# Table of Contents

File_1982-0061 Project Name: Colony Park – Flood Plain Permit
Date_7/23/02

| Present | Scanned | |
|---|---|---|
| | | A few items are denoted with an asterisk (*), which means they are to be scanned for permanent record on the in some instances, not all entries designated to be scanned by the department are present in the file. There are also documents specific to certain files, not found on the standard list. For this reason, a checklist has been provided. Remaining items, (not selected for scanning), will be marked present on the checklist. This index can serve as a quick guide for the contents of each file. Files denoted with (**) are to be located using the ISYS Query System. Planning Clearance will need to be typed in full, as well as other entries such as Ordinances, Resolutions, Board of Appeals, and etc. |
| X | X | *Summary Sheet – Table of Contents |
| X | X | Review Sheet Summary |
| | | Application form |
| | | Review Sheets |
| | | Receipts for fees paid for anything |
| | | *Submittal checklist |
| | | *General project report |
| | | Reduced copy of final plans or drawings |
| | | Reduction of assessor's map |
| | | Evidence of title, deeds |
| | | *Mailing list to adjacent property owners |
| | | Public notice cards |
| | | Record of certified mail |
| | | Legal description |
| | | Appraisal of raw land |
| | | Reduction of any maps – final copy |
| | | *Final reports for drainage and soils (geotechnical reports) |
| | | Other bound or nonbound reports |
| | | Traffic studies |
| | | Individual review comments from agencies |
| | | *Consolidated review comments list |
| | | *Petitioner's response to comments |
| | | *Staff Reports |
| | | *Planning Commission staff report and exhibits |
| | | *City Council staff report and exhibits |
| | | *Summary sheet of final conditions |
| | | *Letters and correspondence dated after the date of final approval (pertaining to change in conditions or expiration date) |

**DOCUMENTS SPECIFIC TO THIS DEVELOPMENT FILE:**

| | | | | | |
|---|---|---|---|---|---|
| X | X | Action Sheet | | | |
| X | X | Review Sheet Summary | | | |
| X | | Review Sheets | | | |
| X | | Flood Plain Permit Application | | | |
| X | X | Letter from Jeff Smith to Ron Rish re: errors in addendum-8/27/82 | | | |
| X | X | Memo from Bob Goldin to Ted Straughan re: found acceptable with provisions to be met – 10/4/82 | | | |
| X | X | Flood Plan Narrative | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

COLORADO
WEST
ENGINEERING

CONSULTING CIVIL ENGINEERS
835 COLORADO AVE., GRAND JUNCTION, COLORADO 81501
303/245-5112

July 28, 1981

Mr. Ronald P. Rish
City Engineer
c/o City of Grand Junction
Grand Junction, CO 81501

Re: Colony Park flood plain permit
application addendum (#101.3)

Dear Mr. Rish:

Some time ago, we accidently came across a copy of your memorandum to Bob Goldin, dated June 9, in which you referred to our flood plain narrative as an "inadequate technical response".

We felt that our opinions and assumptions were adequately supported by information contained in the "Corps of Engineers' Flood Hazard Report", which could easily be verified. We did make contact with the local Corps of Engineers Office and were referred to the Sacramento District Office, to the District Hydrologist. We were told that if it were absolutely necessary, the information might be retrieved from their computer in the form of computer cards which we would have to convert and interpret ourselves. Information already contained in the study led us to belive it unnecessary to go to the trouble of retrieving information(that may not be of additional help. (see letter from Corps of Engineers and sample data available.)

In response to your questions and comments, we are hereby submitting this addendum to our original floodplain permit application, complete with channel cross sections, flood water elevations, hydraulic calculation for channel capacities and replacement culvert sizes, preliminary drainage plan for the development, and other supporting documents and information.

We will address your comments and questions in the order that they appear in your memorandum so as to completely answer all of them.

The original plan for this development included a preliminary plan for development of Colony Park as well as the Gormley property immediately east. Than plan included a single common entrance to the properties, located at channel station 9+75. However, the preliminary plat submitted for approval omitted Gormley's property and showed a single entrance at approximate channel station 8+90. The existing crossing at9+20 (Colony Park east boundary) will be removed.. The crossing at 9+75 will not be affected. The 9+20 crossing is listed by the "Corps of Engineers' Flood Hazard Report" (page 9) as an "obstructive stream crossing". This obstruction is evident when looking at the channel profiles (Flood Hazard Study plat 73) and the channel sections shown on our larger 24" x 26" drawing. The 100-year flood elevation upstream of the crossing is 4590.7. Immediately downstream, the flood elevation drops to 4585.0. The channel section at 9+20 clearly shows that the higher elevation upstrem would force water over the top of the bank, as well as out onto Patterson Road. This is also shown by the 100-year flood line, on plate 20. Immediately downstream of the crossing, the 100-year flood elevation shows that the entire flood flow would be easily and safely contained well within the existing channel. Our removal of the crossing at 9+20 will also remove school and park property, as well as Patterson Road from the flood plain.

We know from the Flood Hazard Report, that the peak 100-year flood flow in Horizon Drive Channel at Independent Ranchman's Ditch is 600 C.F.S. It seems impossible to calculate how much of that volume is contained in the overland sheet flow, which we propose to retain in the existing channel. This quantity, however, seemed less important once we were able to determine that the existing channel is more than safely adequate for the entire 600 C.F.S.

We realize that by containing the entire flow within the channel,we are eliminating some suface retention, which will add slightly to the downstream flow. This volume is also difficult if not impossible to calculate. This led to our "opinion statement" that "sparse industrial areas downstream are less sensitive than more dense residential areas".

Again, in our opinion, if the existing crossing were to remain the first flood waters to top the crossing would undoubtedly wash away the poorly constructed dirt roadway and culvert backfill, which caused the obstruction; thus, increasing channel size and eliminating overland flow in the area south and west of the crossing anyway. In the event of a 100-year flood, we question whether or not the obstruction would remain long enough to cause the anticipated overland sheet flow.

These opinions also seem to be confirmed in the Flood Hazard Report (existing topography, flood water profiles, etc.)

We do anticipate some channel work, as indicated on the typical finished cross sections contained herein. This proposed section is general only, as we intend to correlate this work with the development of Patterson Road. Channel size will not decrease and the removal of the obstructive crossing will keep the 100-year flood out of Colony Park.

Upstream properties will not be adversely affected. Downstream properties could be affected slightly as previously outlined in the original Flood Plain Narrative. (Estimated depression storage volume eliminated = 1.34 acre-feet. Existing flood area at 25 Road = 7.8 acres. If the entire 1.34 acre feet of water entered this 7.8 acres, it would add approximately 1.34/7.8 = 0.17' or two (2) inches to the present flood elevation.) Even this possibility would be eliminated by the replacement of the culvert crossing at 25 Road which is also shown by the Corps of Engineers as an obstructive crossing.

We calculated the size of culvert needed to safely handle the 600 C.F.S. flood flow. See separate sheet.

Sincerely,
COLORADO WEST ENGINEERING

Roger A. Foisy

Roger A. Foisy, P. E.

sjh

## Floodplain Permit

This Package contains the following:

1. This top sheet which describes the application forms and process.
2. A Permit Application form, which is designed to be page one of a floodplain permit application.
3. List of documents which may be required as a part of a floodplain permit application.
4. An illustrated sample (front and back of one page, not to be part of an application).

All floodplain permit applications should start with a discussion with a staff person. Together staff and applicant should review the form and documents list. Those materials determined to be necessary will be identified on the bottom of the permit application form and by placing a check mark next to the required document in the list.

When the completed application form and all the required documents list and the permit application fee are submitted a receipt will be given to the applicant for all materials submitted. Those required materials will become a part of an official file and will not be returned.

The Mesa County Floodplain Administrator will review the submitted materials, make a site visit if necessary, and make a decision whether or not the permit will be granted or denied. The Administrator must, by adopted regulation, make a decision within 20 days.

All decisions concerning floodplain permits will be in writing. The original will be returned to the applicant and a copy will be placed in the file. Evaluation criteria considered in and affecting the application will be included in the written document. In the case of an approval, with conditions, all the conditions will be enumerated in the written permit.

In the situation that an applicant disagrees with the Administrator's decision or conditions there is a Floodplain Board of Appeals established, whose authority is identified in the Mesa County Floodplain Regulations.

NOTE: ANY REQUIRED ENGINEERING REPORTS MUST BE PREPARED AND SIGNED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF COLORADO

## Documents List

The following items, identified by a check mark, must be included as a necessary part of the floodplain permit application. The materials may be submitted in narrative form or in graphical (drawing, sketch, etc.) form. As a minimum for favorable review all required items must be included in a floodplain permit application file.

__✓__ PLOT PLAN drawn to scale at not less than 1"=200', showing the location and dimensions of the lot, the spatial arrangements of all existing and proposed structures and improvements, streets and driveways, stored materials, and floodproofing measures. The plot plan must show both banks of the stream channel, any existing overflow channel(s) and the perimeter of the 100 year flood in relation to the project site.

__NA__ STRUCTURES List all existing and proposed structures on the project site within the floodplain, state the type of construction (frame, metal, masonry, etc.), state the elevation of the lowest floor expressed in feet above Mean Sea Level as determined from comparison to an identified datum point.

__NA__ A CROSS SECTION or elevation view at the point of the proposed development showing:

- __NA__ a. the full channel of the stream,
- __NA__ b. the contours of the adjoining land areas of the project site,
- __NA__ c. the elevation of the 100 year flood event,
- __NA__ d. the elevation of the lowest floor of all proposed structures,
- __NA__ e. the elevation to which each structure has been or will be floodproofed.
- __NA__ f. the elevation of existing and proposed streets, or driveways,
- __NA__ g. areas to be filled or excavated,
- __NA__ h. water or wastewater treatment facilities,
- __NA__ i. existing and proposed storage areas,
- __NA__ j. ______________________
- __NA__ k. ______________________

NOTE: All elevations shall be tied to either USGS datum points or Grand Valley Vertical and Horizontal Control Points, as used by the Army Corps of Engineers in the Flood Hazard Study, November 1976. Location and elevation of the control points are available from the County Floodplain Administrator.

__NA__ STORED MATERIALS Identify in tabular form all materials which are presently or are proposed to be stored within the floodplain on the project site. Provide adequate description of the material (a trade name will be insufficient), identify the least, normal, and maximum quantity of material which will be stored in the floodplain. In the case that the stored material(s) is (are) hazardous to animal or plant life, are explosive, poisonous, flammable, or is (are) volatile when in contact with water, explain the degree of hazard for each such material.

NA — SPECIFICATIONS for construction material(s) floodproofing, filling, dredging, grading, or channel improvement shall be included. Proposed floodproofing measures, designed to mitigate potential flood hazard at the project site must be certified by a professional engineer registered in the State of Colorado.

NA — WATERCOURSE ALTERATIONS OR RELOCATIONS must be indicated on an overhead air photo (scale 1"=200') and at least two cross sections. Existing direction of the water forces, areas of bank erosion, areas of accretion (build-up) or potential for channel movement shall be shown on the air photos. Related hydraulic considerations such as watercourse capacity, efficiency or storage characteristics may be in tabular, narrative, or graphic form.

✓ — A NARRATIVE should describe the effects of the development on adjoining, upstream, and downstream properties and uses at the time of a 100-year flood.

- ✓ a. Describe the effect caused by this development on floodwater height (elevation), velocity, and direction of floodwaters during a 100 year flood event.
- ✓ b. Evaluate the possibility of increased erosion to downstream properties, or scour to adjacent or upstream properties as a result of this development.
- ✓ c. Estimate the additional protective measures necessary to mitigate b above.
- ✓ d. Evaluate the possibility of release and effect of toxic or hazardous materials during a 100 year flood event.

✓ — Describe in written or pictorial fashion the route(s) of ACCESS during a 100 year flood event.

✓ — Describe the locations and list the specifications for floodproofing equipment for each of the following:

| | |
|---|---|
| sanitary sewer | electric power |
| domestic water | natural gas |

✓ — Describe the method of anchoring floatables, call-out the specifications for anchors, and anchoring ties.

NA — A FLOOD PLAIN/HAZARD BOUNDARY MAP prepared by a registered professional engineer, drawn to a scale of not less than 1" = 200' must show those items required on a PLOT PLAN. This document will be necessary when there is not detail floodplain or flood hazard information available.

# FLOODPLAIN NARRATIVE

To Accompany

CITY OF GRAND JUNCTION FLOODPLAIN PERMIT APPLICATION

For

Applicant: Ted Straughan

Address: 639½ Main Street
Grand Junction, Colorado 81501

Project site: 2575 Patterson Road
Grand Junction, Colorado

Prepared by: COLORADO WEST ENGINEERING
835 Colorado Ave.
Grand Junction, Colorado 81501
(303) 245-5112
Roger A. Foisy, P.E.
Colorado Registration No. 15504

ROGER ALLEN FOISY
REGISTERED
15504
PROFESSIONAL ENGINEER
STATE OF COLORADO

Roger Allen Foisy

SOURCES OF INFORMATION -

The source of information for this narrative is the "Corps of Engineers, Flood Hazard Study, dated November 1976, and the floodplain maps and flood profiles generated by that study.

More exact, calculated values of sheet flow volume, detention time, storm intensity and duration are difficult to arrive at because of the absence of known factors and characteristics of the 100 year storm and the watershed area.

Estimates given and assumptions made in this report are based on information given in the Flood Hazard Study. This information has been projected and analyzed according to common drainage practices.

PROJECT SITE -

The property being considered for development is located between 25 5/8 and 25 3/4 Patterson Road, Grand Junction, and extends some 1320 feet, more or less, south of Patterson Road, containing approximately 17 acres.

The petitioner is proposing a planned development with a combination of single-family and multi-family residences.

DEVELOPMENT AND FLOODPLAIN HAZARDS -

The northern 60% of the property is located within the 100 year, Horizon Drive Channel flood plain (sheet flow area), according to the Floos Hazard Study.

The study and the accompanying maps and flood profiles show that the culverts crossing the Independent Ranchmens Ditch at stations 9+20 and 9+75 are "obstructive stream crossings".

From the flood profiles contained in the study, it can be seen that these two obstructive crossings would cause water to back up during the 100 year flood, overrunning the banks of the channel. This overrun water would flow southwesterly across the adjoining property to the east.

This overland flow would then enter the petitioners property and flow west across the Pomona School property until it ultimately reached 25½ Road. Upon reaching the built up 25½ Road, the flow would be directed north along the edge of the road until it ultimately returned to the channel.

There are two entrances back to the channel located approximately at stations 7+87 and 8+67. These are low spots in the south bank of the stream channel which would appear to allow overland flow from the properties to return to the channel.

The proposed development of the petitioners property would involve the removal of the existing culvert crossing at station 9+20 and installation of a new crossing adequately sized to handle the entire 100 year flood flow.

Development of the property immediately east will ultimately involve the replacement of the crossing located at station 9+75.

The removal of these obstructive stream crossings will eliminate the possibility of flow overrunning the banks of the channel and thus eliminate sheet flow from the entire area. The flood plain maps show that the existing channel is of adequate size to handle the anticipated total flood flow.

The typical improved ditch channel included in this report is adequate to safely handle the 100 year flood flow and has been correlated with the City's planned "F" Road improvements.

In addition, we propose an earth berm and swale along our eastern boundary to intercept the sheet flow caused by the inadequate culvert at station 9+75 and return this sheet flow to Ranchman's ditch. See Grading and Drainage Plan for location.

Under existing conditions, the property within the 100 year flood plain, approximately 23 acres, acts not as a "retention" or ponding area but merely as a "detention" area. Sheet flow covering the property ultimately returns to the channel downstream, minus surface retention and that water absorbed into the dry ground.

EFFECTS ON UPSTREAM PROPERTIES -

The development of the property under consideration, including removal of the obstructive stream crossings and thus the elimination of 100 year sheet flow across the property, will have no effect on upstream properties, with the exception of the elimination of sheetflow across a few acres of property immediately east. The remainder of this same adjacent property, within the flood plain, is subject to sheet flow caused by the obstructive crossing at station 9+75 which will probably become the main entrance to that property at the time it is developed.

The crossing located at "26" Road is also listed in the study as an obstructive stream crossing. During the 100 year flood this obstruction becomes the controlling factor in upstream overbank and sheet flow. Thus, any changes made decreasing obstructions or decreasing detention areas downstream of the "26" Road crossing would have no effect upstream of that crossing.

The effects of ponding upstream of our proposed crossing should be minimal as shown in our calculations of headwater elevations.

EFFECTS ON ADJACENT PROPERTIES -

As previously mentioned, the removal of the obstructive crossing at 9+20 and the addition of the earth berm and swale along our eastern boundary would eliminate sheet flow across Colony Park.

Immediately west of the petitioner's property is the Pomona school and playground area. The flood plain boundary takes in the major part of the school grounds as well as the school building. This property is subject to 100 year sheet flow simply because it is lower than the property to the east. Sheet flow originating on the properties to the east naturally flows toward "25½" Road, across the school property. The proposed development would also eliminate sheet flow across the school property.

EFFECTS ON DOWNSTREAM PROPERTIES -

As outlined above, the land being considered for development, as well as some adjacent land east and west (approx. 23 acres total) lies within the 100 year sheet flow flood area. This land in its existing state, although covered by sheet flow, will not retain the total volume of water. As can be seen from the flood plain/topographic map, there are two locations on the south bank of the channel, station 7+87 and station 8+67, where sheet flow will naturally return to the channel.

The only water not returned to the channel would be that volume retained as depression storage and that lost as infiltration. This total volume is estimated to be about 0.7 inches over the entire 23 acres (depression storage = 0.2 inches, infiltration = ½ inch/hour for 100 year storm), or approximately 1.34 acre feet of water.

If development of the property takes place as planned, this estimated volume of water would be added to the downstream flow due to elimination of the depression storage and infiltration on the property. This additional volume is thought to be negligible when compared with the total volume contained in the channel downstream.

The estimated time required for overland flow from the obstructive crossing at 9+20 to "25½" Road, where flow returns to the channel, is approximately 25 minutes (1500 ft./1 ft. per sec., Flood Hazard Study estimated overbank area velocity of flow).

Under present conditions, during a 100 year flood, the temporary storage provided by overland flow would serve to reduce peak discharge only slightly during the time required for that flow to return to the channel. Upon return to the channel, the discharge would then be increased by the same amount minus depression storage and infiltration.

After development takes place sheet flow will be eliminated. The volume of water which would have been detained across the property will be retained in the channel. This will increase the "normal" 100 year flow in the channel, but this increase again is thought to be insignificant when compared to the total flow of 600 C.F.S.

The exact increase to normal flow has not been calculated due to lack of information regarding duration of storm and duration of peak flow from runoff.

The culvert at "25" Road is also listed as an obstructive stream crossing. Water backs up behind this culvert, overflows the banks of the channel and flows downhill along "25" Road. Ponding would occur in this area, covering a narrow strip of land on the east side of the road approximately 200 feet wide and 1700 feet long.

Obviously, the elimination of detention areas upstream would increase the amount of water conducted into such downstream retention areas. This additional effect is impossible to estimate. However, we believe the flooding downstream would not be significantly affected. In addition, this flooded area adjacent to "25" Road is an industrial area and flooding is much less critical and damaging in such sparse industrial areas as opposed to more dense, residential areas.

The development of the property described above is not expected to produce any change in floodwater velocity or direction of flow during the 100 year flood. We also expect no increased erosion or scour to adjacent, upstream or downstream properties.

Flood water ponding elevation would be increased however slightly in the industrial area along the east side of "25" Road, as described above.

RELEASE OF TOXIC MATERIALS -

We do not anticipate at all, any possibility of the release of any toxic materials during the 100 year floow event.

