City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

March 24, 1994

David B. Thompson, P.E.
Wilson & Company
6611 Gulton Court N.E.
Albuquerque, New Mexico 87109
P.O. Box 3548 87190

RE: ENGINEER'S CERTIFICATION FOR ESTATES AT TANOAN PROPERTIES, (E-21/D12)
RECEIVED MARCH 11, 1994 FOR FINANCIAL GUARANTY RELEASE
ENGINEER'S STAMP DATED 3-7-94; PROJECT NO. 4678.90

Dear Mr. Thompson:

Based on the information included in the submittal referenced above, City Hydrology releases the Financial Guaranty for this project.

If I can be of further assistance, You may contact me at 768-2727.

Sincerely,

John P. Curtin

John P. Curtin, P.E.
Civil Engineer/Hydrology

c: Lynda-Michelle DeVanti

WPHYD/3637/jpc

ALBUQUERQUE NEW MEXICO 1706

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

September 20, 1993

David B. Thompson, P.E.
Wilson & Co.
6611 Gulton Court N.E.
Albuquerque, New Mexico 87109
P.O. Box 3548 87190

RE: GRADING PLAN REVISION No. 1 FOR TRACT P-1-A-1, TANOAN PROPERTIES, (E-21/D12), ENGINEER'S STAMP DATED AUGUST 22, 1993, PROJECT No. 4678.90

Dear Mr. Thompson:

Based on the information provided on the referenced submittal received August 24, 1993 which proposes to raise grades on City Lights Drive by 2 feet and lots 7-21 by 2 feet is acceptable.

This revision should be included in your next submittal to FEMA, since it may give them more of a comfort level that the above referenced lots are more adequately floodproofed.

Please be advised that prior to Financial Guarantee release by DRC, an Engineer's Certification must be submitted and approved by this office as required by the infrastructure list.

If you should have any questions, please do not hesitate to contact me.

Cordially,

Gilbert Aldaz

Gilbert Aldaz, P.E. & P.S.
Civil Engineer/Hydrology

xc: Clifford Anderson, AMAFCA
~~File~~

wp+3637

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

ALBUQUERQUE NEW MEXICO 1706

June 29, 1993

David B. Thompson, P.E.
Wilson & Co.
6611 Gulton Court N.E.
Albuquerque, New Mexico 87109
P.O. Box 3548 87190

RE: AMENDED DRAINAGE RESUBMITTAL FOR TRACT P-1-A-1, TANOAN PROPERTIES, (E-21/D12), ENGINEER'S STAMP DATED JUNE 10, 1993, PROJECT No. 4678.90

Dear Mr. Thompson:

Based on the information provided on the referenced submittal received June 15, 1993 the information is acceptable for Final Plat and Building Permit approval.

Please be advised that prior to Financial Guarantee release by DRC, an Engineer's Certification must be submitted and approved by this office as required by the infrastructure list.

If you should have any questions, please do not hesitate to contact me.

Cordially,

Gilbert Aldaz

Gilbert Aldaz, P.E. & P.S.
Civil Engineer/~~Hydrology~~

xc: Lynda Michelle DeVanti, DRC
Clifford Anderson, AMAFCA
File

wp+3637

PUBLIC WORKS DEPARTMENT

Walter H. Nickerson, Jr., P.E.
Assistant Director Public Works

ENGINEERING GROUP

Telephone (505) 768-2500

DRAINAGE MANAGEMENT PLAN
FOR THE ESTATES AT TANOAN

DAVID B. THOMPSON
NEW MEXICO
9677
REGISTERED PROFESSIONAL ENGINEER
3-8-93

Prepared by:

WILSON & COMPANY
6611 Gulton Ct.
Albuquerque, NM 87109

8 March 1993

DRAINAGE MANAGEMENT PLAN
FOR THE ESTATES AT TANOAN

Introduction

This report summarizes the hydrologic and hydraulic analysis for the Drainage Management Plan for the proposed residential subdivision for the Estates at Tanoan, Tract P-1-A-1, Tanoan properties. The report follows the order of the Data Request Checklist for Conditional Letter of Map Revision.

1. Scope

A portion of the project site falls within the 100-year flood hazard boundary from the Pino Arroyo as identified on the City of Albuquerque's Flood Insurance Rate Map.The scope of the Drainage Management Plan is to identify offsite and onsite drainage improvements to convey the 100-year peak flows through the proposed development and contain the peak flows in the Pino Arroyo, thus removing the floodplain from the site. The following report summarizes the analysis completed to determine these improvements.

Site Location

The site, Tract P-1-A-1 within the Tanoan properties, is located at the southeast corner of intersection of San Antonio Drive and Eubank Blvd. The Tanoan Golf Course borders the site on the south and east, San Antonio Drive on the north, and Eubank Blvd. on the west. A 150 foot PNM easement is located along the northern portion of the site which will be vacated to 40 feet. Within the easement there are existing high voltage power lines. The Pino Arroyo currently runs through the site and discharges into a detention pond located in the Eubank Blvd. right-of-way southwest of the property. The detention basin discharges to the Pino Arroyo through the golf course west of Eubank Blvd.. A 48" storm drain in Eubank Blvd. collects runoff from the Eubank/Academy intersection and discharges into the detention pond.

The site generally slopes from northeast to southwest. The northern portion of the site is on a high ridge overlooking the golf course with slopes of approximately 10% to 15%. The southern portion of the site generally slopes at approximately 3.5% from east to west.

The Pino Dam, owned and maintained by AMAFCA, is located approximately one mile east of the site. The principal spillway of the dam discharges into the Pino Arroyo through the Tanoan Golf Course. A 100 foot drainage easement is located over the golf course from the Pino Dam to the confluence with the North Pino Arroyo directly east of the property. A 150 foot AMAFCA drainage easement is located in the golf course along the southern edge of the site from the confluence through Eubank Blvd..

Proposed Development

The subdivision will consist of 57 single family homes with minimum dimensions of 75 feet wide by 120 feet deep. The site will have access from Eubank Blvd., which will be improved with a temporary pavement section from Academy Road to the San Antonio Drive intersection. At the intersection, the temporary Eubank pavement will be terminated, barricaded with Type III barricades, and graded in such a manner to block traffic from proceeding north along Eubank Blvd. or turning on San Antonio Drive. The City of Albuquerque is currently conducting an alignment study for Eubank Blvd. from Academy Road to Paseo del Norte Drive which will recommend future improvements within the corridor. Therefore, permanent roadway improvements will not be constructed within the Eubank corridor for the development. An emergency access from San Antonio Drive will provide a secondary access to the subdivision.

2. Hydraulic Backwater Models

The computer model HEC-2 Water Surface Profiles (The Hydrologic Engineering Center, US Army Corp of Engineers, Sept. 1982) was utilized to determine the water surface profiles and elevations for both the existing arroyo and proposed drainage improvements. The HEC-2 output files can be found in Appendix B.

4. Floodways

The only floodways designated in New Mexico are the Rio Grande River and its tributaries. Since the site is not impacted by any of these floodways, all items required by FEMA for a CLOMR involving floodways including topographic mapping of the floodway boundary (#7b), floodway hydraulic backwater models (#4), printouts from a hydraulic computer model used to determine the limits of the 100-year floodway and to account for any encroachments to it (#15,#18), and documentation concerning the approval of a revised floodway (#19), are not applicable to this report.

5. Flood Insurance Rate Map & 6. Topographic Mapping

A copy of the Flood Insurance Rate Map, Panel õ 18 with the project site indicated is included in the report. The energy grade line from the HEC-2 existing conditions analysis is plotted on Plate 2 as the existing floodplain. The HEC-2 profile used flows obtained from AHYMO Hydrologic Analysis program plus a 5% bulking factor. Also, the 100-year FEMA floodplain boundary from this map is plotted on Plate 2, Floodplain Boundary Map. The basis for the FEMA mapping was an approximate study of the area performed by Bohannan Huston, Inc. When this FEMA mapping was done in 1983, many subdivisions near the project site did not exist. The Highlands at Tanoan south of the project site and adjacent golf course, The Masters at Tanoan west of the Eubank right-of-way, and The Champions at Tanoan southwest of the project site were not yet built at the time the FEMA floodplain was mapped. In addition, the detention pond in the Eubank Blvd., through which the arroyo currently flows, and the adjacent berm did not exist. Also, the well defined arroyo that exists now was not as defined when the mapping was done. For these reasons there are minor differences between the FEMA floodplain and the existing computed floodplain in the area of the subdivisions and detention pond. The existing 100 year computed floodplain is outside of the FEMA floodplain boundary in only two locations. It should be noted that the energy grade line plot is conservative since the 100 year flows are for a fully developed watershed.

Topographic mapping at a 1"= 50' scale with 1' contours was completed for the site. This is shown on the Grading and Drainage Plan, Plate 3.

8. Requested Revision

The nature and extent of this request is for a conditional Letter of Map Removal (CLOMR) to remove the existing floodplain from the subdivision by filling the site and constructing a floodwall along the south property line which would divert the peak 100-year flows to the 150 foot drainage easement on the golf course . Following are the descriptions of the proposed hydrologic conditions and proposed hydraulic conditions on which the conditional revision request is based. The effective Flood Insurance Study (FIS) of Albuquerque was reviewed, but no specific information pertaining to the site area was provided.

12. Hydrologic Analysis

Section 22.2 of the DPM was followed for the hydrologic analysis performed for this project. The design storm for the analysis was the 100-year, 6-hour storm as defined by the NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume IV - New Mexico. Offsite flows from the Pino Arroyo cross the site from east to west. In order to develop the site, the site will be filled and a floodwall constructed diverting the flows to the existing 150 foot AMAFCA easement bordering the site to the south.

A hydrologic computer model was developed for the Pino Arroyo watershed from the Pino Dam to Eubank Blvd. to compute the 100-year peak flows in the arroyo. This model includes the North Pino Tributary from Tramway Blvd. to the diversion dike located east of Browning and north of San Antonio. The hydrologic computer program AHYMO 392, enhanced by AMAFCA, was used to determine peak flows in the Pino Arroyo during a 100-year rainfall event. All approved drainage reports in the Tanoan area were obtained to assist in determining the basin boundaries and characteristics for input to AHYMO. The AHYMO input file from the on-going drainage study called the "Master Drainage Report for the O Tracts at Tanoan" prepared by Bohannan-Huston, Inc. was used for the area from Pino Dam to Sky Valley Road. Information from the drainage reports for the Highlands, Country Club area, Country Club Estates, and Inverness were input to the program. Tract P-1-A-1 was divided into five drainage basins which discharge 93 CFS to the Pino Arroyo. Since the O Tracts and Tract P-1-A-1 are the only undeveloped areas in the Tanoan Properties area discharging to the Pino Arroyo, the AHYMO model was developed for the full build-out condition to obtain the maximum peak flows in the watershed.

For the North Pino Tributary, orthophoto/topographic mapping of the South Domingo Baca area by Resource Technologies, completed in May 1990, was used to delineate the drainage basins. A developed condition of 1 dwelling unit/acre was assumed for the North Pino area as input to the AHYMO model. The diversion of flows east of Tramway to the Pino Dam was accounted for in both the analysis of the North Pino watershed and the Pino Dam. Information for the Pino Dam was obtained from the "Pino Dam Revisions" report prepared by Wilson & Company in June 1991.

Plate 1, the Drainage Basin Map, shows the drainage basin boundaries in the Pino Arroyo watershed from the Pino Dam to Eubank Blvd. The North Pino watershed that drains to the Pino Arroyo is also shown on Plate 1. Analysis points (AP) are shown in key locations along the Pino Arroyo. The Pino Dam discharges 200 CFS to the Tanoan Golf Course through the principal spillway at AP-1. Between Lowell and the dam runoff is accepted from the subdivisions south of the arroyo and east of Lowell. At AP-2, just upstream of Lowell Drive, the 100-year flows in the Pino Arroyo are 336 CFS. At AP-3, where Sky Valley Drive crosses the Pino, the peak flow is 367 CFS accepting runoff from basins south of the arroyo. According to the Master Drainage Plan for the O Tracts, only basins south of the arroyo are contributing runoff to the arroyo. At AP-4, located at the discharge to the irrigation pond, the runoff, 270 CFS, is from the basins north of the arroyo. The North Pino Arroyo contributes 576 CFS at AP-5 at San Antonio Blvd. A critical point in the hydrologic analysis is AP-6 at the confluence of the Pino and North Pino Arroyo just east of Tract P-1-A-1. At this location, flows from both arroyos are added resulting in a peak discharge of 1226 CFS. The last analysis point, AP-7, is at the Eubank Blvd. intersection with the Pino Arroyo which has a peak flow of 1404 CFS. The peak flows at Analysis Point 6 and Analysis Point 7 were increased to 1287 CFS and 1474 CFS respectively, to include the 5% bulking factor. The peak flows including the 5% bulking factor were used to design drainage improvements along Tract P-1-A-1 to remove the floodplain from the site. The AHYMO output for the Pino Watershed is given in Appendix A.

17. Hydraulic Analysis

After the hydrologic analysis was completed and the peak 100-year flows were computed, a hydraulic analysis was conducted to determine the water surface profiles and elevations for the 100-year flow for both the existing arroyo and proposed drainage improvements along the golf course. The computer model HEC-2 Water Surface Profiles (The Hydrologic Engineering Center, U.S. Army Corp of Engineers, Sept. 1982) was utilized for this purpose.

Existing Conditions

The starting water elevation at cross-section 2 shown on Plate 2 for both the existing and proposed condition profiles was computed in the following manner:

1) Separate HEC-2 profiles were computed for the flows coming from the North Pino (cross-sections 1A through 1G) and the remaining flows from the lower irrigation pond and adjacent areas (cross-sections P1 through P4).
2) Both profiles were started at critical depth at cross-sections 1A and P1.
3) At cross-sections 1G and P4, the flow areas were added together to obtain a cross-sectional flow area for the confluence at cross-section 2.
4) A new HEC-2 profile was then started beginning at the confluence at cross-section 2.
5) By trial and error, a starting water surface elevation at cross-section 2 was calculated resulting in the added cross-sectional flow area.
6) This starting water surface elevation was then used at cross-section 2 for both the existing and proposed conditions profiles downstream, since both of the profiles use cross-sections 2, 3, 4, and 4.5.
7) The flows for both existing conditions through the arroyo and proposed conditions through the golf course are supercritical.

A split flow condition exists at cross-section 11 for the existing conditions HEC-2 profile, with the majority of the discharge (1074.2 CFS) staying in the main channel and a small portion of the discharge (212.9 CFS) flowing into the left overbank swale along the adjacent golf course. The existing conditions HEC-2 profile was then divided into two separate profiles, one for the main arroyo with a flow of 1074.2 CFS and a second for the flow of 212.9 CFS in the golf course swale. This spilt flow condition exists until the flows come together at cross-section 26. At this cross-section the flows from the main channel and flows from the golf course swale were added and the profile for the main channel was continued. The existing floodplain was then delineated using the energy gradeline from the main channel profile for the northern boundary and the energy gradeline from the golf course profile for the southern boundary.

Proposed Conditions

The water surface profile for the proposed flow along the golf course upstream of the four 8.5 foot diameter corrugated metal pipe (CMP) culverts under Eubank Blvd. was computed using the HEC-2 program. For this analysis, two separate channel conditions were modeled. In the first analysis, the 100-year discharge of 1287 CFS flows in the golf course along the floodwall until cross-section 7+70 where part of the discharge flows into the golf course. The remaining flow stays along the floodwall. The second analysis modeled the flow on the golf course without the berm separating the channel along the floodwall from the rest of the golf course. This was done to simulate the effects such a large discharge and velocity could have on the golf course, namely, washing out the berm. The higher energy grade line of the two analyses was used to delineate the proposed floodplain and determine the height of the proposed floodwall, which was set either 1) one foot higher than the energy grade line or 2) 3.5 feet higher than critical water surface elevation (CWSEL) at the upstream end of the floodwall, 3.0 feet higher than CWSEL from the middle of the floodwall to the downstream end of the floodwall, and 4.0 feet higher than CWSEL at the downstream end of the floodwall (to 100 feet from the Eubank R/W). To be conservative, the higher of the two elevations was used to set the height of the floodwall.

The water surface profile through the culverts was then found by a trial-and-error procedure. Since there are two identical golf cart culverts and two identical low flow culverts, only one of each was used in the calculations assuming the discharge to be one half of the total flow or 737 CFS. A flow of 385 CFS into the low flow culvert and 352 CFS into the golf cart culvert was assumed Due to the paved invert of the golf cart culvert, an equivalent 8 foot diameter CMP was used to determine headwater depth. The overall headwater water surface elevation was determined to be 5695.08 feet. This occurred at a flow of 388 CFS into the low flow culvert and a flow of 349 CFS into the golf cart culvert because the golf cart culvert can pass less flow at the same headwater depth than the low flow culvert. The flow profile through the culverts is a Type 1 classification of culvert flow, unsubmerged inlet control according to Gupta, "Hydrology and Hydraulic Systems". The flow will approach normal depth at the end of the culverts. The depth at the outlet for the low flow culvert is 3.48 feet and 3.06 feet for the golf cart culvert. This information was used to plot the water surface profile to the end of the culverts. Finally, the outlet areas of the culverts in the Eubank right-of-way and golf course west of Eubank Blvd. were graded with a 27 foot bottom width for the golf cart CMP outlet and an 18 foot bottom width for the low flow CMP outlet. Both areas were graded with 3 to 1 sideslopes.

An additional hydraulic analysis was completed assuming the four 8.5 foot diameter culvert were half filled with sediment to determine if this had any affects on any adjacent private property. This situation was modeled in the following manner:

1) First, an equivalent corrugated steel pipe based on half the area of the 8.5 foot diameter culvert was determined to be a 6 foot diameter culvert.
2) For each of the four culverts the available headwater from the invert of the culvert to the top of Eubank Blvd. was computed.
3) Using the Hydrocalc program, a discharge at the available headwater was computed for each of the four 6 foot diameter culverts (see calculations, Appendix D).
4) The remainder of the total discharge in the golf course, 428.2 CFS, was determined to flow over the road.

Eubank Blvd. was then approximated as a series of broad-crested weirs (see calculation, Appendix D). This calculation showed that this weir flow would reach an elevation of approximately 5699.1 feet and spread out approximately 380 feet in width along Eubank Blvd.. At this elevation the storm flows remain in the golf course and do not damage any private property. A subcritical HEC-2 profile was computed for the area upstream of the culverts to determine the proposed floodplain boundary and water surface profile in this area. Also, another HEC-2 profile was computed with the discharge of 428.2 CFS overtopping Eubank Blvd. to determine the floodplain boundary downstream of Eubank Blvd. The HEC-2 output files can be found in Appendix B and the water surface profile sheet and calculations in Appendix D.

Sedimentation Analysis

A sedimentation analysis for both the existing and proposed conditions was performed on the watershed to compute a bulking factor to apply to the 100-year peak flows. The Draft "Sediment and Erosion Design Guide", prepared for AMAFCA by Resource Consultants, Inc. was used as a guide for the sedimentation analysis. The total sediment load in the watershed is equal to the wash load plus the bed material load. The Modified Universal Soil Loss Equation (MUSLE), as given in Appendix B of the Sediment and Erosion Design Guide, Draft, RCI, 1992 and Predicting Rainfall Erosion Losses, USDA,1978) was used to calculate the wash load for the watershed. The modified MUSLE utilizes factors for peak flows and volumes, soil erodibility factor, topographic factor, and cover factor. The sediment yield for the 100-year storm was computed using a spreadsheet program (refer to Appendix C) for both existing conditions and total build-out conditions in the watershed. The sediment yield during a 100-year storm in existing conditions during a 100-year storm is 4554 tons, and for proposed conditions is only 730 tons. Since the 100-year volume is factored into the sediment concentration equation, the sediment concentration was calculated with the Pino Dam volume and without the Pino Dam volume. Under existing conditions, the sediment concentration with the Pino Dam volume is 9172 ppm, whereas without the Pino Dam volume is 49,024 ppm. To be conservative, the higher sediment concentration of 49,024 ppm was used to determine the total sediment load.

Next, the bed material load was calculated for the watershed. The bed material load is comprised of the bed load and the suspended bed load. Three soil samples from the arroyo bed near the property were obtained and analyzed to determine the gradation of the soil for the bed load calculations. Following the AMAFCA sediment guide, the bed load was calculated to be 0.146 CFS/ft of width of channel. Two methods for computing the suspended bed load were completed. The first method assumed that the suspended bed load is 3.5 times the bed load. The second method used the Zeller and Fullerton equation given on page 3-28 of the AMAFCA sediment guide. Again the more conservative value of 0.75 CFS/ft was used. The Colby procedure was used to correct the bed material load. The wash load and the bed material load were added to give a total sediment discharge of 54.3 CFS. The total sediment concentration was calculated to be 117,400 ppm which yields a bulking factor of 1.05.

