DRAINAGE REPORT FOR:

LOCO OIL FOOD STORE

July, 1995
Revised - December 1995
Revised - September 1996

Prepared For:
Mr. Rob Libson
2249 Broadway
Grand Junction, Colorado 81503
(970) 242-5857

Prepared By:
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Prepared By: Brian C. Hart

Brian C. Hart, E.I.

"I hereby certify that this report for the drainage design of the Loco Oil Food Store was prepared under my direct supervision."

Reviewed By: Philip Hart

Philip M. Hart, P.E.
State of Colorado, #19346

I. General Location and Description

A. Property Location:

The proposed Loco Oil Food Store is located in the town of Fruita, Mesa County and contains 6.75 acres. The subject property is located in part of the Northeast 1/4 of the Southeast 1/4 of Section 18, Township One North, Range Two West, of the Ute Meridian.

Streets in the vicinity include State Highway 340 (SH 340) which is located east of the subject property line. Located to the north of the property is the exit ramp for Interstate I-70. West Grand Avenue is located to the west of the property and defines the south boundary of the site (Exhibit 1.0).

The surrounding land use in the vicinity of the subject property is considered to be of moderate intensity. Located across SH 340, there are a variety of establishments including a Texaco fuel and convenience store, a Super 8 motel, a general merchandise shop and a visitor's center. A McDonald's and a Dinosaur museum is located to the west of the property approximately one-eighth of a mile. A vacant lot is located immediately west of the property and Grand Avenue.

The Parcel identification numbers for the subject property s 2697184-07-001, 2697184-07-002, 2697184-07-003, 2697184-07-004 and 2697184-07-005.

B. Description of Property:

The project site contains approximately 6.75 acres and is planned for a 7,000 square foot building which will contain fuel and convenience services as well as restaurant services.

The entire site is described as pasture land with thick annual weeds and a small number of trees.

Based on the "Soil Survey, Mesa County Area" (Reference 5, Exhibit 3.0) on-site soils are defined as (Ba), Billings silty clay, 0 to 2 percent slopes, hydrological soil group "C".

An irrigation system runs along the north and east borders of the site. This prevents any storm water from north and east off site areas to run into the property in question.

II. Drainage Basins and Sub-Basins

A. Major Basin Description:

As defined in the detailed drainage study entitled "Flood Hazard Information, Colorado River and Tributaries, Fruita Colorado, Sheet 149, Plate 16" (Reference 4, Exhibit 2.0), the 100-year flood plain does not effect the subject property.

Irrigation facilities include an existing concrete irrigation ditch that runs along the north and east boundaries of the site. The ditch flows from the northwest corner of the site to the northeast corner of the site where it meets a second concrete ditch. From this intersection, the flow continues to the south along the site boundary. The ditch continues south past the site parallel to SH 340.

There are no wetlands on the site.

B. Sub-Basin Description:

The entire site is currently a vacant lot with no improvements located anywhere on the property.

Historically, the property drains in a sheetflow fashion from the northeast to the southwest at approximately 0.82% slope.

The historic sub-basin is designated as H1 (Exhibit 4.0), and encompasses approximately 6.75 acres. Two historic off-site basins will contribute stormwater run off to the site. The current location of Grand Avenue at the intersection of SH 340 will contribute flow to the site. This sub-basin will be designated as OS1, and encompasses 0.1 acre. The east side of the Grand Avenue R.O.W. will contribute to the flow of this site. This area will be designated as sub-basin OS2 and contains 0.5 acre. The off-site areas to the north and east of the property will not contribute flow to the site as the site is bounded in these areas by an irrigation ditch which will intercept any flow from these areas.

III. Drainage Design Criteria

A. Development Criteria Reference and Constraints:

There are no site constraints involved in the drainage design of this project, other than the typical relocation of utilities in the Grand Avenue R.O.W., which will be designed and performed with the construction of the Grand Avenue street improvements.

There have been no drainage studies that influence or are influenced by the drainage design for the project.

B. Hydrological Criteria and Discussion:

The "Stormwater Management Manual, City of Grand Junction, Colorado" (Reference 1) and the "Mesa County Storm Drainage Criteria Manual" (Reference 2) were used as the basis for analysis and facility design. The "Urban Storm Drainage Criteria Manual" (Reference 3) was used in the design and calculation of the street and inlet capacities.

Since the project is a commercial development containing approximately 6.75 acres, the "Rational Method" was used to calculate historic and developed flow rates. The minor storm is the 2 year frequency rainfall event and the major storm is the 100 year frequency rainfall event.

Runoff Coefficients used in the computations are based on the most recent City of Grand Junction criteria as defined in Reference 1 and shown on Exhibits 6.0 and 7.0. These coefficients were assigned based on land use and hydrological soils group "C".

The project is located within Mesa County but not within the Grand Junction Urbanized area, therefore the Intensity Duration Frequency Curves (IDFC) shown on Exhibits and 8.0 and 13.0 were used in the analysis and design.

Times of Concentration were calculated based on the Determination of Overland Flow Time and Average Velocities for Overland Flow Curves as provided in Reference 2 and shown on Exhibits 9.0 and 14.0.

Calculation of the required minimum detention pond storage volumes and the size of outlet control elements was based on the most recent Mesa County criteria as defined in Reference 2. The Modified Rational Method was used to calculate the detention size.

C. Hydraulic Criteria and Discussion:

All site facilities and conveyance elements are designed in accordance with the Mesa County guidelines as provided in Reference 2.

The detention outlet is a dual-stage release outlet, which will release the detained run-off volume at a rate consistent with the 2-year historic rate, except in the case of the 100-year storm. The outlet will then release the detained water at a rate equal to the 100-year historic rate.

All calculations for routing stormwater through conveyance elements are provided in the appendix for historic or developed conditions, under the 2 of 100 year storm routing design sheets, specifically Exhibits 15.0 - 17.0 and 22.0 - 32.0.

IV. Drainage Facility Design

A. General Concept:

The existing drainage pattern of the subject property allows the flow to start at the northeast corner of the site and flow towards the southwest corner of the site. The drainage for the developed site will follow this general pattern. See Exhibit 4.0 for a historic basin map of the subject property, and flow paths used to calculate the times of concentration. Exhibits 10.0 - 12.0 calculate the historic times of concentration by using equations 4-1, 4-3 and 4-4 from the Mesa County Storm Drainage Criteria Manual (Reference 2).

The subject property is proposed to be developed into a commercial fuel and food service establishment. A building approximately 7000 square feet in size is proposed to be constructed. In addition to the building, a parking lot, drain pans and curb and gutter associated with the construction of the site will serve to collect, convey and discharge the developed runoff to a detention pond. This detention pond will be located in the southwest corner of the site will subsequently drain into the existing storm sewer. The existing storm sewer is under the jurisdiction of Grand Junction Drainage District.

The proposed drainage plan is divided into two on-site basins, which will be designated as basins "A" (1.49 acres) and "B" (5.29 acres). There are also two off-site basins designated as "OS1" (0.1 acres) and "OS2" (0.5 acres) located east and south of the site, respectively. See Exhibit 5.0 for a developed basin map of the proposed development of the subject property, and flow paths used to calculate the times of concentration. Exhibits 18.0 - 21.0 calculate the developed times of concentration by using equations 4-1, 4-3 and 4-4 from the Mesa County Storm Drainage Criteria Manual (Reference 2).

The run-off from sub-basin "A" shall be collected and redirected via building roof drains, parking lot grading, drain pans and curb and gutter towards the south portion of the site to design point #1. The run-off from sub-basin "OS1" will also be redirected via roof drains, parking lot grading, drain pans and curb and gutter. The run-off from "OS1" will flow to the southeast corner of the site and will be directed through sub-basin "A" and to design point #1. From design point #1, the run-off will continue to design point #1A, where the run-off will discharge into the proposed detention pond located at the southwest corner of the site.

The run-off from sub-basin "B" shall also be collected and redirected via building roof drains, parking lot grading, drain pans and curb and gutter towards the southwest portion of the site to design point #2. The run-off from sub-basin "OS2" is created by the street improvements on Grand Avenue and will be collected and redirected by curb and gutter towards southwest portion of the site to design point #2. This design point will convey run-off into the detention pond to be located at the southwest corner of the site.

B. Specific Details:

The southwest area of the site will be excavated, regraded and resurfaced to form a detention pond which will serve sub-basins, "A". "B", "OS1" and "OS2". A headwall structure and drain pans will help convey run-off towards the detention pond outlet works. Exhibits 15.0 - 17.0 calculate the capacity of v-pans and curb and gutter used to convey run-off to the detention pond.

All design points (1, 1A and 2), describe inlets which direct stormwater run-off to the detention pond. Calculations for the inlet capacities are located in the appendix, Exhibits 22.0 - 25.0.

Exhibits 26.0 and 27.0 calculate the street capacities for Grand Avenue and for the West entrance/exit road into the project. Exhibit 28.0 calculates the required nuisance flows (1% of 100 year flows), with the required flow needed at 0.29 cfs. Exhibits 29.0 - 32.0 calculate the flow capacities of the storm sewer pipes used to convey run-off from the design points to the detention pond.

The detention pond and outlet structure will be sized to attenuate the 2 year and 100 year storm events. The outlet from the pond shall be a dual stage outlet box sized to release the 2 year and 100 year historic flow rates. Run-off released from the pond shall be conveyed to the existing storm sewer that runs west along Grand Avenue. See Exhibits 33.0 - 36.0 for the calculations of the required volumes for the 2 and 100 year storm events. Exhibits 37.0 - 40.0 show the calculations for the design of the outlet structure for the detention pond.

Access to and through the site shall be by private driveways. Ownership and responsibility for the maintenance of the proposed on-site improvements shall be that of the building owner and or the building tenants. Ownership and responsibility for maintenance of the proposed off-site improvements, including any improvements within the Grand Avenue R.O.W., shall be that of the City of Fruita.

V. Conclusions

The general concept of the drainage plan is to follow the historic pattern of flow towards the southwest portion of the site. At this location of the site a detention pond will be located to help control the flow created from the developed conditions.

The detention pond will serve the entire site as well as two off-site basins, located south and east of the subject property. Additional detention requirements should not be needed for future development of the site.

A letter from Mr. Dan M. Beley from the Colorado Department of Public Health and Environment is located in the Appendix of this report (Exhibit 41.0). This letter states that a Stormwater Discharge Permit is not necessary for Retail/Commercial facilities, which this development will be.

This Drainage Report has been prepared to address site-specific drainage concerns in accordance with the requirements of the Mesa County, Colorado. The Appendix of this report includes criteria, exhibits, tables and calculations used in the design and analysis.

VI. References

1. Stormwater Management Manual (SWMM), City of Grand Junction, Colorado, Department of Public Works, June 1994.

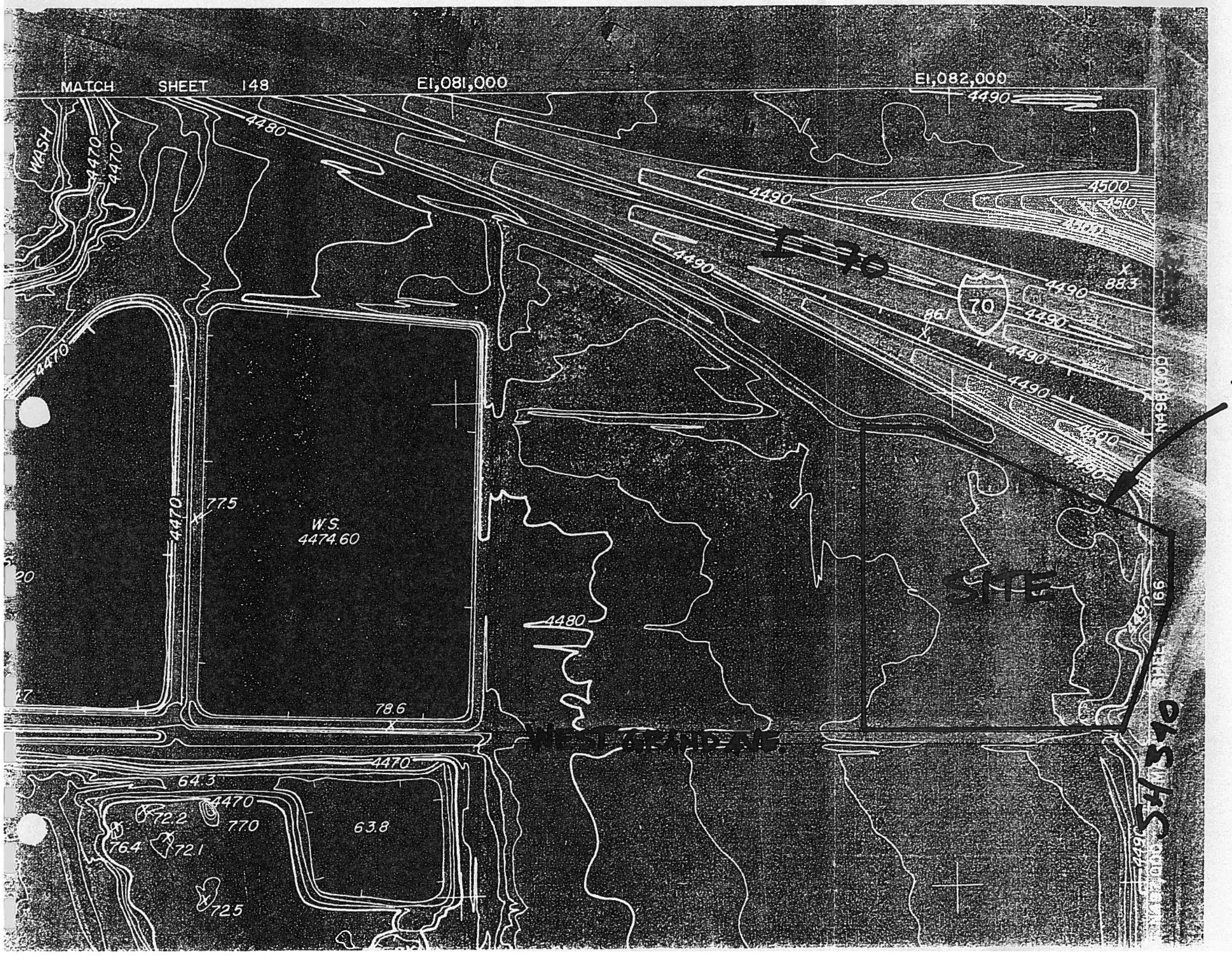
2. Mesa County Storm Drainage Criteria Manual, Final Draft, Mesa County, Colorado, March, 1992.

