LOVEJOY & WILLIAMS, INC.
ENGINEERS AND ENVIRONMENTAL PLANNERS

18 WEST COLORADO AVENUE
COLORADO SPRINGS, COLO. 80902
(303) 633-1773

November 22, 1972

City Engineer
City of Colorado Springs
Colorado Springs, Colorado

Dear Sir:

Transmitted herewith is the engineer's report for the Upper 19th Street Storm Drainage Project with recommended design and estimated costs.

Very truly yours,

Norman B. Lovejoy

NORMAN B. LOVEJOY
REGISTERED
9822
PROFESSIONAL ENGINEER
STATE OF COLORADO

UPPER 19TH STREET STORM DRAINAGE PROJECT

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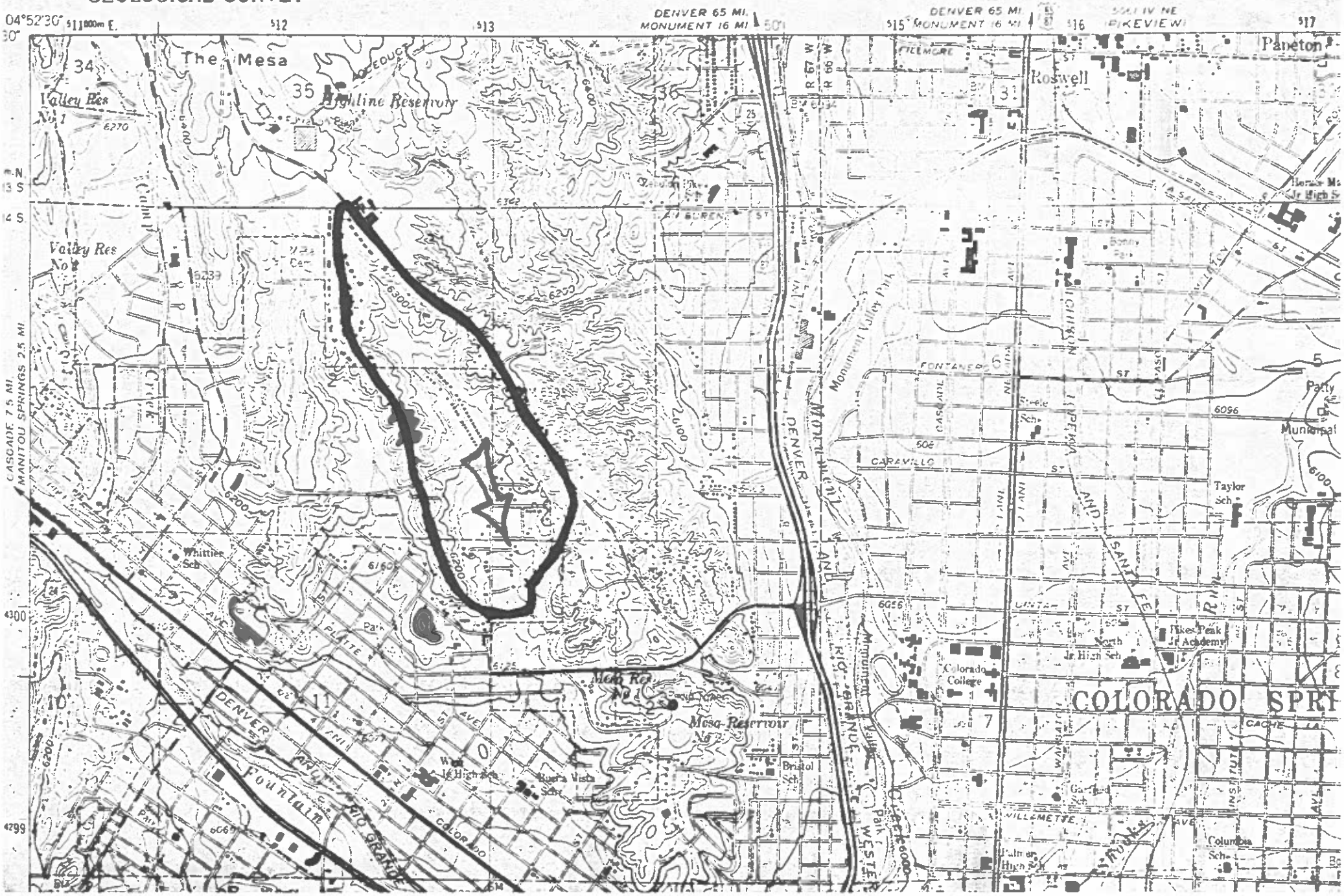
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PROJECT LOCATION