Drainage Management Plan

Offsite Improvements

It was determined the best and most economical approach to remove the 100-year floodplain from the site was to fill the site, build a floodwall along the southern property line and convey the 100-year flows through the golf course south of the site and under Eubank Blvd. through four corrugated steel pipe culverts. Since two of the culverts will be used by golf carts to cross under Eubank Blvd., the 8.5 foot diameter culverts were sized to accommodate a standard size golf cart. The two golf cart culverts will be paved to a depth of 1′ to provide a flat driving surface. The other two 8.5 foot diameter culverts will be used to carry flows from smaller storms which will be conveyed in a grass-lined trapezoidal open channel (see Plate 6) adjacent to the site in the golf course.

All four culverts will be used to carry 100-year storm flows underneath Eubank Blvd. Plates 4 and 5, Eubank Blvd. Plan and Profile sheets, show the proposed culverts' location and grading. Plate 6 shows the floodwall and culvert details.

Rip-rap will be provided at the inlets and the outlets of all four culverts. Type H rip-rap with a mean particle size of 18" will be used at the culvert inlets and culvert outlets as well as the outlet of the 48" RCP. The filter blanket for this riprap is a Type II filter blanket. Gradations for the riprap and filter blanket are shown on Plate 6. Calculations are included in Appendix D.

A scour analysis for the 100 year flows through the golf course indicates that the floodwall needs to extend down to 17 feet deep in some places. The total scour considered consists of local scour, contraction scour and antidune scour. The equations used for the calculations are from the "Sediment and Erosion Design Guide" draft prepared for AMAFCA by Resource Consultants, Inc.. The height of the floodwall was set at 1 foot above the energy grade line of the flow along the golf course. The floodwall design calculations are included in Appendix E. The water surface profile is shown in Appendix D as previously stated.

Eubank Improvements

A 24' wide road will be constructed from Academy Road to San Antonio Drive (refer to Plates 4 and 5). Since the City of Albuquerque is conducting an alignment study for the Eubank Corridor north of Academy Road, the pavement section will be a 24' wide crowned temporary section with no curb and gutter. North of the subdivision entrance at the intersection, Type III barricades will be installed to block traffic from continuing north or turning on San Antonio Drive. Therefore, the only traffic on the road will be for accessing the subdivision. A golf cart path will cross under Eubank through two of the four culverts discussed previously.

Onsite Improvements

The subdivision was divided into five drainage basins (see Plate 3). The runoff from four of these basins (145.1 - 145.4) and an additional offsite basin north of San Antonio Drive. (Basin 145) will be conveyed in the streets to City Lights Dr. where the flows will be collected by inlets and conveyed in a 42" RCP to the golf course just upstream of the pipe arch culverts under Eubank through a riprap outlet. Runoff from basins 145, 145.1, 145.2, and 145.3 are collected by a series of inlets in City Lights Dr. The series of three inlets on each side of the street consists of one Type A inlet followed by two Type C double inlets. The inlets were sized using a peak flow of 47.4 CFS and assuming 50% clogging. Runoff from a portion of basin 145.3 is collected by two double Type C inlets in a sump condition located in City Lights Drive. Runoff from basin 145.4 will be conveyed in Starshine Street and collected by a series of two inlets, one Type A followed by one Type C, in each gutter. Runoff from basin 145.5 will drain directly to Eubank Blvd. and conveyed to the golf course. A total of 93 CFS from the subdivision will drain to the golf course just upstream of Eubank Blvd. through a 42" RCP and riprap outlet. All storm sewers are sized to carry 125% of the 100-year peak flows. Calculations are included in Appendix D.

The lots in the subdivision drain differently based on their location within the subdivision. Some of the lots have breaklines at the building pads and the runoff drains in two directions. The lots along the west side of Starshine Street, the lots along the west side of Morning Star Court, and the lots along the west side of Moon Glow Court have a breakline at the back edge of the building pads. Runoff east of the breaklines drains to the respective streets. Runoff west of the breaklines ponds in the back yards of the lots. The backyard pond volume required is 324 ft^3. The ponding will be accomplished by filling the first course of the garden wall with concrete and allowing the water to pond against the wall. The lots fronting Morning Star Drive also have breaklines at the back edge of the building pads. Runoff north of the breaklines drains to Morning Star Drive. Runoff south of the breaklines drains to City Lights Drive.

The remaining lots drain entirely to the streets. These lots include the lots fronting the east sides of Starshine Street, Morning Star Court, and Moon Glow Court, in addition to the lots fronting City Lights Drive and the lots fronting the north side of Morning Star Drive.

BHI HYMO SUMMARY

	A	B	C	D	E	F	G	H	I	J	K
1	BHI BASIN	WILSON ID	HEIGHT (FT)	LENGTH (FT)	SLOPE (%)	K	VEL (fps)	Tc (MIN)	min Tc=12	Tp (MIN)	Tp (hr)
2	AR-1	102	60	1400	4.3	1.6	3.32	7.03	12	8	0.133333
3	AR-2	101	70	1800	3.9	3	5.92	5.06	12	8	0.133333
4	LL-1	103	5	500	1	3	3.00	2.78	12	8	0.133333
5	LL-2	104	12	500	2.4	3	4.65	1.79	12	8	0.133333
6	GC-A-1	105	80	1300	6.1	1.6	3.95	5.48	12	8	0.133333
7	GC-A-2	106	80	900	8.9	1.4	4.18	3.59	12	8	0.133333
8	GC-A-3	107	80	1600	5	1.7	3.80	7.02	12	8	0.133333
9	GC-A-4	108	50	600	8.3	1.1	3.17	3.16	12	8	0.133333
10	INV	109	94	1800	5.2	3	6.84	4.39	12	8	0.133333
11	GC-B-1	110	80	1400	5.7	1.6	3.82	6.11	12	8	0.133333
12	GC-B-2	111	80	1800	4.4	1.7	3.57	8.41	12	8	0.133333
13	GC-B-3	112	10	400	2.5	0.7	1.11	6.02	12	8	0.133333
14	ON-1	113	50	1000	5	3	6.71	2.48	12	8	0.133333
15	ON-2	114	70	1500	4.7	3	6.50	3.84	12	8	0.133333
16	SA-1	115	90	2600	3.5	3	5.61	7.72	12	8	0.133333
17	SA-2	116	70	1500	4.7	3	6.50	3.84	12	8	0.133333

Wilson Basin Analysis

	A	B	C	D	E	F	G	H	I
1	WILSON ID	LENGTH (FT)	SLOPE (%)	K	VEL (FT/SEC)	Tc (MIN)	min Tc=12	Tp (MIN)	Tp (hr)
2									
3	133	2370	4.5	2	4.24	9.31	12	8	0.133333
4	134	2370	4.5	3	6.36	6.21	12	8	0.133333
5	135	1600	2.4	3	4.65	5.74	12	8	0.133333
6	136	3600	4.3	2	4.15	14.47	14.47	9.646667	0.160778
7	137	3600	4.3	2	4.15	14.47	14.47	9.646667	0.160778
8	138	4800	4.3	2	4.15	~~19.29~~	*17.68	11.78667	0.196444
9	139	1780	4.9	1.7	3.76	7.88	12	8	0.133333
10	140	2300	3.3	1.77	3.22	11.92	12	8	0.133333
11	141	1490	5	3	6.71	3.70	12	8	0.133333
12	142	1400	2	1.63	2.31	10.12	12	8	0.133333
13	145.1	580	5.4	3	6.97	1.39	12	8	0.133333
14	145.2	990	3.3	3	5.45	3.03	12	8	0.133333
15	145.3	490	3.7	3	5.77	1.42	12	8	0.133333
16	145.4	740	4	3	6.00	2.06	12	8	0.133333
17	145.6	1280	3.1	1.6	2.82	7.57	12	8	0.133333
18	145.5	900	2.8	2	3.35	4.48	12	8	0.133333
19	143	1850	5	2	4.47	6.89	12	8	0.133333
20	151	580	9.8	2	6.26	1.54	12	8	0.133333
21	152	1280	3.2	1.6	2.86	7.45	12	8	0.133333

↑note: K's for golf course areas are based on: $\frac{400(.7) + (L-400)2}{L}$

* based on formula in DPM section 22.2 for subbasin reach length between 4000 and 12000 ft.

THIS RUN EXECUTED 12FEB93 11:16:15

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HEC-2 WATER SURFACE PROFILES

Version 4.5.1; September 1990
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

THROUGH TRACT P-1-A-1

SUMMARY PRINTOUT

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
	2.000	5746.00	5747.59	5748.25	1287.09	.00	1287.09	.00	1.59	121.67	103.50	12.44	5749.99
*	3.000	5742.50	5745.71	5746.01	1287.09	.00	1287.09	.00	3.21	89.59	141.78	9.08	5746.99
	4.000	5740.60	5744.05	5744.58	1287.09	.00	1287.09	.00	3.45	56.24	113.14	11.38	5746.06
*	4.500	5740.00	5741.25	5742.08	1287.09	.00	1287.09	.00	1.25	118.76	83.58	15.40	5744.93
*	5.000	5738.00	5739.92	5740.59	1287.09	.00	1114.05	173.04	1.92	97.75	109.03	12.03	5742.10
	7.000	5733.30	5737.29	5738.35	1287.09	.00	1287.09	.00	3.99	42.30	92.49	13.92	5740.29
	8.000	5733.00	5736.35	5737.80	1287.09	.00	1287.09	.00	3.35	38.97	84.22	15.28	5739.98
	11.000	5731.80	5737.12	5737.72	1287.09	212.89	1074.20	.00	5.32	75.23	121.31	11.98	5739.10
	12.000	5731.70	5736.85	5737.35	1074.20	.00	1074.20	.00	5.15	56.37	101.59	10.57	5738.59
*	12.100	5730.40	5735.01	5735.02	1074.20	.00	1074.20	.00	4.61	105.81	155.21	6.92	5735.76
*	12.200	5729.50	5732.15	5732.76	1074.20	.00	1074.20	.00	2.65	52.34	92.45	11.62	5734.25
*	13.000	5728.50	5732.46	5732.46	1074.20	.00	1074.20	.00	3.96	60.34	128.98	8.33	5733.54
*	14.000	5726.80	5728.47	5730.14	1074.20	.00	1074.20	.00	1.67	57.37	72.06	14.91	5731.92
*	16.000	5724.50	5727.58	5727.91	1074.20	.00	1074.20	.00	3.08	97.36	121.86	8.82	5728.78
	17.000	5722.90	5726.17	5726.51	1074.20	.00	1074.20	.00	3.27	77.79	121.35	8.85	5727.38
	18.000	5721.70	5724.27	5724.87	1074.20	.00	1074.20	.00	2.57	79.36	99.81	10.76	5726.06
*	19.000	5719.20	5721.04	5721.64	1074.20	.00	1074.20	.00	1.84	115.75	91.19	11.78	5723.20

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
*	20.000	5717.70	5720.49	5720.60	1074.20	.00	1074.20	.00	2.79	81.35	134.27	8.00	5721.48
*	20.100	5716.00	5718.36	5718.89	1074.20	.00	1074.20	.00	2.36	71.29	98.74	10.88	5720.20
	20.200	5714.00	5715.25	5715.98	1074.20	.00	1074.20	.00	1.25	79.57	84.89	12.65	5717.74
*	21.000	5711.30	5713.60	5713.97	1074.20	.00	1074.20	.00	2.30	91.47	116.03	9.26	5714.93
	21.500	5708.00	5710.84	5711.35	1074.20	.00	1074.20	.00	2.84	82.82	104.79	10.25	5712.48
	22.000	5704.70	5706.62	5707.10	1074.20	.00	861.49	212.71	1.92	120.13	106.04	10.66	5708.26
*	22.500	5701.00	5703.12	5703.52	1074.20	.00	1074.20	.00	2.12	71.28	109.71	9.79	5704.60
	23.000	5697.40	5700.05	5700.52	1074.20	.00	1074.20	.00	2.65	79.60	105.00	10.23	5701.68
	23.500	5695.00	5697.17	5697.73	1074.20	.00	1074.20	.00	2.17	81.96	98.72	10.88	5699.00
	24.000	5691.00	5693.46	5693.92	1074.20	.00	1074.20	.00	2.46	81.73	106.78	10.06	5695.03
	24.300	5689.00	5691.22	5691.70	1074.20	.00	1074.20	.00	2.22	64.26	102.74	10.46	5692.92
*	24.500	5686.50	5688.14	5688.83	1074.20	.00	1074.20	.00	1.64	98.71	84.42	12.72	5690.66
	25.000	5682.90	5684.42	5685.16	1074.20	.00	1074.20	.00	1.52	68.99	84.97	12.64	5686.90
*	25.100	5684.00	5685.83	5685.83	1074.20	.00	1074.20	.00	1.83	85.82	144.99	7.41	5686.68
*	25.200	5684.00	5686.35	5686.35	1074.20	.00	1074.20	.00	2.35	62.57	130.47	8.23	5687.40
*	26.000	5684.20	5689.12	5689.12	1397.20	.00	1397.20	.00	4.92	69.07	159.98	8.73	5690.31
*	27.000	5684.50	5686.79	5687.65	1397.20	.00	1397.20	.00	2.29	66.67	102.29	13.66	5689.69
	28.000	5681.90	5685.19	5685.95	1397.20	.00	1397.20	.00	3.29	77.00	107.01	13.06	5687.84
	29.000	5679.00	5681.63	5682.66	1397.20	.00	1397.20	.00	2.63	51.62	95.94	14.56	5684.92

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                                                         THIS RUN EXECUTED 12FEB93   10:18:35
*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.5.1;  September 1990
*************************************


T1     ESTATES AT TANOAN
T2     EXISTING CROSS SECTIONS ALONG
T3     LEFT OVERBANK IN GOLF COURSE

J1  ICHECK    INQ      NINV     IDIR      STRT     METRIC    HVINS    Q        WSEL      FQ

        0        0        0        1         0         0       0     213   5737.12       0

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

       38       42        1        2        43        13       14       15        8        4
       25       26        3                  0         0        0        0        0        0

J5  LPRNT    NUMSEC                 ********REQUESTED SECTION NUMBERS********

      -10       -10

NC      .03       .03       .03        0         0         0         0         0         0         0

X1       11         6       132      200        35        62        50         0         0         1
GR     5740       132      5739      139      5736       160      5736       180      5737       187
GR   5737.5       200

X1       12        12       156      203        51        51        51         0         0         1
GR     5740       135      5739      141      5738       144      5737       156      5736       164
GR     5735       171      5734      179    5733.5       182    5733.5       192      5734       194
GR     5735       198      5736      203


X1       13         9       147      202        84        84        84         0         0         1
GR     5735       140      5734      147      5733       155      5732       167    5731.5       174
GR   5731.5       185      5732      190      5733       196      5734       202


X1       14        10       132      200        85        85        85         0         0         1
GR     5734       132      5733      140      5732       147      5731       154      5730       160
GR     5729       168      5729      178      5730       185      5731       190    5731.3       200
```

X1	16	10	139	200	93	93	93	0	0	1
GR	5731	139	5730	144	5729	150	5728	155	5727	161
GR	5726	166	5726	179	5727	185	5728	192	5728.2	200
X1	19	10	127	205	90	90	90	0	0	1
GR	5726	127	5726	128	5725	150	5724	165	5723	174
GR	5722.1	180	5722.1	191	5723	194	5724	200	5725	205
X1	20	13	159	219	90	130	110	0	0	1
GR	5728	136	5727	149	5726	153	5725	159	5724	165
GR	5723	170	5722	175	5721	180	5720	185	5720	205
GR	5721	209	5722	212.5	5723	219				
X1	20.1	7	125	215	100	80	65	0	0	1
GR	5720	125	5719	145	5718	163	5717	176	5717	190
GR	5718	203	5718.37	215						
X1	20.2	10	39	145	65	57	50	0	0	1
GR	5718	39	5717	51	5716	64	5715	76	5714	90
GR	5714	100	5715	114	5716	122	5717	130	5718	145
X1	21	6	45	155	45	45	45	0	0	1
GR	5715	45	5714	63	5713	77	5712	91	5712	103
GR	5713	127	5714	144	5715	155				
X1	21.5	12	25	142	105	65	80	0	0	1
GR	5715	15	5714	25	5713	34	5712	60	5711	76
GR	5710.	86	5710.	101	5711	105	5712	115	5713	125
GR	5714	133	5715	142						
X1	22	9	67	165	80	90	85	0	0	1
GR	5711.7	67	5711	76	5710	83	5709	90	5708	97
GR	5708	107	5709	137	5710	153	5711	165		
X1	22.1	7	49	120	60	80	70	0	0	1
GR	5708	49	5707	56	5706	61	5705	67	5705	83
GR	5706	106	5707	120						
X1	22.5	9	27	117	95	75	65	0	0	1
X2	235									
GR	5707	27	5706	41	5705	55	5704	65	5703	74
GR	5703	93	5704	102	5705	110	5705.8	117		

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
*	24.000	5694.50	5695.32	5695.65	235.00	.00	235.00	.00	.82	47.37	28.49	8.25	5696.38
*	24.100	5693.50	5694.87	5694.95	235.00	.00	235.00	.00	1.37	52.58	41.17	5.71	5695.37
	25.000	5691.00	5691.99	5692.21	323.00	.00	323.00	.00	.99	97.24	44.19	7.31	5692.82
	25.100	5690.50	5691.13	5691.35	323.00	.00	323.00	.00	.63	136.38	48.59	6.65	5691.82

SUMMARY OF ERRORS AND SPECIAL NOTES

WARNING SECNO=	14.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	16.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	22.500	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	23.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	24.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=	24.100	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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                                                                    THIS RUN EXECUTED 11FEB93    15:33:08
*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.5.1;  September 1990
*************************************


T1      ESTATES AT TANOAN
T2      FLOW ALONG GOLF COURSE AND FLOODWALL
T3      100 YEAR STORM WITH BERMS AND CHANNEL

J1  ICHECK    INQ      NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0         0         0         1         0         0         0  1287.09   5747.59        0

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

      38        42         1         2        43        13        14        15         8         4
      25        26         3                   0         0         0         0         0         0

J5  LPRNT    NUMSEC                 ********REQUESTED SECTION NUMBERS********

     -10       -10

NC      .025      .025      .025         0         0         0         0         0         0         0
X1         2        13         0       170       134       125       130         0         0         1
GR      5753         0      5752        13      5750        22      5749        28      5747        40
GR      5746        50      5746        57      5747        77      5747       106    5746.5       124
GR      5747       154      5748       161      5750       170

X1         3        10         0       126        69        70        68         0         0         1
GR      5746         0      5745        25      5744        43      5743        50    5742.5        60
GR      5743        74      5744        78      5745        92      5746        99    5748.4       126

X1         4         8         0       106        37        37        37         0         0         1
GR      5751         0      5745        45      5741        65    5740.6        76      5741        80
GR      5742        89      5743        97    5743.8       106

X1       4.5         9        22    144.01        38        38        38         0         0         1
GR      5749         0      5745        22      5742        41      5741        48      5740        60
GR      5740        69    5739.6        85    5739.6       144      5746    144.01

X1       135         8         0    100.01        20        40        30         0         0         1
GR      5744         0      5743        12      5742        24      5741        34      5740        45
GR      5740        70    5739.5       100      5746    100.01
```