3. Urban Storm Drainage Criteria Manual, Vol. 1, Wright - McLaughlin Engineers, Denver, Colorado, March, 1969.

4. Flood Hazard Information, Colorado River & Tributaries Sheet 149, Plate 16, Department of the Army, Sacramento District, Corps of Engineers, Sacramento, California.

5. Soil Survey, Mesa County Area, Colorado, U.S. Department of Agriculture, issued November, 1955.

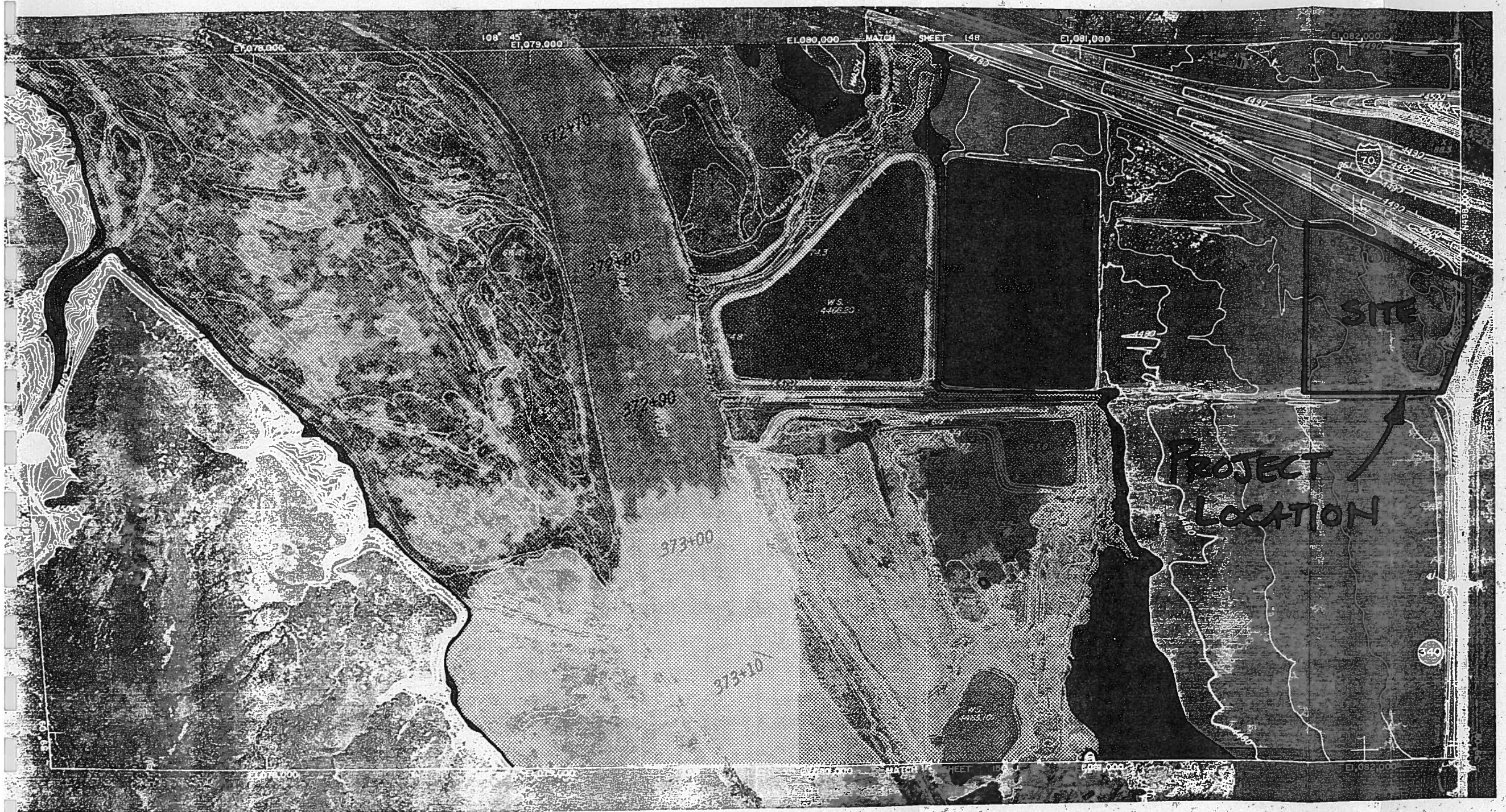
6. Flowmaster I, Version 3.16, Haestad Methods, Inc. Copyright, 1990.



PROJECT LOCATION

N

EXHIBIT 1.0



LEGEND

Overflow Limits

100 Year Flood

500 Year Flood

N

373+10 Distance in miles upstream from Lees Ferry along the Colorado River.

1+00 Distance in thousands of feet upstream from mouth along tributary streams.

NOTES

Map based on April 1975 orthophoto map provided by the U.S. Bureau of Reclamation. Minor additions and adjustments made by Corps of Engineers.

Sheet number agrees with sheet number shown on Bureau of Reclamation maps.

Limits of overflow shown may vary from actual locations on the ground because of accuracy of available topography.

Areas outside the overflow limits shown may be subject to flooding from local runoff.

SCALE IN FEET
200 0 200 400 600
CONTOUR INTERVAL 2 FEET
MEAN SEA LEVEL DATUM

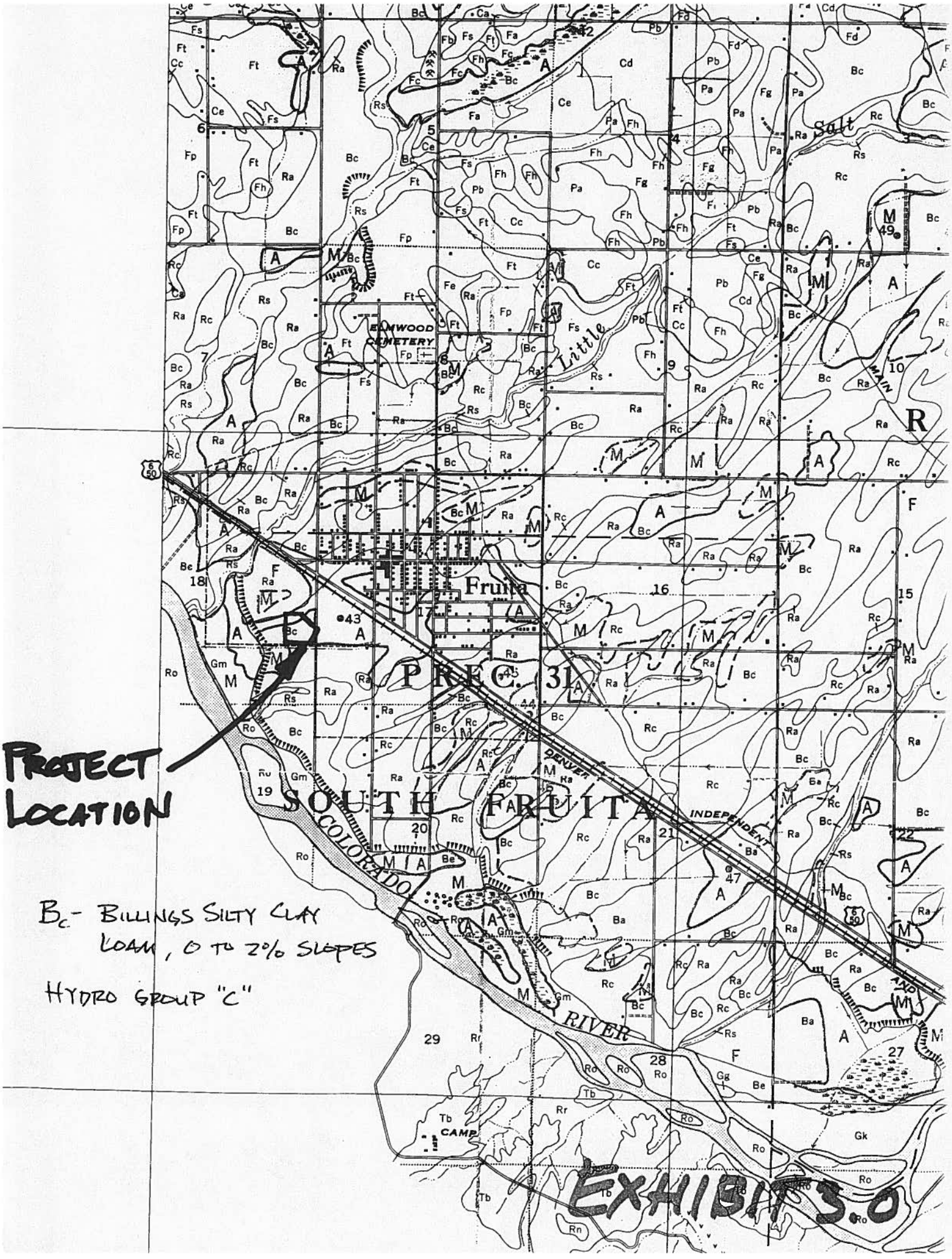
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

FLOOD HAZARD INFORMATION
COLORADO RIVER AND TRIBUTARIES
FRUITA, COLORADO

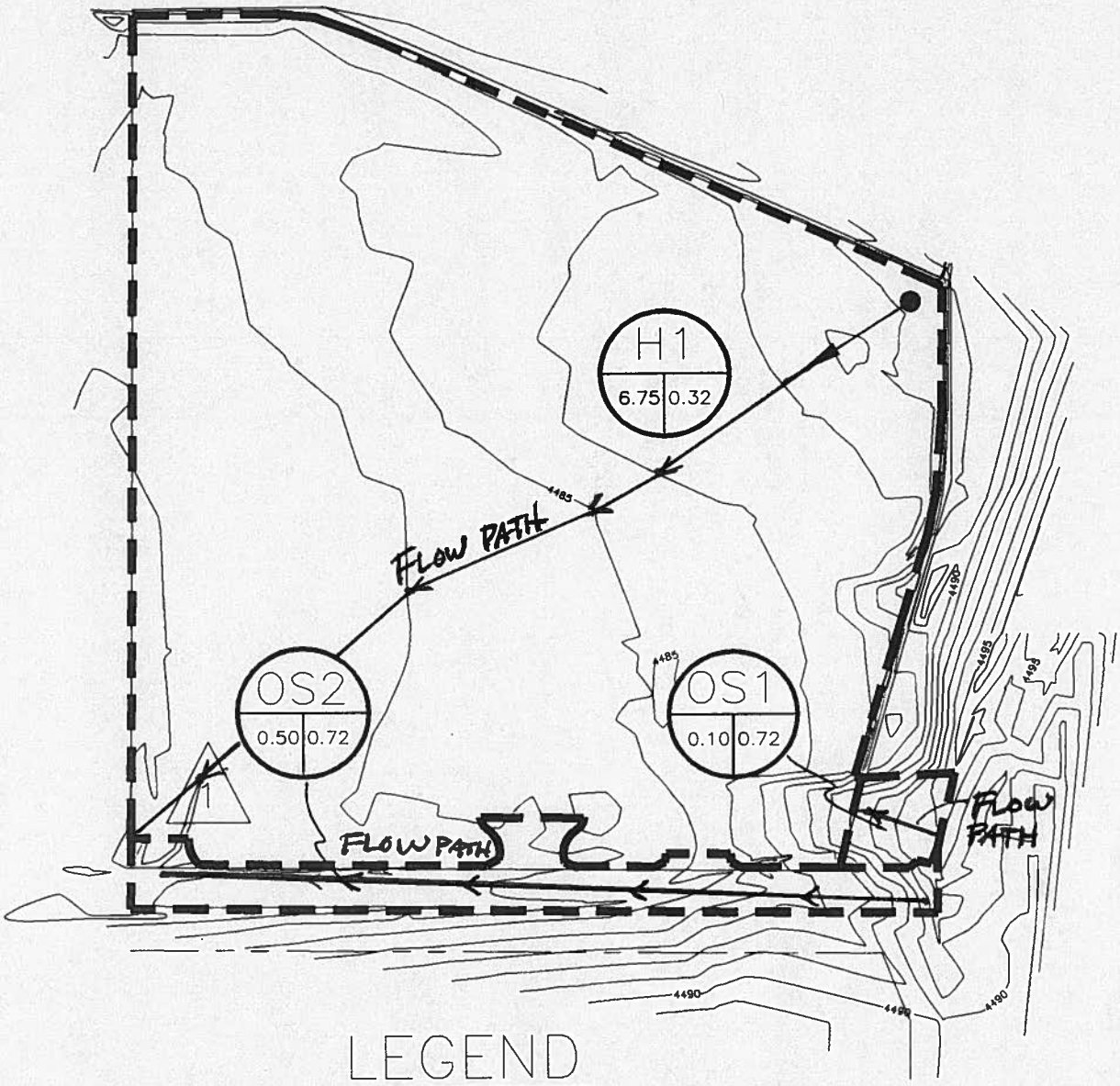
EXHIBIT 2.0

FLOODED AREAS
NOVEMBER 1976

SHEET 149 PLATE 16


PROJECT LOCATION
Bc- BILLINGS SILTY CLAY LOAM, 0 TO 2% SLOPES
HYDRO GROUP "C"
EXHIBIT 3.0
Fruita
SOUTH FRUITA
PREC. 31
ELMWOOD CEMETERY
Little
Salt
MAIN
DENVER
INDEPENDENT
COLORADO
RIVER
CAMP

