Leavenworth County
Department of Public Works

Road Construction and Storm Water Drainage Standards

Prepared by
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Approved by
David L. Mahoney, P.E.
Director of Public Works/County Engineer

For
New Subdivisions
2003 Edition
Official Copy As Incorporated by Resolution No.

January 1, 2003

ROAD CONSTRUCTION
AND
STORM WATER DRAINAGE STANDARDS
FOR
NEW SUBDIVISIONS

Date: January 1, 2003

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CHAPTER I
PROCEDURE FOR PLAN SUBMITTAL

GENERAL: The developer's Professional Engineer who designs the road plans and storm water drainage plans shall be referred to hereafter as design engineer. Each developer or design engineer submitting plans for road improvement and storm drainage system projects in a new subdivision is required to follow the procedures outlined in this standard. No road or storm drainage project may be constructed without the prior written approval of the County Engineer.

PREAPPLICATION CONFERENCE: A preapplication conference with the Leavenworth County Engineer is required prior to filing the preliminary plat, the subdivider, and design engineer shall attend this conference. The purpose of this conference is to: acquaint the applicant with the procedural requirements of this standard; provide for an exchange of information regarding the proposed subdivision and applicable elements of this standard.

PLAN SUBMITTAL: One complete set of prints of the project plans shall be submitted to the office of the County Engineer for review on Final Plats meeting the requirements stated herein.

1) The design engineer shall upon approval of the Preliminary Plat submit complete set of prints meeting the requirements stated hereafter, and make all necessary corrections or revisions as noted by the County Engineer.

2) The final road plans and/or revised plans & sanitary sewer plans shall be submitted 30 days before the Planning Commission is to meet to consider the Final Plat. The revised plans should have identifying notations of the revisions. The design engineer shall also submit with his plans a detailed estimate of the total costs of the improvements, which includes all quantities and individual costs.

3) The County Engineer shall, prior to the Planning Commission meet to consider the Final Plat, Report his findings or recommend approval the road & sanitary sewer plans and Plat.

4) If road & sanitary sewer plans are not submitted in the above time frame approval of plats will be delayed.

CHAPTER II
RESPONSIBILITY DURING CONSTRUCTION

GENERAL: The developer's/owner's design engineer shall be responsible during construction of the project. This work shall be paid for by the developer/owner. The services of the engineer required by this chapter will not be paid for by Leavenworth County.

PRECONSTRUCTION CONFERENCE: A preconstruction conference with the Leavenworth County Public Works Department is required prior to any construction activity on this project. The Contractor, Owner, Design Engineer, and Surveyor are required to attend this conference.

CONSTRUCTION STAKING: Construction staking shall be the responsibility of the contractor and/or design engineer.

SEEDING: All areas disturbed by the construction of said improvements shall be seeded and mulched. Seeding shall be accomplished between the following recommended dates:

Spring Seeding – February 15 to June 1
Fall Seeding – August 15 to October 15

(a) Fertilizer, seed, and mulch shall be per KDOT standard specifications.

If seeding doesn't take developer will be responsible for reseeding until there is a good stand of grass.

STREET SIGNS: The County will install all the necessary permanent street, warning, and regulatory signs, the costs incurred for installation to be paid to the county by the subdivider or owner within (20) days of the billing date.

CONSTRUCTION RECORD DRAWINGS: Construction record drawings shall be submitted to the County Engineer upon completion of the project and prior to final acceptance of the project by the County Engineer. The engineer shall provide the County one complete set of prints showing the project as-built.

COMPLETION CERTIFICATE: Upon completion of the project and prior to final acceptance of the project by the County Engineer, the design engineer and contractor shall certify in writing: (1) that the project was constructed to the lines, grades, and dimensions shown on the approved plans, (2) that sufficient AB-3, asphalt, rock, oil concrete and hot mix were incorporated into the work to construct the project as designed. Before final acceptance of the project the owner/developer, or his contractor shall furnish a Maintenance Bond in the form that's approved in the amount equal to 100 percent of the amount estimated for the improvements and agreeable to the County Engineer.

CHAPTER III
GENERAL PLAN REQUIREMENTS

INTRODUCTION: All plans submitted shall be prepared by, or under the direction of, a professional engineer, licensed in the State of Kansas, and shall be reviewed by the County Engineer for compliance with the minimum design requirements as established in this manual and the storm drainage standards officially adopted by the Public Works Department, effective the date of the plan submittal. Whenever extraordinary or unusual problems are encountered in conjunction with a proposed project, additional information and analysis beyond the minimum requirements of these standards and criteria may be required.

GENERAL: The required plan sheet size is 22" x 36" or 11" x 17" with all sheets in a given set of plans being of the same size. Plan and profile shall be drawn on double or single plan and profile sheets to scales of one (1) inch equals fifty (50) feet horizontal by one (1) inch equals ten (10) feet vertical, unless otherwise approved by the County Engineer.

The plans shall consist of:

1. Title Sheet
2. Standard and Special Detail Sheets
3. Plan and Profile Sheets
4. Cross-Section Sheets

Each sheet shall contain a sheet number, including the individual sheet number and the total number of sheets, the engineer's seal, proper project identification, date, and revision block.

TITLE SHEET

The following items shall be included on the title sheet:

1. Name of project or subdivision.
2. Index of sheets included in plans.
3. A general layout map of the subdivision with existing and final grading contours. (Use 5' intervals if site grading is not required, use 2' intervals if site grading is required). Indicate on the layout map the one hundred-year flood line. A drainage area map if drainage areas are not shown on layout man.
4. A location map showing project location in relation to major streets.
5. A blank line for approval by the County Engineer with the following note:

   These plans are approved for one year, after which they automatically become void. The County Engineer's plan review is only for general conformance with road and storm water drainage standards adopted by Leavenworth County. The County did not check, and is not responsible for the accuracy and adequacy of the design, dimensions, elevations, and quantities.

6. The project control benchmark shall be identified as to location and elevation; USGS datum.
7. Name, address and telephone number of the design engineer and owner/developer.
8. List containing name and telephone number of each utility company in the area of the project.
9. A certification by the design engineer as follow:

   These plans have been prepared in accordance with Leavenworth County's Road Construction and Storm Water Drainage Standards, 2003 Edition. I hereby hold harmless Leavenworth County for errors or omissions in these plans.

STANDARD AND SPECIAL DETAIL SHEETS: Detail sheets shall be included to show all details of appurtenances, materials, and construction. Details and typical sections shall conform to standards adopted by Leavenworth County and are to be drawn clearly and neatly with proper identifications, dimensions, materials, and other information necessary to insure the desired construction. For items that Leavenworth County does not have adopted standards, such as storm sewer inlets, manholes, sidewalks, etc., use the current KDOT standards and details. A traffic control plan shall be detailed showing location of barricades, include signing need when working adjacent to public roads or private roads.

PLAN AND PROFILE SHEETS: The following items shall be included on the plan and profile sheets for all improvement projects.

1. North arrow and vertical & horizontal scale.
2. Elevation and location of all applicable bench marks (USGS datum).
3. Existing and proposed streets with names or numbers and street widths and right of way widths.
4. Property lines properly identified as to existing or proposed lot, block and subdivision.
5. All existing and proposed utilities such as power, cable t.v., gas, oil, water, fire hydrants, telephone, sewer and other items shall be properly located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, material, and type of construction.
6. All existing and known proposed improvements within seventy-five (75) feet each side of centerline shall be shown at their proper locations. This shall include such existing items as paved streets, curbs and gutters, driveways, culverts, fire hydrants, utility poles, trees, shrubs, fences, walls, houses, and other such items, and shall be identified as to type, size, material, etc., as may be applicable. In case of new developments, some irrelevant items may be omitted.
7. All existing easement and right-of-way information recorded with the Register of Deeds and the Public Works Department.
8. Minor construction notes shall appear on the proper plan and profile sheets.
9. Locations and widths of existing and proposed sidewalks, if any.
10. Horizontal curve data, vertical curve data, and stopping sight distances.
11. Gradient between vertical curves.
12. Typical section and slope of improved channels.

13. Stations and grade at curb returns (at 1/5 points).
14. Profile shall show existing grade at centerline as a dashed line, proposed finish grades or established street grades by solid lines.
15. Existing elevations for existing outfall ditches.
16. Special ditch grades if needed.
17. Show size, location, and flow line of all culverts.
18. Show the plan and profile of proposed sanitary sewers with grades and pipe sizes indicated.
19. Needed traffic control signage.

CROSS-SECTIONS SHEETS: The following items shall be included on the cross-section sheets:

1. Street cross-section at each station showing existing grade by dashed lines and proposed grade by a solid line. Cross-sections to show existing grade lines a minimum of ten (10) feet beyond right-of-way lines.
2. Center line elevation of top of pavement.
3. Cross-section shall be shown at all intersecting streets and driveways.
4. Channel cross-sections shall be shown for all drainage channel improvements at 100 feet intervals.
5. Additional cross-sections shall be shown as required too clearly describe the extent of the grading operations.

CHAPTER IV
DESIGN CRITERIA

GENERAL: Streets and storm drainage systems for proposed subdivisions shall be designed in conformance with these standards and the drawings attached.

CLASSIFICATION OF STREETS: The classification of streets shall be as described in the relevant subdivision regulations made applicable for Leavenworth County. The Department of Public Works will designate collector streets on the preliminary plat review.

STEET DESIGN CRITERIA

CLASSIFICATION TYPE:	Arterial and/or Collector A	B	Local
Design Speed (MPH)	50	50	30
Stopping Sight distance	450'	450'	200'
Minimum Grade	0.8%	0%	0.8%
Maximum Grade	8%	8%	9%
Maximum grade within 200' of an intersection	3%	3%	5%
Minimum ditch Grade	-	0.6%	0.6%
Minimum radius of Horizontal curve	955'	764'	302'
Minimum R/W width	100'	80'	60'
Tan. between Reverse Curves with super	150'	200'	100'
Tan. Between Reverse Curves (no super)	150'	150'	100'
Cul-de-sac radius (R/W)	-	-	60'
Cul-de-sac radius (mini)	-	-	50'
Maximum rate of super Elevation	0.04	0.08	0.04
Curb return radius (min)	35'	35'	25'-30'

Other standards will be determined on a case-by-case basis.

VERTICAL ALIGNMENT: All changes in street grades shall be connected by vertical curves of such length as to provide for the desired sight distance.

ADDITONAL RIGHT-OF-WAY: When existing or anticipated traffic on arterial and/or collector streets warrants greater right-of-way width, the additional right-of-way shall be dedicated on the final plat.

SEEDING: Seeding and mulching of all disturbed areas is required and shall be included as part of the street and storm drainage plans. In accordance with this standard see pages 3-4.

CUL-DE-SACS AND DEAD ENDS: Except in cases where there is unusual topographic conditions, which may make it advisable to modify these provisions, the following shall apply:

1) The location of cul-de-sac shall be per regulations and depends on the type of road. The minimum radius for any street for vehicular turnaround shall be fifty (50) feet and the minimum radius for right-of-way shall be sixty (60) feet.

2) In the case of temporary dead-end streets, which are stub streets designed to provide future connection with unsubdivided areas adjoining, the planning Board may require a temporary easement for a turnaround of a nature indicated above. Minimum radius of 30', minimum easement of 40'.

3) When a subdivision is replated or the existing road ends and is to be extended, the existing cul-de-sac shall be eliminate and the road brought to the standards as specified in this document.

KDOT SPECIFICATIONS: All construction procedures and materials shall meet Kansas Department of Transportation (KDOT) specifications. The plans should reference all appropriate KDOT specifications that apply to the project.

STORM WATER DRAINAGE STANDARDS

STORM WATER DRAINAGE OF ENCLOSED SYSTEMS AND OPEN CHANNELS: Unless otherwise provided in this document, the design Criteria for Storm Drainage Systems and Facilities, latest addition, prepared by the Kansas City Metropolitan Chapter of the American Public Works Association, Section 5600, inclusive, or as amended, which is by reference made a part hereof as though expressly rewritten and incorporated in the resolution, shall govern the design of enclosed systems and open channels within Leavenworth County. (See enclosed)

STORM WATER RUNOFF MANAGEMENT PLANS: When in the opinion of the County Engineer a proposed development does not follow the intent of these standards or the development may increase hazards to persons and lessen public health, safety, and general welfare; he may require the developer to submit Storm Water Management Plan. The Storm Water Management Plan shall be prepared by a licensed professional engineer in this State. The plan shall meet the approval of the County Engineer.

STORM WATER DRAINAGE SYSTEM: Design for storm water drainage must always allow for ultimate density with the intention of attaining a zero net gain in storm water runoff between the tract in its natural state and the proposed developed state. The improvement plans for an adequate storm water drainage system including all necessary open ditches, pipes, culverts, intersectional drains, drop inlets, bridges, and other necessary structures and improvements which are required for the proper drainage of all surface waters shall be provided. This system must prevent the infiltration of water in areas of cuts and fills thereby causing the land to slip or collapse. Adequate provision and maintenance must be made for one-lot drainage channels and control of erosion on slope areas for either cuts and fills.

STORM DRAINAGE PIPE: Corrugated steel pipe aluminum coated or zinc coated meeting the requirements stated above or Reinforced concrete pipe is required for storm drainage pipe. Corrugated plastic may be used when pipe type, plans and specifications are submitted and approved by the County Engineer.

CROSS ROAD-CULVERTS CULVERTS: Cross road culverts shall be reinforced concrete pipe (RCP) with manufactured end sections. Downstream ends of CSPA larger than 30" diameter and all cap shall have poured concrete toewalls. CSP culverts smaller than 36" shall be 16 gage. CSP culverts from 36" to 42" shall be 14 gage. Larger diameter culverts will be analyzed on an individual basis. If large diameter CRP is needed CSPA pipe may be used with approval of County Engineer.

ENTRANCE PIPE CULVERTS: All entrance pipe shall be corrugated steel pipe aluminum coated or zinc coated meeting the requirements stated above. The culvert diameter to be approved by the County Engineer or his representative. Minimum culvert length shall be 24 feet or entrance width plus 10 feet which ever is greater. Manufactured coupling bands are required for corrugated pipe. When entrance pipe is installed by the contractor/or developer manufactured end sections shall be furnished.

DRAINAGE EASEMENTS: Drainage easements shall be required, in addition to street right-of-way, where the street or streets adjoin or are parallel with streams or drainage areas or where lots back on said drainage areas. The width of said drainage easements shall be determined by the County Engineer.

STREET IMPROVEMENT TYPES

Type A Collector/Arterial Streets: These streets are paved (eight (8) inches Asphaltic Concrete Pavement over four (4) inches of Aggregate subbase and six (6) inches of compacted soil subgrade) streets with concrete curbs and gutters. Type A Collector streets are required when designated by the Department of Public Works on a new road in subdivisions.

Type B Collector/Arterial Streets: These streets are paved (eight (8) inches Asphaltic Concrete Pavement over four (4) inches of Aggregate subbase and six (6) inches of compacted soil subgrade) streets with open road ditches. Type B Collector streets are required when extending an existing County Road with the open road ditches.

Urban Streets: Urban streets are paved (six (6) inches Asphaltic Concrete Pavement over four (4) inches of Aggregate subbase and six (6) inches of compacted soil subgrade) streets with concrete curb and gutters. Urban streets are required in subdivisions located within the urban growth boundary of any incorporated City in Leavenworth County, and are allowed in all subdivisions in the unincorporated areas of Leavenworth County.

Rural Streets: Type rural streets are paved (double chip & seal over eight (8) inches of Aggregate subbase and six (6) inches of compacted soil subgrade) with open road ditches. Rural streets are allowed in subdivisions outside the urban growth boundaries of all incorporated cities in Leavenworth County. Developer to pay County of total costs for future third seal before final acceptance of roads.

Type Rural Streets: Type R-A Rural streets are paved (six (6) inches Asphaltic Concrete Pavement over four (4) inches of Aggregate subbase and six (6) inches of compacted soil subgrade) with open road ditches. Type R-A streets are allowed in subdivisions, in the unincorporated areas of Leavenworth County. But must be 1 mile from existing City limits to be allowed. If any City objects to these standard developer shall get that cities approval.

APPEALS: Any person aggrieved by these Standards may appeal any order, requirement, decision, or determination first to the Board of Zoning Appeals, then to the Board of County Commissioners in accordance with the procedures set forth below.

(A) A hearing before the Board of Zoning Appeals may be required within the time of their next date, to consider such order, requirement, decision or determination of these Standards. The Board shall consider any information offered by the aggrieved person bearing on the dispute and may recommend to the County Engineer, in writing, an appropriate course of action: either reversal, modification, or confirmation. The County Engineer shall act on the written recommendation in a manner consistent with his responsibilities under these standards.

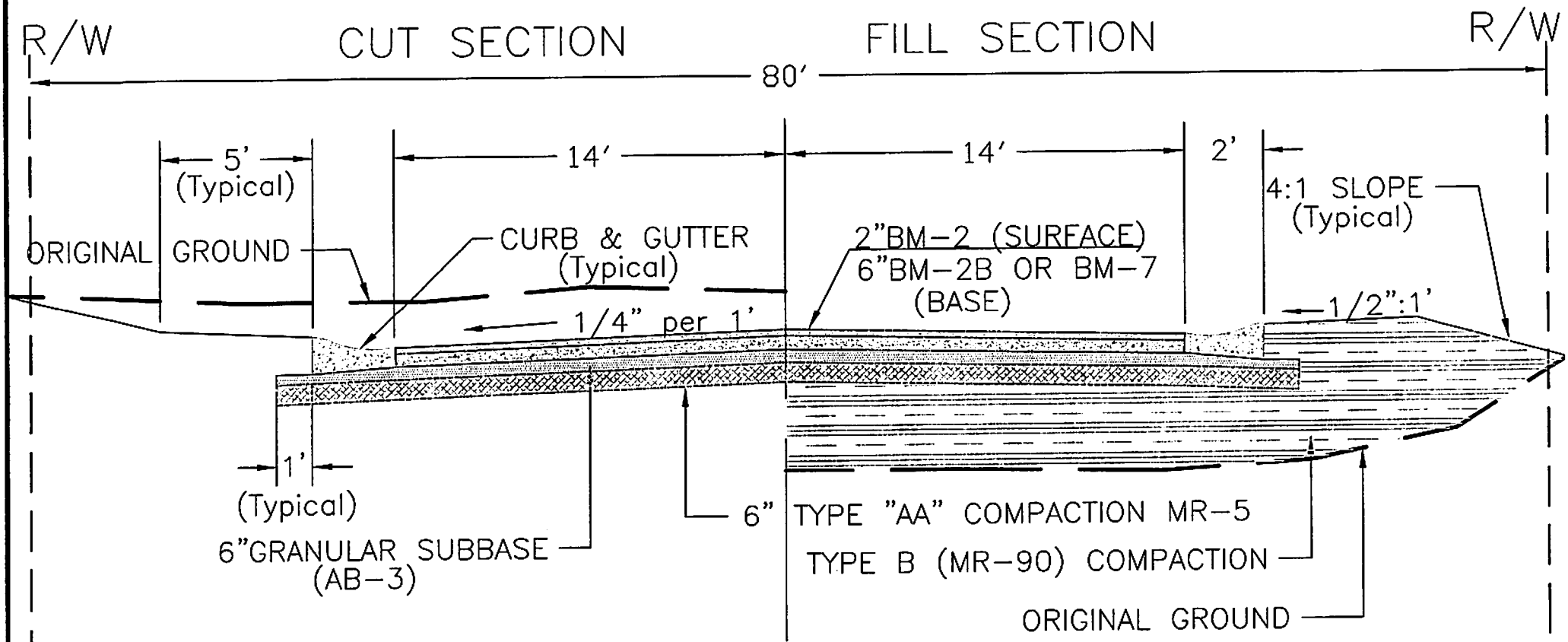
(B) Any person aggrieved by any decision of Board of Zoning Appeals may seek review by the Board of County Commissioners in manner as described above.