X1	165	7	0	128.01	100	70	85	0	0	1
GR	5742	0	5741	25	5740	58	5739	76	5738.7	89
GR	5738.7	128	5745	128.01						
X1	245	21	0	200.01	100	100	100	0	0	1
GR	5747	0	5747	29	5746	56	5745.8	67	5746	88
GR	5746	116	5745	122	5744	128	5743	134	5742	139
GR	5741	145	5740	150	5739	156	5738	161	5737	166
GR	5736	172	5735.4	176	5735.4	182	5736	189	5737	200
GR	5745	200.01								
X1	345	22	0	200.01	85	85	85	0	0	1
GR	5740	0	5741	9	5741.1	20	5741	30	5740	44
GR	5739	73	5738	82	5737	85	5737	100	5738	109
GR	5737	123	5736	136	5735	143	5734	150	5733	155
GR	5732	167	5731.5	174	5731.5	186	5732	190	5733	196
GR	5733.5	200	5740	200.01						
X1	430	13	92	200.01	90	90	90	0	0	1
GR	5735	92	5735.3	107	5735	122	5734	132	5733	140
GR	5732	147	5730	160	5729	167	5729	177	5730	184
GR	5731	190	5731.3	200	5739	200.01				
X1	520	16	62	200.01	90	90	90	0	0	1
GR	5729.8	62	5730	76	5731	88	5732	102	5732	125
GR	5731	135	5730	141	5729	147	5728	152	5727	157
GR	5726	165	5726	180	5727	187	5728	193	5728.2	200
GR	5735	200.01								
X1	610	15	63	200.01	90	90	90	0	0	1
GR	5726	63	5726.1	66	5726.2	70	5726.3	73	5726.4	76
GR	5726	95	5726	115	5725	150	5724	162	5723	175
GR	5722.1	182	5722.1	191	5723	196	5724	200	5732	200.01
X1	700	12	136	200.01	45	45	45	0	0	1
GR	5728	136	5727	149	5726	153	5725	159	5724	165
GR	5723	170	5722	175	5721	180	5720	185	5719.9	187
GR	5719.9	200	5727	200.01						
X1	745	8	134	200.01	25	25	25	0	0	1
GR	5723	134	5722	151	5721	157	5720	169	5719	183.5
GR	5719	193.5	5719.2	200	5725	200.01				
X1	770	7	162	200.01	20	20	20	0	0	1
X2	1055									
GR	5720.6	162	5720	168	5719	173	5718.25	183.5	5718.25	193.5
GR	5718.5	200	5723	200.01						

THIS RUN EXECUTED 11FEB93 15:33:37

****
HEC-2 WATER SURFACE PROFILES

Version 4.5.1; September 1990
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

100 YEAR STORM WITH BERM

SUMMARY PRINTOUT

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
	2.000	5746.00	5747.59	5748.25	1287.09	.00	1287.09	.00	1.59	121.67	103.50	12.44	5749.99
*	3.000	5742.50	5745.71	5746.01	1287.09	.00	1287.09	.00	3.21	89.59	141.78	9.08	5746.99
	4.000	5740.60	5744.05	5744.58	1287.09	.00	1287.09	.00	3.45	56.24	113.14	11.38	5746.06
*	4.500	5739.60	5740.58	5741.57	1287.09	.00	1287.09	.00	.98	90.88	76.92	16.73	5744.92
*	135.000	5739.50	5741.73	5742.26	1287.09	.00	1287.09	.00	2.23	73.26	118.56	10.86	5743.56
	165.000	5738.70	5740.37	5741.14	1287.09	.00	1287.09	.00	1.67	82.02	102.33	12.58	5742.82
*	245.000	5735.40	5738.95	5739.51	1287.09	.00	1287.09	.00	3.55	43.75	108.18	11.90	5741.14
*	345.000	5731.50	5733.68	5735.04	1287.09	.00	1287.09	.00	2.18	48.34	70.95	18.14	5738.79
	430.000	5729.00	5731.83	5732.88	1287.09	.00	1287.09	.00	2.83	51.93	86.87	14.82	5735.24
	520.000	5726.00	5728.53	5729.60	1287.09	.00	1287.09	.00	2.53	50.65	83.48	15.42	5732.22
	610.000	5722.10	5724.86	5726.25	1287.09	.00	1287.09	.00	2.76	48.24	79.80	16.13	5728.90
*	700.000	5719.90	5723.76	5724.65	1287.09	.00	1287.09	.00	3.86	33.80	93.15	13.82	5726.73
*	745.000	5719.00	5721.41	5722.73	1287.09	.00	1287.09	.00	2.41	45.44	78.02	16.50	5725.63
	770.000	5718.25	5720.59	5721.73	1055.00	.00	1055.00	.00	2.34	37.80	65.25	16.17	5724.65
	790.000	5717.70	5719.96	5721.10	950.00	.00	950.00	.00	2.26	34.79	59.77	15.89	5723.89
	835.000	5716.50	5718.75	5719.80	950.00	.00	950.00	.00	2.25	34.73	62.61	15.17	5722.32
	880.000	5715.30	5717.60	5718.58	950.00	.00	950.00	.00	2.30	37.20	65.11	14.59	5720.91

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
*	925.000	5714.00	5715.98	5716.91	670.00	.00	670.00	.00	1.98	33.75	45.67	14.67	5719.32
	970.000	5712.20	5714.58	5715.48	670.00	.00	670.00	.00	2.38	30.28	47.68	14.05	5717.65
*	1015.000	5710.40	5711.96	5712.94	400.00	.00	400.00	.00	1.56	22.55	25.32	15.80	5715.83
	1050.000	5709.00	5710.67	5711.56	400.00	.00	400.00	.00	1.67	23.06	27.60	14.49	5713.93
	1148.000	5705.00	5706.74	5707.66	400.00	.00	400.00	.00	1.74	23.63	29.34	13.63	5709.63
*	1225.000	5702.00	5704.50	5705.21	1315.00	.00	1315.00	.00	2.50	101.58	109.92	11.96	5706.72
	1295.000	5700.00	5701.64	5702.29	1315.00	.00	1315.00	.00	1.64	121.22	110.27	11.93	5703.85
	1370.000	5697.00	5699.29	5700.05	1315.00	.00	1315.00	.00	2.29	84.29	114.51	11.48	5701.34
	1435.000	5695.70	5698.19	5698.72	1315.00	.00	1315.00	.00	2.49	82.67	120.64	10.90	5700.04
	1505.000	5694.00	5696.93	5697.41	1315.00	.00	1071.31	243.69	2.93	96.30	127.49	10.88	5698.63
	1538.000	5693.00	5696.23	5696.71	1315.00	.00	1271.54	43.46	3.23	123.87	128.78	10.47	5697.90
	1570.000	5692.00	5695.02	5695.55	1461.30	.00	1461.30	.00	3.02	139.00	132.06	11.07	5696.92

THIS RUN EXECUTED 08MAR93 08:33:14

****
HEC-2 WATER SURFACE PROFILES

Version 4.5.1; September 1990
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

100 YEAR STORM SUBCRITIC

SUMMARY PRINTOUT

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
	1660.000	5688.21	5699.10	.00	1474.20	.00	1474.20	.00	10.89	186.48	1161.86	1.27	5699.13
	1620.000	5689.60	5699.11	.00	1474.20	.00	1474.20	.00	9.51	245.02	1453.15	1.01	5699.13
	1580.000	5691.00	5699.10	.00	1474.20	.00	1474.20	.00	8.10	232.00	1159.72	1.27	5699.13
*	1538.000	5692.50	5699.07	.00	1474.20	.00	1474.20	.00	6.57	227.00	763.99	1.93	5699.13
*	1505.000	5694.00	5698.99	.00	1474.20	.00	1474.20	.00	4.99	191.44	476.32	3.09	5699.14
*	1470.000	5695.00	5698.77	5698.77	1474.20	.00	1474.20	.00	3.77	143.45	213.22	6.91	5699.51
*	1435.000	5695.70	5698.94	5698.94	1474.20	.00	1474.20	.00	3.24	97.41	188.70	7.81	5699.89
*	1370.000	5697.00	5700.18	5700.18	1474.20	.00	1474.20	.00	3.18	124.16	202.62	7.28	5701.00

PROFILE FOR STREAM 100 YEAR STORM SUBCRITIC

PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA

```
ELEVATION 5688.     5690.     5692.     5694.     5696.     5698.     5700.     5702.     5704.     5706.
   SECNO  CUMDIS

  1660.00     0.  I         .         .         .         .         . R WE   L.         .         .         .         .
              5.  CI        .         .         .         .         .R  WE   L.         .         .         .         .
             10.  C I       .         .         .         .         .R  WE   L.         .         .         .         .
             15.  C  I      .         .         .         .         .R  WE   L.         .         .         .         .
             20.  C   I     .         .         .         .         R   WE   L.         .         .         .         .
             25.  C   I     .         .         .         .         R   WE   L.         .         .         .         .
             30.  C    I    .         .         .         .         R   WE   L.         .         .         .         .
             35.  C     I   .         .         .         .        R.   WE   L.         .         .         .         .
  1620.00    40.  C      I  .         .         .         .        R.   WE   L.         .         .         .         .
             45.  C       I .         .         .         .      MR .   WEL   .         .         .         .         .
             50.  C        I.         .         .         .    M  R . L WE    .         .         .         .         .
             55.  C         I         .         .         .  M   R L.   WE    .         .         .         .         .
             60.  C         I         .         .         .M    L   .   WE    .         .         .         .         .
             65.  C         .I        .         .        M.  L  R   .   WE    .         .         .         .         .
             70.  C         . I       .         .      M L.    R    .   WE    .         .         .         .         .
             75.  C         .  I      .         .    ML   .    R    .   WE    .         .         .         .         .
  1580.00    80.  C         .   I     .         .  L      .   R     .   WE    .         .         .         .         .
             85.  C         .    I    .         .    L    .    R    .   WE    .         .         .         .         .
             90.  C         .     I   .         .      L  .    R    .   WE    .         .         .         .         .
             95.  C         .      I  .         .        L.     R   .   WE    .         .         .         .         .
            100.  C         .       I .         .         .L    R   .   WE    .         .         .         .         .
            105.  C         .        I.         .         .  L   R  .   WE    .         .         .         .         .
            110.  C         .         I         .         .    L  R .   WE    .         .         .         .         .
            115.  C         .         .I        .         .      LR .   WE    .         .         .         .         .
  1538.00   120.  C         .         .I        .         .        L.   WE    .         .         .         .         .
            125.  C         .         .  I      .         .         .  LWE    .         .         .         .         .
            130.  C         .         .   I     .         .         .   WE L  R         .         .         .         .
            135.  C         .         .    I    .         .         .   WE    L    R    .         .         .         .
            140.  C         .         .     I   .         .         .   WE    .   L     R         .         .         .
            145.  C         .         .      I  .         .         .   WE    .       L .    R    .         .         .
            150.  C         .         .       I .         .         .   WE    .         . L       .R        .         .
  1505.00   155.  C         .         .        I.         .         .   WE    .         .    L    .    R    .         .
            160.  C         .         .         I         .         .   WE    .         .   L     .  R      .         .
            165.  C         .         .         I         .         .   WE    .         .  L      .R        .         .
            170.  C         .         .         .I        .         .  W E    .         .  L     R.         .         .
            175.  C         .         .         . I       .         .  W   E  .         .L       R.         .         .
            180.  C         .         .         .  I      .         .  W   E  .         L      R  .         .         .
  1470.00   185.  .         .         .         .    I    .         .  W   E  .        L.    R    .         .         .
            190.  .         .         .         .    I    .         .  W    E .         L       R .         .         .
            195.  .         .         .         .     I   .         .  W    E .         L         .R        .         .
            200.  .         .         .         .     I   .         .  W    E .         .L        .    R    .         .
            205.  .         .         .         .      I  .         .  W     E.         .  L      .       R .         .
            210.  .         .         .         .      I  .         .  W     E.         .  L      .         .R        .
            215.  .         .         .         .       I .         .  W     E.         .   L     .         .    R    .
            220.  .         .         .         .       I .         .    W   E.         .    L    .         .        R.
  1435.00   225.  .         .         .         .       I .         .    W   E.         .    L    .         .         R.
            230.  .         .         .         .        I.         .    W   E.         .     L   .         .        R.
            235.  .         .         .         .        I.         .     W  E.         .     L   .         .       R .
            240.  .         .         .         .        I.         .     W    .E       .      L  .         .       R .
            245.  .         .         .         .        I.         .      W   .E       .       L .         .      R  .
            250.  .         .         .         .         .I        .      W   . E      .        L.         .     R   .
            255.  .         .         .         .         .I        .       W  . E      .        L.         .    R    .
            260.  .         .         .         .         . I       .       W  . E      .        L.         .    R    .
            265.  .         .         .         .         . I       .       W  .  E     .         .L        .   R     .
            270.  .         .         .         .         .  I      .        W .  E     .         . L       .  R      .
            275.  .         .         .         .         .  I      .        W .   E    .         .  L      . R       .
            280.  .         .         .         .         .   I     .         W.  E     .         .  L      .R        .
            285.  .         .         .         .         .   I     .         W.   E    .         .   L     .R        .
  1370.00   290.  .         .         .         .         .    I    .          W   E    .         .    L    R.        .
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THIS RUN EXECUTED 15FEB93 17:17:29

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HEC-2 WATER SURFACE PROFILES

Version 4.5.1; September 1990
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

IF CMP'S ARE HALF FILLED

SUMMARY PRINTOUT

	SECNO	ELMIN	CWSEL	CRIWS	Q	QLOB	QCH	QROB	DEPTH	TOPWID	AREA	VCH	EG
*	1725.000	5698.14	5698.83	5698.83	428.20	.00	428.20	.00	.69	299.87	119.24	3.59	5699.03
*	1742.000	5696.00	5697.19	5697.57	428.20	.00	428.20	.00	1.19	112.81	42.63	10.04	5698.76
*	1787.000	5683.60	5685.08	5686.47	1474.20	.00	1474.20	.00	1.48	67.99	71.91	20.50	5691.61
*	1848.000	5682.00	5684.13	5685.07	1474.20	.00	1474.20	.00	2.13	60.75	104.55	14.10	5687.21
	1895.000	5681.00	5682.96	5683.75	1474.20	.00	1474.20	.00	1.96	76.51	117.05	12.59	5685.42
	1941.000	5680.00	5682.20	5682.73	1474.20	.00	1474.20	.00	2.20	83.78	135.81	10.85	5684.03
	1991.000	5679.00	5681.27	5681.69	1474.20	.00	1474.20	.00	2.27	84.99	144.71	10.19	5682.88

```
         265.  I   WC E L    .      .      .      .      .      .      .      .      .
1991.00  270.  I   W  E L    .      .      .      .      .      .      .      .      .
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COMP.
CK.
DATE 7-23-92

WILSON & COMPANY

LOC.
PROJ.
SUBJ.

FILE 92-522

Soil Loss calculation using MUSLE

references: Sediment and Erosion Design Guide, Draft, RCI 1992
Predicting Rainfall Erosion Losses, USDA, 1978

MUSLE

$$Y_S = R_w * K * L_S * C * P$$

Y_S = sediment yield, tons/acre for storm event

R_w = storm runoff energy factor

K = soil erodibility factor

L_S = topographic factor

C = cover and management factor

P = erosion control practice factor

Storm - runoff Energy factor, R_w

$$R_w = \alpha (V q_p)^\beta$$

$\alpha = 95$ $\beta = .56$

V = runoff volume (ac-ft)

q_p = peak flow rate (cfs)

COMP.

CK.

DATE 7-23-92

WILSON & COMPANY

LOC. FILE

PROJ. SHEET 3

SUBJ. OF 4

SOIL ERODIBILITY FACTOR, K

$100K = 2.1 M^{1.14} (10^{-4})(12-a) + 3.25(b-2) + 2.5(c-3)$

m = (% silt + % vfs) * (100 − % clay)

a = % organic matter

b = soil structure code

c = profile permeability class

Soil types in project Area:

1) EmB, EtC − Unified Class SM, gravelly fine sandy loam and gravelly sandy loam

2) TgB − Unified class SM, CL-ML or CL gravelly fine sandy loam and sandy clay loam

1) $M = (30)(100-0) = 3000$

a = 0, b = 2, fine granular c = 5, slow

$100K = 2.1(3000)^{1.14}(10^{-4})(12-0) + 3.25(2-2) + 2.5(5-3)$

$\boxed{K = 0.28}$

2) $M = 45(100-10) = 4050$

a = 0 b = 1, very fine granular c = 4, slow to med

$100K = 2.1(4050)^{1.14}(10^{-4})(12-0) + 3.25(1-2) + 2.5(4-3)$

$\boxed{K = 0.32}$

Topographic Factor, LS

$$LS = \left(\frac{\lambda}{72.6}\right)^n (0.065 + 0.0454S + 0.0065S^2)$$

λ = slope length - distance from the point of origin of overland flow to the point where the runoff water enters a well-defined channel

S = percent slope

n = 0.3 for slopes ≤ 3%

n = 0.4 for slopes $3.5 \le S \le 4.5\%$

n = 0.5 for slopes ≥ 5%

Hydrograph 101:

$$LS = \left(\frac{300}{72.6}\right)^{.4} [0.065 + .0454(3.9) + .0065(3.9)^2]$$

$$\boxed{LS = 0.601}$$

COVER & MANAGEMENT FACTOR, C

Table 10, pg 32 from "Predicting ..."

C = 0.35 - undeveloped areas

C = 0.2 developed areas

C = .003 - golf course

Erosion-Control Practice Factor, P

For all project areas P = 1.0

		RUNOFF VOI	PEAK Q	COEFFICIENTS IN MUSLE EQUATION			
HYDROGRAPH	AREA (ac)	ACRE-FT	CFS	Rw	K	S LENGTH	S
101	18.5472	3.167	81.43	6386.267	0.28	300	3.9
102	6.432	0.577	18.78	1082.363	0.28	300	4.3
103	1.5488	0.29	7.24	431.7589	0.28	300	1
104	3.0208	0.542	13.72	876.6026	0.28	300	2.4
105	11.9104	1.212	38.01	2434.16	0.28	300	6.1
106	6.8288	0.671	21.55	1272.155	0.28	300	8.9
107	14.2976	1.394	43.73	2847.531	0.28	300	5
109	15.6032	2.762	70.2	5443.508	0.284	300	5.2
108	5.8432	0.554	17.61	1020.553	0.3	300	8.3
110	15.1296	1.45	46.38	3008.543	0.3	300	5.7
111	18.208	1.853	58.09	3915.181	0.28	300	4.4
112	2.0992	0.232	6.93	371.8166	0.28	300	2.5
113	4.0512	0.556	15.79	962.0125	0.3	300	5
115	6.1824	0.801	21.33	1396.735	0.3	300	3.5
114	6.4192	0.881	25.02	1610.914	0.28	300	4.7
116	3.1232	0.448	11.64	718.6116	0.28	300	4.7
117	26.0992	4.251	111.76	8991.668	0.28	300	4.8
133	18.4576	2.59	71.65	5311.459	0.28	300	4.5
134	28.4672	3.994	110.49	8627.684	0.28	300	4.5
135	13.5872	1.906	52.75	3768.411	0.3	300	2.4
136	46.1888	6.481	162.09	14022.58	0.284	300	4.3
137	27.2704	3.826	95.55	7764.459	0.3	300	4.3
138	40.2176	5.643	125.13	11225.69	0.3	300	4.3
139	19.1616	1.868	58.59	3951.819	0.28	300	4.9
140	20.0896	1.959	61.42	4167.136	0.28	300	3.3
141	36	5.901	153.53	12907.18	0.284	300	5
142	9.2736	0.904	28.36	1753.132	0.288	300	2
145.1	3.86	0.608	15.94	1016.774	0.28	300	5.4
145.2	5.86	0.84	22.88	1491.889	0.28	300	3.3
145.3	3.25	0.513	13.53	843.4073	0.28	300	3.7
145.4	6.19	0.976	25.75	1733.692	0.28	300	4
145.5	2.33	0.233	7.28	383.1402	0.28	300	2.8
145.6	7.03	0.676	21.34	1270.468	0.28	300	3.1
143	9.088	1.6707	39.19	2963.781	0.28	300	5
150	2.0992	0.3441	8.97	535.7375	0.28	300	4
151	4.5888	0.9742	23.43	1642.708	0.28	300	9.8
152	15.6544	0.973	30.54	1904.209	0.28	300	3.4
TOTAL	484.008	64.521					
AREA=	ACRE	AC-FT					