ROUTES OF ACCESS DURING 100 YEAR FLOOD EVENT -

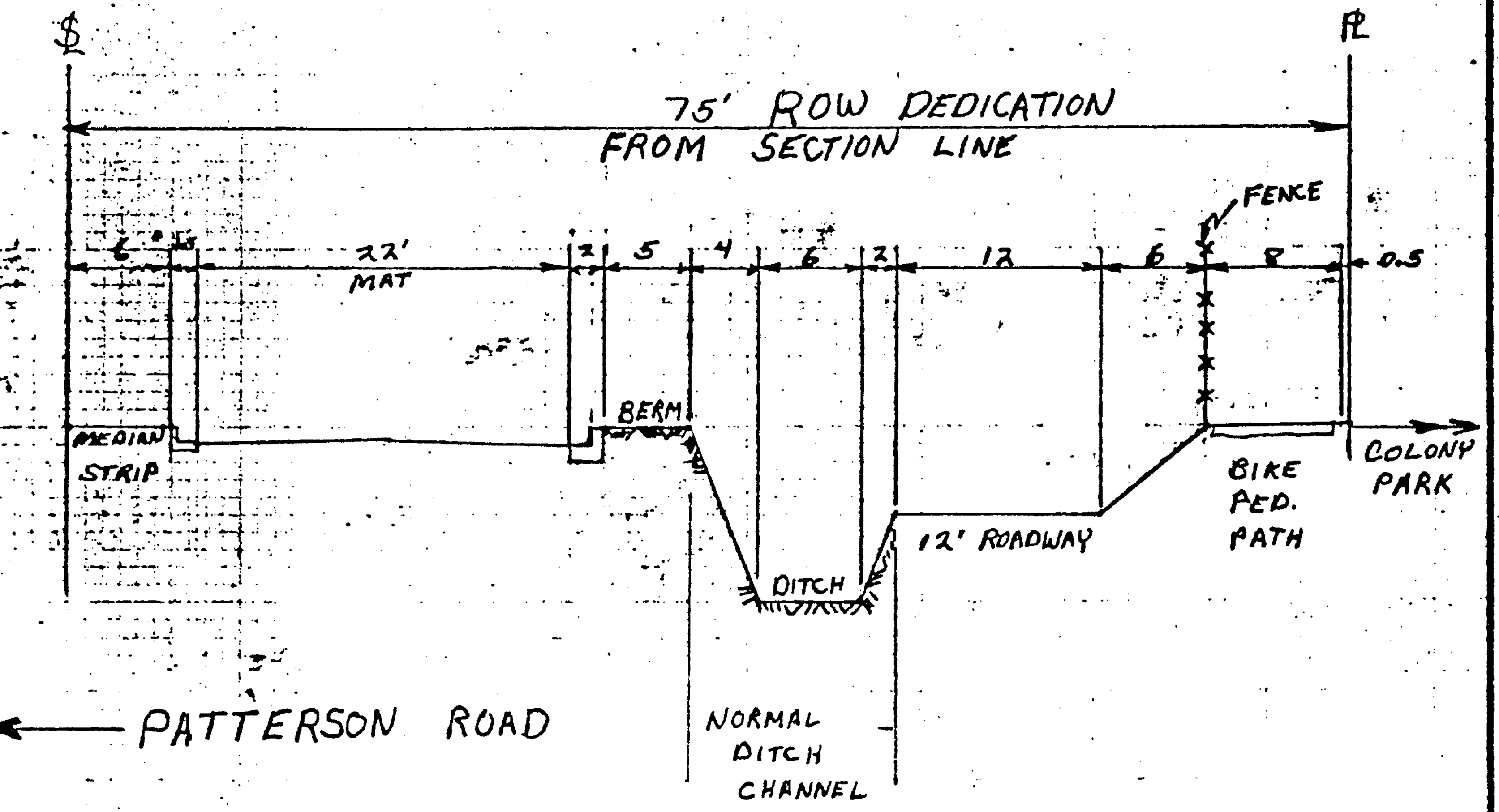
Because replacement of the obstructive stream crossings and further development of the property will completely eliminate flood waters from the interior of the property, and retain the flow within the channel, the normal, planned routes of access would also be open and accessible during the 100 year flood.

FLOODPROOFING OF UTILITIES -

Because sheet flow will be completely eliminated from the developed property, sanitary sewer, domestic water, electric power, natural gas and telephone cables, boxes, etc., will not require any protection against flood water.

ANCHORING FLOATABLES -

Also because of the elimination of sheet flow from the entire developed property, there will be no need to provide for anchoring of floatables.




PROPOSED LOCATION OF
PATH, DITCH AND PATTERSON
ROAD ADJACENT TO
COLONY PARK SUBDIVISION

COLORADO WEST ENGINEERING
835 Colorado Avenue
Grand Junction, CO
245-5112

835 Colorado Ave. · Grand Junction, Colorado 81501 · (303) 245-9430

Job 532.3 Colony Park
Client TED STRAUGHN
Designed by
Checked by
Date 3-11-82
Sheet No. 1 of 1

# APPENDIX

.....listing sources of information used in calculations and in support of assumptions and opinions expressed in the original Floodplain Narrative and the Addendum for Colony Park, contained herewith.

Response from Corps of Engineers

Table 4 - Obstructive stream crossings

Plat 73 - Flood Profiles

Table 3 - Peak Flows 100- and 500-year floods

Chart 2-53 - Headwater depth for C.M.P. culverts

Table 10-1 - Values of "n" for Mannings Formula

Grand Junction Intensity - Duration Curves

# INTRODUCTION

## PURPOSE AND SCOPE OF REPORT

The purpose of this report is to describe and illustrate the flood hazard in the vicinity of Grand Junction, Mesa County, Colorado. The report will aid in planning the best use of lands subject to inundation from 100- and 500-year floods. However, it does not contain recommendations for solving flood problems or plans for use of flood plain areas because these activities are the responsibilities of local governments.

## LIMITS OF STUDY

The report covers the Colorado River from 22 Road upstream to 32 Road and the lower reaches of the Gunnison River, Leach Creek, Horizon Drive Channel, and Lewis Wash in and around Grand Junction. The Gunnison River, Leach Creek, and Lewis Wash are direct tributaries to the Colorado River. Horizon Drive Channel flows through the northern portion of the city. It becomes Independent Ranchmens Ditch in the vicinity of Grand Valley Canal. The Colorado River is the only other stream under study to enter the city, passing through the western sector. Plate 1 is a general map of the area. The stream reaches studied are shown in Table 1.

### TABLE 1

#### STREAM REACHES STUDIED

| Stream | Reach | | Length of Reach (miles) |
|---|---|---|---|
| | From: | Upstream to: | |
| Colorado River | 22 Road | 32 Road | 12 |
| Gunnison River | Mouth | Redlands Dam | 2 |
| Leach Creek | 24 Road | H Road | 4 |
| Lewis Wash | Mouth | Government Highline Canal | 3 |
| Horizon Drive Channel | F Road | Vicinity of Walker Field | 3 |

## TABLE 2

### DRAINAGE AREAS AND HEADWATER ELEVATIONS

| Stream | Location | Approximate Drainage Area sq. mi. | Approximate Elevation of Headwater Area ft. (msl) |
|---|---|---|---|
| Colorado River | Gaging Station near Fruita | 17,100 | 12,000 |
| Gunnison River | Gaging Station near Grand Junction | 7,930 | 14,000 |
| Leach Creek | At mouth | 25 | 5,500 |
| Horizon Drive Channel | At "F" Road | 2 | 5,500 |
| Lewis Wash | At mouth | 5 | 5,500 |

The climate of the area is arid to semiarid with yearly precipitation averaging about 8 inches at Grand Junction, from about 10 to 15 inches in headwater areas of the Book Cliffs, and about 40 inches in the headwater regions of the Colorado and Gunnison Rivers. Most of the annual precipitation in the higher elevations occurs as snow and a deep snowpack accumulates. Temperatures are often in the nineties in the summer and below freezing in the winter. Occasionally, summertime temperature may exceed 100° and winter temperature may drop as low as -20°. Natural vegetation in valley areas primarily consists of cottonwood and willow, desert shrub, and an understory of hardy grasses. Prominent between 5000 and 8000 feet are juniper, piñon pine, oak, big sagebrush, and Douglas Fir. From 8000 feet to timberline, vegetation consists mainly of aspen, spruce, sub-alpine fir, lodgepole pine, and native grasses and shrubs. Vegetation is sparse above timberline but includes grasses, sedges, and alpine willow.

## NATURE OF FLOOD PROBLEMS

As noted, most of the annual precipitation in the higher regions of the basins of the Colorado and Gunnison Rivers occurs as snow and a deep snowpack accumulates. General rainstorms covering large areas for extended periods can occur in the region during spring and summer. Convective type cloudburst storms of small areal extent, which account for about half of the normal annual precipitation in the Grand Junction area, can be the drainage basins of the Colorado and Gunnison Rivers and convective type cloud-burst storm runoff from the drainage basins of the tributary streams create the most severe flood conditions in the study area.

The unit hydrographs for Leach Creek, Horizon Drive Channel, and Lewis Wash were developed by using the Snyder technique and data from several similar nearby basins with recorded thunderstorm runoff. Regional snowmelt flood envelope curves for the Colorado and Gunnison Rivers were developed using flow-discharge frequency data.

Snowmelt flows of the Colorado and Gunnison Rivers at Grand Junction were developed from frequency curves for those streams above Grand Junction. Based on available data, the 1921 flood was selected as being most representative for combined runoff from the two rivers, and the standard project flood was determined to have a frequency of 250 years (50 percent larger than the 1921 flood). To establish standard project flows on the Colorado River, a 150 percent value of the 1921 floodflows at Palisade was determined and then reduced by 8,000 cubic feet per second to reflect the effect of upstream reservoirs. For standard project flows on the Gunnison River, 150 percent of the 1921 floodflow at Grand Junction was established and then divided into runoff above and below Blue Mesa Reservoir (55 and 45 percent, respectively). Blue Mesa Reservoir was completed in 1965. Runoff above the reservoir was computed as a ratio of the 1921 flows and adjusted for present conditions. Reservoir releases were made so that downstream channel capacities would not be exceeded and assuming maintenance of minimum power pool level. Downstream runoff was then added to arrive at present standard project flow at Grand Junction. Flows in the two rivers were combined for total standard project snowmelt flows at Grand Junction. The 100-year flood event was established as an .89 percent value of the standard project event. The resulting floodflows are shown in Table 3.

## TABLE 3

### PEAK FLOWS
### 100- AND 500-YEAR FLOODS

| Stream | Location | Peak Flow cfs 100-Year Flood | 500-Year Flood |
|---|---|---|---|
| Colorado River | Above mouth of Gunnison River | 63,000 | 82,000 |
| Colorado River | Below mouth of Gunnison River | 82,000 | 107,000 |
| Gunnison River | At Grand Junction | 20,000 | 25,000 |
| Leach Creek | At H Road | 1,800 | 4,200 |
| Horizon Drive Channel | At Independence Ranchmens Ditch | 600 | 1,800 |
| Lewis Wash | At I-70 | 1,400 | 3,800 |

# TABLE 4

## OBSTRUCTIVE STREAM CROSSINGS[1]

| Identification | Location[3] | Elevation[2] Streambed | Under-clearance[4] | Top of Roadway[5] | 100-year Flood | 500-year Flood |
|---|---|---|---|---|---|---|
| **COLORADO RIVER** | | | | | | |
| Grand Avenue (State Highway 340): | | | | | | |
| Westbound Lanes | 385.53 | 4538 | 4559 | 4562 | 4553 | 4555 |
| Eastbound Lanes | 385.56 | 4538 | 4559 | 4562 | 4554 | 4556 |
| DRGWRR | 386.71 | 4546 | 4566 | 4570 | 4563 | 4565 |
| 5th Street (U.S. 50): | | | | | | |
| Northbound Lanes | 386.83 | 4549 | 4570 | 4575 | 4564 | 4566 |
| Southbound Lanes | 386.84 | 4550 | 4565 | 4572 | 4565 | 4567 |
| 32 Road | 393.05 | 4606 | 4625 | 4630 | 4627 | 4629 |
| **LEACH CREEK** | | | | | | |
| River Road* | 2,040 | 4532 | 4540 | 4542 | 4543 | 4545 |
| DRGWRR | 2,100 | 4534 | 4541 | 4545 | 4544 | 4546 |
| U.S. Highway 6/50* | 2,440 | 4536 | 4542 | 4546 | 4545 | 4547 |
| 6/50 Frontage Road* | 2,625 | 4536 | 4544 | 4545 | 4545 | 4547 |
| 24½ Road* | 9,890 | 4565 | 4574 | 4575 | 4574 | 4574 |
| 25 Road* | 12,530 | 4576 | 4587 | 4591 | 4590 | 4590 |
| Main Line Grand Valley Canal | 13,630 | 4584 | 4594 | 4599 | 4593 | 4594 |
| G½ Road* | 19,130 | 4627 | 4637 | 4650 | 4640 | 4640 |
| I-70 Frontage Road* | 19,540 | 4638 | 4646 | 4661 | 4660 | 4661 |
| 26 Road* | 21,330 | 4653 | 4659 | 4662 | 4664 | 4667 |
| H Road* | 22,570 | 4666 | 4674 | 4684 | 4685 | 4686 |
| **LEWIS WASH** | | | | | | |
| D Road | 2,070 | 4610 | 4620 | 4622 | 4621 | 4623 |
| D½ Road | 4,730 | 4629 | 4638 | 4640 | 4639 | 4642 |
| E Road | 7,370 | 4644 | 4656 | 4660 | 4657 | 4661 |
| Grand Valley Canal | 8,120 | 4651 | 4664 | 4668 | 4663 | 4670 |
| U.S. Highway 6/24 | 9,080 | 4663 | 4674 | 4678 | 4670 | 4677 |
| E½ Road | 10,030 | 4672 | 4682 | 4685 | 4684 | 4686 |
| F½ Road | 15,470 | 4737 | 4748 | 4750 | 4747 | 4752 |
| Interstate 70* | 17,800 | 4762 | 4769 | 4778 | 4770 | 4779 |
| **HORIZON DRIVE CHANNEL** | | | | | | |
| Private Crossing* | 9,200 | 4580 | 4586 | 4590 | 4591 | 4591 |
| Private Crossing* | 9,750 | 4588 | 4594 | 4595 | 4596 | 4596 |
| 26 Road* | 10,400 | 4597 | 4604 | 4606 | 4606 | 4607 |
| 26½ Road* | 13,450 | 4618 | 4628 | 4634 | 4635 | 4636 |
| Main Line Grand Valley Canal* | 14,250 | 4630 | 4635 | 4643 | 4635 | 4644 |
| Grand Valley High-line Canal* | 15,700 | 4645 | 4649 | 4658 | 4659 | 4660 |
| Horizon Drive* | 16,540 | 4648 | 4653 | 4657 | 4660 | 4661 |
| 27 Road* | 17,440 | 4657 | 4662 | 4669 | 4670 | 4671 |
| G Road* | 19,900 | 4688 | 4692 | 4702 | 4703 | 4704 |

[1] Culverts are designated by *.
[2] At the upstream face of the structure (except for top of roadway), rounded to the nearest foot, mean sea level datum.
[3] Miles upstream from Lees Ferry, Arizona, on the Colorado River; feet upstream from mouth on tributary streams.
[4] Low steel at lowest point on structure for all types of bridge except arch. Top of opening at mid-span on arch bridges and culverts.
[5] At the center line of road immediately above underclearance point.

## VELOCITIES OF FLOW

During a 100-year flood, average velocities of flow in main channel and overbank areas would be as shown in Table 5.

### TABLE 5

AVERAGE VELOCITIES OF FLOW
100-YEAR FLOOD

| Stream | Velocity (feet per second) Main Channel | Velocity (feet per second) Overbank Areas |
|---|---|---|
| Colorado River | 7-9 | 2-4 |
| Gunnison River | 6-8 | 1 |
| Leach Creek | 3-7 | 1-2 |
| Horizon Drive Channel | 3-5 | 1 |
| Lewis Wash | 6 | [1] |

[1] No overbank flow.

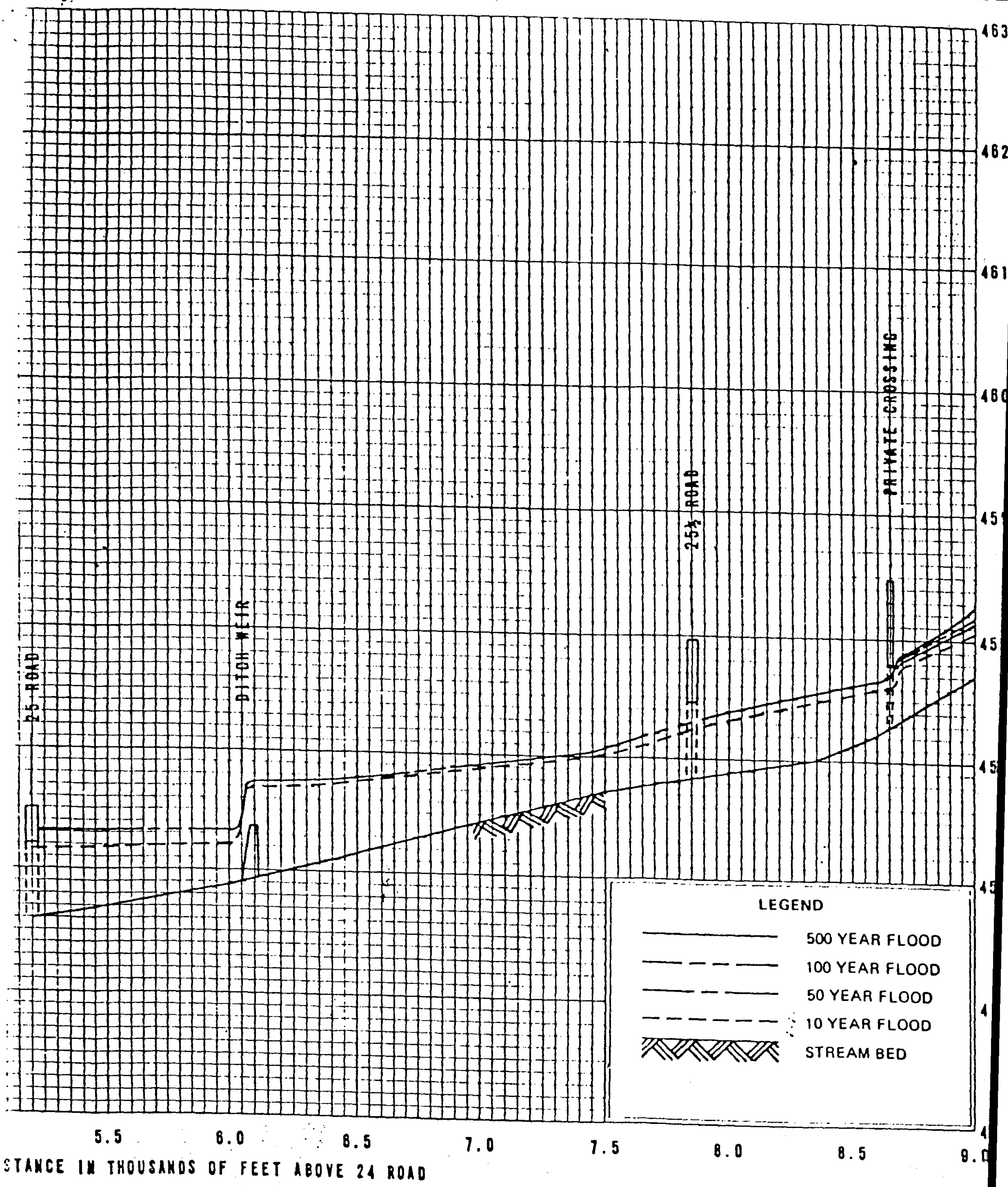
In sheet flow[5] areas, velocities would range from 1-3 feet per second. In some localized stream reaches, downstream from natural or manmade obstructions, for example, velocities of flow could significantly exceed those shown in Table 5. Velocity of flow during a 500-year flood would be slightly higher than during a 100-year flood.