CHAPTER V

DETAIL DRAWINGS-COLLECTOR STREETS

COLLECTOR STREET

TYPE A



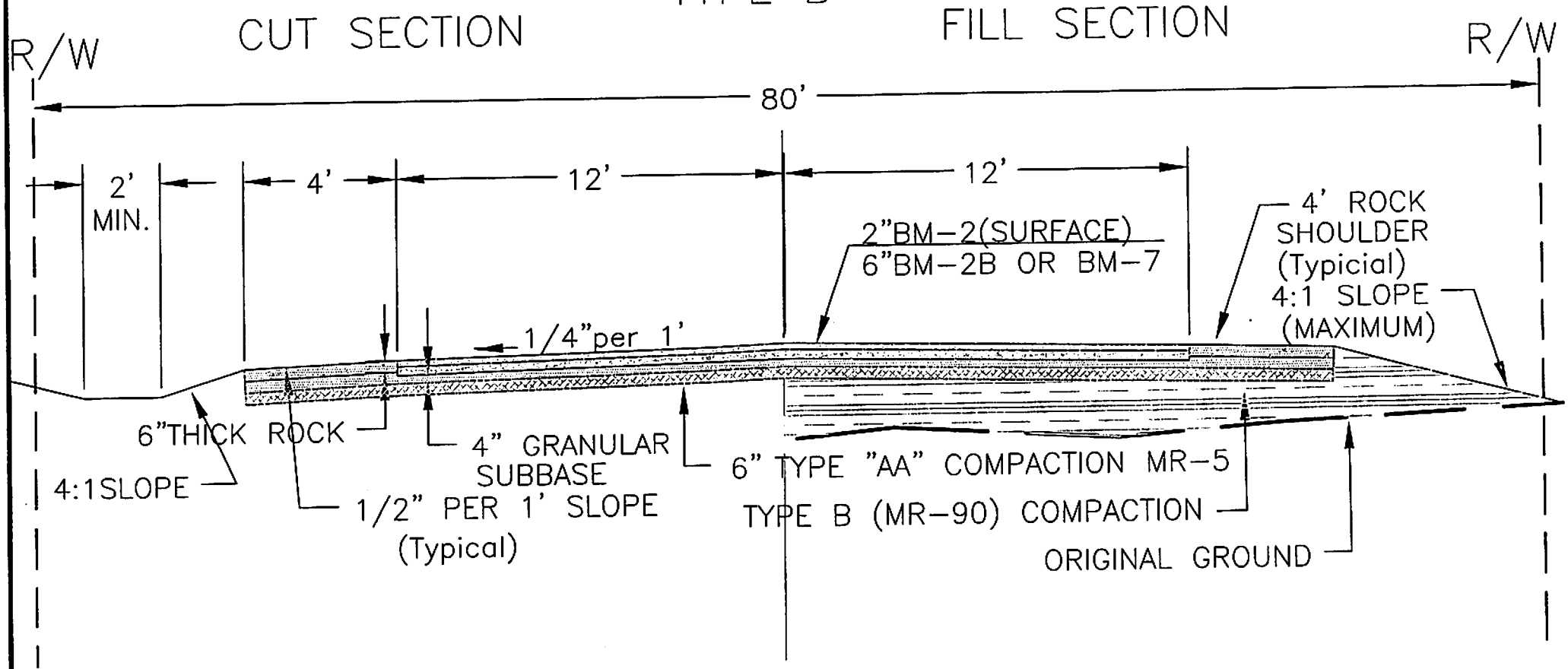
LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County
Department of Public Works

DESIGNED BY: DLM	DATE: JAN. 10, 1996	
REVISED BY:	DATE:	
REVISED BY:	DATE:	
NO SCALE	FILE: LC-TYPCA	SHEET 1

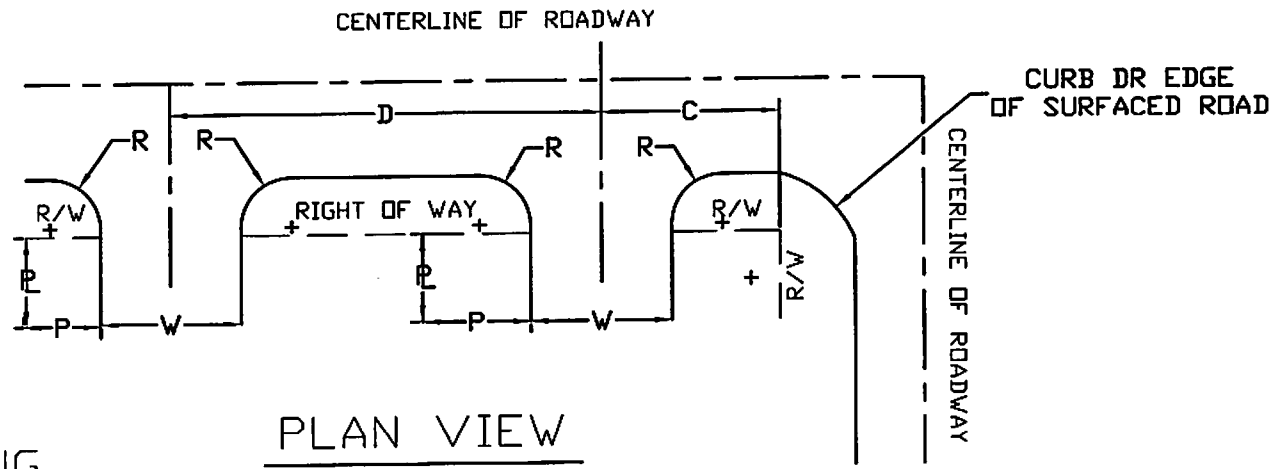
COLLECTOR STREET

TYPE B



LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County Department of Public Works		
DESIGNED BY:DLM	DATE: OCT. 26, 1994	
REVISED BY:	DATE:	
REVISED BY:	DATE:	
NO SCALE	FILE: LC-CBTYP	SHEET 2



PLAN VIEW

MIMIMUM DRIVEWAY SPACING

		RESIDENTIAL AREA	COMMERCIAL AREA	INDUSTRIAL AREA	
P	FROM PROPERTY LINE	5′	10′	15′	
C	FROM RIGHT OF WAY	50′	100′	100′	LOCAL/COLLECTOR ST.
		125′	125′	125′	ARTERIAL ST.
D	BETWEEN DRIVEWAYS	200′	200′	200′	COLLECTOR ST.
		300′	250′	250′	ARTERIAL ST.
		125′	125′	125′	LOCAL ST.

NO ENTRANCE OR SIDE ROAD IS ALLOWED AT LOCATIONS WHERE THE SIGHT DISTANCE ON THE THROUGH ROAD IS LESS THAN THE REQUIRED MINI FOR THE POSTED SPEED LIMIT.

WIDTH AND RADIUS LIMITS

		RESIDENTIAL AREA	COMMERCIAL AREA	INDUSTRIAL AREA	
W	ENTRANCE WIDTH (**)	10′	24′	24′	MINIMUM
		24′	36′	36′	MAXIMUM
R	RADIUS (*)	5′	10′	15′	MINIMUM
		15′	25′	30′	MAXIMUM

(**Edge of Pav't to Edge of Pav't. or Back of Curb to Back of Curb)
(*Edge of Pav't or Back of Curb)

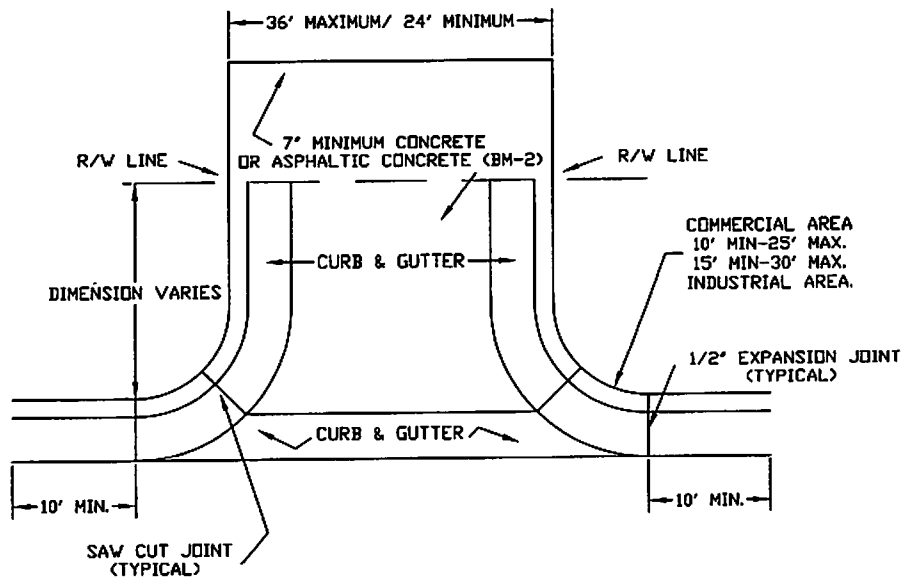
LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County
Department of Public Works

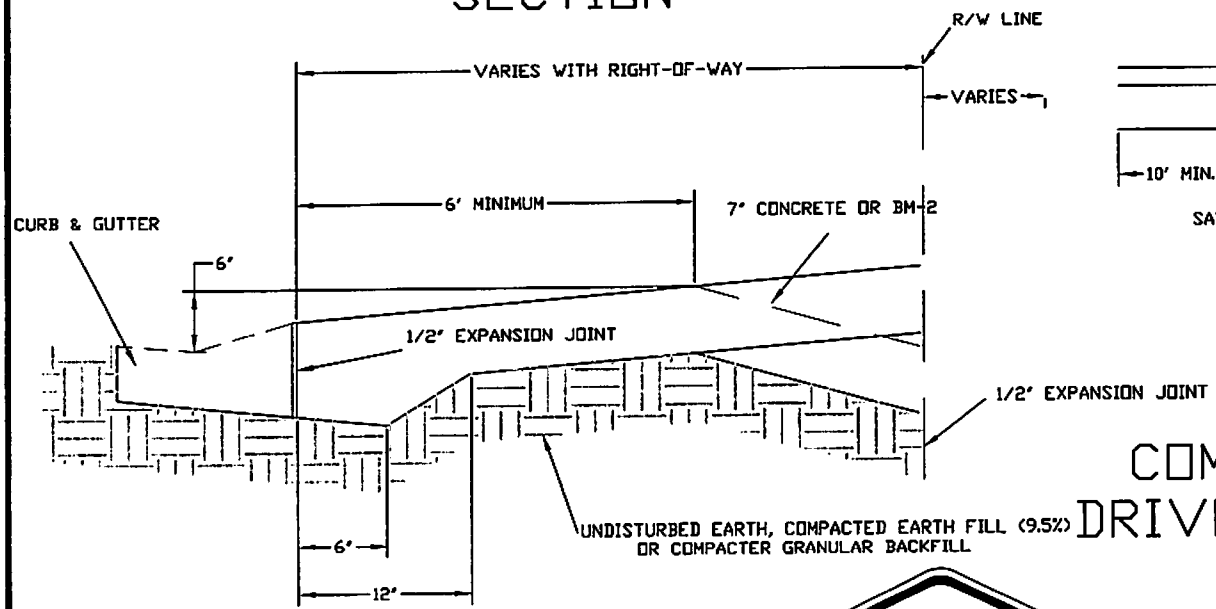
DESIGNED BY: DLM	DATE: 2-26-03
NO SCALE	SHEET 3
DWG FILE: DRVWT-SP03.DWG	

- CURB & GUTTER MAY BE TAPERED FROM FULL CURB TO NOTHING AT RIGHT OF WAY.
- CUT OR SAW CONSTRUCTION JOINTS AT 10' (MAX) EACH DIRECTION.
- INSPECTION OF DRIVEWAY FORMS IS REQUIRED PRIOR TO PAVING.
- CONCRETE SHALL BE 4,000 PSI WITH AE.
- THE DRIVEWAY SHALL BE CONSTRUCTED TO 6" CURB HEIGHT AT 6' BACK OF CURB IF R/W LINE ELEVATION IS LOWER THAN TOP OF CURB.

PLAN VIEW



SECTION



COMMERCIAL / INDUSTRIAL DRIVEWAY ENTRANCE DETAILS

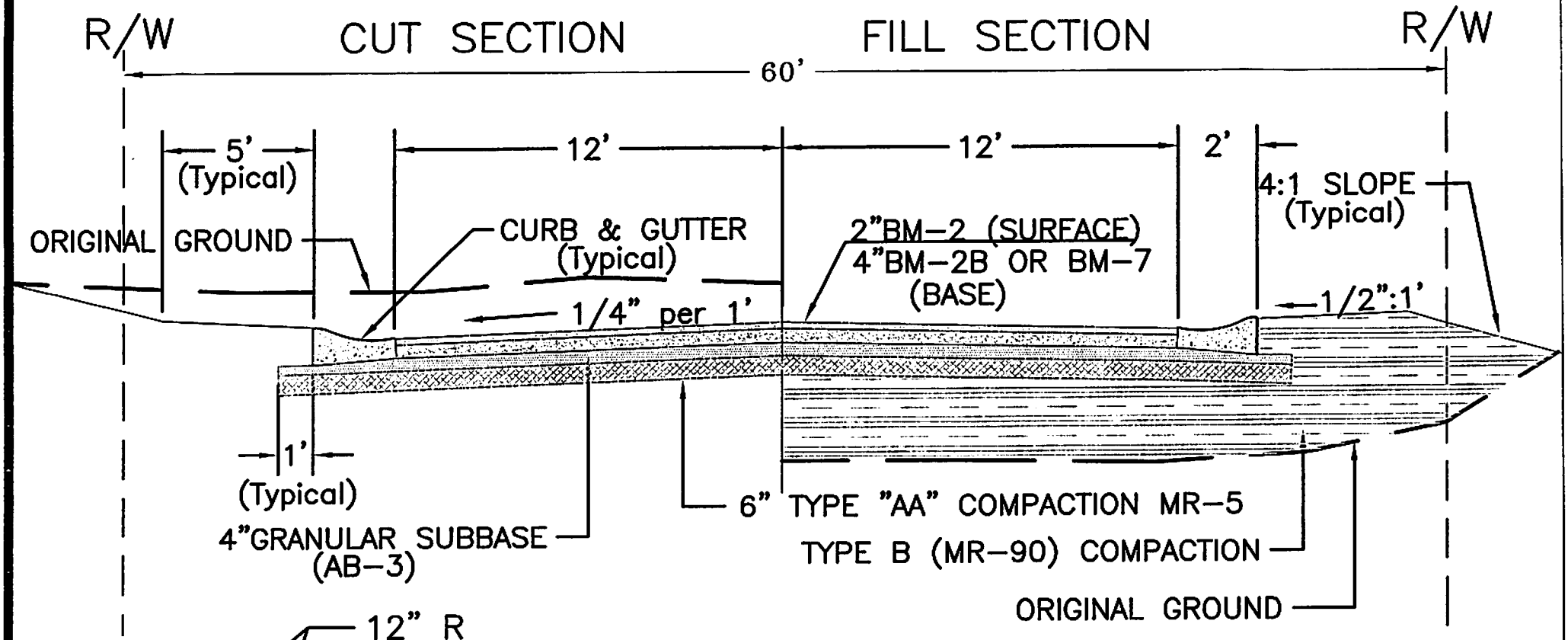
LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County Department of Public Works	
DESIGNED BY: DLM	DATE: 2-26-03
NO SCALE	SHEET 4
DWG FILE: C-I-DRIVE03.DWG	

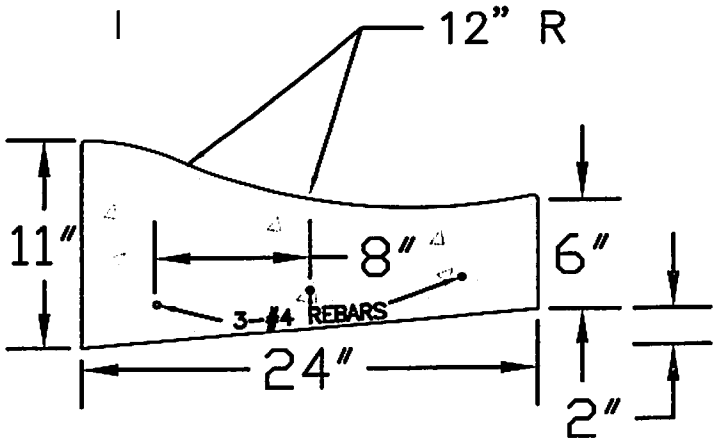
CHAPTER VI

DETAIL DRAWINGS-RESIDENTIAL STREETS WITHIN URBAN GROWTH AREAS

URBAN STREET



This typical section will be used when the new road is within a City's urban growth boundary

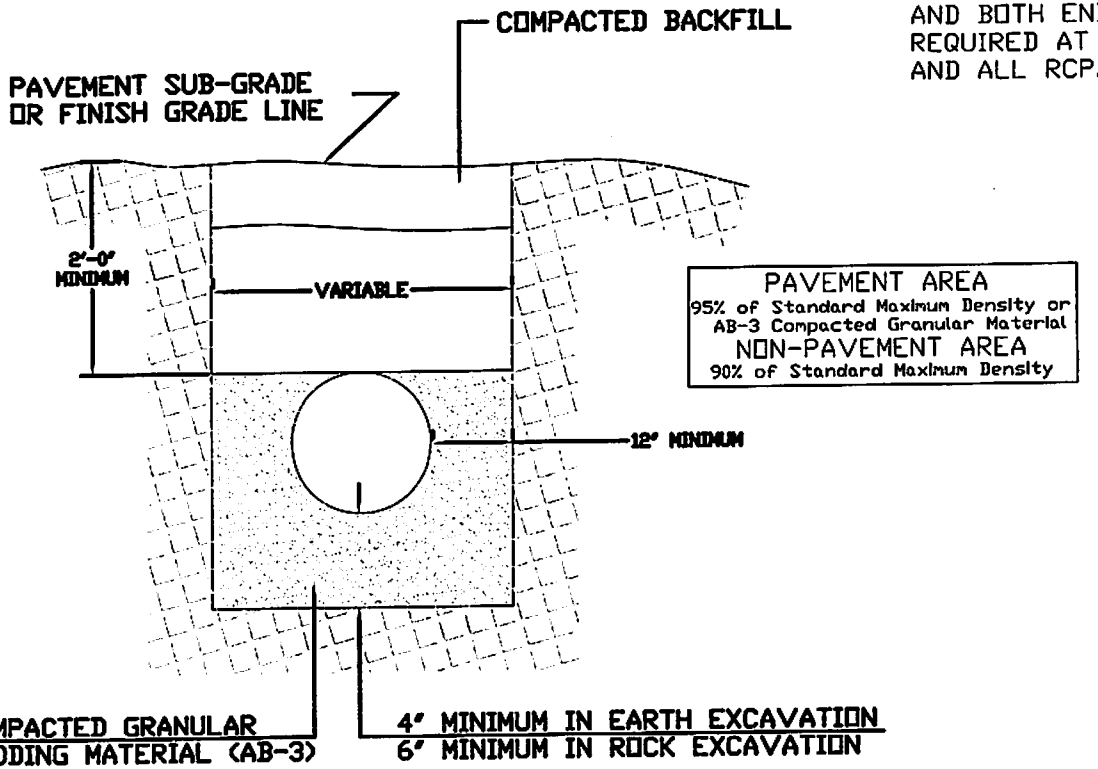


TYPICAL CURB SECTION

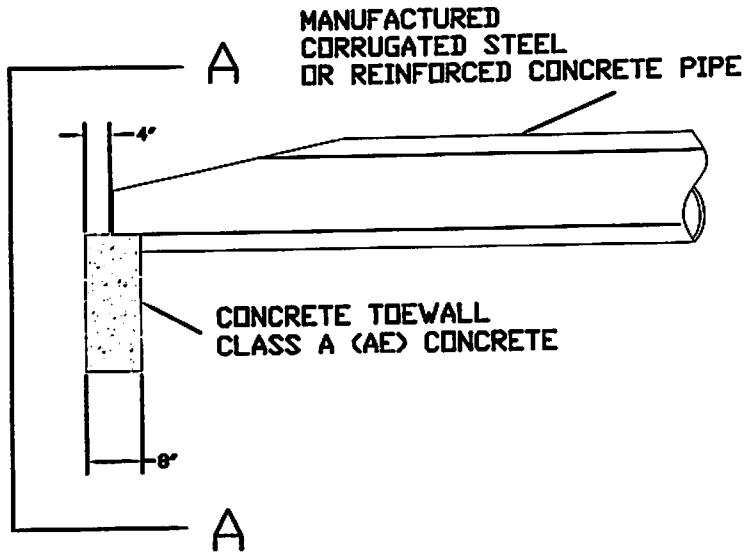
LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County Department of Public Works		
DESIGNED BY: DPL	DATE: 10-11-02	
REVISED BY:	DATE:	
REVISED BY:	DATE:	
NO SCALE	FILE: UrbanStreet	SHEET 1

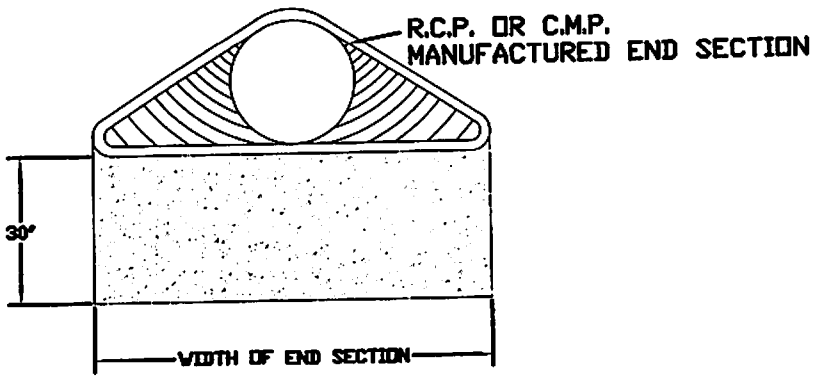
MANUFACTURED END SECTIONS ARE REQUIRED AT STORM SEWER OUTFALLS AND BOTH ENDS OF CROSSROAD TUBES. CONCRETE TOEWALLS ARE REQUIRED AT DOWNSTREAM ENDS OF CMP LARGER THAN 20" DIAMETER AND ALL RCP.