COEFFICIENTS IN MUSLE EQUATION				SOIL LOSS			
n	LS	C	P	TONS			
0.4	0.60	0.2	1.00	215.06			
0.4	0.67	0.003	1.00	0.61			
0.3	0.18	0.2	1.00	4.33			
0.3	0.32	0.2	1.00	15.88			
0.5	1.19	0.003	1.00	2.43			
0.5	2.00	0.003	1.00	2.14			
0.5	0.92	0.003	1.00	2.21			
0.5	0.97	0.2	1.00	299.70			
0.5	1.81	0.003	1.00	1.66			
0.5	1.09	0.003	1.00	2.94			
0.4	0.69	0.003	1.00	2.27			
0.3	0.34	0.003	1.00	0.10			
0.5	0.92	0.35	1.00	93.32			
0.4	0.54	0.35	1.00	78.52			
0.5	0.86	0.35	1.00	135.42			
0.5	0.86	0.35	1.00	60.41			
0.5	0.88	0.35	1.00	775.04			
0.4	0.71	0.35	1.00	368.11			
0.4	0.71	0.35	1.00	597.94			
0.3	0.32	0.35	1.00	128.03			
0.4	0.67	0.35	1.00	935.26			
0.4	0.67	0.35	1.00	547.04			
0.4	0.67	0.35	1.00	790.90			
0.5	0.90	0.003	1.00	2.99			
0.3	0.44	0.003	1.00	1.53			
0.5	0.92	0.35	1.00	1185.34			
0.3	0.28	0.003	1.00	0.42			
0.5	1.02	0.35	1.00	101.22			
0.3	0.44	0.35	1.00	63.91			
0.4	0.57	0.35	1.00	46.94			
0.4	0.62	0.35	1.00	105.07			
0.3	0.37	0.35	1.00	13.97			
0.3	0.41	0.35	1.00	51.11			
0.5	0.92	0.2	1.00	153.34			
0.4	0.62	0.2	1.00	18.55			
0.5	2.31	0.2	1.00	212.09			
0.3	0.45	0.003	1.00	0.72			
				SOIL LOSS=	7016.546	TONS/100-YR STORM	
	C= .35 - UNDEVELOPED						
	C= .2 - DEVELOPED CONDITIONS						
	C= .003 - GOLF COURSE						

	EXISTING CONDITIONS				SOIL LOSS	
HYDROGRAPH	%A	%B	%C	%D	TONS	
101	0	30	10	60	21.5064	
102	0	100	0	0	0	
103	0	25	0	75	0	
104	0	25	8	67	1.270694	
105	0	75	20	5	0.485309	
106	0	70	30	0	0.641202	
107	0	94	0	6	0	
109	0	26	9	65	26.97334	
108	0	94	0	6	0	
110	0	85	13	2	0.382789	
111	0	75	20	5	0.453176	
112	0	84	0	16	0	
113	0	25	50	25	46.66231	
115	59	0	0	41	46.32587	
114	0	25	50	25	67.70755	
116	50	0	0	50	30.20362	
117	40	0	60	0	775.0424	
133	70	0	20	10	331.2984	
134	70	0	20	10	538.1456	
135	70	0	20	10	115.226	
136	70	0	20	10	841.7378	
137	70	0	20	10	492.3377	
138	70	0	20	10	711.8111	
139	0	94	0	6	0	
140	0	94	0	6	0	
141	0	36	9	55	106.6809	
142	0	94	0	6	0	
145.1	40	0	60	0	101.2167	
145.2	40	0	60	0	63.91222	
145.3	40	0	60	0	46.94031	
145.4	40	0	60	0	105.0712	
145.5	40	0	60	0	13.96974	
145.6	40	0	60	0	51.11075	
143	0	20	10	70	15.33417	
150	0	36	9	55	1.669815	
151	0	6	0	94	0	
152	0	94	0	6	0	
	EXISTING SEDIMENT YIELD =			4554.117	TONS/100-YR STORM	

TAN SOIL LOSS/MUSLE

		PROPOSED CONDITIONS				SOIL LOSS	
HYDROGRAPH	%A	%B	%C	%D	NEW C	TONS	
101	0	30	10	60	0.2	21.5064	
102	0	100	0	0	0.003	0	
103	0	25	0	75	0.2	0	
104	0	25	8	67	0.2	1.270694	
105	0	75	20	5	0.003	0.485309	
106	0	70	30	0	0.003	0.641202	
107	0	94	0	6	0.003	0	
109	0	26	9	65	0.2	26.97334	
108	0	94	0	6	0.003	0	
110	0	85	13	2	0.003	0.382789	
111	0	75	20	5	0.003	0.453176	
112	0	84	0	16	0.003	0	
113	0	25	50	25	0.2	26.66418	
115	0	0	10	90	0.2	4.486767	
114	0	25	50	25	0.2	38.69003	
116	0	0	10	90	0.2	3.451843	
117	0	29	19	52	0.2	84.14746	
133	0	63	20	17	0.2	42.06964	
134	0	63	20	17	0.2	68.33595	
135	0	63	20	17	0.2	14.63187	
136	0	63	20	17	0.2	106.8873	
137	0	63	20	17	0.2	62.51908	
138	0	63	20	17	0.2	90.38872	
139	0	94	0	6	0.003	0	
140	0	94	0	6	0.003	0	
141	0	36	9	55	0.35	106.6809	
142	0	94	0	6	0.003	0	
145.1	0	48	0	52	0.2	0	
145.2	0	51	10	39	0.2	3.652127	
145.3	0	40	10	50	0.2	2.682303	
145.4	0	40	10	50	0.2	6.004071	
145.5	0	88	5	7	0.2	0.399136	
145.6	0	95	0	5	0.2	0	
143	0	20	10	70	0.2	15.33417	
150	0	36	9	55	0.2	1.669815	
151	0	6	0	94	0.2	0	
152	0	94	0	6	0.003	0	
		FUTURE SEDIMENT YIELD =			730.4083	TONS/100-YR STORM	

COMP.
CK.
DATE

WILSON
&COMPANY

LOC. FILE
PROJ. SHEET
SUBJ. OF

AVERAGE SECTION THROUGH REACH
FOR SEDIMENT CALCULATIONS
EXISTING CROSS SECTIONS

SECTION	Q	DEPTH	AREA	TOPWIDTH	HYD. DEPTH	VEL	FROUDE
3	1226	3.16	137.14	87.92	1.56	8.94	1.26
7	1226	3.83	86.00	41.09	2.09	14.23	1.73
11	1226	5.52	117.66	69.17	1.70	10.42	1.41
15	1226	2.54	113.79	109.39	1.04	10.77	1.86
20	1226	2.98	149.84	84.93	1.76	8.18	1.09
24	1226	2.43	110.31	81.27	1.36	11.11	1.68
AVG				79.0	1.59 FT	10.61 FPS	1.51 FT

TOTAL SEDIMENT LOAD = WASH LOAD + BED MATERIAL LOAD

$\boxed{\text{WASH LOAD}}$

USE MUSLE EQUATION TO DETERMINE WASHLOAD

$$Y_S = R_W K L S C P = \alpha (V q_p)^\beta K L S C P$$

FOR 100 YR STORM

V_{100} = 360.75 ACRE-FT

Q_{100} = 1226 CFS

FROM MUSLE EQ'N

SEDIMENT YIELD EXISTING CONDITIONS = 4554 TONS

SEDIMENT YIELD FUTURE CONDITIONS = 730 TONS

CALCULATE SEDIMENT CONCENTRATION

$$C_S = 10^6 \frac{W_S}{W_W + W_S}$$

EXISTING CONDITIONS W/ PINO DAM VOLUMES

$$C_S = 10^6 \frac{4554(2000)}{362(43560)62.4 + 4554(2000)} = 9172 \text{ PPM}$$

FUTURE CONDITIONS W/ PINO DAM VOLUMES

$$C_S = 10^6 \frac{730(2000)}{362(43560)62.4 + 730(2000)} = 1482 \text{ PPM}$$

EXISTING CONDITIONS W/O PINO DAM

V_{100} = 64.06 ACRE-FT

$$C_S = 10^6 \frac{4554(2000)}{65(43560)(62.4) + 4554(2000)} = 49{,}024 \text{ PPM}$$

FUTURE CONDITIONS

C_S = 8195 PPM

USE THE MOST CONSERVATIVE CONCENTRATION

C_S = 49,024 PPM ≃ 49,000 PPM

COMP. ______ WILSON &COMPANY LOC. ______ FILE ______

CK. ______ PROJ. ______ SHEET ______

DATE ______ SUBJ. ______ OF ______

$\boxed{\text{BED MATERIAL LOAD}}$

BED MATERIAL LOAD = BED LOAD + SUSPENDED BED LOAD

BED LOAD

BED MATERIAL GRADATION

$D_{50} = 1.0$ mm

$D_{84} = 3.2$ mm

$D_{16} = 0.2$ mm

COMPUTE THE CRITICAL SHEAR FOR THE PARTICLE SIZE

AVG HYDRAULIC CHANNEL SECTION FOR REACH

AVG HYDRAULIC DEPTH = 1.59 FT

AVG VELOCITY = 10.61 FPS

$\tau_0 = \gamma R S = 62.4(1.59)(.035) = 3.47$ PSF

R = depth

S = slope

COMPUTE GRAIN SHEAR STRESS

$$\tau_0' = \rho \frac{V^2}{\left[5.75 \log\left(12.27 \frac{Y_0}{K_s}\right)\right]^2} \qquad K_s = D_{84}$$

$$= 1.94 \frac{10.61^2}{\left[5.75 \log\left(12.27 \frac{1.59}{\frac{3.2}{305}}\right)\right]^2} = 0.62 \text{ PSF}$$

CHECK DARCY-WEISBACH FRICTION FACTOR

$$f = \frac{8gn^2}{1.49^2 y^{1/3}} = \frac{8(32.2)(.035)^2}{1.49^2 (1.59)^{1/3}} = .122 > .07$$

IF $f > .07$ USE $f = .07$

$$\tau_0' = \frac{f}{8} \rho V^2 = \frac{.07}{8} 1.94(10.61)^2 = 1.91 \text{ PSF}$$

COMP.	**WILSON & COMPANY**	LOC.	FILE
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DETERMINE CRITICAL GRAIN SIZE OR INCIPIENT PARTICLE SIZE

$$D_c = \frac{\tau_o'}{.047(\gamma_s - \gamma)} = \frac{1.91}{.047(165-62.4)} = .40 \text{ FT} = 122 \text{ mm}$$

THEREFORE THE BED IS MOBILE

COMPUTE BED MATERIAL DISCHARGE OR BED LOAD

$$\tau_c = .047(\gamma_s - \gamma) D_{50} = .047(165-62.4)\frac{1.0}{305} = .0158$$

$$q_{bi} = \frac{12.85}{\sqrt{\rho}\,\gamma_s}(\tau_o' - \tau_c)^{1.5}$$

$$= \frac{12.85}{\sqrt{1.94}(165)}(1.91 - .016)^{1.5}$$

$q_{bi} = .146$ CFS/ft of width of channel

COMPUTE TOTAL BED MATERIAL LOAD

CALCULATE USING 2 DIFFERENT METHODS

$q_s = (q_b + q_s)$; $q_s = (2 \text{ to } 5)\, q_b$ Choose 3.5 SINCE GRADATIONS ARE SMALL

$q_s = (.146 + 3.5(.146)) = .656$ CFS/FT

OR

$$q_s = .0064 \frac{n^{1.77} V^{4.32} G^{0.45}}{Y^{.30} D_{50}^{0.61}}$$ ZELLER-FULLERTON

$$G = \frac{1}{2}\left(\frac{D_{84}}{D_{50}} + \frac{D_{50}}{D_{16}}\right) = .5\left(\frac{3.2}{1.0} + \frac{1.0}{0.2}\right) = 4.1$$

$$q_s = .0064 \frac{.035^{1.77}\ 10.61^{4.32}\ 4.1^{0.45}}{1.59^{0.30}\ \ 1.0^{0.61}}$$

$$= .0064\left(\frac{134.8}{1.15}\right) = 0.75 \text{ CFS/FT}$$

$q_s = 0.75$ CFS/FT, $W_{AVG} = 40$ FT ; $Q_s = 0.75(40) = \underline{30.0 \text{ CFS}}$

SELECT MORE CONSERVATIVE VALUE

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CK.		PROJ.	SHEET
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COMPUTE TOTAL SEDIMENT LOAD
CORRECT THE BED MATERIAL LOAD USING THE COLBY PROCEDURE GIVEN ON PAGE 3-32 OF "SEDIMENT AND EROSION DESIGN GUIDE" AMAFCA

WASH LOAD CONCENTRATION IS 49,000 PPM /= 1.59
ASSUME TEMPERATURE = 60°F

$K_1 = 1$

$K_2 = 2.0$

$K_3 = .055$ $(D_{50} = 1.0\ mm)$

$Q_s' = [1 + (K_1 K_2 - 1) K_3] Q_s$

$= [1 + (1(2.0-1)(.055)] \; 30.0$

$Q_{S_{BED}} = 31.65$ CFS

$Q_{S\ WASH} = \frac{C_s Q}{2.65 \times 10^6} = \frac{49{,}000(1226)}{2.65 \times 10^6} = 22.67$

$Q_{S\ TOTAL} = Q_{S_{WASH}} + Q_{S_{BED}} = 22.67 + 31.65 = 54.32$ CFS
TOTAL SEDIMENT DISCHARGE

TOTAL SEDIMENT CONCENTRATION

$C_s = 2.65 \times 10^6 \; \frac{54.32}{1226} = 117{,}400$ PPM

CALCULATE BULKING FACTOR

$$Bf = \frac{1}{1 - \frac{C_w}{S - C_w(S-1)}} = \frac{1}{1 - \frac{.1174}{2.65 - .1174(2.65-1)}}$$

$Bf = 1.05$
THIS GIVES A 5% BULKING FACTOR

FLOODWALL SCOUR 2/93

SECTION	Q	DEPTH	AREA	TOPWIDTH	HYD. D	VELOCITY	FROUDE	LOCAL	ANTI DUNE	CONTR	TOTAL
4.5	1287.1	0.98	76.92	90.88	0.85	16.73	3.20	4.97	3.82	0.00	8.80
135	1287.1	2.23	118.56	73.26	1.62	10.86	1.50	7.41	1.61	0.86	9.88
165	1287.1	1.67	102.33	82.02	1.25	12.58	1.98	6.26	2.16	0.00	8.42
245	1287.1	3.55	108.18	43.75	2.47	11.9	1.33	10.88	1.93	0.00	12.81
345	1287.1	2.18	70.95	48.34	1.47	18.14	2.64	8.09	4.49	0.00	12.58
430	1287.1	2.83	86.87	51.93	1.67	14.82	2.02	8.44	3.00	0.00	11.44
520	1287.1	2.53	83.48	50.65	1.65	15.42	2.12	8.44	3.25	0.00	11.69
610	1287.1	2.76	79.8	48.24	1.65	16.13	2.21	8.60	3.55	0.00	12.15
700	1287.1	3.86	93.15	33.8	2.76	13.82	1.47	12.51	2.61	0.00	15.12
745	1287.1	2.41	78.02	45.44	1.72	16.5	2.22	8.93	3.72	0.00	12.65
770	1055	2.34	65.25	37.8	1.73	16.17	2.17	8.91	3.57	0.00	12.49
790	950	2.26	59.77	34.79	1.72	15.89	2.14	8.83	3.45	0.00	12.28
834	950	2.25	62.61	34.73	1.80	15.17	1.99	9.05	3.14	0.00	12.19
880	950	2.3	65.11	37.2	1.75	14.59	1.94	8.72	2.91	0.00	11.63
925	670	1.98	45.67	33.75	1.35	14.67	2.22	7.04	2.94	0.00	9.98
970	670	2.38	47.68	30.28	1.57	14.05	1.97	7.88	2.70	0.00	10.58
1015	400	1.56	25.32	22.55	1.12	15.8	2.63	6.18	3.41	0.00	9.59
1050	400	1.67	27.6	23.06	1.20	14.49	2.33	6.33	2.87	0.00	9.20
1148	400	1.74	29.34	23.63	1.24	13.63	2.16	6.40	2.54	0.00	8.94
1225	1315	2.5	109.92	101.58	1.08	11.96	2.03	5.46	1.95	0.00	7.42
1295	1315	1.64	110.27	121.22	0.91	11.93	2.20	4.72	1.94	0.00	6.67
1370	1315	2.29	114.51	84.29	1.36	11.48	1.74	6.52	1.80	0.00	8.32
1435	1315	2.55	125.81	83.88	1.50	10.45	1.50	6.86	1.49	0.00	8.36
1470	1315	3.38	161.78	115.72	1.40	8.13	1.21	5.96	0.90	0.00	6.86
1505	1474	4.99	476.32	191.44	2.49	3.09	0.35	7.01	0.00	0.00	7.01

COMP. RMV

CK.

DATE 2/93

WILSON
&COMPANY

LOC.

FILE 92-522

PROJ. Tanoan

SHEET

SUBJ.

OF

Determine volume of runoff that will pond in backyards of lots.

Typical Lot backyard: 90' x 40' = 3600 sq ft

from DPM sec 22.2

for Zone 4, land treatment type B

excess precipitation = 1.08 in

$$\text{Volume of ponding} = 3600 \times \frac{1.08}{12}$$

$$= 324 \text{ ft}^3$$

Ponding will be against back garden walls.

COMP. JMS, RMV

CK.

DATE 2/15/93

WILSON & COMPANY

LOC.

FILE 92-522

PROJ. Tanoan Estates

SHEET 1

SUBJ.

OF

Check Inlet capacity for City Lights Drive with additional offsite flows included:

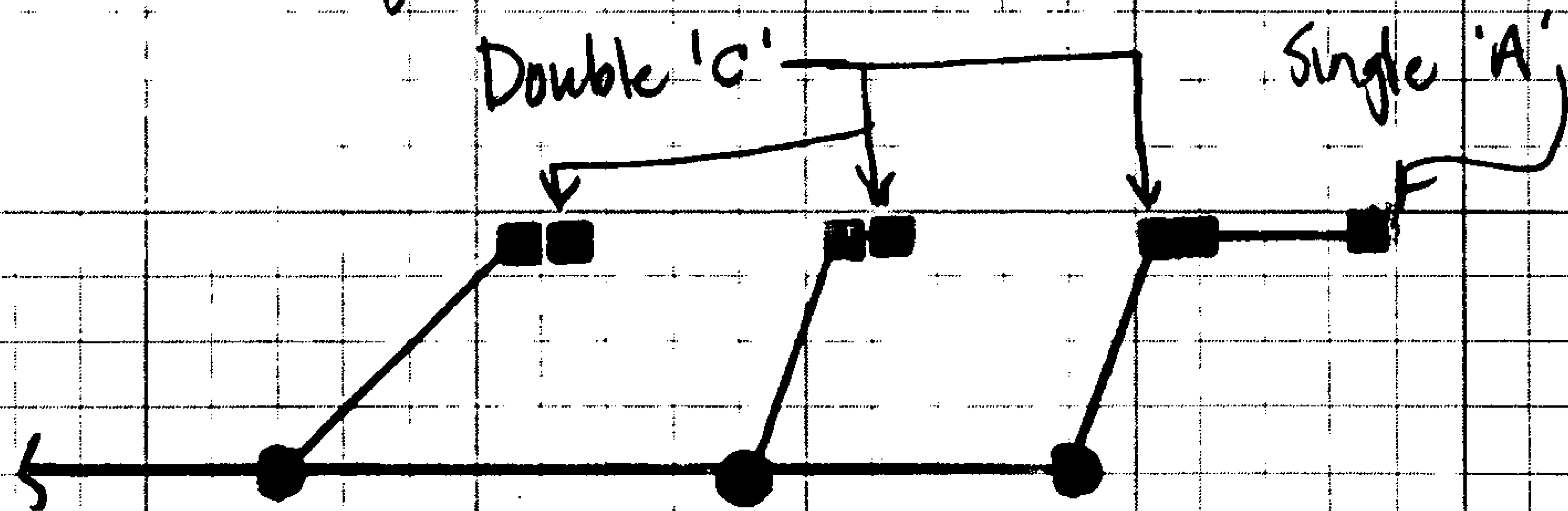
$Q_{full\ street} = 67.2$, $Q_{half\ street} = 33.6$

Determine street depth:

$Q = \frac{1.49}{n} R_h^{2/3} S^{1/2}$, $S = 0.037$, $n = 0.017$

using computer ⇒ $d = 0.43'$

Determine capacity of inlets in series:



a) Single 'A' ⇒ using DPM Plate 22.3 D-5

$Q_{grate} = 7.3$ cfs, assume 50% clogged ⇒ $Q_{cap} = 3.6$ cfs

COMP. JMS, RWV
CK.
DATE 2/15/93

WILSON & COMPANY

LOC.
FILE 92-522
PROJ. Tanoan Estates
SHEET 2
SUBJ.
OF

$Q_{\text{curb opening}} = CLH^{1.5}$, $C = 3.0$ weir

$L = 6.0'$

$Q = (3.0)(6.0)(0.43)^{1.5} = 5.1$ cfs

$Q_{\text{total}} = Q_{\text{grate}} + Q_{\text{curb opening}} = 3.6 + 5.1$

$\underline{\underline{Q_{\text{total}} = 8.7 \text{ cfs}}}$

b) Double 'C' ⇒ using DPM Plate 22.3 D-5

$Q_{\text{grate}} = 6.6$ cfs, assume 50% clogged ⇒ $Q_{\text{cap}} = 3.3$ cfs

$Q_{\text{curb opening}} = CLH^{1.5} = (3.0)(6.0)(0.38)^{1.5} = 4.2$

$Q_{\text{total}} = 3.3 + 4.2 = 7.5$

c) Double 'C' Inlet in sump condition

$Q_{\text{total}} = CA\sqrt{2gh}$, $C = 0.3$,

$A_{\text{total}} = A_{\text{grate}} + A_{\text{curb opening}}$

COMP. JMS, RMW

CK.