SCOPE AND CHARACTER OF PROJECT: The project which is the subject of this engineer's report is a storm drainage project in a small urbanized basin in the west side of the City of Colorado Springs. Over the years, a series of single family subdivisions have been constructed. Storm drainage from each subdivision was directed overland into the streets. The increasing urbanization has reached the point where flooding now occurs with a definite hazard to life and property. It is anticipated that the remaining open area will soon be developed. A storm drainage collection system is needed and is the subject of this report.

DESCRIPTION OF DRAINAGE BASIN: The upper 19th Street Drainage Basin is a relatively small enclosed basin in western Colorado Springs. (see map) It is bounded on the north and east by Mesa Road, on the west by Friendship Lane, and on the south by an existing City detention reservoir. The overall drainage basin extends southerly to the Fountain Creek, but for the purposes of this report, the retaining reservoir has been selected as the point of effluent discharge. A new underground storm drainage collection system was recently constructed south of this reservoir.

A. TOPOGRAPHY: Topographically, the drainage basin is an elongated, steep sided bowl. It is surrounded on the east and west sides by high, steep hills. Although a small portion of the center is relatively level, this level portion of land is confined to an area a few hundred feet in width surrounding 19th Street and Oswego Street.

B. SOILS: The soils in the basin are threefold. The Pierre Shale underlies the entire area and can be considered as the basic soil type. Over this, a cover of Mesa Gravel is found on the higher elevations, and to some extent, on the slopes. The center, or relatively flat area, of the basin is composed of a mixture of these two types, but is predominantly of the shale formation. The soils found in the lower areas are typical of torrential stream wash and are highly stratified. Runoff in the basin is high and rapid. This is due not only to the steep slopes to be found on the side of the basin, but to the relatively impervious character of the underlying soil. In general, this soil can be classified as Type "C" or "D" under the Soil Conservation Service classification.

C. DEVELOPMENT: Nearly all of the development found in this basin is found either in the low, relatively flat areas or at the summit of the Mesa along the edges of the basin. Practically no development has taken place on the steep slopes. Development in this area will probably be retarded due to the steepness of the slopes. These slopes can, however, be developed, and this report assumes that development has taken place on the basis of ½ to 1-acre lots.

D. INTERNAL DRAINAGE: In general, the water enters the basin from the east and west, flowing rather rapidly down steep slopes. At the mid point in the basin, it turns southerly and runs in streets and alleys to King

Street where it ponds. Water then runs in a gully and across developed land to the 19th Street reservoir.

FUTURE DEVELOPMENT: (see map) There are areas within the study area that are currently not platted for development. Each of these areas is described below with a description of anticipated development.

Area A: City streets can be extended into the area. The area is presently zoned "R-residential zone-estate". Small single family lots is the most likely use to be permitted in the area. This will require a zone change.

Area B: Steep slopes and lack of access for an extension of city streets will probably prevent future development.

Area C: This area is zoned PBC-2 and is planned for a shopping center.

Area D: This area is the eastern half of a school site. Runoff from this area will probably drain into the study basin.

Area E: Access is from Mesa Road. The area is zoned "R-residential zone-estates". Single family dwellings on lots of a minimum size of twenty thousand square feet is the most probable future use due to the rough terrain.

Area F: This area is zoned "R-3, residential zone; two family". One and two family dwellings are permitted on lots of a minimum size of five thousand and three thousand five hundred square feet respectively. The area is very rough. Access is limited. It is unlikely that this dense a development will be possible.

Area G: This area is zoned R-5, multi-family. There is good access. Topography is suited to multi-family development.

