.1 | | | | 10175.5 | 557.3 | 4.93 | 0.38 | 57. |
| 4.4 | 57.4 | DITCH | 81.0 | 26.8 | 3.02 | 2.09 | 8387.2 | | | | |
| | | RD | 55.0 | 31.5 | 1.75 | 1.45 | 5386.8 | | | | |
| | | | 136.0 | | | | 13773.9 | 754.4 | 5.55 | 0.48 | 57. |
| 4.5 | 57.5 | DITCH | 86.3 | 26.8 | 3.22 | 2.18 | 9318.9 | | | | |
| | | RD | 58.2 | 31.5 | 1.85 | 1.51 | 5919.2 | | | | |
| | | | 144.5 | | | | 15238.1 | 834.6 | 5.76 | 0.52 | 58. |

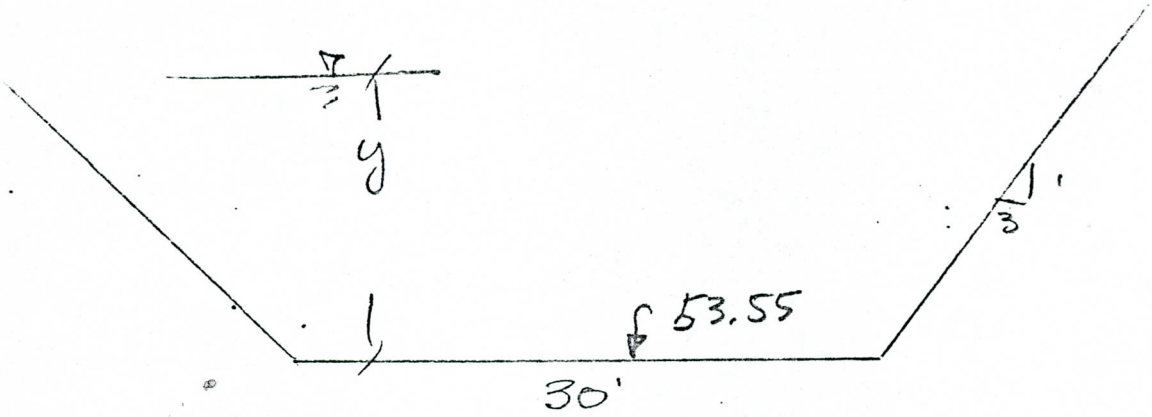



Assume bank height sufficient

STA 1+50

$A = 15y + 3y^2$

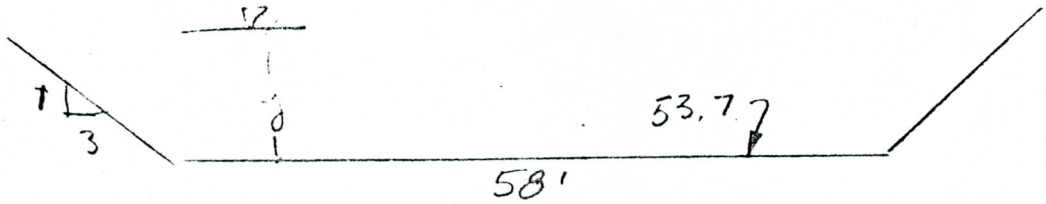
$P = 15 + 6.2y$




Sta 4+00

$A = 30y + 3y^2$

$P = 30 + 6.2y$




Sta 5+00

$A = 58y + 3y^2$

$P = 58 + 6.2y$

42 381 50 SHEETS 5 SQUARE
42 382 100 SHEETS 5 SQUARE
42 389 200 SHEETS 5 SQUARE

# Backwater Sta 0+00 to 5+00 Sossaman

Q = 780 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0+00 | 57.4 | 136. | | | | 0.03 | 5.73 | 0.51 | 57.91 | 0.00300 | | | | 57.91 | |
| | | | | | | | | | | | 0.00320 | 150 | .48 | | |
| * 1+50 above both banks | 57.5* | 120.0 | 41.7 | 2.86 | 2.02 | 0.027 | 6.50 | 0.66 | 58.16 | 0.00340 | | | | 58.39 | 0.23 |
| | | | | | | | | | | | 0.00292 | 150 | 0.44 | | |
| ~~1+50~~ | ~~57.7*~~ | ~~128.3~~ | 42.9 | 2.99 | 2.08 | 0.027 | 6.08 | 0.57 | 58.27 | 0.00284 | | | | 58.35 | 0.08 |
| | | | | | | | | | | | 0.00280 | 150 | 0.42 | | |
| 1+50 | 57.8* | 132.5 | 43.5 | 3.04 | 2.10 | 0.027 | 5.89 | 0.54 | 58.34 | 0.00259 | | | | 58.33 | 0.01 |
| | | | | | | | | | | | 0.00170 | 250 | 0.43 | | |
| ~~4+00~~ | ~~58.35*~~ | ~~213.1~~ | 59.8 | 3.57 | 2.33 | 0.027 | 3.66 | 0.21 | 58.56 | 0.00081 | | | | 58.76 | 0.20 |
| | | | | | | | | | | | 0.00164 | 250 | 0.41 | | |
| 4+00 | 58.55* | 225 | 61 | 3.69 | 2.39 | 0.027 | 3.47 | 0.19 | 58.74 | 0.00070 | | | | 58.74 | 0.00 |
| | | | | | | | | | | | 0.00046 | 100 | 0.04 | | |
| 5+00 | 58.7 | 365 | 89 | 4.10 | 2.56 | 0.027 | 2.14 | 0.07 | 58.77 | 0.00023 | | | | 58.79 | 0.02 |

USE Q = 780 H = 58.78

Q = 560 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0+00 | 57.0 | | | | | | | | 57.38 | 0.00300 | | | | 57.38 | |
| | | | | | | | | | | | 0.00246 | 150 | 0.37 | | |
| 1+50 | 57.4 | 116.0 | 41.0 | 2.83 | 2.00 | 0.027 | 4.82 | 0.36 | 57.76 | 0.00193 | | | | 57.75 | 0.01 |
| | | | | | | | | | | | 0.00125 | 250 | 0.31 | | |
| 4+00 | 57.95 | 190.1 | 57.3 | 3.32 | 2.22 | 0.027 | 2.95 | 0.13 | 58.08 | 0.00058 | | | | 58.06 | 0.02 |
| | | | | | | | | | | | 0.00038 | 100 | | | |
| 5+00 | 58.1 | 313.3 | 85.3 | 3.67 | 2.38 | 0.027 | 1.8 | 0.05 | 58.15 | 0.00019 | | | 0.04 | 58.10 | 0.05 |

USE Q = 560 H = 58.12

Backwater, Sta 0+00 to 5+00 — Sossaman

Q = 370 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0+00 | 56.5 | | | | | 0.030 | | | 56.79 | 0.00300 | | | | 56.79 | |
| | | | | | | | | | | | 0.00220 | 150 | .33 | | |
| 1+50 | 56.9 | 96.6 | 37.9 | 2.55 | 1.86 | 0.027 | 3.83 | 0.23 | 57.13 | 0.00139 | | | | 57.12 | 0.01 |
| | | | | | | | | | | | 0.00093 | 250 | 0.23 | | |
| 4+00 | 57.25 | 152.1 | 52.9 | 2.87 | 2.02 | 0.027 | 2.43 | 0.09 | 57.34 | 0.00048 | | | | 57.35 | 0.01 |
| | | | | | | | | | | | 0.00032 | 100 | 0.03 | | |
| 5+00 | 57.3 | 247.7 | 80.3 | 3.08 | 2.12 | 0.027 | 1.49 | 0.03 | 57.33 | 0.00016 | | | | 57.38 | 0.05 |

USE Q = 370 H = 57.35

Q = 225 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0+00 | 56.0 | | | | | | | | 56.23 | 0.0030 | | | | 56.23 | |
| | | | | | | | | | | | 0.00195 | 150 | 0.29 | | |
| 1+50 | 56.4 | 78.7 | 34.8 | 2.26 | 1.72 | 0.027 | 2.86 | 0.13 | 56.53 | 0.000910 | | | | 56.52 | 0.01 |
| | | | | | | | | | | | 0.000623 | 250 | 0.16 | | |
| 4+00 | 56.65 | 121.8 | 49.2 | 2.48 | 1.83 | 0.027 | 1.85 | 0.05 | 56.70 | 0.000336 | | | | 56.68 | 0.02 |
| | | | | | | | | | | | | 100 | | | |
| 5+00 | 56.7 | 201 | 76.6 | 2.62 | 1.90 | 0.027 | 1.12 | 0.02 | 56.72 | 0.000114 | | | | 56.70 | 0.02 |