HISTORIC BASIN MAP



LEGEND

H1
6.75 0.32

SUB-BASIN DESIGNATION

AREA-ACRES	2-YEAR RUN-OFF COEFFICIENT

SUB-BASIN BOUNDARY

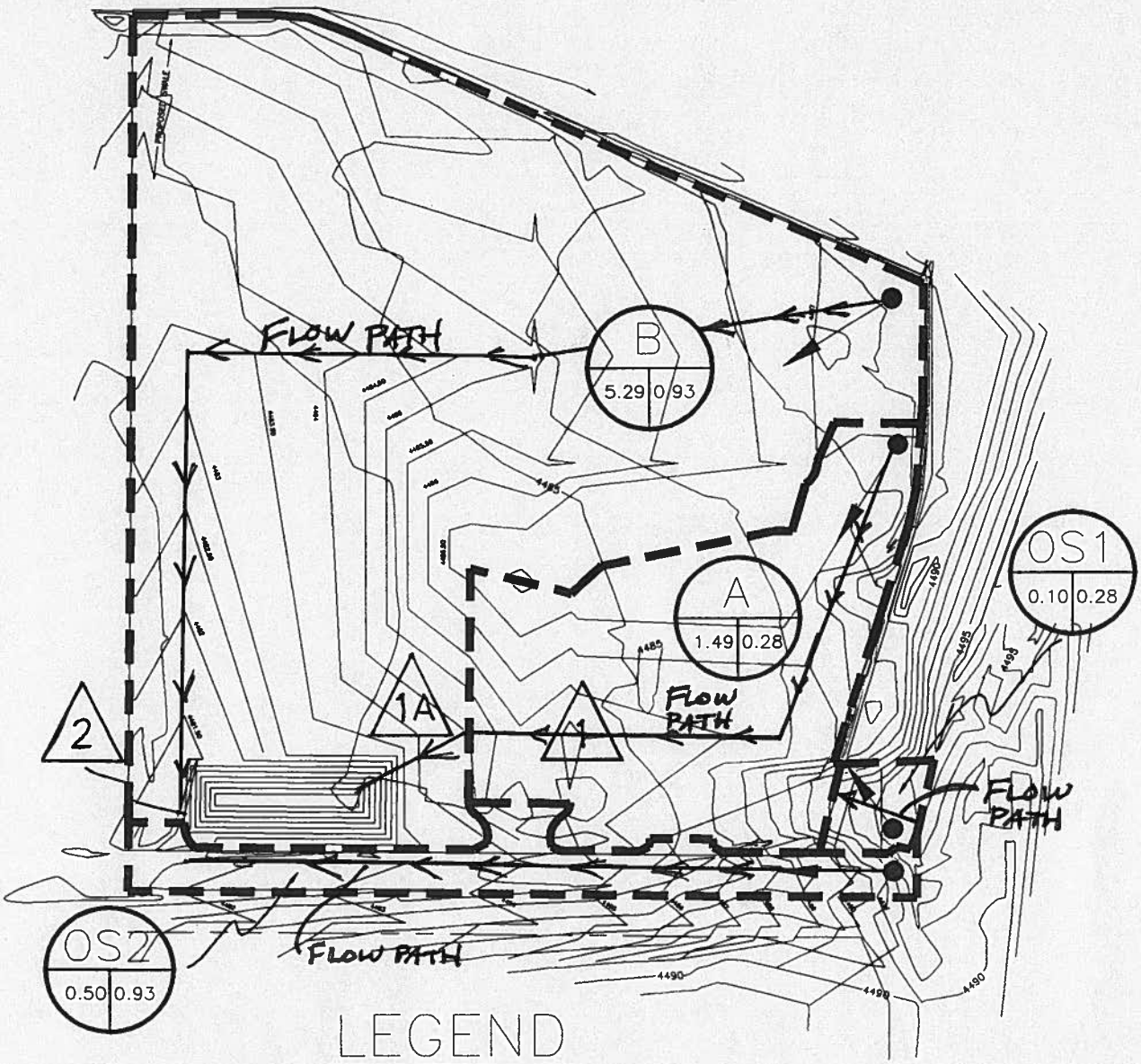
ORIGIN OF FLOW

1

DESIGN POINT

EXHIBIT 4.0

DEVELOPED BASIN MAP



LEGEND

A
5.29 0.28

SUB-BASIN DESIGNATION

AREA-ACRES | 2-YEAR RUN-OFF COEFFICIENT

SUB-BASIN BOUNDARY

ORIGIN OF FLOW

1

DESIGN POINT

EXHIBIT 5.0

LAND USE OR SURFACE CHARACTERISTICS	SCS HYDROLOGIC SOIL GROUP (SEE APPENDIX "C" FOR DESCRIPTIONS)											
	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
UNDEVELOPED AREAS												
Bare ground	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .40 - .48	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	.08 - .18 .14 - .24	.13 - .23 .18 - .28	.16 - .26 .22 - .32	.11 - .19 .16 - .24	.15 - .23 .21 - .29	.21 - .29 .28 - .36	.14 - .22 .20 - .28	.19 - .27 .25 - .33	.26 - .34 .34 - .42	.18 - .26 .24 - .32	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture (2 YR / 100 YR)	.12 - .22 .15 - .25	.20 - .30 .25 - .35	.30 - .40 .37 - .47	.18 - .26 .23 - .31	.28 - .36 .34 - .42	.37 - .45 .45 - .53	.24 - .32 .30 - .38	.34 - .42 .42 - .50	.44 - .52 .52 - .60	.30 - .38 .37 - .45	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .44 - .52	.24 - .32 .30 - .38	.32 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	.05 - .15 .08 - .18	.08 - .18 .11 - .21	.11 - .21 .14 - .24	.08 - .16 .10 - .18	.11 - .19 .14 - .22	.14 - .22 .18 - .26	.10 - .18 .12 - .20	.13 - .21 .16 - .24	.16 - .24 .20 - .28	.12 - .20 .15 - .23	.16 - .24 .20 - .28	.20 - .28 .25 - .33
RESIDENTIAL AREAS												
1/8 acre per unit	.40 - .50 .48 - .58	.43 - .53 .52 - .62	.46 - .56 .55 - .65	.42 - .50 .50 - .58	.45 - .53 .54 - .62	.50 - .58 .59 - .67	.45 - .53 .53 - .61	.48 - .56 .57 - .65	.53 - .61 .64 - .72	.48 - .56 .56 - .64	.51 - .59 .60 - .68	.57 - .65 .69 - .77
1/4 acre per unit	.27 - .37 .35 - .45	.31 - .41 .39 - .49	.34 - .44 .42 - .52	.29 - .37 .38 - .46	.34 - .42 .42 - .50	.38 - .46 .47 - .55	.32 - .40 .41 - .49	.36 - .44 .45 - .53	.41 - .49 .52 - .60	.35 - .43 .43 - .51	.39 - .47 .47 - .55	.45 - .53 .57 - .65
1/3 acre per unit	.22 - .32 .31 - .41	.26 - .36 .35 - .45	.29 - .39 .38 - .48	.25 - .33 .33 - .41	.29 - .37 .38 - .46	.33 - .41 .42 - .50	.28 - .36 .36 - .44	.32 - .40 .41 - .49	.37 - .45 .48 - .56	.31 - .39 .39 - .47	.35 - .43 .43 - .51	.42 - .50 .53 - .61
1/2 acre per unit	.16 - .26 .25 - .35	.20 - .30 .29 - .39	.24 - .34 .32 - .42	.19 - .27 .28 - .36	.23 - .31 .32 - .40	.28 - .36 .36 - .44	.22 - .30 .31 - .39	.27 - .35 .35 - .43	.32 - .40 .42 - .50	.26 - .34 .34 - .42	.30 - .38 .38 - .46	.37 - .45 .48 - .56
1 acre per unit	.14 - .24 .22 - .32	.19 - .29 .26 - .36	.22 - .32 .29 - .39	.17 - .25 .24 - .32	.21 - .29 .28 - .36	.26 - .34 .34 - .42	.20 - .28 .28 - .36	.25 - .33 .32 - .40	.31 - .39 .40 - .48	.24 - .32 .31 - .39	.29 - .37 .35 - .43	.35 - .43 .46 - .54
MISC. SURFACES												
Pavement and roofs (2 YR / 100 YR)	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97
Traffic areas (soil and gravel)	.55 - .65 .65 - .70	.60 - .70 .70 - .75	.64 - .74 .74 - .79	.60 - .68 .68 - .76	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.69 - .77 .77 - .85	.72 - .80 .80 - .87	.75 - .83 .82 - .89	.77 - .85 .84 - .92
Green landscaping (lawns, parks)	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .42 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Non-green and gravel landscaping	.30 - .40 .34 - .44	.36 - .46 .42 - .52	.45 - .55 .50 - .60	.45 - .55 .50 - .60	.42 - .50 .48 - .56	.50 - .58 .57 - .65	.40 - .48 .46 - .54	.48 - .56 .55 - .63	.56 - .64 .64 - .72	.44 - .52 .50 - .58	.50 - .58 .60 - .68	.60 - .68 .70 - .78
Cemeteries, playgrounds	.20 - .30 .24 - .34	.26 - .36 .32 - .42	.35 - .45 .40 - .50	.35 - .45 .40 - .50	.32 - .40 .38 - .46	.40 - .48 .47 - .55	.30 - .38 .36 - .44	.38 - .44 .45 - .53	.46 - .54 .54 - .62	.34 - .42 .40 - .48	.40 - .48 .50 - .58	.50 - .58 .60 - .68

NOTES:
1. Values above and below pertain to the 2-year and 100-year storms, respectively.
2. The range of values provided allows for engineering judgement of site conditions such as basic shape, homogeneity of surface type, surface depression storage, and storm duration. In general, during shorter duration storms (Tc ≤ 10 minutes), infiltration capacity is higher, allowing use of a "C" value in the low range. Conversely, for longer duration storms (Tc) 30 minutes), use a ""C value in the higher range.
3. For residential development at less than 1/8 acre per unit or greater than 1 acre per unit, and also for commercial and industrial areas, use values under MISC SURFACES to estimate "C" value ranges for use.

RATIONAL METHOD RUNOFF COEFFICIENTS
(Modified from Table 4, UC-Davis, which appears to be a modification of work done by Rawls)

TABLE "B-1"

EXHIBIT 6.0

"C": RUNOFF COEFFICIENTS

HYDRO GROUP "C"
0-2% SLOPES

2YEAR HISTORIC

BASIN H1:	0.32	PASTURE
OS1:	0.72	GRAVEL ROAD
OS2:	0.72	GRAVEL ROAD

100YEAR HISTORIC

BASIN H1:	0.38	PASTURE
OS1:	0.80	GRAVEL ROAD
OS2:	0.80	GRAVEL ROAD

2YEAR DEVELOPED

BASIN A:	0.28	GREEN LANDSCAPING
B:	0.93	PAVEMENT
OS1:	0.28	BARE GROUND
OS2:	0.93	PAVEMENT

100YEAR DEVELOPED

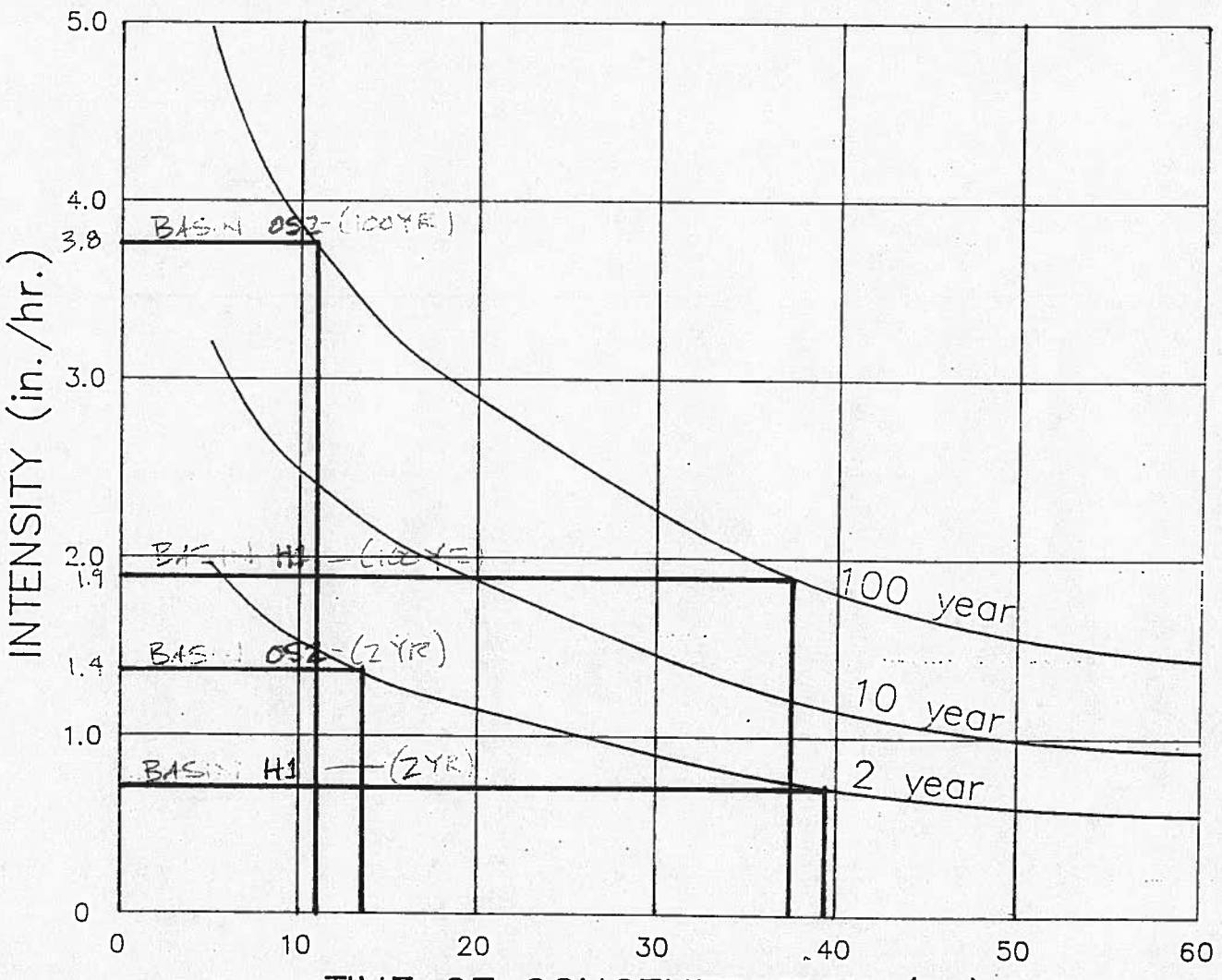
BASIN A:	0.34	GREEN LANDSCAPING
B:	0.95	PAVEMENT
OS1:	0.34	BARE GROUN
OS2:	0.95	PAVEMENT