STORM SEWER TRENCH
STORM SEWER TRENCH AND END SECTION TOEWALL DETAILS



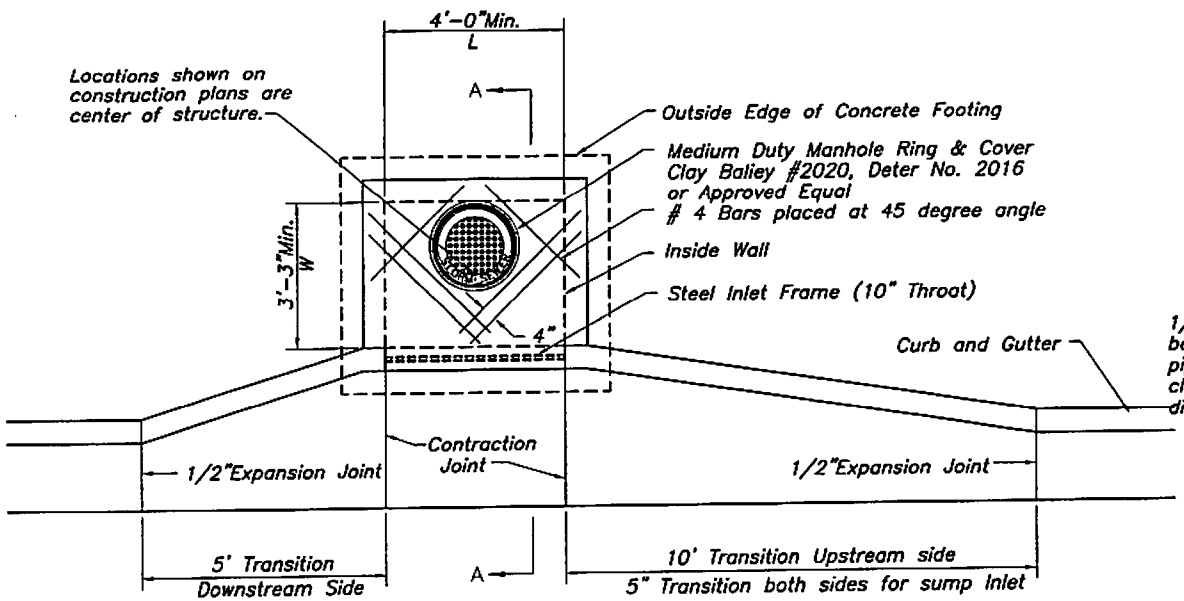
END SECTION TOEWALL

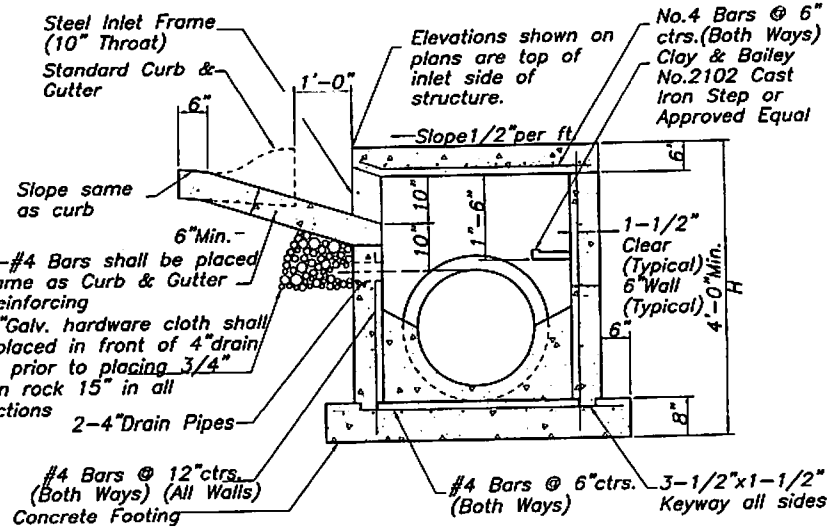


SECTION A-A

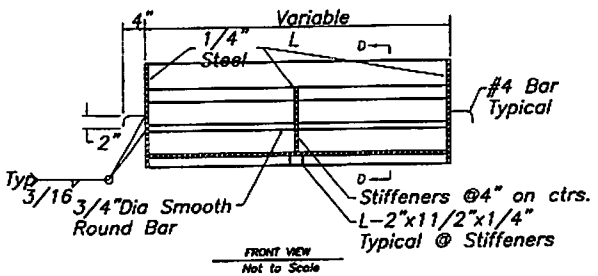
LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

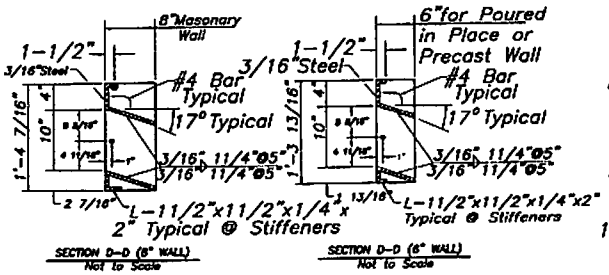
Leavenworth County Department of Public Works	
DESIGNED BY: DLM	DATE: 2-25-2003
NO SCALE	SHEET 3
DWG FILE: STM-SWER.DWG	





PLAN
Not to Scale

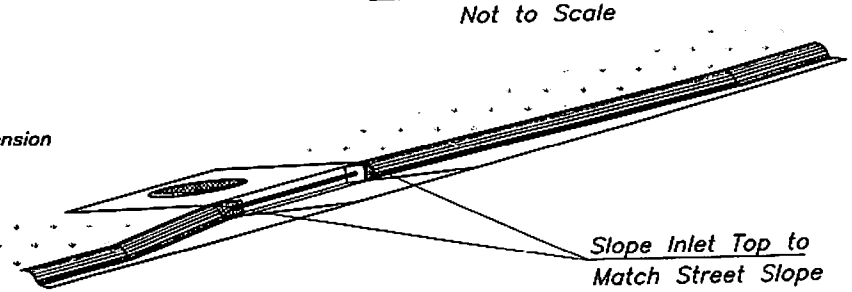




STEEL INLET FRAME (10" THROAT)

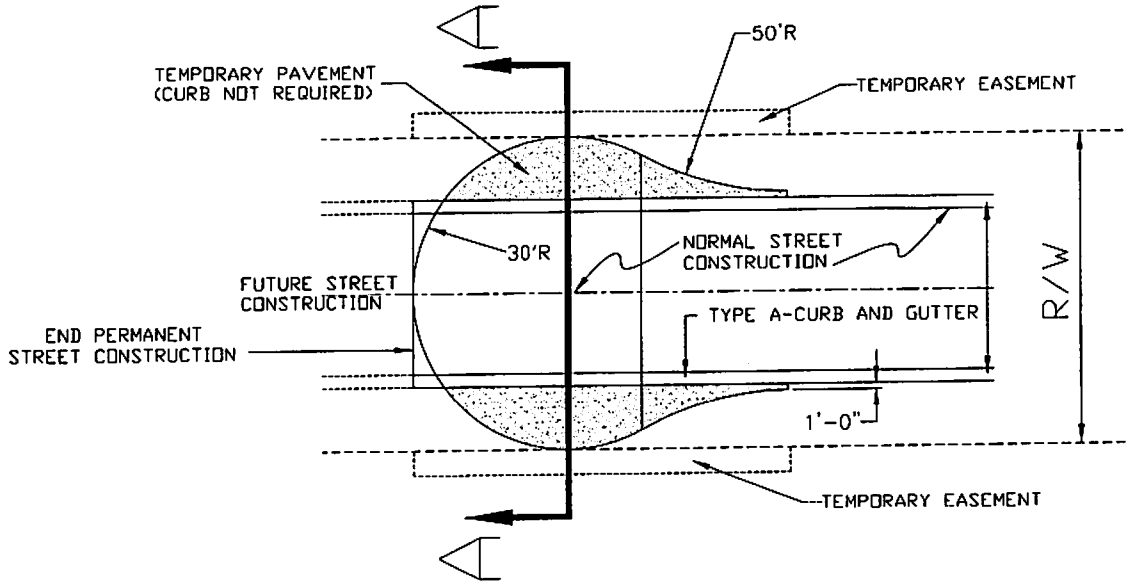
NOTES:
1. Use Class "A"(AE) Concrete throughout.
2. The First dimension used in the Construction Plans is the "L" dimension. The second dimension is the "W" dimension.
3. Expansion Joints shall be Premolded Expansion Joint Filler.
4. Floor of Inlet shall be shaped with Non-reinforced Class "A"(AE) Concrete Invert to provide smooth flow.
5. Steps shall be used when "H" exceeds 5'-0".
6. Bevel all exposed edges with 3/4" Triangular Moulding.
7. Pre-cast Conc. Inlets or 8" Solid Conc. Block for walls may be used when Approved by the County Engineer.
8. All exposed Steel and cast iron surfaces shall be painted with one coat of approved primer, followed by two (2) field coats of aluminum paint.
9. Type 22 Inlet may be used when approved by the County Engineer but the Face of Inlet shall be set 1'-0" behind the back of curb.
10. All crushed stone used as aggregate for Concrete Construction shall be obtained from quarries & beds designated by the KDOT as meeting the durability requirements of Class 1 or Class 6.

SECTION VIEW
Not to Scale



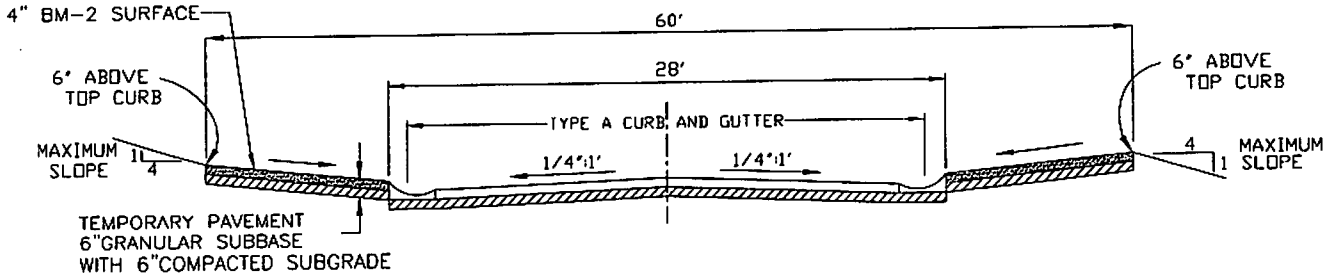
CURB INLET DETAIL

Leavenworth County Department of Public Works	
DRAWN BY: DLM	DATE: Feb. 25, 2003
REVISED BY:	DATE:
REVISED BY:	DATE:
NO SCALE	FILE:LC-INLE2.DWG | SHEET 4



PLAN VIEW

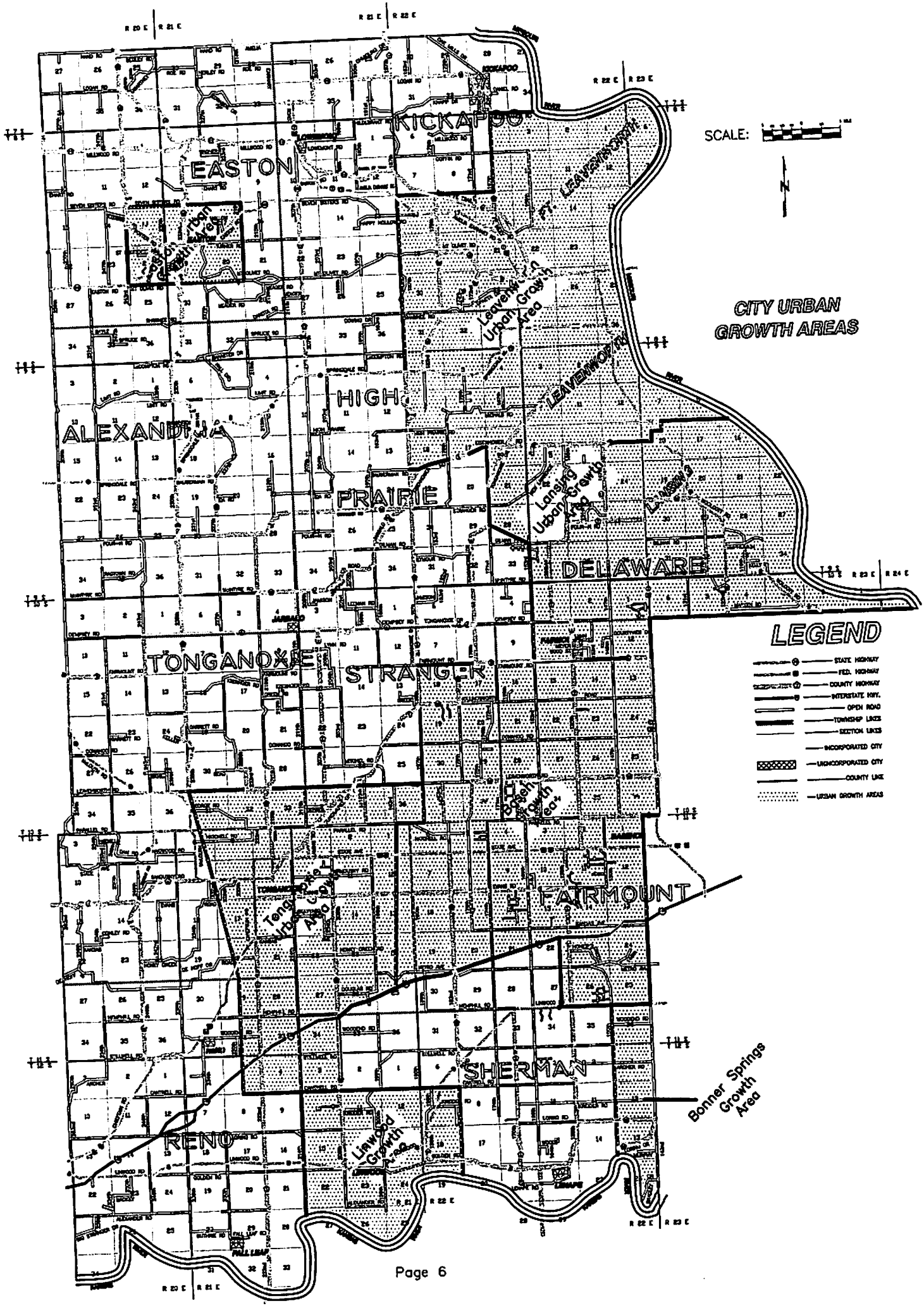
- TEMPORARY CUL-DE-SACS TO BE CONSTRUCTED WHEN REQUIRED BY ZONING AND SUBDIVISION REGULATIONS.
- TEMPORARY EASEMENTS SHALL BE SIZED AS REQUIRED FOR THE CONDITIONS.
- TEMPORARY CUL-DE-SACS MAY BE CONSTRUCTED ON ONE SIDE OF THE STREET ONLY USING A 25' TURNING RADIUS.



SECTION A-A

TEMPORARY CUL-DE-SAC DETAILS

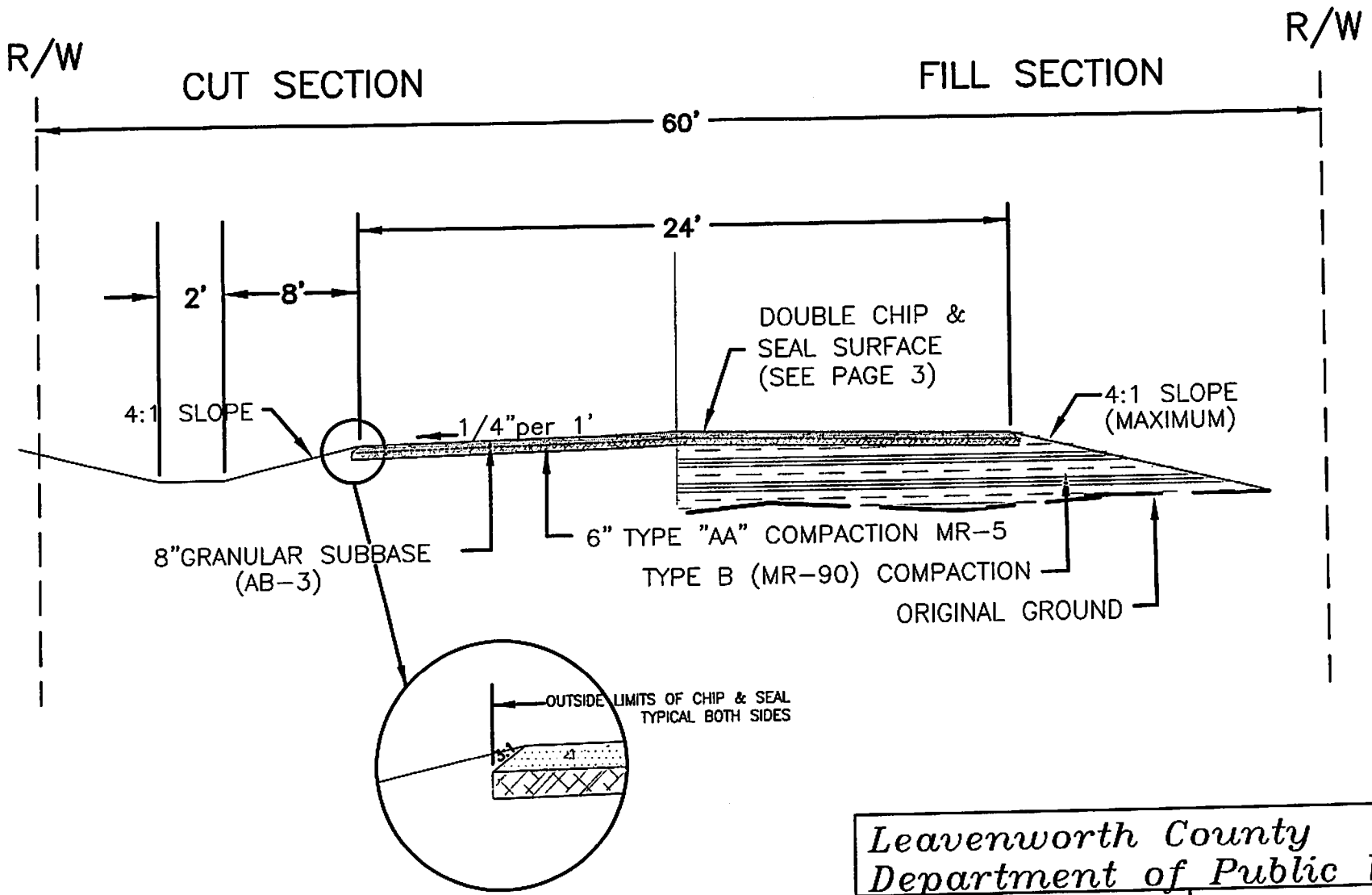
Leavenworth County Department of Public Works	
DESIGNED BY: DLM	DATE: MARCH 3, 1995
DRAWN BY: KAC	DATE:
REVISED BY:	DATE:
NO SCALE	FILE: CUL-DE SHEET 5


SCALE:
N
CITY URBAN GROWTH AREAS
EASTON
KICKAPOO
HIGH ALEXANDRIA
PRAIRIE
DELAWARE
TONGANOXIE
STRANGER
FARMINGTON
SHERMAN
RENO
Easton Urban Growth Area
Leavenworth Urban Growth Area
LEAVENWORTH
Lansing Urban Growth Area
LANSING
Tonganoxie Urban Growth Area
Bonner Springs Growth Area
Linwood Growth Area
LEGEND
STATE HIGHWAY
FED. HIGHWAY
COUNTY HIGHWAY
INTERSTATE HWY.
OPEN ROAD
TOWNSHIP LINES
SECTION LINES
INCORPORATED CITY
UNINCORPORATED CITY
COUNTY LINE
URBAN GROWTH AREAS