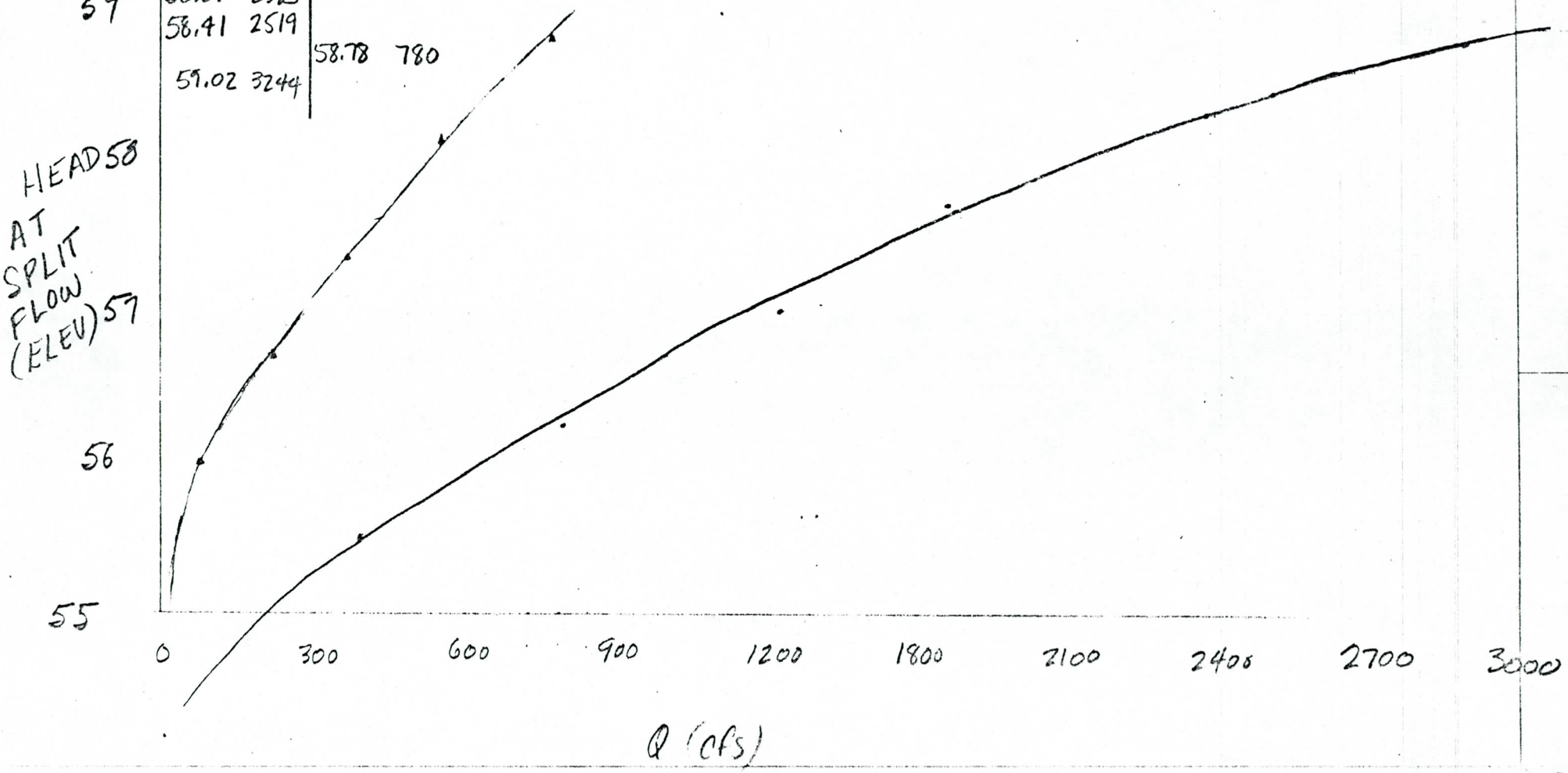
USE Q = 225 cfs H = 56.71

Q = 75 cfs

| Sta | Z | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{S}_f$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0+00 | 55.5 | | | | | | | | 55.69 | 0.00300 | | | | 55.69 | |
| | | | | | | | | | | | 0.00160 | 150 | 0.24 | | |
| 1+50 | 55.9 | 62.4 | 32.0 | 1.95 | 1.56 | 0.027 | 1.20 | 0.02 | 55.92 | 0.00020 | | | | 55.93 | 0.01 |
| | | | | | | | | | | | 0.00014 | 250 | 0.04 | | |
| 4+00 | 56.05 | 93.8 | 45.8 | 2.05 | 1.61 | 0.027 | 0.80 | 0.01 | 56.06 | 0.00008 | | | | 55.97 | 0.09 |
| | | | | | | | | | | | 0.00015 | 250 | 0.04 | | |
| 4+00 | 55.95 | 89.3 | 45.1 | 1.98 | 1.58 | 0.027 | 0.86 | 0.01 | 55.96 | 0.00009 | | | | 55.97 | 0.01 |
| | | | | | | | | | | | 0.00006 | 100 | 0.01 | | |
| 5+00 | 56.00 | 143 | 72.5 | 2.06 | 1.62 | 0.027 | 0.56 | 0.00 | 56.00 | [illegible] | | | | 55.96 | 0.02 |

| WEST ON GUADALUPE | | SOUTH ON SOSSAMAN | |
|---|---|---|---|
| H | Q | H | Q |
| 55.52 | 389 | | |
| | | 56.00 | 75 |
| 56.25 | 793 | | |
| | | 56.71 | 225 |
| 56.98 | 1289 | | |
| | | 57.35 | 370 |
| 57.70 | 1866 | | |
| | | 58.12 | 560 |
| 58.27 | 2383 | | |
| 58.41 | 2519 | | |
| | | 58.78 | 780 |
| 59.02 | 3244 | | |

Q vs Total HEAD
FLOWS AT Division Point
Guadalupe & Sossaman



C 11/1

Sta 7+00
WSE

| H | $\Sigma Q$ | $Q_s$ | $Q_G$ | $Q_G/Q_s$ |
|---|---|---|---|---|
| 56.0 | 710 | 75 | 635 | 8.47 |
| 57.0 | 1400 | 280 | 1120 | 4.00 |
| 57.6 | 2300 | 440 | 1860 | 4.23 |
| 58.0 | 2660 | 540 | 2120 | 3.93 |
| 58.3 | 3020 | 620 | 2400 | 3.87 |
| 58.4 | 3150 | 650 | 2500 | 3.85 |
| 58.5 | 3260 | 600 | 2580 | 3.79 |

42 381 50 SHEETS 5 SQUARE
42 382 100 SHEETS 5 SQUARE
42 389 200 SHEETS 5 SQUARE
NATIONAL

# APPENDIX D

Item 3 Backwater Calcs along Sossaman from Guadalupe to Baseline - Starting at Sta 7+00 (Sossaman)

I. Design 100 year flow $Q = 3200$ cfs

From appendix C - the 3200 cfs flow split would require a total head of 58.45 (ele

A. Check Critical Conditions in Sossaman Ditch where b=5

$$\frac{Q^2}{g} = \frac{A^3}{T} \qquad \text{with } A = 3y^2 + 50y$$

$$\frac{Q^2}{g} = 318{,}012 \qquad T = 50 + 6y$$

| $y$ | $A$ | $T$ | $A^3/T$ | $\Delta$ | |
|---|---|---|---|---|---|
| 5.0 | 325 | 80 | 429,102 | +111,000 | |
| 4.6 | 293.5 | 77.6 | 325742 | +7730 | use $y_c = 4.6$ |
| 4.5 | 285.8 | 77 | 303018 | -14,994 | $V_c = \frac{3200}{293.5} = 10.90$ ft |

$H_c$ = Bed EL + 6.45'  $\frac{V_c^2}{2g} = 1.85$ ft

(and $H_c$ is defined as min. SPEC.E.) $E = 6.45$

$H_c$ @ Sta 7+00  54.01 + 6.45 = 60.46 ELEV

But a Head of 58.45 is only required for the flow split of 3200 cfs. The excess energy must go somewhere - and indicates that flow would go through critical upstream of the split. And would arrive at the split in a supercritical state. Control at the split under these conditions could not

be defined. Therefore a design revision would be required to dissipate the 2.01 ft of excess head (one or two more drop structures in the Sossoman Road Channel) to prevent critical flow - and the obviously unacceptable 10.90 ft/sec flow velocity.

B. Check normal (steady-uniform) flow in the two typical reaches $b=50'$ & $b=30'$

1. $Q=3200$ cfs $S_o=0.0017$ $b=50'$ $z=3$ $n=0.027$

$AR^{2/3} = \frac{Qn}{1.49 S_o^{1/2}} = 1410.2$ $A: 3y^2+50y$ $P=6.2y+50$

| y | A | P | R | $R^{2/3}$ | $AR^{2/3}$ | Δ |
|---|---|---|---|---|---|---|
| 8.0 | 592 | 99.6 | 5.94 | 3.28 | 1942.5 | +532.3 |
| 7.0 | 497 | 93.4 | 5.32 | 3.05 | 1514.8 | +104.6 |
| 6.8 | 478.7 | 92.2 | 5.19 | 3.00 | 1435.8 | +25.6 |
| 6.7 | 469.7 | 91.5 | 5.13 | 2.97 | 1397.2 | -13.0 use |

$V=6.81$ ft/sec $V^2/2g=0.72$ $E=7.42$ ft $H=61.43$

WSE 7+00 (if normal flow) = 54.01+6.7 = 60.71 = z

Which would not be contained at 7+00 (only indication of channel depth is a note "not less than 1360.0 west bank and "existing grade at section line" generally 1358.5 to 1359.5 - which would presumably control on east bank from typical section.)

Note: It is desirable to be at or above normal depth to maintain velocity at minimum (max allowable) unless backwater

analysis indicates otherwise

2. Normal flow where $b = 30'$ $S_o = 0.0017$

$$AR^{2/3} = \frac{Qn}{1.486 S_o^{1/2}} = 1410.2 \qquad A = 3y^2 + 30y$$

$$P = 6.3y + 30$$

| $y$ | $A$ | $P$ | $R$ | $R^{2/3}$ | $AR^{2/3}$ | $\Delta$ | |
|---|---|---|---|---|---|---|---|
| 8' | 432.0 | 79.6 | 5.43 | 3.09 | 1334.1 | −76.1 | |
| 8.2 | 447.7 | 80.8 | 5.54 | 3.13 | 1401.5 | −8.7 | use |

$V = 7.15$ $\quad V^2/2g = 0.79$ $\quad E = 8.99$ $\quad y = 8.2$

Note: velocity exceeds 7 fps

II. 10 year flow $\quad Q = 1800$ cfs - controlling velocity

From Appendix C 1800 cfs would require approx. head $H = 57.3$

A. Check critical conditions

$$\frac{Q^2}{g} = \frac{A^3}{T} = 100,621$$

| $y$ | $A$ | $T$ | $A^3/T$ | $\Delta$ | |
|---|---|---|---|---|---|
| 4.0 | 248 | 74 | 206122 | +105500 | |
| 3.5 | 211.8 | 71 | 133,725 | +33,103 | |
| 3.2 | 190.7 | 69.2 | 100,249 | −371 | use |

$y_c = 3.2$ $\quad V_c = 9.44$ ft/sec $\quad V_c^2/2g = 1.38$ $\quad E_c = 4.58$

at 7+00 $\quad H_c = 54.01 + 4.58 = 58.59$ $\quad Z = 54.01 + 3.2 = 57.2$

Again flow at critical would have excess energy (1.29 ft) -

Design not adequate for 10-yr flow

B. Normal flow 1. $b = 50$ $\quad AR^{2/3} = \frac{Qn}{1.486 S_o^{1/2}} = 793.2$

| $y$ | $A$ | $P$ | $R$ | $R^{2/3}$ | $AR^{2/3}$ | $\Delta$ | |
|---|---|---|---|---|---|---|---|
| 5 | 325 | 81.0 | 4.01 | 2.53 | 820.6 | +27.4 | |
| 4.9 | 317.0 | 80.4 | 3.94 | 2.50 | 791.4 | −1.8 | use |

$y_n = 4.9$ $\quad V = 5.68$ ft/sec $\quad V^2/2g = 0.50$ $\quad E_n = 5.40$ ft $\quad H_{7+00} = 57.$

$Z = 58.91$

III. Water-surface profiles for $Q_{100}$ & $Q_{10}$

Because of the design fault approaching the split, redesign is recommended and actual conditions will not be modelled - would not be useful. Assume that flow at Sta 7+00 is normal flow (steady-uniform) in order to evaluate performance of the 30' to 50' transition and drop structures and to evaluate adequacy of channel design (velocities will result from the analysis which can be used later to compare with allowable velocities.