EXHIBIT 7.0

MESA COUNTY
STORM DRAINAGE CRITERIAL MANUAL

FIGURE 401a

INTENSITY DURATION FREQUENCY CURVES
MESA COUNTY, COLORADO

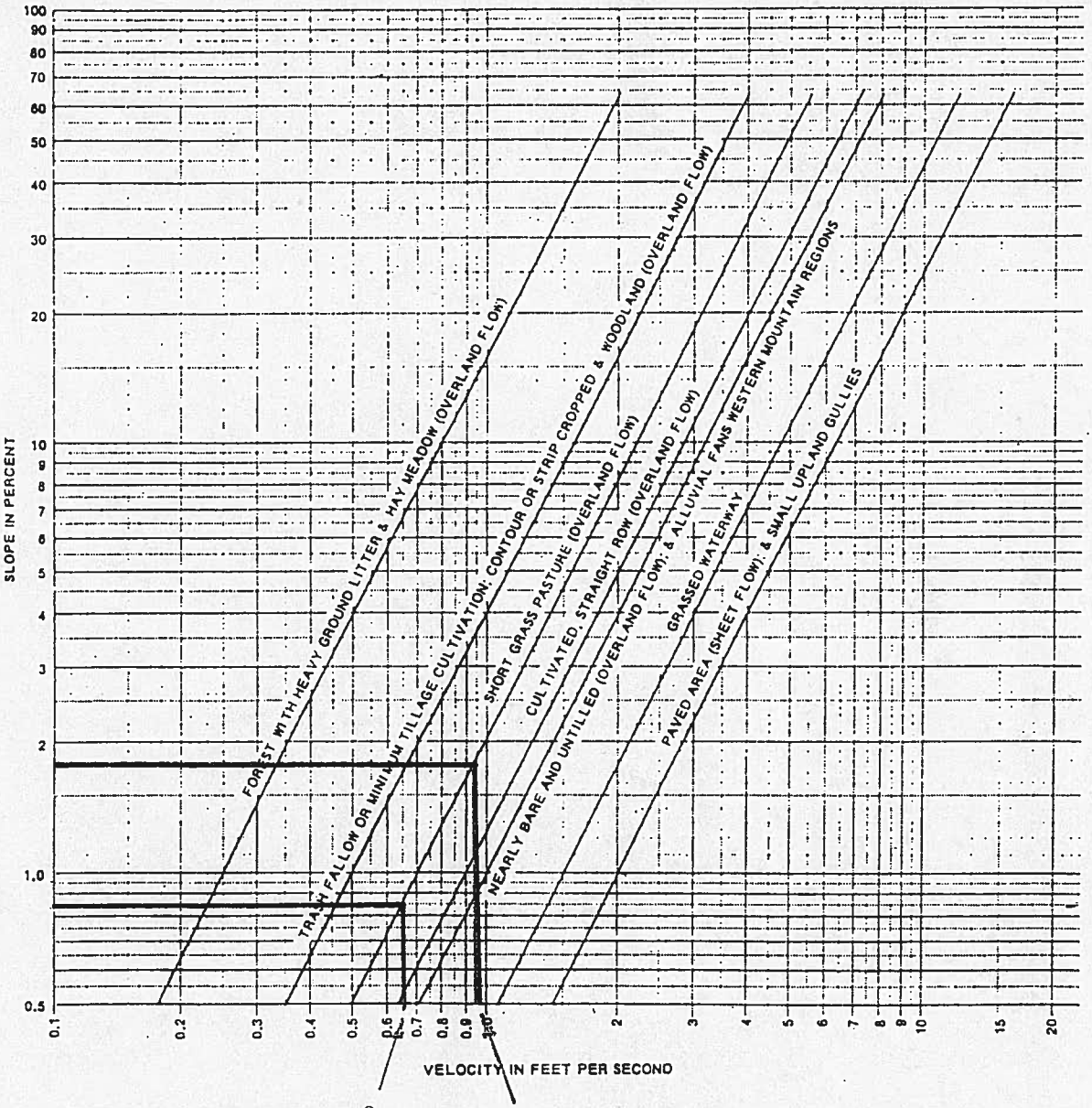


BASIN 'OS1'
$T_c < 5$ MIN
THEREFORE
$I = 5.0$ IN/HR

EXHIBIT 8.0

MESA COUNTY
STORM DRAINAGE CRITERIAL MANUAL

FIGURE 402



$0.65 f_p$ (BASIN H1)

$0.95 f_p$ (BASIN OS2)

AVERAGE VELOCITIES FOR OVERLAND FLOW

EXHIBIT 9.0

TIME OF CONCENTRATION CALCULATIONS

(2 YEAR STORM EVENT)
HISTORIC CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

DATE:
13-Dec-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME TIME (Tt)				INITIAL	Tc CHECK (URBANIZED BASINS)		FINAL	REMARKS
BASIN	C 2	AREA AC.	LENGTH FT.	SLOPE %	Ti MIN.	LENGTH FT.	SLOPE %	VEL F.P.S.	Tt MIN.	Tc MIN.	TOTAL LENGTH FT.	Tc = (L/180)+10 MIN.	Tc MIN.	
H1	0.32	6.75	500.0	0.82	33.54									OVERLAND FLOW UNDEVELOPED
						230.00	0.82	0.65	5.90	39.44	730.00	--	39.44	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS1	0.72	0.10	80.0	6.25	3.32									OVERLAND FLOW UNDEVELOPED
						0.00	0.00	0.00	0.00	3.32	80.00	--	3.32	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS2	0.72	0.50	500.0	1.83	12.50									OVERLAND FLOW UNDEVELOPED
						75.00	1.83	0.95	1.32	13.82	575.00	--	13.82	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

FORMULAS

$$Ti = \frac{1.8(1.1-C)(L)^{1/2}}{S^{1/3}} \qquad Tt = \frac{(L)}{60 \text{ SEC/MIN. (V F.P.S.)}}$$

EXHIBIT 10.0

TIME OF CONCENTRATION CALCULATIONS

(100 YEAR STORM EVENT)
HISTORIC CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

DATE:
13-Dec-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME TIME (Tt)				INITIAL	Tc CHECK (URBANIZED BASINS)		FINAL Tc	REMARKS
BASIN	C 100	AREA AC.	LENGTH FT.	SLOPE %	TI MIN.	LENGTH FT.	SLOPE %	VEL F.P.S.	Tt MIN.	Tc MIN.	TOTAL LENGTH FT.	Tc = (L/180)+10 MIN.	MIN.	
H1	0.38	6.75	500.0	0.82	30.96									OVERLAND FLOW UNDEVELOPED
						230.00	0.82	0.65	5.90	36.86	730.00	--	36.86	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS1	0.80	0.10	80.0	6.25	2.62									OVERLAND FLOW UNDEVELOPED
						0.00	0.00	0.00	0.00	2.62	80.00	--	2.62	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS2	0.80	0.50	500.0	1.83	9.87									OVERLAND FLOW UNDEVELOPED
						75.00	1.83	0.95	1.32	11.19	575.00	--	11.19	TO SW CORNER OF SITE
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

FORMULAS

$$Ti = \frac{1.8(1.1-C)(L)^{1/2}}{S^{1/3}} \qquad Tt = \frac{(L)}{60 \text{ SEC/MIN. } (V \text{ F.P.S.})}$$

EXHIBIT 11.0

STORM DRAINAGE SYSTEM DESIGN DATA

(2 YEAR STORM EVENT)
HISTORIC CONDITION - MESA COUNTY, COLORADO

DATE: 13-Dec-95

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

LOCATION OR NODE	BASINS	LENGTH FEET	INLET TIME min.	FLOW STREET	TIME PIPE	Tc min.	COEFF. "C"	INTENSITY "I"	AREA "A" AC.	DIRECT RUNOFF C.F.S.	OTHER RUNOFF C.F.S.	SUM RUNOFF C.F.S.	STREET SLOPE %	STREET CAPACITY ALLOWED C.F.S.	PIPE SLOPE %	PIPE SIZE IN.	PIPE CAPACITY ALLOWED C.F.S.	STREET DESIGN F.P.S.	STREET VELOC. F.P.S.	PIPE DESIGN F.P.S.	PIPE VELOC. F.P.S.	REMARKS
1	H1					39.44	0.32	0.70	6.75	1.5		**1.5**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
1	OS1					3.32	0.72	5.00	0.10	0.4		**0.4**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
2	OS2					13.82	0.72	1.40	0.50	0.5		**0.6**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
												2.4	TOTAL									

STORM DRAINAGE SYSTEM DESIGN DATA

(100 YEAR STORM EVENT)
HISTORIC CONDITION - MESA COUNTY, COLORADO

DATE: 13-Dec-95

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

LOCATION OR NODE	BASINS	LENGTH FEET	INLET TIME min.	FLOW STREET	TIME PIPE	Tc min.	COEFF. "C"	INTENSITY "I"	AREA "A" AC.	DIRECT RUNOFF C.F.S.	OTHER RUNOFF C.F.S.	SUM RUNOFF C.F.S.	STREET SLOPE %	STREET CAPACITY ALLOWED C.F.S.	PIPE SLOPE %	PIPE SIZE IN.	PIPE CAPACITY ALLOWED C.F.S.	STREET DESIGN F.P.S.	STREET VELOC. F.P.S.	PIPE DESIGN F.P.S.	PIPE VELOC. F.P.S.	REMARKS
1	H1					36.86	0.38	1.90	6.75	4.9		**4.9**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
1	OS1					2.62	0.80	5.00	0.10	0.4		**0.4**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
2	OS2					11.19	0.80	3.80	0.50	1.5		**1.5**										OVERLAND FLOW UNDEVELOPED TO THE SW CORNER OF THE SITE
												6.8	TOTAL									

EXHIBIT 12.0

MESA COUNTY
STORM DRAINAGE CRITERIAL MANUAL

FIGURE 401a

INTENSITY DURATION FREQUENCY CURVES
MESA COUNTY, COLORADO

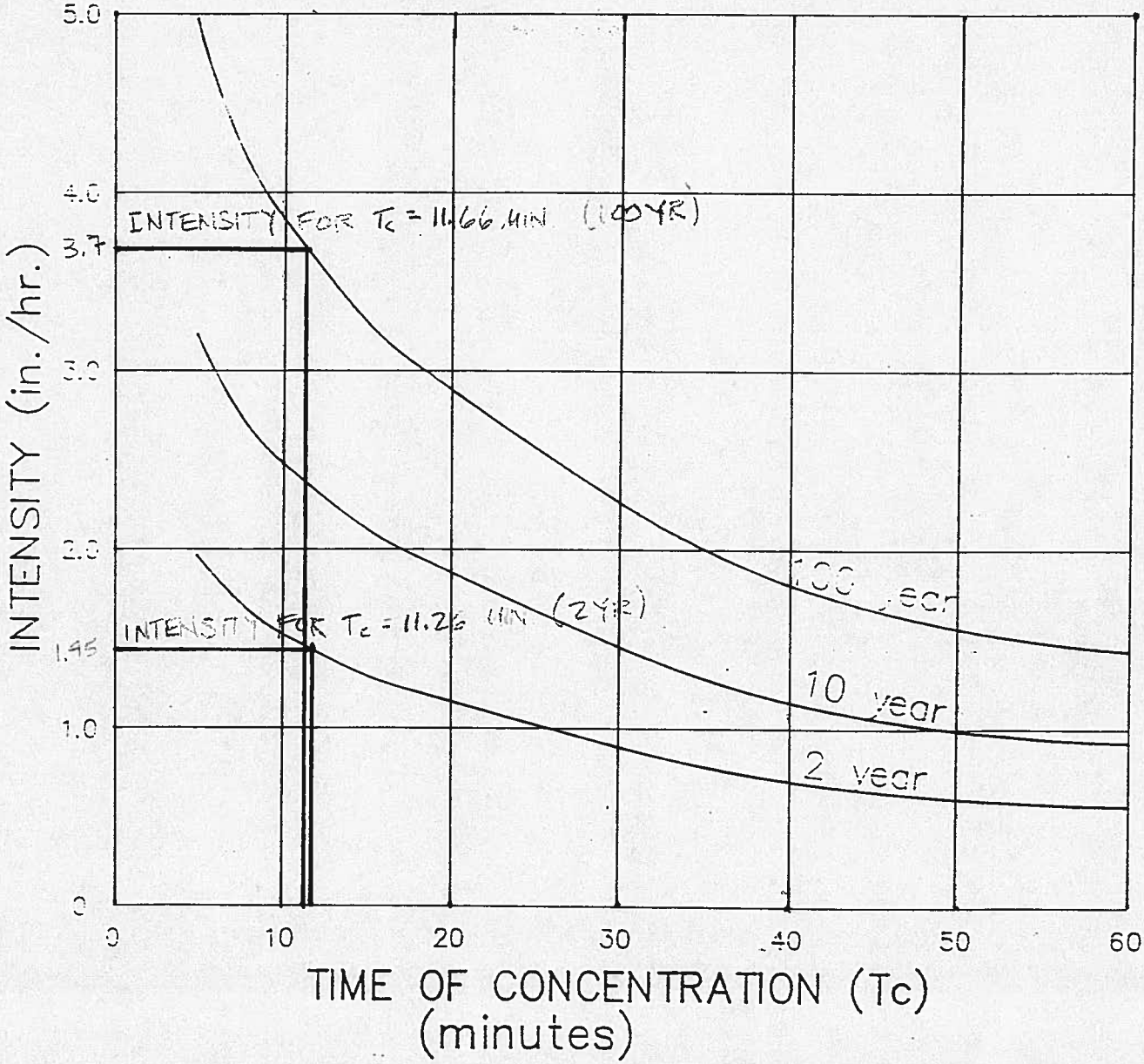
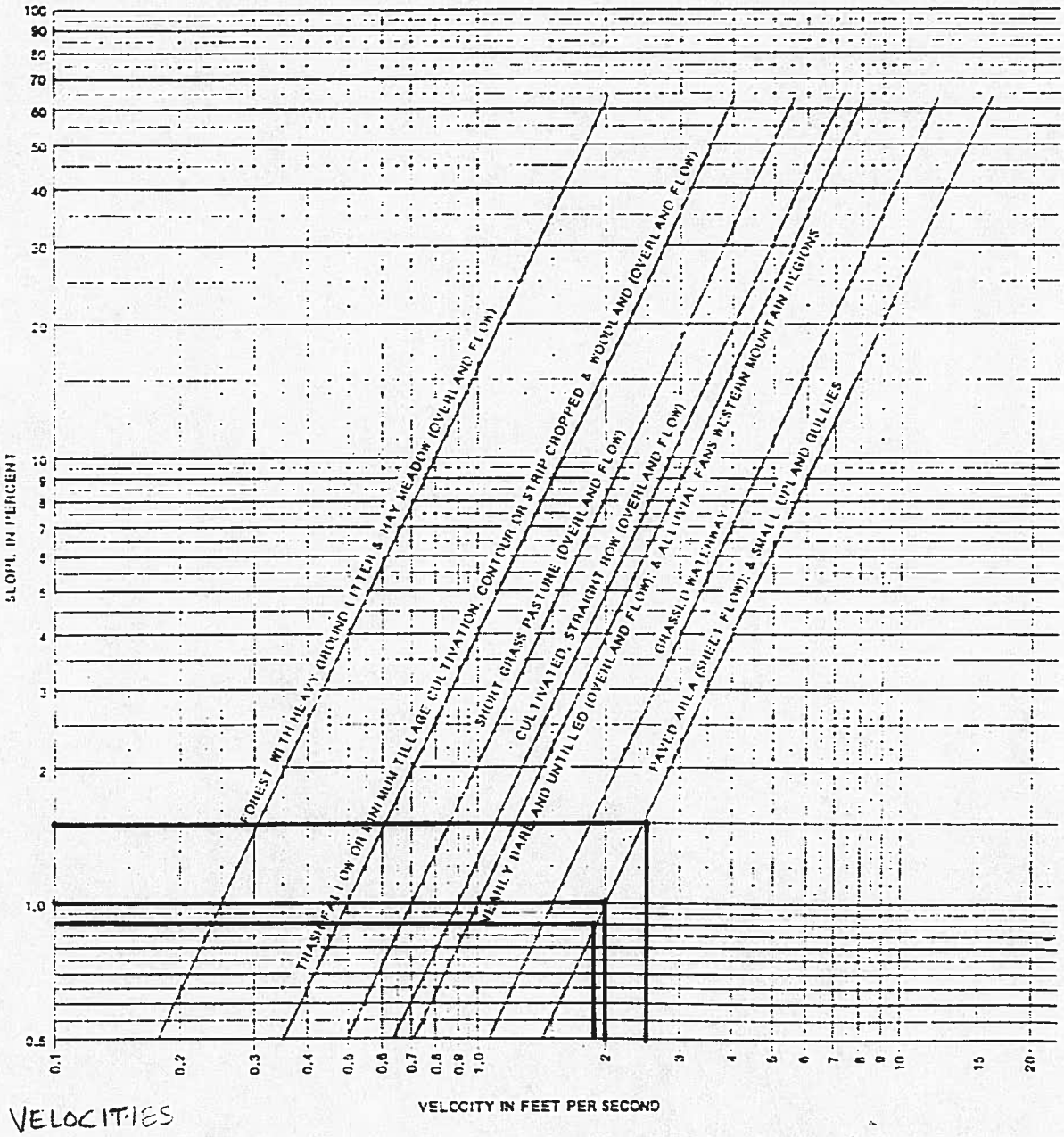