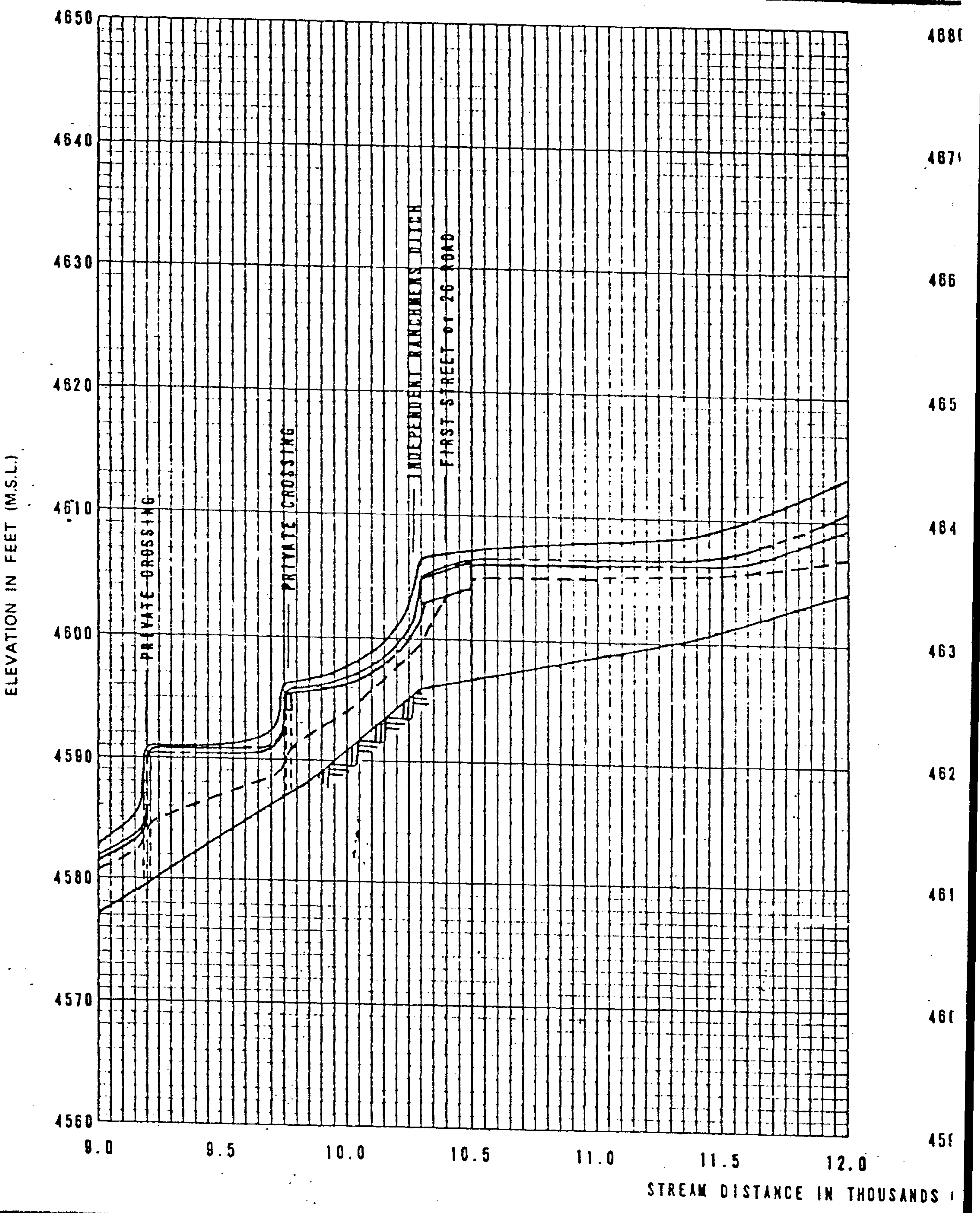
Water flowing at a rate of 7 feet per second or greater will cause severe erosion of streambanks and is capable of transporting large rocks. Streambanks and the fill around bridge abutments may be eroded and large amounts of gravel, sand, and silt may be transported by water flowing at a rate of 5-7 feet per second. Water flowing at about 2 feet per second or less will deposit sand, silt, and other debris.

## FLOODED AREAS

The areas that would be inundated by the 100- and 500-year floods are shown on Plates 2-57. As may be seen from those plates, the 100-year flood on the Colorado and Gunnison Rivers would be confined to the immediately adjacent overbank areas. Colorado River floodflows will inundate bottom lands along the north side of the river and sandbar islands immediately upstream from Grand Junction. The commercially developed area near the Fifth Street bridges and the residential area near Riverside Park would be threatened by the high flows of the Colorado River. Floodflows can back into the Connecticut Lakes area to the south of the river, as well as into the lower reach of No Thoroughfare Canyon. The higher flows on the Gunnison River would flood agricultural areas upstream from the mouth.

[5] Broad, shallow overland flow generally less than 2 feet deep.


25 ROAD
DITCH WEIR
25½ ROAD
PRIVATE CROSSING
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
STANCE IN THOUSANDS OF FEET ABOVE 24 ROAD



4650
4640
4630
4620
4610
4600
4590
4580
4570
4560
ELEVATION IN FEET (M.S.L.)
PRIVATE CROSSING
PRIVATE CROSSING
INDEPENDENT RANCHMENS DITCH
FIRST STREET or 26 ROAD
9.0
9.5
10.0
10.5
11.0
11.5
12.0
STREAM DISTANCE IN THOUSANDS

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF
SPKED-T

5 December 1980

Mr. Roger A. Foisy
Colorado West Engineering
835 Colorado Avenue
Grand Junction, Colorado 81501

Dear Mr. Foisy:

Pursuant to your 4 November 1980 letter, a list of cross sections used in our 1976 study of Horizon Drive Channel in the Grand Junction area is inclosed. Also inclosed are an HEC-2 computer card deck and card list for a portion of the Colorado River in Grand Junction. Other information that you requested was discussed with you in a 3 December telephone conversation with Messrs. Dail Hatch and Herb Hereth of this office. Additional backup material for our 1976 flood hazard information report is available for inspection and use in this office. If you have any questions on the materials inclosed, please contact Mr. Dail Hatch at (916) 440-3105.

Sincerely,

GEORGE C. WEDDELL
Chief, Engineering Division

2 Incl
1. Cross-sec list
2. Comp deck & card list

EXAMPLE OF USE OF ENG. DATA AVAILABLE

```
   T1   GRAND JUNCTION FLOOD HAZARD INFORMATION  STUDY  MESA COUNTY COLORADO
   T2    REF STATION 10.500 AT 26 ROAD                              J. BLEVINS
   T3      HORIZON DRIVE CHANNEL

   J1   ICHECK     INQ      NINV      IDIR      STRT     METRIC     HVINS      Q       WSEL       FQ
            -0      2.        -0        -0        -0         -0        -0      -0   4563.000        -0

   J2    NPROF    IPLOT     PRFVS     XSECV     XSECH        FN     ALLDC     IBW     CHNIM     ITRACE
         1.000       -0    -1.000        -0        -0        -0        -0      -0       -0.    15.000

   J3   -2.000    1.000     2.000     3.000     4.000     6.000     7.000    34.000    21.000    22.000
   J3   26.000   43.000    14.000   206.000    40.000    58.000    82.000   100.000   109.000   146.000
   NC     .060     .060      .035      .100      .300        -0        -0        -0        -0        -0
   QT    5.000  160.000   180.000   200.000   220.000   240.000        -0        -0        -0        -0

                 25 ROAD

   X1    5.450    7.000  1500.000  1600.000         0         0         0        -0        -0        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0
   GR 4566.000        0  4565.000    10.000  4564.000   350.000  4563.000   800.000  4564.000  1500.000
   GR 4556.500 1540.000  4565.500  1600.000        -0        -0        -0        -0        -0        -0

   X1    6.060   10.000  1360.000  1400.000   450.000   610.000   610.000        -0        -0        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0
   GR 4570.000        0  4568.000   250.000  4566.500  1000.000  4566.500  1330.000  4568.700  1360.000
   GR 4559.000 1370.000  4559.000  1382.000  4567.700  1400.000  4568.000  1560.000  4570.000  1700.000

   X1    6.061        0         0         0    10.000    10.000    10.000        -0        -0        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0
   SB    1.250    1.000     3.100    12.000      .001      .000      .001         0  4563.000  4563.000

   X1    6.062        0         0         0    10.000    10.000    10.000        -0        -0        -0
   X2       -0       -0     1.000  4563.100  4564.000        -0        -0        -0        -0        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0

   X1    6.063        0         0         0    50.000    50.000    50.000        -0      .150        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0

   X1    7.480    7.000  2220.000  2300.000  1100.000  1410.000  1410.000        -0        -0        -0
   X3   10.000       -0        -0        -0        -0        -0        -0        -0        -0        -0
   GR 4576.000  980.000  4576.000  2200.000  4576.500  2220.000  4576.000  2235.000  4567.100  2260.000
   GR 4576.000 2280.000  4577.500  2300.000        -0        -0        -0        -0        -0        -0

                 25 1/2 ROAD

   X1    7.850    6.000  2200.000  2280.000   520.000   550.000   350.000        -0        -0        -0
   GR 4580.000  940.000  4579.000  2200.000  4579.500  2230.000  4568.300  2250.000  4568.380  2254.700
   GR 4580.000 2280.000        -0        -0        -0        -0        -0        -0        -0        -0

   X1    7.851        0         0         0     1.000     1.000    10.000        -0        -0        -0
```

# TABLE 4

## OBSTRUCTIVE STREAM CROSSINGS[1]

| Identification | Location[3] | Elevation[2] Streambed | Under-clearance[4] | Top of Roadway[5] | 100-year Flood | 500-year Flood |
|---|---|---|---|---|---|---|
| **COLORADO RIVER** | | | | | | |
| Grand Avenue (State Highway 340): | | | | | | |
| Westbound Lanes | 385.53 | 4538 | 4559 | 4562 | 4553 | 4555 |
| Eastbound Lanes | 385.56 | 4538 | 4559 | 4562 | 4554 | 4556 |
| DRGWRR | 386.71 | 4546 | 4566 | 4570 | 4563 | 4565 |
| 5th Street (U.S. 50): | | | | | | |
| Northbound Lanes | 386.83 | 4549 | 4570 | 4575 | 4564 | 4566 |
| Southbound Lanes | 386.84 | 4550 | 4565 | 4572 | 4565 | 4567 |
| 32 Road | 393.05 | 4606 | 4625 | 4630 | 4627 | 4629 |
| **LEACH CREEK** | | | | | | |
| River Road* | 2,040 | 4532 | 4540 | 4542 | 4543 | 4545 |
| DRGWRR | 2,100 | 4534 | 4541 | 4545 | 4544 | 4546 |
| U.S. Highway 6/50* | 2,440 | 4536 | 4542 | 4546 | 4545 | 4547 |
| 6/50 Frontage Road* | 2,625 | 4536 | 4544 | 4545 | 4545 | 4547 |
| 24½ Road* | 9,890 | 4565 | 4574 | 4575 | 4574 | 4574 |
| 25 Road* | 12,530 | 4576 | 4587 | 4591 | 4590 | 4590 |
| Main Line Grand Valley Canal | 13,630 | 4584 | 4594 | 4599 | 4593 | 4594 |
| G¼ Road* | 19,130 | 4627 | 4637 | 4650 | 4640 | 4640 |
| I-70 Frontage Road* | 19,540 | 4638 | 4646 | 4661 | 4660 | 4661 |
| 26 Road* | 21,330 | 4653 | 4659 | 4662 | 4664 | 4667 |
| H Road* | 22,570 | 4666 | 4674 | 4684 | 4685 | 4686 |
| **LEWIS WASH** | | | | | | |
| D Road | 2,070 | 4610 | 4620 | 4622 | 4621 | 4623 |
| D½ Road | 4,730 | 4629 | 4638 | 4640 | 4639 | 4642 |
| E Road | 7,370 | 4644 | 4656 | 4660 | 4657 | 4661 |
| Grand Valley Canal | 8,120 | 4651 | 4664 | 4668 | 4663 | 4670 |
| U.S. Highway 6/24 | 9,080 | 4663 | 4674 | 4678 | 4670 | 4677 |
| E½ Road | 10,030 | 4672 | 4682 | 4685 | 4684 | 4686 |
| F½ Road | 15,470 | 4737 | 4748 | 4750 | 4747 | 4752 |
| Interstate 70* | 17,800 | 4762 | 4769 | 4778 | 4770 | 4779 |
| **HORIZON DRIVE CHANNEL** | | | | | | |
| Private Crossing* | 9,200 | 4580 | 4586 | 4590 | 4591 | 4591 |
| Private Crossing* | 9,750 | 4588 | 4594 | 4595 | 4596 | 4596 |
| 26 Road* | 10,400 | 4597 | 4604 | 4606 | 4606 | 4607 |
| 26½ Road* | 13,450 | 4618 | 4628 | 4634 | 4635 | 4636 |
| Main Line Grand Valley Canal* | 14,250 | 4630 | 4635 | 4643 | 4635 | 4644 |
| Grand Valley High-line Canal* | 15,700 | 4645 | 4649 | 4658 | 4659 | 4660 |
| Horizon Drive* | 16,540 | 4648 | 4653 | 4657 | 4660 | 4661 |
| 27 Road* | 17,440 | 4657 | 4662 | 4669 | 4670 | 4671 |
| G Road* | 19,900 | 4688 | 4692 | 4702 | 4703 | 4704 |

[1] Culverts are designated by *.
[2] At the upstream face of the structure (except for top of roadway), rounded to the nearest foot, mean sea level datum.
[3] Miles upstream from Lees Ferry, Arizona, on the Colorado River; feet upstream from mouth on tributary streams.
[4] Low steel at lowest point on structure for all types of bridge except arch. Top of opening at mid-span on arch bridges and culverts.
[5] At the center line of road immediately above underclearance point.

the drainage basins of the Colorado and Gunnison Rivers and convective type cloudburst storm runoff from the drainage basins of the tributary streams create the most severe flood conditions in the study area.

The unit hydrographs for Leach Creek, Horizon Drive Channel, and Lewis Wash were developed by using the Snyder technique and data from several similar nearby basins with recorded thunderstorm runoff. Regional snowmelt flood envelope curves for the Colorado and Gunnison Rivers were developed using flow-discharge frequency data.

Snowmelt flows of the Colorado and Gunnison Rivers at Grand Junction were developed from frequency curves for those streams above Grand Junction. Based on available data, the 1921 flood was selected as being most representative for combined runoff from the two rivers, and the standard project flood was determined to have a frequency of 250 years (50 percent larger than the 1921 flood). To establish standard project flows on the Colorado River, a 150 percent value of the 1921 floodflows at Palisade was determined and then reduced by 8,000 cubic feet per second to reflect the effect of upstream reservoirs. For standard project flows on the Gunnison River, 150 percent of the 1921 floodflow at Grand Junction was established and then divided into runoff above and below Blue Mesa Reservoir (55 and 45 percent, respectively). Blue Mesa Reservoir was completed in 1965. Runoff above the reservoir was computed as a ratio of the 1921 flows and adjusted for present conditions. Reservoir releases were made so that downstream channel capacities would not be exceeded and assuming maintenance of minimum power pool level. Downstream runoff was then added to arrive at present standard project flow at Grand Junction. Flows in the two rivers were combined for total standard project snowmelt flows at Grand Junction. The 100-year flood event was established as an 89 percent value of the standard project event. The resulting floodflows are shown in Table 3.

## TABLE 3

### PEAK FLOWS
### 100- AND 500-YEAR FLOODS

| Stream | Location | Peak Flow cfs 100-Year Flood | Peak Flow cfs 500-Year Flood |
|---|---|---|---|
| Colorado River | Above mouth of Gunnison River | 63,000 | 82,000 |
| Colorado River | Below mouth of Gunnison River | 82,000 | 107,000 |
| Gunnison River | At Grand Junction | 20,000 | 25,000 |
| Leach Creek | At H Road | 1,800 | 4,200 |
| Horizon Drive Channel | At Independence Ranchmens Ditch | 600 | 1,800 |
| Lewis Wash | At I-70 | 1,400 | 3,800 |

*Table 10.1 Values of n in Manning's formula*
Prepared by R. E. Horton and Others

| Nature of surface | n | |
|---|---|---|
| | Min | Max |
| Neat cement surface | 0.010 | 0.013 |
| Wood-stave pipe | 0.010 | 0.013 |
| Plank flumes, planed | 0.010 | 0.014 |
| Vitrified sewer pipe | 0.010 | 0.017 |
| Metal flumes, smooth | 0.011 | 0.015 |
| Concrete, precast | 0.011 | 0.013 |
| Cement mortar surfaces | 0.011 | 0.015 |
| Plank flumes, unplaned | 0.011 | 0.015 |
| Common-clay drainage tile | 0.011 | 0.017 |
| Concrete, monolithic | 0.012 | 0.016 |
| Brick with cement mortar | 0.012 | 0.017 |
| Cast iron | 0.013 | 0.017 |
| Cement rubble surfaces | 0.017 | 0.030 |
| Riveted steel | 0.017 | 0.020 |
| Canals and ditches, smooth earth | 0.017 | 0.025 |
| Metal flumes, corrugated | 0.022 | 0.030 |
| Canals: | | |
| Dredged in earth, smooth | 0.025 | 0.033 |
| In rock cuts, smooth | 0.025 | 0.035 |
| Rough beds and weeds on sides | 0.025 | 0.040 |
| Rock cuts, jagged and irregular | 0.035 | 0.045 |
| Natural streams: | | |
| Smoothest | 0.025 | 0.033 |
| Roughest | 0.045 | 0.060 |
| Very weedy | 0.075 | 0.150 |

The Manning formula may be expressed in terms of $1/\sqrt{f}$ by comparing Eqs. (10.4) and (10.6), from which