A. Initial Conditions $Q_{100} = 3200$ cfs

$b = 50'$ $n = 0.027$

$Z = 60.71$ $S_f = 0.0017$ (normal flow $S_f - S_o$)

$H = 61.43$ $V = 6.81$ ft/sec $V^2/2g = 0.72$ ft

Sta 7+00

B. Initial Conditions $Q_{10} = 1800$ cfs

$b = 50'$ $n = 0.027$

$Z = 58.91$ $S_f = 0.0017$

$H = 59.41$ $V = 5.68$ ft/sec $V^2/2g = 0.50$

Sta 7+00

Appendix C III-A Profile Sossaman Rd Sta 7+00 to Baseline Q=3200 cfs

| Sta | Z | Bedel. | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | $S_f$ | $\bar{S}_f$ | $\Delta x$ | $h_c$ | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7+00 | 60.71 | 54.01 | | | | | 0.027 | | 0.72 | 61.43 | 0.0017 | | | | | 61.43 | |
| | | | | | | | | | | | | 0.0017 | 1700 | | 2.89' | | |
| 24+00 | 63.61 | 56.91 | | | | | 0.027 | 6.81 | 0.72 | 64.33 | 0.0017 | | | | | 64.32 | |
| | | | | | | | | | $C_e$=0.2 | | | 0.00193 | 25 | | 0.03 0.05 | | |
| 24+25 | 63.55 | 56.95 | 427.7 | 85.9 | 4.98 | 2.92 | 0.027 | 7.48 | 0.87 | 64.42 | 0.00219 | | | | | 64.40 | 0.02 |
| | | | | | | | | | $C_e$=0.2 | | | 0.00194 | 25 | | 0.03 0.05 | | |
| 24+25 | 63.53 | 56.95 | 426.0 | 85.8 | 4.97 | 2.91 | 0.027 | 7.51 | 0.88 | 64.41 | 0.00220 | | | | | 64.40 | 0.01 |
| | | | | | | | | | | | | 0.00196 | 25 | | 0.03 0.05 | | |
| 24+25 | 63.52 | 56.95 | 425.1 | 85.7 | 4.96 | 2.91 | 0.027 | 7.52 | 0.88 | 64.40 | 0.00221 | | | | | 64.40 | 0.00 |
| | | | | | | | | | | | | 0.00257 | 25 | | | | |
| 24+50 | 63.43 | 57.00 | 381.2 | 80.5 | 4.74 | 2.82 | | 8.39 | 1.09 | 64.52 | 0.00293 | | | 0.04 | 0.06 | 64.50 | |
| | | | | | | | | | | | | 0.00259 | | | | | |
| 24+50 | 63.40 | 57.00 | 378.9 | 80.3 | 4.72 | 2.81 | 0.027 | 8.45 | 1.11 | 64.51 | 0.00298 | y=6.4 $y_c$=5.1 | | 0.05 | 0.06 | 64.51 | 0.00 |
| | | | | | | | | | | | | 0.00356 | 25 | 0.066 | 0.08 | | |
| 24+75 | 63.24 | 57.04 | 332.3 | 74.1 | 4.49 | 2.72 | | 9.63 | 1.44 | 64.68 | 0.00414 | y=6.2 $y_c$=5.4 | | | | 64.66 | |
| | | | | | | | | | | | | 0.00360 | | 0.069 | 0.090 | | |
| 24+75 | 63.21 | 57.04 | 330.2 | 73.9 | 4.47 | 2.71 | | 9.69 | 1.46 | 64.67 | 0.00421 | y=6.17 $y_c$=5.4 | | | | 64.67 | 0.00 |
| | | | | | | | | | | | | 0.00543 | | 0.134 | 0.136 | | |
| 25+00 | 62.90 | 57.08 | 276.2 | 66.7 | 4.14 | 2.58 | 0.027 | 11.72 | 2.13 | 65.13 | 0.00666 | y=5.82 $y_c$=5.8 | | | | 64.94 | 0.17 |
| | | no | shallower | | - $y_c$ = 5.8 | | | | Try higher Z | | to test | convergence | | | | | |
| 25+00 | 63.00 | 57.08 | 282.7 | 67.3 | 4.20 | 2.60 | 0.027 | 11.32 | 1.99 | 64.99 | 0.00624 | 0.00522 | | 0.106 | 0.131 | 64.91 | 0.08 |
| | | | | | | | | | | | | 0.00507 | 25 | | | | |
| 25+00 | 63.08 | 57.08 | 288.0 | 67.8 | 4.25 | 2.62 | 0.027 | 11.11 | 1.92 | 65.00 | 0.00593 | | | 0.092 | 0.126 | 64.89 | 0.11 |
| | | | | | | | | | | | | 0.00533 | 25 | | | | |
| 25+00 | 62.95 | 57.08 | 279.5 | 67.0 | 4.17 | 2.59 | 0.027 | 11.45 | 2.04 | 64.99 | 0.00645 | y=5.87 | | 0.115 | 0.133 | 64.92 | 0.07 |
| | | | | | | | | | | | | 0.00528 | | | | | |
| 25+00 | 62.97 | 57.08 | 280.8 | 67.1 | 4.18 | 2.60 | | 11.40 | 2.02 | 64.99 | 0.00643 | 5.87 | | 0.11' | 0.132 | 64.91 | 0.08 |

fails to converge ∴ discontinuity in energy gradient - Goes to Critical near Sta 25+00

Assume normal depth at Sta 25+00 for b=30' & proceed upstr to evaluate drop ctrs. Initial Conds $S_f$=0.0017 n=0.027 Z=65.28 H=66.07

D
6

Transition Calcs

Sta 24+25 $b=45$ $A=3y^2+45y$ $P=45+6.3y$

Sta 24+50 $b=40$ $A=3y^2+40y$ $P=40+6.3y$

Sta 24+75 $b=35$ $A=3y^2+35y$ $P=35+6.3y$

Sta 25+00 $b=30$ $A=3y^2+30y$ $P=30+6.3y$

Critical Flow 3200 cfs $b=50$ $z=3$ $y_c=4.6$

$b=45$ $z=3$ $y_c=4.8$

$b=40$ $z=3$ $y_c=5.1$

$b=35$ $z=3$ $y_c=5.4$

$b=30$ $z=3$ $y_c=5.8$ $A=274.9$ $P=66.5$
$V=11.64$ $V^2/2g=2.10$

Critical Flow 1800 cfs $b=50$ $z=3$ $y_c=3.2'$

$b=45$ $z=3$ $y_c=3.4'$

$b=40$ $z=3$ $y_c=3.6'$

$b=35$ $z=3$ $y_c=3.9'$

$b=30$ $z=3$ $y_c=4.2'$

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE

Continue Profile Sossaman Channel Sta 7100 to Baseline Q = 3200 cfs

| Sta | Z | Bed El. | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | $S_f$ | $\bar{S}_f$ | $\Delta x$ | $h_f$ | H | $\Delta$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25+00 | 65.28 | 57.08 | | | | | | | | 66.07 | 0.0017 | | | | 66.07 | |
| | | | normal flow | | | | | | | | | | 642 | | | |
| 31+32 | OHO | 66.37 | 58.17 | | | | | | | 67.16 | | | | | 71.49 | |
| 31+42 | | TEST | Critical @ Drop | | | | | | 66.37 | | | | | | | |
| crest | 0+92 | 66.79* | 60.99 | | | | | | | | | | | | | |

* critical depth

Z > tailwater indicates critical - ASSUME CRITICAL COND 3 to 4 x $y_c$ upstr say 20'

| Sta | Z | Bed El. | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | $S_f$ | $\bar{S}_f$ | $\Delta x$ | $h_f$ | H | $\Delta$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1+12 | 66.82 | 61.02 | 274.9 | 66.5 | 4.13 | 2.58 | 0.027 | 11.64 | 2.10 | 68.92 | 0.00672 | | | | 68.92 | |
| | | | | | | | | | | | | 0.00541 | 100 | 0.54 | | |
| 2+12 | 67.79 | 61.19 | 328.7 | 71.6 | 4.59 | 2.76 | | 9.74 | 1.47 | 69.26 | 0.00411 | | | | 69.46 | 0.20 |
| | | | | | | | | | | | | 0.00529 | 100 | 0.52 | | |
| 2+12 | 67.9 | 61.19 | 336.4 | 72.3 | 4.65 | 2.78 | | 9.51 | 1.40 | 69.30 | 0.00387 | | | | 69.45 | 0.15 |
| | | | | | | | | | | | | 0.00508 | 100 | 0.51 | | |
| 2+12 | 68.09 | 61.19 | 349.8 | 73.5 | 4.76 | 2.83 | 0.027 | 9.15 | 1.30 | 69.39 | 0.00345 | | | | 69.43 | 0.04 |
| | | | | | | | | | | | | 0.00317 | 200 | 0.63 | | |
| 4+12 | 68.93 | 61.53 | 368.3 | 76.6 | 5.04 | 2.94 | 0.027 | 8.28 | 1.07 | 70.00 | 0.00288 | | | | 70.06 | 0.06 ok. |
| | | | | | | | | | | | | 0.00236 | 400 | 0.94 | | |
| 8+12 | 70.31 | 62.21 | 439.8 | 81.0 | 5.43 | 3.09 | 0.027 | 7.28 | 0.82 | 71.13 | 0.00183 | | | | 71.00 | 0.13 |
| | | | | | | | | | | | | 0.00295 | 400 | 0.98 | | |
| 8+12 | 70.11 | 62.21 | 424.2 | 79.8 | 5.32 | 3.05 | 0.027 | 7.54 | 0.88 | 70.99 | 0.00202 | | | | 71.04 | 0.05 |
| | | | | | | | | | | | | 0.00193 | 198 | 0.38 | | |
| 10+10 | 70.65 | 62.55 | 439.8 | 81.0 | 5.43 | 3.09 | 0.027 | 7.29 | 0.82 | 71.47 | 0.00183 | | | | 71.42 | 0.05 |

Test critical - Tailwater - Z - 70.65

Crest El = 65.65 $Z_c$, Crit WSE = 65.65 + 5.8 = 71.45 indicates Critical $Z_c$ > tailwater

Subsequent reaches will have identical profile for 898' upstr corresponding to values for Sta 1+12 through 10+10, with only modified elevations adjusted for Bed Elev.