DATE 2/15/93

WILSON & COMPANY

LOC.

FILE 92-522

PROJ. Tamaan Estates

SHEET 3

SUBJ.

OF

$A_{grate} = 4.6\ ft^2$, $A_{curb\ opening} = 6(0.67) = 4.02$

$A_{total} = 4.6 + 4.02 = 8.62$

$Q_{capacity} = (0.3)(8.62)\sqrt{2(32.2)(0.67)} = 17.0$ cfs

Compute Inlet capacity as shown on sheet 1:

Q (Single 'A') = 8.7

2 @ Q (Double 'C') = 15.0

Q (Double 'C' in sump) = 17.0

$Q_{capacity} = 40.7$ cfs

Since $Q_{street} = 33.6 < 40.7$ cfs OK

$Q_{excess\ capacity} = 40.7 - 33.6 = 7.1$ cfs

COMP. JMS, RMV	**WILSON & COMPANY**	LOC.	FILE 92-522
CK.		PROJ. Tanoan Estates	SHEET 4
DATE 2/15/93		SUBJ.	OF

Check Inlet Capacity for Star Shine Street:

$Q_{full\ street} = 25.8$, $Q_{half\ street} = 12.9$ cfs

Single 'A' ⇒ per DPM Plate 22.3 D-5

$Q_{grate} = 4.0$ cfs , $Q_{50\%\ clogged} = 2.0$ cfs

$Q_{Opening} = (3.0)(6.0)(0.35)^{1.5} = 3.7$

$Q_{total} = 2 + 3.7 = 5.7$ cfs

Single 'C' ⇒ per DPM Plate 22.3 D-5

Q_{grate} (50% clogged) = 2.0 cfs

$Q_{curb\ opening} = (3)(3)(0.35)^{1.5} = 1.9$

$Q_{total} = 3.9$ cfs

Inlets in series (Single 'A' w/ Single 'C')

COMP. JMS, RMW

CK.

DATE 2/16/93

WILSON & COMPANY

LOC.

PROJ. Tarzan Estates

SUBJ.

FILE 92-522

SHEET 5

OF

$Q_{capacity}$ = 5.7 + 3.9 = 9.6

$Q_{getting\ to\ inlets\ on\ City\ Lights}$ = 12.9 - 9.6 = 3.3

- The inlets on City Lights have an excess capacity of 7.1 cfs, so the inlets are ok

Check pipe hydraulics:

Q (into 18" storm sewer) = 8.7 cfs

need 18" dia @ S = 0.006 (use 1%)

HGL @ Outlet to main channel = 5695.0

- All pipes will flow @ normal depth except outlet pipe which will flow @ pressure conditions for the 100 yr storm.

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 16, 1993
ESTATES AT TANOAN
4.75 FOOT CONCRETE RUNDOWN
FROM SAN ANTONIO TO MORNING STAR DRIVE

===

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	15.5
Channel Bottom Slope (feet per foot)...................	0.0300
Manning's Roughness Coefficient (n-value)..............	0.0130
Channel Side Slope - Left Side (horizontal/vertical)....	0.00
Channel Side Slope - Right Side (horizontal/vertical)...	0.00
Channel Bottom Width (feet)............................	4.8

===

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	0.36
Flow Velocity (feet per second)........................	9.11
Froude Number (Flow is Super-Critical).................	2.683
Velocity Head (feet)...................................	1.29
Energy Head (feet).....................................	1.65
Cross-Sectional Area of Flow (square feet).............	1.70
Top Width of Flow (feet)...............................	4.75

===

TRAPEZOIDAL CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.3 (c) 1986 Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092 (713) 895-8322. A manual with equations & flow chart is available.

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER
CITY LIGHTS DRIVE

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	32.4
Channel Bottom Slope (feet per foot)	0.0100
Manning's Roughness Coefficient (n-value)	0.0130
Channel Diameter (feet)	2.50

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	1.68
Flow Velocity (feet per second)	9.25
Froude Number (Flow is Super-Critical)	1.336
Velocity Head (feet)	1.33
Energy Head (feet)	3.01
Cross-Sectional Area of Flow (square feet)	3.50
Top Width of Flow (feet)	2.35

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER
CITY LIGHTS DRIVE

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	47.4
Channel Bottom Slope (feet per foot)....................	0.0100
Manning's Roughness Coefficient (n-value)...............	0.0130
Channel Diameter (feet).................................	3.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....................................	1.87
Flow Velocity (feet per second).........................	10.26
Froude Number (Flow is Super-Critical)..................	1.434
Velocity Head (feet)....................................	1.63
Energy Head (feet)......................................	3.50
Cross-Sectional Area of Flow (square feet)..............	4.62
Top Width of Flow (feet)................................	2.91

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER
CITY LIGHTS DRIVE

==

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	73.8
Channel Bottom Slope (feet per foot)...................	0.0100
Manning's Roughness Coefficient (n-value)..............	0.0130
Channel Diameter (feet)................................	3.50

==

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	2.22
Flow Velocity (feet per second)........................	11.46
Froude Number (Flow is Super-Critical).................	1.461
Velocity Head (feet)...................................	2.04
Energy Head (feet).....................................	4.26
Cross-Sectional Area of Flow (square feet).............	6.44
Top Width of Flow (feet)...............................	3.37

==

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER
STARSHINE STREET

===

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	19.2
Channel Bottom Slope (feet per foot)...................	0.0100
Manning's Roughness Coefficient (n-value)..............	0.0130
Channel Diameter (feet)................................	2.00

===

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	1.42
Flow Velocity (feet per second)........................	8.06
Froude Number (Flow is Super-Critical).................	1.241
Velocity Head (feet)...................................	1.01
Energy Head (feet).....................................	2.43
Cross-Sectional Area of Flow (square feet).............	2.38
Top Width of Flow (feet)...............................	1.82

===

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER
DISCHARGE TO GOLF COURSE

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)........................	93.0
Channel Bottom Slope (feet per foot).....................	0.0100
Manning's Roughness Coefficient (n-value)...............	0.0130
Channel Diameter (feet).................................	3.50

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	2.66
Flow Velocity (feet per second).........................	11.87
Froude Number (Flow is Super-Critical)..................	1.292
Velocity Head (feet)....................................	2.19
Energy Head (feet)......................................	4.84
Cross-Sectional Area of Flow (square feet)..............	7.84
Top Width of Flow (feet)................................	2.99

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	92.5
Channel Bottom Slope (feet per foot)	0.0100
Manning's Roughness Coefficient (n-value)	0.0130
Channel Diameter (feet)	3.50

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	2.64
Flow Velocity (feet per second)	11.87
Froude Number (Flow is Super-Critical)	1.301
Velocity Head (feet)	2.19
Energy Head (feet)	4.83
Cross-Sectional Area of Flow (square feet)	7.79
Top Width of Flow (feet)	3.01

For 125% of Q_{100}

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
ESTATES AT TANOAN
ON-SITE STORM SEWER

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)........................	106.0
Channel Bottom Slope (feet per foot).....................	0.0100
Manning`s Roughness Coefficient (n-value)...............	0.0130
Channel Diameter (feet)..................................	3.50

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)......................................	3.08
Flow Velocity (feet per second)..........................	11.81
Froude Number (Flow is Super-Critical)...................	1.046
Velocity Head (feet).....................................	2.17
Energy Head (feet).......................................	5.25
Cross-Sectional Area of Flow (square feet)...............	8.97
Top Width of Flow (feet).................................	2.27

CIRCULAR CHANNEL ANALYSIS COMPUTER PROGRAM, Version 1.5
Dodson & Associates, Inc., 7015 W. Tidwell, #107, Houston, TX 77092
(713) 895-8322. A complete program manual is available.

For 114% of Q_{100} under normal depth, but can carry 125% of Q_{100} under pressure flow

COMP: | WILSON & COMPANY | LOC. | FILE
CK. | PROJ. | SHEET
DATE | SUBJ. | OF

DETERMINE EROSION PROTECTION AT OUTLET OF 42" RCP ONTO GOLF COURSE FROM DENVER DRAINAGE CRITERIA MANUAL

SELECT RIP RAP

$F = 1.3$ FLOW IS SUPERCRITICAL

$Da = \frac{1}{2}(D + Y_n) = \frac{1}{2}(3.5 + 2.66) = 3.08$

$Q/Da^{1.5} = 93/3.1^{1.5} = 17.0$

$Y_t/D_a = 2.66/3.08 = 0.86$

FROM FIGURE 5-7

USE TYPE L RIP RAP $D_{50} = 9"$

TO BE CONSERVATIVE USE TYPE M $D_{50} = 12"$

DETERMINE EXTENT OF PROTECTION

$L = (1/(2\tan\theta))(A_t/Y_t - W)$

$A_t = Q/V = 93/5.5 = 16.9$

V = ALLOWABLE NON ERODING VELOCITY

$\frac{1}{2\tan\theta}$ = expansion factor of Culvert

$Q/D_a^{2.5} = 5.5$ $Y_t/D_a = 0.86$

FROM FIGURE 5-9 $\frac{1}{2\tan\theta} = 4.7$

$L = 4.7(6.35 - 3.5) = 13.4$ FT $> 10D$

$\therefore$ USE $10(3.5) = 35$ LF

WILSON & COMPANY

ESTATES AT TANOAN
WATER SURFACE PROFILE

DSGN. DBT	DR. RMV	CK. DBT
FILE 92-522	DATE 3-8-93	SHEET 1

COMP.

CK.

DATE 2/93

WILSON & COMPANY

LOC.

FILE 92-522

PROJ. Tanoan

SHEET

SUBJ.

OF

Determine Headwater depth and elevation for 8.5' dia CMP culverts

Low flow culverts: 8.5' diameter

$A_{8.5} = 56.75\ ft^2$

Golf cart culverts: 8.5' dia, but 1' paved invert

$A_{orig} = 56.75\ ft^2$

$A_{red} = 53\ ft^2$

$d_{equiv} = 8.0'$ dia

COMP.		LOC.		FILE 92-522
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DATE 2/93		SUBJ.	OF	

$Q_T = 1474$ cfs $\quad \frac{1}{2}Q = 737$ cfs

	8.5' Low Flow Culvert S = .0365 Inv = 5687.59	8.0' Golf Cart Culvert S = .048 Inv = 5688.39
Q	385 cfs	352 cfs
HW	7.45	7.29 ⇒ $A_8 = 48.07$ ⇒ $d_{8.5} = 6.71'$
WS	5695.04	5695.10
Q	386 cfs	351 cfs
HW	7.46	7.27' ⇒ $A_8 = 47.98$ ⇒ $d_{8.5}$ 6.70
WS	5695.05	5695.09
☆ Q	388 cfs	349 cfs
HW	7.48	7.25' ⇒ $A_8 = 47.89$ ⇒ $d_{8.5} = 6.69'$
WS	5695.07 ⟵ = ⟶	5695.08
Q	389	348 cfs
HW	7.50	7.23 ⇒ $A_8 = 47.79$ ⇒ $d_{8.5} = 6.67$
WS	5695.09	5695.06

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 15, 1993
THE ESTATES AT TANOAN
8.5' DIA LOW FLOW CULVERT HW CALCULATIONS
INVERT ELEVATION = 5687.59

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)................................	8.50
FHWA Chart Number (1,2 or 3)............................	2
Scale Number on Chart (Type of Culvert Entrance)........	2
Manning's Roughness Coefficient (n-value)...............	0.0240
Entrance Loss Coefficient of Culvert Opening............	0.50
Culvert Length (feet)...................................	70.0
Culvert Slope (feet per foot)...........................	0.0365

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
385.0	3.50	7.45	5.52	3.45	4.89	3.45	17.78
386.0	3.50	7.46	5.53	3.46	4.90	3.46	17.81
388.0	3.50	7.48	5.55	3.48	4.91	3.48	17.76
389.0	3.50	7.50	5.56	3.48	4.92	3.48	17.82

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 15, 1993
THE ESTATES AT TANOAN
8.0' EQUIVALENT GOLF CART CULVERT HW CALCULATIONS
INVERT ELEVATION = 5688.39'

===

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)................................	8.00
FHWA Chart Number (1,2 or 3)............................	2
Scale Number on Chart (Type of Culvert Entrance)........	2
Manning`s Roughness Coefficient (n-value)...............	0.0240
Entrance Loss Coefficient of Culvert Opening............	0.50
Culvert Length (feet)...................................	70.0
Culvert Slope (feet per foot)...........................	0.0480

===

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
352.0	3.20	7.29	4.51	3.14	4.76	3.14	19.25
351.0	3.15	7.27	4.50	3.14	4.75	3.14	19.20
349.0	3.15	7.25	4.48	3.06	4.74	3.06	19.72
~~348.0~~	~~3.00~~	~~7.23~~	~~4.47~~	~~3.12~~	~~4.73~~	~~3.12~~	~~19.19~~

===

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
THE ESTATES AT TANOAN
8.5' DIA LOW FLOW CULVERT
INVERT ELEVATION = 5687.59

==

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	388.0
Channel Bottom Slope (feet per foot)....................	0.0365
Manning's Roughness Coefficient (n-value)...............	0.0240
Channel Diameter (feet).................................	8.50

==

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....................................	3.48
Flow Velocity (feet per second).........................	17.76
Froude Number (Flow is Super-Critical)..................	1.936
Velocity Head (feet)....................................	4.90
Energy Head (feet)......................................	8.38
Cross-Sectional Area of Flow (square feet)..............	21.85
Top Width of Flow (feet)................................	8.36

==

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
THE ESTATES AT TANOAN
8.0' DIA EQUIVALENT GOLF CART CULVERT
INVERT ELEVATION = 5688.39'

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second).......................	349.0
Channel Bottom Slope (feet per foot)....................	0.0480
Manning`s Roughness Coefficient (n-value)...............	0.0240
Channel Diameter (feet).................................	8.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet).....................................	3.06
Flow Velocity (feet per second).........................	19.72
Froude Number (Flow is Super-Critical)..................	2.303
Velocity Head (feet)....................................	6.04
Energy Head (feet)......................................	9.10
Cross-Sectional Area of Flow (square feet)..............	17.70
Top Width of Flow (feet)................................	7.78

COMP.

CK.

DATE 2-5-93

WILSON
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LOC.

FILE 92-522

PROJ. Tanoan

SHEET 1

SUBJ.

OF

Determine how much flow will go through culverts and how much will go over Eubank when culverts are 1/2 filled with sediment.

Culverts : 8.5' diameter $\Rightarrow A = 56.75 \text{ ft}^2$

Culverts 1/2 filled with sediment $\Rightarrow A = 28.38 \text{ ft}^2$

equivalent size culvert: $\pi r^2 = 28.38 \text{ ft}^2$

$r = 3.00$

$\therefore$ equiv diam = 6 ft

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 5, 1993
ESTATES AT TANOAN
EQUIVALENT 6' CULVERT FOR LOW FLOW CULVERT
TO DETERMINE FLOW OVER EUBANK

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)................................	6.00
FHWA Chart Number (1,2 or 3)...........................	2
Scale Number on Chart (Type of Culvert Entrance)........	2
Manning`s Roughness Coefficient (n-value)...............	0.0240
Entrance Loss Coefficient of Culvert Opening............	0.50
Culvert Length (feet)..................................	70.0
Culvert Slope (feet per foot)..........................	0.0365

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
250.0	3.00	7.44	5.26	3.25	4.33	3.25	15.98
255.0	3.00	7.77	5.39	3.28	4.37	3.28	16.10
260.0	3.00	8.08	5.52	3.30	4.42	3.30	16.29
259.0	3.00	8.02	5.49	3.32	4.41	3.32	16.12

PIPE CULVERT ANALYSIS
COMPUTATION OF CULVERT PERFORMANCE CURVE

February 5, 1993
ESTATES AT TANOAN
EQUIVALENT 6' CULVERT FOR GOLF CART CULVERT
TO DETERMINE FLOW OVER EUBANK

==

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Culvert Diameter (feet)....................................	6.00
FHWA Chart Number (1,2 or 3)................................	2
Scale Number on Chart (Type of Culvert Entrance)........	2
Manning`s Roughness Coefficient (n-value)...............	0.0240
Entrance Loss Coefficient of Culvert Opening............	0.50
Culvert Length (feet).......................................	70.0
Culvert Slope (feet per foot)...............................	0.0480

==

PROGRAM RESULTS:

Flow Rate (cfs)	Tailwater Depth (ft)	Headwater (ft) Inlet Control	Headwater (ft) Outlet Control	Normal Depth (ft)	Critical Depth (ft)	Depth at Outlet (ft)	Outlet Velocity (fps)
250.0	3.00	7.44	4.45	2.99	4.33	2.99	17.76
255.0	3.00	7.77	4.58	3.02	4.37	3.02	17.85
260.0	3.00	8.07	4.71	3.06	4.42	3.06	17.93
265.0	3.00	8.35	4.84	3.10	4.46	3.10	18.02
264.0	3.00	8.30	4.82	3.09	4.45	3.09	17.98
263.0	3.00	8.24	4.79	3.09	4.44	3.09	17.93

==

PIPE CULVERT ANALYSIS COMPUTER PROGRAM Version 1.7

COMP.

CK.

DATE 2-5-93

WILSON &COMPANY

LOC.

PROJ. Tanoan

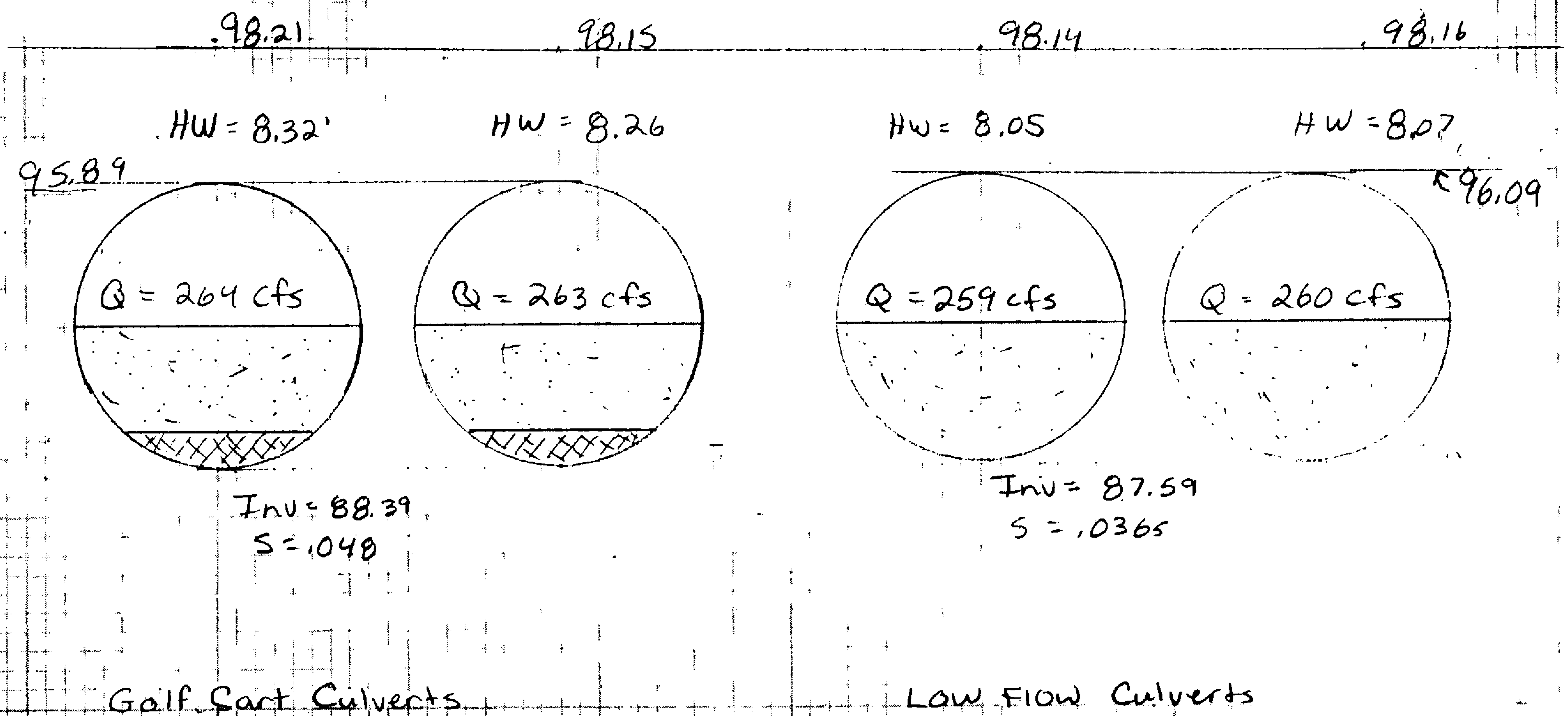
SUBJ.