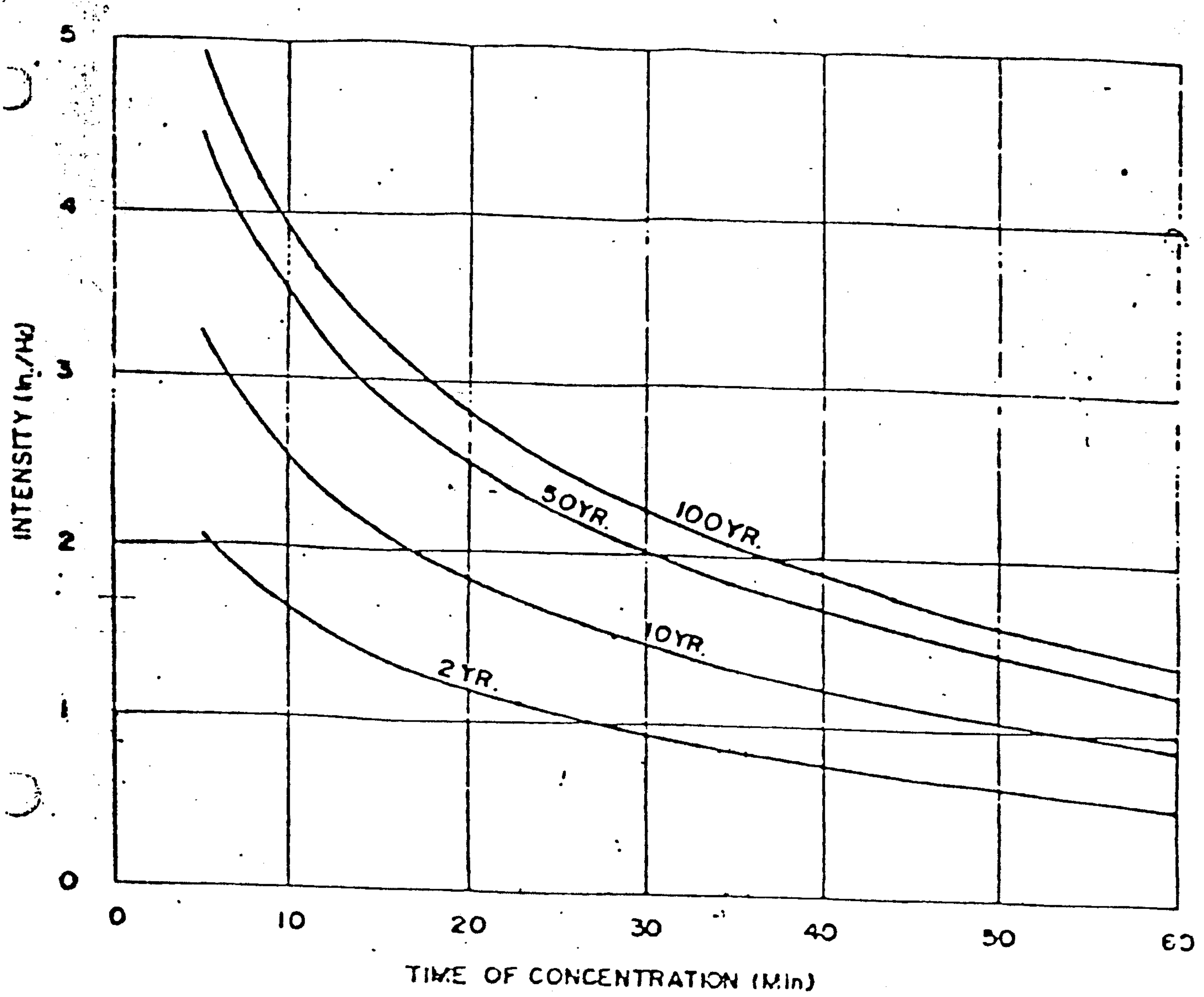
$$C = \sqrt{\frac{8g}{f}} = \frac{1.49}{n} R^{1/6}$$

or

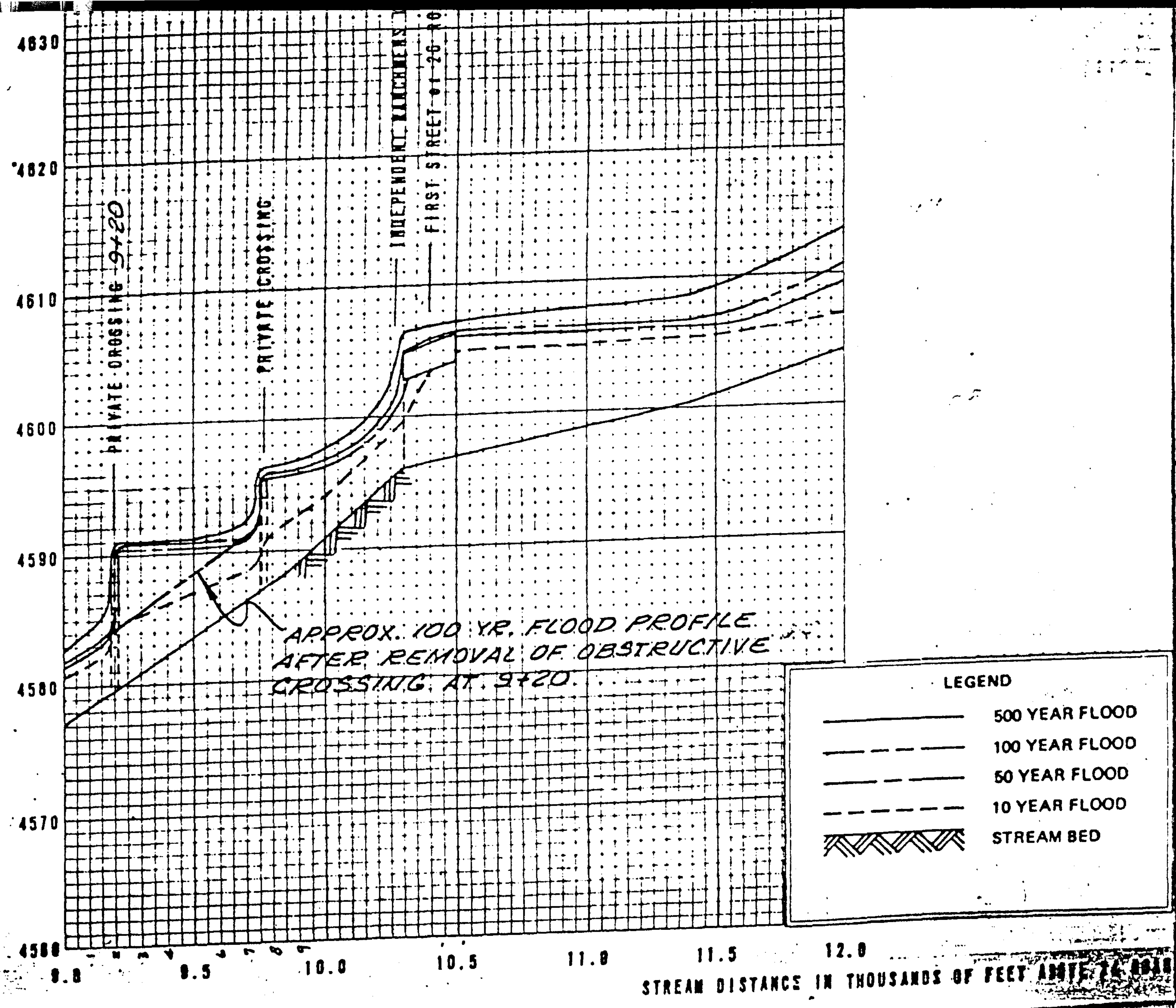
$$\frac{1}{\sqrt{f}} = \frac{1.49 R^{1/6}}{n\sqrt{8g}} \qquad (10.9)$$

Equating the right-hand sides of Eqs. (10.8) and (10.9) provides the desired correlation between $\epsilon$ and $n$, which is plotted as the solid lines in Fig. 10.3 for three representative values of the hydraulic radius.

The curves of $\epsilon$ versus $n$ in Fig. 10.3 must be regarded in the light of the components making up the equation which is plotted. The values of $\epsilon$, for example, were originally determined for artificially roughened pipes




INTENSITY DURATION CURVES
GRAND JUNCTION, COLORADO




DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

NOVEMBER 1976

FLOOD HAZARD INFORM
GRAND JUNCTION, COL

FLOOD PROFILE
HORIZON DRIVE CHAN

PLATE 73

COLORADO
WEST
ENGINEERING

CONSULTING CIVIL ENGINEERS
835 COLORADO AVE., GRAND JUNCTION, COLORADO 81501
303 / 245-5112

September 16, 1982

City - County Planning
Mr. Bob Goldin
559 White Avenue
Grand Junction, Colorado 81501

RE: Colony Park Flood Plain Application (#532.3)

Dear Bob;

As you requested, we have rewritten the flood plain application to reflect final design of Colony Park. We also added an earth berm and swale along our east property line to direct sheet flow back into Ranchman's Ditch.

We will be waiting to hear from you concerning the progress of this application.

Thank you.

Sincerely,
COLORADO WEST ENGINEERING

by Jeff Smith
Jeff Smith
Civil Engineer

RJS/bjs
Enclosure

RECEIVED
SEP 17 1982
CITY - COUNTY
PLANNING DEPARTMENT

## ENTRANCE CULVERT DESIGN

Design Flow = 600 c.f.s.
Average channel slope = 1.36% over 700' of channel.
n = 0.024 for C.M.P.
Pipe Slope = 1.34%

Assume inlet control, since normal depth is less than 8.5 ft. and the tailwater elevation is also less than 8.5' as shown on our ditch cross sections. Flow is defined by the orifice equation:

$$Q = CdA(2gh)^{\frac{1}{2}}$$

where

Q = flow c.f.s.

$C_d$ = coefficient of discharge

A = cross sectional area of orifice, $ft.^2$.

g = acceleration of gravity

h = head on center of orifice, ft.

Cd varies with the type and shape of orifice. Values range from 0.62 for a sharp edged orifice with no suppression of contraction, to 1.0 for a smooth orifice with no contraction. Since the bottom of the channel intersects the pipe flowline there is a partial suppression of the contraction. This requires the coefficient of discharge to fall between 0.62 and 1.0. If we select the worst case value for $C_d$ of 0.62, and the maximum allowable upstream headwater depth of 9.8 feet the flow obtained using the orifice equation is:

$$Q = 0.62(56.75)\left[2(32.2)5.55\right]^{\frac{1}{2}} = 665 \text{ c.f.s.}$$

is greater than 600 o.k.

The headwater depth of 9.8 feet is 1.15 times the diameter of the pipe (8.5 feet). The theoretical division between a free entrance condition and orifice flow is approximately 1.2 times the pipe diameter. Therefore it is necessary to check the pipe capacity for a free entrance condition of flow. The mannings equation for a full pipe predicts a pipe capacity of:

$$Q = \frac{1.49}{n} AR^{2/3} S^{\frac{1}{2}}$$

$$Q = \frac{1.49}{0.024} (56.75)(2.125)^{2/3} (0.0134)^{\frac{1}{2}} =$$

674 cfs is greater than 600

The headwater elevation may then be calculated using the bernoulli principle with an added term to account for entrance loss. Using an entrance loss coefficient of 0.90 for a sharp-edged inlet, the headwater elevation for a flow of 600 c.f.s. is found to be 8.64 ft., (see calculations).

If the orifice equation is solved for head on the center of the orifice necessary for a flow of 600 c.f.s.

$$h = \frac{1}{{C_d}^2} \frac{Q^2}{2gA}$$

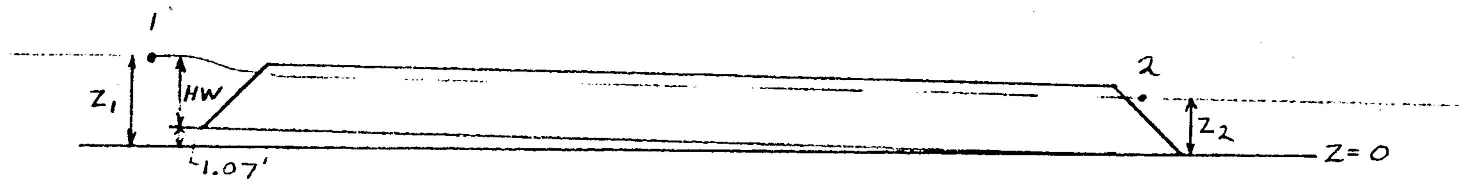
$$h = \frac{1}{0.62^2} \frac{600^2}{2(32.3)(56.75)^2} = 4.52 \text{ feet}$$

Since h is the head on the center of the orifice the headwater depth is therefore $(4.52 + \frac{8.5}{2}) = 8.77$ feet.

As shown above, the headwater which would exist under free entrance conditions is 8.64 feet. It can be assumed therefore that the actual headwater elevation will fall somewhere around 8.8 feet, this allows a freeboard of approximately 1 foot during a 100 year flood event.

## CALCULATIONS FOR FREE ENTRANCE CONDITION

Open channel flow in pipe because normal depth is less than 8.5 ft, and tailwater is less than 8.5 ft.




$$\frac{P_1}{\gamma} + Z_1 + \frac{V_1^2}{2g} = \frac{P_2}{\gamma} + Z_2 + \frac{V_2^2}{2g} + H_{L1-2}$$

$V_1$ = 10.31 fps in channel immediately upstream from culvert at flow of 600 c.f.s.

$V_2$ = 10.57 at end of full pipe. Since yn = 8.14' the pipe is not full, adjust $V_2$ to account for partially full pipe.

$V_2$ = 1.05 (10.57) = 11.10 f.p.s.

$$Z_1 = Z_2 + \frac{V_2^2}{2g} - \frac{V_1^2}{2g} + H_{L1-2}$$

If partially full pipe the headloss equals the entrance loss, plus energy lost in the energy grade line.

$$\text{Entrance loss} = 0.9\left[\frac{V_2^2}{2g} - \frac{V_1^2}{2g}\right] = 0.90\left[\frac{11.1^2}{2g} - \frac{10.31^2}{2g}\right] = 0.24$$

Using an entrance loss coefficient of 0.90 for a sharp edge projecting inlet.
Energy loss in energy grade line = 80 ft (0.0134 ft/ft) = 1.07 ft.

$H_{L1-2}$ = 0.24 + 1.07 = 1.31 ft.

$$Z_1 = 8.14 + \frac{11.1^2}{2g} - \frac{10.31^2}{2g} + 1.31 \text{ ft.}$$

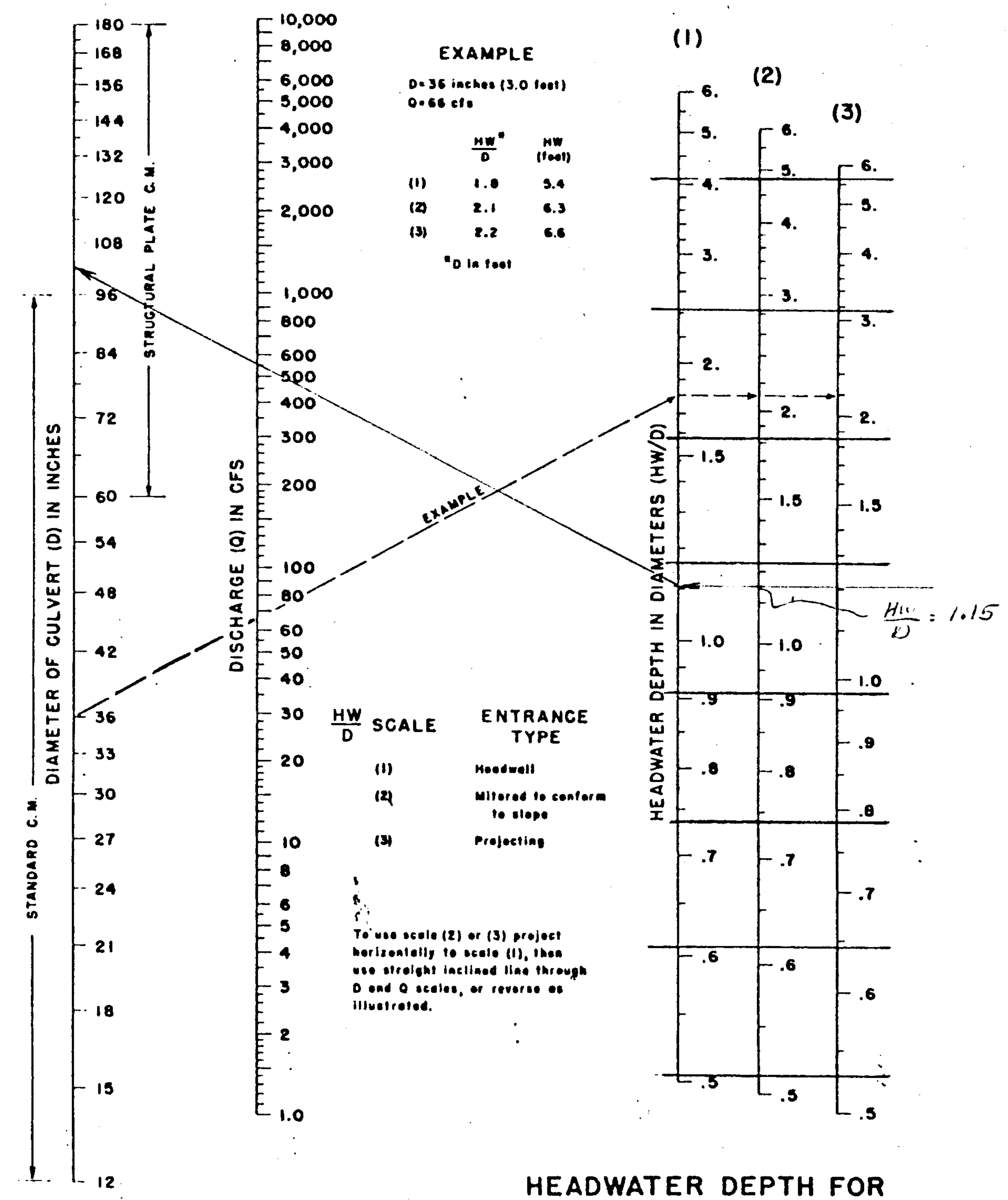
$Z_1$ = 9.71 ft.

Therefore headwater depth HW = 9.71 - 1.07 = 8.64 feet under free entrance conditions.

We have used the worst case coefficients to evaluate the pipe flow in both inlet control and free entrance conditions. Our results in our opinion are conservative. If Figure 804-1E from The Division of Highways Design manual is worked backwards from the "mitered to conform to slope" scale, using the maximum headwater elevation available in our case the flow given is 550 c.f.s. (See sample Figure 804-1E). We do not know if a safety factor has been applied to this nomograph or what values of entrance loss coefficient correspond to scales 1, 2, 3 on Figure 804-1E. We believe however that our results are a more accurate representation of the actual flow conditions.

We have shown that although the culvert may flow either as an orifice with entrance control or in a free entrance condition the 102" pipe will safely pass a flow of 600 c.f.s., with a mitered end treatment.

# FIGURE 804-1E




HEADWATER DEPTH FOR
C. M. PIPE CULVERTS
WITH INLET CONTROL

# Calculations for Culvert at Ranchman's Ditch

100 year storm flow in Ranchman's Ditch = 600 c.f.s.
Slope = 0.0134 ft/ft
n = 0.024

To determine condition of flow find normal depth for circular pipe carrying 600 c.f.s.

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$600 = \frac{1.49}{n} \left(\frac{\pi y_n^2}{4}\right) \left(\frac{y_n}{4}\right)^{2/3} (0.0134)^{1/2}$$

$$y_n^{8/3} = 267.86$$

$$y_n = 8.14 \text{ FEET (NORMAL DEPTH)}$$

PIPE SIZE = 102" Ø

Since $y_n$ is less than 8.5' and headwater depth is less than 10.2 foot and $y_c$ is less than $y_n$ flow occurs in a free entrance condition.

$$Q = \frac{1.49}{0.024} A R^{2/3} S^{1/2} = 674 \text{ C.F.S} > 600 \text{ C.F.S.} \quad \text{O.K.}$$

The headwater elevation may be computed using a Bernoulli equation with an allowance for entrance loss. The headwater required for a flow of 600 c.f.s. is 0.33 ft. A freeboard of approximately 1 foot is provided during a 100 year storm event.