Continue Profile Sossaman Channel Sta 7+00 to Baseline Rd Q=3200

| Sta | Z | Bed | A | P | R | $R^{2/3}$ | n | V | $V^2/2g$ | H | Sf | $\bar{Sf}$ | Δx | $h_f$ | H | Δ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10+82 | 71.45 | | | | | | | 11.64 | | | | | | | | |
| 11+82 | 72.72 | | | | | | | | | | | | | | | |
| 13+82 | 73.56 | 66.16 | 386.3 | | | | | | 1.07 | 74.63 | 0.00288 | | | | 74.69 | 0.06 |
| | | | | | | | | | | | | 0.00256 | 228' | 0.58 | | |
| 16+10 | 74.26 | 66.56 | 408.9 | 78.5 | 5.21 | 3.00 | 0.027 | 7.83 | 0.95 | 75.21 | 0.00225 | | | | 75.27 | 0.06 |

Drop is 3.06' vs 3.07' @ Sta 9+80 - again critical

69.65

16+82 75.45

17+82 76.72

19+82 77.56

21+60 78.00 EST. VALUE

Drop is 4.1' - again critical

22+30 80.37

23+10 81.64

25+10 82.48

27+10 83.00 EST VALUE

Drop 4.1' again critical

Sta 27+80 through Baseline culvert will be supercritical - Although excluded, redesign is required. Note: Supercritical flow in curved channel not desirable

# APPENDIX E

# Appendix E

## Allowable Velocity Determination

80-10

Based on Design Configuration 10yr 100yr Q
From Field data by MCHD & Engineers' Testing Lab*

Station Sossaman Rd

| | | (Sheet E-6) Avg Blow Count Bull /Std | Avg Overburden | (Fig 4-2 Sheet E-7) Rel. Density | (Fig 3-7 Sheet E-8) Void Ratio |
|---|---|---|---|---|---|
| 6+00 | P.I. | | | | |
| 3'-7' | 22 | 40 / 24 | 6' | 95% | 0.72 |
| 7'-10' | 15 | 49 / 29 | 8' | 100% | 0.70 |
| 16+00 | | | | | |
| 3'-8' (3'-5') "refusal 5.5' | 14 | 30 / 19 | 4.5 | 90% | 0.73 |
| 30+00 | | | | | |
| unusable boring | | | | | |

*See Appendix F for Field Soils Data

Guadalupe

7+00 * outside design reach

| | | | | | |
|---|---|---|---|---|---|
| 3-8' (3-10') | 5 | 35 / 21 | 7.5 | 91% | 0.73 |
| 33+00 | | | | | |
| 3-8' (3-10) | 12 | 34 / 20 | 7.5 | 88% | 0.74 |
| 44+50 | | | | | |
| 3-8' (3-10) | 14 | 43 / 25 | 7.5 | 95% | 0.72 |

Sossaman - Sediment free flow

| Sta | Type Soil | Vb * | Bank slope B * | Void Ratio Ce * | Vb×B×Ce | Depth 10 yr bed 30' | Depth 10 yr bed 50' | 10 yr Vall 30' | 10 yr Vall 50' | Depth 100 yr 30' | Depth 100 yr 50' | F 100 yr * | 100 yr Vall 30 | 100 yr Vall 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6+00 | ML | 15% (22%) | 3:1 | 0.72 | | 7 | 5 | | | 9 | 7 | | | |
| | | 2.75 | 0.86 | ~~0.98~~ 1.08 | ~~2.37~~ 2.56 | 1.18 | 1.12 | ~~2.74~~ 3.02 | ~~2.60~~ 2.87 | 1.23 | 1.18 | 1.50 | ~~4.28~~ 4.72 | ~~4.11~~ 4.53 |
| 16+00 | ML | 14% | | N/A EST .71 * | | | | | | | | | | |
| | | 2.60 | 0.86 | ~~0.95~~ 1.05 | ~~2.17~~ 2.34 | | | ~~2.50~~ ~~2.70~~ | ~~2.37~~ ~~2.62~~ | | | | ~~3.97~~ ~~4.36~~ | ~~3.75~~ ~~4.14~~ |
| 17+00 | ML | 17% | | NO TEST | | | | | | | | | | |
| | | 3.05 | 0.86 | ~~0.95~~ * 1.05 | ~~2.79~~ 2.75 | | | ~~2.94~~ 3.25 | ~~2.78~~ 3.08 | | | | ~~4.59~~ 5.07 | ~~4.41~~ 4.87 |
| 30+00 | ML | 16% | | N/A | | | | | | | | | | |
| | | 2.90 | 0.86 | ~~0.95~~ * 1.05 | ~~2.37~~ 2.62 | | | ~~2.80~~ 3.09 | ~~2.65~~ 2.93 | | | | ~~4.37~~ 4.83 | ~~4.14~~ 4.63 |
| 15+00 (AHD) | ML | 25% | | NO TEST | | | | | | | | | | |
| | | 3.50 | 0.86 | ~~0.95~~ * 1.05 | ~~2.86~~ 3.16 | | | ~~3.37~~ ~~3.72~~ | ~~3.20~~ ~~3.64~~ | | | | ~~5.28~~ ~~5.84~~ | ~~5.06~~ ~~5.69~~ |
| | | | | | Avg Allowable | | | 3.12 | 2.96 | | | | 4.87 | 4.68 |

* Evaluation of Base Velocity and Correction factors per Fig 6-2 Sheets E-9 & E-10

Depth of flow approx calc

$Q_{100}$ 3200 cfs

10 yr $Q_{10}$: 1800 cfs $n = 0.030$ b=30' b=50' $z=3$ $S_o = 0.0017$

| y | $Q_{10}$ b 30 A | P | Q | b 50 A | P | Q |
|---|---|---|---|---|---|---|
| 5 | 225 | 62 | 1084 | 325 | 92 | 1659 |
| 6 | 288 | 68 | 1541 | 408 | 98 | 2316 |
| 7 | 357 | 74 | 2085 | 497 | 94 | 3076 |
| 8 | 432 | 81 | 2691 | 592 | 101 | 3929 |
| 9 | 513 | 87 | 3426 | 693 | 107 | |

Hatched velocities do not apply because of change in bed width. They are included in establishing average Vallowable for each case

*Assumed values of void ratio of 0.76 compared with penetrometer analysis of 0.70 to 0.74

01-08

# Guadalupe Sediment free flow

| Sta | Type $V_b$ P.I | Bank Slope B. | Void Ratio $C_e$ | $V_b \times B \times C_e$ | Depth 10yr D | 10 yr Vall | Depth 100yr D | F 100 yr (50) | 100 yr Vall |
|---|---|---|---|---|---|---|---|---|---|
| 17+00 | ML 19% | 3:1 | no test | | | | | | |
| | 3.35 | 0.86 | ~~0.95~~ 1.05 | 3.03 | 3 1.01 | 3.06 | 3 1.01 | 1.50 ~~1.50~~ | 4.59 |
| 27+00 | ML 18% | | no test | | | | | | |
| | 3.20 | 0.86 | ~~0.95~~ 1.05 | 2.89 | 4.5 1.09 | 3.15 | 5 1.12 | | 4.86 |
| 33+00 | ML 12% | | 0.74 | | | | | | |
| | 2.30 | 0.86 | 1.06 | ~~2.09~~ 2.10 | 4 1.07 | ~~2.25~~ | 5 1.12 | | ~~3.37~~ |
| 39+00 | ML 19% | | no test | | | | | | |
| | 3.35 | 0.86 | 1.05 | 3.03 | 4 1.07 | ~~3.24~~ | 5 1.12 | | ~~4.86~~ |
| 44+50 | ML 13% | | 0.72 | | | | | | |
| | 2.45 | 0.86 | 1.07 | 2.25 | 4 1.07 | 2.41 | 5 1.12 | | 3.61 |
| 50+75 | ML 19% | | no test | | | | | | |
| | 3.35 | 0.86 | 1.05 | 3.03 | 4 1.07 | 3.24 | 5 1.12 | | 4.86 |
| | | | | Avg. Allowable | | 2.97 | | | 4.48 |

10-yr flow from design notes
on Split at Guadalupe Sossaman Intersection
total of 1800 cfs would generate Q approx 1375 along Guadalupe

100 year per design tables

80-10

# Flows - Guadalupe

(presumed overflow conditions for 10-yr event)

assume between 21+00 & 31+00

470 ← (550 overflow) ← 1020 (355 overflow) ← 1375 (0 overflow) ← (1375) Q10 from Design Chart

470 ← (550 overflow) ← 1020 (1000 overflow) ← 2020 (400 overflow) ← 2420 Q100 (Design)

11+00 21+00 39+00 51+00

## Guadalupe Stationing

**27+00**

Approx Q = 1225

b = 30 z = 3 $S_o$ = 0.0025

n = 0.03

$AR^{2/3}$ = 495

**10yr 39+00**

Q = 1375 b = 40 z = 3 $S_o$ = 0.0025

n = 0.03

$AR^{2/3}$ = 555

| y | A | P | R | $R^{2/3}$ | $AR^{2/3}$ |
|---|---|---|---|---|---|
| 4 | 208 | 65 | 3.2 | 2.17 | 451 |
| 5 | 275 | 72 | 3.82 | 2.45 | 674 |

use A'

Also Sta. 33+00

**10yr 51+00**

Q = 1375 b = 50 z = 3 $S_o$ = 0.0025

n = 0.03

$AR^{2/3}$ = 555

| y | A | P | R | $R^{2/3}$ | $AR^{2/3}$ |
|---|---|---|---|---|---|
| 3 | 177 | 69 | 2.57 | 1.68 | 333 |
| 4 | 248 | 75 | 3.31 | 2.24 | 555 |

y = 4

also Sta 44+50

80-10 Sheet E4 of 5

E 41

# Average Allowable Velocities for Design Review

## Sossaman Road

| 10-year (1800 cfs) | Bed Width | 100-year (3200 cfs) |
|---|---|---|
| 3.12 ft/sec | 30' | 4.87 ft/sec |
| 2.96 ft/sec | 50' | 4.68 ft/sec |