FILE 92-522

SHEET

OF

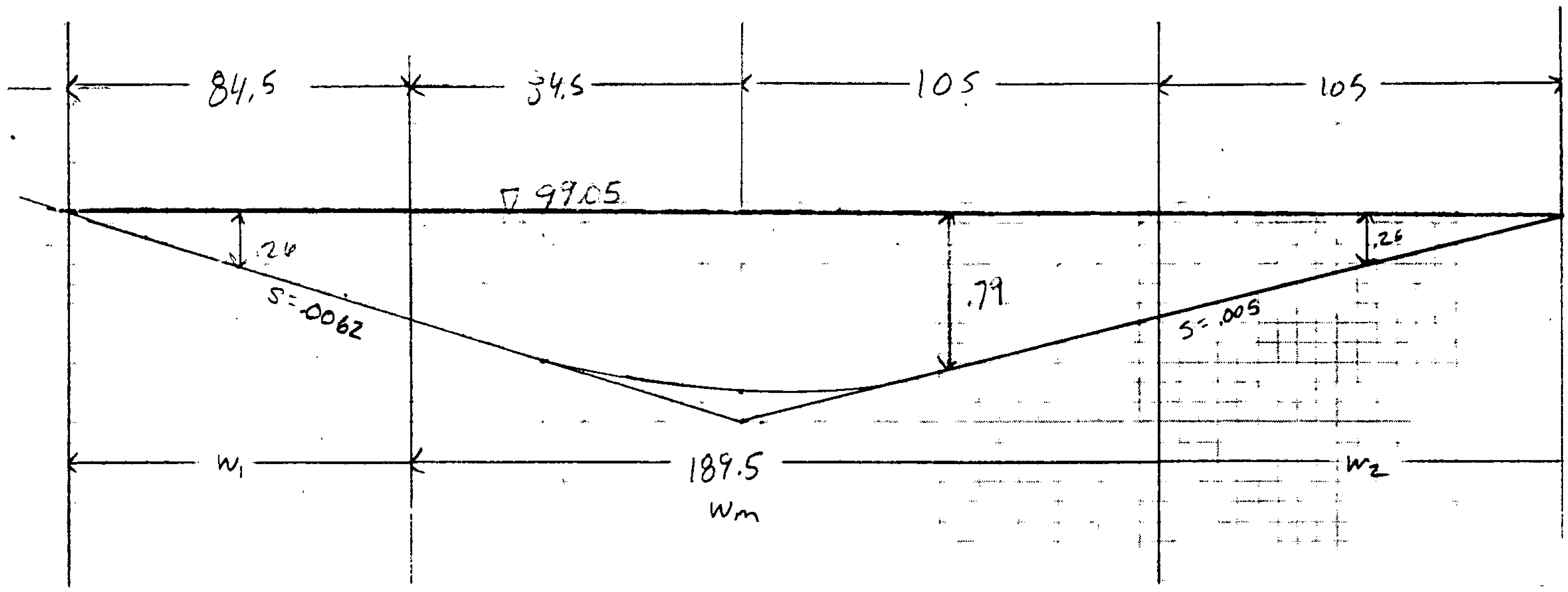
$Q_{weir} = 1474.2 - 264 - 263 - 259 - 260 = \underline{\underline{428.2}}\text{ cfs}$



NTS

$Q_{weir} = 428.2$ cfs

Try a series of broad-crested approximations



$$Q = C_m W_m H_m^{3/2} + C_0 W_1 H_1^{3/2} + C_0 W_2 H_2^{3/2}$$

$C_m = 2.68$ $W_m = 189.5'$ $W_2 = 105$ $H_m = .79$

$C_0 = 2.70$ $W_1 = 84.5$ $H_1 = H_2 = .26$

$$Q = 2.68(189.5)(.79)^{3/2} + 2.70(84.5)(.26)^{3/2} + 2.70(105)(.26)^{3/2}$$

$Q = 424.4$ CFS

$\therefore H = 99.05 - 98.14 = 0.91'$

$L \approx 379'$

$WS = 5699.05$

COMP. RMV

CK.

DATE 2-11-93

WILSON & COMPANY

LOC.

FILE 92-522

PROJ. Tanoan

SHEET

SUBJ.

OF

Determine size of riprap to be used at entrance to low flow 8.5' dia. corrugated steel pipe culverts.

From Urban Drainage Criterra Manual

Equation 5-4

$$\frac{V S^{0.17}}{d_{50}^{0.5}(S_s-1)^{.66}} = 4.5$$

V = 11.0 = mean channel velocity (fps)

S = 0.0365 = longitudinal channel slope

S_s = 2.65 = specific gravity of rock

d_{50} = rock size in feet for which 50% of the rip rap by weight is smaller

$$d_{50}^{0.5} = \frac{(11.0)(0.0365)^{0.17}}{4.5(2.65-1)^{0.66}}$$

d_{50} = 1.00 = 12 inches

∴ use type M riprap

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
THE ESTATES AT TANOAN
GOLF CART CULVERTS OUTLET CHANNEL

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	698.0
Channel Bottom Slope (feet per foot)....................	0.0480
Manning`s Roughness Coefficient (n-value)..............	0.0350
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet)............................	27.0

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	1.77
Flow Velocity (feet per second)........................	12.18
Froude Number (Flow is Super-Critical).................	1.740
Velocity Head (feet)...................................	2.30
Energy Head (feet).....................................	4.08
Cross-Sectional Area of Flow (square feet).............	57.29
Top Width of Flow (feet)...............................	37.64

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

February 15, 1993
THE ESTATES AT TANOAN
LOW FLOW CULVERTS OUTLET CHANNEL

===

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)......................	776.0
Channel Bottom Slope (feet per foot)...................	0.0365
Manning`s Roughness Coefficient (n-value)..............	0.0350
Channel Side Slope - Left Side (horizontal/vertical)....	3.00
Channel Side Slope - Right Side (horizontal/vertical)...	3.00
Channel Bottom Width (feet)............................	16.0

===

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)....................................	2.61
Flow Velocity (feet per second)........................	12.49
Froude Number (Flow is Super-Critical).................	1.571
Velocity Head (feet)...................................	2.42
Energy Head (feet).....................................	5.03
Cross-Sectional Area of Flow (square feet).............	62.14
Top Width of Flow (feet)...............................	31.65

===

COMP.

CK.

DATE 2/93

WILSON & COMPANY

LOC.

PROJ. Tanoan

SUBJ.

FILE 92-522

SHEET

OF

Determine size of riprap to be used at outlet of low flow and golf cart corrugated steel pipe culverts. Assume open channel flow at outlet. See Hydrocalc printouts.

<u>low flow</u>

Q = 776 cfs
S = .0365
n = .035
W = 16'
depth = 2.61'
vel = 12.49 fps

<u>golf cart</u>

Q = 69.8 cfs
S = .048
n = .035
W = 27'
depth = 1.77'
vel = 12.18 fps

use higher velocity to design riprap

$$(d_{50})^{0.5} = \frac{(12.49)(.0365)^{0.17}}{4.5(2.65-1)^{0.66}}$$

$d_{50} = 1.13'$

∴ use Type H riprap
$d_{50} = 18''$

Use 8" thick Type II Filter Blanket for Course Grained Soils

See plate 6 for Riprap and Filter Blanket Gradations.

CIRCULAR CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

November 6, 1992
48" RCP
OUTLET NEAR GOLF CART PATH

PROGRAM INPUT DATA:

DESCRIPTION	VALUE
Flow Rate (cubic feet per second)	154.0
Channel Bottom Slope (feet per foot)	0.0326
Manning`s Roughness Coefficient (n-value)	0.0130
Channel Diameter (feet)	4.00

PROGRAM RESULTS:

DESCRIPTION	VALUE
Normal Depth (feet)	2.20
Flow Velocity (feet per second)	21.71
Froude Number (Flow is Super-Critical)	2.865
Velocity Head (feet)	7.32
Energy Head (feet)	9.52
Cross-Sectional Area of Flow (square feet)	7.09
Top Width of Flow (feet)	3.98

COMP.

CK.

DATE 11/92

WILSON & COMPANY

LOC. Tanoan

PROJ.

SUBJ.

FILE 92522

SHEET

OF

Determine size of rip rap for new outlet of 48" RCP near golf cart path under Eubank.

Original 48" RCP $s = .01$, $n = .013$

assume flowing full $\Rightarrow Q = 154$ cfs

Realigned at $s = .0326$

$Q = 154$ cfs

$n = .013$

Hydrocalc program:

$V = 21.71$

$Y_n = 2.2$

$F = 2.9$

"Urban Storm Drainage manual", Figure 5-7

Supercritical flow $D_a = \frac{1}{2}(D + Y_n)$

$= \frac{1}{2}(4 + 2.2)$

$= 3.1$

$$\frac{Q}{D_a^{1.5}} = \frac{154}{(3.1)^{1.5}} = 28.21$$

$$\frac{Y_t}{D_a} = \frac{2}{3.1} = .71$$

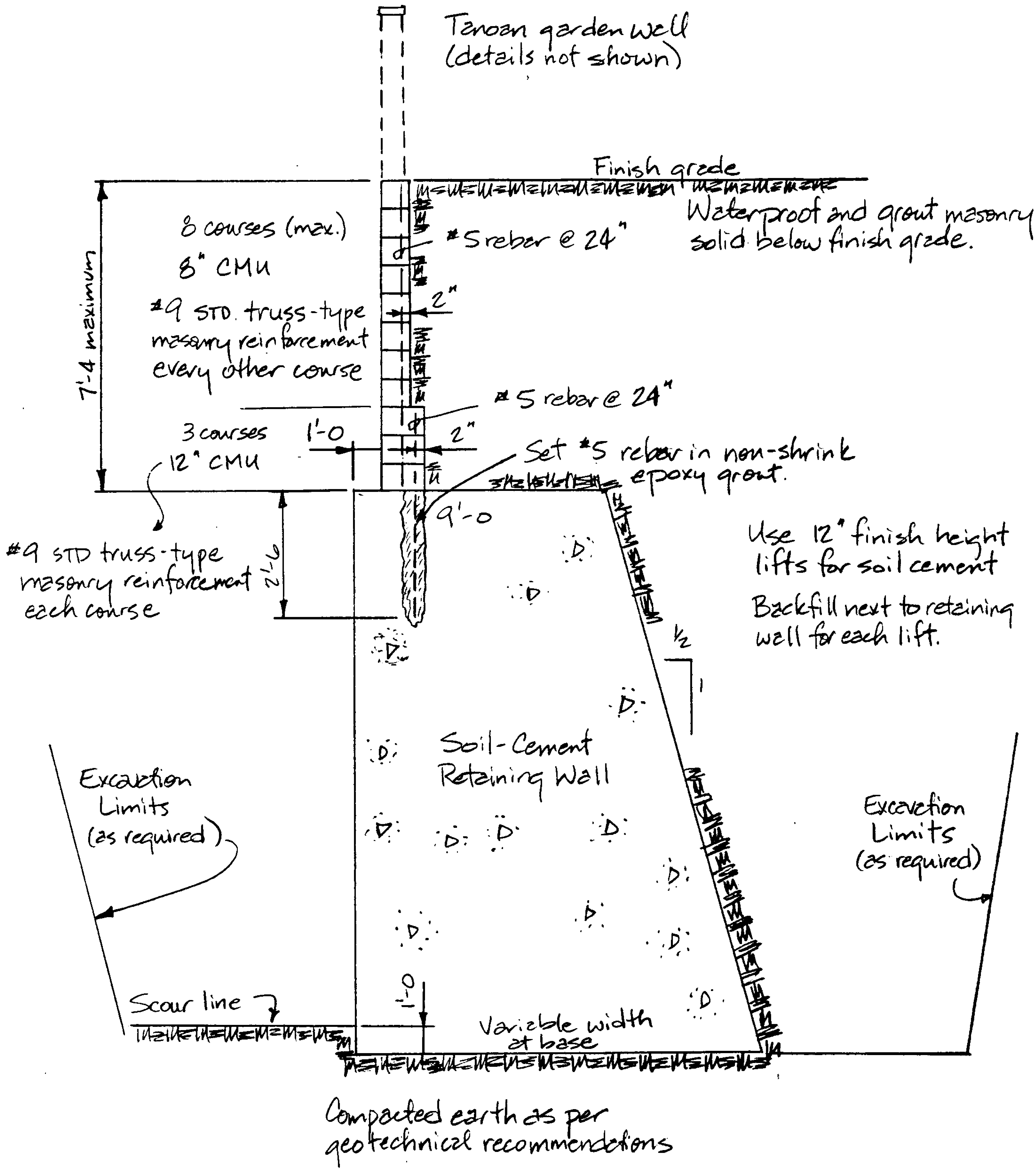
$\Rightarrow$ $\therefore$ use Type M ripRap

$D_{50} = 12"$

thickness $= 2D_{50}$

$= 24"$

COMP. | WILSON & COMPANY | LOC. Tanoan | FILE
CK. | | PROJ. | SHEET
DATE | | SUBJ. | OF



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COMP. SMD | **WILSON & COMPANY** | LOC. Tanoan | FILE 92-522

CK. | PROJ. | SHEET 1

DATE 3/6/93 | SUBJ. Soil Cement Wall | OF 5

Assumptions

Soil Cement $f'_c = 1000$ psi

$\gamma_c = 120$ pcf

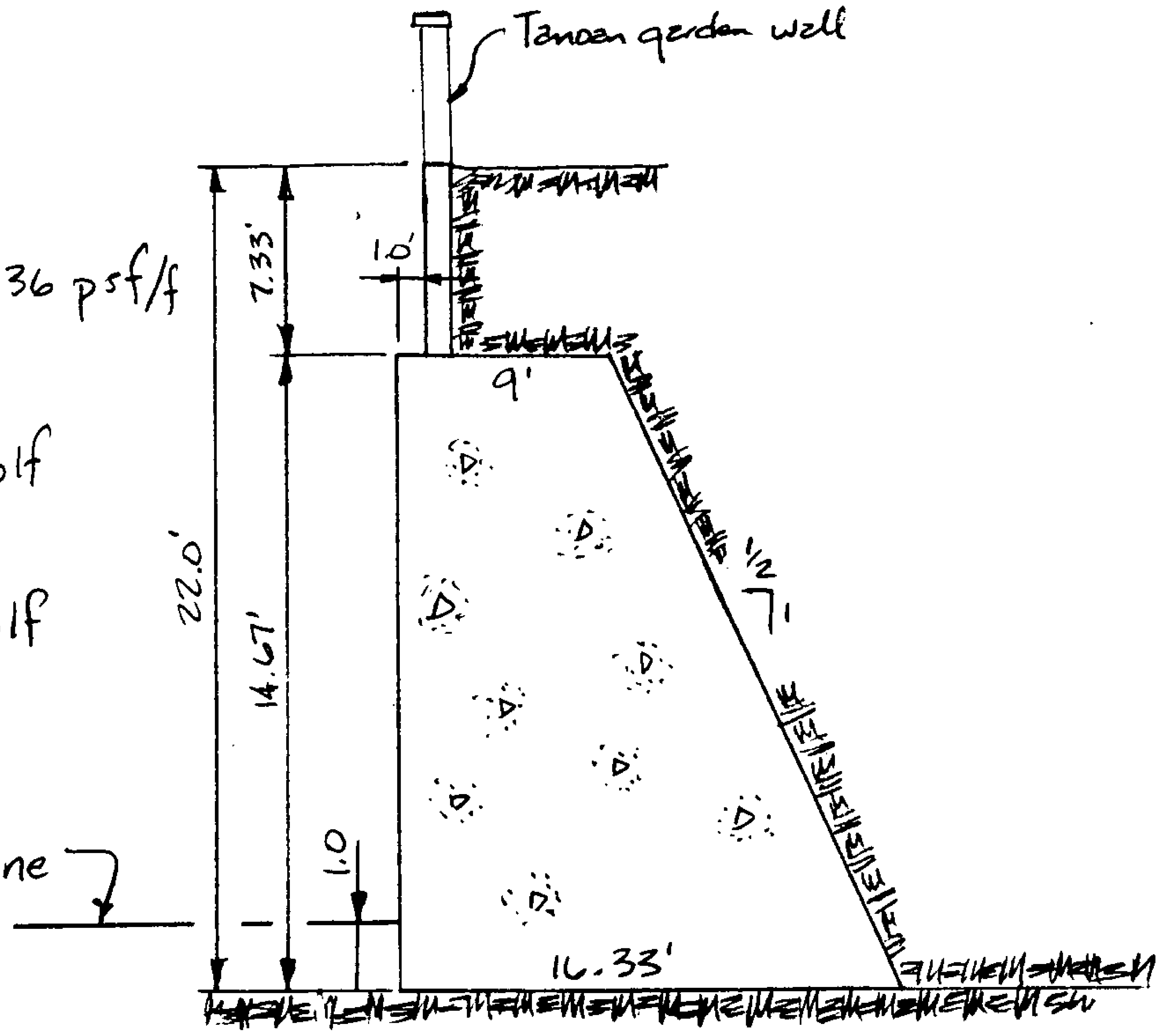
$\gamma_s = 110$ pcf, $\gamma_a = 36$ psf/f

Tanoan garden wall

use 6' × 150 pcf = 900 plf

masonry wall

use 61 psf × 7.33' = 447 plf

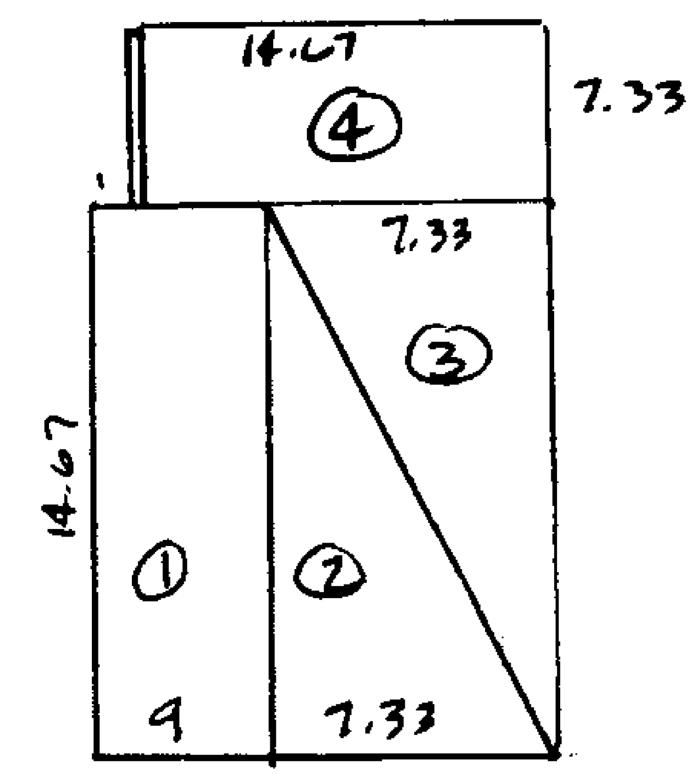


Wall Stability

$$P = \gamma h^2/2 = \frac{36(22)^2}{2} = 8712 \text{ lb}$$

$$M = P \times h/3 = 8712 \times 22/3 = 63{,}888 \text{ ft-lb}$$

Sliding Stability



Weights (per linear foot of wall)

① 9 × 14.67 × 120 = 15,843 lb

② 14.67 × 7.33 × ½ × 120 = 6,450

③ 14.67 × 7.33 × ½ × 110 = 5914

④ 14.67 × 7.33 × 110 = 11,828

40,035 lb

$$FS_{sliding} = \frac{40{,}035 \times 0.4}{8712} = 1.84 \checkmark$$

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Overturning Stability

Section	Weight	Arm	Moment
①	15,843	4.5	71,294
②	6,450	11.44	73,788
③	5914	13.89	82,145
④	11,828	9.0	106,452
	40,035		333,679

$$FS = \frac{333{,}679}{63{,}888} = 5.22 \checkmark$$

Soil Pressures

$$\bar{x} = \frac{333{,}679 - 63{,}888}{40{,}035} = 6.74' \qquad e = \frac{B}{2} - \bar{x} = \frac{16.33}{2} - 6.74 = 1.43'$$