# CITY OF GRAND JUNCTION, COLORADO

## MEMORANDUM

Reply Requested
Yes ☐ No ☐

Date
September 30, 1982

To: (From:) Bob Goldin — From: (To:) Ron Rish RPR

Subject: Floodplain Permit Application for Colony Park

As requested, I have reviewed the above as submitted by Colorado West Engineering on September 16, 1982, and received by my office on September 21, 1982. The submittal included recent explanatory calculations, an addendum dated August 27, 1982, and the original application of July 28, 1981. I have reviewed all the aforementioned material and feel that in the aggregate it is a very comprehensive and responsible report. The proposed flood mitigation is acceptable to this office with one suggestion. Should not some erosion protection be provided at the 102 inch culvert outlet to address anticipated flood velocities of up to 11.10 fps at the pipe outlet?

I agree the culvert will operate in a "marginal" hydraulic zone which is subject to analytical interpretation depending on loss coefficients and other assumptions. Obviously the Colorado Division of Highways nomogram is conservative but I feel that Colorado West Engineering West has consistently made conservative assumptions of various parameters, has properly analyzed the hydraulics and have presented reasonable recommendations.

I appreciate the analytical detail furnished with this latest submittal.

cc - Colorado West Engineering
Jim Straughan
John Kenney
Jim Patterson
File

Development Department
CITY - COUNTY PLANNING
grand junction-mesa county 559 white ave. rm. 60 grand jct.,colo. 81501
(303) 244-1628

MEMORANDUM

TO: Ted Straughan

FROM: Bob Goldin, Floodplain Administrator

DATE: October 4, 1982

RE: Colony Park Floodplain Permit #61-81

The floodplain permit for Colony Park, File #61-82 has been found acceptable by this office with the following provisions being met prior to construction:

1) As per the City Engineer's memo 9/30/82 re: the floodplain permit, erosion protection is to be provided. The exact method and manner should be resolved with the City Engineer prior to construction.

2) All other requirements of Section 5-8 Floodplain Regulations of the Grand Junction Zoning and Development Code be met where applicable.

3) Any change, modification or alteration to the approved plan be re-submitted for re-review by this office.

4) Coordinate work schedule within the floodplain with the City Engineer to provide for any improvements etc. on Patterson not be in conflict with Colony Park.

5) The petitioner come down to this office and pick up the actual permit, paying the $40.00 fee at that time.

BG/vw

xc Colo West Eng

# FLOODPLAIN NARRATIVE

To Accompany

CITY OF GRAND JUNCTION FLOODPLAIN PERMIT APPLICATION

For

Applicant: Ted Straughan

Address: 639½ Main Street
Grand Junction, Colorado 81501

Project site: 2575 Patterson Road
Grand Junction, Colorado

Prepared by: COLORADO WEST ENGINEERING
835 Colorado Ave.
Grand Junction, Colorado 81501
(303) 245-5112
Roger A. Foisy, P.E.
Colorado Registration No. 15504

ROGER ALLEN FOISY
REGISTERED
15504
PROFESSIONAL ENGINEER
STATE OF COLORADO

Roger Allen Foisy

## SOURCES OF INFORMATION -

The source of information for this narrative is the "Corps of Engineers, Flood Hazard Study, dated November 1976, and the floodplain maps and flood profiles generated by that study.

More exact, calculated values of sheet flow volume, detention time, storm intensity and duration are difficult to arrive at because of the absence of known factors and characteristics of the 100 year storm and the watershed area.

Estimates given and assumptions made in this report are based on information given in the Flood Hazard Study. This information has been projected and analyzed according to common drainage practices.

## PROJECT SITE -

The property being considered for development is located between 25 5/8 and 25 3/4 Patterson Road, Grand Junction, and extends some 1320 feet, more or less, south of Patterson Road, containing approximately 17 acres.

The petitioner is proposing a planned development with a combination of single-family and multi-family residences.

## DEVELOPMENT AND FLOODPLAIN HAZARDS -

The northern 60% of the property is located within the 100 year, Horizon Drive Channel flood plain (sheet flow area), according to the Floos Hazard Study.

The study and the accompanying maps and flood profiles show that the culverts crossing the Independent Ranchmens Ditch at stations 9+20 and 9+75 are "obstructive stream crossings".

From the flood profiles contained in the study, it can be seen that these two obstructive crossings would cause water to back up during the 100 year flood, overrunning the banks of the channel. This overrun water would flow south-westerly across the adjoining property to the east.

This overland flow would then enter the petitioners property and flow west across the Pomona School property until it ultimately reached 25½ Road. Upon reaching the built up 25½ Road, the flow would be directed north along the edge of the road until it ultimately returned to the channel.

There are two entrances back to the channel located approximately at stations 7+87 and 8+67. These are low spots in the south bank of the stream channel which would appear to allow overland flow from the properties to return to the channel.

The proposed development of the petitioners property would involve the removal of the existing culvert crossing at station 9+20 and installation of a new crossing adequately sized to handle the entire 100 year flood flow.

Development of the property immediately east will ultimately involve the replacement of the crossing located at station 9+75.

The removal of these obstructive stream crossings will eliminate the possibility of flow overrunning the banks of the channel and thus eliminate sheet flow from the entire area. The flood plain maps show that the existing channel is of adequate size to handle the anticipated total flood flow.

Under existing conditions, the property within the 100 year flood plain, approximately 23 acres, acts not as a "retention" or ponding area but merely as a "detention" area. Sheet flow covering the property ultimately returns to the channel downstream, minus surface retention and that water absorbed into the dry ground.

EFFECTS ON UPSTREAM PROPERTIES -

The development of the property under consideration, including removal of the obstructive stream crossings and thus the elimination of 100 year sheet flow across the property, will have no effect on upstream properties, with the exception of the elimination of sheetflow across a few acres of property immediately east. The remainder of this same adjacent property, within the flood plain, is subject to sheet flow caused by the obstructive crossing at station 9+75 which will probably become the main entrance to that property at the time it is developed.

The crossing located at 26 Road is also listed in the study as an obstructive stream crossing. During the 100 year flood this obstruction becomes the controlling factor in upstream overbank and sheet flow. Thus, any changes made decreasing obstructions or decreasing detention areas downstream of the 26 Road crossing would have no effect upstream of that crossing.

EFFECTS ON ADJACENT PROPERTIES -

As previously mentioned, the removal of obstructive crossings at 9+20 and 9+75 would eliminate 100 year sheet flow on approximately 7 acres of property immediately east of the petitioner's property and along the south bank of the channel.

Immediately west of the petitioner's property is the Pomona school and playground area. The flood plain boundary takes in the major part of the school grounds as well as the school building. This property is subject to 100 year sheet flow simply because it is lower than the property to the east. Sheet flow originating on the properties to the east naturally flows toward 25½ Road, across the school property. The proposed development would also eliminate sheet flow across the school property.

EFFECTS ON DOWNSTREAM PROPERTIES -

As outlined above, the land being considered for development, as well as some adjacent land east and west (approx. 23 acres total) lies within the 100 year sheet flow flood area. This land in its existing state, although covered by sheet flow, will not retain the total volume of water. As can be seen from the flood plain/topographic map, there are two locations on the south bank of the channel, station 7+87 and station 8+67, where sheet flow will naturally return to the channel.

The only water not returned to the channel would be that volume retained as depression storage and that lost as infiltration. This total volume is estimated to be about 0.7 inches over the entire 23 acres (depression storage= 0.2 inches, infiltration = ½ inch/hour for 100 yr. storm), or approximately 1.34 acre feet of water.

If development of the property takes place as planned, this estimated volume of water would be added to the downstream flow due to elimination of the depression storage and infiltration on the property. This additional volume is thought to be negligible when compared with the total volume contained in the channel downstream.

The estimated time required for overland flow from the obstructive crossing at 9+20 to 25½ Road, where flow returns to the channel, is approximately 25 minutes (1500 ft./ 1 ft. per sec., Flood Hazard Study estimated overbank area velocity of flow).

Under present conditions, during a 100 year flood, the temporary storage provided by overland flow would serve to reduce peak discharge only slightly during the time required for that flow to return to the channel. Upon return to the channel, the discharge would then be increased by the same amount minus depression storage and infiltration.

After development takes place sheet flow will be eliminated. The volume of water which would have been detained across the property will be retained in the channel. This will increase the "normal" 100 year flow in the channel, but this increase again is thought to be insignificant when compared to the total flow of 600 C.F.S.

The exact increase to normal flow has not been calculated due to lack of information regarding duration of storm and duration of peak flow from runoff.

The culvert at 25 Road is also listed as an obstructive stream crossing. Water backs up behind this culvert, overflows the banks of the channel and flows downhill along 25 Road. Ponding would occur in this area, covering a narrow strip of land on the east side of the road approximately 200 feet wide and 1700 feet long.

Obviously, the elimination of detention areas upstream would increase the amount of water conducted into such downstream retention areas. This additional effect is impossible to estimate. However, we believe the flooding downstream would not be significantly affected. In addition, this flooded area adjacent to 25 Road is an industrial area and flooding is much less critical and damaging in such sparse industrial areas as opposed to more dense, residential areas.

The development of the property described above is not expected to produce any change in floodwater velocity or direction of flow during the 100 year flood. We also expect no increased erosion or scour to adjacent, upstream or downstream properties.

Flood water ponding elevation would be increased however slightly in the industrial area along the east side of 25 Road, as described above.

RELEASE OF TOXIC MATERIALS -

We do not anticipate at all, any possibility of the release of any toxic materials during the 100 year flood event.

ROUTES OF ACCESS DURING 100 YEAR FLOOD EVENT -

Because replacement of the obstructive stream crossings and further development of the property will completely eliminate flood waters from the interior of the property, and retain the flow within the channel, the normal, planned routes of access would also be open and accessible during the 100 year flood.

FLOODPROOFING OF UTILITIES -

Because sheet flow will be completely eliminated from the developed property, sanitary sewer, domestic water, electric power, natural gas and telephone cables, boxes, etc., will not require any protection against flood water.

ANCHORING FLOATABLES -

Also because of the elimination of sheet flow from the entire developed property, there will be no need to provide for anchoring of floatables.

# INTRODUCTION

## PURPOSE AND SCOPE OF REPORT

The purpose of this report is to describe and illustrate the flood hazard in the vicinity of Grand Junction, Mesa County, Colorado. The report will aid in planning the best use of lands subject to inundation from 100- and 500-year floods. However, it does not contain recommendations for solving flood problems or plans for use of flood plain areas because these activities are the responsibilities of local governments.

## LIMITS OF STUDY

The report covers the Colorado River from 22 Road upstream to 32 Road and the lower reaches of the Gunnison River, Leach Creek, Horizon Drive Channel, and Lewis Wash in and around Grand Junction. The Gunnison River, Leach Creek, and Lewis Wash are direct tributaries to the Colorado River. Horizon Drive Channel flows through the northern portion of the city. It becomes Independent Ranchmens Ditch in the vicinity of Grand Valley Canal. The Colorado River is the only other stream under study to enter the city, passing through the western sector. Plate 1 is a general map of the area. The stream reaches studied are shown in Table 1.

### TABLE 1

#### STREAM REACHES STUDIED

| Stream | Reach | | Length of Reach (miles) |
|---|---|---|---|
| | From: | Upstream to: | |
| Colorado River | 22 Road | 32 Road | 12 |
| Gunnison River | Mouth | Redlands Dam | 2 |
| Leach Creek | 24 Road | H Road | 4 |
| Lewis Wash | Mouth | Government Highline Canal | 3 |
| Horizon Drive Channel | F Road | Vicinity of Walker Field | 3 |

## TABLE 2

### DRAINAGE AREAS AND HEADWATER ELEVATIONS

| Stream | Location | Approximate Drainage Area sq. mi. | Approximate Elevation of Headwater Area ft. (msl) |
|---|---|---|---|
| Colorado River | Gaging Station near Fruita | 17,100 | 12,000 |
| Gunnison River | Gaging Station near Grand Junction | 7,930 | 14,000 |
| Leach Creek | At mouth | 25 | 5,500 |
| Horizon Drive Channel | At "F" Road | 2 | 5,500 |
| Lewis Wash | At mouth | 5 | 5,500 |

The climate of the area is arid to semiarid with yearly precipitation averaging about 8 inches at Grand Junction, from about 10 to 15 inches in headwater areas of the Book Cliffs, and about 40 inches in the headwater regions of the Colorado and Gunnison Rivers. Most of the annual precipitation in the higher elevations occurs as snow and a deep snowpack accumulates. Temperatures are often in the nineties in the summer and below freezing in the winter. Occasionally, summertime temperature may exceed 100° and winter temperature may drop as low as -20°. Natural vegetation in valley areas primarily consists of cottonwood and willow, desert shrub, and an understory of hardy grasses. Prominent between 5000 and 8000 feet are juniper, piñon pine, oak, big sagebrush, and Douglas Fir. From 8000 feet to timberline, vegetation consists mainly of aspen, spruce, sub-alpine fir, lodgepole pine, and native grasses and shrubs. Vegetation is sparse above timberline but includes grasses, sedges, and alpine willow.

## NATURE OF FLOOD PROBLEMS

As noted, most of the annual precipitation in the higher regions of the basins of the Colorado and Gunnison Rivers occurs as snow and a deep snowpack accumulates. General rainstorms covering large areas for extended periods can occur in the region during spring and summer. Convective type cloudburst storms of small areal extent, which account for about half of the normal annual precipitation in the Grand Junction area, can be the drainage basins of the Colorado and Gunnison Rivers and convective type cloud-burst storm runoff from the drainage basins of the tributary streams create the most severe flood conditions in the study area.

The unit hydrographs for Leach Creek, Horizon Drive Channel, and Lewis Wash were developed by using the Snyder technique and data from several similar nearby basins with recorded thunderstorm runoff. Regional snowmelt flood envelope curves for the Colorado and Gunnison Rivers were developed using flow-discharge frequency data.

Snowmelt flows of the Colorado and Gunnison Rivers at Grand Junction were developed from frequency curves for those streams above Grand Junction. Based on available data, the 1921 flood was selected as being most representative for combined runoff from the two rivers, and the standard project flood was determined to have a frequency of 250 years (50 percent larger than the 1921 flood). To establish standard project flows on the Colorado River, a 150 percent value of the 1921 floodflows at Palisade was determined and then reduced by 8,000 cubic feet per second to reflect the effect of upstream reservoirs. For standard project flows on the Gunnison River, 150 percent of the 1921 floodflow at Grand Junction was established and then divided into runoff above and below Blue Mesa Reservoir (55 and 45 percent, respectively). Blue Mesa Reservoir was completed in 1965. Runoff above the reservoir was computed as a ratio of the 1921 flows and adjusted for present conditions. Reservoir releases were made so that downstream channel capacities would not be exceeded and assuming maintenance of minimum power pool level. Downstream runoff was then added to arrive at present standard project flow at Grand Junction. Flows in the two rivers were combined for total standard project snowmelt flows at Grand Junction. The 100-year flood event was established as an 89 percent value of the standard project event. The resulting floodflows are shown in Table 3.

## TABLE 3

### PEAK FLOWS
### 100- AND 500-YEAR FLOODS

| Stream | Location | Peak Flow cfs 100-Year Flood | Peak Flow cfs 500-Year Flood |
|---|---|---|---|
| Colorado River | Above mouth of Gunnison River | 63,000 | 82,000 |
| Colorado River | Below mouth of Gunnison River | 82,000 | 107,000 |
| Gunnison River | At Grand Junction | 20,000 | 25,000 |
| Leach Creek | At H Road | 1,800 | 4,200 |
| Horizon Drive Channel | At Independence Ranchmens Ditch | 600 | 1,800 |
| Lewis Wash | At I-70 | 1,400 | 3,800 |

## TABLE 4

### OBSTRUCTIVE STREAM CROSSINGS[1]

| Identification | Location[3] | Elevation[2] Streambed | Under-clearance[4] | Top of Roadway[5] | 100-year Flood | 500-year Flood |
|---|---|---|---|---|---|---|
| **COLORADO RIVER** | | | | | | |
| Grand Avenue (State Highway 340): | | | | | | |
| Westbound Lanes | 385.53 | 4538 | 4559 | 4562 | 4553 | 4555 |
| Eastbound Lanes | 385.56 | 4538 | 4559 | 4562 | 4554 | 4556 |
| DRGWRR | 386.71 | 4546 | 4566 | 4570 | 4563 | 4565 |
| 5th Street (U.S. 50): | | | | | | |
| Northbound Lanes | 386.83 | 4549 | 4570 | 4575 | 4564 | 4566 |
| Southbound Lanes | 386.84 | 4550 | 4565 | 4572 | 4565 | 4567 |
| 32 Road | 393.05 | 4606 | 4625 | 4630 | 4627 | 4629 |
| **LEACH CREEK** | | | | | | |
| River Road* | 2,040 | 4532 | 4540 | 4542 | 4543 | 4545 |
| DRGWRR | 2,100 | 4534 | 4541 | 4545 | 4544 | 4546 |
| U.S. Highway 6/50* | 2,440 | 4536 | 4542 | 4546 | 4545 | 4547 |
| 6/50 Frontage Road* | 2,625 | 4536 | 4544 | 4545 | 4545 | 4547 |
| 24½ Road* | 9,890 | 4565 | 4574 | 4575 | 4574 | 4574 |
| 25 Road* | 12,530 | 4576 | 4587 | 4591 | 4590 | 4590 |
| Main Line Grand Valley Canal | 13,630 | 4584 | 4594 | 4599 | 4593 | 4594 |
| G½ Road* | 19,130 | 4627 | 4637 | 4650 | 4640 | 4640 |
| I-70 Frontage Road* | 19,540 | 4638 | 4646 | 4661 | 4660 | 4661 |
| 26 Road* | 21,330 | 4653 | 4659 | 4662 | 4664 | 4667 |
| H Road* | 22,570 | 4666 | 4674 | 4684 | 4685 | 4686 |
| **LEWIS WASH** | | | | | | |
| D Road | 2,070 | 4610 | 4620 | 4622 | 4621 | 4623 |
| D½ Road | 4,730 | 4629 | 4638 | 4640 | 4639 | 4642 |
| E Road | 7,370 | 4644 | 4656 | 4660 | 4657 | 4661 |
| Grand Valley Canal | 8,120 | 4651 | 4664 | 4663 | 4663 | 4670 |
| U.S. Highway 6/24 | 9,080 | 4663 | 4674 | 4678 | 4670 | 4677 |
| E½ Road | 10,030 | 4672 | 4682 | 4685 | 4684 | 4686 |
| F½ Road | 15,470 | 4737 | 4748 | 4750 | 4747 | 4752 |
| Interstate 70* | 17,800 | 4762 | 4769 | 4778 | 4770 | 4779 |
| **HORIZON DRIVE CHANNEL** | | | | | | |
| Private Crossing* | 9,200 | 4580 | 4586 | 4590 | 4591 | 4591 |
| Private Crossing* | 9,750 | 4588 | 4594 | 4595 | 4596 | 4596 |
| 26 Road* | 10,400 | 4597 | 4604 | 4606 | 4606 | 4607 |
| 26½ Road* | 13,450 | 4618 | 4628 | 4634 | 4635 | 4636 |
| Main Line Grand Valley Canal* | 14,250 | 4630 | 4635 | 4643 | 4635 | 4644 |
| Grand Valley High-line Canal* | 15,700 | 4645 | 4649 | 4658 | 4659 | 4660 |
| Horizon Drive* | 16,540 | 4648 | 4653 | 4657 | 4660 | 4661 |
| 27 Road* | 17,440 | 4657 | 4662 | 4669 | 4670 | 4671 |
| G Road* | 19,900 | 4688 | 4692 | 4702 | 4703 | 4704 |

[1] Culverts are designated by *.
[2] At the upstream face of the structure (except for top of roadway), rounded to the nearest foot, mean sea level datum.
[3] Miles upstream from Lees Ferry, Arizona, on the Colorado River; feet upstream from mouth on tributary streams.
[4] Low steel at lowest point on structure for all types of bridge except arch. Top of opening at mid-span on arch bridges and culverts.
[5] At the center line of road immediately above underclearance point.