DESIGN STORM: Local storms are characterized by high intensity rainfall of relatively short duration in a localized area. A 2 inch rainfall in one hour is not uncommon. A 2 inch rainfall in one hour is specified by the City of Colorado Springs as the basis of design for structures in subdivisions and is the basis of design for this report.

CONCEPT OF DESIGN: The system approach will be used. The storm drainage system will include existing street gutters, planned street gutters, culverts, cross pans, ditches, inlets, conduits, manholes and other appurtenances. Storm sewers will be specified when the surface system no longer has the capacity for additional runoff.

Streets in the project area consist of local, collector and arterial streets. Allowable use of gutters will be limited as follows:

Local and collector streets - No curb over-topping. Flow may spread to crown.

Arterial - No curb over-topping. Limit flow to maximum of 30 C.F.S.

A gutter capacity reduction factor will be used based on slope of gutter. When runoff exceeds gutter capacities, catch basins will be installed leading to storm sewers.

RUNOFF CALCULATIONS: Sub-basins used in calculating runoff are shown on the enclosed drainage plan. Calculations assume full

development in the basin based upon projections listed under "Future Development".

Runoff is calculated using the Soil Conservation Service Synthetic Hydrograph Method as modified by the Bureau of Reclamation. Table I gives the results of this calculation for each sub-basin.

EXISTING DRAINAGE CONDITIONS: Flow pattern for runoff from each sub-basin is shown on the drainage plan. Runoff will total 226 C.F.S. at point A resulting in flooding and possible damage to property to the south. Flow in the streets with full development upstream from point A exceeds the allowable gutter capacity at points B and C as shown on the plan. Upstream from these points the runoff can be safely carried in the streets and no improvements are needed. A 5.7 C.F.S. runoff is carried in a private alley running between Oswego Street and Tonka Avenue. This alley is not paved.

POINT OF EFFLUENT DISCHARGE: All the runoff from this basin now empties into an existing City owned detention reservoir as shown on the map. This reservoir has a capacity of 40 acre feet. A 12 inch V.C.P. conduit (existing) releases water from the reservoir into the existing storm sewer system downstream. This 12 inch outlet conduit drains from an outlet manhole located at the southwest corner of the detention reservoir. The new storm sewer system which is the subject of this report will empty into this detention reservoir. Figure 1 is a consolidated hydrograph showing peak flow into the reservoir. The design storm will total

approximately 25 acre feet into the reservoir. The detention reservoir is adequate to handle anticipated flows.

DRAINAGE SYSTEM ALTERNATIVES: The major problem is to conduct the storm runoff from King Street to the detention reservoir without causing damage to homes and businesses downstream. Four alternatives are examined.

A. A storm sewer down 19th Street: The sewer could be located in city streets; thus no right of way acquisitions would be required. Construction would be expensive. A deep trench would have to be excavated along a portion of 19th Street. Existing utilities in 19th Street would have to be relocated. The street would have to be resurfaced after construction of the line. Drainage from the open area to the west of 19th Street and south of King Street would still drain over private property to the south unless an area catch basin was located just to the south of this open area.

B. An open channel in the undeveloped area south of King Street: This is not feasible at this time. That area is zoned PBC-2. There are no plans for development at this time. Considerable fill is being dumped in the area in anticipation of future construction. The right of way would have to be purchased at considerable cost through condemnation. Since the channel would make it very difficult to plan a future PBC-2 development, the purchase price of an easement through condemnation would be high.

C. Dump storm water in open area to south of King Street. Pick up again to north of private homes: The C.F.S. of runoff flowing in that open area would create erosion and would be

difficult to control. The runoff would pick up a full load of silt and clay. This silt and mud laden runoff would cause silting in the detention reservoir and eventually reduce its capacity. An expensive area inlet would be required at the south end of the open area. This inlet and the storm sewer between that point and the detention reservoir would require cleaning after every storm. If the uncontrolled storm runoff passing through the open area should bypass the area inlet to the south, the City could be subject to damage claims from private property owners.

D. A storm sewer system from point A on King Street to the detention reservoir: The owners of the land south of King Street have stated that they will grant easements at no cost for construction of a storm sewer. Such a storm sewer will pass the runoff through developed areas without the hazards and disadvantages of alternatives B and C. Construction costs will be less than alternative A. It is recommended that this method of handling the runoff be selected.