$\frac{B}{6} = 2.72' > 1.43'$, resultant is in the middle third

Bearing Pressure $\quad q = \frac{R}{B}\left(1 \pm \frac{6e}{B}\right)$

$$= \frac{40{,}035}{16.33}\left(1 \pm \frac{6(1.43')}{16.33}\right)$$

$$= 2452 \times (1.53,\ 0.47)$$

$$= 3752,\ 1152 \text{ psf} \checkmark$$

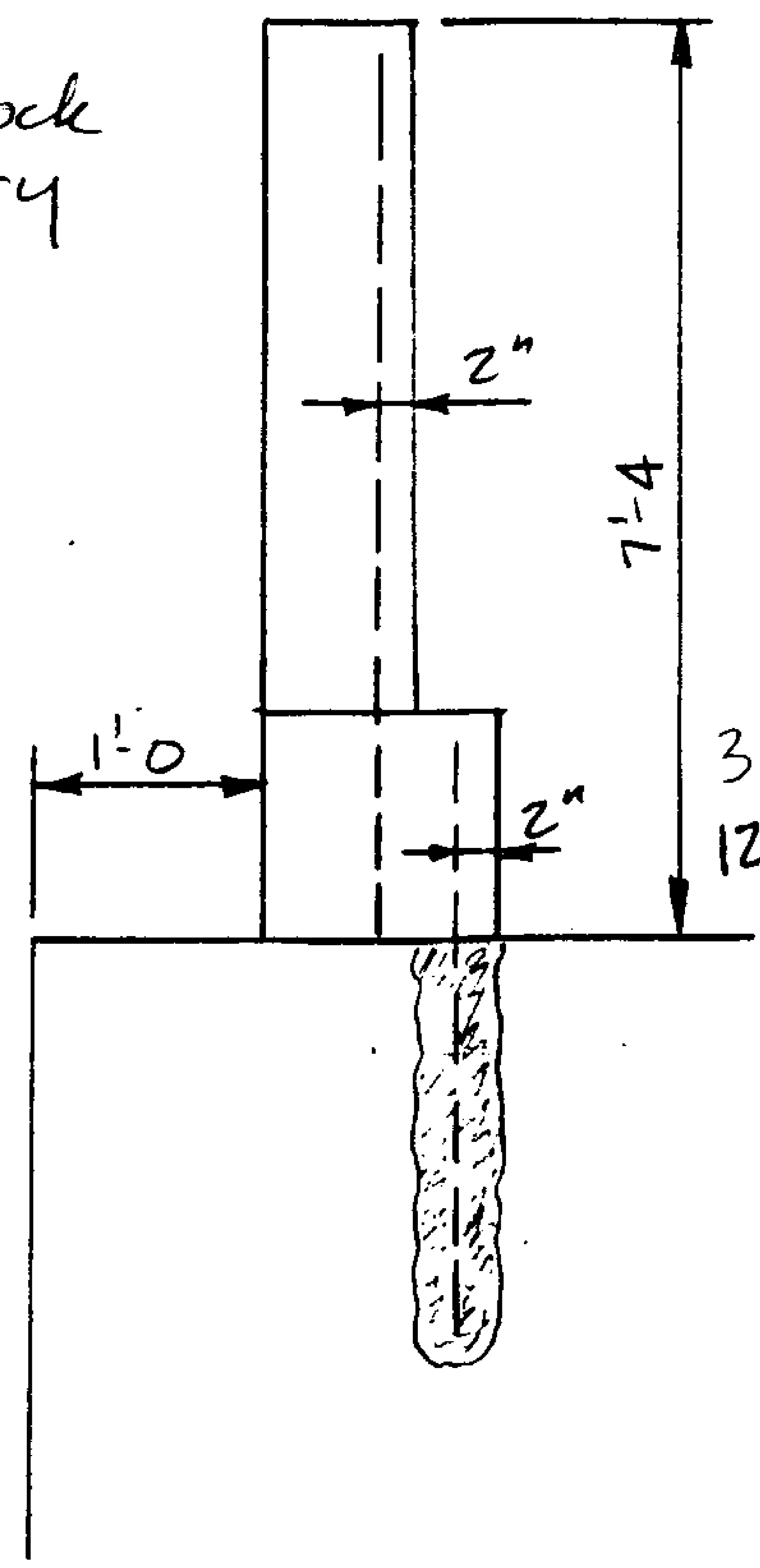
Concrete block wall design

Type S mortar
No special inspection

$f'_m = 1000$ psi
$n = 14$
$E = 2.1 \times 10^6$
$F_b = 0.33 f'_m = 330$ psi
$F_v = f'^{1/2}_m = 32$ psi
$F_s = 24{,}000$ psi

8" block
$d = 5.63"$
$t = 5.2"$

Use 2800 psi concrete block



Lateral Loads
$\gamma = 110$ pcf, $\gamma_a = 36$ psf/f

Forces at wall bottom

$P = \gamma_a h^2/2 = 36(7.33^2)/2 = 968$ lb/ft

$M = P \times h/3 = 968 \times 7.33/3 = 2366$ ft-lb/ft

Moments @ intervals

2' $M = \gamma_a h^3/6 = 36(2.0)^3/6 = 48$ ft-lb/ft
4' $M = 36(4.0)^3/6 = 384$ ft-lb/ft
6' $M = 36(6.0)^3/6 = 1296$ ft-lb/ft

5'-4 $M = 36(5.33)^3/6 = 910$ ft-lb/ft $V = 36(5.33^2)/2 = 511.4$ lb/ft

COMP. Sm-D	**WILSON & COMPANY**	LOC. Tanoan	FILE 92-522
CK.		PROJ.	SHEET 4
DATE 3/6/93		SUBJ. Soil Cement Wall	OF 5

For moment @ base of wall

using 12" concrete block, try #5 @ 24"

$d = 9.63"$, $A_s = .15\ in^2/ft$, $M = 2366\ ft\text{-}lb/ft$

$$p = \frac{.15}{12(9.63)} = 0.0013 \qquad np = 0.0182$$

$$k = (.0182^2 + 2 \times .0182)^{1/2} - .0182 = 0.1735$$

$$j = 1 - \frac{.1735}{3} = 0.9422$$

$$\frac{2}{kj} = \frac{2}{(.1735)(.9422)} = 12.23$$

$$f_b = 12.23 \times \frac{2366(12)}{12(9.63)^2} = 312\ psi < 330\ ✓$$

$$f_s = \frac{2366(12)}{.15(.9422)(9.63)} = 20.86\ ksi < 24\ ✓$$

bar development length = .002 (.625)(20,860) = 26.07" ⟹ use 30"

Shear @ base

$$f_v = \frac{968}{12(.9422)(9.63)} = 8.9\ psi < 32 ✓$$

Place #9 std truss type masonry reinforcement - each course

Bearing Stress

$P = 6 \times 0.5 \times 150\ pcf = 450\ plf$ $\qquad t = 7.8"$

$+ 61 \times 5.33 = 325$

$+ 92 \times 2.0 = 184$

$959\ plf$

$$F_{br} = \frac{959}{12(7.8)} = 10.2\ psi < 260\ ✓$$

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For moment @ change from 12" to 8" block

using 8" block, try #5 @ 24"

$d = 5.63"$, $A_s = .15\ in^2/ft$, $M = 910\ ft \cdot lb/ft$

$p = \frac{.15}{12(5.63)} = 0.0022 \quad np = 0.0311$

$k = (.0311^2 + 2 \times .0311)^{1/2} - .0311 = 0.2202$

$j = 1 - \frac{.2202}{3} = 0.9266$

$\frac{2}{kj} = \frac{2}{(.2202)(.9266)} = 9.80$

$f_b = 9.80 \times \frac{910(12)}{12(5.63)^2} = 281.4\ psi < 330$ ✓

$f_s = \frac{910(12)}{.15(.9266)(5.63)} = 13{,}955\ psi < 24{,}000$ ✓

bar development length = $.002(.625)(13{,}955) = 17.45"$

run bars to bottom of the wall

Shear @ transition

$f_v = \frac{511.4}{12(.9266)(5.63)} = 8.2\ psi < 32$ ✓

Place #9 std truss type masonry reinforcement - every other course

Bearing Stress

$P = 775\ lb/ft$

$F_{br} = \frac{775}{12(5.2)} = 12.4\ psi < 260$ ✓

COMP.

CK.

DATE

WILSON &COMPANY

LOC. Tanoan

PROJ.

SUBJ.

FILE 92-522

SHEET 1

OF

From "Far Northeast Heights Master Drainage Plan"
for the City of Albuquerque Public Works Department
October 1989

Determine Runoff on Academy + Eubank, - How much gets into the inlets on Academy + Eubank and how much will be flowing on Eubank.

From Basin Map:

Basin 204 - area already accounted for in other basins

$.1255 \ mi^2 - .0554 \ mi^2 = \underline{.0701 \ mi^2}$

Low

From AHYMO model

with land treatments B = 67%, D = 33%

$\underline{Q = 120.77 \ cfs}$

JUN 15

Further divide into amounts getting to Academy inlets and Eubank inlets.

$Q_{Eubank} = 20\%(120.77) = 24.2 \ cfs$

$Q_{Academy} = 120.77 - 24.2 = 96.57 \ cfs$


ARROYO DE DOMINGO
BACA DAM
RECEIVED
JUN 1 5 1993
404
406
401
307
305
NORTH ARROYO DEL PINO
201
NORTH ARROYO DEL
PINO DIVERSION CH
THE MASTERS
209
207
207 A
207 B
A = .0701 mi²
Q_T = 120.77 cfs
SS204
SS203
204
212
S351
S353
S352
Q = 96.57 cfs
Q = 24.2 cfs
S291
S301
SS202
S311
S312
S321
TRAMWAY
202
603
614 A
614
610
THE MEADOWS
S641
S642
S591
S692
S693
S694
S782
S783
S784
S741
S751
SM12
S752
S761
S762
SM13
S731
602
S701
S711
S712
S721
S722
S631
S641
SM11
AMHOME
600
PEPPERTREE
SS603
611
606
SS601
605
109
108
101
S953
S952
S951
102
612
MOUNTAIN RUN
HARRISON MIDDLE SCHOOL
SS102
SM50
SS101
S31
S41
500
117
115
100 A
VISTA GRANDE
SANDIA
THOMAS

APPENDIX E

SUMMARY OF SUBBASIN HYDROLOGY

NOTE: FUTURE CONDITIONS ARE SHOWN IN BRACKETS [ ]

SUBBASIN ID NO.	AREA (SQ.MI.)	CURVE NO.	PERCENT IMP.	LENGTH (FT.)	SLOPE	TC (MIN.)	TP (HRS.)	K (HRS.)	Q10 (cfs)	Q100 (cfs)
100	0.3766	72	20	6600	0.0379	24.014	0.267	0.133	131	323
101	0.1076	75	40	4000	0.0300	17.864	0.198	0.099	91	192
102	0.0574	75	40	2900	0.0352	13.118	0.146	0.073	64	134
108	0.0646	75	40	3400	0.0265	16.541	0.184	0.092	59	123
109	0.0717	80	52	2600	0.0250	13.754	0.153	0.076	104	209
114	0.1507	76	41	6100	0.0344	23.447	0.261	0.130	106	222
115	0.0646	83	58	2200	0.0273	11.695	0.130	0.065	122	241
116	0.1722	81	46	3800	0.0316	16.837	0.187	0.094	197	402
117	0.1148	81	54	2400	0.0396	10.835	0.120	0.060	212	425
120	0.0646	85	65	2400	0.0333	11.576	0.129	0.064	138	266
121	0.0646	85	65	3000	0.0367	13.251	0.147	0.074	122	234
123	0.0610	83	54	2100	0.0190	12.956	0.144	0.072	82	148
126	0.0717	78	35	1500	0.0267	8.784	0.098	0.049	108	237
		[88]	[75]						[219]	[413]
127	0.0789	79	41	3100	0.0323	14.276	0.159	0.079	91	191
128	0.0789	85	65	3100	0.0226	16.378	0.182	0.091	124	238
129	0.0215	85	65	900	0.0289	5.748	0.064	0.032	82	160
130	0.0538	78	47	3000	0.0293	14.439	0.160	0.080	66	135
134	0.1255	82	58	3600	0.0217	18.671	0.207	0.104	156	305
137	0.1220	75	40	3500	0.0263	16.960	0.188	0.094	109	175
139	0.0717	78	65	2100	0.0333	10.445	0.116	0.058	151	293
143	0.1220	78	54	3300	0.0212	17.604	0.196	0.098	140	279
145	0.1435	70	20	3250	0.0246	16.430	0.183	0.091	59	143
146	0.0968	75	40	3100	0.0271	15.268	0.170	0.085	88	143
149	0.1435	70	10	3000	0.0267	14.979	0.166	0.083	35	105
151	0.0717	90	78	2100	0.0286	11.083	0.123	0.062	162	305
152	0.0897	74	34	2900	0.0228	15.511	0.172	0.086	63	138
157	0.0897	78	48	3500	0.0154	20.822	0.231	0.116	71	145
158	0.0359	74	32	1300	0.0200	8.789	0.098	0.049	39	86
159	0.0574	75	33	2200	0.0136	15.272	0.170	0.085	41	90
160	0.0789	79	41	2700	0.0289	13.393	0.149	0.074	83	177
161	0.1004	75	40	2600	0.0177	15.712	0.175	0.087	82	174
162	0.1578	65	5	3600	0.0267	17.237	0.192	0.096	14	44
164	0.0395	75	40	1600	0.0200	10.313	0.115	0.057	46	99
165	0.0574	88	75	2300	0.0122	16.510	0.183	0.092	89	167
168	0.0538	92	85	1600	0.0125	12.358	0.137	0.069	118	220
171	0.0610	85	61	2500	0.0180	15.144	0.168	0.084	87	170
172	0.0646	90	80	2600	0.0169	15.983	0.178	0.089	108	202
174	0.1148	88	76	6400	0.0172	31.790	0.353	0.177	101	189
201	0.5398	69	24	8900	0.0438	28.581	0.318	0.159	174	398
202	0.0323	68	14	1600	0.0375	8.096	0.090	0.045	18	46
~~204~~	~~0.1255~~	~~73~~	~~33~~	~~5400~~	~~0.0389~~	~~20.368~~	~~0.226~~	~~0.113~~	~~78~~	~~169~~
207	0.4771	67	11	7800	0.0372	27.507	0.306	0.153	73	209
209	0.1040	71	21	6500	0.0338	24.784	0.275	0.138	35	86
212	0.1291	77	43	3000	0.0320	13.964	0.155	0.078	149	312
217	0.0502	71	28	2800	0.0307	13.452	0.149	0.075	37	82

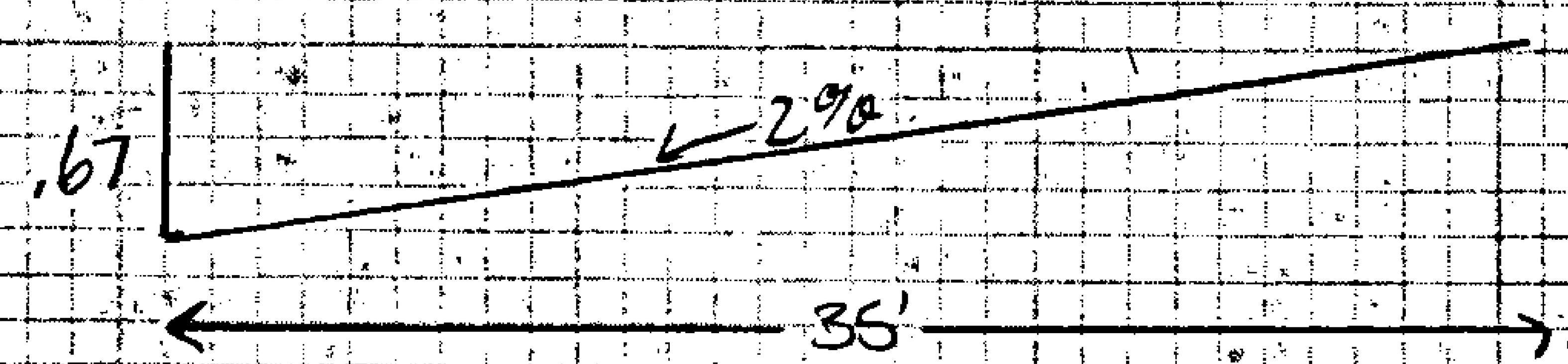
Eubank inlets $Q = 24.2$ cfs

$S = 1.08\%$, $n = .017$

2 type "A" inlets

35' F-F

depth of flow in each side of street according to mannings eqn



$d = .40$

From DPM Plate 22.3 D-5

Single "A" inlet — $Q_{grate} = 4.5 \text{ cfs} \times 50\% \text{ clogging}$

$= 2.25$ cfs

$Q_{curb\ opening} = CLH^{1.5}$

$= 3(6)(.4)^{1.5}$

$= 4.55$ cfs

$Q_{Total} = 4.55 + 2.25 = 6.80$ cfs

$Q_{excess} = 24.2 \text{ cfs} - 2(6.80)$

$= 10.6$ cfs, 5.3 cfs in each side of street

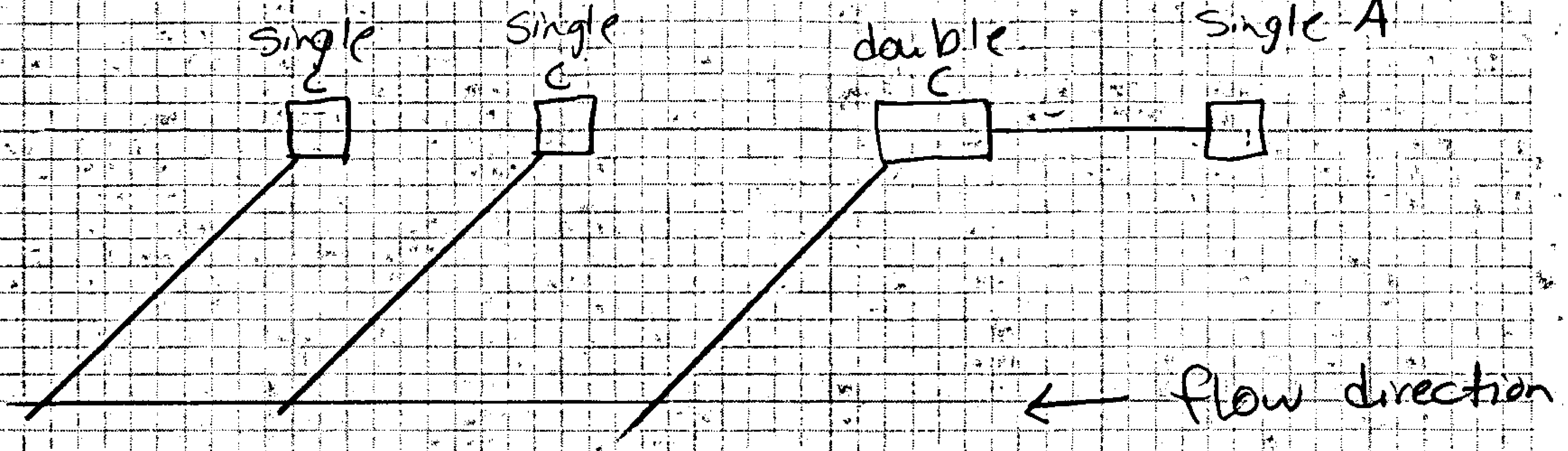
COMP. | LOC. | FILE

CK. | PROJ. | SHEET 3

DATE | SUBJ. | OF

WILSON & COMPANY

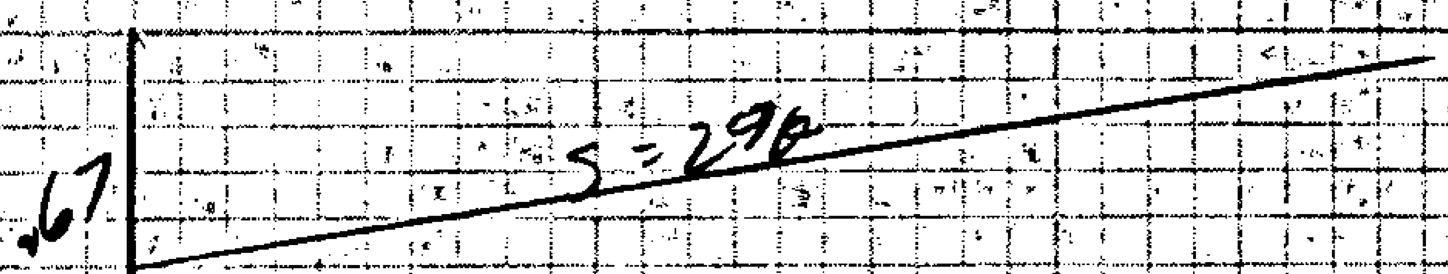
Academy inlets



Q = 96.57 cfs, 48.29 cfs each side of street

S = 4%

n = .017



Mannings equation → d = .52'