CHAPTER VII

DETAIL DRAWINGS-RESIDENTIAL STREETS OUTSIDE URBAN GROWTH AREA

RURAL STREET

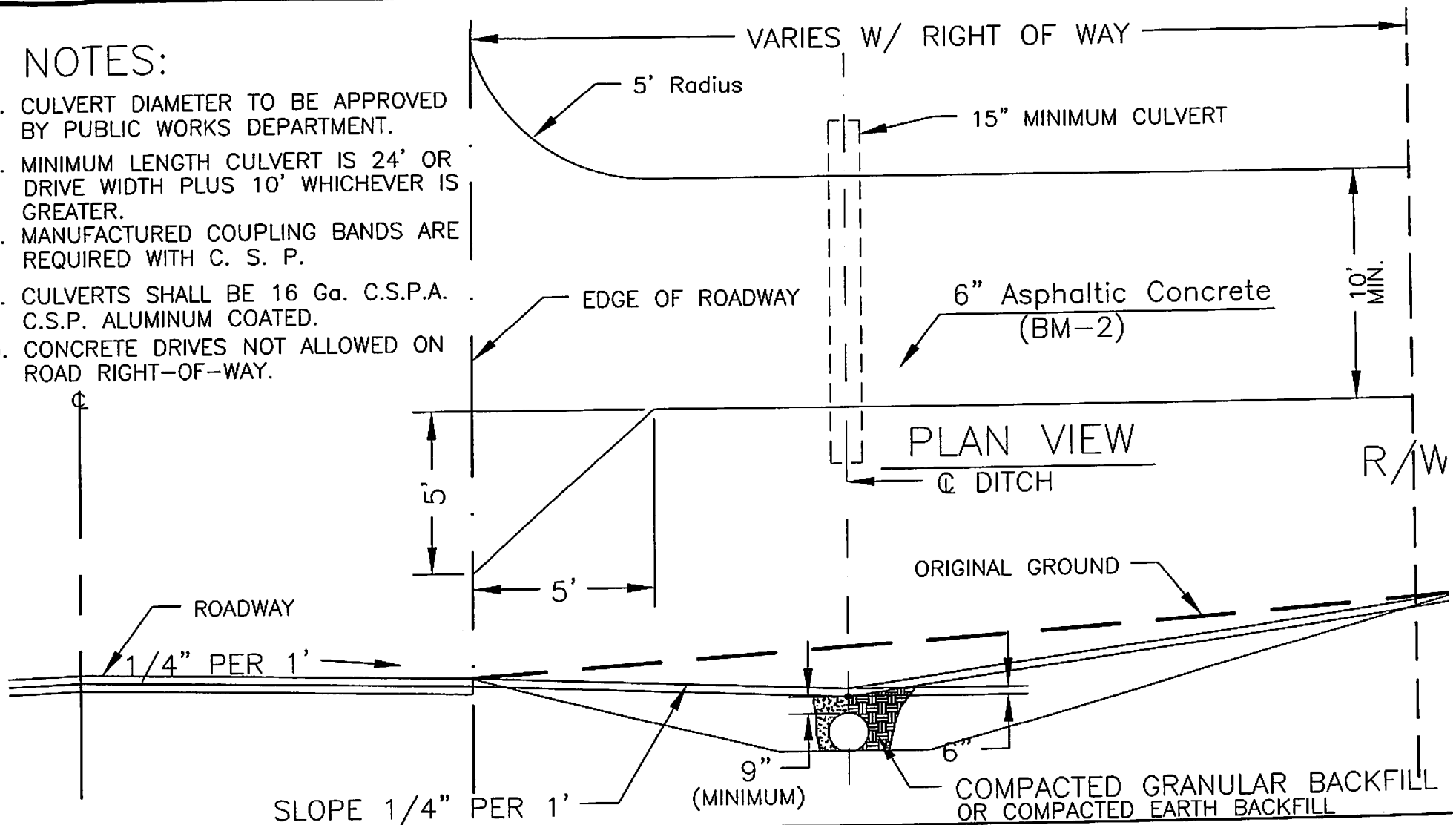


Before the new road is accepted by the County the developer will post a one year maintenance bond and pay the County for the first future reseal of the new road

Leavenworth County Department of Public Works	
DRAWN BY: DPL	DATE:10-11-02
REVISED BY:	DATE:
REVISED BY:	DATE:
NO SCALE	FILE: RuralStreet	SHEET 1

NOTES:

1. CULVERT DIAMETER TO BE APPROVED BY PUBLIC WORKS DEPARTMENT.
2. MINIMUM LENGTH CULVERT IS 24' OR DRIVE WIDTH PLUS 10' WHICHEVER IS GREATER.
3. MANUFACTURED COUPLING BANDS ARE REQUIRED WITH C. S. P.
4. CULVERTS SHALL BE 16 Ga. C.S.P.A. C.S.P. ALUMINUM COATED.
5. CONCRETE DRIVES NOT ALLOWED ON ROAD RIGHT-OF-WAY.



SECTION VIEW

RESIDENTAL DRIVE ENTRANCE

For Non-Curbed Streets

Leavenworth County Department of Public Works		
DESIGNED BY: DLM	DATE: NOV. 3, 1994	
REVISED BY: DLM	DATE: DEC. 9, 1997	
REVISED BY:	DATE:	
NO SCALE	FILE: LC-DRIVE	SHEET 2

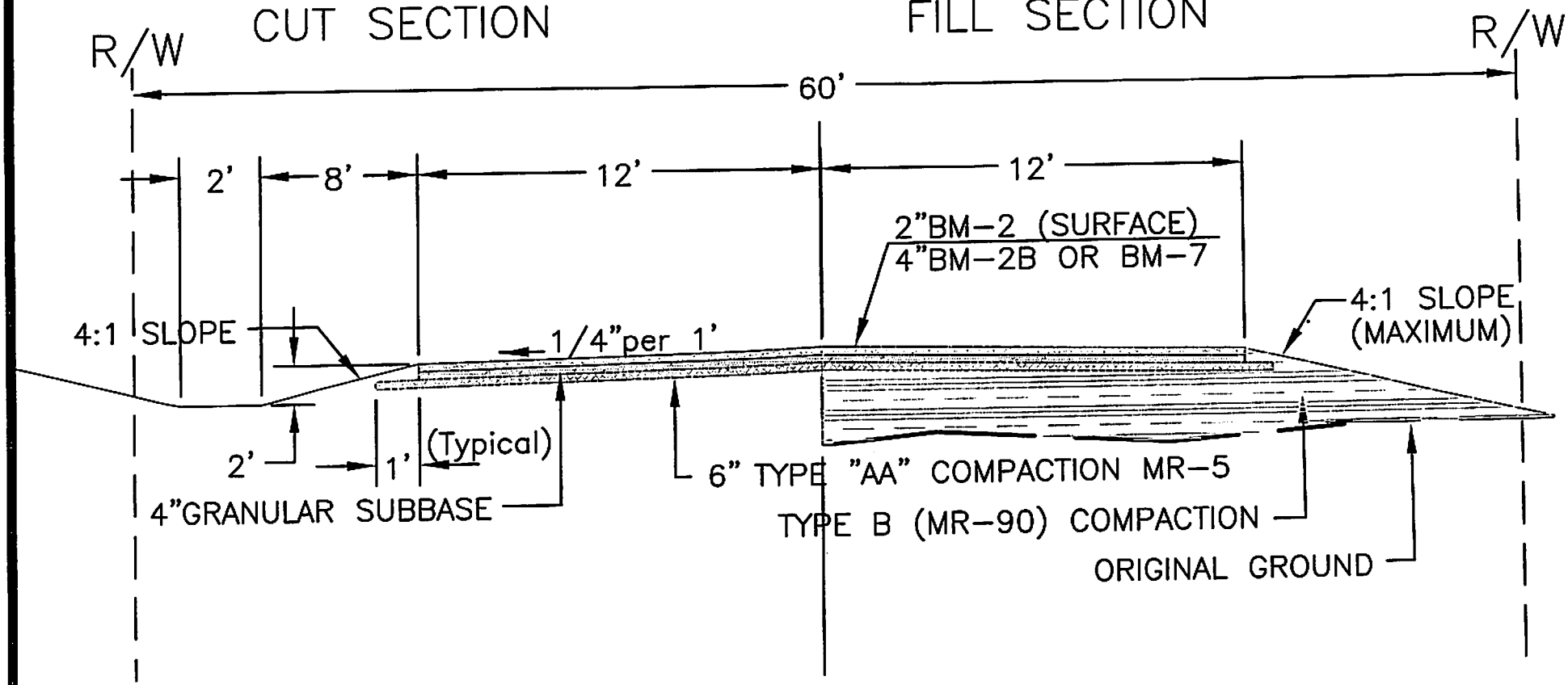
DP 8-8-02

Asphalt Chip & Seal (Double)

Contractor Specifications

1. Place 8" of AB-3 rock base with a top width of 24'. AB-3 rock base to be in accordance with KDOT Specifications for combined material (AB-3).
2. Apply Asphalt – MC-250 – In accordance with KDOT specifications.
3. Application – The MC-250 is to be placed with an approved distributor and a uniform thickness of .35 gallon per square yard, shoulder-to-shoulder coverage, but not less than 28' width.
4. Chips – The rock chips are to be limestone and to be in compliance with KDOT Specifications for CMH type material. Rock chips must be used on first & second seals. No Haydite.
5. The chips are to be applied with a self-propelled chip spreader with a minimum hopper width of 13' 6". The application is to be 30 lbs. per square yard.
6. Ambient temperature should be a minimum 60 F., and material shall not be placed during rain.
7. Prior to placing the asphalt, the road surface shall be rolled with a steel roller. The road needs to dampen approximately 1 hour before the oil application. Immediately following the chip application, the material must be rolled with a steel roller.
8. Next phase 45 to 60 days following step 5, the second chip and seal shall be laid down. The second seal shall be applied over a surface that is free of loose stone, debris, or other foreign material. Either MC-800 liquid cutback asphalt or CRS-1H asphalt emulsion may be used for this seal. MC-800, if used, shall be applied at .30 gal/sq. yd., and CRS-1H, if used, shall be applied at a rate of .35 gal/sq. yd. Cover material, as described in Step 5 above, shall be applied at a rate sufficient to prevent bleeding, but not less than 30 lbs. per square yard.
9. County to be notified and present before each seal coat is applied.
10. Pay County for future third seal.

RESIDENTIAL STREET
TYPE R-A



LEAVENWORTH DEPARTMENT OF PUBLIC WORKS COUNTY

Leavenworth County Department of Public Works	
DESIGNED BY: DLM	DATE: OCT. 26,1994
REVISED BY:	DATE:
REVISED BY:	DATE:
NO SCALE	FILE: LC-RATYP SHEET 4

CHAPTER VIII

EXAMPLE FORMS

MAINTENANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

That we _____, as Principal and

_____, as Surety, are held and firmly bound unto the County of Leavenworth, Kansas, in the full and just sum of $_____ for the payment of which, well and truly to be made, we, and each of us, bind ourselves, our heirs, executors and assigns, themselves, and its successor's and assigns, jointly and severally, firmly by these presents.

Dated this _____ day of _____, 200___.

The conditions of this obligation are such, that whereas _____ _____, upon this completion of the installation of roadway improvements, (and has been accepted by the County of Leavenworth, Kansas, as having been built in accordance with the approved plans and specifications with no unacceptable deviations thereof,) has agreed to guarantee the construction and installation, including all materials and workmanship, for the period of one year beginning on the date the County so accepts said work, said date being the formal acceptance date.

NOW, THEREFORE, if said _____ shall Guarantee the above work for a period of one year from date of formal acceptance, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed, sealed and delivered the day and year first above written.

By: _____

Countersigned:

By: _____
Kansas Resident Agent

By: _____
Attorney-in-Fact
Power of Attorney attached.

RESOLUTION NO. 2003-17

A RESOLUTION OF THE BOARD OF COUNTY COMMISSIONERS OF LEAVENWORTH COUNTY, KANSAS, ADOPTING NEW ROAD CONSTRUCTION AND STORM DRAINAGE STANDARDS TO GOVERN CONSTRUCTION OF IMPROVEMENTS CONCERNING NEW DEVELOPMENTS IN LEAVENWORTH COUNTY, KANSAS; REPEALING RESOLUTION 1998-2.

Now on this 29th day of May, 2003, the Board of County Commissioners (hereinafter Board), meets in regular session, and there comes on for consideration and action the following resolution of the Board.

WHEREAS, the County's Public Works Department has reviewed and studied the current standards, specifications and requirements utilized by the County to govern road construction and storm drainage improvements concerning new developments in unincorporated Leavenworth County, Kansas; and

WHEREAS; as part of the continuing process of evaluating, improving and updating the current standards, the County's Public Works Department has written and presented to the Board a proposed new set of standards to govern such improvements, those standards to be known as the Road Construction and Storm Drainage Standards for New Subdivisions (2003 Ed.) and;

WHEREAS, pursuant to state law, notice of a public hearing was given once in the official County Newspaper informing that a public hearing would be held before the Board of County Commissioners on May 20, 2003 to consider the adoption of new road construction and storm drainage for Leavenworth County, Kansas; and

WHEREAS, in keeping with the Board's past practice of providing various construction standards and specifications, the Board desires after having held a public hearing to implement the proposed new standards so as to better provide for orderly development and protection of the health, safety and welfare of the residents of Leavenworth County, Kansas.

IT IS, THEREFORE; BY SAID BOARD OF COUNTY COMMISSIONERS HEREBY ORDERED AND RESOLVED THAT:

1. The Road Construction and Storm Drainage Standards for New Subdivisions (2003 Ed.), as prepared by the Public Works Department of Leavenworth County, Kansas be hereby adopted as the governing standards, specifications and requirements to govern such improvements concerning new developments in unincorporated Leavenworth County, Kansas. The 2003 Edition standards are hereby incorporated into this Resolution by reference as if they were fully set forth in detail herein.

2. Copies of the 2003 edition standards shall be furnished, with a ten ($ 10.00) fee for first copy, all other copies can be obtained with ten-dollar ($10.00) fee.

3. Effective upon publication of this Resolution, County Resolution No. 1998-2 is hereby declared to be repealed by this Resolution for the purpose of governing road construction and storm drainage improvements regarding development in unincorporated Leavenworth County.

4. This resolution shall become effective upon publication in the Official County newspaper.

ADOPTED THIS 29th DAY OF May, 2003.

THE BOARD OF COUNTY COMMISSIONERS
OF LEAVENWORTH COUNTY, KANSAS

Joseph Daniels, Chairman

Robert Adams, Member

Donald Navinsky, Member

ATTEST:

Linda A. Scheer by D. Cox
Linda A. Scheer, County Clerk

REVIEWED BY:

David L. Mahoney
David L. Mahoney, P.E.,
County Engineer

RESOLUTION NO. 2003-18

A RESOLUTION OF THE BOARD OF COUNTY COMMISSIONERS OF LEAVENWORTH, KANSAS, ADOPTING A NEW STORM SEWER DESIGN CODE AND ADOPTING STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION TO GOVERN CONSTRUCTION OF IMPROVEMENTS CONCERNING NEW DEVELOPMENTS IN LEAVENWORTH COUNTY, KANSAS; RESCINDING PREVIOUSLY ADOPTED CODES ON STORM SEWER, ROAD AND BRIDGE DESIGN AND CONSTRUCTION. REAPLING RESOLUTION 1995-15

Now on this 29th day of May, 2003, the Board of County Commissioners (hereinafter Board), meets in regular session and there comes on for consideration and action the following resolution of the Board.

WHEREAS, the Board desires to adopt the Design Criteria for Storm Sewers and Appurtenances latest edition of the Kansas City Metropolitan Chapter of the American Public Works Association; and the Standard Specifications for State Road and Bridge Construction (1990 Ed) promulgated by the Kansas Department of Transportation; and

WHEREAS, K.S.A. 12-3301 et seq. Provides that in the event the Board adopts a code, it may adopt the provisions of the code by incorporating its contents by reference in a County resolution; and

WHEREAS, prior to the adoption of a code, and pursuant to state law, notice of a public hearing was given once in the official County newspaper informing that a public hearing before the Board of County Commissioners would be held on May 29 2003, to consider the adoption of a new storm sewer design code and the adoption of road and bridge specifications for Leavenworth County, Kansas; and

WHEREAS, in keeping with the Boards past practice of updating and improving their applicable codes and standards, the Board desires after having held the public hearing to adopt the newest revised edition of the Design Criteria for storm drainage systems and also desires to adopt the edition of the K.D.O.T. Standard Specifications so as to better provide for orderly development and the protection of the health, safety and welfare of the residents of Leavenworth County, Kansas,

IT IS THEREFORE, BY SAID BOARD OF COUNTY COMMISSIONERS HEREBY ORDERED AND RESOLVED THAT:

1. Division V, Section 5600, design criteria for storm drainage systems (latest edition) of the Kansas City Metropolitan Chapter of the American Public Works Association is hereby adopted as the governing standards, except section 5601-8 A., amended to read as follows:

A. In-System Capacity:

1. Floodway in 100-year Flood Plain	100-year
2. Bridges, Pipes, and Culverts Crossing Collector/Arterial Streets	50-year
3. Bridges, Pipes, and Culverts Crossing All other streets	25-year
4. All other System Components	15-year

5606.4B

~~5604.4B~~ **The maximum release rate shall not exceed 2.2 cfs per acre.**

The rest of section 5600 shall be hereby adopted as the governing standards, specifications and requirements to govern such improvements concerning new developments in unincorporated Leavenworth County, Kansas. The 2003 edition Design Criteria are hereby incorporated into this Resolution by reference as if they were fully set forth in detail herein, except as amended by this resolution.

2. Standard Specifications for State Road and Bridge Construction (1990 Ed.) promulgated by the Kansas Department of Transportation, specifications and requirements to govern the construction of roads and bridges in unincorporated Leavenworth County, Kansas. The 1990 edition Standard Specifications, are hereby incorporated into this Resolution by reference as if they were fully set forth in detail herein.

3. All sections of the 2003 edition Design Criteria and all sections of the 2003 edition Standard Specifications shall be applicable to all portions of unincorporated Leavenworth County, Kansas.

4. Effective upon publication of this Resolution, County Resolution No. 1995-15 is hereby declared to be repealed by this Resolution for the purpose of governing road construction and storm drainage improvements regarding development in unincorporated Leavenworth County.

5. This Resolution shall become effective upon publication in the Official County newspaper.

ADOPTED THIS 29th DAY OF May, 2003.

BOARD OF COUNTY COMMISSIONERS
OF LEAVENWORTH COUNTY, KANSAS

Joseph Daniels, Chairman

Robert Adams, Member

Donald Navinsky, Member

ATTEST:

Linda A. Scheer by D. Cox
Linda Scheer, County Clerk

Reviewed by:

David L. Mahoney
David L. Mahoney, P.E., County Engineer

DIVISION V
DESIGN CRITERIA

SECTION 5600 STORM DRAINAGE SYSTEMS AND FACILITIES

Approved and Adopted this 21 day of March 1990

Kansas City Metropolitan Chapter
Of the American Public Works Association

DIVISION V
DESIGN CRITERIA

SECTION 5600 STORM DRAINAGE SYSTEMS AND FACILITIES

SECTION 5601 GENERAL

5601.1 Introduction: this criteria provides uniform procedures for designing and checking the design of storm drainage systems under the rainfall and land characteristics typical of the Kansas City Metropolitan Area. Specific criteria have been developed and are applicable to the types of drainage systems and facilities ordinarily encountered in local urban and suburban areas. Other special situations may be encountered that require added criteria or more complex technology than included herein. Any design procedure conforming to current accepted engineering practice, including the application of computers, may be used for the design of storm drainage systems in lieu of the computation methods presented in this criteria, providing equivalent results are obtained.

5602.2 Definitions:

A. **Bank Line**: the line of intersection, above the normal depth of flow at design capacity, of the side slope of an open channel and the adjacent ground.

B. **County**: the municipality or body having jurisdiction and authority to govern.

C. **County Engineer**: The municipal public works official or body having jurisdiction and authority to review and approve plans and designs for storm drainage systems.

D. **Controlled Area**: That part of the tributary area for which a detention facility is design to control peak discharge rates.

E. **Detention Storage**: The volume occupied by water above the level of the spillway crest during operation of a storm water detention facility.

F. **Dry Detention Facility**: any detention facility designed to permit no permanent impoundment of water.

G. **Developer:** Any person, partnership, association, corporation, public agency, or governmental unit proposing to or engaged in "development" as defined below; except the widening, resurfacing, or other improvement to existing streets, alleys, and sidewalks.

5601.2

H. **Development**: Any activity, including subdivision, that alter the surface of the land to create additional impervious surfaces, including, but not limited to, pavement, buildings, and structures; except:

1. Additions to, improvements, and repair of existing single-family and duplex dwellings.
2. Construction of any buildings, structures, and/or appurtenant service roads, drives, and walks on a site having previously provided storm water control as part of a larger unit of development.
3. Remodeling, repair, replacement, and improvements to any existing structure or facility and appurtenances that does not cause an increased area of impervious surface on the site in excess of 10 percent of that previously existing.
4. Improvements on any site having a gross land area of one-half acre or less, regardless of land use.
5. Construction of any one new single-family duplex dwelling unit, irrespective of the site area on which the same may be situated.

I. **Easement**: Authorization by a property owner for the use by another for a specified purpose, of any designated part of the property.

J. **Emergency Spillway:** A device or devices used to discharge water under conditions of inflow that exceed the design outflow from a detention facility. The emergency spillway functions primarily to prevent damage to the detention facility that would permit the sudden release of impounded water.

K. **Freeboard:** The difference in elevation between the top of a structure such as a dam or open channel and the maximum design water surface elevation or high water mark. It is an allowance against overtopping by waves or other transient disturbances.

L. **Improved Channel:** Any channel changed by grading or the construction of lining materials as approved by the City Engineer.

M. **Natural Channel:** An existing channel that has not been altered by previous construction.

N. **Owner:** The owner of record of real property.

O. **Principal Spillway:** A device such as an inlet, pipe, weir, etc., used to discharge water during operation of the facility under the conditions of the 100-year or less return frequency.

P. **Private Detention Facility:** Any detention facility located on and controlling discharge from a site wholly owned and controlled by one owner and not platted for future subdivision of ownership. Also, all facilities incorporating detention storage of storm water in or on any of the following:

1. Roofs of buildings or structures also used for other purposes.
2. Paved or surfaced areas also used for other purposes.
3. Enclosed or underground pipes or structures on private property when the surface is used for other purposes.

