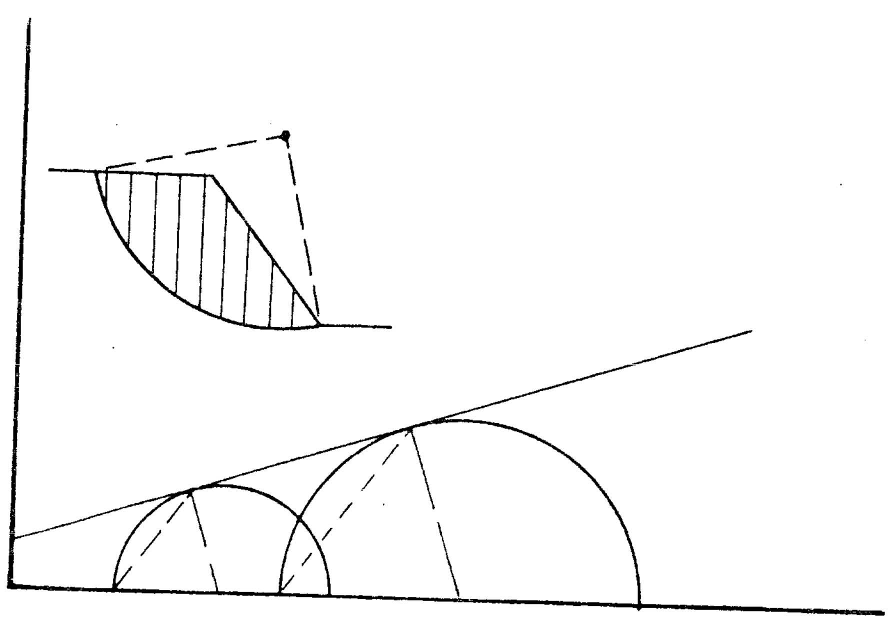
City ENGINEER
Check-out Copy #2

[redacted]

SPRING CREEK DRAINAGE STUDY

MARCH, 1968

THE LINCOLN DeVORE TESTING LABORATORY
COLORADO SPRINGS, COLORADO



THE LINCOLN-DeVORE TESTING LABORATORY

1000 W. Fillmore
Colorado Springs, Colorado

MEMBER: A.S.T.M.

Geo. D. Morris, P.E.
Phone:
632-3593

Soil Testing

Foundation-Evaluation

Materials Tests

Concrete Batch Design

Asphalt Mix Design

Geologic Interpretation

Groundwater Hydrology

by

Registered Professional Engineers & Geologists

March 7, 1968

Director of Public Works
City of Colorado Springs
City Hall
Colorado Springs, Colorado

Dear Sir:

Enclosed herewith is the Engineering Study and Revision of the Spring Creek Flood Drainage Basin authorized by the City Council of the City of Colorado Springs.

The report includes a study of the rainfall runoff characteristics and channel improvements for the entire basin. It also includes a restudy of all storm sewer requirements, hydrographs, and existing and required streets and grading in the area.

The study may be used as a master drainage plan for the basin as it completes development in the near future.

Respectfully submitted,

LINCOLN-DeVORE TESTING LAB.

George D. Morris, P. E.

/jb

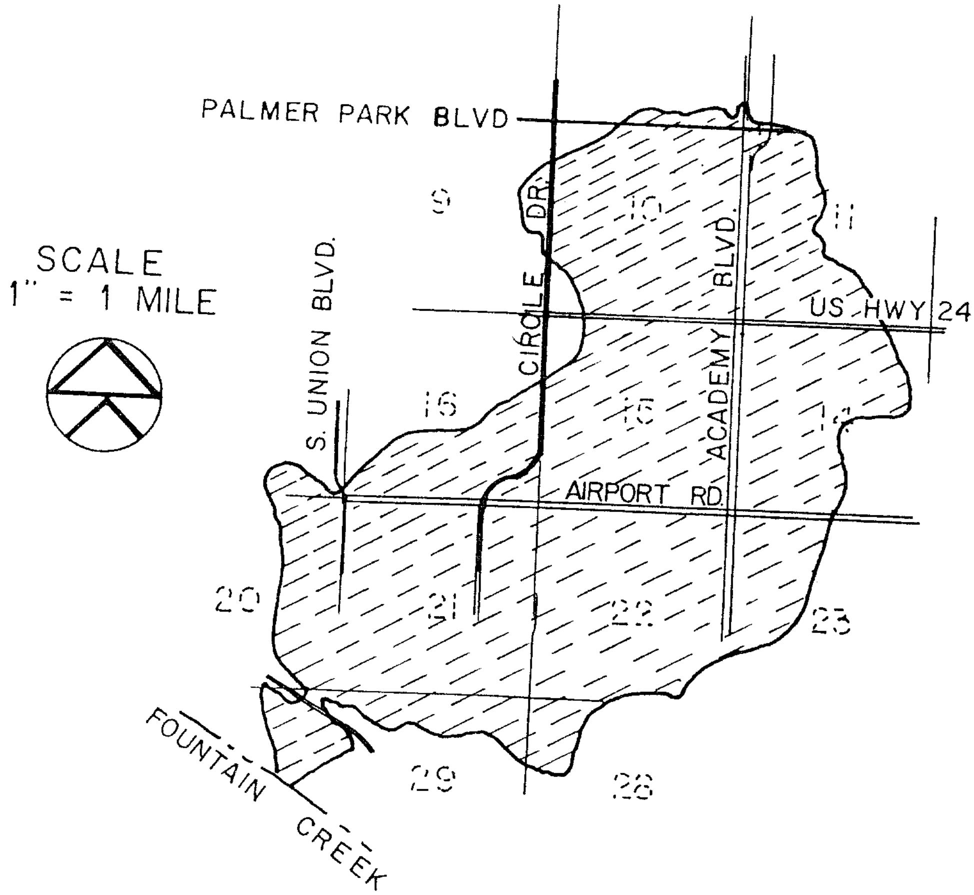
TABLE OF CONTENTS

Item	Page Number
LETTER OF TRANSMITTAL	
TABLE OF CONTENTS	
VICINITY MAP	
SCOPE	1
BASIN DESCRIPTION	4
GEOLOGIC FORMATIONS	5
RAINFALL & RUNOFF PATTERNS	7
PREVIOUS DRAINAGE WORK IN BASIN	11
MAIN CHANNELS - GREENBELTS	14
INDIVIDUAL IMPROVEMENTS	16
SPECIFIC PROBLEM AREAS	19
SUMMARY & RECOMMENDATIONS	22
BIBLIOGRAPHY	25

LIST OF DETAIL SHEETS

BASIN MAP
BASIN MAP - FINAL
INDIVIDUAL BASIN HYDROGRAPHS
COMBINED GREENBELT HYDROGRAPHS
CURB INLET
CURB OUTLET
HIGH CAPACITY INLET
GREENBELT DITCH SECTIONS
RESIDENTIAL DITCH SECTIONS

TABLE I	DRAINAGE DITCHES
TABLE II	DRAINAGE DITCHES LOCAL
TABLE III	STORM SEWERS
TABLE IV	MAJOR STRUCTURES ON GREENBELT



SPRING CREEK DRAINAGE BASIN

VICINITY MAP

THE LINCOLN DeVORE
TESTING LABORATORY

SCOPE AND PURPOSE OF STUDY:

This report is intended to furnish the basis for an overall plan for placing storm sewers and drainage appurtenances in the Spring Creek Drainage Basin in the near future. The original study of this area was done in August of 1961 by United Western Engineers under the direction of George D. Morris, P. E. At that time, about 1/2 to 2/3 of the basin was undeveloped and the storm sewers were proposed for projected subdivisions in the area. As the basin developed, it was found that certain subdivisions did not develop as anticipated and that therefore the drainage requirements have changed to some extent.

In addition to this, certain changes were made in the criteria for these drainage studies and these changes must be reflected in the restudy. Probably the greatest change in criteria was that involving the use of small storage retention reservoirs in the original study. These have been eliminated by the direction of the Colorado Springs City Drainage Board and a revision of the greenbelt width and depth requirements was therefore necessary.

The intent of this study is not to establish the precise design of a storm sewer or channel in any area. It should rather establish the general location of any required storm drainage structures and their required general sizes. It will establish those natural channels which should remain as water carrying channels or greenbelts and those which may be eliminated. It will also establish the size of major structures along the greenbelts.

For the most part, the design of the proposed subdivisions in the area is now known and the locations of storm sewers and drainage appurtenances can be relatively closely established. In some areas, however, the street plan is not as yet known and any study of this type must be necessarily general in these areas. Some changes will be noted between this revision and the original drainage study. These changes have mostly been brought about by what is now known of the area development and by existing bridges and other appurtenances which have been constructed or proposed. The land use of the area is now almost completely known and more accurate rainfall runoff criteria can be established.

Fortunately, by use of the original drainage study of the area, the major drainage channels have been saved and are available for use at the present time.

In some cases, the sizes of these channels must be increased. In those areas in which no plan exists, streets have been located in positions which will facilitate the removal of storm water. If these streets are not constructed as shown, then the possibility exists of greater storm sewer design requirements.