ANALYSIS OF DESIGN: Design in accordance with Alternative D and based on criteria discussed above is shown on the attached drainage plan. The estimated construction cost breakdown is shown in Table II. This cost exceeds the budget for the project. Therefore, an analysis of design is made to determine priorities. Priorities for construction should be as follows:

Priority 1 - A system of catch basins at the foot of Tonka Avenue and Oswego Street leading to manholes and catch basins at the low spot between Tonka Avenue and Oswego Street, thence

through a storm sewer to the detention reservoir. Estimated construction cost for this alternative is $168,713. This construction schedule would require Oswego Street to carry up to 60 c.f.s. in the street without further development in the upper basin. This condition would not cause curb overtopping until further development. King Street would carry 57 c.f.s. which is within the carrying capacity of the street but would leave only one lane free for arterial traffic.

Priority 2 - add to priority 1 construction schedule a storm sewer to the foot of Friendship Lane. King Street is an arterial street with heavy traffic; second priority should go to this street. Total for priorities 1 and 2 is estimated to be $192,763.

Priority 3 - add a storm sewer up to the head of Oswego Street with catch basins and manholes. This street should be a last priority. Traffic at the present time is light. A portion of the calculated runoff results from development which has not yet occurred. If sufficient funds are not available at this time, the Oswego Street storm sewer can be added at the time the upper basin is developed. Total for priorities 1, 2 and 3 is estimated to be $230,513.

CONSTRUCTION SCHEDULE

Construction funds authorized - January 1, 1972

Advertise for bids - January 9, 1973

Open bids - January 30, 1972

Award contract - February 14, 1973

Complete construction - June 14, 1973

REAL ESTATE: There is no land to be acquired. The storm sewer will be constructed in city owned streets or across easements on private land. The land owners involved have been contacted will grant easements at no cost to the city.

RECOMMENDATION: Recommend that the total design package consisting of priorities 1, 2 and 3 be advertised in such a manner that award can be made for all or part in order of priority depending on availability of funds at time of bid opening.

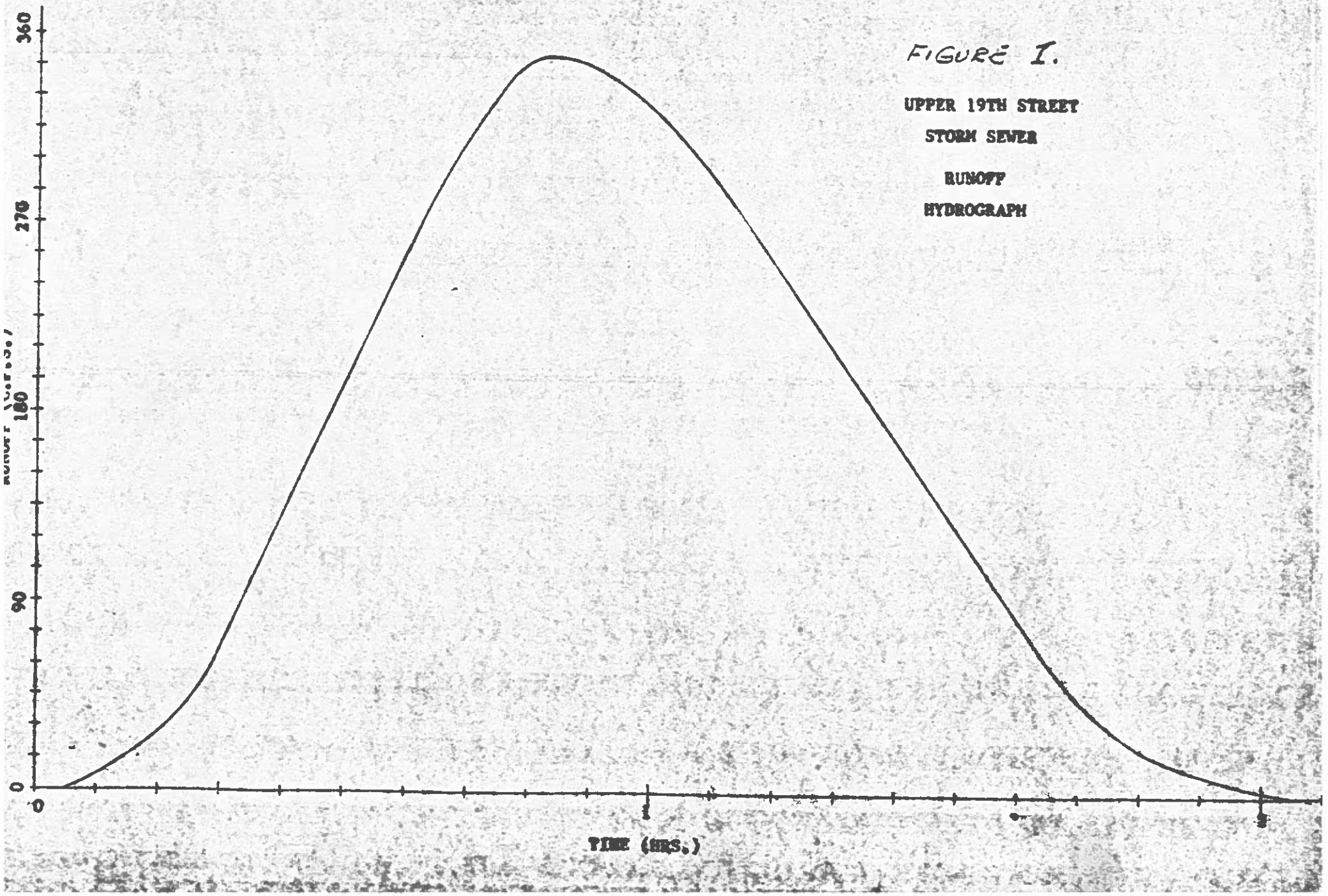
FIGURE I.