Q. **Public Detention Facility:** Any detention facility controlling discharge from a tributary area owned by more than one owner and/or platted for future subdivision of ownership, except as defined as a private detention facility herein.

R. **Registered Professional Engineer:** A licensed engineer who is registered with and authorized by the "State Board" to practice within the state of registration.

S. **Return Frequency:** The statistical average interval between rainfalls of equal magnitude.

T. **Sediment Storage:** The volume allocated to contain accumulated sediments within a detention facility.

U. **Site:** A tract or contiguous tracts of land owned and/or controlled by a developer or owner. Platted subdivisions, industrial and/or office-commercial parks, and other planned unit developments shall be considered a single site.

V. **Storm Drainage System:** All of the natural and man-made facilities and appurtenances such as ditches, natural channels, pipes, culverts, bridges, open improved channels, street gutters, inlets, and detention facilities which serve to convey surface drainage.

W. **Storm Water Detention Facility:** Any structure, device, or combination thereof with a controlled discharge rate less than its inflow rate.

X. **Tributary Area:** All land draining to the point of consideration, regardless of ownership.

Y. **Wet Detention Facility:** A detention facility that is designed to include permanent storage of water in addition to the temporary storage used to control discharge rates from the facility.

5601.3 General Requirements: The design shall be accomplished under the direction of a Registered Professional Engineer. The design shall also be based on land use in the tributary area as zoned, actually developed, or indicated by an adopted future land use plan, whichever basis produces the greatest runoff.

5601.4 Existing Drainage System: Existing drainage system component pipes, structures, and appurtenances within the project limits may be retained as elements of an improved system providing:

1. They are in sound structural condition.
2. Their hydraulic capacity, including surcharge, is equal to or greater than the capacity required by this criteria.
3. Easements exist or are dedicated to allow operation and maintenance.

Discharge from an existing upstream storm drainage system shall be computed meeting the hydraulic capacity of this criteria. The computed discharge shall be used to design the new downstream system even if the actual capacity of the existing upstream system is less.

5601.5 System Types and Applications:

A. **Enclosed Systems**: Enclosed systems consisting of underground pipes, culverts, and similar functional underground structures shall be used to convey stormwater at all locations.

1. Where the design peak discharge of a 10-year return period storm is equal to or less than the capacity of a 72-inch diameter round pipe having a Manning's "n" of 0.013, and designed in accordance with Section 5604.
2. Within the right-of-way of improved streets, regardless of system design capacity.
3. Within 60-feet of any existing or proposed habitable building, regardless of system design capacity.
4. Where the design peak discharge of a 10-year return period storm equals or exceeds 8 c.f.s. and the collected drainage is generated from more than 1 lot.

Enclosed systems may be used to convey stormwater at all locations where open systems are permitted.

B. **Open Systems:** Open systems consisting of natural and/or improved open channels with intermittent culverts or bridges crossing streets and other surfaced areas may be used to convey stormwater at all locations where the use of an enclosed system is not required by the foregoing criteria.

C. **Stormwater Detention/Retention Facilities:** Detention facilities shall be provided in connection with the development of land whenever.

1. Homes, building, or other structures downstream from a proposed development are flooded in a 100-year or more frequent flood.
2. Flood damage problem areas have been identified, or an engineering study as required by Section 5601.6 indicates the proposed development would cause or increase such flooding.

These requirements to provide detention apply to all development except when downstream flooding is entirely confined within the limits of the 100-year flood plain as defined by the Federal Flood Insurance Study current at the time development is proposed.

D. **Overflow Systems:** Each conveyance element of the stormwater drainage system (whether enclosed or open) shall include an overflow system having sufficient hydraulic capacity when combined with the capacity of the conveyance elements to convey the peak discharge generated by a 100-year return period storm without damage to land or buildings, defined as:

100-year stage, plus one foot freeboard, at an elevation equal to or greater than the lowest elevation at which water may enter any proposed or existing building or structure.

5601.6 Waivers: The City Engineer may waive requirements to provide specific types of stormwater elements as follows:

A. **Detention/Retention Facilities:** Detention may be waived and/or release rates other than those released by Section 5606 may be approved by the City Engineer when:

1. The developer makes arrangements to provide an improved downstream conveyance system of hydraulic capacity meeting the requirements of this criteria.
2. A detention facility would increase the downstream peak rate of discharge by creating a delayed peak.

B. **Study:** The Developer provides an adequate study by a registered professional engineer that quantifies the problems and demonstrates that a waiver of the requirement to provide detention facilities is appropriate.

C. **Overflow Channels:** In previously developed areas, requirements to provide for 100-year storm conveyance may be reduced in circumstances where 100-year

protection is not reasonably attainable due to the location of damageable improvements with respect to the drainage system.

5601.7 Other References: Other agencies have criteria and regulations pertaining to drainage systems which may complement this criteria. When conflicts are encountered most rigorous criteria shall govern.

A. **Federal Insurance Agency-Floodplain Regulations and Implementing Ordinances Adopted by Municipalities: Drainage** systems designed within the limits of the designated to convey the flood as defined by applicable published flood plain information studies. For areas located in FIA Zone "A" outside the detailed study area, the Developer shall prepare studies and calculations establishing the floodplain, and floodway elevation and width. These calculations shall be submitted to the reviewing agency for approval.

B. **Missouri Department of Natural Resources:** Rules and regulations of the Dam and Reservoir Safety Council shall apply to those Missouri structures classified as dams thereunder.

C. **Kansas Department of Agriculture:** Rules and regulations of the Water Resources Board shall apply.

5601.8 Return Frequencies: Enclosed and open channel conveyance system components shall be designed for the following return period storms, irrespective of the land use in which the system is located or the land use in the drainage area tributary to the system:

A. **In-System Capacity:**

1. Floodway in 100-year Flood Plain 100-year
2. Bridges, Pipes, and Culverts Crossing Arterial Streets 50-year
3. Bridges, Pipes, and Culverts Crossing All-other streets 25-year
4. All other system components 15-year

B. **Overflow Channels:** The combined capacity of the overflow channel and in-system conveyance element shall be sufficient to convey the 100-year storm at all locations; except that an overflow depth not exceeding seven (7) inches at the lowest point of the traveled way will be permitted where culverts cross streets.

SECTION 5602 HYDROLOGY AND HYDRAULICS

5602.1 Scope: This section sets forth the hydrologic parameters to be used for computations involving the definition of runoff mass and peak rates to be accommodated by the storm drainage system.

5602.2

5602.2

5602.2 Runoff Coefficients: Runoff coefficients relative to development and land use shall have the following values:

LAND USE ZONING	AVERAGE PERCENT IMPERVIOUS	AVERAGE PERCENT PERVIOUS	RATIONAL METHOD "C"	S.C.S CURVE NUMBER
a. Business				
Downtown Area	95	5	0.87	96
Neighborhood Areas	85	15	0.81	94
b. Residential				
Single-Family Areas	35	65	0.51	83
Multi-Family Areas	60	40	0.66	88
Churches and Schools	75	25	0.75	92
c. Industrial				
Light Areas	60	40	0.66	88
Heavy Areas	80	20	0.78	93
Parks, Cemeteries	10	90	0.36	77
Railroad Yard Areas	25	75	0.45	80
d. Undeveloped Areas				
Permanent Unimproved Areas Greenbelts, etc.	0	100	0.3	75
e. All Surfaces				
Impervious: asphalt				

concrete, roofs, etc.	100	0	0.9	98
Turfed	0	100	0.3	75
Wet detention basins	100	0	0.9	98

Land areas not zoned; but whose future land use is defined by an adopted land use plan, shall be assigned runoff coefficients for the land use indicated by such plan. Undeveloped areas designated as agricultural or those for which no specific future land use is indicated shall be assigned a minimum of 35 percent impervious surface for purposed of the design of storm drainage systems. (C = 0.51, CN = 83)

As an alternative to the above coefficients; and for areas not listed above (planned building groups, shopping centers, trailer parts, etc.) a composite runoff coefficient based on the actual percentages of pervious and impervious surfaces shall be used.

5602.3 Rainfall Mass: The U.S. Soil Conservation Service (SCS) Type 2 twenty-four hour rainfall distribution shall be used for all computations that employ the use of rainfall mass. That rainfall distribution is reproduced as follows:

TIME IN HOURS	ACCUMULATED RAINFALL IN PERCENT OF 24-HOUR RAINFALL
0	0
2.0	2.22
4.0	4.80
6.0	8.00
8.0	12.00
9.0	14.70
9.5	16.30
10.0	18.10
10.5	20.40
11.0	23.50
11.5	28.30
11.75	38.70
12.0	66.30
12.5	73.50
13.0	77.20
13.5	79.90
14.0	82.00
16.0	88.00
20.0	95.20
24.0	100.00

5602.4 Unit Hydrographs: The SCS Dimensionless Unit Hydrograph (either curvilinear or triangular) shall be the basis for computation of runoff hydrographs.

5602.5 Rainfall Intensity: Rainfall intensity shall be determined from Figure 1 or Table C using a calculated time of concentration, T_C. T_C is equal to the overland flow time to the most upstream inlet or other point of entry to the system, inlet time, T_I plus the time for flow in the system is travel to the point under consideration travel time, T_T. ($T_C = T_I + T_T$)

A. **Inlet Time:** T_I shall be calculated by the following formula or determined graphically from Figure 2, but shall not be less than 5.0 minutes nor greater than 15.0 minutes:

5602.5 5602.6

$$T_I = 1.8 \frac{(1.1 - C) D \frac{1}{2}}{S^{1/3}} \text{ where:}$$

TI = Inlet time in minutes:

C = Rational Method Runoff Coefficient as determined in accordance with paragraph 5602.2

D = Overland flow distance parallel to slope in feet.
(300-feet shall be the maximum distance used for overland flow)

S = Slope of tributary area surface perpendicular to contour in percent.

B. **Travel Time:** T_T shall be calculated as the length of travel in the channelized system divided by the velocity of flow. Velocity shall be calculated by Manning's equation assuming all system elements are flowing full without surcharge. Travel time may be determined graphically from Figure 3 in lieu of calculation.

To provide for future development when the upstream channel is unimproved, the following table shall be used for calculation T_T.

AVERAGE CHANNEL SLOPE, PERCENT	VELOCITY IN FT/SEC
<2	7
2 TO 5	10
>5	15

5602.6 Computation Methods for Runoff: Runoff rates to be accommodated by each element of the proposed storm drainage system shall be calculated using the foregoing criteria for land use runoff factors, rain fall, and system time. The following alternative computation methods are acceptable. Other methods, including computer models may b employed so long as they produce calculated runoff to the system that is substantially the same as that calculated by the foregoing criteria:

A. **Watersheds Less than ~~600~~ 200 Acres:** The Rational Method may be used to calculate peak rates of runoff to elements of enclosed and open channel systems, including inlets, when the total upstream area tributary to the point of consideration is less than 600 acres. The Rational Method is defined as follows:

5602.6

5602.7

$Q = K C i A$, where

Q = Peak rate of runoff to system is C.F.S.

C = Runoff coefficient as determined in accordance with Paragraph 5602.2

i = Rainfall intensity in inches per hour as determined in accordance with Paragraph 5602.4

K = Dimensionless coefficient to account for antecedent precipitation as follows; except the product of "C" * "K" shall not exceed 1.0.

YEARS RETURN PERIOD	"K"
10 and Less	1.0
25	1.1
50	1.2
100	1.25

B. **All Watersheds:** The following methods are acceptable for all watersheds:

1. SCS Technical Release No. 55 – "Urban Hydrology for Small Watersheds", 2nd Edition, June 1986.
2. SCS Technical Release No. 20 – "Project Formulation – Hydrology", 2nd Edition, May 1983.
3. U.S. Army Corps of Engineers, Hydrologic Engineering Center – "HEC-1 Flood Hydrograph Package"

Copies of the above publications and micro-computer programs based thereon are available for purchase through National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

5603.4 Gutter Flow: Inlets shall be located to limit the width of flow in street gutters at the time of peak discharge of a 10-year return period storm to the following limits:

BACK TO BACK OF CURB STREET WIDTH IN FEET	MAXIMUM ALLOWABLE SPREAD IN EACH OUTSIDE CURB LANE FROM BACK OR CURB IN FEET
28 or less	10.5
Over 28 to 36	11.5
Over 36	12.0
Divided Roadways	As above for each direction roadway
Arterial and Collector Street Intersections and Pedestrian Crosswalks	6.0

5603.5 Gutter Capacity: Izzard's Formula or Figure 9 shall be used to determine gutter flow:

$$Q = 0.56 \frac{(z)}{n} (S\ ½) (D^{1/3}) \text{ where:}$$

Q = The gutter flow in cubic feet per second.

Z = The reciprocal of the average cross-slope, including gutter section in feet per foot.

S = The longitudinal street grade in feet per foot.

D = The depth of flow at curb face in feet.

n = Manning's "n" see Table A.

5603.6 Street Grade on Vertical Curves: The following formula shall be used to determine the street grade (Sx) at any point on a vertical curve using plus for grades ascending forward and minus for grades descending forward, in feet per foot.

$Sx = S_1 + \frac{X}{L}(S_2 - S_1)$ where:

Sx = The street grade on a vertical curve a point x, in feet per foot.

S_1 = The street grade at the PC of a vertical curve, in feet per foot.

S_2 = The street grade at the PT of a vertical curve, in feet per foot.

X = The distance measured from the PC to a point x on a vertical curve, in feet.

L = The total length of a vertical curve, in feet.

5603.7 Loading Conditions for Structures: shall be in accordance with Section 5700.

5604.1 5604.4

SECTION 5604 ENCLOSED PIPE SYSTEMS:

5604.1 Easements: Permanent easements shall be dedicated to the County & City for operation and maintenance of the storm drainage facilities. Easement width shall not be less than 15-feet, or the outside width of the pipe or conveyance structure plus 10-feet; whichever is greater. Easements shall be centered on the pipe.

A. **Permanent:** The County Engineer may require wider easements when other utilities are located within the same easement and/or when the depth of cover is greater than 4-feet.

B. **Temporary:** Temporary construction easements of sufficient width to provide access for construction shall be acquired when the proposed work is located in areas developed prior to construction.

5604.2 Capacity: Capacity shall be based on either inlet or outlet control, whichever condition indicates the least capacity. Minimum design pipe size shall be 12-inch diameter.

5604.3 Surcharge: An enclosed system may be designed to operate with surcharge if the following conditions are met:

1. The Hydraulic Grade Line (HGL) must be 0.5-feet below any openings to the ground or street at all locations.
2. Watertight joints capable of withstanding the internal surcharge pressure are used in the construction.
3. Appropriate energy loses for bends, transitions, manholes, inlets, and outlets, are used in computing the HGL.
4. Energy methods (Bernoulli's equation) must be used for the computations.

5604.4 Energy Dissipation: The outfall of all enclosed systems shall be designed so that the exiting velocity does not exceed the following. Effective energy dissipating structures shall be provided if necessary to meet these requirements.

OUTLET CHANNEL TYPE	MAXIMUM EXITING VELOCITY
Natural or Unimproved Channel	5 ft./sec.
Grass Lined Channel	5 ft./sec.
Improved Channel with Riprap Lining	10 ft./sec.
Concrete Lining, or Gabion Revetment or Grouted Riprap Lining, or Excavated in Rock	15 ft./sec.

5604.5 Velocity Within the System: The velocity within the system shall be between 3 and 20-feet per second.

5604.6 Loading:

A. **Cover:** Minimum depth of cover shall be 18-inches.

B. Minimum Loading Conditions:

1. Live load: H-20
2. Unit Weight of soil cover: 120 pcf.

3. Rigid pipes hall be bedded and backfilled to provide a minimum factor of safety of 1.5 at the 0.01-inch crack loading condition.

SECTION 5605 OPEN CHANNELS

5605.1 Easements: Permanent easements shall be dedicated to the County & City for operation and maintenance of open channels.

A. **Improved Open Channels:** Easements shall be as wide as the top of bank width; plus 10-feet on each side. Easements shall be continuous between street right-of-ways. When an improved channel begins or ends at a point other than the right-of-way of a dedicated street, a 15-foot or wider easement graded so as to permit access by truck shall be dedicated from the end of the channel to a street right-of-way.

B. **Natural Channels:** Natural open channel easements shall be in the area between the lines of intersection of the natural ground with a plane 12-inches above the design water surface, plus 10-feet measured horizontally on each side thereof; however the width of the easement shall not be less than 30-feet and the width shall be increased if necessary to permit access by truck along the entire length of the channel.

5605.2 Freeboard:

1. No "in-channel" freeboard is required above the 100-year frequency design storm water surface profile elevation.
2. Freeboard shall not be required above the design headwater pool elevation at culvert entrance.

5605.3 5605.4

5605.3 Channel Linings:

1. All improved channels shall be lined to the minimum of the 10-year frequency design storm water profile elevation plus 0.5-foot freeboard minimum.
2. All channel linings, except turf, shall contain provision for relieving back pressures and water entrapment at regular intervals.
3. Lining height on the concave side of curves shall be increased by:

$y = \frac{D}{4}$ where:

y = Increased vertical height of lining in feet.

D = Depth of design flow in feet.

Increased lining height shall be transitioned from y to zero feet over a minimum of:

a. 30(y) feet downstream from the point of tangency (P.T.).
b. 10(y) feet upstream from the point of curvature (P.C.).

5605.4 Lining Material: The following types of lining material and minimum thicknesses shall be used to control damage and erosion. All riprap, grouted riprap, and gabion linings shall be designed with a filer fabric in conformance with Section 2605.2C.2

A. **Improved Open Channels:** Below the 10-year hydraulic grade line +6 inch Freeboard elevation.

DESIGN FLOW VELOCITY-FPS	LINING MATERIAL
0 TO 10	Riprap- 15-inches minimum thickness
0 TO 15	Grouted riprap, gabion revetment or paved concrete
Over 15	Paved concrete or sound in situ bedrock

B. **Overflow Open Channels:** Above the elevation of the 10-year hydraulic grade line +6-inch Freeboard:

DESIGN FLOW VELOCITY-FPS	LINING MATERIAL
Less than 3	Seeded
0 to 5	Sod, staked
0 to 7	Erosion control blanket as approved by the County Engineer
0 to 10	Riprap-15-inches minimum thickness
0 to 15	Grouted riprap, gabion revetment
Over 15	Grouted rip rap or gabion revetment

C. **Other Lining Materials:** Other types of lining materials not specifically listed above may be used when approved by the County Engineer.

5605.5 Side Slopes: Side slopes shall not be steeper than:

1. 3 horizontal to 1 vertical for turf lining.
2. 2 horizontal to 1 vertical for all other lining materials.
3. Flatter if necessary for stability of slopes.

5605.6 Alignment Changes: Alignment changes shall be achieved by curves having a minimum radius of:

$R = \frac{V^2W}{8D}$ where:

R = Minimum radius on centerline in feet

V = Design velocity of flow in feet per second

W = Width of channel at water surface in feet

D = Depth of flow in feet

5605.7 Special Improved Channels: Improved open channels having a design cross sectional flow area of greater than 100-square feet at peak discharge from a 10-year storm may be designed to reduce the height of concrete/rock lining to that required to convey a 2-year storm; subject to the following special requirements:

1. Sod or natural vegetation above the structural lining shall be provided.
2. The elevation of the structural lining material shall be a minimum of 18-inches above the adjacent channel flow line.

5605.8 Vertical Wall Channels: Vertical walls may be used for structural lining of improved channels; subject to the following special requirements:

1. Walls shall be designed and constructed to act as retaining walls.
2. Adequate provisions shall be made for pedestrian entry exit from the channel.

5602.7 Hydraulic Calculations for Pipes, Culverts, and Open Channels: Computations shall be by Manning's formula:

$$Q = \frac{A\,(1.486)}{n}\,(R^{2/3})\,(S^{1/2})$$ where:

Q = Discharge in cubic feet per second.

A = Cross sectional area of flow in square feet.

n = Roughness Coefficient (see Table A).

R = Hydraulic radius (R = A/P) in feet.

S = Slope in feet per foot.

P = Wetted perimeter in feet.

Minor losses shall be calculated by:

$H = k\,(V^2/2g)$ where:

h = Head loss in feet.

V = Velocity of flow in feet per second at point of interest.

2g = 64.4 feet per second per second

k = Coefficient as shown in Table B.

Hydraulic calculations for open channels may also be made by the U.S. Army Corps of Engineers "HEC-2 Water Surface Profiles" computer program.

5602.8 Entrance Control: Design variables for culverts operating under entrance control shall be determined from Figure 7-1 through 7-7.

5602.9 Outlet Control: Design variables for culverts operating under outlet control shall be determined from Figure 7-8 through 7-14.

SECTION 5603 INLETS, MANHOLES, AND JUNCTION BOXES

5603.1 Inlet Design:

A. **Type:** Only curb-opening inlets shall be used on public streets, except as approved by the County Engineer.

B. **Capacity:** Inlet capacity shall be rated at 80 percent of the theoretical capacity indicated by Tables 8-1 through 8-3 and Figures 8-1 through 8-3 to allow for partial obstruction and clogging. Capacity for sizes not shown may be interpolated from these figures.