EXHIBIT 13.0

MESA COUNTY
STORM DRAINAGE CRITERIAL MANUAL

FIGURE 402



VELOCITIES

BASIN A: 2.50 fps | BASIN B: 1.90 fps | BASIN OS1: 2.90 fps

AVERAGE VELOCITIES
FOR OVERLAND FLOW

EXHIBIT 14.0

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO V-PAN

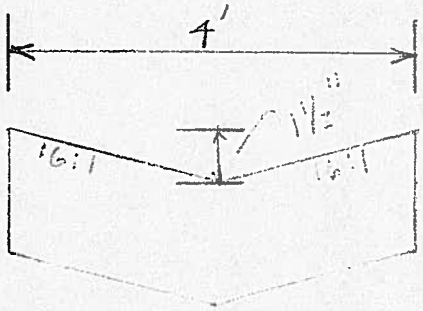
Solve For Discharge

Given Input Data:

Left Side Slope..	16.00:1 (H:V)
Right Side Slope.	16.00:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0065 ft/ft ← 0.65% SLOPE
Depth.....	0.13 ft

Computed Results:

Discharge.....	0.35 cfs
Velocity.....	1.29 fps
Flow Area.....	0.27 sf
Flow Top Width...	4.16 ft
Wetted Perimeter.	4.17 ft
Critical Depth...	0.12 ft
Critical Slope...	0.0083 ft/ft
Froude Number....	0.89 (flow is Subcritical)



V-PAN FOR
SASH B

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 15.0

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO V-PAN

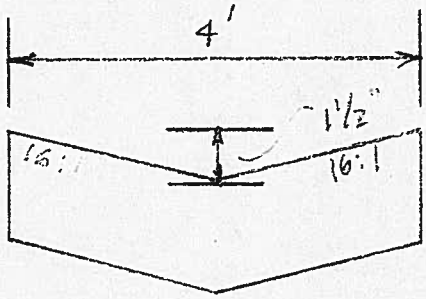
Solve For Discharge

Given Input Data:

Left Side Slope..	16.00:1 (H:V)
Right Side Slope.	16.00:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0050 ft/ft ← 0.50% SLOPE
Depth.....	0.13 ft

Computed Results:

Discharge.....	0.31 cfs
Velocity.....	1.13 fps
Flow Area.....	0.27 sf
Flow Top Width...	4.16 ft
Wetted Perimeter.	4.17 ft
Critical Depth...	0.12 ft
Critical Slope...	0.0085 ft/ft
Froude Number....	0.78 (flow is Subcritical)



V-P[illegible] FOR
BAS[illegible] A"

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 16.0

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: OFF SITE BASIN TRAVEL TIME

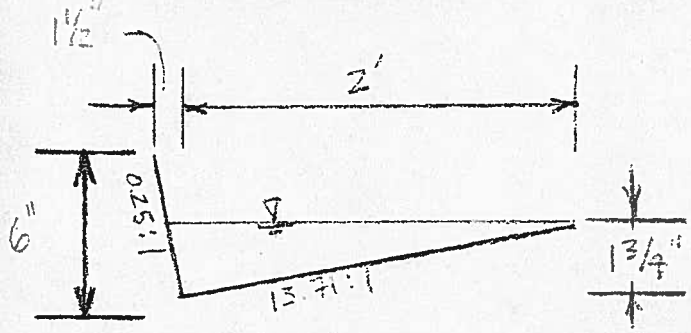
Solve For Discharge

Given Input Data:

Left Side Slope..	13.71:1 (H:V)
Right Side Slope.	0.25:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0181 ft/ft
Depth.....	0.15 ft

Computed Results:

Discharge.....	0.36 cfs
Velocity.....	2.28 fps ← OSD CURB & GUTTER VELOCITY
Flow Area.....	0.16 sf
Flow Top Width...	2.09 ft
Wetted Perimeter.	2.22 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0080 ft/ft
Froude Number....	1.47 (flow is Supercritical)



AVERAGE SLOPE 1.81%

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 17.0

TIME OF CONCENTRATION CALCULATIONS

(2 YEAR STORM EVENT)
DEVELOPED CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

DATE:
28-Dec-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME TIME (Tt)				INITIAL	Tc CHECK (URBANIZED BASINS)		FINAL Tc	REMARKS
BASIN	C 2	AREA AC.	LENGTH FT.	SLOPE %	Ti MIN.	LENGTH FT.	SLOPE %	VEL F.P.S.	Tt MIN.	Tc MIN.	TOTAL LENGTH FT.	Tc = (L/180)+10 MIN.	MIN.	
A	0.28	1.49	26.0	2.65	5.44									OVERLAND SHEETFLOW ACROSS TURF
						12.0	1.50	2.50	0.08	5.52	38.00	10.21	5.52	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--		--	--	--	--	--	--	--	---
B	0.93	5.29	10.0	15.00	0.39									OVERLAND SHEETFLOW ACROSS TURF
						275.0	0.91	1.90	2.41	2.80	285.00	11.58	2.80	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--	--	--	--	--	--	--	--	--	---
OS1	0.28	0.10	80.0	6.90	6.93									OVERLAND SHEETFLOW ACROSS TURF
						40.0	0.98	2.00	0.33	7.27	120.00	10.67	7.27	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--	--	--	--	--	--	--	--	--	---
OS2	0.93	0.50	--	--	--									CURB AND GUTTER FLOW
						575.0	1.81	2.28	4.20	4.20	575.00	13.19	4.20	
--	--	--	--	--	--	--	--	--	--	--	--	--	--	---

FORMULAS

$$Ti = \frac{1.8(1.1-C)(L)^{1/2}}{S^{1/3}} \qquad Tt = \frac{(L)}{60 \text{ SEC/MIN. } (V \text{ F.P.S.})}$$

EXHIBIT 18.0

STORM DRAINAGE SYSTEM DESIGN DATA

(2 YEAR STORM EVENT)
DEVELOPED CONDITION - MESA COUNTY, COLORADO

DATE:
28-Dec-95

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

LOCATION OR NODE	BASINS	LENGTH FEET	INLET TIME min.	FLOW STREET	TIME PIPE	Tc min.	COEFF. "C"	INTENSITY "I"	AREA "A" AC.	DIRECT RUNOFF C.F.S.	OTHER RUNOFF C.F.S.	SUM RUNOFF C.F.S.	STREET SLOPE %	STREET CAPACITY ALLOWED C.F.S.	PIPE SLOPE %	PIPE SIZE IN.	PIPE CAPACITY ALLOWED C.F.S.	STREET DESIGN F.P.S.	STREET VELOC. F.P.S.	PIPE DESIGN F.P.S.	PIPE VELOC. F.P.S.	REMARKS
						5.52																OVERLAND FLOW FROM NE CORNER OF BASIN A
1	A												0.50	V-PAN					1.13			FLOW FROM START OF V-PAN IN BASIN A, 373FT
		373.0		5.50		5.50																
						11.02	0.93	1.50	1.49	2.1		**2.1**										
						7.27																OVERLAND FLOW FROM OS1 TO V-PAN
1	OS1																					OVERLAND FLOW FROM END OS1 TO V-PAN
		153.0		2.26		2.26																
						9.53	0.93	1.55	0.10	0.1		**0.1**										
						5.52																OVERLAND FLOW FROM NE CORNER OF BASIN A
1	OS1																					
	A	220.0		3.24		3.24			0.10				0.50	V-PAN					1.13			FLOW FROM START OF V-PAN IN BASIN A, 220FT
		153.0		2.26		2.26			1.49				0.50	V-PAN					1.13			FLOW IN V-PAN FOR LAST 153FT TO INLET
						11.02	0.93	1.55	1.59	2.3		**2.3**										
						11.02			0.10													
1A	OS1																					
	A	150.0			0.64	0.64			1.49				1.00	18" PIPE							5.44	FLOW FROM PIPE TO DETENTION POND
						11.66	0.93	1.45	1.59	2.1		**2.1**										
						2.80																OVERLAND FLOW FROM NE CORNER OF BASIN B
2	B																					
		478.0		6.18		6.18							0.65	V-PAN					1.29			FLOW FROM V-PAN INTERSECTION TO INLET
						8.98	0.93	1.60	5.29	7.9		**7.9**										
2	OS2																					
						4.20	0.93	1.85	0.50	0.9		**0.9**	1.81	C&G					2.28			FLOW FROM NORTHEAST CORNER OF BASIN B

EXHIBIT 19.0

TIME OF CONCENTRATION CALCULATIONS

(100 YEAR STORM EVENT)
DEVELOPED CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

DATE:
15-Dec-95

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME TIME (Tt)				INITIAL	Tc CHECK (URBANIZED BASINS)		FINAL Tc	REMARKS
BASIN	C 100	AREA AC.	LENGTH FT.	SLOPE %	Ti MIN.	LENGTH FT.	SLOPE %	VEL F.P.S.	Tt MIN.	Tc MIN.	TOTAL LENGTH FT.	Tc = (L/180)+10 MIN.	MIN.	
A	0.34	1.49	26.0	2.65	5.04									OVERLAND SHEETFLOW ACROSS TURF
						12.0	1.50	2.50	0.08	5.12	38.00	10.21	5.12	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
B	0.95	5.29	10.0	15.00	0.35									OVERLAND SHEETFLOW ACROSS TURF
						275.0	0.91	1.90	2.41	2.76	285.00	11.58	2.76	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS1	0.34	0.10	80.0	6.90	6.43									OVERLAND SHEETFLOW ACROSS TURF
						40.0	0.98	2.00	0.33	6.76	120.00	10.67	6.76	AREA AND PAVEMENT TO V-PAN @ LOW PT
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----
OS2	0.95	0.50	--	--	--									CURB AND GUTTER FLOW
						575.0	1.81	2.28	4.20	4.20	575.00	13.19	4.20	
--	--	--	--	--	--	--	--	--	--	--	--	--	--	----

FORMULAS

$$Ti = \frac{1.8(1.1-C)(L)^{1/2}}{S^{1/3}} \qquad Tt = \frac{(L)}{60 \text{ SEC/MIN. } (V \text{ F.P.S.})}$$

EXHIBIT 20.0

STORM DRAINAGE SYSTEM DESIGN DATA

(100 YEAR STORM EVENT)
DEVELOPED CONDITION - MESA COUNTY, COLORADO

DATE:
28-Dec-95

PROJECT: LOCO OIL FOOD STORE
JOB # 94-038
LANDesign LTD.