UPPER 19TH STREET

STORM SEWER

RUNOFF

HYDROGRAPH



c = GRAPH pg. 47 "DESIGN OF SMALL DAMS"

SUB-BASIN RUNOFF TABLE I

$c = \left(\frac{11.9\,L^3}{H}\right)^{0.385}$ $\quad T_p = \frac{D}{2} + 0.6\,T_c$ $\quad q = \frac{484\,AQ}{T_p}$ $\quad T_b = 2.67\,T_p$

BASIN	AREA ACRES	AREA SQ. MI.	L ft./Mi.	H ft.	Tc hrs.	Tp hrs.	Q	q	Tb hrs.
I	14.40	.0225	500/.0947	5	.092	.555	1.2	23.54	1.482
II	30.21	.0472	800/.1515	80	.054	.533	0.6	25.74	1.422
III	17.64	.0276	2300/.4356	105	.166	.599	1.0	22.29	1.600
IV	2.23	.0035	210/.0398	2	.048	.529	1.2	3.84	1.412
V	4.85	.0076	1540/.2917	40	.151	.591	1.6	9.96	1.577
VI	14.53	.0227	1605/.3040	32	.173	.604	1.6	29.12	1.612
VII	29.22	.0457	2350/.4451	120	.161	.597	1.0	37.06	1.593
VIII	8.76	.0137	2035/.3854	60	.178	.607	1.6	17.48	1.621
IX	3.15	.0049	1540/.2917	45	.144	.587	1.4	5.66	1.566
X	12.95	.0202	1905/.3608	45	.185	.611	1.5	24.01	1.631
XI	1.42	.0022	320/.0606	20	.032	.519	1.9	3.90	1.386
XII	5.04	.0079	1045/.1979	30	.108	.565	1.7	11.51	1.508
XIII	1.93	.0030	390/.0739	12	.049	.529	1.5	4.11	1.414
XIV	32.06	.0501	2280/.4318	140	.147	.588	1.6	65.98	1.570
XV	8.12	.0127	1060/.2008	30	.110	.566	1.5	16.30	1.511
XVI	19.31	.0302	1060/.2008	120	.064	.539	1.8	48.85	1.438
XVII	9.05	.0141	715/.1354	105	.043	.526	1.5	19.47	1.404
XVIII	14.00	.0219	1300/.2462	100	.087	.552	1.0	19.19	1.475
XIX	9.22	.0144	920/.1742	100	.059	.535	1.0	13.02	1.429
XX	8.23	.0129	1035/.1960	20	.125	.575	1.5	16.29	1.535