## Guadalupe Road

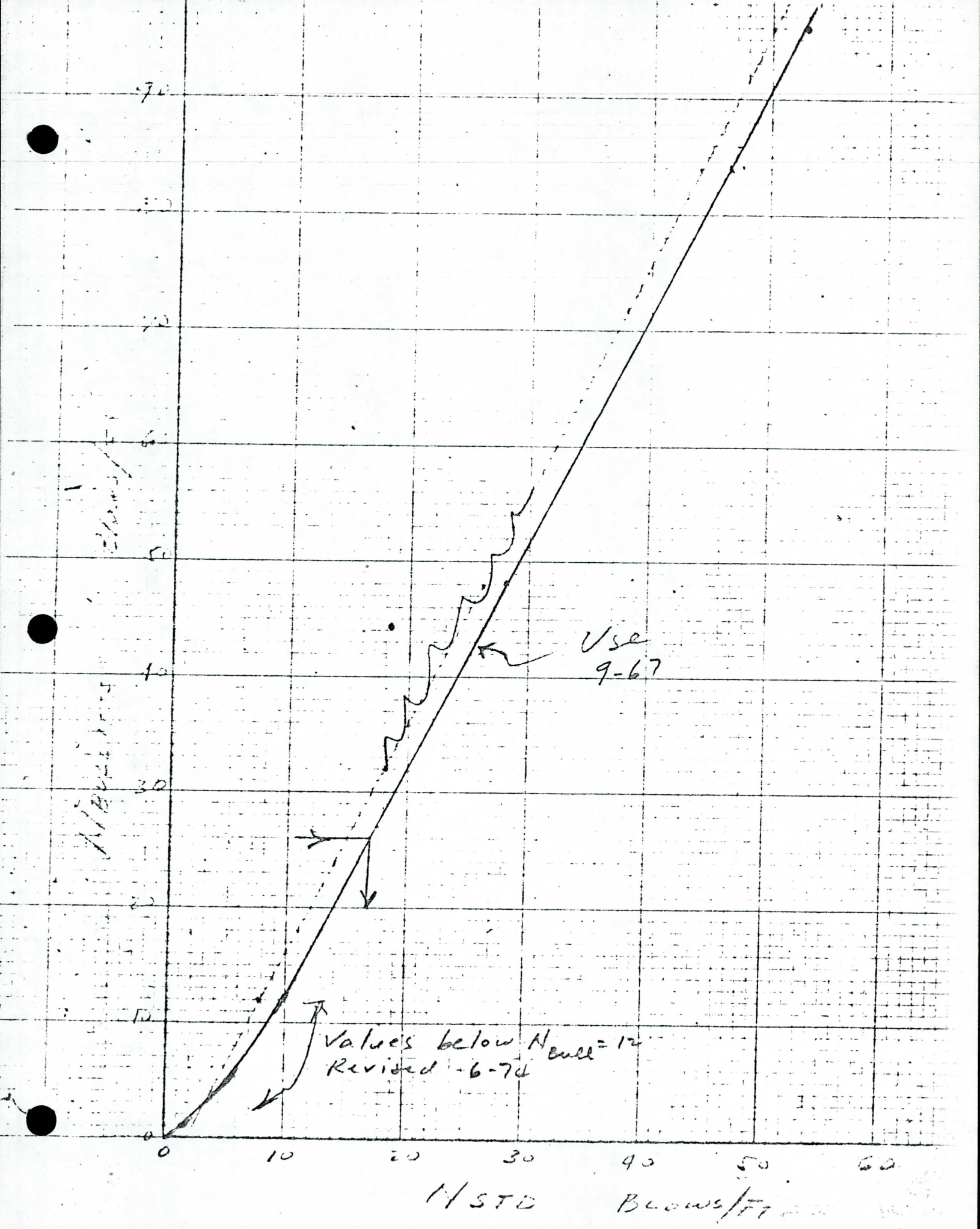
| 10-year (1360 cfs) | 100-year (2420 cfs) |
|---|---|
| 2.97 ft/sec | 4.48 ft/sec |

Values not adjusted for curves

These values are based on sediment-free water

For "100-year" Q the frequency factor of 50 year recurrence is used - velocity allowable is not a capacity parameter but a frequency parameter.

Recommend velocity redesign based on these values (or values adjusted for new design conditions depth & curvature) - At a 10-year recurrence. Channel must still accomodate 3200 cfs within $V_{all}$ for $Q_{100}$.


Use
9-67
Values below N_cull = 12
Revised 6-74
0
10
20
30
40
50
60
70
N STD Blows/Ft