													STREET		PIPE			STREET		PIPE		
LOCATION OR NODE	BASINS	LENGTH FEET	INLET TIME min.	FLOW STREET	TIME PIPE	Tc min.	COEFF. "C"	INTENSITY "I"	AREA "A" AC.	DIRECT RUNOFF C.F.S.	OTHER RUNOFF C.F.S.	SUM RUNOFF C.F.S.	SLOPE %	CAPACITY ALLOWED C.F.S.	SLOPE %	SIZE IN.	CAPACITY ALLOWED C.F.S.	DESIGN F.P.S.	VELOC. F.P.S.	DESIGN F.P.S.	VELOC. F.P.S.	REMARKS
						5.12																OVERLAND FLOW FROM NE CORNER OF BASIN A
1	A					5.50							0.50	V-PAN					1.13			FLOW FROM START OF V-PAN IN BASIN A, 373FT
		373.0		5.50		10.62	0.95	3.80	1.49	5.4		**5.4**										
						6.76																OVERLAND FLOW FROM OS1 TO V-PAN
1	OS1					2.26																OVERLAND FLOW FROM END OS1 TO V-PAN
		153.0		2.26		9.02	0.95	4.00	0.10	0.4		**0.4**										
						5.12																OVERLAND FLOW FROM NE CORNER OF BASIN A
1	OS1					3.24			0.10				0.50	V-PAN					1.13			FLOW FROM START OF V-PAN IN BASIN A, 220FT
	A	220.0		3.24		2.26			1.49				0.50	V-PAN					1.13			FLOW IN V-PAN FOR LAST 153FT TO INLET
		153.0		2.26		10.62	0.95	3.80	1.59	5.7		**5.7**										
						10.62			0.10													FLOW FROM INLET TO DETENTION POND
1A	OS1					0.64			1.49													
	A	150.0			0.64	11.26	0.95	3.70	1.59	5.6		**5.6**	1.00	18" PIPE							5.44	
						2.76																OVERLAND FLOW FROM NE CORNER OF BASIN B
2	B					6.18							0.65	V-PAN					1.29			FLOW FROM V-PAN INTERSECTION TO INLET
		478.0		6.18		8.94	0.95	4.00	5.29	20.1		**20.1**										
2	OS2					4.20	0.95	5.00	0.50	2.4		**2.4**	1.8	C&G					2.28			FLOW FROM NORTHEAST CORNER OF BASIN B

EXHIBIT 21.0

INLET CALCULATIONS

DESIGN POINT #1 – TYPE "C" INLET (ELEV = 84.78)

OPEN AREA = 24" X 24" = 4 ft²

PONDING DEPTH = 0.38' (85.16 – 84.78)

FLOW PER SQ. FT. OF OPEN AREA = 3.10 CFS/FT² (SEE EXHIBIT

REDUCTION FACTOR = 0.50 (SEE EXHIBIT

Q = (4.0 FT²)(3.10 CFS/FT²)(0.50) = 6.20 CFS (REQ'D = 5.7 CFS)

DESIGN POINT #1A – SINGLE COMBINATION INLET (ELEV = 84.49)

OPEN AREA: GRATE = 17 3/4" X 33" = 4.07 ft² ~ 4.0 FT²

CURB OPENING LENGTH = 33" = 2.75'

PONDING DEPTH = 0.48' (84.80 – 84.32 ... 2" DEPRESSION DEPTH)

FLOW PER SQ. FT. OF OPEN AREA = 3.40 CFS/FT² (SEE EXHIBIT

FLOW PER FOOT OF LENGTH OF CURB OPENING = 0.9 CFS/FT

REDUCTION FACTOR = 0.65 (SEE EXHIBIT

Q = [(4.0 FT²)(3.4 CFS/FT²) + (2.75 FT)(0.9 CFS/FT)](0.65)

= 10.45 CFS (REQ'D = 5.7 CFS)

DESIGN POINT #2 – DOUBLE COMBINATION INLET (ELEV = 81.00)

OPEN AREA: GRATE = 2 X SINGLE COMB. = 8.0 FT²

CURB OPENING LENGTH = 2 X 2.75' = 5.50'

PONDING DEPTH = 0.59' (81.42 – 80.83 ... 2" DEPRESSION DEPTH)

FLOW PER SQ. FT. OF OPEN AREA = 3.7 CFS/FT² (SEE EXHIBIT

FLOW PER FOOT OF LENGTH OF CURB OPENING = 1.1 CFS/FT (SEE EXHIBIT

REDUCTION FACTOR = 0.65 (SEE EXHIBIT

Q = [(8.0 FT²)(3.7 CFS/FT²) + (5.5)(1.1)](0.65) =

= 23.2 CFS (REQ'D = 22.5 CFS)

EXHIBIT 22.0

TABLE 2-1
REDUCTION FACTORS TO APPLY TO INLETS

Condition (1)	Inlet Type (2)	Percentage of Theoretical Capacity Allowed (3)
Sump	Curb Opening	80%
Sump	Grated	50%
Sump	Combination	65%
Continuous Grade	Curb Opening	80%
Continuous Grade	Deflector	75%
Continuous Grade	Longitudinal Bar Grated	60%
Continuous Grade	Transverse Bar Grate or Longitudinal Bar Grate incorporating transverse bars	50%
Continuous Grade	Combination	110% of that listed for type of grate utilized

EXHIBIT 23.0

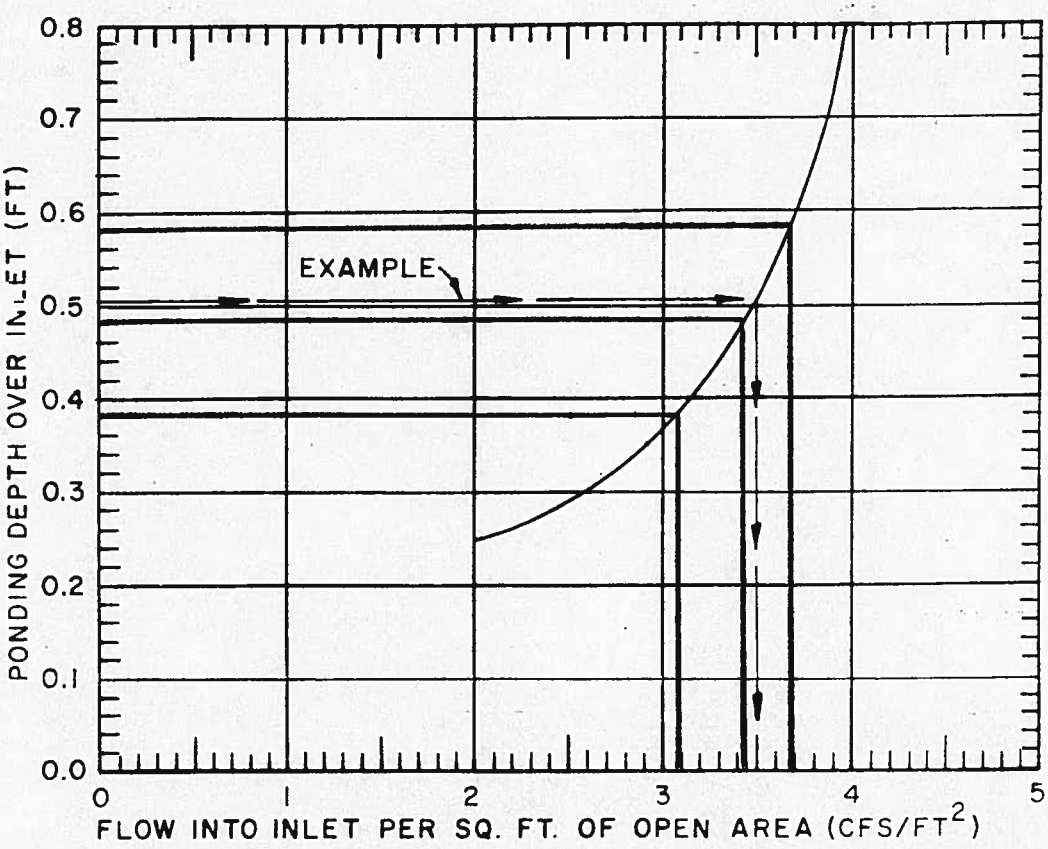


FIGURE 4-1. CAPACITY OF GRATED INLET IN SUMP

EXHIBIT 24.0

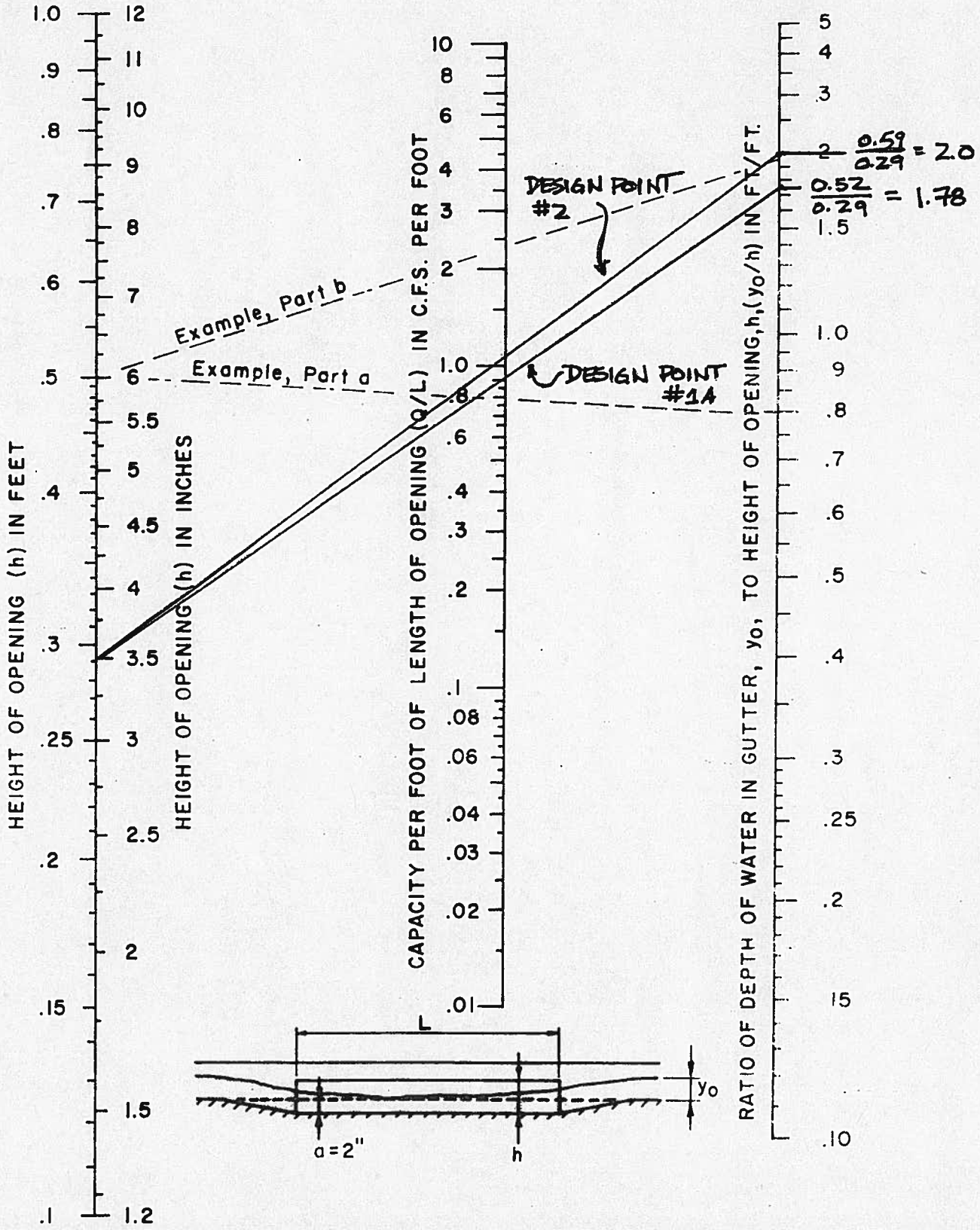
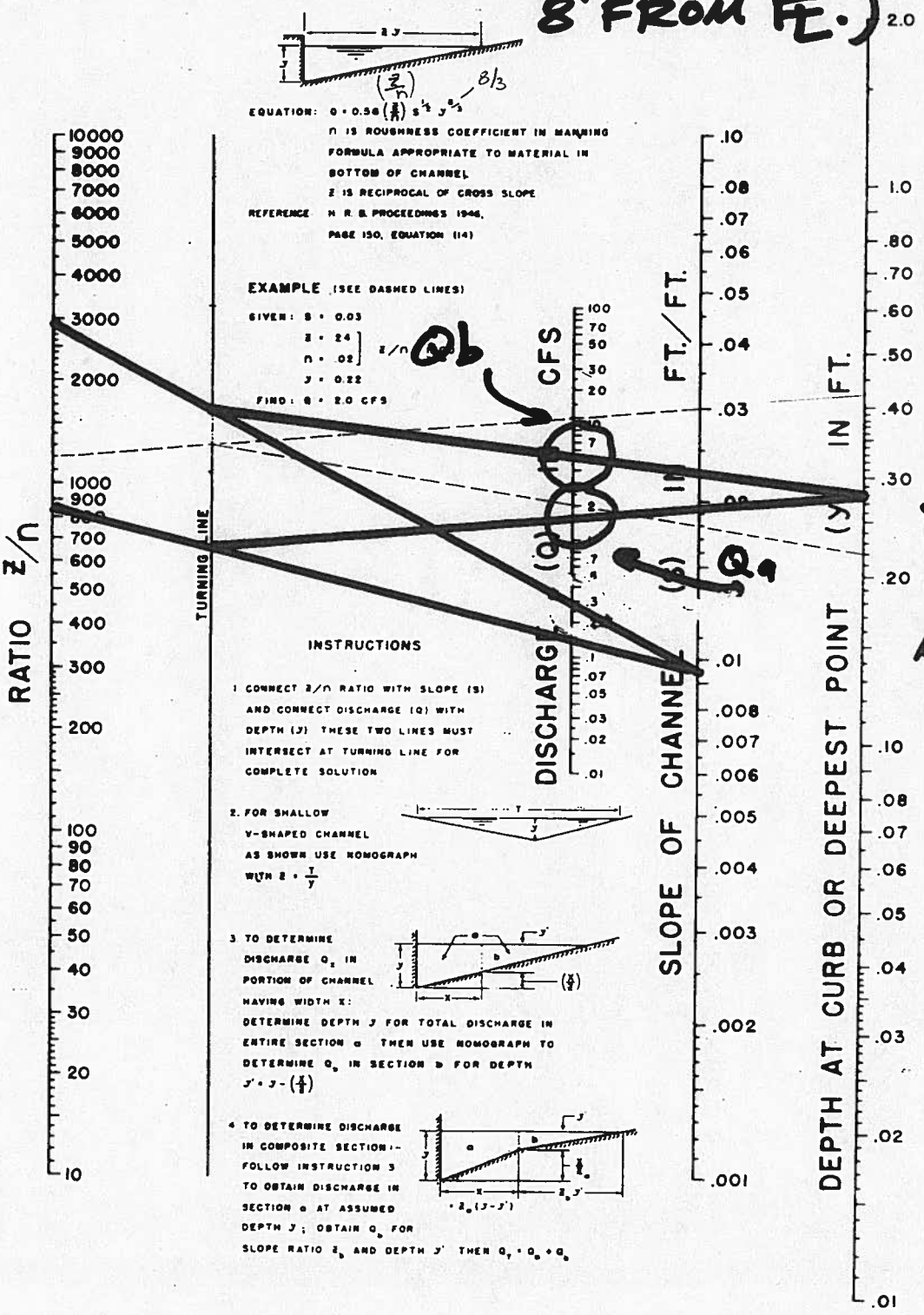


FIGURE 3-1. NOMOGRAPH FOR CAPACITY OF CURB OPENING INLETS IN SUMPS, DEPRESSION DEPTH 2"

Adapted from Bureau of Public Roads Nomograph.

EXHIBIT 25.0

GRAND AVE. CAPACITY (ASSUME INUDATION 8' FROM FE.)