As the basin has developed, it has become impossible to use as many small ditches as were originally proposed. It was noted in the original report that ditches are usually more economical than underground pipe and therefore somewhat preferable. The revision indicates the use of many ditches at various points on the subdivision where it is practical. It has, however, become impractical to use ditches in various developments, and therefore, underground storm sewage works are more extensive on this second plan than on the first.

These studies of undeveloped basins have provided the basis of a logical overall storm drainage plan prior to the time of subdivision development. It was noted in redoing the Spring Creek Drainage Basin that this plan has in general been a help in the area, mainly in maintaining existing channels and rights of way. It is felt that the drainage plans have been useful since major construction problems caused by the existance of streets or structures over the drainage areas have been avoided.

BASIN DESCRIPTION:

The Spring Creek Basin contains approximately eight square miles of land lying immediately east and southeast of the City of Colorado Springs. Its northern divide is in the vicinity of Palmer Park Boulevard near Academy Boulevard. It is bounded on the west by the Little Shook's Run Drainage Basin in Knob Hill and on the East by a low ridge of hills separating it from the Sand Creek Drainage Basin. It empties into the Fountain Creek near the City sewage disposal plant.

The topography of the basin is generally described as rolling hills. It contains some steep hills and bluffs, mainly in the north edge of the basin, and near the outfall. In general the hills surrounding the basin are relatively low--being somewhat higher along the east divide than along the west. The valley of Spring Creek is relatively wide in the northern 2/3 of the basin and it narrows down considerably in the south 1/3.

The final 1000 feet, more or less, of the Creek runs across the flood plain of Fountain Creek where the grade is quite flat.

For the most part, the Spring Creek Drainage Basin is drained by a single stream. Near the intersection of Pikes Peak Avenue and Academy Boulevard, however, a tributary stream enters from the east and north-east. In general, the stream flow is approximately in the center of the basin allowing good distribution for runoff in the entire basin.

GEOLOGIC FORMATIONS, SOILS & WATER TABLE:

At least four geologic formations are found in the basin. These include in general three soil types. Along the south side of the hills at the upper end of the basin, large quantities of windblown sands and silts have been deposited forming a fifth geological formation, as it were. Near the upper portion of the basin, the soil is mostly Dawson arkose alluvially transported material consisting of clays and silts and some coarse sands. The Fox Hills and Laramie Formations occupy the central portion of the basin and consist primarily of fine sands and some shales. This is the area which has been covered by the windblown sands and silts. In general, infiltration rates of the upper 2/3 of the basin are quite high in the sandy material and somewhat lower in the shales. The windblown sands especially have a very high infiltration rate.

Some of the Fox Hills shales are found in the vicinity of Highway 24 and south. Along the greenbelt and to the east of the greenbelt, the material tends to be generally quite clayey or shaley with very low infiltration rates and high runoff rates.

Along the main greenbelt at approximately Pikes Peak Avenue, the Pierre Shale is found in the bed of the greenbelt. This is a very heavy clay shale material with infiltration rates that are quite low and with high runoff rates. The Pierre Shale does not extend across the entire basin at any point except at the far south end, mainly because the western ridge of the basin consists of the Fox Hills sands. Pierre Shale is quite common south of Airport Road, however, and is probably the predominate soil in this area.

There is no consistent water table in this basin at any depth. Certain marshy areas do exist, however, particularly near Airport Road and near the golf course at Chelton and Fountain Boulevard. These areas are marshy due to a relatively flat grade and Pierre Shale near the surface of the ground.

RAINFALL & RUNOFF PATTERNS:

Average annual rainfall in the Spring Creek Basin is low--being about 14-1/2 inches per year. The major portions of this rainfall occur in May, June, July, and August. Both mountain-type storms and plains-type storms fall on this basin. Storms of record in the basin fall into two general categories: (1) Short, intense storms lasting up to two hours and usually local in nature (2) Long term storms lasting six hours or more being spread over a large area.

Long term storms last a longer period of time and allow high infiltration. This produces a large total volume of runoff, but a relatively low flood peak due to the period of time involved. Short duration storms produce less total runoff, but being quite intense, have a high flood peak. With development in the area, the peak becomes even higher. The original basin report investigated four storm types. They were:

(1) 30 minute duration .8 inch intensity, 2 year frequency storm

(2) 1 hour duration, 2 inch intensity, 50 year frequency storm

(3) 6 hour duration, .75 inch intensity, 25 year frequency storm

(4) 6 hour duration, 3 inch intensity, 50 year frequency storm

The inititial investigation indicated that the 1 hour duration, 2 inch intensity, 50 year frequency storm would produce the highest flood peak. This criteria was again checked in this second report on the basin and was found to be correct. The 50 year, 1 hour storm was then confirmed for use in design. For the purpose of this report, therefore, all data given is for this particular design storm.

The 50 year occurance mentioned above is misleading in some ways. It is true that a storm of this intensity can be expected to cover the entire area of the basin approximately every 50 years. It is also true, however, that a storm of this intensity may be expected on a local basis about every three years. For design purposes, therefore, it is not considered safe to consider any storm of lesser rainfall than the one used in this report.

No measured runoff data exists for this basin other than observations which have been taken at various points in the last 4 to 5 years. These observations indicate that the design flood peaks will be approximately correct for a 50 year storm of the type anticipated.

It should be noted that in several portions of the Spring Creek Basin, particularly near Academy and Galley Roads, the land use of the area has changed considerably from the initial thinking in the area. In Basin No. 1, for instance, a large portion of the area is now occupied by apartment sites and the Rustic Hills Shopping Center. In Basins 5 and 9, a large portion of the area is anticipated as being developed as "The Citadel" Shopping Center. Both of these areas will be nearly 100% paved and have quite high runoff values. In the area of the Union Printers' Home, the same general condition is true with the large proposed shopping and apartment areas which will contribute a great deal more runoff than was originally anticipated in the Spring Creek development plan. Runoff hydrographs are therefore somewhat higher and of slightly longer duration than shown in the original plan. Also, a great deal of the runoff data in this report is somewhat different than the original Spring Creek report not due to any change in the design storm, but simply due to changes in land use in the area. In some cases, the location of new streets speeds up the runoff to some extent, increasing the peak of the hydrograph.

All the hydrographs developed in this report are based on the assumption that the entire area has been developed according to existing plans. The basin is now divided into 47 sub-basins as shown on the attached drawings. An outfall point was assigned to each sub-basin and a synthetic hydrograph was constructed for these points. Due to the absence of measured data, the available data by the Soil Conservation Method must be used. Runoff for each basin was estimated by the system developed by the Soil Conservation Service and modified by the Bureau of Reclamation.

The final hydrographs of each minor basin were routed on a time scale so that the combined hydrograph could be constructed at various points on the proposed greenbelt. The combination hydrographs give a graphical picture of the flow down Spring Creek and its various tributaries. As it takes a certain amount of time for a flood crest to travel from point to point and since the length of the various tributaries is relatively large, it was found that the peak of the combined hydrograph gradually increases in time intervals as the crest moves to the southwest. The pattern of flow shown in the report is somewhat different than the original report due to the various changes previously mentioned. It should be noted that the crest of the hydrograph becomes sufficiently large to become a flood hazard by the time the crest reaches Pikes Peak Avenue. From this point to the south, the flood crest can be destructive at any time it is allowed to leave the greenbelt.

PREVIOUS DRAINAGE WORK IN THE BASIN:

With the exception of an outfall flowing across the Valley Hi golf course in Basin 34, no runoff control measures have been taken in this basin. If anything, the runoff has been speeded up by construction of certain storm sewers and streets in the area.

The two small reservoirs noted as being storm control features are located in the Valley Hi golf course and are used as a part of the landscaping of said golf course. These two small reservoirs were utilized in the early 1960's as a drainage control structure which has proved reasonably efficient through Basin 34. The major reservoir in the area, however, is of no help as a drainage control structure. Unless the water level is quite low in the lake at the time of the rainfall and consequent runoff, this structure will hold practically none of the flood water and will in effect act merely as a wide, flat channel for the water to flow across. This large reservoir was therefore not considered in any of the runoff computations or flood control design works since it is incapable of acting as a control structure. It is recommended that some attention be given to the outlet work of this reservoir since the spillway is probably not adequate for the flood peak which is anticipated. This spillway was washed out in a storm which occurred in the mid 1960's and has been rebuilt. It has been enlarged to some extent apparently, but not sufficiently to handle the flood peak anticipated.

A very large percentage of the bridges and other structures across the main channel have already been constructed. Some of these are of adequate size and some are not. Where these structures are not of adequate size, it has been recommended that they be enlarged. The most practical method of enlarging them would not be to tear the structure out and replace it, but would be to add a box or pipe to each side of the existing structure. In effect, the existing structure would be lengthened.

Some portions of the proposed storm sewers in the original report for Spring Creek have been constructed, notably near Chelton Road, Galley Road at Academy Boulevard, Circle Drive and Airport Road, and at Circle Drive and Fountain Boulevard. These have all been shown on the map as existing structures. Other storm sewers are planned in the area in two subdivisions. Nearly two-thirds of the area, however, consists of old subdivisions which have been constructed without storm sewers or any drainage facilities of any sort. These are recommended for construction in the future.