## VELOCITIES OF FLOW

During a 100-year flood, average velocities of flow in main channel and overbank areas would be as shown in Table 5.

### TABLE 5

**AVERAGE VELOCITIES OF FLOW**
**100-YEAR FLOOD**

| Stream | Velocity (feet per second) Main Channel | Overbank Areas |
|---|---|---|
| Colorado River | 7-9 | 2-4 |
| Gunnison River | 6-8 | 1 |
| Leach Creek | 3-7 | 1-2 |
| Horizon Drive Channel | 3-5 | 1 |
| Lewis Wash | 6 | [1] |

[1] No overbank flow.

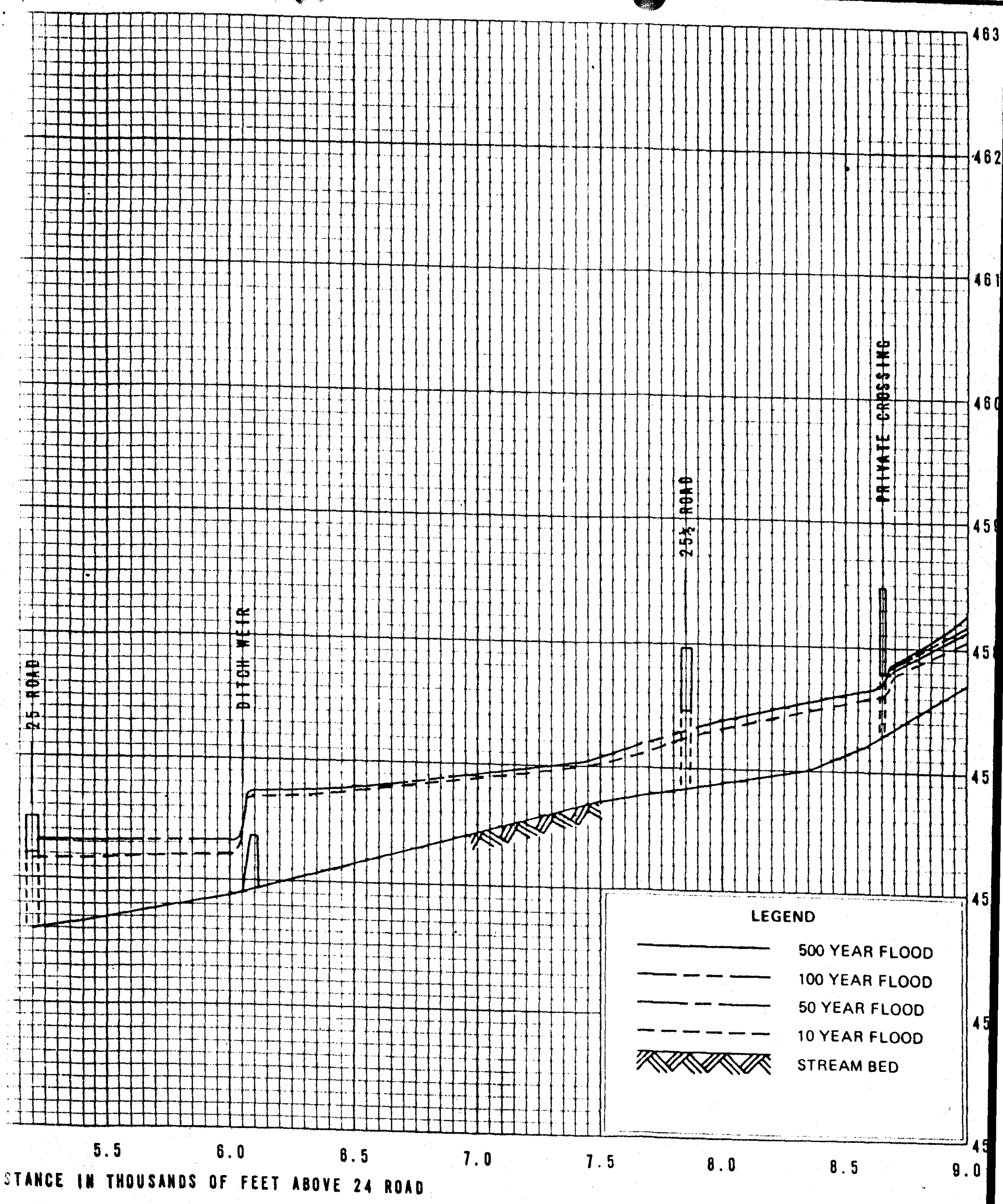
In sheet flow[5] areas, velocities would range from 1-3 feet per second. In some localized stream reaches, downstream from natural or manmade obstructions, for example, velocities of flow could significantly exceed those shown in Table 5. Velocity of flow during a 500-year flood would be slightly higher than during a 100-year flood.

Water flowing at a rate of 7 feet per second or greater will cause severe erosion of streambanks and is capable of transporting large rocks. Streambanks and the fill around bridge abutments may be eroded and large amounts of gravel, sand, and silt may be transported by water flowing at a rate of 5-7 feet per second. Water flowing at about 2 feet per second or less will deposit sand, silt, and other debris.

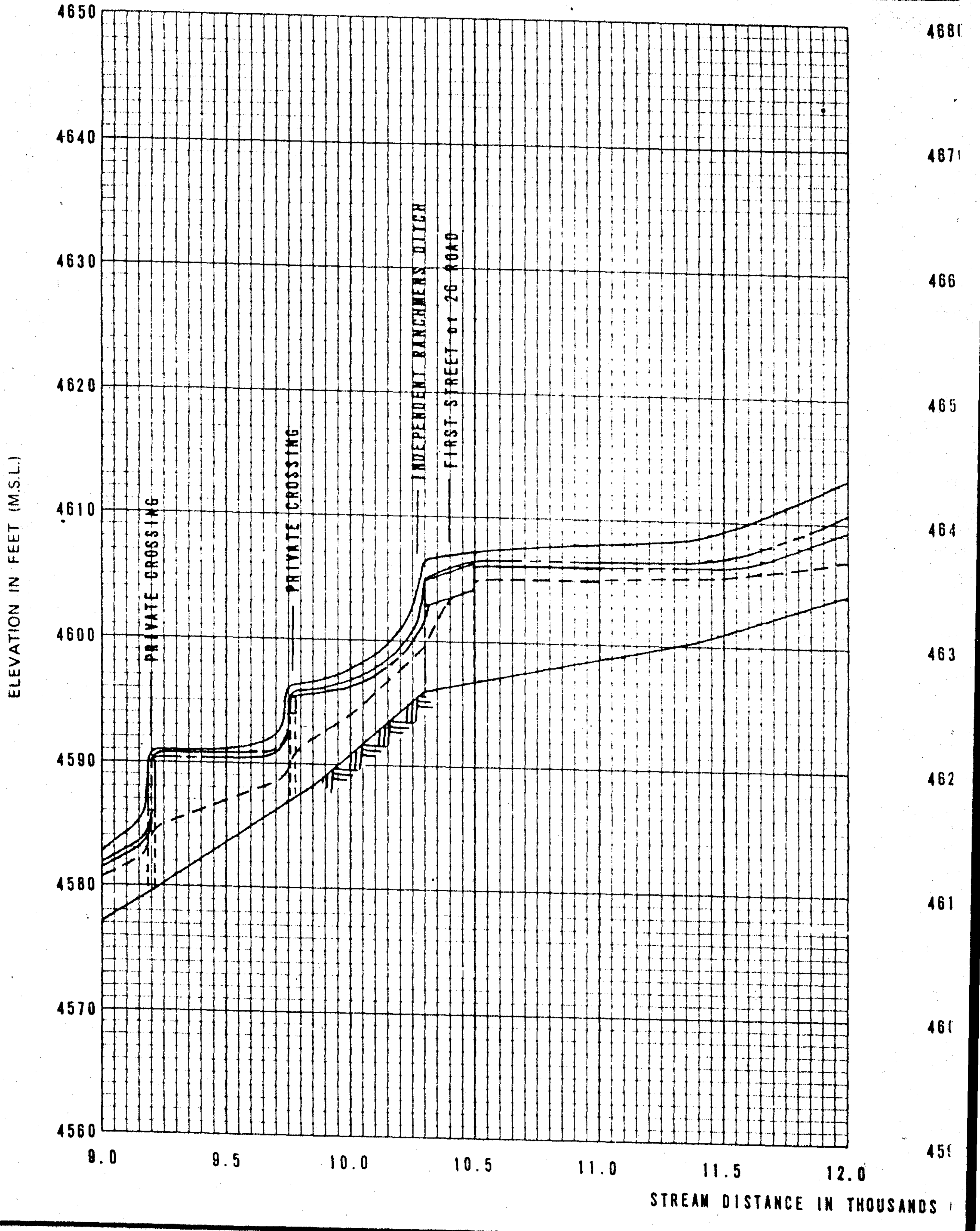
## FLOODED AREAS

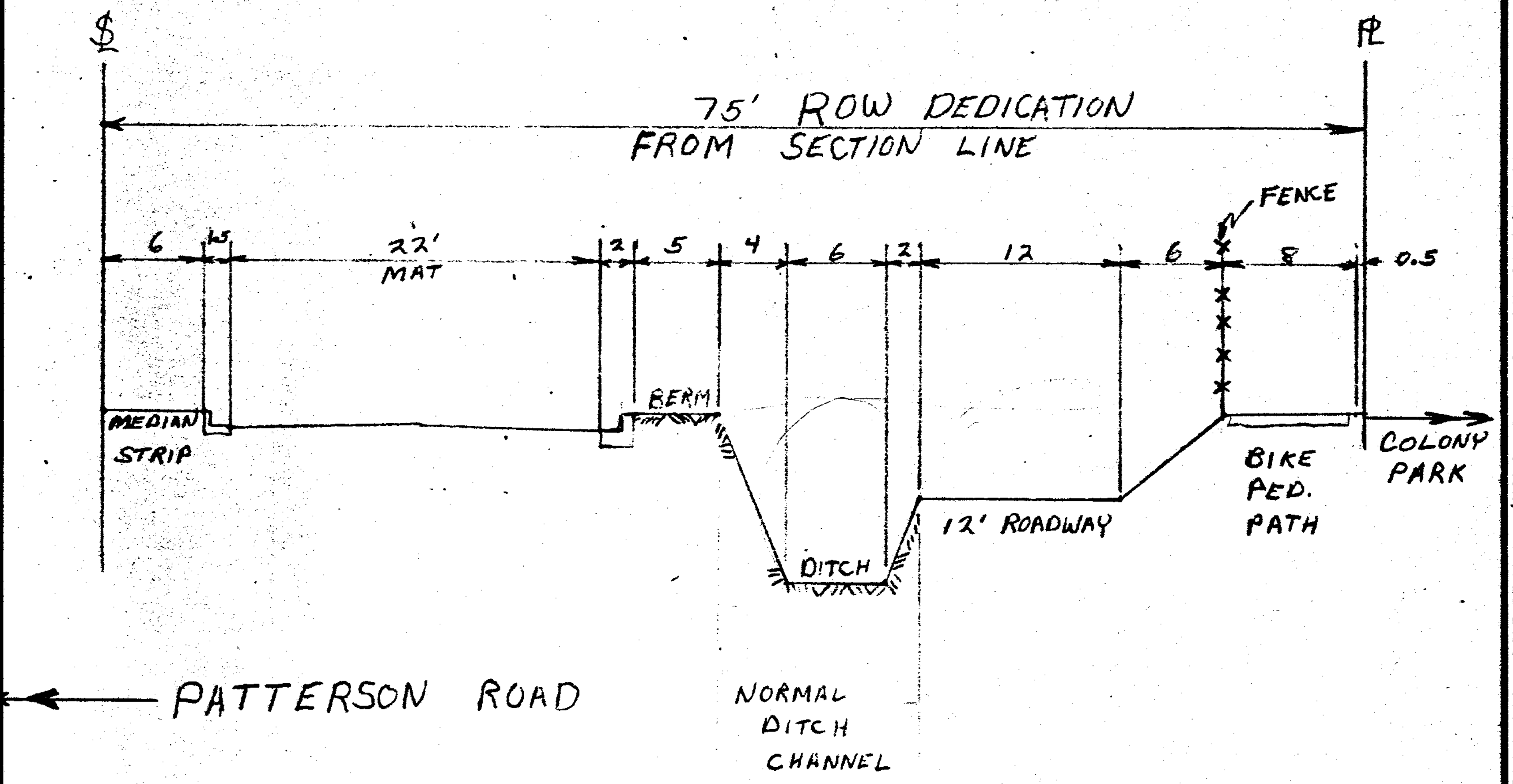
The areas that would be inundated by the 100- and 500-year floods are shown on Plates 2-57. As may be seen from those plates, the 100-year flood on the Colorado and Gunnison Rivers would be confined to the immediately adjacent overbank areas. Colorado River floodflows will inundate bottom lands along the north side of the river and sandbar islands immediately upstream from Grand Junction. The commercially developed area near the Fifth Street bridges and the residential area near Riverside Park would be threatened by the high flows of the Colorado River. Floodflows can back into the Connecticut Lakes area to the south of the river, as well as into the lower reach of No Thoroughfare Canyon. The higher flows on the Gunnison River would flood agricultural areas upstream from the mouth.

[5] Broad, shallow overland flow generally less than 2 feet deep.



25 ROAD
DITCH WEIR
25½ ROAD
PRIVATE CROSSING
LEGEND
500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
463
462
461
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
STANCE IN THOUSANDS OF FEET ABOVE 24 ROAD


4650
4640
4630
4620
4610
4600
4590
4580
4570
4560
ELEVATION IN FEET (M.S.L.)
PRIVATE CROSSING
PRIVATE CROSSING
INDEPENDENT RANCHMENS DITCH
FIRST STREET or 26 ROAD
9.0
9.5
10.0
10.5
11.0
11.5
12.0
STREAM DISTANCE IN THOUSANDS




COLORADO WEST ENGINEERING
835 Colorado Avenue
Grand Junction, CO
245-5112

835 Colorado Ave. · Grand Junction, Colorado 81501 · (303) 245-9430

Job 532.3 Colony Park
Client TED STRAUGHN
Designed by ______ Date 3-11-82
Checked by ______ Sheet No. 1 of 1

# APPENDIX

.....listing sources of information used in calculations and in support of assumptions and opinions expressed in the original Floodplain Narrative and the Addendum for Colony Park, contained herewith.

Response from Corps of Engineers

Table 4 - Obstructive stream crossings

Plat 73 - Flood Profiles

Table 3 - Peak Flows 100- and 500-year floods

Chart 2-53 - Headwater depth for C.M.P. culverts

Table 10-1 - Values of "n" for Mannings Formula

Grand Junction Intensity - Duration Curves

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

SPKED-T

5 December 1980

Mr. Roger A. Foisy
Colorado West Engineering
835 Colorado Avenue
Grand Junction, Colorado 81501

Dear Mr. Foisy:

Pursuant to your 4 November 1980 letter, a list of cross sections used in our 1976 study of Horizon Drive Channel in the Grand Junction area is inclosed. Also inclosed are an HEC-2 computer card deck and card list for a portion of the Colorado River in Grand Junction. Other information that you requested was discussed with you in a 3 December telephone conversation with Messrs. Dail Hatch and Herb Hereth of this office. Additional backup material for our 1976 flood hazard information report is available for inspection and use in this office. If you have any questions on the materials inclosed, please contact Mr. Dail Hatch at (916) 440-3105.

Sincerely,

for GEORGE C. WEDDELL
Chief, Engineering Division

2 Incl
1. Cross-sec list
2. Comp deck & card list

EXAMPLE OF COPY OF

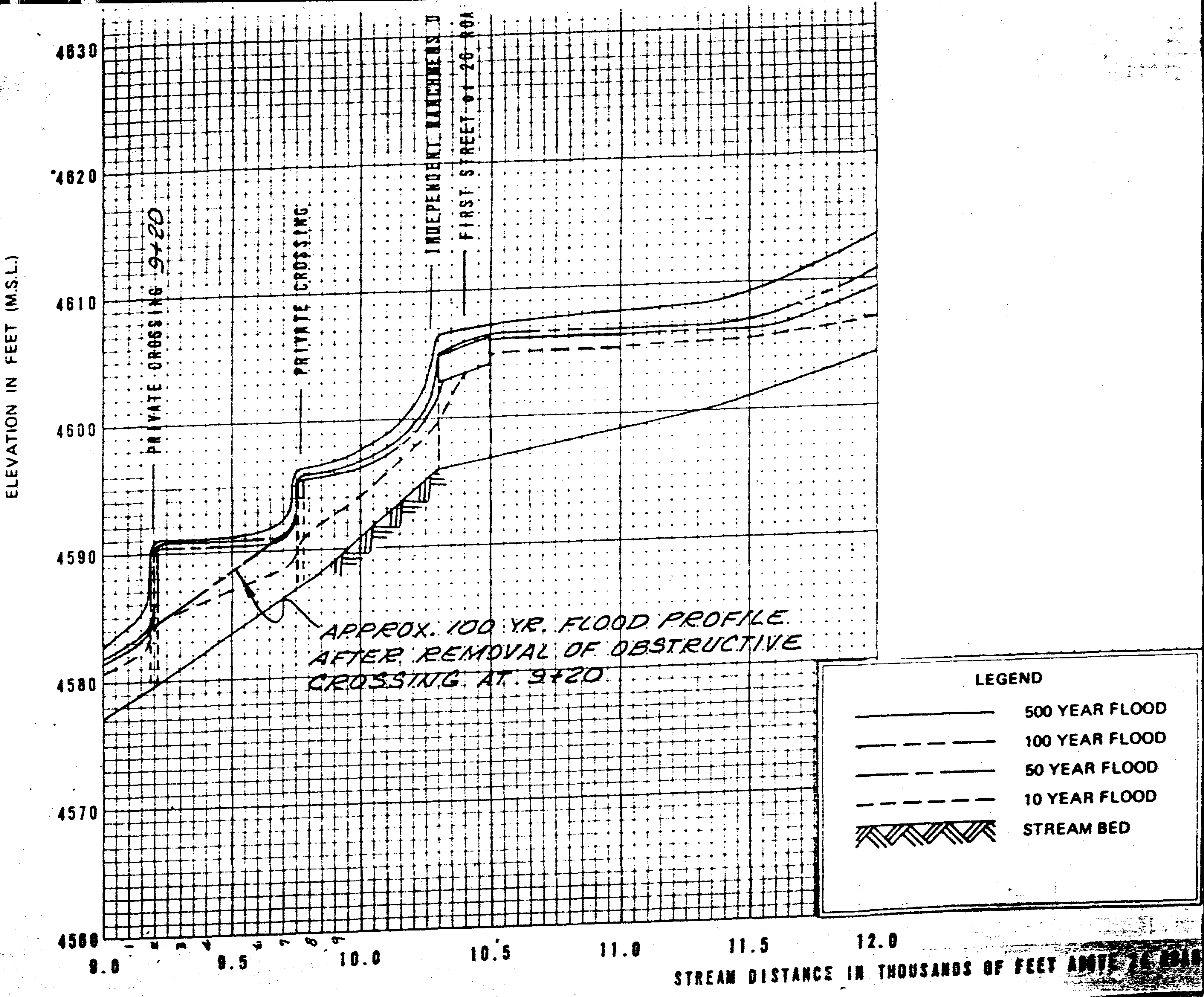
```
C
T1  GRAND JUNCTION FLOOD HAZARD INFORMATION  STUDY  MESA COUNTY COLORADO
T2   REF STATION 10.500 AT 26 ROAD                              J. BLEVINS
T3      HORIZON DRIVE CHANNEL

J1  ICHECK     INQ      NINV      IDIR      STRT     METRIC    HVINS      Q       WSEL      FQ
       -0       2.       -0        -0        -0        -0        -0        -0  4563.000     -0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH      FN       ALLDC      IBW      CHNIM     ITRACE
    1.000       -0    -1.000        -0        -0        -0        -0        -0        -0.   15.000

J3   -2.000     1.000     2.000     3.000     4.000     6.000     7.000    34.000    21.000    22.000
J3   26.000    43.000    14.000   206.000    40.000    58.000    82.000   100.000   109.000   146.000
NC     .060      .060      .035      .100      .300        -0        -0        -0        -0        -0
QT    5.000   160.000   180.000   200.000   220.000   240.000        -0        -0        -0        -0

               25 ROAD

X1    5.450     7.000  1500.000  1600.000         0         0         0        -0        -0        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0
GR 4566.000         0  4565.000    10.000  4564.000   350.000  4563.000   800.000  4564.000  1500.000
GR 4556.500  1540.000  4565.500  1600.000        -0        -0        -0        -0        -0        -0

X1    6.060    10.000  1360.000  1400.000   450.000   610.000   610.000        -0        -0        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0
GR 4570.000         0  4568.000   250.000  4566.500  1000.000  4566.500  1330.000  4568.700  1360.000
GR 4559.000  1370.000  4559.000  1382.000  4567.700  1400.000  4568.000  1560.000  4570.000  1700.000

X1    6.061         0         0         0    10.000    10.000    10.000        -0        -0        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0
SB    1.250     1.000     3.100    12.000      .001      .000      .001         0  4563.000  4563.000

X1    6.062         0         0         0    10.000    10.000    10.000        -0        -0        -0
X2       -0        -0     1.000  4563.100  4564.000        -0        -0        -0        -0        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0

X1    6.063         0         0         0    50.000    50.000    50.000        -0      .150        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0

X1    7.480     7.000  2220.000  2300.000  1100.000  1410.000  1410.000        -0        -0        -0
X3   10.000        -0        -0        -0        -0        -0        -0        -0        -0        -0
GR 4576.000   980.000  4576.000  2200.000  4576.500  2220.000  4576.000  2235.000  4567.100  2260.000
GR 4576.000  2280.000  4577.500  2300.000        -0        -0        -0        -0        -0        -0

               25 1/2 ROAD

X1    7.850     6.000  2200.000  2280.000   520.000   550.000   350.000        -0        -0        -0
GR 4580.000   940.000  4579.000  2200.000  4579.500  2230.000  4568.300  2250.000  4568.300  2254.700
GR 4580.000  2280.000        -0        -0        -0        -0        -0        -0        -0        -0

X1    7.851         0         0         0     1.000     1.000    10.000        -0        -0        -0
```