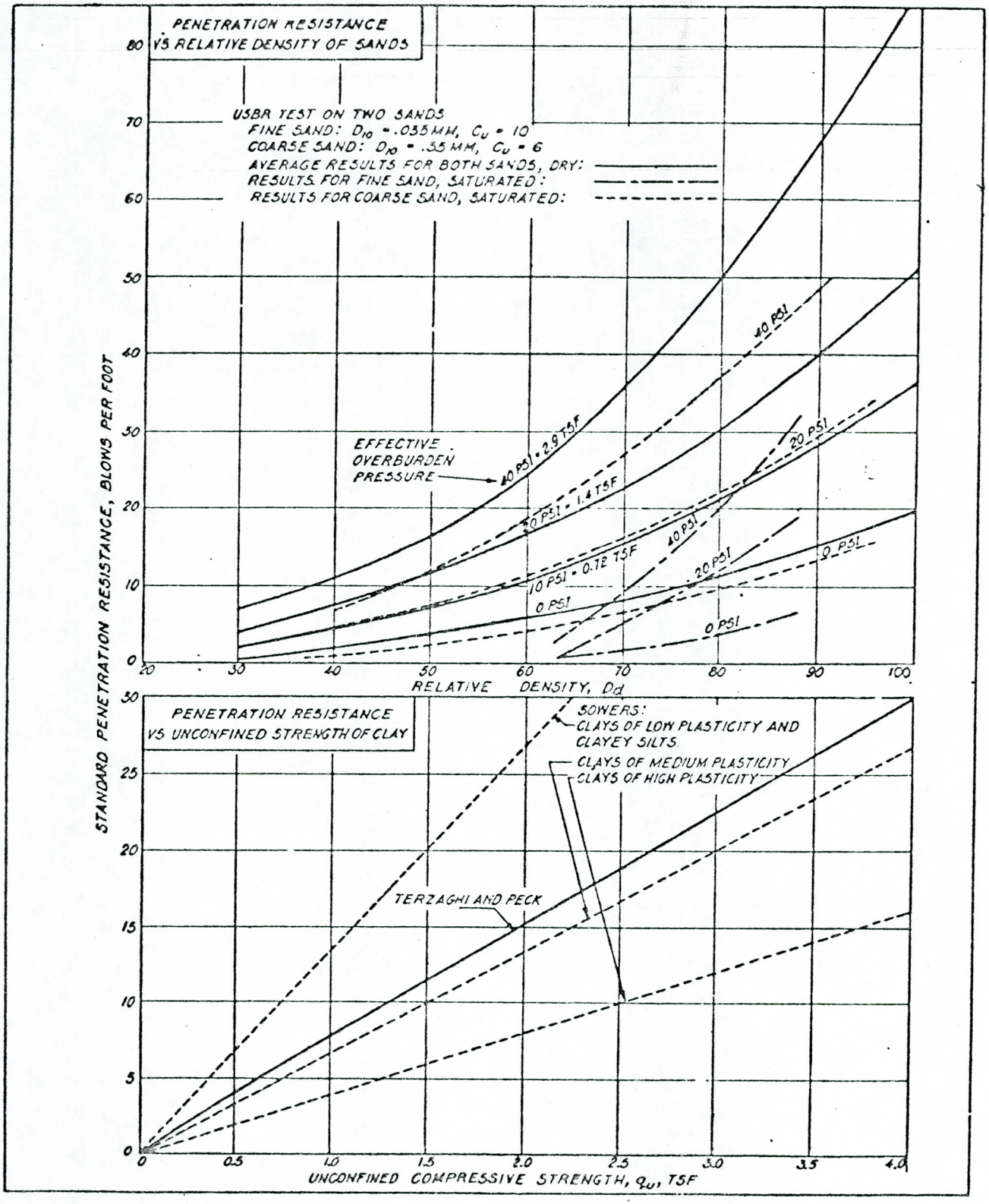



**FIGURE 4-2**
**Correlations of Standard Penetration Resistance**



Sheet E-7 of 10

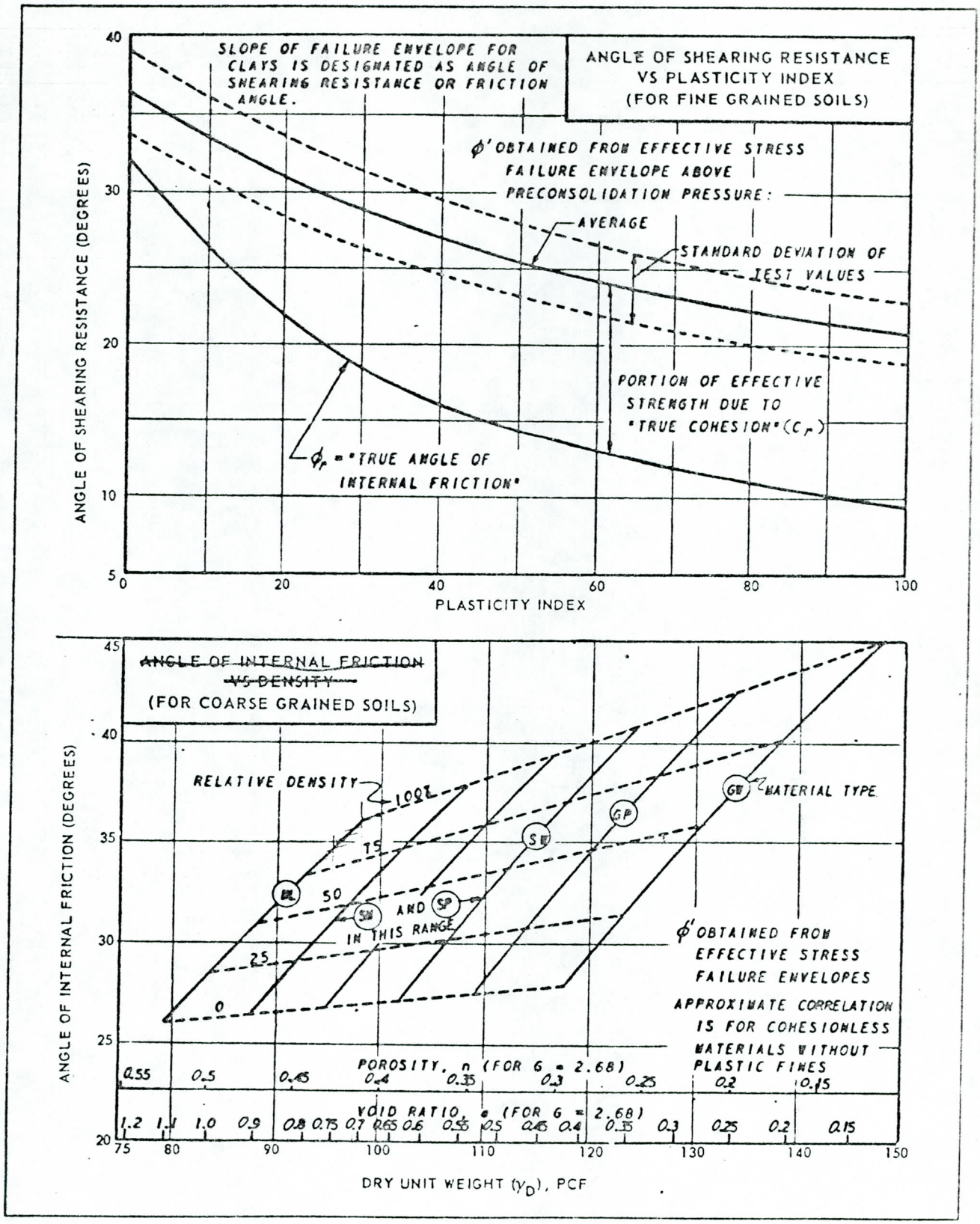
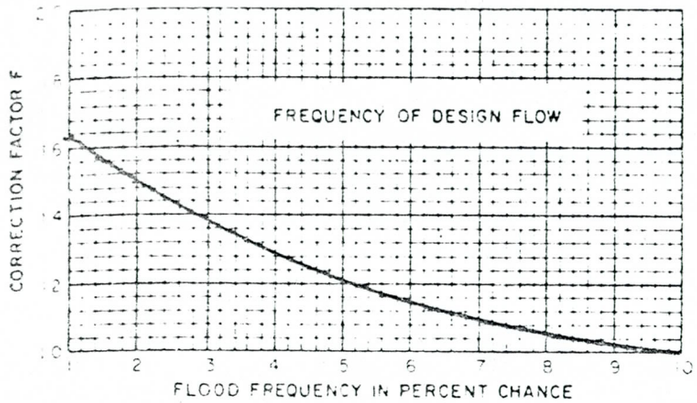
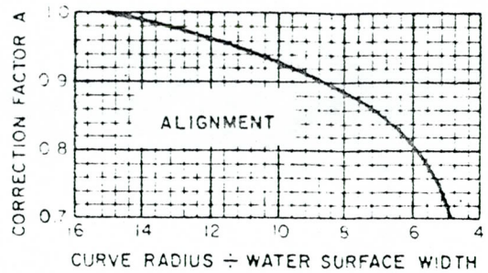


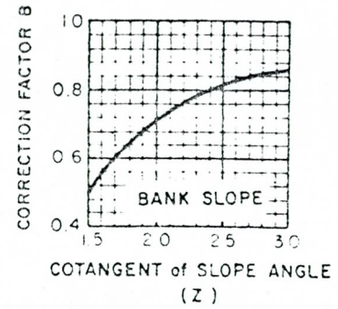

FIGURE 3-7
Correlations of Strength Characteristics

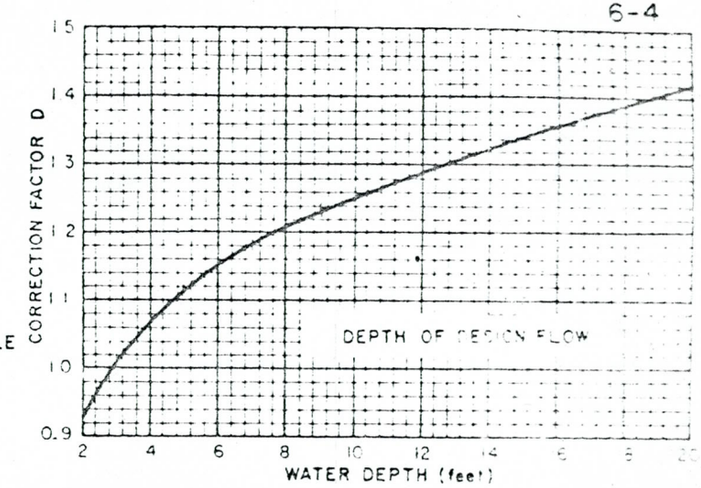


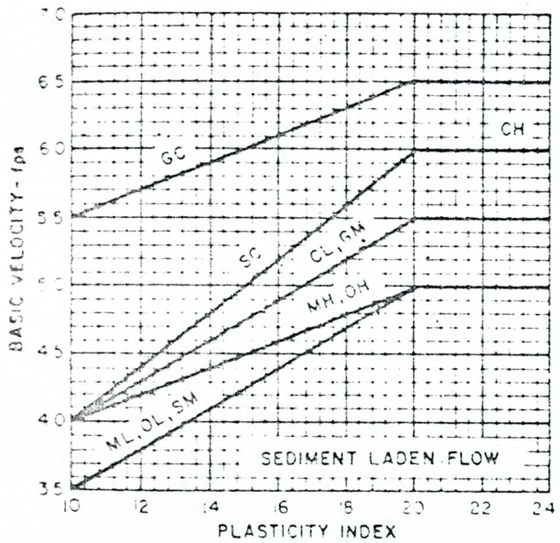
Sheet E-8 of 10



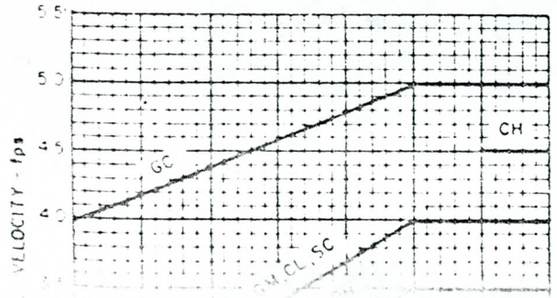



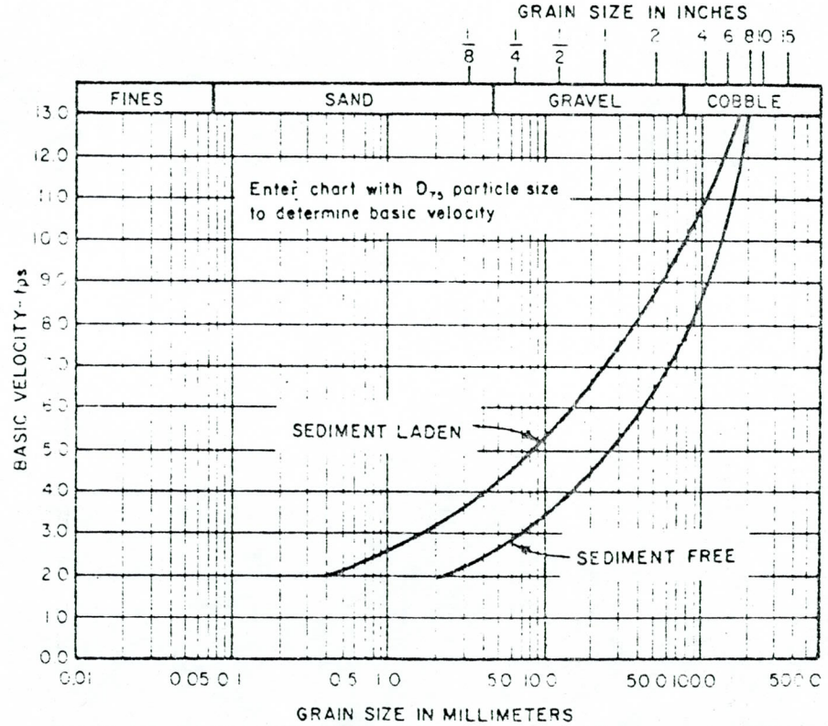



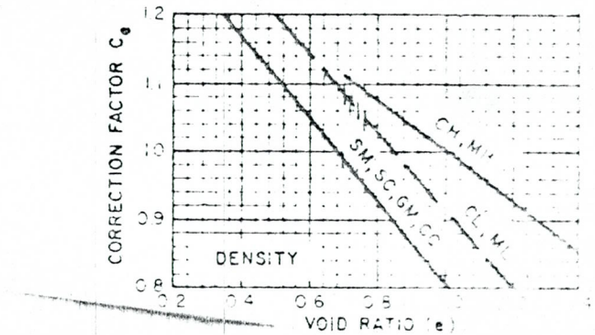




BASIC VELOCITIES FOR COHERENT EARTH MATERIALS ($v_b$)



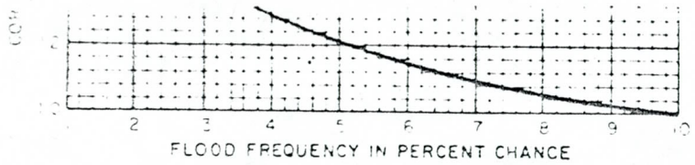

BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS ($v_b$)

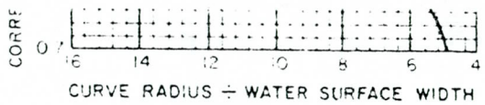


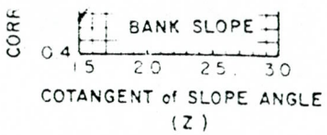

NOTES:

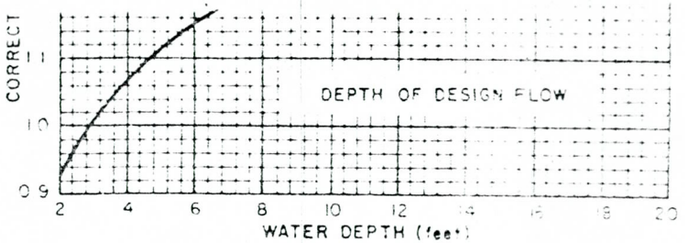
1. In no case should the allowable velocity be exceeded when the 10% chance discharge occurs, regardless of the design flow frequency.