MAIN CHANNELS - GREENBELTS:

All previous studies commissioned by the City of Colorado Springs have recommended a greenbelt drainage system in the areas. This is desirable as it is generally the most economical method of removing flood runoff from any developed area. The cost of open ditches or drainage channels is almost always lower than that of pipes, and ditches are usually easier to maintain than a pipe.

In this particular basin nearly all of the subdivisions since 1961 have been planned with regard to the greenbelt and have assumed that the greenbelt is in existance. Therefore, the entire length of the proposed greenbelts is available for use, although in some places it is somewhat narrower than desirable. Any further subdivisions in contact with any of the greenbelts should also include the proper area for the greenbelt channels.

It will be found upon examination of the accompanying maps that all the greenbelts tend to follow the natural streambed and generally do not interfere with land suitable for subdividing. Required channel widths and depths are shown on the maps and in the appendix, but in general the channel design should be such that the channel will be wide and shallow. This reduces the velocity of flow in the channels to an amount which will partly control scour. This also reduces the danger to people and reduces the amount of required channel stabilization. With the velocities present, it is felt that the channel can be stabilized by either riprap or concrete sides and a soil bottom. Over most of this particular area, the soil will resist scour to some extent, particularly at the velocities used, and it is felt that the bottoms of the channels may be left as a dirt bottom, or possibly, a grass bottom without unnecessary danger.

The various areas which will require scour protection across the entire ditch are noted on the plan and in the appendix. For the most part, these consist of junctions in the greenbelt and points of structures over and across the greenbelts.

It should be noted that several of the structures now existing across the greenbelts will impede the flow and cause the greenbelts to act as storage reservoirs for short times. Since the abandonment of the storage reservoir concept, it is recommended that these structures across the greenbelts be increased in size to accommodate the entire flow and not impede the flow.

In order that the channel may not be blocked or the flow impeded at any point, it is felt that the greenbelts should be controlled by the City of Colorado Springs and not allowed to exist merely as an easement across the rear of a lot. If this cannot be done, then the ordinance should specifically restrict the building of chain link or other structural type fences across the channels.

INDIVIDUAL IMPROVEMENTS:

Attention is directed to that portion of the appendix which lists individual improvements to be used in this basin. This list together with the map of the basin shows recommended improvements to much greater advantage than any possible discussion.

After designing the main channel and individual ditches, each individual basin was studied using the minor basin hydrographs previously described. Waterflow at various points in the basin was compared to street capacity and distribution. The street capacity used was according to the latest City chart of usable street capacity. In some cases it was found that the specification of certain size streets would be sufficient to distribute runoff properly. In other cases this will probably not be sufficient and storm sewers or ditches will be required. These are shown on the attached list and maps.

This particular basin does not lend itself well to the control of runoff with street design. Some flood water may be spread through a street system, as has been done in the Eastborough area. In general, however, major streets all tend to lead toward the greenbelt and collect water on the way. Therefore, storm sewers will be required on many of these major streets. Certain proposed streets are shown specifically in the lower or southern portion of the basin. Basins 21, 22, 41, 42, and 45 in particular, indicate major streets leading toward the greenbelt. In some cases these streets contain storm sewers and in other cases not. The locations of these streets as shown do not necessarily have to be followed but would be best for drainage purposes. At nearly every connection of a street with a greenbelt, a drop out structure has been noted on the plans. These consist for the most part of a concrete structure carrying water directly from the street into the ditch, or possibly, directly into the greenbelt. These dropout structures should be individually designed for the condition which prevails at each point. However, generalized standards have been included in the report for use in any of these inlet or outlet structures.

Inlet problems are very difficult, particularly in the case of streets with steep grades. Such problems must be worked out as each area is designed since individual street design will alter the sewer design somewhat.

Curb inlets in general do not allow a great deal of water to flow into a storm collection system. The City of Colorado Springs standard curb inlet can only be assigned an intake value of about 8 cfs per opening. Specially designed intakes will therefore be advantageous at several places in the basin. The high capacity intake shown in the appendix, for instance, will allow a total of nearly 48 cfs to enter the storm sewer system. This is roughly the equivalent of six standard City street design openings. Even though construction of the high capacity inlet is somewhat more complicated, it would prove more advantageous in many locations.

Throughout the basin the water which is being carried in the streets is generally directed to the greenbelts through small ditches. This has been incorporated into the study as a general basin design. Pipe culverts could be substituted for the ditches, if desired, but are more expensive and do not carry the water as well. Inlet problems are also magnified with the pipe culverts. These ditches are designed uniformly for concrete lining. This is not always absolutely necessary, but is recommended for the purpose of ease of maintenance in these open ditches.

SPECIFIC PROBLEM AREAS:

Four specific problem areas are noted in this basin. Near sub-basin 15 along Highway 24, it was noted that during a flood period in the mid 1960's some water jumped the boundary from the Sand Creek Drainage Basin into the Spring Creek Drainage Basin. The ditch which allows this jump to take place is along U.S. Highway 24 and should be blocked so that the water from Sand Creek will not enter the Spring Creek Basin under any circumstances.

A second problem area exists in the vicinity of Basin No. 10. A glance at the topography of this basin indicates that it is an isolated basin with no direction in which the runoff water can flow. We have recommended a ditch and pipe across U.S. 24 leading into sub-basin 16. However, if this is not desired, considerable earthwork may be done in the easternmost portion of Sub-basin No. 5 which would allow the water to flow north and west into the Citidel Site. Our recommendation is to build the proposed ditch and small structure across U.S. 24. The expense of this is relatively high but the problems involved in the earthwork in Sub-basin 5 are also great and a new structure would have to be constructed under Academy Boulevard. It is felt that the cost of either method of removing storm drainage water is approximately the same.

The third problem area lies in Basin 20 along the east side of the cemetery at the intersection of Airport & Academy Boulevard. If the balance of Basin 20 is subdivided as proposed, considerable drainage water would enter this cemetery unless it is protected. A ditch has been shown along the eastern boundary of the cemetery to conduct water to Airport Road and thence to the greenbelt. It may be impractical to construct this ditch due to the topography of the land. If this is the case, then the ditch should be placed along the south boundary of the cemetery leading to a storm sewer shown in Basin 21 at approximately that point.

The fourth problem area exists in a ditch from Point F to Point G along the major greenbelt. This ditch was constructed by the Valley Hi Golf Course as a temporary water carrying ditch to relieve the golf course from flooding. This ditch is not sufficiently wide to act as a proper greenbelt. Due to the height of the dikes involved, the flow of water in this ditch will be quite rapid, leading to erosion and possible danger to the area if the dikes should break. It is recommended that the greenbelt be constructed of the width shown in the appendix and on the maps. If this is not possible, a narrower greenbelt can be used but should be lined completely with concrete.

As previously noted, various structures along the greenbelt are of unsuitable size for the proposed flow and need to be enlarged.

The experience of the 1960's has proven that several of the storm sewers shown on this proposal are desperately needed. The storm sewer up Chelton Road and Brentwood, the storm sewer system at Circle Drive and Bassett Drive, and the storm sewer along Winnipeg Drive are specific examples of this problem. Flooding has occurred in the last ten years on all of these streets. To date, damage has been relatively small. However, larger areas above these streets are now proposed for paving and commercial use. If this should occur, the amount of runoff will be higher as reflected in the figures in this report and storm sewers will become badly needed.

SUMMARY & RECOMMENDATIONS:

Experience in and around the City of Colorado Springs has shown the futility of trying to control high runoff with street drainage only. Streets will carry large quantities of water under favorable conditions, but cannot contain the high flood peaks which are common to the local intense storms of the area. The new specifications of the City of Colorado Springs indicate that water is not desired in streets, particularly arterial streets, increasing the original problem of carrying the water in the streets.

The use of streets as drainage flow structures can be tolerated up to a point. It is therefore recommended that all streets be used as drainage-ways insofar as possible. There is a point, however, at which a street is simply unable to carry the water and also traffic. At this point, a storm drainage facility must be designed. For this purpose, the greenbelts and storm sewers have been recommended in this report.

The specific recommendations in this report are mostly shown in the appendix and on the attached maps. The greenbelt widths are specified along with ditch sizes and storm sewer sizes in general. Some caution must be used in using these sizes in undeveloped basins since the layout of the new streets in the basins will affect the sizes required.

An additional recommendation is to increase the size of certain major structures over the existing greenbelts. This increase in size can be accomplished by the construction of extra boxes or pipes on each end of the existing structure thereby lengthening the effective structure but not removing the entire structure.

Due to the removal of the formerly proposed reservoirs from the Spring Creek plan, it is recommended that the greenbelt be widened to some extent, that the sides of the greenbelt ditches be either riprapped or concrete, and that all local ditches be fully lined with concrete.

Specific portions of the greenbelt are recommended to be completely lined with concrete at points where heavy scour is expected. Other points of the greenbelt can be left as dirt bottom or grass bottom since the velocities are lower and turbulence is much less.

The general recommendation of this study is that the design features shown in all the appendices and on the map be followed, in general terms at least.

BIBLIOGRAPHY

1. "Hydrology Guide for use in Watershed Planning", Sec. 4 Supplement A. US Dept. of Agriculture Soil Conservation Service.