5603.1 5603.4

C. **Configuration:** Curb inlets shall be as follows (illustrated by Figure 8.0)

Opening length, inside	4.0 ft. (min)
Width, perpendicular to curb line, inside	3.0 ft. (min)
Setback curb line to face	1.0 ft. (min)
Opening, clear height	6.0 in. (min)
Gutter depression at inlet	6. in. (min)
Gutter transition length	
(a) Both sides in sump and upstream sides on slopes	5.0 ft. (min)
(b) Downstream side on slopes	3.0 ft. (min)

5603.2 Freeboard Requirements: Any opening, which surface water, is intended to enter (or may backflow from) the system shall be 0.5-feet or more above an elevation calculated as follows:

1. Invert elevation of the outlet channel (pipe) of the structure, plus;
2. Depth (diameter) of the outlet channel (pipe), plus;
3. "h" minor losses as determined by Section 5602.7. When 50 percent or more of the discharge enters the structure from the surface, "k" shall be 1.0.

5603.3 Inverts and Pipes: The crown(s) of pipe(s) entering a structure shall be at or above the crown of the pipe exiting from the structure and provide a minimum fall of the invert in the structure of 0.2-feet for straight flow through the structure or 0.5-feet fall for all other types of flow (bends more than 22.5 deflection angle, multiple lines entering, enlargement transition, ...etc.) through the structure. The desirable minimum fall across the invert is 0.5-feet.

SECTION 5606 STORMWATER DETENTION AND RETENTION

5606.1 Scope: This section governs the requirements and design of stormwater detention and retention facilities.

5606.2 Easements: Easements shall be dedicated to the county to provide adequate access for inspection, construction, and maintenance of all public detention facility components. The owner shall dedicate the detention facility and easements upon completion of construction and approval by the County Engineer. This shall be land occupied by the facility, plus a 20-foot wide strip around the perimeter of the highest elevation attained by the design storage volume, plus an access easement 20-feet in width between the facility and a public street, except:

1. Private detention facilities as described in Section 5601.2.
2. When multi-purpose wet facilities are planned or are suitable for use as private aquatic recreation or for aesthetic enhancement of the owner's property.
3. When multi-purpose dry facilities incorporate surface recreational improvements.
4. Other special cases.

5606.3 Maintenance and Continued Performance: Maintenance of private detention facilities shall be the responsibility of the property owner and shall include:

1. Debris removal and cleaning
2. Cutting of vegetation
3. Repair of erosion
4. Removal of silt
5. Maintenance of structural facilities, including outlet works, not located in a public drainage easement.
6. Annual or more frequent inspections to assure that the detention basin has full storage capacity and all inlet and outlet structures are fully functional.

5606.4

~~5604.4~~ **Performance Criteria:**

A. **General Provisions:** The criteria set forth herein are applicable to detention facilities:

1. Having 1,000 acres or less area tributary to the facility.
2. Impoundments formed by dams, which are greater than 10-feet in height. Dams which are greater than 10-feet in height but do not fall into state or federal requirement categories shall be designed in accordance with SCS Technical Release No. 60, "Earth Dams and Reservoirs", August 1981, as Class "C" structures.
3. Other agencies have criteria and regulations pertaining to drainage systems which may complement this criteria. State and federal laws and regulations pertaining to dams shall take precedence over this criteria to the extent that detention facility may be classified as "dams" thereunder.

    a. Federal Insurance Agency- Floodplain Regulations and Implementing Ordinances Adopted by Municipalities: Drainage systems designed within the limits of the designated 100-year floodplain on the principal stream shall be designed to convey the flood as defined by applicable published floodplain information studies. For areas located in FIA Zone "A" outside the detailed study area, the Developer shall prepare studies and calculations establishing the floodplain, elevation and width. These calculations shall be submitted to the reviewing agency for approval.

    b. Missouri Department of Natural Resources: Rules and regulations of the Dam and Reservoir Safety Council shall apply to those Missouri structures classified as dams thereunder.

    c. Kansas State Board of Agriculture: Regulations of the Water Resources Division shall apply.

B. **Release Rate: The** maximum release rate from any development for the 100-year and more frequent storms shall not exceed 2.2 c.f.s. per tributary acre. When areas outside the development are also tributary, their inflow hydrograph (s) may be added to the above maximum release rate to determine the total maximum release rate. If the downstream conditions dictate a lower release rate, then the above release rates do not govern.

C. **Detention Basin Size:** For purposes of evaluation, projects will be classified in two categories according the acreage of tributary area.

1. Less than 10 acres: Volume of detention for projects having 10 acres or less tributary to the detention facility may be evaluated using either the "Simplified Volume" Figure 11 or by the more precise methods set forth in Section 5606.4.C.2.
2. Over 10 acres: For projects of more than 10 acres tributary area the owners/engineers may utilize methodology outlined in Technical Release No. 55 "Urban Hydrology for Small Watersheds," June, 1986. A Type 2 rainfall distribution shall be the required storm hydrograph. Hydrologic simulation models shall be based on not less than Antecedent Moisture Condition II. Detention storage shall be based upon the allowable release rate during the 100-year storm with the development in place.

D. **Principal Spillways**: The principal spillway shall be designed to meet the following requirements:

1. The principal spillway shall be designed to function without requiring attendance or operation of any kind or requiring use of equipment or tools, or any mechanical devices.
2. All discharge from the detention facility when inflow is equal to or less than the 100-year inflow shall be via the principal spillway(s).
3. The design shall allow for discharge of at least 80 percent of the detention storage volume within 24 hours after the peak or center of mass of the inflow has entered the detention basin.
4. The design discharge rate via the principal spillway shall continuously increase with increasing head and shall have hydraulic characteristics similar to weirs, orifices or pipes.

E. **Emergency Spillways:** The emergency spillway may either be combined with the principal spillway or be a separate structure or channel. Emergency spillways shall be designed so that their crest elevation is 0.5-foot or more above the maximum water surface elevation in the detention facility attained by the 100-year storm.

F. **Outlet Works:** Outlet works consisting of valves, gates, pipes, and other devices as necessary to completely drain the facility in 72 hours or less when required for maintenance or inspection shall e provided.

G. **Erosion Control:** Principal spillways and outlet works, as well as conveyance system entrances to detention basins, shall be equipped with energy dissipating devices as necessary to limit the peak discharge velocity. See Section 5604 for velocity criteria.

5606.5 Detention Methods: In addition to the foregoing criteria, the following shall be applicable, depending on the detention alternative (s) selected:

A. **Wet Bottoms Basins/Retention Facility:** For basins designed with permanent pools:

1. Minimum Depths: The minimum normal depth of water before the introduction of excess stormwater shall be four feet plus a sedimentation allowance of not less than 5 years accumulation determined in accordance with Figure 6. The side slopes of dry and wet basins shall conform as closely as possible to regraded or natural land contours, and should not exceed three horizontal to one vertical. Slopes exceeding this limit shall require erosion control and safety measures.

2. Depth for Fish: If the pond is to contain fish, at least one-quarter of the area of the permanent pool must have a minimum depth of ten-feet plus sedimentation allowance.

B. **Dry Bottom Basins/Detention Facility:** For basins designed to be normally dry:

1. Interior Drainage: Provisions must be incorporated to facilitate interior drainage to outlet structures. Grades for drainage facilities shall not be less than two percent on turf. Concrete swales, with a minimum gradient of 1.0 percent, may be used as need to conduct storm water from turfed bottom areas to the outlet structure.

2. Earth Bottoms: Earth bottoms shall be seeded and sodded.

3. Multipurpose Feature: These shall be designed to serve secondary purposes for recreation, open space, or other types of use which will not be adversely affected by occasional or intermittent flooding, if possible.

C. **Anti-Clogging Protection:** Trash racks or other approved devices shall be installed where required to insure that the principal spillway (s) will remain functional.

D. **Rooftop Storage:** Detention storage may be met in total or in part by detention on roofs. Details of such designs shall include the depth and volume of storage, details of outlet devices and downdrains, elevations and details of overflow scuppers, and emergency overflow provisions. Connections of roof drains to sanitary sewers are prohibited. Design oadings and special building and structural details shall be subject to approval by the County Engineer.

E. **Parking Lot Storage:** Paved parking lots may be designed to provide temporary detention storage of stormwater on a portion of their surfaces. Generally, such detention areas shall be in the more remote portions of such parking lots. Depths of storage shall be limited to a maximum depth of seven inches, and such areas shall be located so that access to and from parking areas is not impaired.

F. **Other Storage:** All or a portion of the detention storage may also be provided in underground or surface detention areas, including, but not limited to, oversized storm sewers, vaults, tanks, swales, etc.

5606.6 Computational Methods:

A. **Time of Concentration and Travel Time:** Use methods as outlined in Technical Release No. 55, "Urban Hydrology for Small Watersheds," Chapter 3.

B. **Temporary Storage Volume:** A preliminary value of the storage requirement may be obtained through methods outlined Technical Release No. 55, Chapter 6 or other acceptable methods. The storage shall be checked during routing of design hydrographs through the basin and adjusted appropriately.

C. **Hydrograph Routing:** The storage indication method (Modified Plus) of routing a hydrograph through a detention basin may be utilized. Reference: "Introduction to Hydrology," by Warren "Viessman, Jr., John W. Knapp, Gary Lewis, Second Edition, Section 7-2.

5606.7 Required Submittals: The Owner shall submit the following information and data to the County Engineer.

1. Elevation-area-volume curves for the storage facility including notation of the storage volumes allocated to runoff, sediment, and permanent residual water storage for other uses (wet basins only).

2. Inflow hydrographs for the 10-year and 100-year recurrence interval design storms.

3. Stage-discharge rating curves for each spillway and for combined spillway discharges.

4. Routing curves for the 10-year and 100-year recurrence interval design storms with time plotted as the abscissa and the following plotted as ordinates:

    a. Cumulative inflow volume.
    b. Cumulative discharge.
    c. Stage elevation.
    d. Cumulative storage.

5606.8 Additional Requirements:

A. **Access:** Provisions shall be made to permit access and use of auxiliary equipment to facilitate emptying, cleaning, maintenance, or for emergency purposes.

B. **Underground Storage:** Underground detention facilities shall be designed with adequate access for maintenance (cleaning and sediment removal). Such facilities shall be provided with positive gravity outlets. Venting shall be sufficient to prevent accumulation of toxic or explosive gases.

SECTION 5607 PLAN REQUIREMENTS

5607.1 Scope: This section governs the preparation of plans for stormwater system projects.

5607.2 General: The plans shall include all information necessary to build and check the design of storm drainage systems. The plans shall be arranged as required by the County Engineer. Standard drawings of the County shall be included by reference only. Plans shall be sealed by a Registered Professional Engineer and shall be submitted to the County Engineer for review and approval.

5607.3 Scale: Plans shall be drawn at the following minimum scales. Larger scales may be needed to clearly present the design. Bar scales shall be shown on each sheet for each scale.

Plan:	1-inch = 50-feet
Profile:	
Vertical:	1-inch = 10-feet
Horizontal:	1-inch = 50-feet
Cross Sections:	
Vertical:	1-inch = 5-feet
Horizontal:	1-inch = 5-feet
Drainage Area Map:	
On site:	1-inch = 200-feet
Off site:	1-inch = 1,000-feet
Structural Plans:	¼- inch = 1-foot
Graphic Drawings:	Varies

5607.4 Required Information:

A. **Drainage Area Map:** A drainage map shall be included and shall contain the following:

1. Ridge line of the area tributary to each principal element of the system.
2. Note the area in acres.
3. Note the runoff coefficient C for each area.

B. **Plan View:** All designed storm drainage systems shall be drawn in plan view and shall contain the following:

1. North arrow and bar scale.

2. Ties to permanent reference points for each system located outside of the street right-of-way.

3. Identification and location of each pipe, culvert, inlet, structure, and existing utility affecting construction.

4. Right-of-way, property, and easement lines. The 100-year flood plain and setback from the top of bank of an open channel to any building.

5. Existing man-made and natural topographic features, such as buildings, fences, trees, channels, ponds, streams, etc., and all existing and proposed utilities.

6. Location of test borings.

7. Existing and finish grade contours at intervals of 2.0-feet or less in elevation; or equivalent detail indicating existing and finish grades and slopes.

8. A uniform set of symbols subject to approval by the County Engineer.

9. The centerline of open channels within 50-feet of an enclosed drainage system and showing the direction of flow.

10. The existing and proposed drainage systems 100-feet upstream and 100-feet downstream from the development.

C. **Profile View:** All designed storm drainage systems shall be drawn in profile view and shall contain the following:

1. Existing and finish surface grade along the centerline of pipe (except street centerline may be used when construction includes street construction).
2. Length, size and slope of each line or channel segment. Slope shall be expressed in percent.

3. Headwater elevation at the inlet end of each culvert.
4. Flow line (invert elevation in and out at each structure).
5. Each existing utility line crossing the alignment shall be properly located and identified as to type, size, and material.
6. Test borings.
7. All station and invert elevations of manholes, junction boxes, inlets or other structures.
8. The profile shall show existing grade above the centerline as a dashed line, proposed finish grades or established street grades by solid lines; and shall show the flow line of any drainage channel, either improved and unimproved, within 50-feet of either side of the centerline. Each line shall be properly identified. The proposed sewer shall be shown as double solid lines properly showing the top of the pipe.
9. All manholes, inlets or other structures shall be shown and labeled with appropriate "Standard Drawing" designation.

D. **Cross Sections:** Cross sections shall be drawn for all open channels. Sections shall be at appropriate intervals not greater than 50-feet. Additional sections shall be drawn at all structures and intersecting drainage systems. The following shall be indicated on each section:

1. Ties from centerline to baseline.
2. Existing and proposed grade line.
3. Elevation of the proposed flow line.
4. Cut and fill end areas if required for bid quantities.

E. **Design Information for Each Part of the System:** The plans shall present design information for each culvert, structure, facility, pipe and channel segment and shall contain the following:

1. Tributary area in acres.
2. Design discharge and capacity in cubic feet per second.
3. Runoff coefficient C, design storm return frequency rainfall intensity and Manning's "n".
4. Discharge velocity at design flow.
5. Hydraulic grade line.
6. Type and grade of material (gage, class...etc.).

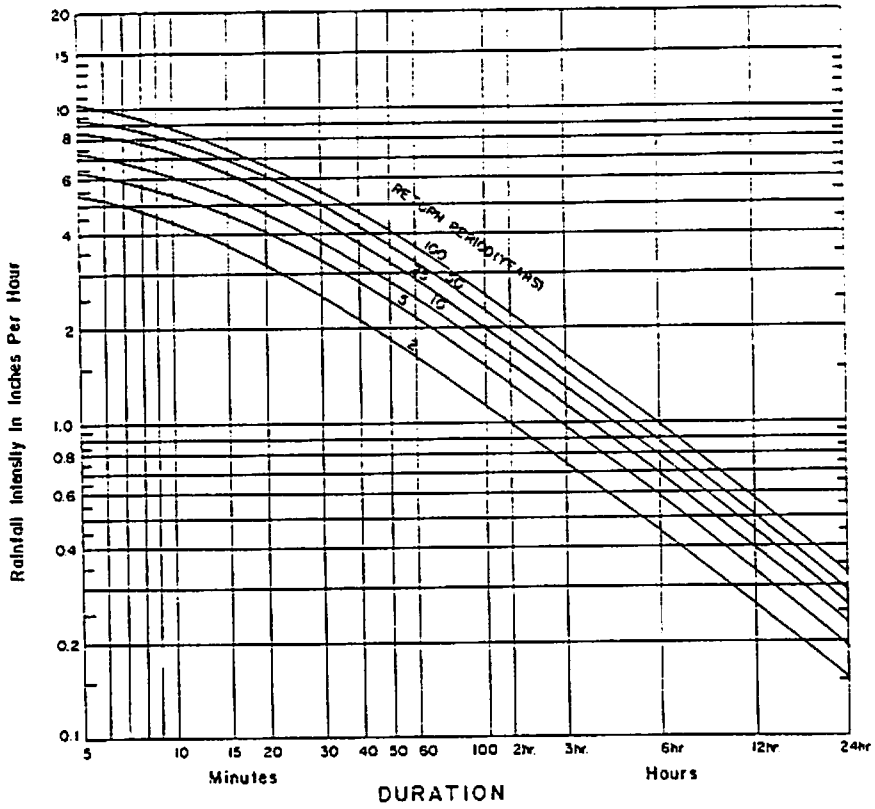
Schedules, which indicate all variable dimensions and elevations, covered by standards or "typical" drawings shall be shown on the plans. All design details for nonstandard structures shall be indicated on the plans. A minimum of one plan view and one sectional view shall be shown on the plans for each structure. Additional views may be required if necessary to clearly define the design. A reinforcing bar list is not required. However, the grade, type, size and location of the bars shall be clearly indicated on the plans.

SECTION 5608 FIGURES AND TABLES

FIG. 1 RAINFALL

INTENSITY-DURATION-FREQUENCY

KANSAS CITY, MISSOURI
1896 - 1972



REFERENCES

1. NOAA Technical Memorandum NWS HYDRO-35 National Oceanic and Atmospheric Administration Of The National Weather Service, Department Of Commerce Silver Spring, Md., June 1977.

2. Technical Paper No. 40, Rainfall Frequency Atlas For Durations From 30 Minutes To 24 Hours And Return Periods From 1yr To 100 Yrs. U.S. Weather Bureau, Department Of Commerce, Washington, D.C., January 1963.

3. Design Of Urban Highway Drainage - State Of The Art FHWA-TS-79-225 U.S. Department Of Transportation Federal Highway Administration, Washington, D.C., August 1979.

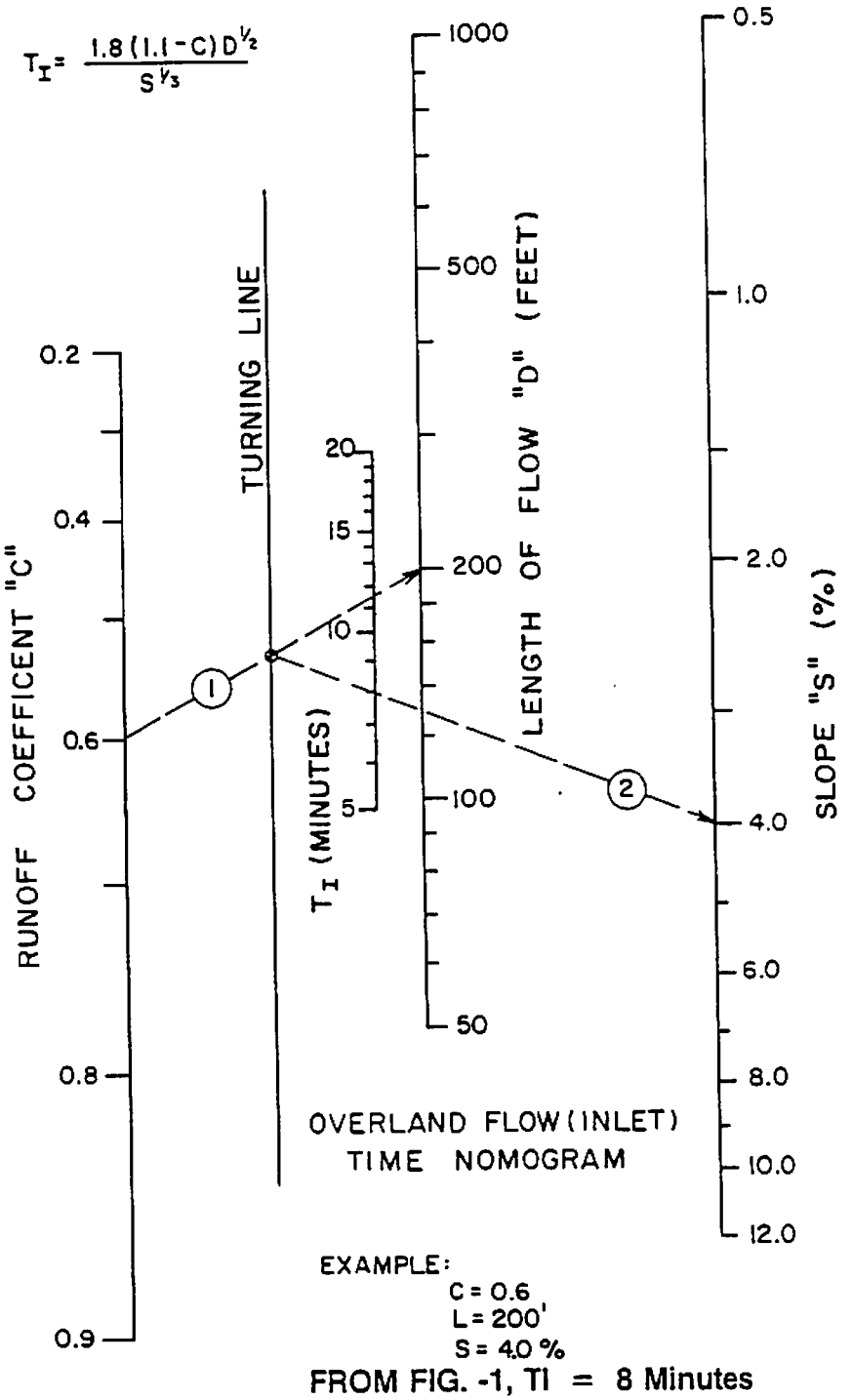
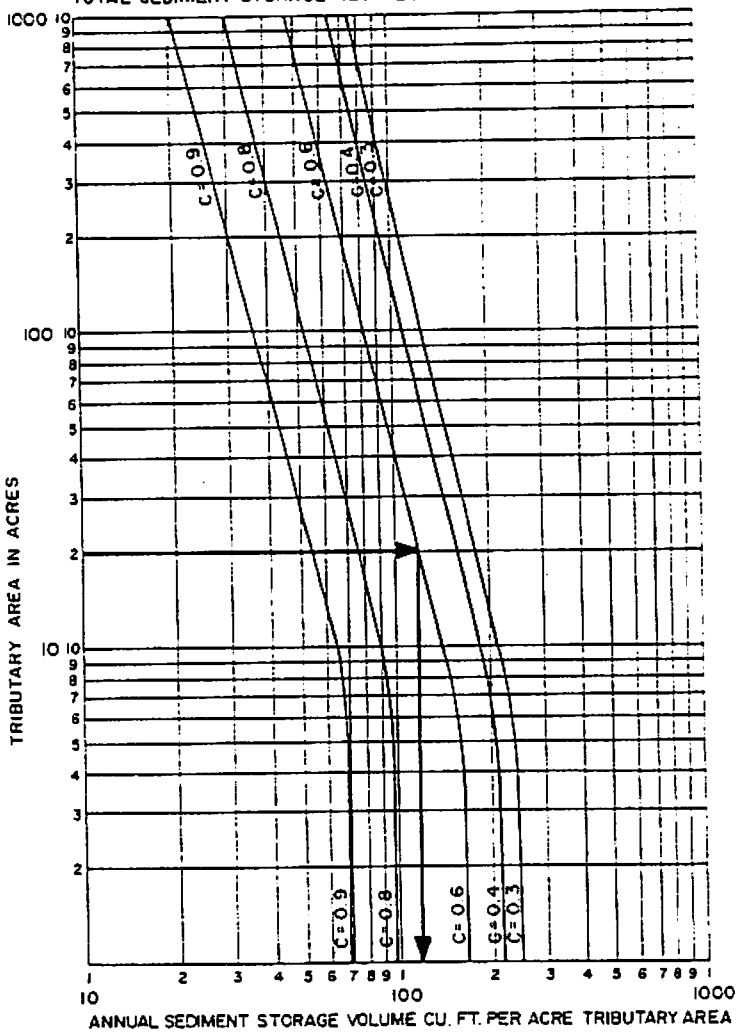