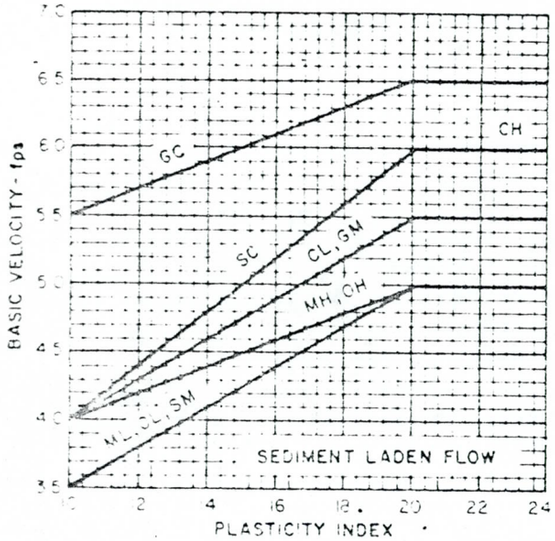
| ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS | |
|---|---|
| CHANNEL BOUNDARY MATERIALS | ALLOWABLE VELOCITY |
| DISCRETE PARTICLES | |



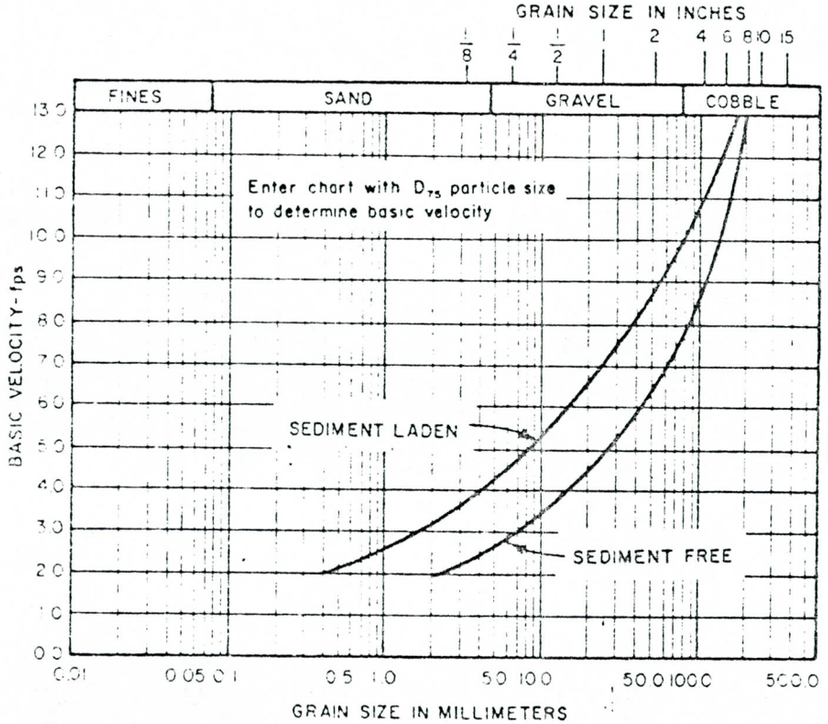



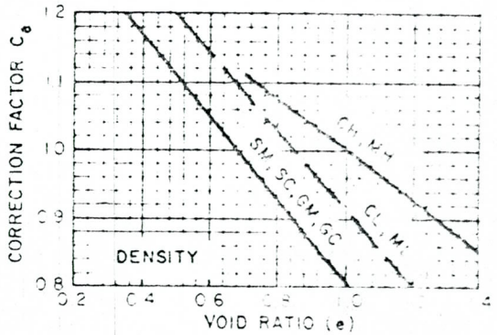



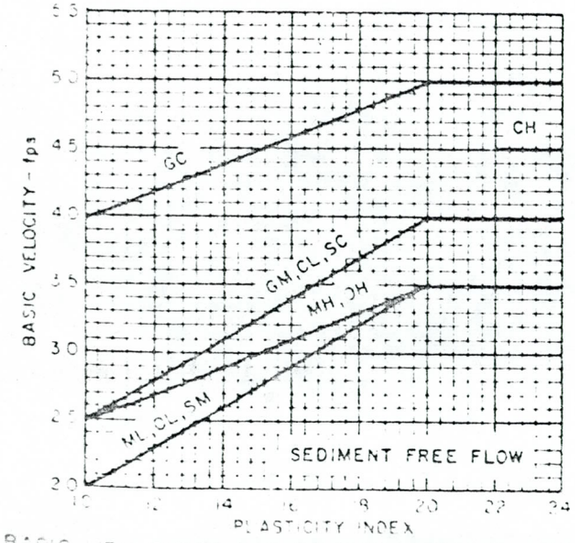




BASIC VELOCITIES FOR COHERENT EARTH MATERIALS ($v_b$)




BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS ($v_b$)




BASIC VELOCITIES FOR COHERENT EARTH MATERIALS ($v_b$)

NOTES:

1. In no case should the allowable velocity be exceeded when the 10 % chance discharge occurs, regardless of the design flow frequency.

| ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS | |
|---|---|
| CHANNEL BOUNDARY MATERIALS | ALLOWABLE VELOCITY |
| DISCRETE PARTICLES | |
| Sediment Laden Flow | |
| $D_{75} > 0.4$ mm | Basic velocity chart value x D x A x B |
| $D_{75} < 0.4$ mm | 2.0 fps |
| Sediment Free Flow | |
| $D_{75} > 2.0$ mm | Basic velocity chart value x D x A x B |
| $D_{75} \leq 2.0$ mm | 2.0 fps |
| COHERENT EARTH MATERIALS | |
| PI > 10 | Basic velocity chart value x D x A x F x $C_e$ |
| PI ≤ 10 | 2.0 fps |

FIGURE 6-2

ALLOWABLE VELOCITIES FOR UNPROTECTED EARTH CHANNELS

# APPENDIX F

# SOIL BORING DATA

Location of Boring: Maricopa Flood Control District  No. Sta. 6+00 (Sacramento)  Job No. 218 01 217

Elev. Top of Hole:  Datum:  Prepared By: B.S.  Date: 4-28-80

Type/Size of Boring: 6"  Date: 4-28-80  Driller: JDH  Reviewed By:  Date:

| Depth Ft | Penetration Resistance Blows/Ft C | Penetration Resistance Blows/Ft N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max. Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12 | | | | -PL | | Sandy Clay, trace fine gravel | CL | 1/2" | | | tr. | 40/50 | 50/60 | X | X X | | X | X | XX | X |
| 2 | 17 | | | | | | medium plasticity | | | | | | | | | | | | | | |
| 3 | 28 | | | | | | predominantly fine-medium sand | | | | | | | | | | | | | | |
| 4 | 24 | | | | | | | | | | | | | | | | | | | | |
| 5 | 35 | | | | | | light cementation below 11' | | | | | | | | | | | | | XX | |
| 6 | 50 | | | | dry | | Clayey Sand, some gravel | SC | 1" | | | 12/25 | 50/60 | 24/30 | X | X X | X | XX | XX | | X |
| 7 | 46 | | | | | | moderate-heavy cementation | | | | | | | | | | | | | | |
| 8 | 49 | | | | | | well graded sands | | | | | | | | | | | | | | |
| 9 | 21 | | | | | | low-medium plasticity fines | | | | | | | | | | | | | | |
| 10 | 22 | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | End @ 10' | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | No Groundwater | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | 4-28-80 | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | |

Appendix F

# SOIL BORING DATA

Location of Boring: Maricopa Flood Control District No. Sta. 1606 (Sossaman) Job No. 218-05-017

Elev. Top of Hole: Datum: Prepared By: B.S. Date: 4-28-86

Type/Size of Boring: 6" Date: 4-28-86 Driller: JDH Reviewed By: Date:

| Depth Ft. | Penetration Resistance Blows/Ft C | Penetration Resistance Blows/Ft N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max. Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med. Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28 | | | | dry | | Clayey Sand, brown | SC | -1/4" | | | | 50/60 | 40/50 | XX | X X | XX | X | X | | X |
| 2 | 41 | | | | | | medium plasticity fines | | | | | | | | | | | | | | |
| 3 | 50 | | | | | | well graded sands | | | | | | | | | | | | | | |
| 4 | 25 | | | | | | | | | | | | | | | | | | | | |
| 5 | 26 | | | | -FL. | | Sandy Clay, brown | CL | -1/4" | | | | 40/50 | 50/60 | X | X X | | X | X | X | |
| 6 | 100/5" | | | | | | medium plasticity | | | | | | | | | | | | | X | |
| 7 | (refusal) | | | | | | moderate cementation | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | trace fine gravel below 9' | | 1/2" | | | tr. | | | | | | | | | |
| 1 | | | | | | | End @ 10' | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | No Groundwater | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | 4-28-86 | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | |

# SOIL BORING DATA

Location of Boring Michigan Flood Control District No. Sta. 80+00 (Crossman) Job No. [illegible]

Elev. Top of Hole Datum Prepared By [illegible] Date [illegible]

Type/Size of Boring 6" Date 4-28-80 Driller [illegible] Reviewed By Date

| Depth Ft. | Penetration Resistance Blows/Ft. C | N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | [illegible] | | | | dry | | Silty Sand - Clayey Sand, brown, trace fine gravel, low plasticity, slight increase in Bl. w/ depth | SM-SC | 1/2" | | | tr. | 53/65 | [illegible]/41 | X | X X | X | XX | X | | X |
| 2 | [illegible] | | | | | | | | | | | | | | | | | | | | |
| 3 | [illegible] | | | | | | | | | | | | | | | | | | | | |
| 4 | [illegible] | | | | | | | | | | | | | | | | X | | | | |
| 5 | [illegible] | [illegible] (refusal) | | | | | Sandy Clay, brown, trace gravel, low-medium plasticity, light cementation | CL | 1/2" | | | tr. | 40/60 | [illegible]/60 | X | X X | | XX | XX | XX | X |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | Clayey Sand & Gravel, light-moderate cementation | SC-SC | 1" | | | 20% | 50/80 | 30/14 | X | X X | X | X | X | | XX |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | End @ 10' | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | No Groundwater | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | 4-28-80 | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | |

# SOIL BORING DATA

Location of Boring: Maricopa Flood Control District — No. Sta. 7+00 (Guadalupe) — Job No. 21002 [illegible]