2. Lindsey, R.K. Kohler M.A. & Paulhus, J.L.H., "Hydrology for Engineers", McGraw-Hill Book Company, 1958.

3. "Design of Small Dams", US Dept. of Interior, US Bureau of Reclamation, 1960.

4. Tech Paper No. 28 "Rainfall Intensities for Local Drainage Design in Western United States", US Dept. of Commerce, 1956.

5. Tech Paper No. 40 "Rainfall Frequency Atlas of the U.S.", Dept. of Commerce, 1961.

6. Survey Report "Runoff, Waterflow Retardation & Soil Erosion Prevention - Fountain River & Tributaries, Colorado", Soil Conservation Service, 1939.

7. Chow, V.T. "Open Channel Hydraulics" McGraw-Hill Book Company, 1959.

8. Savini & Kammerer, "Urban Growth and Water Regimen", US Geol. Survey Water-Supply Paper 1951-A, 1961.

9. Geol. Survey Water-Supply Paper 1260-E "Floods of April-June, 1952 in Utah and Nevada".

10. Geol. Survey Water-Supply Paper 1544-H "Methods of Collecting and Interpreting Ground-Water Data."

11. Geol. Survey Water-Supply Paper 1526 "Hydraulic and Hydrologic Aspects of Flood-Plain Planning".

12. "The Design of Storm-Water Inlets" Johns Hopkins University, 1956.

13. "Fountain Creek Basin Planning" Pueblo Regional Planning Commission (unpublished)

14. "The Computation of Optimum Realizable Unit Hydrographs from Rainfall & Runoff Data, " Mass. Inst. of Technology, 1965.

E BASIN BOUNDARY
N BOUNDARY
OLLECTION POINT
ROADWAY
D ROADWAY
CULVERT
BRIDGE
ELT
DITCH
D DRAINAGE STREET
D DRAINAGE DITCH
URTENANCES
STORM SEWER
STORM SEWER
H BASINS