$Q_T = Q_a + Q_b$

$Q_T = 1.5 + 5$

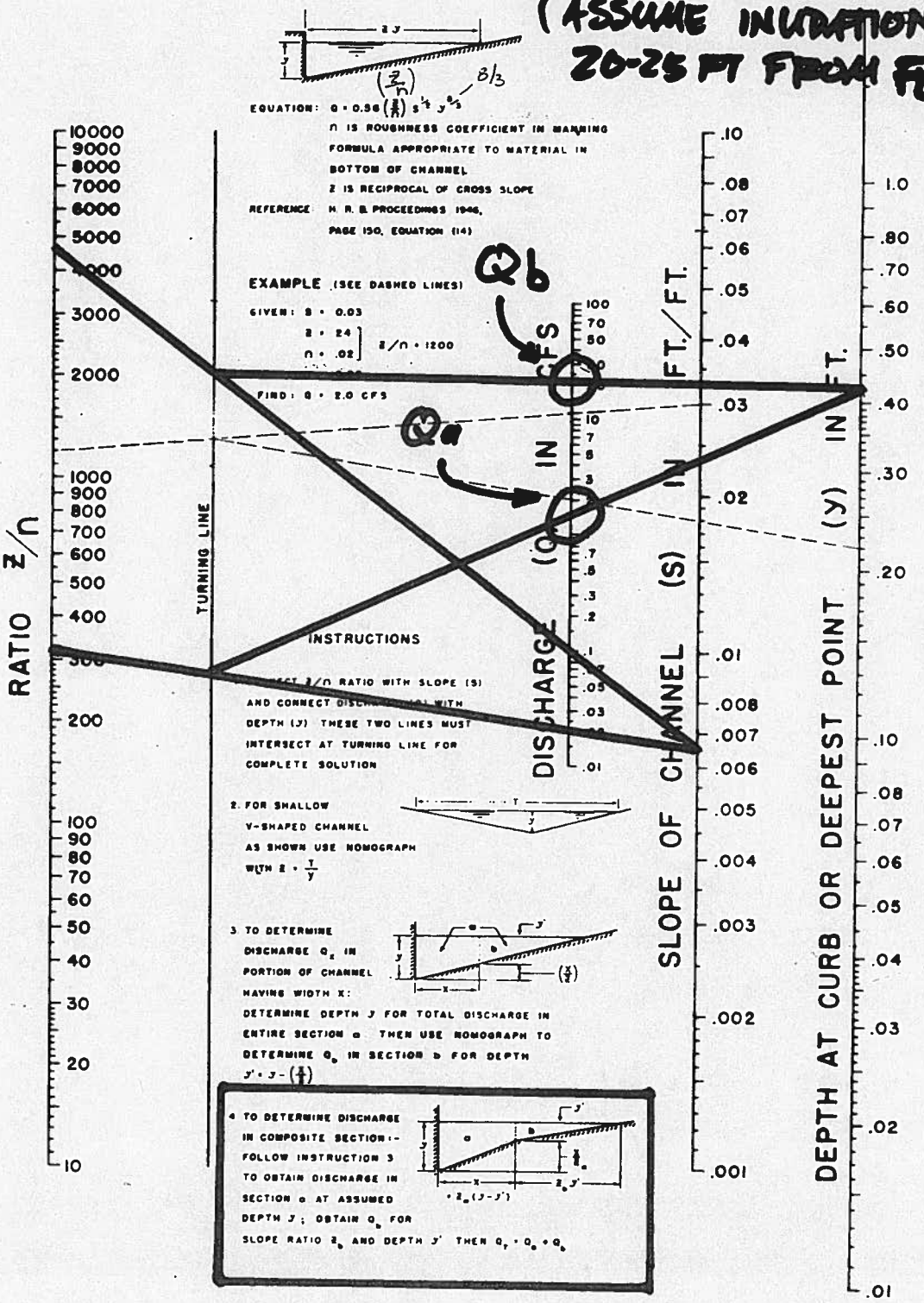
$= 6.5$ cfs

ASSUME n=0.016

FIGURE 6-1. NOMOGRAPH FOR FLOW IN TRIANGULAR GUTTERS.

EXHIBIT 26.0

WEST ENTRANCE/EXIT ROAD CAPACITY (ASSUME INUNDATION 20-25 FT FROM FE.)



$Q_T = Q_a + Q_b$

$Q_T =$

$1.5 + 22$

$= 23.5$ cfs

ASSUME $n = 0.016$

FIGURE 6-1. NOMOGRAPH FOR FLOW IN TRIANGULAR GUTTERS.

EXHIBIT 27.0

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: V-PAN IN DETENTION POND

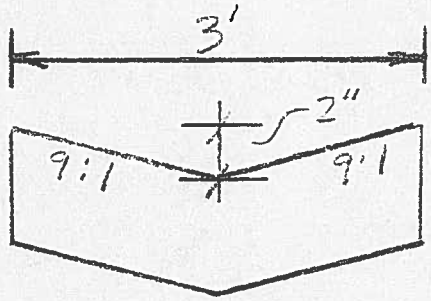
Solve For Discharge

Given Input Data:

Left Side Slope..	9.00:1 (H:V)
Right Side Slope.	9.00:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0050 ft/ft
Depth.....	0.17 ft

Computed Results:

Discharge.....	0.33 cfs ← 0,28 CFS REQ'D
Velocity.....	1.33 fps
Flow Area.....	0.25 sf
Flow Top Width...	3.01 ft
Wetted Perimeter.	3.02 ft
Critical Depth...	0.15 ft
Critical Slope...	0.0078 ft/ft
Froude Number....	0.81 (flow is Subcritical)



V-PAN IN DETENTION POND
(1% OF 100 YR STORM FLOW CAPACITY REQ'D)

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06

EXHIBIT 28.0

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO STORM SEWER

Solve For Actual Discharge

Given Input Data:

Diameter.....	1.50 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.015
Depth.....	1.50 ft

Computed Results:

Discharge.....	9.10 cfs
Velocity.....	5.15 fps
Flow Area.....	1.77 sf
Critical Depth....	1.17 ft
Critical Slope....	0.0111 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	9.10 cfs
QMAX @.94D.....	9.79 cfs
Froude Number.....	FULL

18" RCP FROM DESIGN POINT 1, TO DESIGN POINT 1A TO DETENTION POND.

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 29.0

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO STORM SEWER

Solve For Actual Discharge

Given Input Data:

Diameter.....	1.50 ft
Slope.....	0.0100 ft/ft
Manning's n.....	0.015
Depth.....	0.86 ft

Computed Results:

Discharge.....	5.70 cfs ← 100 YR FLOW
Velocity.....	5.44 fps
Flow Area.....	1.05 sf
Critical Depth....	0.92 ft
Critical Slope....	0.0081 ft/ft
Percent Full.....	57.33 %
Full Capacity.....	9.10 cfs
QMAX @.94D.....	9.79 cfs
Froude Number.....	1.14 (flow is Supercritical)

18" RCP FROM DESIGN POINT 1, TO DESIGN POINT 1A TO DETENTION POND, FLOWING @ 100YR RATE.

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 30.0

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO STORM SEWER

Solve For Actual Discharge

Given Input Data:

Diameter.....	2.00 ft
Slope.....	0.0161 ft/ft
Manning's n.....	0.015
Depth.....	2.00 ft

Computed Results:

Discharge.....	24.88 cfs
Velocity.....	7.92 fps
Flow Area.....	3.14 sf
Critical Depth....	1.76 ft
Critical Slope....	0.0145 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	24.88 cfs
QMAX @.94D.....	26.76 cfs
Froude Number.....	FULL

24" RCP FROM DESIGN POINT 2, TO DETENTION POND

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 31.0

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: LOCO DRAINAGE REPORT

Comment: LOCO STORM SEWER

Solve For Actual Discharge

Given Input Data:

Diameter.....	1.50 ft
Slope.....	0.0309 ft/ft
Manning's n.....	0.015
Depth.....	1.50 ft

Computed Results:

Discharge.....	16.00 cfs
Velocity.....	9.06 fps
Flow Area.....	1.77 sf
Critical Depth....	1.42 ft
Critical Slope....	0.0268 ft/ft
Percent Full.....	100.00 %
Full Capacity.....	16.00 cfs
QMAX @.94D.....	17.21 cfs
Froude Number.....	FULL

18" RCP FROM DETENTION POND OUTLET WORKS TO EXISTING STORM SEWER.

Open Channel Flow Module, Version 3.16 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

EXHIBIT 32.0

2 YEAR STORAGE VOLUME

DEVELOPED CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94038
LANDesign LTD.

SITE DESIGN DATA

I-D-F DATA FOR GRAND JUNCTION URBANIZED AREA

AREA AC. = 6.75
""C" = 0.93
Tc MIN. = 11.66
TYPE OF STORAGE = DETENTION
OUTFLOW = 2.40 CFS

*TIME TO BASIN PEAK

DURATION MIN.	INTENSITY "I" IN./HR.	"C" x "I" x "A"	BEGIN STORM MIN.	TIME TO BASIN PEAK MIN.	DURATION OF PEAK INFLOW MIN.	END OF STORM DURATION MIN.	TOTAL INFLOW C.F.	TOTAL OUTFLOW C.F.	TOTAL VOLUME REQUIRED C.F.	
5	1.96	----------		----------						
10	1.52	----------		----------						
11.66	1.49	9.353		11.66	0.00	23.32	6,543.7	2,926.8	3,617	
15	1.28	8.035	0	11.66	3.34	26.66	7,231.7	3,344.4	3,887	
30	0.89	5.587	0	11.66	18.34	41.66	10,056.6	5,275.4	4,781	MAX
60	0.56	3.515	0	11.66	48.34	71.66	12,655.4	9,170.6	3,485	
120	0.32	2.009	0	11.66	108.34	131.66	14,463.4	----------	OUTFLOW EXCEEDS	
180	0.23	1.444	0	11.66	168.34	191.66	15,593.3	----------	INFLOW	
360	0.13	0.816	0	11.66	348.34	371.66	17,627.2	----------		
720	0.07	0.439	0	11.66	708.34	731.66	18,983.2	----------		
1440	0.04	0.251	0	11.66	1428.34	1451.66	21,695.0	----------		

EXHIBIT 3.0

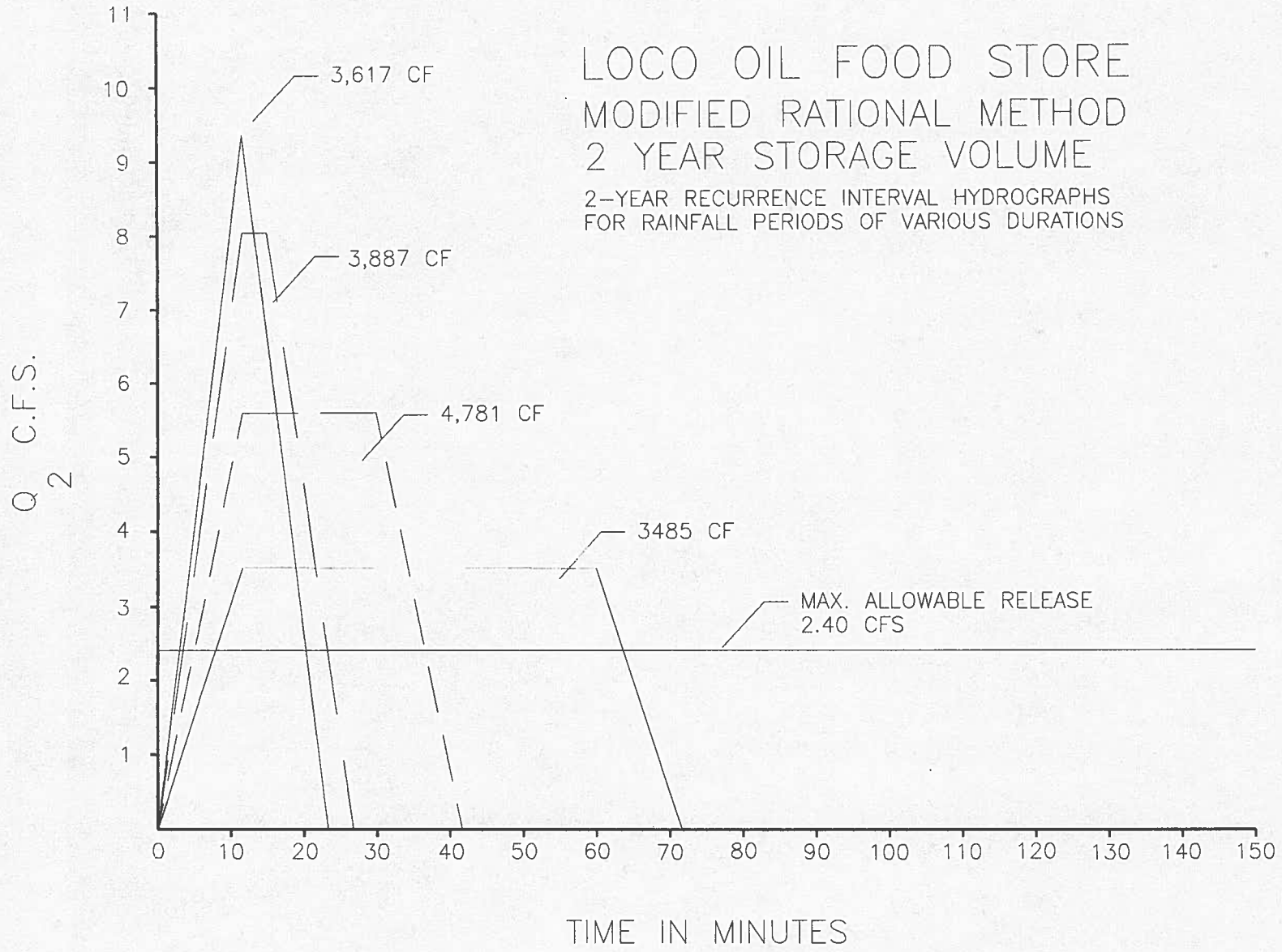

LOCO OIL FOOD STORE
MODIFIED RATIONAL METHOD
2 YEAR STORAGE VOLUME
2-YEAR RECURRENCE INTERVAL HYDROGRAPHS
FOR RAINFALL PERIODS OF VARIOUS DURATIONS
3,617 CF
3,887 CF
4,781 CF
3485 CF
MAX. ALLOWABLE RELEASE
2.40 CFS
Q C.F.S.
2
11
10
9
8
7
6
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
TIME IN MINUTES

EXHIBIT 34.0

100 YEAR STORAGE VOLUME

DEVELOPED CONDITION - MESA COUNTY, COLORADO

PROJECT: LOCO OIL FOOD STORE
JOB # 94038
LANDesign LTD.