Elev. Top of Hole — Datum — Prepared By: R.C — Date: 4-28-80

Type/Size of Boring: 6" — Date: 4-28-80 — Driller: JDH — Reviewed By — Date

| Depth Ft | Penetration Resistance Blows/Ft C | Penetration Resistance Blows/Ft N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max. Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | [illegible] | | | | -PL | | Sandy Silt [illegible] | ML-CL | -1/4" | | | - | [illegible] | [illegible] | / | X | | X | X | X | X |
| 2 | 25 | | | | -12 | | Sandy Clay, brown, medium plasticity, fine-medium sand sizes | CL | | | | | 40/60 | 60/60 | X | X | | X | X | XX | X |
| 3 | 35 | | | | | | | | | | | | | | | | | | | | |
| 4 | 32 | | | | | | | | | | | | | | | | | | | | |
| 5 | 26 | | | | | | | | | | | | | | | | | | | | |
| 6 | 22 | | | | | | Clay content increases w/depth, moderate cementation below 6', some nodules present | | | | | | 30/40 | 70/70 | | | | | | | X |
| 7 | 43 | | | | | | | | | | | | | | | | | | | | |
| 8 | 28 | | | | | | | | | | | | | | | | | | | | |
| 9 | 24 | | | | | | | | | | | | | | | | | | | | |
| 10 | 23 | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | End @ 10' | | | | | | | | | | | | | | |
| 2 | | | | | | | No Groundwater | | | | | | | | | | | | | | |
| 3 | | | | | | | 4-28-80 | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | |

# SOIL BORING DATA

Location of Boring: Maricopa Flood Control District No. Sta. 44+50 (Guadalupe) Job No. 218 05219

Elev. Top of Hole: Datum: Prepared By: R.S. Date: 4-29-80

Type/Size of Boring: 6" Date: 4-29-80 Driller: JDH Reviewed By: Date:

| Depth Ft. | Penetration Resistance Blows/Ft. C | N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max. Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | | | | slightly moist | | Clayey Sand, brown low plasticity, fine-medium sand | SC | -1/4 | | | - | 55/65 | 35/45 | X | X X X | | X | X | | X |
| 2 | 5 | | | | | | | | | | | | | | | | | | | | |
| 3 | 7 | | | | | | | | | | | | | | | | | | | | |
| 4 | 14 | | | | | | | | | | | | | | | | | | | | |
| 5 | 35 | | | | ~P.L. | | Sandy Clay, medium plasticity light cementation trace fine gravel | CL | 1/2" | | | tr. | 35/45 | 55/65 | X | X X | | X | X | X.X | X |
| 6 | 41 | | | | | | | | | | | | | | | | | | | | |
| 7 | 24 | | | | | | | | | | | | | | | | | | | | |
| 8 | 26 | | | | | | | | | | | | | | | | | | | | |
| 9 | 32 | | | | | | | | | | | | | | | | | | | | |
| 10 | 21 | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | End @ 10' No Groundwater 4-29-80 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | | | | | | | | |

# SOIL BORING DATA

Location of Boring: Maricopa Flood Control District No. Sta. 33+00 (Guadalupe) Job No. [illegible]

Elev. Top of Hole: Datum: Prepared By: B.S. Date: 4-28-50

Type/Size of Boring: 6" Date: 4-28-50 Driller: SDH Reviewed By: Date:

| Depth Ft. | Penetration Resistance Blows/Ft C | Penetration Resistance Blows/Ft N | Sample Type | Dry Density pcf | Moisture Content | Graphical Log | Description | Soil Classification | Max. Size, In. | Particle Size Distribution % Boulders | Cobbles | Gravel | Sand | Silt & Clay | Gradation Well Med Poor | Grain Shape Angular Subangular Rounded Subrounded | Relative Density Low Med High | Dry Strength None Very Low Low Medium High Very High | Plasticity None Low Medium High | Consistency Soft Firm Stiff Very Stiff Hard | Cementation None Light Moderate Heavy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | [illegible] | | | | -RL | | Sandy Clay, brown | CL | -1/4" | | | - | 35/45 | 55/65 | X | X X | | X | X | XX | X |
| 2 | [illegible] | | | | | | medium plasticity | | | | | | | | | | | | | | |
| 3 | [illegible] | | | | | | Fine-medium sand sizes | | | | | | | | | | | | | | |
| 4 | [illegible] | | | | | | | | | | | | | | | | | | | | |
| 5 | [illegible] | | | | | | light cementation below 4' | | | | | | | | | | | | | | X |
| 6 | [illegible] | | | | | | | | | | | | | | | | | | | | |
| 7 | [illegible] | | | | | | | | | | | | | | | | | | | | |
| 8 | 70 | | | | | | some fine angular gravel | | 1/2" | | | 5/10 | | | | | | | | XX | |
| 9 | 61 | | | | | | below 7' | | | | | | | | | | | | | | |
| 10 | 36 | | | | | | | | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | End @ 10' | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | No Groundwater | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | 4-28-50 | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 0 | | | | | | | | | | | | | | | | | | | | | |

6/10

MARICOPA COUNTY HIGHWAY DEPARTMENT
MATERIALS LABORATORY

SIEVE ANAYLSIS, ATTERBURG LIMITS,
SAND EQUIVALENT, AND AASHO SOIL CLASSIFICATION

PROJECT NAME- ~~SOSSAMAN~~ Guadalupe RD. SOSSAMAN RD. TO POWER RD. W.O.- 62000 DATE 3 31 80 PROJECT NUMBER-

zero to 3ft.

| LAB NO. | DEPTH | LOCATION | PERCENT PASSING NO.10 | NO.40 | NO.200 | LL | PI | M.C. | AASHO |
|---|---|---|---|---|---|---|---|---|---|
| 744 | 0'3' | STA. 50+75 ON DITCH CL. | 90 | 70 | 51 | 38 | 20 | 10 | A-6( 7) |
| 745 | 3'8' | STA. 50+75 ON DITCH CL. | 89 | 73 | 54 | 39 | 19 | 7 | A-6( 7) |
| 746 | 0'3' | STA. 44+50 ON DITCH CL. | 95 | 75 | 44 | 20 | 4 | 12 | A-4( 2) |
| 747 | 3'8' | STA. 44+50 ON DITCH CL. | 92 | 75 | 48 | 35 | 13 | 8 | A-6( 4) |
| 748 | 0'3' | STA. 39+00 ON DITCH CL. | 97 | 84 | 59 | 26 | 13 | 11 | A-6( 6) |
| 749 | 3'5' | STA. 39+00 ON DITCH CL. | 94 | 79 | 55 | 33 | 19 | 10 | A-6( 8) |
| 750 | 5'8' | STA. 39+00 ON DITCH CL. | 89 | 73 | 53 | 38 | 20 | 9 | A-6( 7) |
| 751 | 0'3' | STA. 33+00 ON DITCH CL. | 0 | 79 | 56 | 31 | 17 | 11 | A-6( 7) |
| 752 | 3'8' | STA. 33+00 ON DITCH CL. | 86 | 67 | 48 | 31 | 12 | 10 | A-6( 3) |
| 753 | 0'3' | STA. 27+00 ON DITCH CL. | 0 | 77 | 53 | 41 | 25 | 12 | A-7-6( 9) |
| 754 | 3'8' | STA. 27+00 ON DITCH CL. | 94 | 80 | 57 | 39 | 18 | 5 | A-6( 8) |
| 755 | 0'2' | STA. 17+00 ON DITCH CL. | 0 | 77 | 49 | 25 | 10 | 6 | A-4( 3) |
| 756 | 2'3' | STA. 17+00 ON DITCH CL. | 97 | 85 | 59 | 34 | 18 | 7 | A-6( 6) |

Appendix F (Continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 757 | 3'8' | STA. 17+00 ON DITCH CL. | 0 | 87 | 64 | 37 | 19 | 6 | A-6( 9) |
| 758 | 0'3' | STA. 7+00 ON DITCH CL. | 0 | 80 | 57 | 39 | 15 | 8 | A-6( 6) |
| 759 | 3'8' | STA. 7+00 ON DITCH CL. | 0 | 90 | 64 | 23 | 5 | 9 | A-4( 6) |

ADDITIONAL COMMENTS -

MARICOPA COUNTY HIGHWAY DEPARTMENT
MARERIALS LABORATORY

SIEVE ANAYLSIS, ATTERBURG LIMITS,
SAND EQUIVALENT, AND AASHO SOIL CLASSIFICATION

PROJECT NAME- SOSSAMAN RD. GUAD. TO BASELINE RD. W.O.- 62000 DATE 3 31 80 PROJECT NUMBER-

| LAB NO. | DEPTH | LOCATION | PERCENT PASSING NO.10 | NO.40 | NO.200 | LL | PI | M.C. | AASHO |
|---|---|---|---|---|---|---|---|---|---|
| 760 | 0'3' | STA. 6+00 ON DITCH CL. | 86 | 70 | 53 | 49 | 28 | 12 | A-7-6(11) |
| 761 | 3'7' | STA. 6+00 ON DITCH CL. | 77 | 60 | 40 | 42 | 22 | 4 | A-7-6( 4) |
| 762 | 7'8' | STA. 6+00 ON DITCH CL. | 83 | 64 | 40 | 34 | 15 | 4 | A-6( 2) |
| 763 | 0'3' | STA. 16+00 ON DITCH CL. | 92 | 73 | 43 | 29 | 12 | 9 | A-6( 2) |
| 764 | 3'8' | STA. 16+00 ON DITCH CL. | 92 | 76 | 51 | 31 | 14 | 7 | A-6( 5) |
| 893 | 0'2' | STA. 17+00 ON DITCH CL. | 94 | 76 | 52 | 30 | 15 | 8 | A-6( 5) |
| 894 | 5'7' | STA. 17+00 ON DITCH CL. | 91 | 75 | 55 | 39 | 17 | 11 | A-6( 7) |
| 895 | 0'2' | STA. 30+00 ON DITCH CL. | 92 | 68 | 45 | 21 | 6 | 4 | A-4( 2) |
| 896 | 5'7' | STA. 30+00 ON DITCH CL. | 93 | 75 | 55 | 36 | 16 | 9 | A-6( 6) |

ADDITIONAL COMMENTS -

9/10

MARICOPA COUNTY HIGHWAY DEPARTMENT
MATERIALS LABORATORY

SIEVE ANAYLSIS, ATTERBURG LIMITS,
SAND EQUIVALENT, AND AASHO SOIL CLASSIFICATION

PROJECT NAME- SOSSAMAN RD. E. .25 COR. SEC. 6 W.O.- 62000 DATE 3 31 80 PROJECT NUMBER-

| LAB NO. | DEPTH | LOCATION | PERCENT PASSING NO.10 | NO.40 | NO.200 | LL | PI | M.C. | AASHO |
|---|---|---|---|---|---|---|---|---|---|
| 897 | 0'2' | STA. 15+00 ON DITCH CL. | 96 | 80 | 54 | 25 | 9 | 8 | A-4( 4) |
| 898 | 5'7' | STA. 15+00 ON DITCH CL. | 92 | 81 | 65 | 47 | 25 | 13 | A-7-6(13) |

ADDITIONAL COMMENTS -

10/10