SPRING CREEK

DRAINAGE STUDY

FOR THE

CITY OF COLORADO SPRINGS

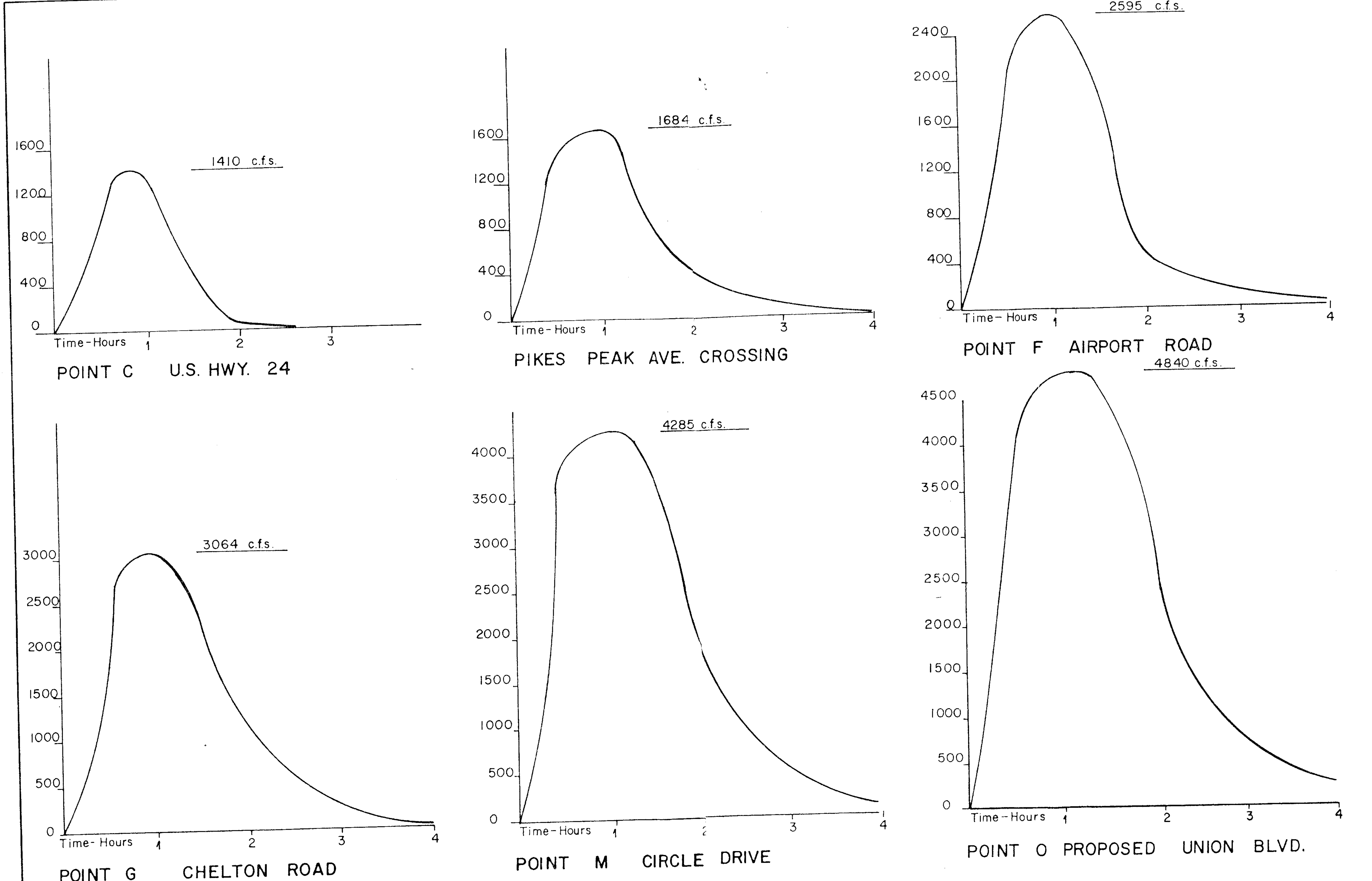
REVISED MAR. 1968

BY

THE LINCOLN DeVORE TESTING LABORATORY

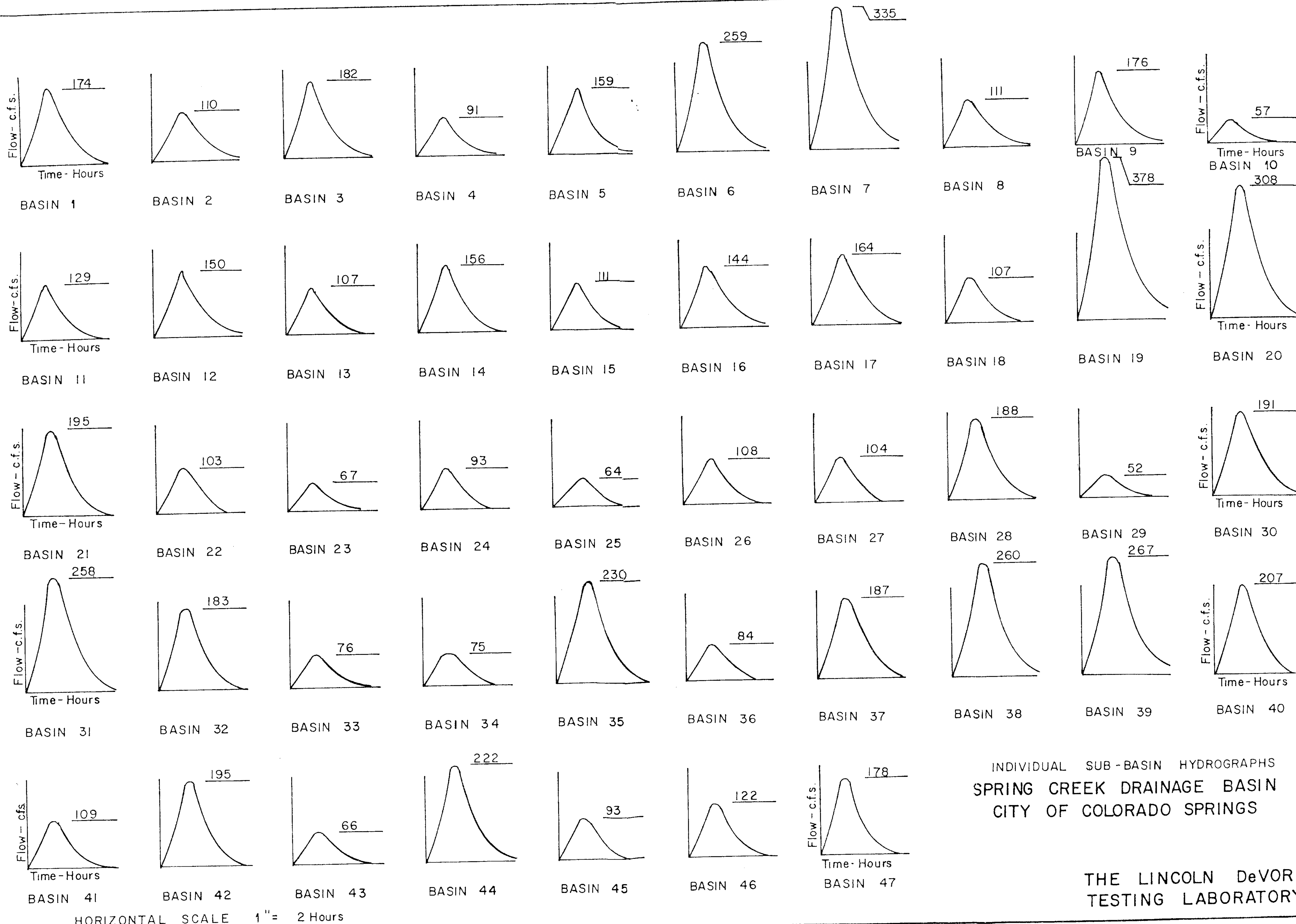
COLORADO SPRINGS, COLORADO

ORIGINAL STUDY BY
UNITED WESTERN ENGINEERS
COLORADO SPRINGS, COLORADO
AUG. 1961



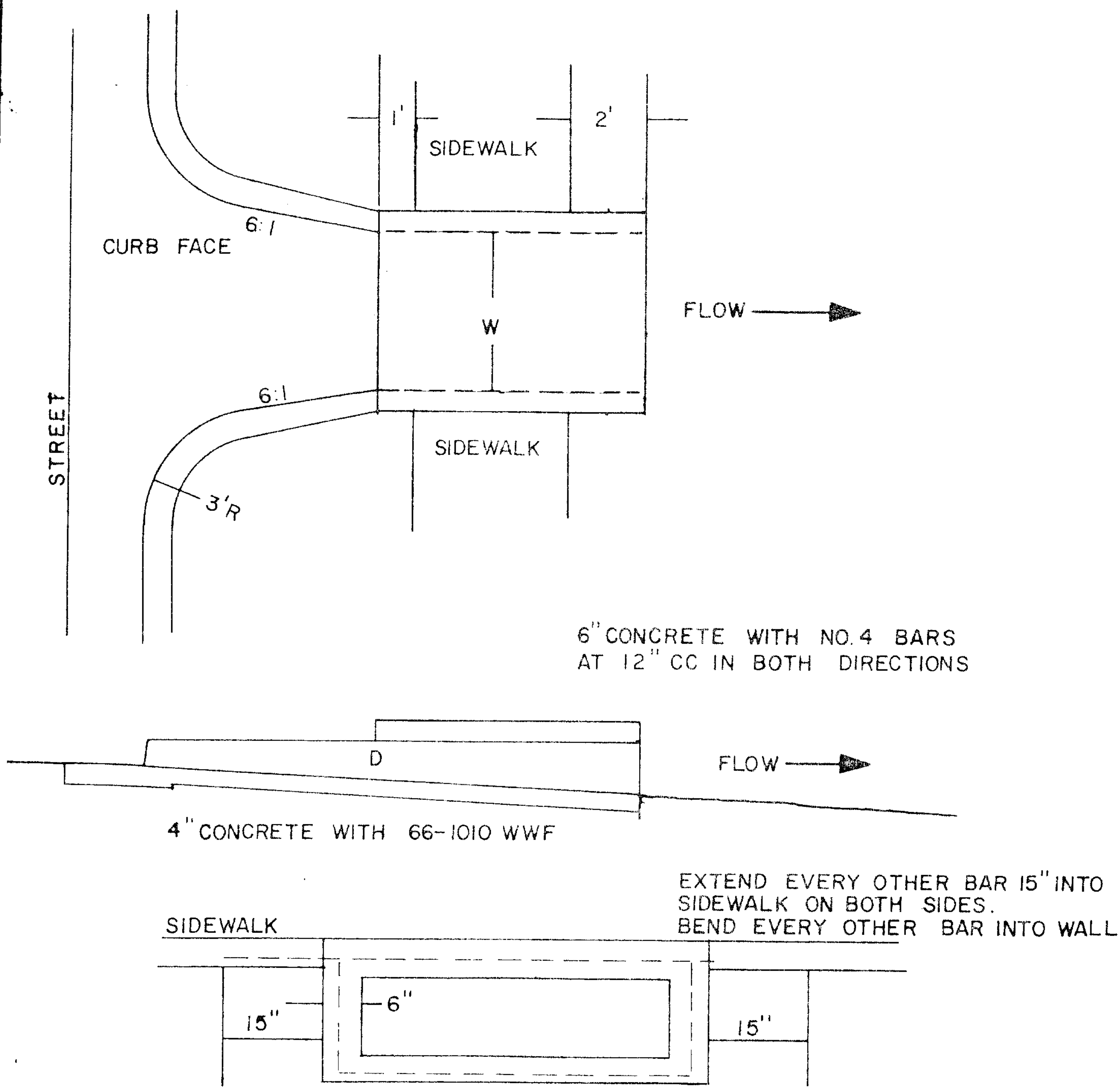
COMBINED GREENBELT HYDROGRAPHS SPRING CREEK DRAINAGE BASIN CITY OF COLORADO SPRINGS, COLORADO

THE LINCOLN DeVORE TESTING LABORATORY



INDIVIDUAL SUB-BASIN HYDROGRAPHS
SPRING CREEK DRAINAGE BASIN
CITY OF COLORADO SPRINGS

THE LINCOLN DeVORE TESTING LABORATORY



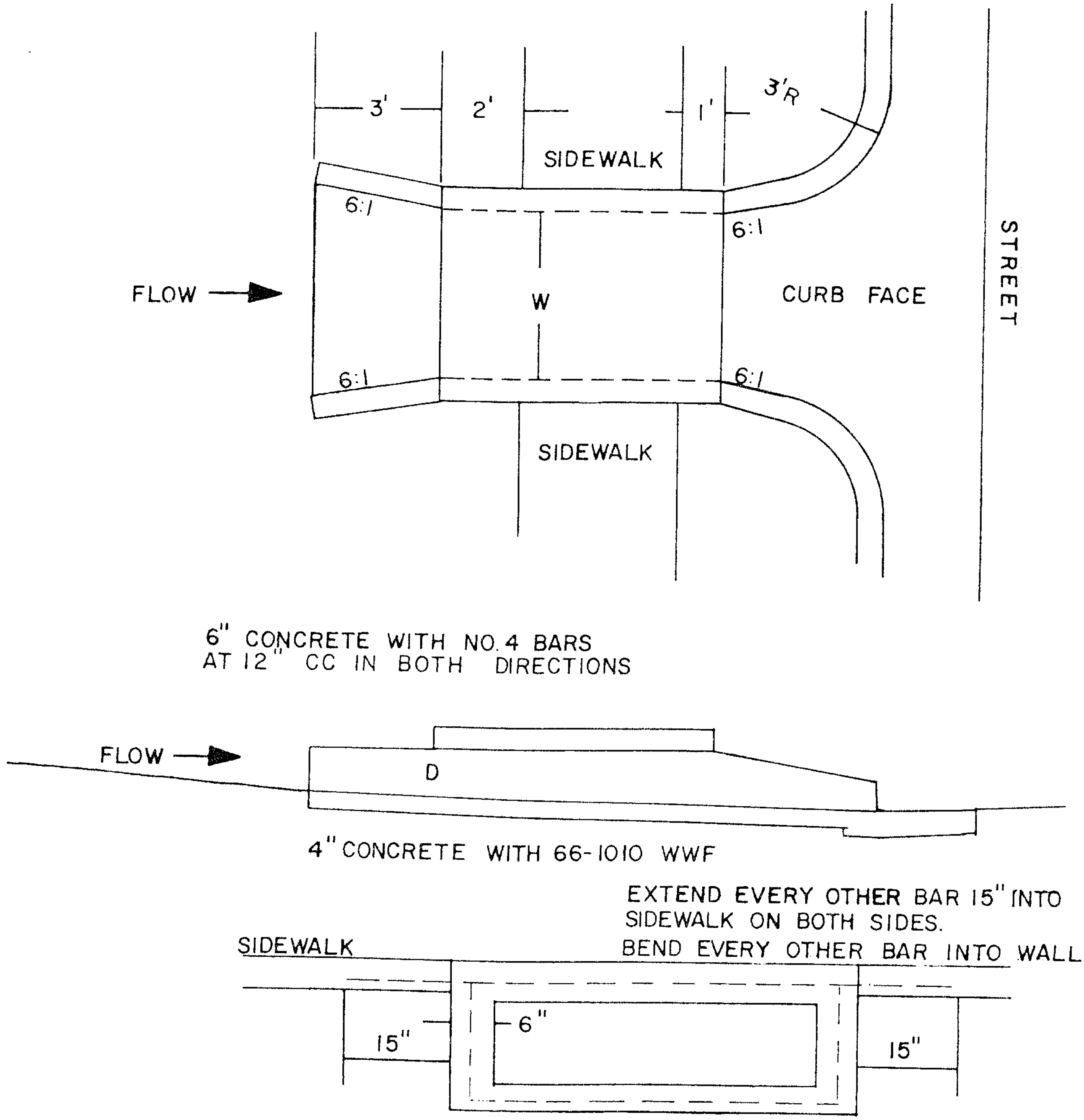
NOTE:

W IS VARIABLE DEPENDING ON QUANTITY OF WATER MINIMUM 4'

D IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

CURB INLET

THE LINCOLN DeVORE
TESTING LABORATORY



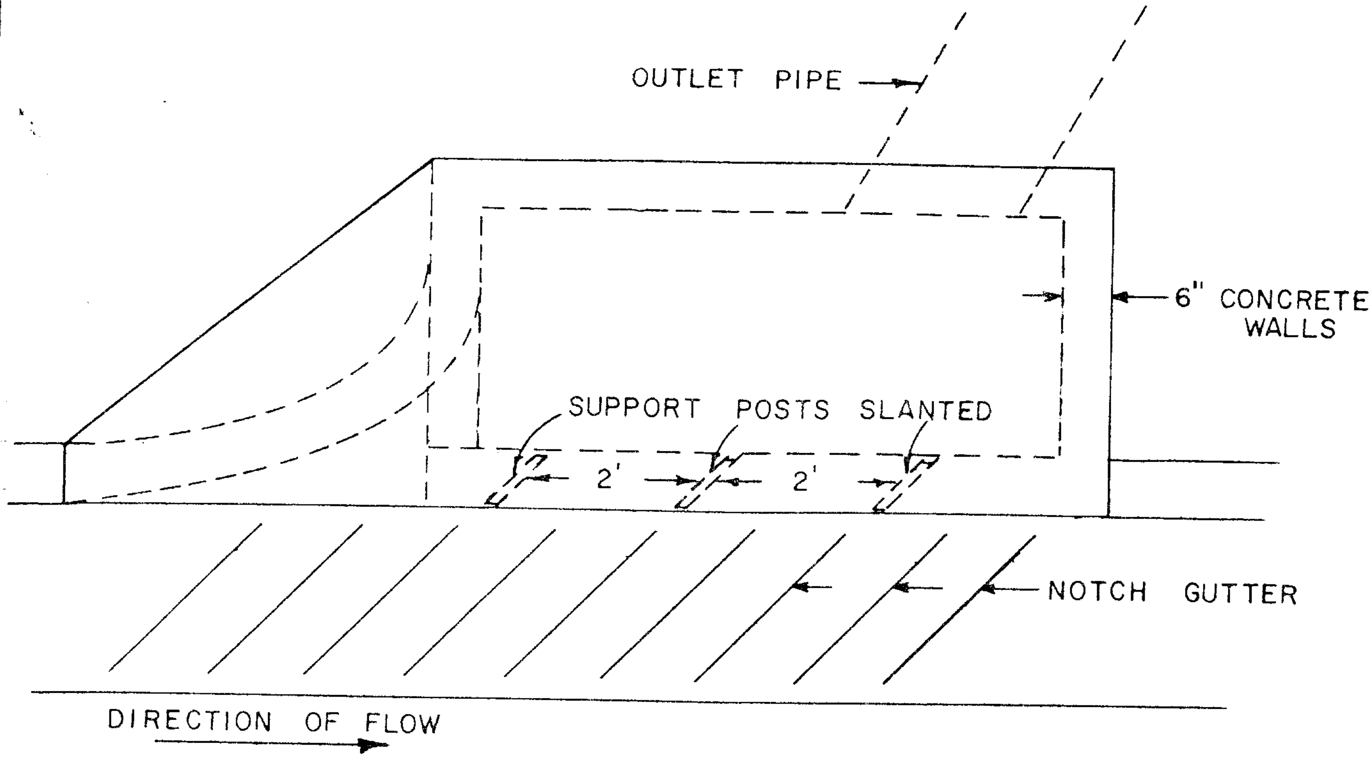
NOTE:

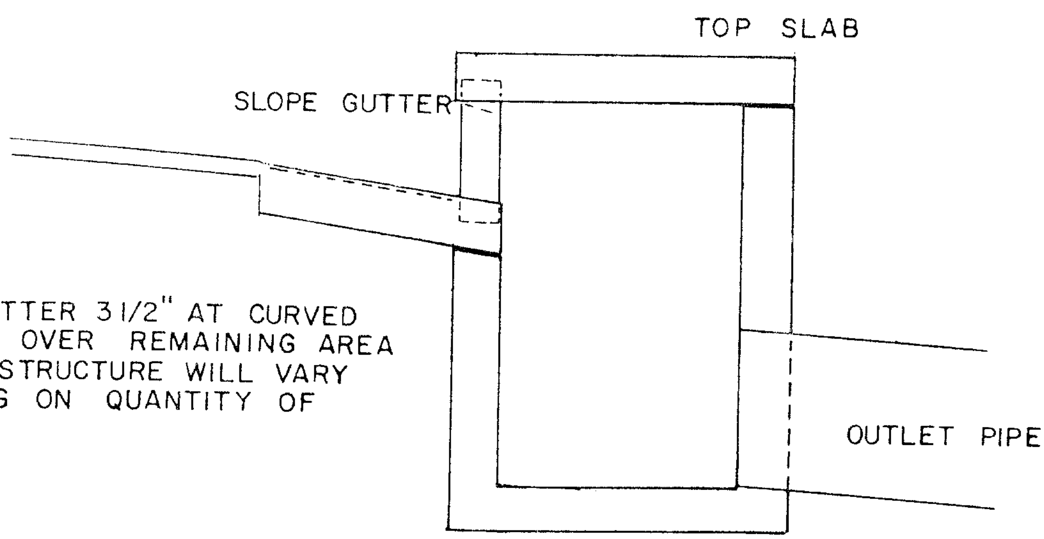
W IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 4'

D IS VARIABLE DEPENDING ON QUANTITY OF WATER. MINIMUM 1'