TABLE II

CONSTRUCTION COST ESTIMATE

Part I: Total Project (Priority 1, 2 and 3 phases)

A. Storm Sewer Installed

Size	Linear Feet	Unit Cost	Total Cost
18"	60'	$19	$1,140
21"	65'	19	1,235
24"	1185'	20	23,700
27"	1470'	20	29,400
30"	50'	21	1,050
36"	55'	25	1,375
42"	450'	30	13,500
48"	165'	35	5,775
54"	1185'	42	49,770
60"	1065'	48	51,120
		Subtotal	$178,065

B. Manholes and Inlets

17 manholes @ $500 each		$8,500
9 drop inlets (8 ft.) @ $1,250 each		11,250
2 drop inlets (6 ft.) @ $950 each		1,900
2 drop inlets (10 ft.) @ $1,550 each		3,100
	Subtotal	$24,750

C. Paving and Base Course (Removal and Repair)

3800 sq. yds. @ $4.00 sq. yd.	$15,198

D. Relocation of Existing Utilities $12,500

Estimated Total - Priorities 1, 2 and 3 $230,513

Part II: Priorities 1 and 2 only

Deduct	50 ft. of 24" pipe	$1,000
	1300 ft. of 27" pipe	26,000
	2 Manholes	1,000
	2 drop inlets (8 ft.)	2,500
	relocation utilities	3,250
	paving and base course	4,000
	TOTAL DEDUCT	$37,750
	Estimated cost priorities 1 and 2	$192,763

Part III: Priority 1 only

Deduct	760 ft. of 24" pipe	$15,200
	50 ft. of 21" pipe	950
	3 manholes	1,500
	2 drop inlets (8 ft.)	2,500
	2 drop inlet (6 ft.)	1,900
	paving and base course	2,000
	TOTAL DEDUCT	$24,050
	Estimated cost priority 1 only	$168.713

Engineering

LOVEJOY & WILLIAMS, INC.
ENGINEERS AND ENVIRONMENTAL PLANNERS

18 WEST COLORADO AVENUE
COLORADO SPRINGS, COLO. 80902
(303) 633-1773

December 18, 1972

Mr. Greg Trainor
Office of Intergovernmental Affairs
City of Colorado Springs
P. O. Box 1575
Colorado Springs, Colorado 80901

Job 7229

Dear Greg:

This is in reference to the Engineer's Report for the 19th Street Area Storm Control Project Phase II (Upper 19th Street).

The above described project has been designed and will be constructed and operated so as to preclude the introduction of domestic sewage and industrial and agricultural wastes, the discharge of the flow into the designated waterway without treatment will meet applicable Federal, State, interstate and local water quality standards existing at this time.

Very truly yours,

Norman B. Lovejoy

NBL/sj

cc: City Engineer

7229
(Engineering)

LOVEJOY & WILLIAMS, INC.
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ADDENDUM TO ENGINEER'S REPORT FOR UPPER 19TH STREET STORM CONTROL PROJECT (PHASE II)