$T_I = \frac{1.8(1.1-C)D^{1/2}}{S^{1/3}}$
RUNOFF COEFFICENT "C"
0.2
0.4
0.6
0.8
0.9
TURNING LINE
T_I (MINUTES)
20
15
10
5
LENGTH OF FLOW "D" (FEET)
1000
500
200
100
50
SLOPE "S" (%)
0.5
1.0
2.0
4.0
6.0
8.0
10.0
12.0
1
2
OVERLAND FLOW (INLET) TIME NOMOGRAM
EXAMPLE:
C = 0.6
L = 200'
S = 4.0 %
FROM FIG. -1, TI = 8 Minutes

FIG. 2

EXAMPLE:
TRIBUTARY AREA = 20 ACRES
RATIONAL METHOD RUNOFF COEFFICIENT "C" = 0.6
SEDIMENT STORAGE = 120 CU. FT. PER ACRE PER YEAR
TOTAL SEDIMENT STORAGE = 120 X 20 = 2400 CU. FT. PER YEAR.



ANNUAL SEDIMENT STORAGE

FIG. 6

Table A
MANNING'S ROUGHNESS COEFFICENT n

Type of Channel	n
Closed Conduits	
Reinforced Concrete Pipe	0.013
Reinforced Concrete Elliptical Pipe	0.013
Corrugated Metal Pipe:	
2 2/3 x ½ in. Annular Corrugations unpaved-plain	0.024
2 2/3 x ½ in. Annular Corrugations paved invert	0.021
3 x 1 in. Annular Corrugations unpaved-plain	0.027
3 x 1 in. Annular Corrugations paved invert	0.023
6 x 2 in. Corrugations unpaved-plain	0.033
6 x 2 in. Corrugations paved invert	0.028
Vitrified Clay Pipe	0.013
Asbestos Cement Pipe	0.012
Open Channels (Lined)	
Gabions	0.025
Concrete	
Trowel Finish	0.013
Float Finish	0.015
Unfinished	0.017
Concrete, bottom float finished, with sides of	
Dressed Stone	0.017
Random Stone	0.020
Cement Rubble masonry	0.025
Dry Rubble or Riprap	0.030
Gravel bottom, side of	
Random Stone	0.023
Riprap	0.033
Grass (Sod)	0.030
Riprap	0.035
Grouted Riprap	0.030
Open Channels (Unlined) Excavated or Dredged	
Earth, straight and uniform	0.027
Earth, winding and sluggish	0.035
Channels, not maintained, weeds & brush uncut	0.090
Natural Stream	
Clean stream, straight	0.030
Stream with pools, sluggish reaches, heavy underbrush	0.100
Flood Plains	
Grass, no brush	0.030
With some brush	0.090
Street Curbing	0.014

Table B
HEAD LOSS COEFFICIENT k

Condition	k
Manhole, junction boxes and inlets with shaped inverts:	
Thruflow	0.15
Junction	0.4
Contraction transition	0.1
Expansion transition	0.2
90 degree bend	0.4
45 degree and less bend	0.3
Culvert outlet	
Culvert inlets:	
Projecting from fill, socket end (groove end)	0.2
Projecting from fill, sq. cut	0.5
Headwall or headwall and wingwalls	
Socket end of pipe (groove end)	0.2
Square edge	0.5
Round (radius = 1/12D)	0.2
Mitered to conform to fill slope	0.7
Standard end section	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or-slope-tapered inlet	0.2
Pipe, or Pipe-Arch, Corrugated Metal	
Projecting from fill (no headwall)	0.9
Headwall or headwall and wingwalls square edge	0.5
Mitered to conform to fill slope, paved or unpaved slope	0.7
Standard end section	0.5
Beveled edges, 33.7° or 45° bevels	0.2
Side-or-slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square edged on 3 edges	0.5
Rounded on 3 edges to radius of 1/12 barrel dimension,	
Or beveled edges on 3 sides	0.2
Wingwalls at 30° to 75° to barrel	
Square edged at crown	0.4
Crown edge rounded to radius of 1/12 barrel dimension,	
Or beveled top edge	0.20

Note: When 50 percent or more of the discharge enters the structure from the surface "k" shall be 1.0. See 5603.2.3

TABLE B CONTINUED

Wingwall at 10° to 25° to barrel	
Square edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square edged at crown	0.
Side-or-slope-tapered inlet	0.2

TABLE C

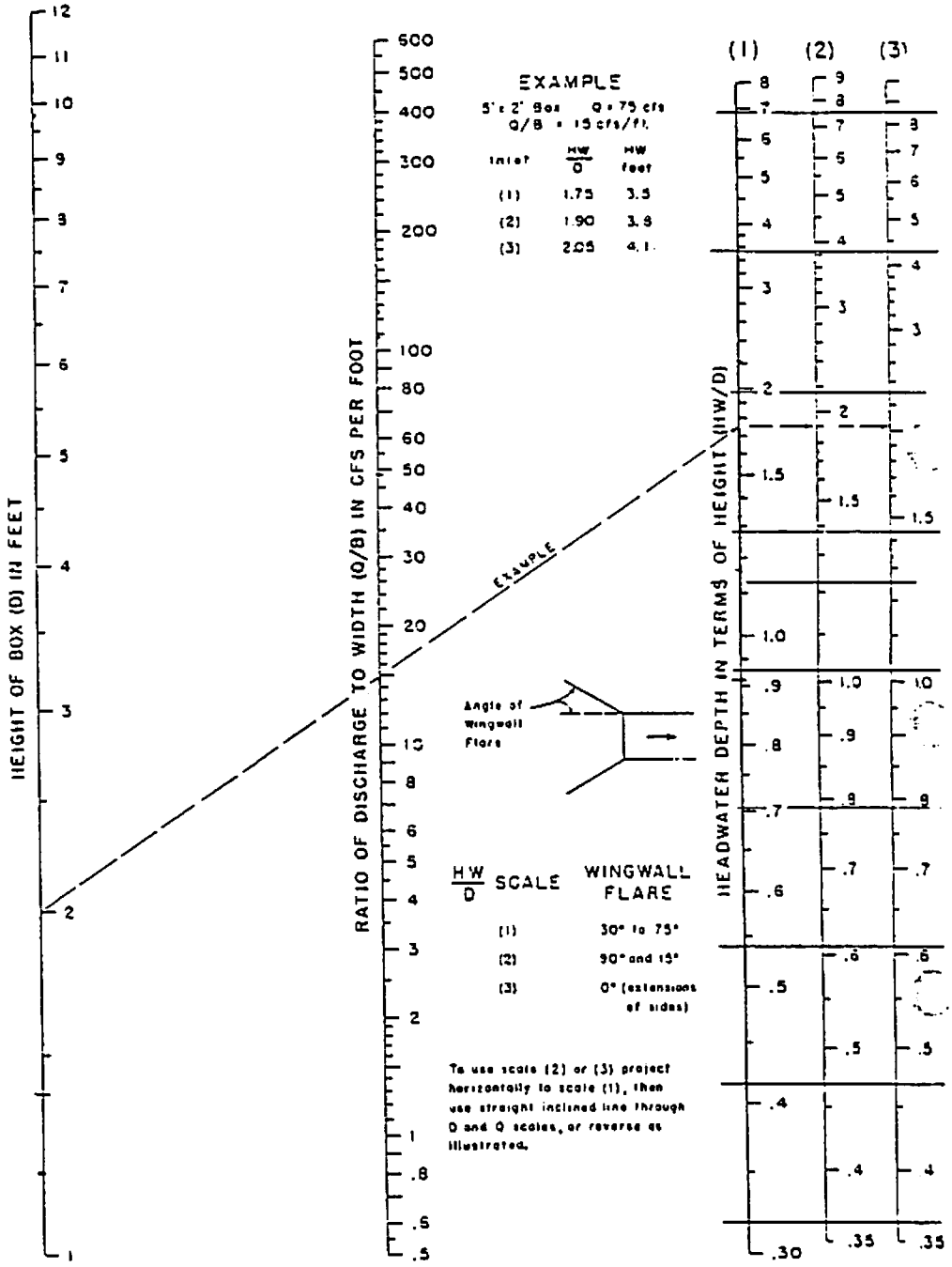
DESIGN AIDE FOR CALCULATING RAINFALL INTENSITY
KANSAS CITY METROPLITAN AREA

Return Period	Equation 1 $5 \leq To \leq 15$	Equation 2 $15 < To \leq 60$
2 yr.	$i = \frac{119}{Tc + 17}$	$i = \frac{134}{Tc + 21.4}$
5 yr.	$i = \frac{154}{Tc + 18.8}$	$i = \frac{182}{Tc + 25}$
10 yr.	$i = \frac{175}{Tc + 18.8}$	$i = \frac{214}{Tc + 26.7}$
25 yr.	$i = \frac{203}{Tc + 18.8}$	$i = \frac{262}{Tc + 28.8}$
50 yr.	$i = \frac{233}{Tc + 19.8}$	$i = \frac{296}{Tc + 29.6}$
100 yr.	$i = \frac{256}{Tc + 19.8}$	$i = \frac{331}{Tc + 30}$

I = Rainfall intensity in inches per hour.

Tc = Time of concentration in minutes.

Note: Table C is a design aide for use with computers to calculate rainfall intensity in the Kansas City Metropolitan Area using the Steel Formula.



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

FIG. 7-1

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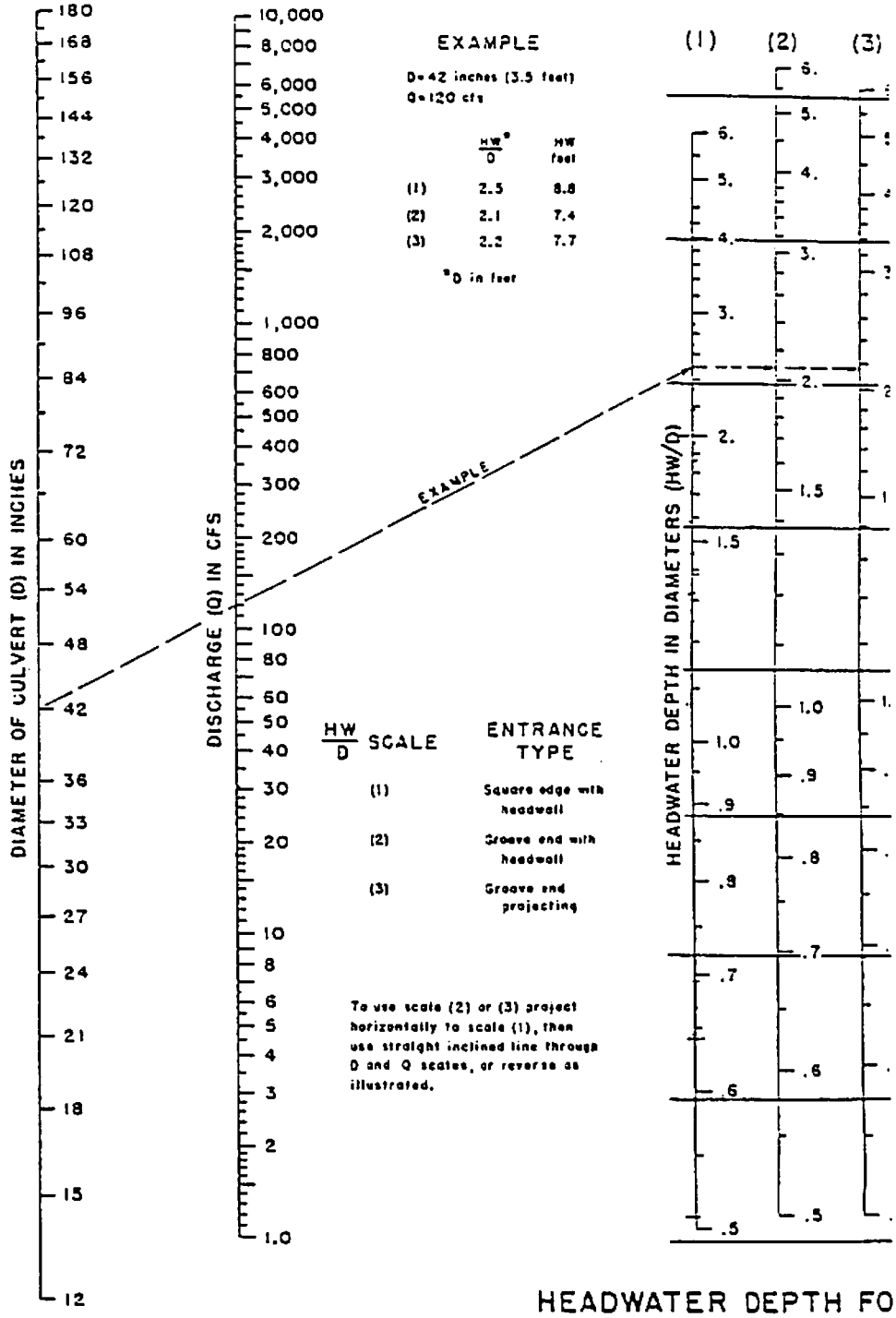
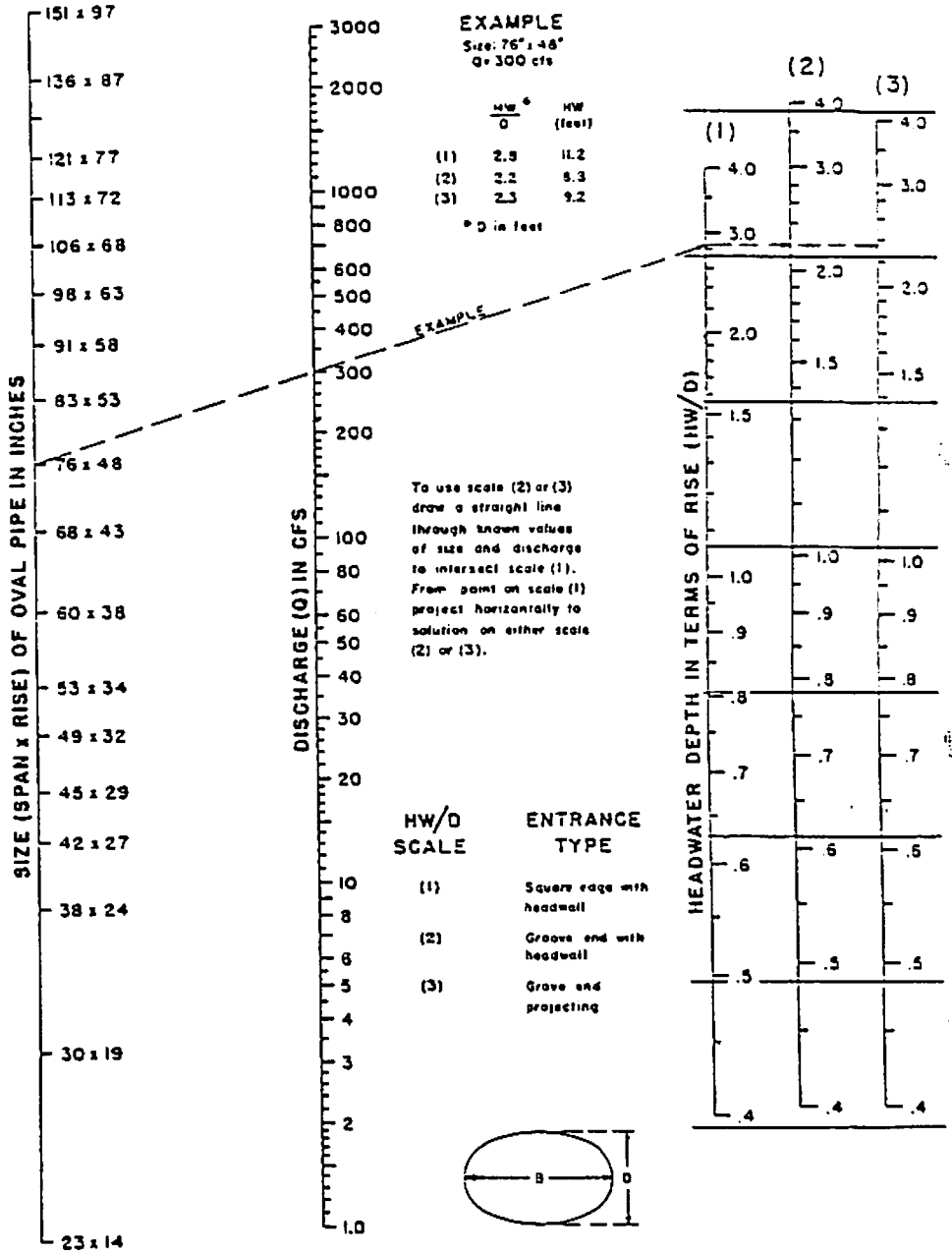