CURB OUTLET

THE LINCOLN DeVORE
TESTING LABORATORY

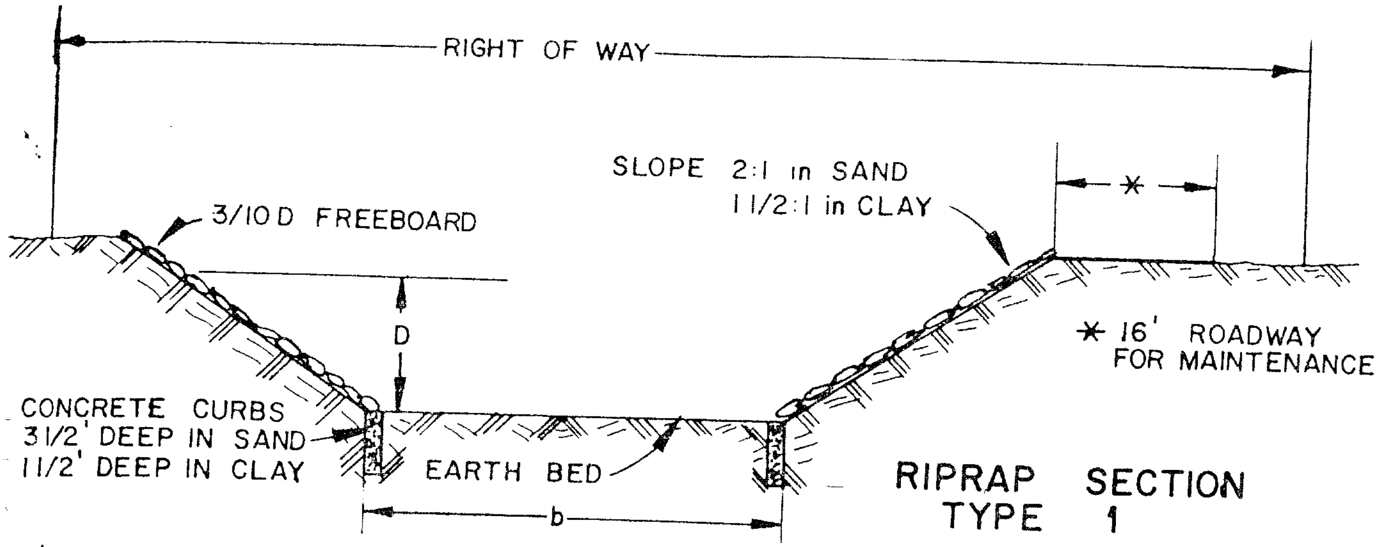




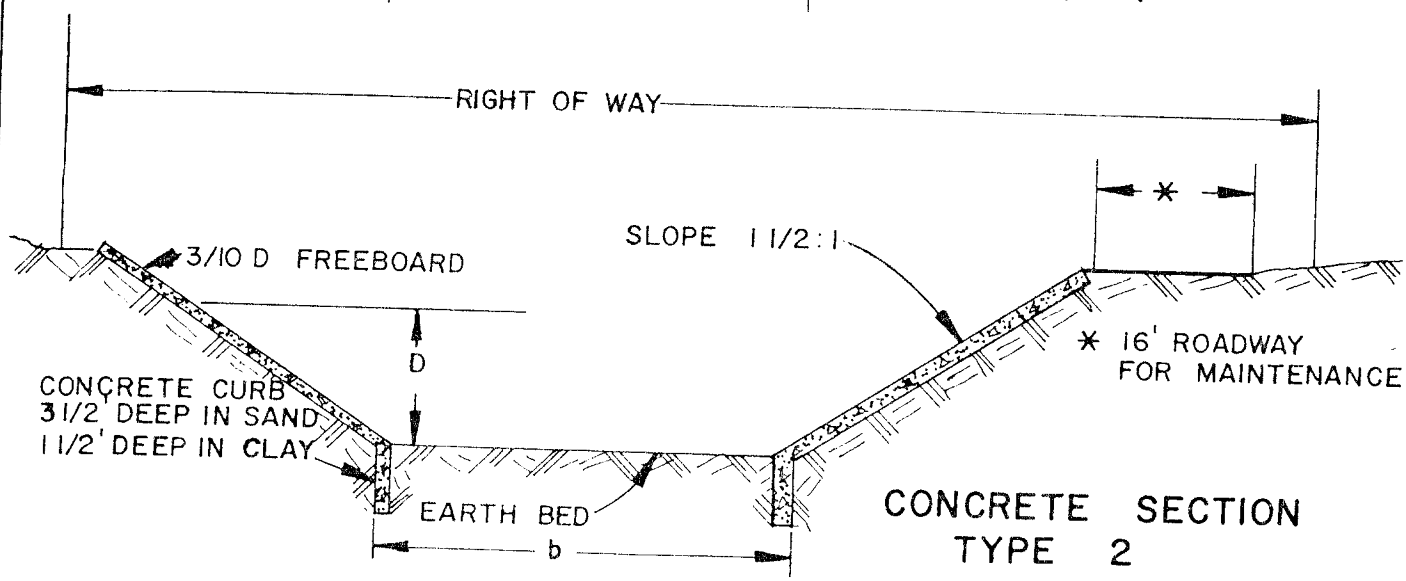
NOTE:
1. SLOPE GUTTER 3 1/2" AT CURVED ENTRY 2" OVER REMAINING AREA
2. SIZE OF STRUCTURE WILL VARY DEPENDING ON QUANTITY OF WATER

HIGH CAPACITY INLET

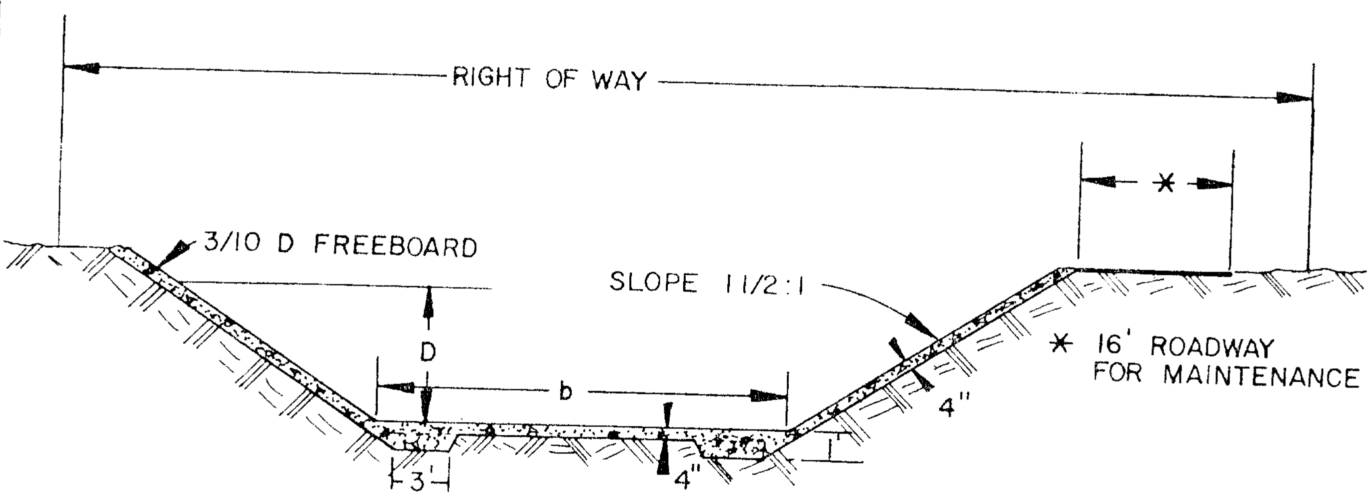
THE LINCOLN DeVORE
TESTING LABORATORY



RIPRAP SECTION
TYPE 1



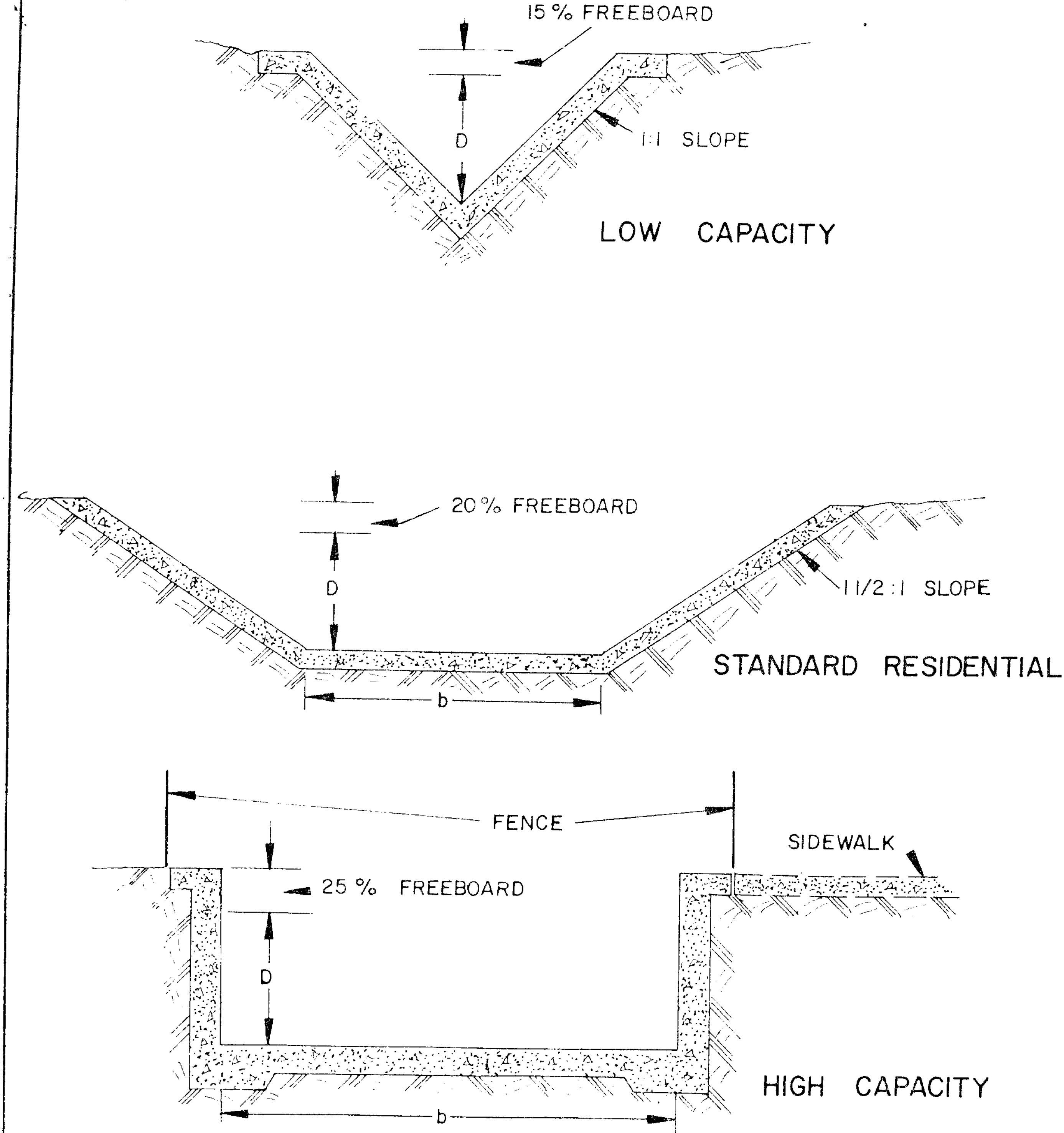
CONCRETE SECTION
TYPE 2



HEAVY SCOUR SECTION
TYPE 3

TYPICAL GREENBELT DITCH SECTIONS

THE LINCOLN DeVORE
TESTING LABORATORY



TYPICAL RESIDENTIAL DITCH SECTIONS

THE LINCOLN DeVORE
TESTING LABORATORY

SUMMARY
DRAINAGE DITCHES
TABLE (1)

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	REC. R/W	MAX. CALCUL. WATER DEPTH	RECOMMENDED FREE-BOARD	RECOMMENDED DITCH TYPE	LENGTH
A	B	9.5	30'	60'	2.5'	1'	1	2900
–	B	10	30'	60'	2.5'	1'	3	150
B	C	12.5	40'	70'	2.5'	1'	1 or 2	1100
–	C	12.5	50'	70'	2.5'	1'	3	40
C	Bijou	12	50'	80'	2.5'	1.5'	1 or 2	1600
	Bijou	12.5	50'	80'	2.5'	1'	3	50
Bijou	D	11	55'	80'	2.5'	2'	1 or 2	500
–	D	11	65'	90'	3.0'	2'	3	150
US 24	Bijou	11	10'	36'	1.5'	1.5'	1	2200
Bijou	E	10	28'	50'	1.5'	2'	1 or 2	1700
E	Academy	8	30'	87'	2.5'	2'	1 or 2	600
cademy	D	9	30'	60'	2.5'	2'	1 or 2	600
–	D	10	30'	60'	2.5'	2'	3	50
D	Shelley	11.5	65'	90'	3'	2'	1 or 2	400
–	Shelley	12	65'	90'	3'	2'	3	200