Single "A" inlet: DPM → Q_{grate} = 10 cfs × 50% clogging = 5 cfs

$Q_{curb\ opening} = CLH^{1.5}$

$= 3(6)(.52)^{1.5}$

= 6.75 cfs

Q_{Total} = 6.75 + 5.0 = 11.75 cfs

Q_{excess} = 48.29 − 11.75 = 36.54 cfs

Double C inlet: Q = 36.54 Mannings eqn d = .47'

DPM → Q_{grate} = 10 cfs × 50% = 5 cfs

$Q_{curb} = CLH^{1.5} = 3(6)(.47)^{1.5}$ = 5.8 cfs

$Q_{Total} = 5 + 5.8 = 10.8$ cfs

$Q_{excess} = 36.54 - 10.8 = 25.74$ cfs

Single "C" inlet : $Q = 25.74$ cfs , $n = .017$ $s = 4\%$

manning's → $d = .41'$

DPM: $Q_{grate} = 7.2$ cfs ±50% = 3.6 cfs

$Q_{curb} = CLH^{1.5} = 3(3)(.41)^{1.5} = 2.36$ cfs

$Q_{Total} = 3.6 + 2.36 = 5.96$ cfs

$Q_{excess} = 25.74 - 5.96$ cfs
$= 19.78$ cfs

Single "C" inlet : $Q = 19.78$ cfs $n = .017$ $s = 4\%$

manning's : $d = .37'$

DPM : $Q_{grate} = 6$ cfs ±50% = 3 cfs

$Q_{curb} = 3(3)(.37)^{1.5} = 2.03$ cfs

$Q_{Total} = 3 + 2.03 = 5.03$ cfs

$Q_{excess} = 19.78 - 5.03 = 14.75$ cfs

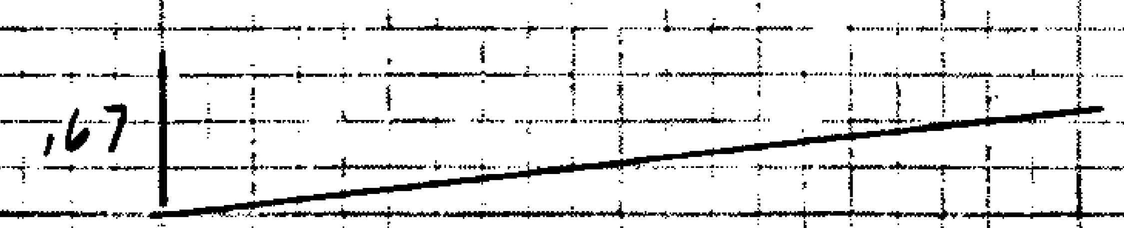
Excess Q each side of Academy = 14.75 cfs
= 29.5 cfs total


TYPE A INLET, STA 31+30, 43' LT. TC 10.73, INV 6.96
16 LF 18" RCP @ 18.44%
DOUBLE TYPE C INLET, STA 31+10 ACADEMY RD. 43' LT, T.C. 2.03, INV 3.00
61 LF 30" RCP @ 3.92%
SINGLE TYPE C INLET, STA 30+90 ACADEMY RD. 43' LT, T.C. 9.03, INV 3.50
44 L.F. 18" RCP @ 5.78%
SINGLE TYPE C INLET, STA 30+70 ACADEMY RD. 43' LT., T.C. 8.11, INV 2.66
47 L.F. 18" RCP @ 5.01%
CONSTRUCT MH #3
STA. 30+65.00 ACADEMY RD., 6' RT. =
STA. 11+88.00 LINE A
TYPE A INLET, STA 31+52, 43' RT. TC 11.71, INV 4.38
15 LF 18" RCP @ 15.57%
DOUBLE TYPE C INLET, STA 31+00 ACADEMY RD., 43' RT., T.C. 10.55, INV. 3.88
71 LF 30" RCP @ 3.53%
6 EXTEND CONNECTOR FOR 1000 DAY, TYP.
SINGLE TYPE C INLET, STA. 30+90 ACADEMY RD 43' RT., T.C. 9.27, INV. 3.13
50 L.F. 18" RCP @ 10.50%
SINGLE TYPE C INLET STA 30+70 ACADEMY RD. 43' RT., T.C. 8.54, INV. 3.30
47 L.F. 18" RCP @ 12.09%
NOTE: STATIONS 11 + 46, 11 + 56, + 66 AND 11 + 76 LINE A CONSTRUCT FABRICATED WYE CONNECTION INTO 48" TO RECEIVE INLET PIPES AT 45°. CONTRACTOR SHALL GROUT INLET PIPES INTO MAIN PIPE. INLET PIPE SHALL CENTER ON MAIN AND INLET PIPE WALL SHALL NOT PROJECT INTO MAIN PIPE. (SEE DETAIL LEFT.)
LINE A
EXISTING 18" W
INV 100.05
14.75 cfs
14.75 cfs
CONSTRUCT MH #2
STA. 28+77.23 ACADEMY RD., 10' RT. =
STA. 10+00.00 LINE A
TYPE A INLET STA 21+18.76 EUBANK 29' RT. TOP MEDIAN CURB 4.15 INV. 00.07
PROFILE BASE LINE = E 48" STORM SEWER
EUBANK BLVD.
EUBANK BLVD. CENTERLINE
EXTEND CHANNEL PER SECTION, THIS SHEET, TO STA. 2+00
REFER TO SHEET 25
5.3 cfs
5.3 cfs
NOTE:
CONTRACTOR SHALL SAWCUT & REMOVE EXISTING PCC PAVEMENT 10' TO EITHER SIDE OF PIPE. PAVEMENT SHALL BE REPLACED WITH 8" PCC PAVEMENT WITH TIE JOINTS PER DETAIL, SHEET 47.
EXISTING 6" WATERMAIN SHALL BE REMOVED TO 6' WEST OF STORM SEWER AND RECAPPED AND BLOCKED.
TYPE 'A' INLET STA 19+60.70 EUBANK, TC 09.91; INV. 99.57
CONSTRUCT MH #4
STA. 28+67.23 ACADEMY RD. =
STA. 22+06.76 EUBANK BLVD.
TEMPORARY MACADAM CURB
EXIST. W-18"
REFER TO SHEETS 25, 33 & 52 FOR PAVING & UTILITIES.
NOTE: EXIST. 4" GAS LINE IN ACADEMY RD. MUST BE LOWERED WHERE CONFLICTING W/ INLETS. CONTRACTOR SHALL COORDINATE WORK W/ GAS CO. OF NEW MEXICO.
6' CONC. SIDEWALK
10'
2:1 TYP.
ACADEMY ROAD
DED EARTH CHANNEL
SCALE:
MH #2 6' Ø TYPE 'C' MH
MH #3 6' Ø TYPE 'C' MH
JUN 15
5730
5720
5710
5700
5690
5680
FOR REVISIONS
GROUND ABOVE PIPE =
F EARTH CHANNEL SEE SECTION ABOVE
EXIST. 6" WATERMAIN
INV W. 98.11
INV. S. 95.00
E. 96.30
N. 96.10
109.0 L.F. 48" RCP CLASS III @ 2.84%
2.5 L.F. 48" RCP CLASS III @ 1.00%
AS-BUILT CERTIFICATION
11
12

COMP. | **WILSON & COMPANY** | LOC. | FILE
CK. | | PROJ. | SHEET 5
DATE | | SUBJ. | OF

proposed single "A" inlet on east side of Eubank just north of Academy

$Q = 14.75$ cfs $s = 2\%$ $n = .017$



Manning's eqn: $d = .38$

DPM $Q_{grate} = 4.7$ cfs

$Q_{curb} = CLH^{1.5} = 3(6)(.38)^{1.5}$

$= 4.22$ cfs

$Q_{Total} = 4.7 + 4.22 = 8.92$ cfs

$Q_{excess} = 14.75 - 8.92 = 5.83$ cfs

East side of Eubank: $Q = 5.83$ cfs

West side of Eubank: $Q = 14.75 + 5.3 + 5.3$

$Q = 25.35$ cfs

JUN 1 5 199

WILSON & COMPANY

COMP. ____ CK. ____ DATE ____

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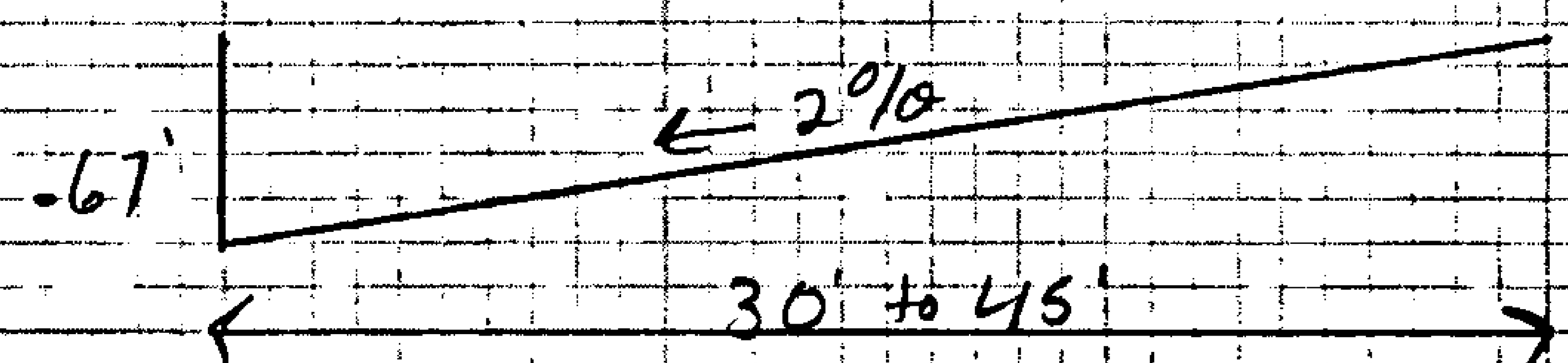
SUBJ. ____ OF ____

West side of Eubank

Section 1-1, Sheet 5 of 21 Construction Plans



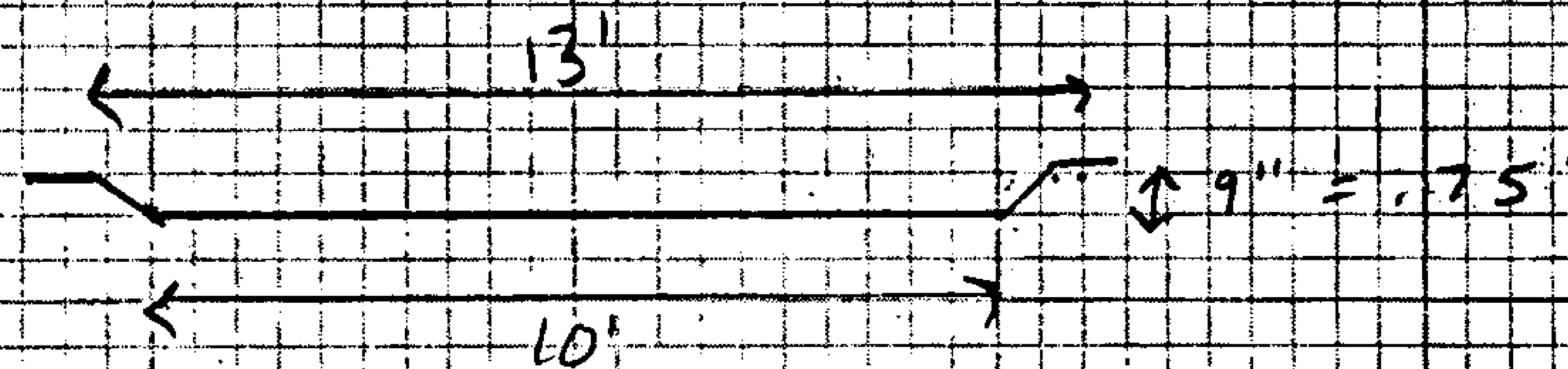
Q = 25.35 cfs

s = .62%

n = .017

→ Manning's eqn: d = .58' ✓ OK

proposed sec 2-2, sheet 5 of 21 Construction Plans



S = .75% n = .017

Q = 25.35 cfs

⇒ Mannings: d = .51' ✓ OK

COMP.

CK.

DATE

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LOC.

PROJ.

SUBJ.

FILE

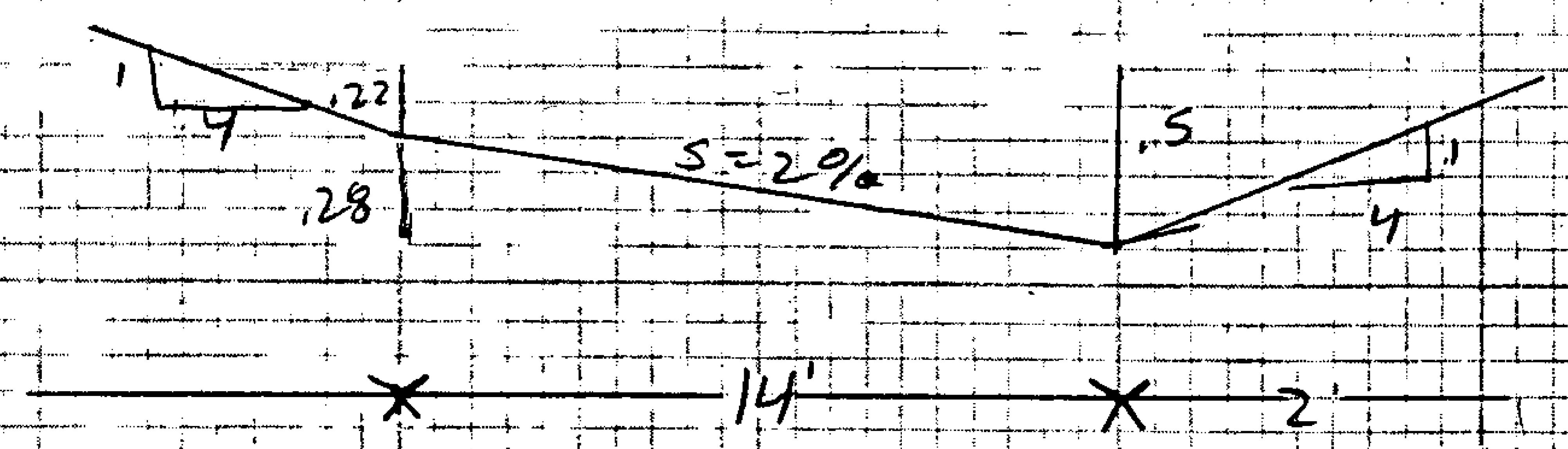
SHEET 7

OF

East side of Eubank

Q = 5.83 cfs

Sec A-A



n = .017

S = .62%

Q = 5.83 cfs

→ Mannings eqn: d ≅ .33' ✓ ok

PRINTED ON RECYCLED PAPER

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

May 3, 1993

Bob Hendrix, Branch Chief
Region VI, Federal Center
800 North Loop 288
Denton, Texas 76201-3698

RE: REQUEST FOR CONDITIONAL LETTER OF MAP REVISION FOR THE ESTATES AT TANOAN, CITY OF ALBUQUERQUE, NEW MEXICO COMMUNITY NO. 350002

Dear Mr. Hendrix::

The purpose of this letter is to request a C.L.O.M.R. for the above referenced site. The request is a privately funded project for a residential subdivision, approved by the City and AMAFCA. Enclosed with this letter is the following information:

1. The new implemented detailed application and certification forms for requesting revisions to the National Flood Insurance Program (NFIP) maps. Along with the forms is a detailed technical and NFIP-related considerations in a fashion that should facilitate an efficient review.

2. A check for $945.00 to begin your review.

The referenced subdivision is proposing to place fill in the existing floodplain and is also proposing a structural wall to protect the fill embankment from scour, as required by local drainage ordinances. Since the forms are relatively new it was not clear whether this CLOMR should have been submitted as a structural improvement or forms based on fill. A more conservative approach was taken and the forms were based on a structural improvement, with the intent that this would expedite FEMA's technical review.

Our Community would greatly appreciate your expeditious cursory review and

PUBLIC WORKS DEPARTMENT

Walter H. Nickerson, Jr., P.E.
Assistant Director Public Works

ENGINEERING GROUP

Telephone (505) 768-2500

your forwarding of this document to Headquarters for their technical review. If you should have any questions concerning this submittal, please do not hesitate to call me at (505) 768-2650.

Cordially,

Gilbert Aldaz

Gilbert Aldaz, P.E. & L.S.
City/County Floodplain Administrator

xc: William R. Locke, Chief, Risk Studies Div.
David B. Thompson, Wilson & Company

(WP+1596)

WILSON
& COMPANY

6611 Gulton Court, N.E.
Albuquerque, New Mexico 87109
P.O. Box 3548 87190
505-345-5345

Albuquerque
Colorado Springs
Kansas City
Phoenix
Salina, Kansas
Wichita

28 April 1993

Mr. Gilbert Aldaz, P.E.
Flood Plain Administrator
Hydrology Department
City of Albuquerque
P.O. Box 1293
Albuquerque, New Mexico 87103

Re: Submittal of Estates at Tanoan FEMA
CLOMR Documentation (E-21/D-12)
WCEA File: 92-522

Dear Gilbert:

Enclosed is the submittal package to FEMA for the request for a CLOMR for the Estates at Tanoan. All applicable forms have been completed with supporting documentation. It is not clear whether this request should be based on fill or not. The proposed subdivision will be filling in the existing floodplain with a structural wall protecting the subdivision against scour. A ruling is requested on whether this CLOMR should be based on fill or based on a structural improvement. As you are aware the drainage analysis has been approved locally by both the City of Albuquerque and AMAFCA.

Please review this documentation at your earliest convenience and then forward the information on to FEMA. Should you have any questions or comments, please do not hesitate to contact me.

WILSON & COMPANY

Rita Van der Vossen for

David B. Thompson, P.E.
Associate

DBT/dlg

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APR 29 1993

NFIP Regulations, 44 CFR Ch. I Section 65.12
Item 5

I, David B. Thompson, Registered Professional Engineer in New Mexico, hereby certify that no structures are located in areas which would be impacted by the increased base flood elevation.

DAVID B. THOMPSON
NEW MEXICO
9677
REGISTERED PROFESSIONAL ENGINEER

David B. Thompson
N.M. P.E. # 9677

Albuquerque
Metropolitan
Arroyo
Flood
Control
Authority

2600 PROSPECT N.E. · ALBUQUERQUE
TELEPHONE (505) 884-2215

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JAN 19 1993
HYDROLOGY DIVISION

Fred

E 21/D12

January 13, 1993

David B. Thompson, P.E.
Wilson & Company
6611 Gulton Court, NE
Albuquerque, NM 87109

RE: Drainage Management Plan (Drainage Report) for the Estates at Tanoan, dated December 10, 1992 (E-21/D12)

Dear Mr. Thompson:

As you know, AMAFCA retained Resource Consultants and Engineers, Inc. (RCE) to review the drainage plan for the above-referenced project. AMAFCA has provided specific input to RCE and these comments have been included in RCE's comments. The enclosed letter from RCE represents AMAFCA's comments on the latest submittal for this project. As an active participant in the preparation of the comments, AMAFCA concurs that they represent appropriate issues which should be addressed with this subdivision approval.

Appropriate covenants and a license agreement with AMAFCA will also need to be completed before the project can be approved. The license agreement will require approval by AMAFCA's Board of Directors. In addition, some additional private or public easements will likely be required for drainage facilities. These should be included on the plat or in separate filed documents.

Sincerely,
AMAFCA

Clifford E. Anderson

Clifford E. Anderson, P.E. & L.S.
Drainage Engineer

CEA:ij

copy: Gilbert Aldaz, City-County Floodplain Administrator
Fred Aguirre, Hydrologist, City of Albuquerque, PWD