## TABLE 4

### OBSTRUCTIVE STREAM CROSSINGS[1]

| Identification | Location[3] | Elevation[2] Streambed | Under-clearance[4] | Top of Roadway[5] | 100-year Flood | 500-year Flood |
|---|---|---|---|---|---|---|
| **COLORADO RIVER** | | | | | | |
| Grand Avenue (State Highway 340): | | | | | | |
| Westbound Lanes | 385.53 | 4538 | 4559 | 4562 | 4553 | 4555 |
| Eastbound Lanes | 385.56 | 4538 | 4559 | 4562 | 4554 | 4556 |
| DRGWRR | 386.71 | 4546 | 4566 | 4570 | 4563 | 4565 |
| 5th Street (U.S. 50): | | | | | | |
| Northbound Lanes | 386.83 | 4549 | 4570 | 4575 | 4564 | 4566 |
| Southbound Lanes | 386.84 | 4550 | 4565 | 4572 | 4565 | 4567 |
| 32 Road | 393.05 | 4606 | 4625 | 4630 | 4627 | 4629 |
| **LEACH CREEK** | | | | | | |
| River Road* | 2,040 | 4532 | 4540 | 4542 | 4543 | 4545 |
| DRGWRR | 2,100 | 4534 | 4541 | 4545 | 4544 | 4546 |
| U.S. Highway 6/50* | 2,440 | 4536 | 4542 | 4546 | 4545 | 4547 |
| 6/50 Frontage Road* | 2,625 | 4536 | 4544 | 4545 | 4545 | 4547 |
| 24½ Road* | 9,890 | 4565 | 4574 | 4575 | 4574 | 4574 |
| 25 Road* | 12,530 | 4576 | 4587 | 4591 | 4590 | 4590 |
| Main Line Grand Valley Canal | 13,630 | 4584 | 4594 | 4599 | 4593 | 4594 |
| G½ Road* | 19,130 | 4627 | 4637 | 4650 | 4640 | 4640 |
| I-70 Frontage Road* | 19,540 | 4638 | 4646 | 4661 | 4660 | 4661 |
| 26 Road* | 21,330 | 4653 | 4659 | 4662 | 4664 | 4667 |
| H Road* | 22,570 | 4666 | 4674 | 4684 | 4685 | 4686 |
| **LEWIS WASH** | | | | | | |
| D Road | 2,070 | 4610 | 4620 | 4622 | 4621 | 4623 |
| D½ Road | 4,730 | 4629 | 4638 | 4640 | 4639 | 4642 |
| E Road | 7,370 | 4644 | 4656 | 4660 | 4657 | 4661 |
| Grand Valley Canal | 8,120 | 4651 | 4664 | 4668 | 4663 | 4670 |
| U.S. Highway 6/24 | 9,080 | 4663 | 4674 | 4678 | 4670 | 4677 |
| E½ Road | 10,030 | 4672 | 4682 | 4685 | 4684 | 4686 |
| F½ Road | 15,470 | 4737 | 4748 | 4750 | 4747 | 4752 |
| Interstate 70* | 17,800 | 4762 | 4769 | 4778 | 4770 | 4779 |
| **HORIZON DRIVE CHANNEL** | | | | | | |
| Private Crossing* | 9,200 | 4580 | 4586 | 4590 | 4591 | 4591 |
| Private Crossing* | 9,750 | 4588 | 4594 | 4595 | 4596 | 4596 |
| 26 Road* | 10,400 | 4597 | 4604 | 4606 | 4606 | 4607 |
| 26½ Road* | 13,450 | 4618 | 4628 | 4634 | 4635 | 4636 |
| Main Line Grand Valley Canal* | 14,250 | 4630 | 4635 | 4643 | 4635 | 4644 |
| Grand Valley Highline Canal* | 15,700 | 4645 | 4649 | 4658 | 4659 | 4660 |
| Horizon Drive* | 16,540 | 4648 | 4653 | 4657 | 4660 | 4661 |
| 27 Road* | 17,440 | 4657 | 4662 | 4669 | 4670 | 4671 |
| G Road* | 19,900 | 4688 | 4692 | 4702 | 4703 | 4704 |

[1] Culverts are designated by *.
[2] At the upstream face of the structure (except for top of roadway), rounded to the nearest foot, mean sea level datum.
[3] Miles upstream from Lees Ferry, Arizona, on the Colorado River; feet upstream from mouth on tributary streams.
[4] Low steel at lowest point on structure for all types of bridge except arch. Top of opening at mid-span on arch bridges and culverts.
[5] At the center line of road immediately above underclearance point.




DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

NOVEMBER 1976

FLOOD HAZARD INFORMAT
GRAND JUNCTION, COLOR

FLOOD PROFILES
HORIZON DRIVE CHANNE

PLATE 73

the drainage basins of the Colorado and Gunnison Rivers and convective type cloudburst storm runoff from the drainage basins of the tributary streams create the most severe flood conditions in the study area.

The unit hydrographs for Leach Creek, Horizon Drive Channel, and Lewis Wash were developed by using the Snyder technique and data from several similar nearby basins with recorded thunderstorm runoff. Regional snowmelt flood envelope curves for the Colorado and Gunnison Rivers were developed using flow-discharge frequency data.

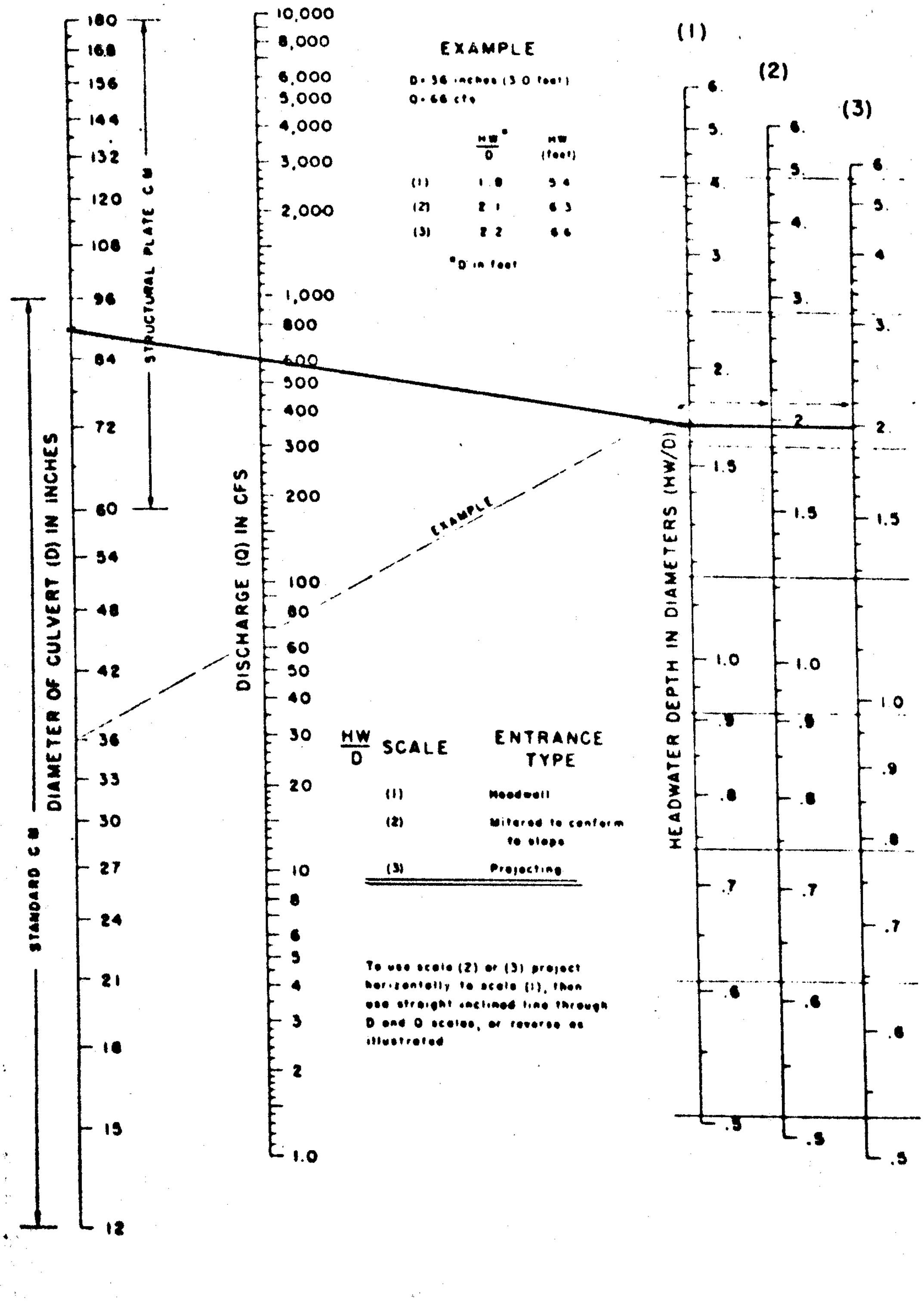
Snowmelt flows of the Colorado and Gunnison Rivers at Grand Junction were developed from frequency curves for those streams above Grand Junction. Based on available data, the 1921 flood was selected as being most representative for combined runoff from the two rivers, and the standard project flood was determined to have a frequency of 250 years (50 percent larger than the 1921 flood). To establish standard project flows on the Colorado River, a 150 percent value of the 1921 floodflows at Palisade was determined and then reduced by 8,000 cubic feet per second to reflect the effect of upstream reservoirs. For standard project flows on the Gunnison River, 150 percent of the 1921 floodflow at Grand Junction was established and then divided into runoff above and below Blue Mesa Reservoir (55 and 45 percent, respectively). Blue Mesa Reservoir was completed in 1965. Runoff above the reservoir was computed as a ratio of the 1921 flows and adjusted for present conditions. Reservoir releases were made so that downstream channel capacities would not be exceeded and assuming maintenance of minimum power pool level. Downstream runoff was then added to arrive at present standard project flow at Grand Junction. Flows in the two rivers were combined for total standard project snowmelt flows at Grand Junction. The 100-year flood event was established as an 89 percent value of the standard project event. The resulting floodflows are shown in Table 3.

## TABLE 3

### PEAK FLOWS
### 100- AND 500-YEAR FLOODS

| Stream | Location | Peak Flow cfs 100-Year Flood | Peak Flow cfs 500-Year Flood |
|---|---|---|---|
| Colorado River | Above mouth of Gunnison River | 63,000 | 82,000 |
| Colorado River | Below mouth of Gunnison River | 82,000 | 107,000 |
| Gunnison River | At Grand Junction | 20,000 | 25,000 |
| Leach Creek | At H Road | 1,800 | 4,200 |
| Horizon Drive Channel | At Independence Ranchmens Ditch | 600 | 1,800 |
| Lewis Wash | At I-70 | 1,400 | 3,800 |

Chart 2-53: HEADWATER DEPTH FOR C.M.P. CULVERTS WITH INLET CONTROL




BUREAU OF PUBLIC ROADS JAN 1963

***Table 10.1 Values of n in Manning's formula***
Prepared by R. E. Horton and Others

| Nature of surface | $n$ | |
|---|---|---|
| | Min | Max |
| Neat cement surface | 0.010 | 0.013 |
| Wood-stave pipe | 0.010 | 0.013 |
| Plank flumes, planed | 0.010 | 0.014 |
| Vitrified sewer pipe | 0.010 | 0.017 |
| Metal flumes, smooth | 0.011 | 0.015 |
| Concrete, precast | 0.011 | 0.013 |
| Cement mortar surfaces | 0.011 | 0.015 |
| Plank flumes, unplaned | 0.011 | 0.015 |
| Common-clay drainage tile | 0.011 | 0.017 |
| Concrete, monolithic | 0.012 | 0.016 |
| Brick with cement mortar | 0.012 | 0.017 |
| Cast iron | 0.013 | 0.017 |
| Cement rubble surfaces | 0.017 | 0.030 |
| Riveted steel | 0.017 | 0.020 |
| Canals and ditches, smooth earth | 0.017 | 0.025 |
| Metal flumes, corrugated | 0.022 | 0.030 |
| Canals: | | |
| Dredged in earth, smooth | 0.025 | 0.033 |
| In rock cuts, smooth | 0.025 | 0.035 |
| Rough beds and weeds on sides | 0.025 | 0.040 |
| Rock cuts, jagged and irregular | 0.035 | 0.045 |
| Natural streams: | | |
| Smoothest | 0.025 | 0.033 |
| Roughest | 0.045 | 0.060 |
| Very weedy | 0.075 | 0.150 |

The Manning formula may be expressed in terms of $1/\sqrt{f}$ by comparing Eqs. (10.4) and (10.6), from which

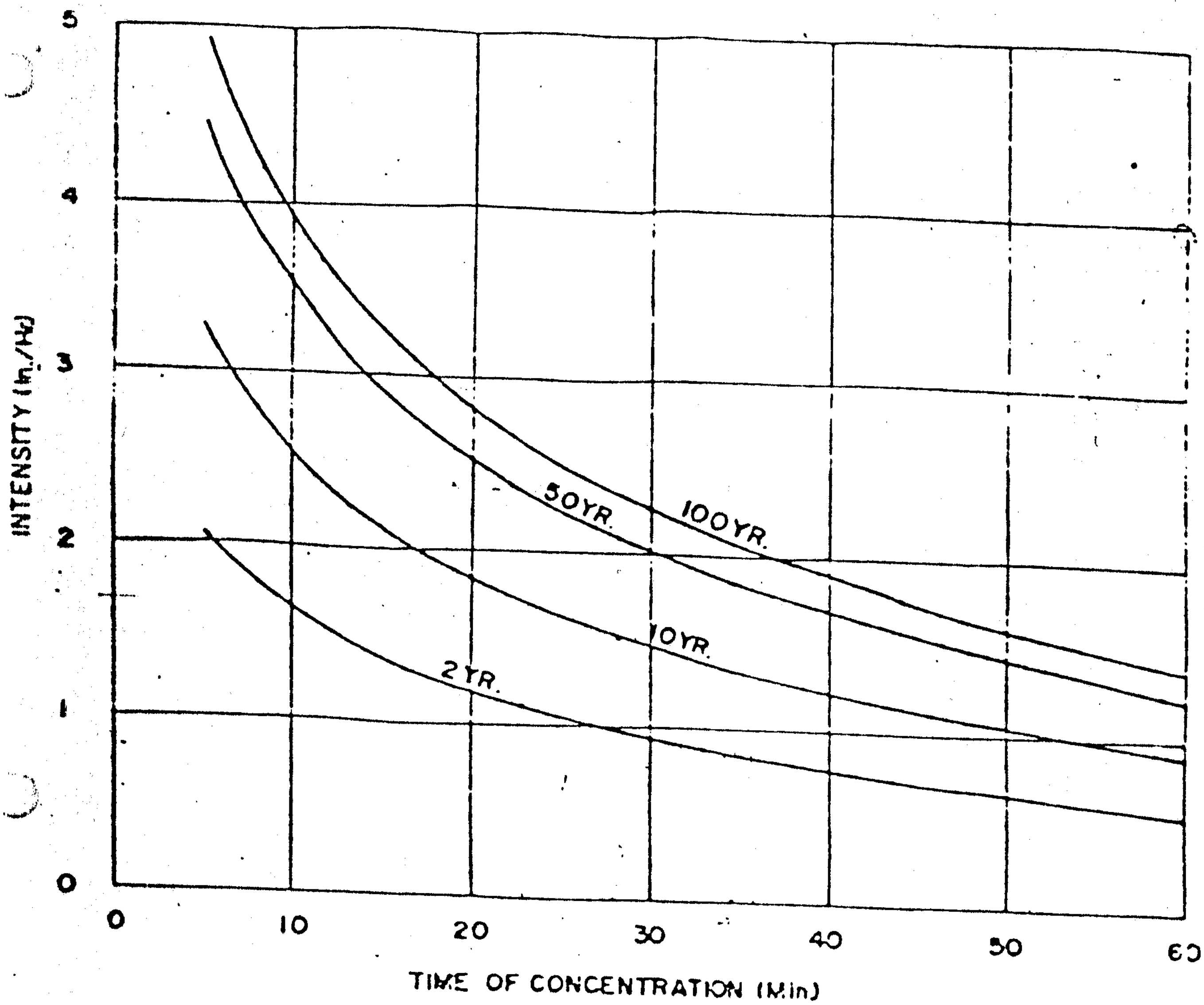
$$C = \sqrt{\frac{8g}{f}} = \frac{1.49}{n} R^{1/6}$$

or

$$\frac{1}{\sqrt{f}} = \frac{1.49 R^{1/6}}{n\sqrt{8g}} \tag{10.9}$$

Equating the right-hand sides of Eqs. (10.8) and (10.9) provides the desired correlation between $\epsilon$ and $n$, which is plotted as the solid lines in Fig. 10.3 for three representative values of the hydraulic radius.