SUMMARY
DRAINAGE DITCHES
TABLE (1)

POINT FROM	POINT TO	GREENBELTS APPRX. VELOC.	GREENBELTS BOTTOM WIDTH	REC. R/W	MAX. CALCUL. WATER DEPTH	RECOM-MENDED FREE-BOARD	RECOM-MENDED DITCH TYPE	LENGTH
Shelley	F	11	75'	100'	3'	2'	1 or 2	1100
–	F	11.5	75'	100'	3'	2'	3	50
F	G	11	86'	120'	3'	1.5'	1 or 2	3000
–	G	11	75'	100'	4'	1.5'	3	80
G	K	11	75'	100'	4'	1.5'	1 or 2	900
K	L	15	58'	90'	4'	2'	2	1300
L	M	15	60'	80'	4'	2'	3	300
–	M	17	65'	100'	4'	1.5'	3	60
M	N	16	80'	120'	3'	1.5'	2	2200
N	P	11	110'	150'	3.5'	1.5'	1 or 2	1600
P	Q	11.5	95'	130'	4'	1.5'	1 or 2	1000
Q	Outfall	11.5	95'	140'	4'	1.5'	1 or 2	2200

SUMMARY
DRAINAGE DITCHES - LOCAL
TABLE (2)

BASIN NO.	WATER DEPTH b	D	LENGTH
4	2'	1.5'	200'
5	5'	3'	850'
9	4'	3'	1000'
9	2'	2'	800'
10	3'	2'	750'
11	4'	3'	350'
11	3'	2'	150'
11	3'	2'	50'
12	4'	3'	800'
13	3'	2'	350'
14	8'	2'	900'
16	5'	2'	400'
19	5'	2'	150'
19	10'	2.5'	500'
20	5'	2'	1100'
20	4'	2'	650'
21	6'	2'	150'

* All ditches paved as shown on detail sheet.
Ditches near Chelton @ Dale, Basin 34, Basin 36, and from Winnipeg to Fountain are existing.

SUMMARY
DRAINAGE DITCHES - LOCAL
TABLE (2)

BASIN NO.	WATER DEPTH b	D	LENGTH
22	4'	2'	300'
26	3'	2'	100'
27	3'	2'	200'
27	2'	2'	100'
37	18'	2.5'	400'
38	12'	2'	450'
39	2'	1.5'	400'
39	8'	3'	550'
40	5'	2'	1250'

* All ditches paved as shown on detail sheet.
Ditches near Chelton @ Dale, Basin 34, Basin 36, and from Winnipeg to Fountain are existing.

SUMMARY
STORM SEWERS
DEVELOPED
TABLE (3)

BASIN	PIPE DIA.	LOCATION	LENGTH	INLETS	
3	24"	Auburn & Reinhart	340'	3-2x	
	30"	" "	500'	4-2x	
	36"	" "	550'	2-2x	
	48"	" "	700'	5-2x	
6	24"	Querida	300'	2-2x	
	30"	"	700'	3-3x	
	42"	"	750'	4-2x	
7	30"	De Cortez or Galley	650'	1-5x	
	42"	" "	600'	4-2x	
	48"	" "	1000'	4-3x	
10	36"	Across U.S. 24	200'		
16	36"	Murray	400'	2-3x	
	48"	"	200'	2-3x	
17	48"	Bijou	950'	2-4x	

SUMMARY
STORM SEWERS
DEVELOPED
TABLE (3)

BASIN	PIPE DIA.	LOCATION	LENGTH	INLETS	
19	24"	Shelley	200'	2-2x	
	36"	"	300'	1 HC 1	
	42"	"	850'	4-2x	
	48"	"	1200'	3-2x	
	66	"	350'	4-2x	
20	36"	Airport	800'	1HC1	
	42"	"	550'	4-2x 1-3x	
21	36"	Proposed Street	800'	2-2x	
	48"	" "	600'	4-2x	
	24"	Academy	120'	Headwalls	
22	24"	Meadow Hills Dr.	300'	2-2x	
	30"	" " "	350'	2-2x	
23	24"	Fountain	350'	2-2x	

SUMMARY
STORM SEWERS
DEVELOPED
TABLE (3)

BASIN	PIPE DIA.	LOCATION	LENGTH	INLETS	
25	36"	Chelton	1000'	4-2x	
	42"	"	450'	2-2x	
26	30"	Mallard	400'	2-3x	
	36"	"	300'	2-3x	
28	24"	Brentwood	100'	2-2x	
	36"	"	800'	2-3x	
	42"	"	1000'	5-2x	
30	48"	Chelton	800'	6-2x	
	54"	"	1200'	5-2x	
	60"	"	800'	2-2x	
31	24"	Bassett, Circle & Garo	200'	Sp-3x	
	36"	" " "	1100'	6-3x	
	42"	" " "	350'	2-3x	
	48"	" " "	450'	4-2x	
	54"	" " "	200'	-	
35	36"	Placid, Sequoia, Carls-bad	1100'	2-3x 4-2x	

SUMMARY
STORM SEWERS
DEVELOPED
TABLE (3)

BASIN	PIPE DIA.	LOCATION	LENGTH	INLETS
35	42"	Placid, Sequoia, Carlsbad	400'	2-2x
	48"	" " "	1350'	5-2x
	54"	" " "	800'	6-2x
	60"	" " "	300'	2-2x
37	24"	Verde	550'	2-2x
	36"	"	350'	4-2x
	42"	"	350'	2-2x
	48"	"	600'	4-2x
	54"	"	650'	4-2x
38	24"	Capulin	100'	2-2x
	30"	"	300'	2-2x
	36"	"	300'	2-2x
	42"	"	650'	5-2x
	48"	"	650'	4-2x
	54"	"	300'	2-3x
	60"	"	400'	2-3x
39	24"	Winnepeg	500'	4-2x

SUMMARY
STORM SEWERS
DEVELOPED
TABLE (3)

BASIN	PIPE DIA.	LOCATION	LENGTH	INLETS	
39	36"	Winnipeg	400'	2-4x	
	42"	"	450'	3-3x	
	48"	"	650'	2-2x	
	54'	"	550'	2-2x	
42	30"	Proposed Street	400'	2-2x	
	36"	" "	450'	2-3x	
	42"	" "	400'	2-2x	
	48"	" "	550'	4-2x	
44	24"	Union	250'	2-2x	
	36"	"	200'	1-3x	
	48"	"	750'	3-3x	
	54"	"	950'	4-2x	

NOTES:

1. Existing sewers not listed above.
2. Inlets shown as 3x or larger would be more efficient using the high capacity design.

SUMMARY
MAJOR STRUCTURES ON GREENBELT

TABLE 4

LOCATION	EXISTING FACILITY	REQUIRED FACILITY	
Galley & Academy	54" pipe headwall	Sp. Street Dropout	
US 24 near Chelton	8x10 Concrete Box	100□' opening with 4 street drops	
US 24 near Murray	3x8 Concrete Box	No additional	
Bijou near Auburn	5x7 Concrete Box	180□'opening with 2 street drops	
Bijou at Emerson School	none	5'9"x 8'2" arch	
Pikes Peak near University	3-48" CMP	190□' opening with 3 street drops	
Pikes Peak near Ruskin	Twin 3x9 Conc.Box	No additional cap. 2 street drops	
Academy near Pikes Peak	Twin 4x10 Conc.Box	No additional cap. 2 street drops	
Airport Road	5x12.8+5x16+5x12.8 Triple Concrete Box	240□' opening with 2 street drops	
Chelton Road	Quad 8x 6 Conc.Box with street drops	260□' opening	
Fountain Boulevard near Circle	Apprx. 9.5x15.0 CMP arch	250□' opening with 1 street drop	
Circle Drive near Fountain Blvd	Twin 6x10 Conc.Box	260□'opening with 2 street drops	
Union Boulevard extension	none	420□' opening 2 street drops	

SUMMARY
MAJOR STRUCTURES ON GREENBELT
TABLE 4

LOCATION	EXISTING FACILITY	REQUIRED FACILITY	
Hancock	Av.30x20'bridge	none additional	
AT&SF ROW	Twin 24'wide, av.ht 20' masonry arch	none additional	
Las Vegas	Bridge-90'wide Av. Ht. 12.5'	none additional	
D & RG ROW	Quad CMP-width 13.5 av. ht. 11.5'	none additional	

SPRING CREEK

DRAINAGE STUDY

FOR THE

CITY OF COLORADO SPRINGS

REVISED MAR. 1968

BY

THE LINCOLN DeVORE TESTING LABORATORY

COLORADO SPRINGS, COLORADO

ORIGINAL STUDY BY

UNITED WESTERN ENGINEERS

COLORADO SPRINGS, COLORADO

AUG 1961