Estimate of Operating and Maintenance Costs

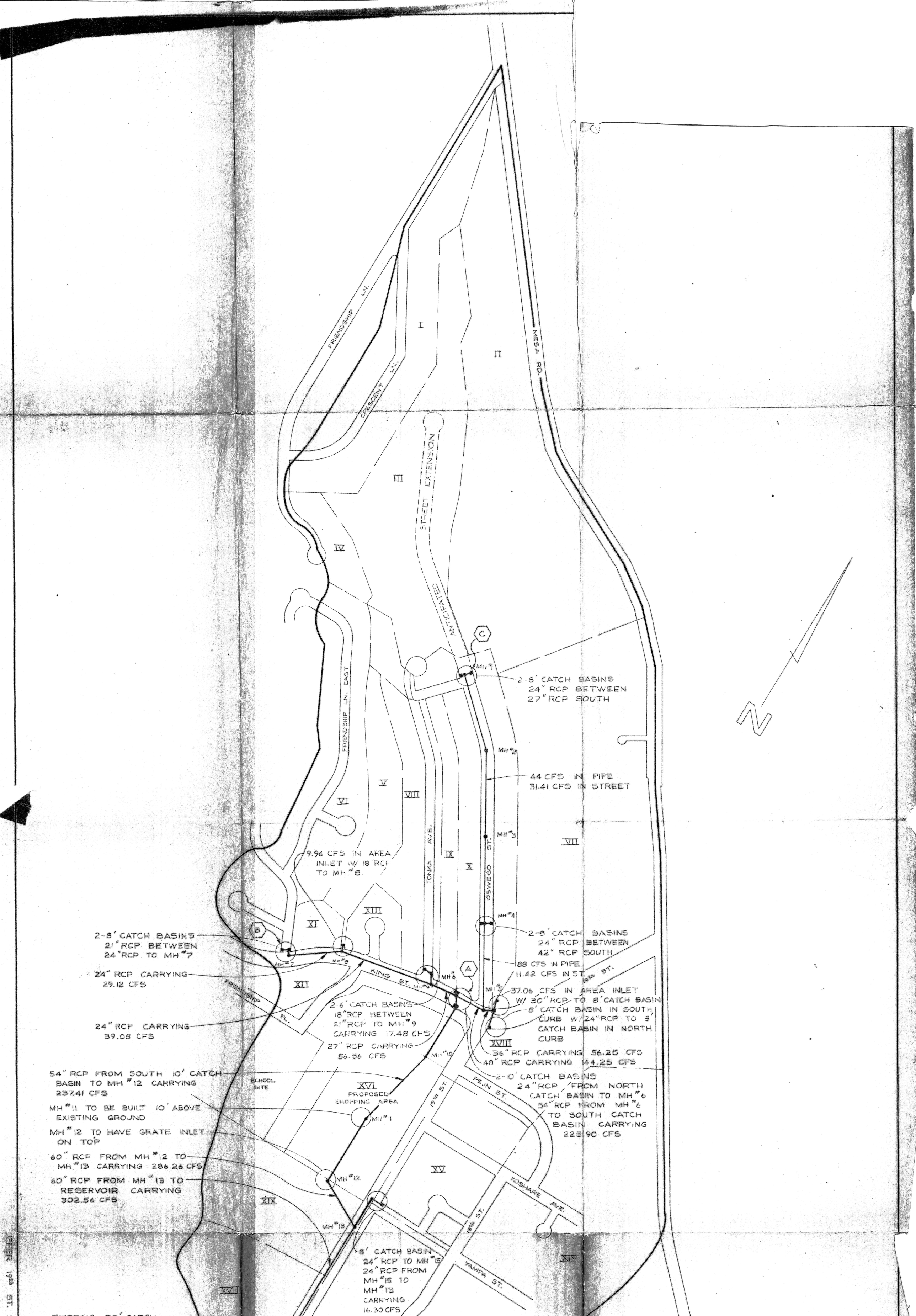
Elements of cost:

	Activity	Frequency
a.	Clean entries	After each storm
b.	Clean catch basins & manholes	Annual
c.	Maintenance of fence around detention reservoir	Annual
d.	Clean detention reservoir	Every five years
e.	Repair damaged pipe	As needed

Estimates cost: $1,400 per year

or

Add to project cost for 40 year life at 5% the lump sum of $24,022



UPPER 19th ST. STORM SEWER DRAINAGE PLAN DWG. NO. 2435

LOVEJOY & WILLIAMS, INC.
ENGINEERS AND ENVIRONMENTAL PLANNERS
18 West Colorado Avenue — Colorado Springs, Colo. 80902

UPPER 19TH. STREET STORM SEWER

DRAINAGE PLAN

DATE	REVISIONS	DRAWN JRM	SCALE 1"= 200'	SHEET 1 OF 1
		CHECKED	JOB NO. 7229	DWG. NO. 2435
		APPROVED		