The curves of $\epsilon$ versus $n$ in Fig. 10.3 must be regarded in the light of the components making up the equation which is plotted. The values of $\epsilon$, for example, were originally determined for artificially roughened pipes




INTENSITY DURATION CURVES
GRAND JUNCTION, COLORADO

# CITY OF GRAND JUNCTION, COLORADO

## MEMORANDUM

Reply Requested
Yes ☐ No ☐

Date
Oct. 11, 1982

To: (FXOHX) Bob Goldin - Floodplain Administrator From: (XTox) Ron Rish RPR

SUBJECT: 25 Rd. and F Rd. Culvert Extensions

Enclosed as promised are hydraulic calculations showing conditions before and after the Ranchmen's Ditch culverts were extended by the City. The sheet flow is so poorly defined in the Corps of Engineer's Report it is difficult to justify any opinion about the significance of 440 cfs (after) vs 395 cfs (before) in "sheetflow".

Enclosure

cc: Jim Patterson
Jim Taylor

# CITY OF GRAND JUNCTION
## DEPARTMENT OF PUBLIC WORKS AND UTILITIES
## ENGINEERING DIVISION

**PROJECT:** 25 & Patterson Road
**SUBJECT:** Hydraulic Analysis of Culverts
**DATE** 9/10/82 : **BY** JHT : **FILE NO.** ____ : **SHEET** 1 **OF** ____

CONDITIONS PRIOR TO MARCH 8, 1982

Existing Culvert under 25 Road - 60.68' of 81"x59" Structural Plate

End Condition - Beveled

Inlet Elevation - 4556.63

Outlet Elevation - 4555.99

100 year flow - $Q_{100}$ = 600 cfs from Flood Hazard Information Grand Junction, Colorado by the Corps of Engineers Nov. 1976 Table 3, Page 7

Lowest Bank Elevation up stream of inlet - 4562.61

Check Inlet Control:

$$\frac{HW}{D} = \frac{4562.61 - 4556.63}{4.92} = 1.22$$

End beveled to slope - scale #2

Using Figure 804-1F from Roadway Design Manual Colo. Highway Dept. $Q \doteq 205$ cfs.

Check Outlet Control: The channel will carry more water than the pipe will. Therefore assume the tailwater depth will be 0.85 D or 0.85 x 4.92 = 4.18'

# CITY OF GRAND JUNCTION
## DEPARTMENT OF PUBLIC WORKS AND UTILITIES
## ENGINEERING DIVISION

**PROJECT:** 25 & PATTERSON ROAD
**SUBJECT:** Hydraulic Analysis of Culverts
**DATE** ______ : **BY** JHT : **FILE NO.** ______ : **SHEET** 2 **OF** ______

∴ Tailwater Elev = 4555.99 + 4.18
= 4560.17

$H = 4562.61 - 4560.17$
$= 2.44'$

$K_e = 0.7$ $L = 60.68'$

Using Figure 804-14 from Roadway Design Manual Colo. Highway Dept.

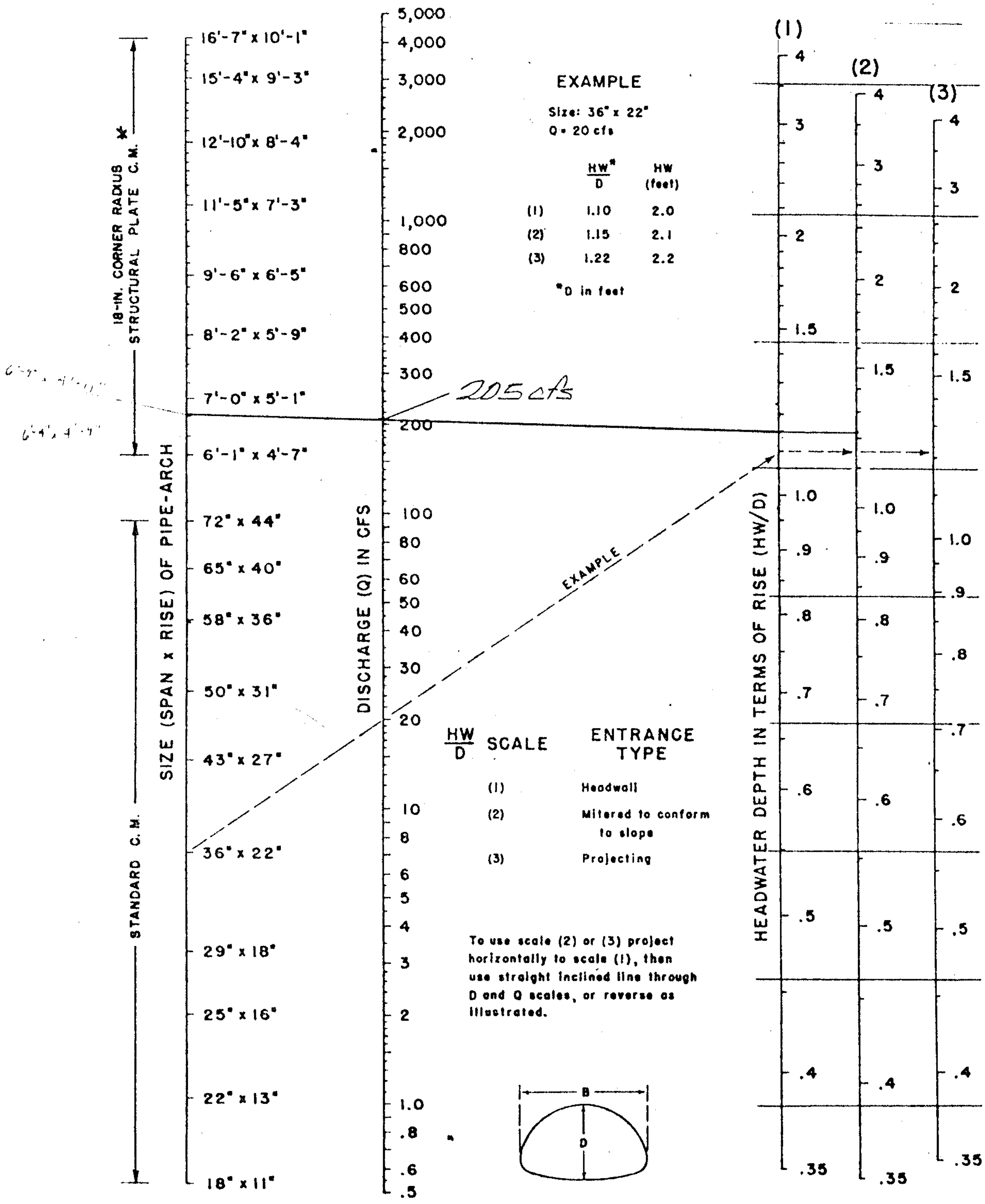
$Q = 230$ cfs.

∴ Inlet Control. $Q = 205$ cfs.

*Prior to Extensions*



# FIGURE 804-1F

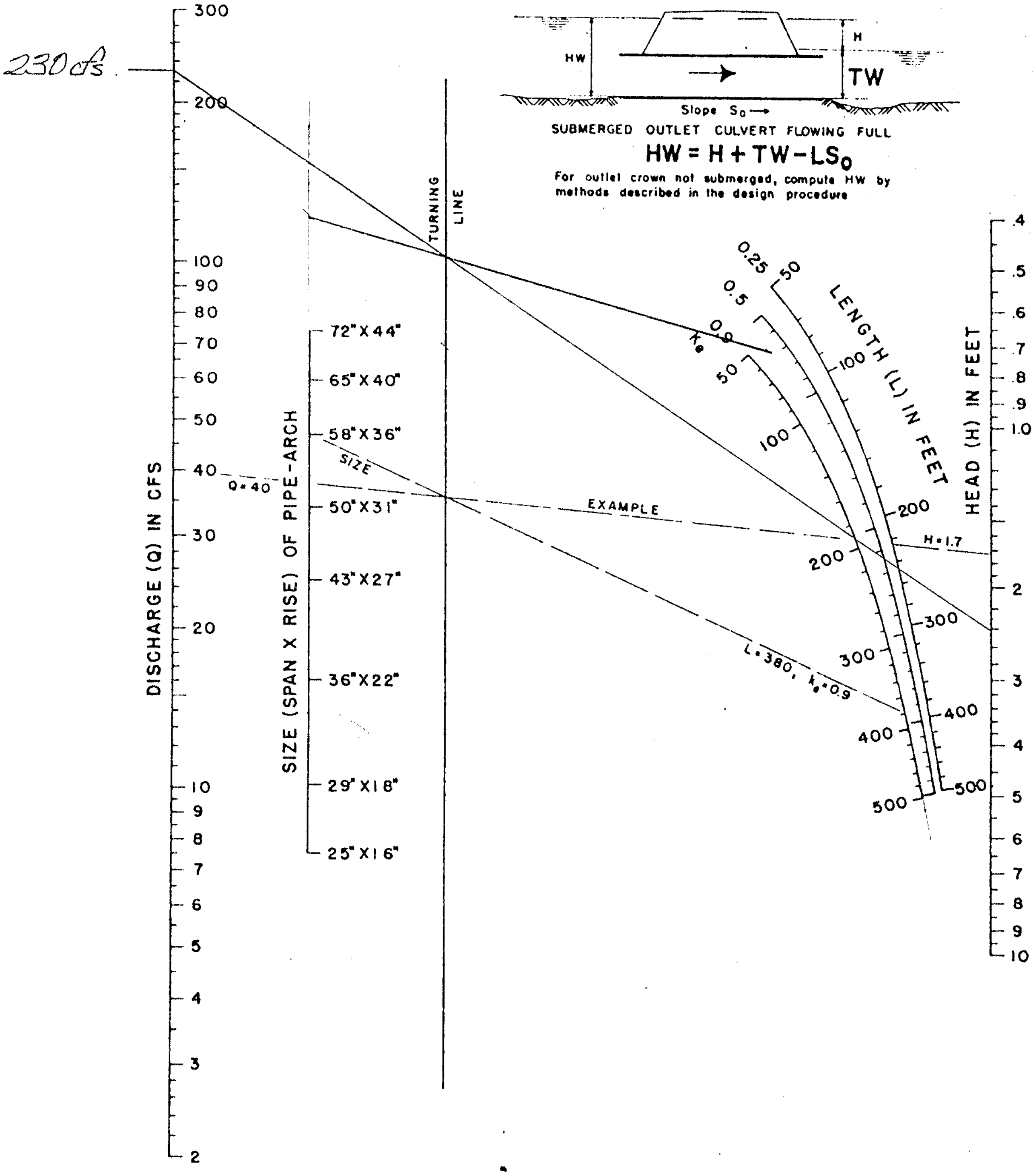



*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

Prior to Extensions






HEAD FOR
STANDARD C. M. PIPE-ARCH CULVERTS
FLOWING FULL
n=0.024

CITY OF GRAND JUNCTION
DEPARTMENT OF PUBLIC WORKS AND UTILITIES
ENGINEERING DIVISION

PROJECT: 25 & PATTERSON ROAD
SUBJECT: Hydraulic Analysis of Culverts
DATE ______ : BY JHT ______ : FILE NO. ______ : SHEET 3 OF ______

CONDITIONS AFTER MARCH 8, 1982 - CULVERTS HAVE BEEN EXTENDED.

New culvert extensions 81"x59" CMPA. Total Length = 531'

End Condition - Projecting.

Inlet Elevation - 4557.26

Outlet Elevation - 4554.64

100 year flow - $Q_{100}$ = 600 cfs.

Lowest Bank Elevation up stream of inlet - 4562.6

Check Inlet Control:

$$\frac{HW}{D} = \frac{4562.6 - 4557.26}{4.92}$$ End projecting - scale #3

$$= 1.08$$

Using Figure 804-1F from Roadway Design Manual Colo. Highway Dept. Q = 175 cfs.

Check Outlet Control: The channel will carry more water than the pipe will. Therefore assume the tailwater depth will be 0.85 D or 0.85 x 4.92 = 4.18'

# CITY OF GRAND JUNCTION
## DEPARTMENT OF PUBLIC WORKS AND UTILITIES
## ENGINEERING DIVISION

GJ

**PROJECT:** 25 & PATTERSON ROAD
**SUBJECT:** Hydraulic Analysis of Culverts
**DATE** ______ : **BY** JHT : **FILE NO.** ______ : **SHEET** 4 **OF** ______

Tailwater Elev = 4554.64 + 4.18
= 58.82

H = 4562.6 − 4558.82
= 3.78'

$K_e$ = 0.9  L = 531'

Using Figure 804-11 from Roadway Design Manual Colo Highway Dept.

Q = 160 cfs

∴ Outlet Control.

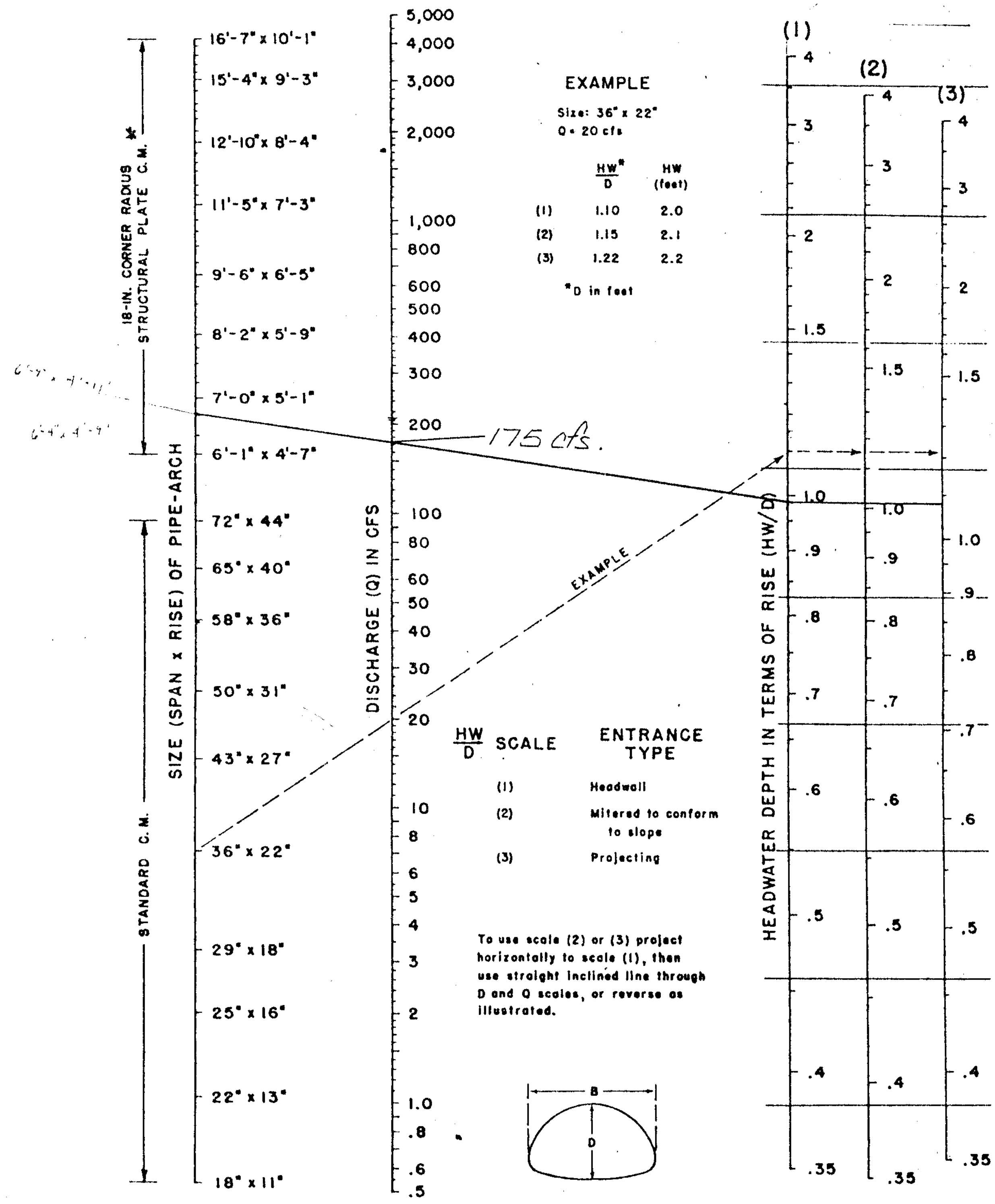
The pipe capacity before extension was 205 cfs and was determined by inlet control. The pipe capacity after extension was 160 cfs and this was determined by outlet control. The extension of the pipe has decreased the capacity by 45 cfs.

The Flood Hazard Information - Grand Junction Colorado - by the Corps of Engineers dated November 1976 states the 100 year flow for the Independent Ranchman's Ditch, to be 600 cfs. Prior to the culvert extensions, the culvert at 25 Road had a capacity of 205 cfs. The difference (600 cfs − 205 cfs = 395 cfs) is sheet flow.
After the extensions, the culvert at 25 Road had a capacity of 160 cfs. The difference (600 cfs − 160 cfs = 440 cfs) is sheet flow.

*After Extensions*



# FIGURE 804-1F




*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

## HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

#61-82

COLORADO WEST ENGINEERING

CONSULTING CIVIL ENGINEERS

835 COLORADO AVE., GRAND JUNCTION, COLORADO 81501

303/245-5112

August 27, 1982

Mr. Ronald P. Rish, P. E.
City of Grand Junction
250 North 5th Street
Grand Junction, Colorado 81501

RE: Colony Park Food Plain Permit Application, Revised Addendum

Dear Ron;

Enclosed is our complete Floodplain Permit Application for Colony Park.

This addendum addresses the hydraulic calculations necessary to size the proposed single culvert crossing of Ranchman's Ditch.

In our addendum of July 28, 1981 we were in error in stating a 90 inch culvert with 2 feet of headwater would pass the 100 year storm flow of 600 c.f.s. A 90 inch culvert would require 6 feet of head to pass 600 c.f.s.

A 102" culvert is required to safely handle the 100 year storm flow of 600 c.f.s. The 102" culvert will be operating under free entrance conditions during a 100 year flood event.

Our earlier calculations and comments contained in the body of the floodplain permit application are valid, technically correct statements, based on the best information available.

We wish to be informed of the progress of this floodplain application.

Sincerely,
COLORADO WEST ENGINEERING

by Jeff Smith
Jeff Smith
Civil Engineer

RJS/bjs
Enclosure

CITY OF GRAND JUNCTION, COLORADO

MEMORANDUM

Reply Requested
Yes ☐ No ☐

Date
September 30, 1982

To: (From:) Bob Goldin From: (To:) Ron Rish RPR

Subject: Floodplain Permit Application for Colony Park

As requested, I have reviewed the above as submitted by Colorado West Engineering on September 16, 1982, and received by my office on September 21, 1982. The submittal included recent explanatory calculations, an addendum dated August 27, 1982, and the original application of July 28, 1981. I have reviewed all the aforementioned material and feel that in the aggregate it is a very comprehensive and responsible report. The proposed flood mitigation is acceptable to this office with one suggestion. Should not some erosion protection be provided at the 102 inch culvert outlet to address anticipated flood velocities of up to 11.10 fps at the pipe outlet?

I agree the culvert will operate in a "marginal" hydraulic zone which is subject to analytical interpretation depending on loss coefficients and other assumptions. Obviously the Colorado Division of Highways nomogram is conservative but I feel that Colorado West Engineering West has consistently made conservative assumptions of various parameters, has properly analyzed the hydraulics and have presented reasonable recommendations.

I appreciate the analytical detail furnished with this latest submittal.

cc - Colorado West Engineering
Jim Straughan
John Kenney
Jim Patterson
File