SITE DESIGN DATA

I-D-F DATA FOR GRAND JUNCTION URBANIZED AREA

AREA AC. = 6.75
""C" = 0.95
Tc MIN. = 11.26
TYPE OF STORAGE = DETENTION
OUTFLOW = 6.80 CFS

*TIME TO BASIN PEAK

DURATION MIN.	INTENSITY "I" IN./HR.	"C" x "I" x "A"	BEGIN STORM MIN.	TIME TO BASIN PEAK MIN.	DURATION OF PEAK INFLOW MIN.	END OF STORM DURATION MIN.	TOTAL INFLOW C.F.	TOTAL OUTFLOW C.F.	TOTAL VOLUME REQUIRED C.F.	
5	4.97	----------		----------						
10	3.86	----------		----------						
11.26	3.83	24.560	0	11.26	0.00	22.52	16,592.7	7,915.0	8,678	
15	3.26	20.905	0	11.26	3.74	26.26	18,814.3	9,220.8	9,593	
30	2.26	14.492	0	11.26	18.74	41.26	26,086.1	14,732.9	11,353	MAX
60	1.43	9.170	0	11.26	48.74	71.26	33,011.6	25,669.3	7,342	
120	0.78	5.002	0	11.26	108.74	131.26	36,012.6	----------	OUTFLOW EXCEEDS	
180	0.54	3.463	0	11.26	168.74	191.26	37,397.7	----------	INFLOW	
360	0.30	1.924	0	11.26	348.74	371.26	41,553.0	----------		
720	0.18	1.154	0	11.26	708.74	731.26	49,863.6	----------		
1440	0.11	0.705	0	11.26	1428.74	1451.26	60,944.4	----------		

EXHIBIT 3S.0

LOCO OIL FOOD STORE
MODIFIED RATIONAL METHOD
100 YEAR STORAGE VOLUME

100-YEAR RECURRENCE INTERVAL HYDROGRAPHS
FOR RAINFALL PERIODS OF VARIOUS DURATIONS

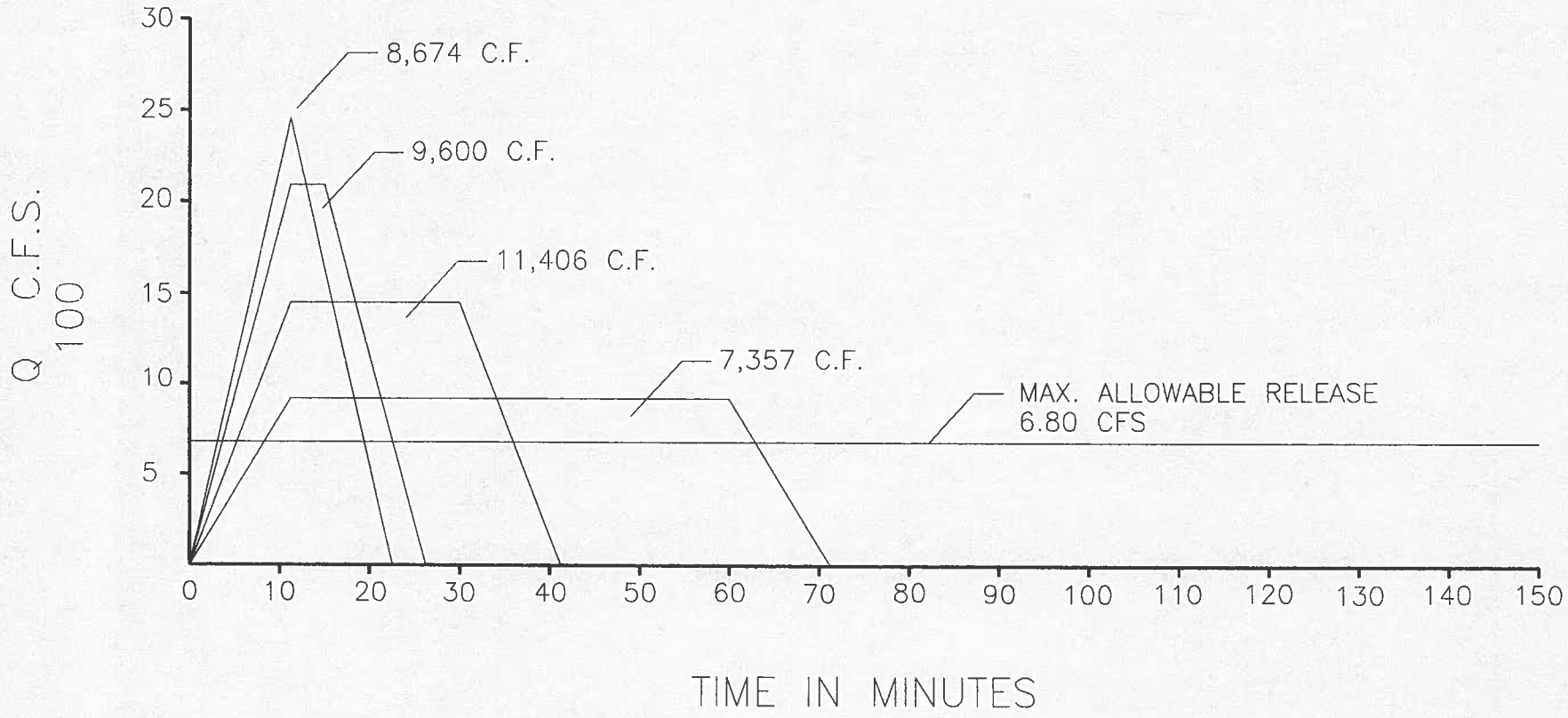


EXHIBIT 36.0

VOLUME CALCULATIONS

VOLUME EQUATION: $V = \frac{1}{3}\left(A_n + A_{n+1} + \sqrt{A_n \times A_{n+1}}\right)(D_{n+1} - D_n)$

V = VOLUME

A_n = SURFACE AREA AT ELEVATION "n"

A_{n+1} = SURFACE AREA AT ELEVATION "n+1"

D_n = ELEVATION "n"

D_{n+1} = ELEVATION "n+1"

ELEV. INTERVAL		VOLUME	ΣVOLUME
75.27 to 76	$V = \frac{1}{3}(0 + 945 + \sqrt{0})(0.73) =$	230 CF	230 CF
76 to 77	$V = \frac{1}{3}(945 + 1913 + \sqrt{945 \times 1913})(1) =$	1401 CF	1631 CF
77 to 78	$V = \frac{1}{3}(1913 + 3002 + \sqrt{1913 \times 3002})(1) =$	2437 CF	4068 CF
78 to 79	$V = \frac{1}{3}(3002 + 4212 + \sqrt{3002 * 4212})(1) =$	3590 CF	7658 CF
79 to 80	$V = \frac{1}{3}(4212 + 5543 + \sqrt{4212 \times 5543})(1) =$	4862 CF	12520 CF

2 YEAR SURFACE ELEVATION: @ 78^{20}

100 YEAR SURFACE ELEVATION: @ 79^{77}

EXHIBIT 37.0

LOCO DETENTION POND OUTLET CALCULATIONS

REQUIRED STORAGE VOLUME:

- 2 YEAR: 4781 CF — WATER SURFACE ELEVATION: 78.20
- 100 YEAR: 11,406 CF — WATER SURFACE ELEVATION: 79.77

HISTORIC RELEASE RATES:

2 YEAR:

TOTAL ON-SITE	1.5 CFS	
TOTAL OFF-SITE	0.9 CFS	
	2.4 CFS	2 YEAR-RELEASE RATE

100 YEAR:

TOTAL ON-SITE	4.9 CFS	
TOTAL OFF-SITE	1.9 CFS	
	6.8 CFS	100 YEAR-RELEASE RATE

OUTLET CALCULATIONS * SEE

2 YEAR OUTLET

ORIFICE EQUATION:

$Q = CA\sqrt{2GH}$

$Q = 2.4$ CFS

$C = 0.61$ ENTRANCE COEF.

$A =$ AREA

$G = 32.2$ FT²/S

$H =$ HEAD

EXHIBIT 38.0

OUTLET CALCULATIONS CONT...

2 YEAR POND ELEV. = 78.20
2 YEAR ORIFICE ELEV. = 75.27
2.93'

HEAD = 2.93 − (DISTANCE TO CENTER OF ORIFICE FROM BOTTOM OF ORIFICE) ← ASSUME 0.31
= 2.93 − 0.31 = 2.62

$Q = CA\sqrt{2GH} \Rightarrow 2.4 = (0.61)(A)\sqrt{2(32.2)(2.62)}$

$A = 0.303 \Rightarrow$ GIVES A 7.45" DIAMETER ORIFICE
(0.31 DISTANCE TO CENTER = ASSUMED)

USE 7 3/8" DIAMETER ORIFICE

100 YEAR OUTLET

$Q = 6.8$ CFS

$C = 0.61$

$A =$ AREA

$G = 32.2\ FT^2/S$

$H =$ HEAD

100YEAR POND ELEV. = 79.77
100 YEAR ORIFICE ELEV. = 75.27
4.5'

HEAD = 4.50 − 0.47 ← ASSUMED = 4.03

$Q = CA\sqrt{2GH} \Rightarrow 6.8 = (0.61)(A)\sqrt{2(32.2)(4.03)}$

EXHIBIT 39.0

OUTLET CALCULATIONS CONT....

$A = 0.69 \Rightarrow$ GIVES A 11.26" DIAMETER ORIFICE
(0.47 DISTANCE TO CENTER = ASSUMED)

USE 11 1/4" DIAMETER ORIFICE

FREEBOARD

REQUIRED FREEBOARD = 1 FOOT

TOP OF ELEVATION OF POND = 81^{00}
100 YEAR WATER SURFACE ELEV. = 79^{77}
1.23 FEET

PROVIDED FREEBOARD = 1.23 FEET

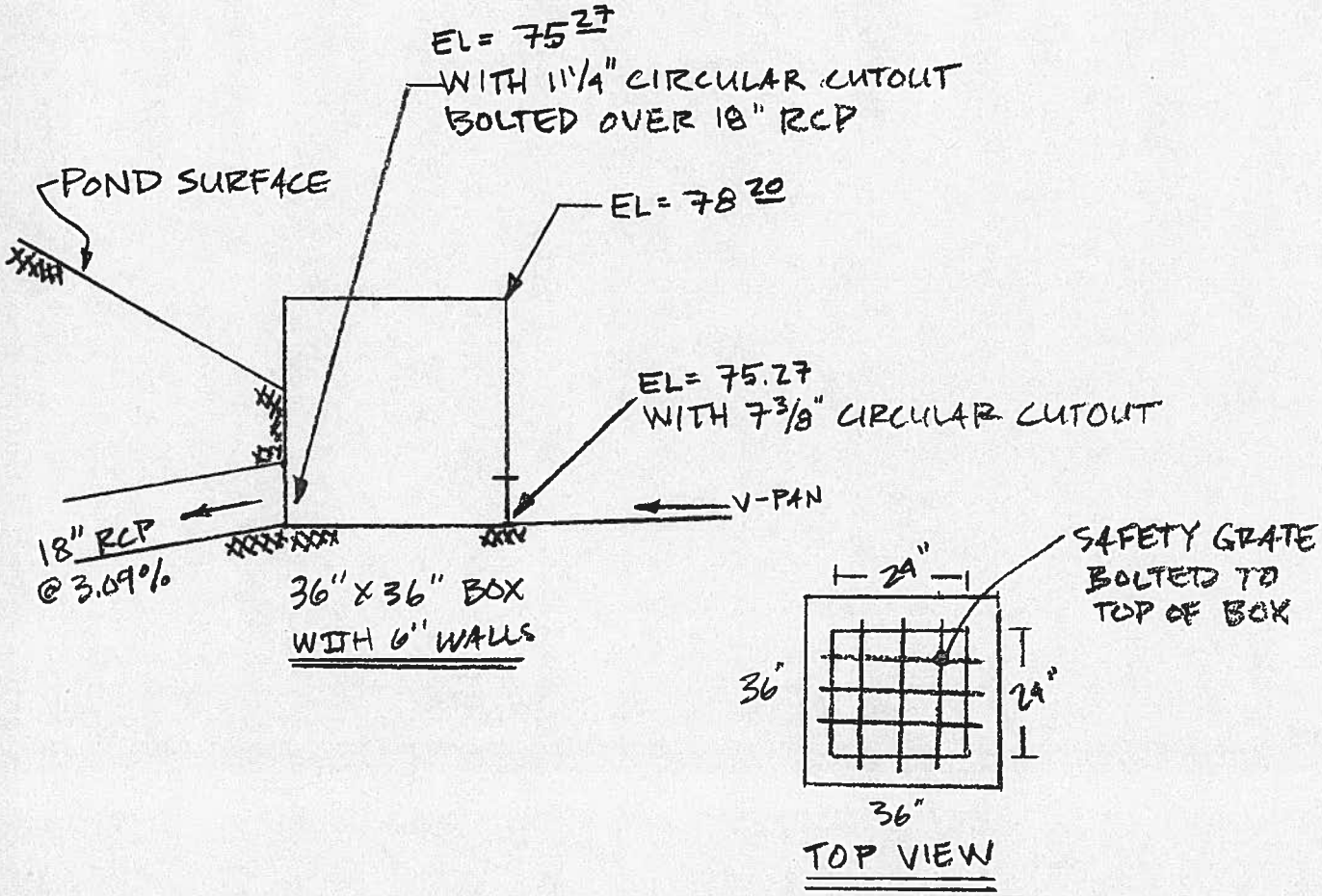


EXHIBIT 40.0

STATE OF COLORADO

Roy Romer, Governor
Patti Shwayder, Acting Executive Director

Dedicated to protecting and improving the health and environment of the people of Colorado

4300 Cherry Creek Dr. S.
Denver, Colorado 80222-1530
Phone (303) 692-2000

Laboratory Building
4210 E. 11th Avenue
Denver, Colorado 80220-3716
(303) 691-4700

Colorado Department
of Public Health
and Environment

June 13, 1995

Monty Stroup
Landesign
200 North 6th Street
Grand Junction, CO 81501

RE: Loco Food Mart, Fruita, Colorado
Stormwater Permitting Requirements

Dear Mr. Stroup,

I received your letter concerning permitting requirements for the Loco Food Mart in Fruita.

Your understanding that Stormwater Discharge Permits are not necessary for Retail/Commercial facilities is correct. I have enclosed a copy of the Standard Industrial Classification Codes (SIC) that are covered by the regulations. To confirm that the facility is not subject to the regulations, compare their SIC code to those on the list.

Please remember that this list of SIC codes subject to the Stormwater Regulations could change with the reauthorization of the Federal Clean Water Act.

If you have any questions, please call me at (303)692-3606.

Sincerely,

Daniel M. Beley
Environmental Protection Specialist
Permits and Enforcement Section
Water Quality Control Division

Enclosure

EXHIBIT 41.0