BUREAU OF PUBLIC ROADS JAN 1963

HEADWATER DEPTH FO
CONCRETE PIPE CULVEF
WITH INLET CONTROL
FIG. 7-2



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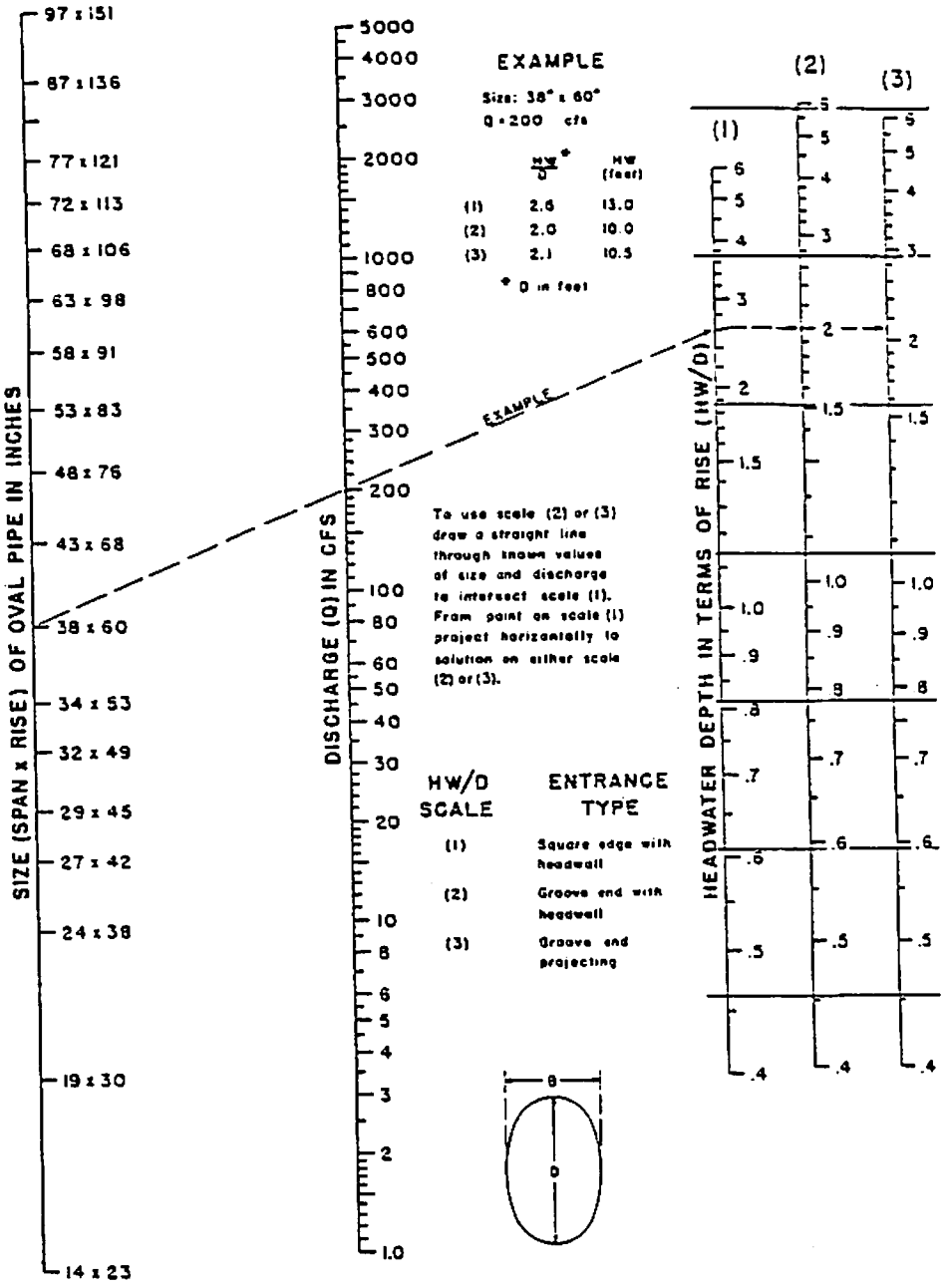
HEADWATER DEPTH FOR
OVAL CONCRETE PIPE CULVERTS
LONG AXIS HORIZONTAL
WITH INLET CONTROL

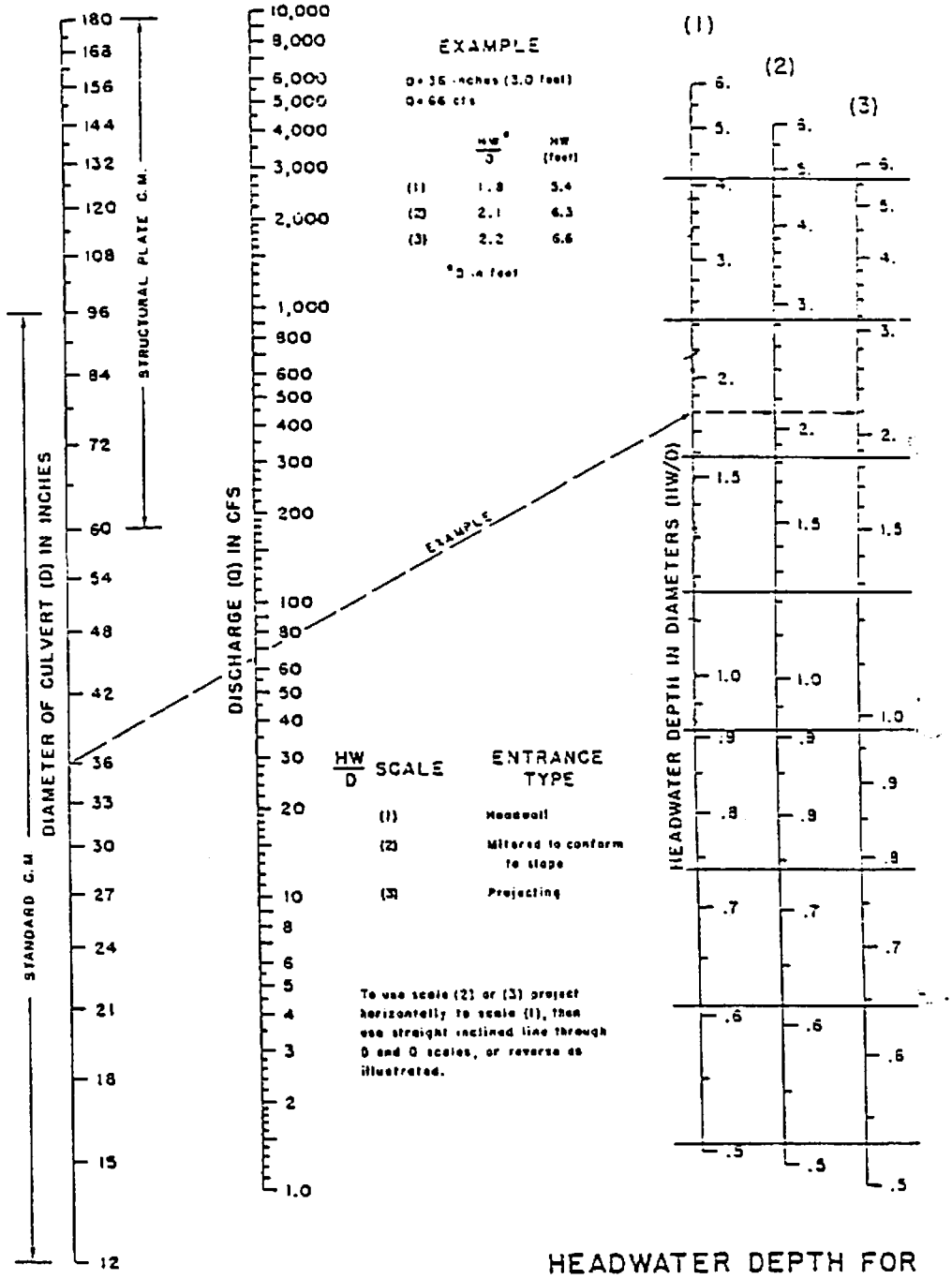
FIG. 7-3



HEADWATER DEPTH FOR
OVAL CONCRETE PIPE CULVERTS
LONG AXIS VERTICAL
WITH INLET CONTROL

FIG. 7-4

BUREAU OF PUBLIC ROADS JAN. 1963



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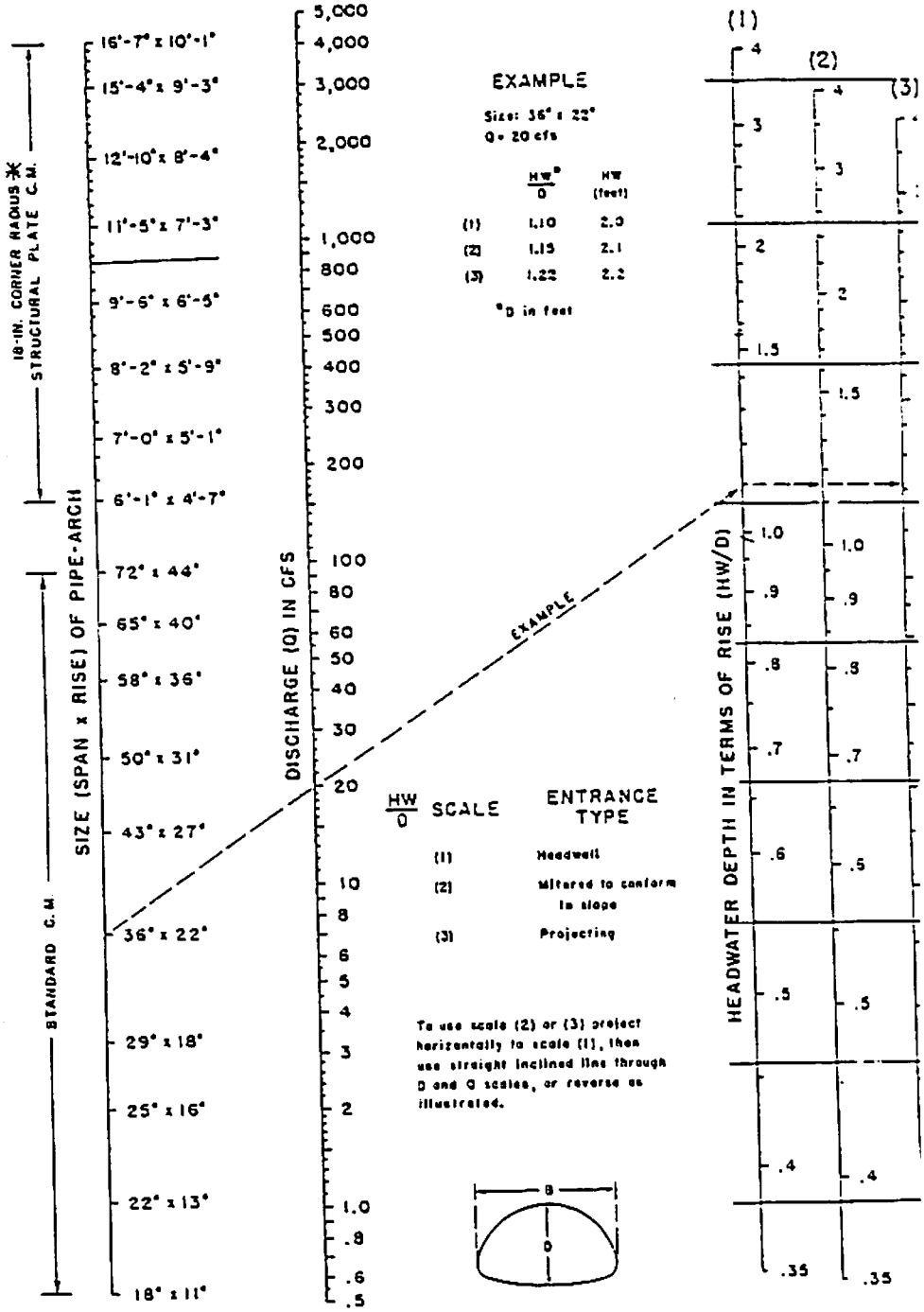
HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

FIG. 7-5

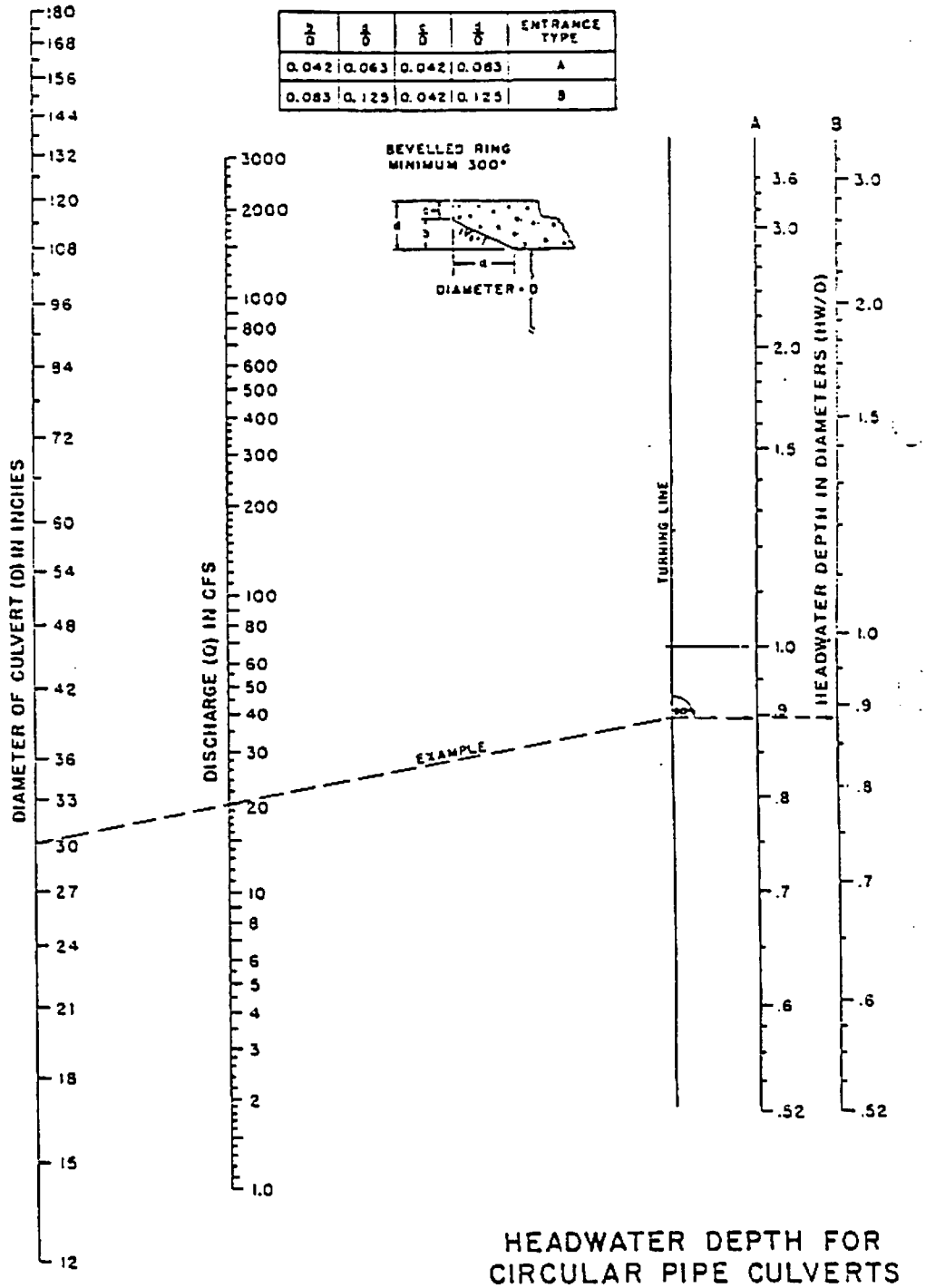


*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH F
C. M. PIPE-ARCH CULVE
WITH INLET CONTRO

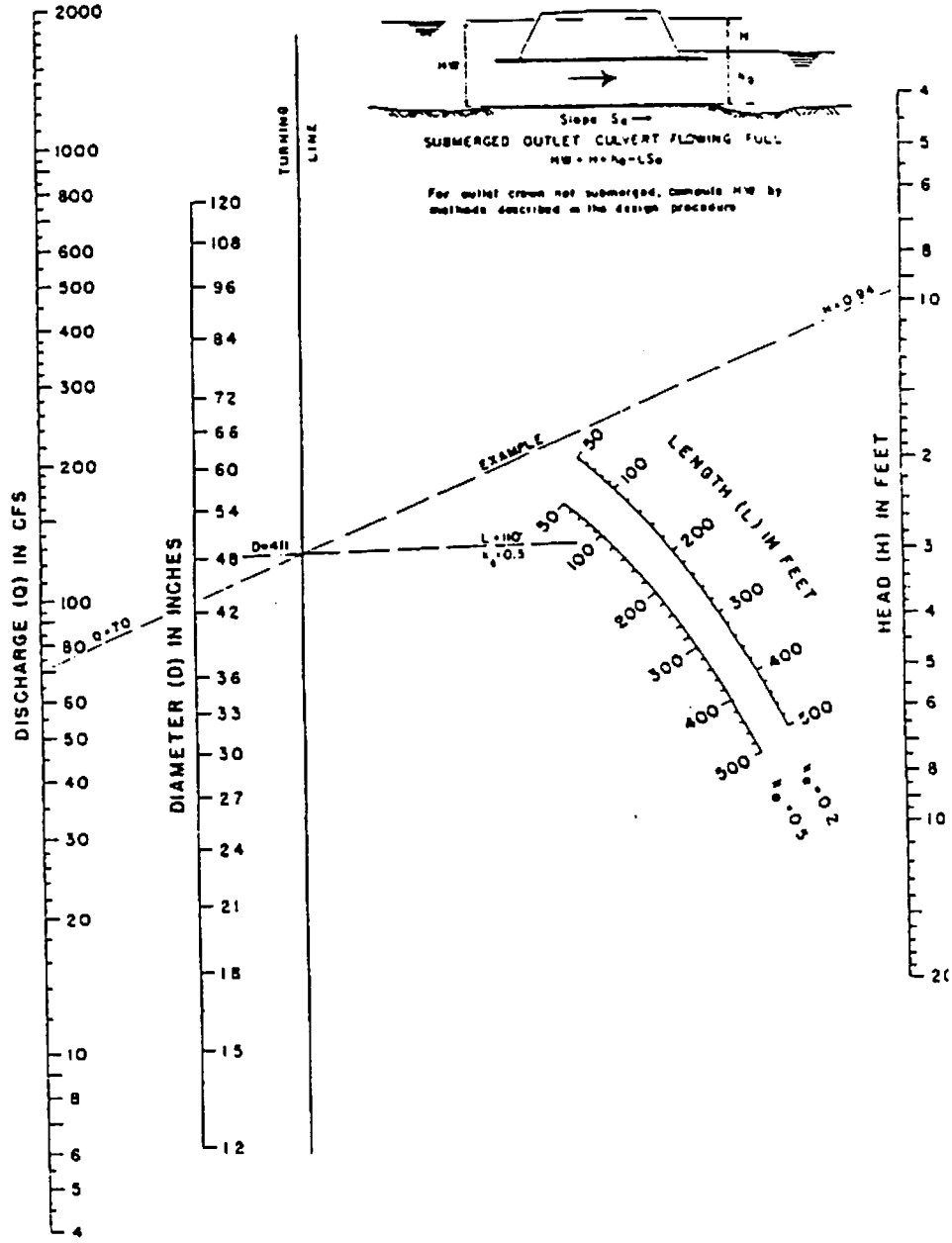
FIG



BUREAU OF PUBLIC ROADS
MARCH 1964

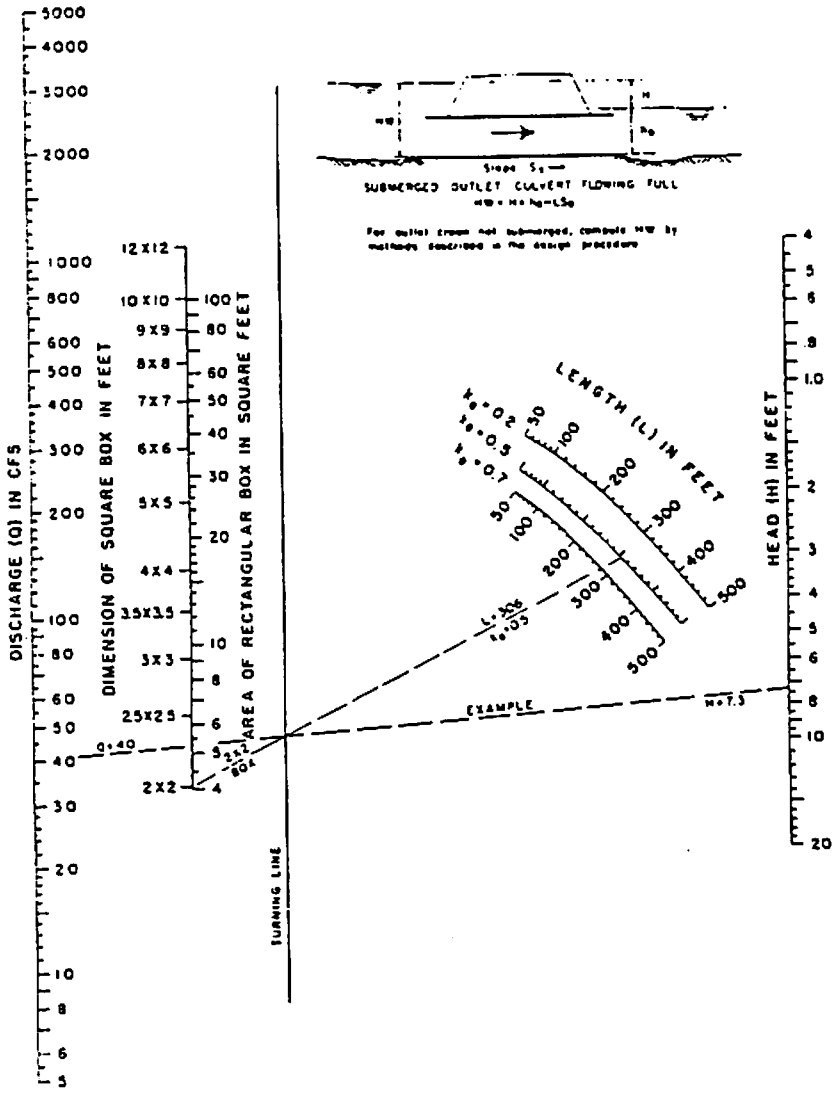
HEADWATER DEPTH FOR CIRCULAR PIPE CULVERTS WITH BEVELLED RING INLET CONTROL

FIG. 7-7



HEAD FOR
CONCRETE PIPE CULVERTS
FLOWING FULL
n = 0.012

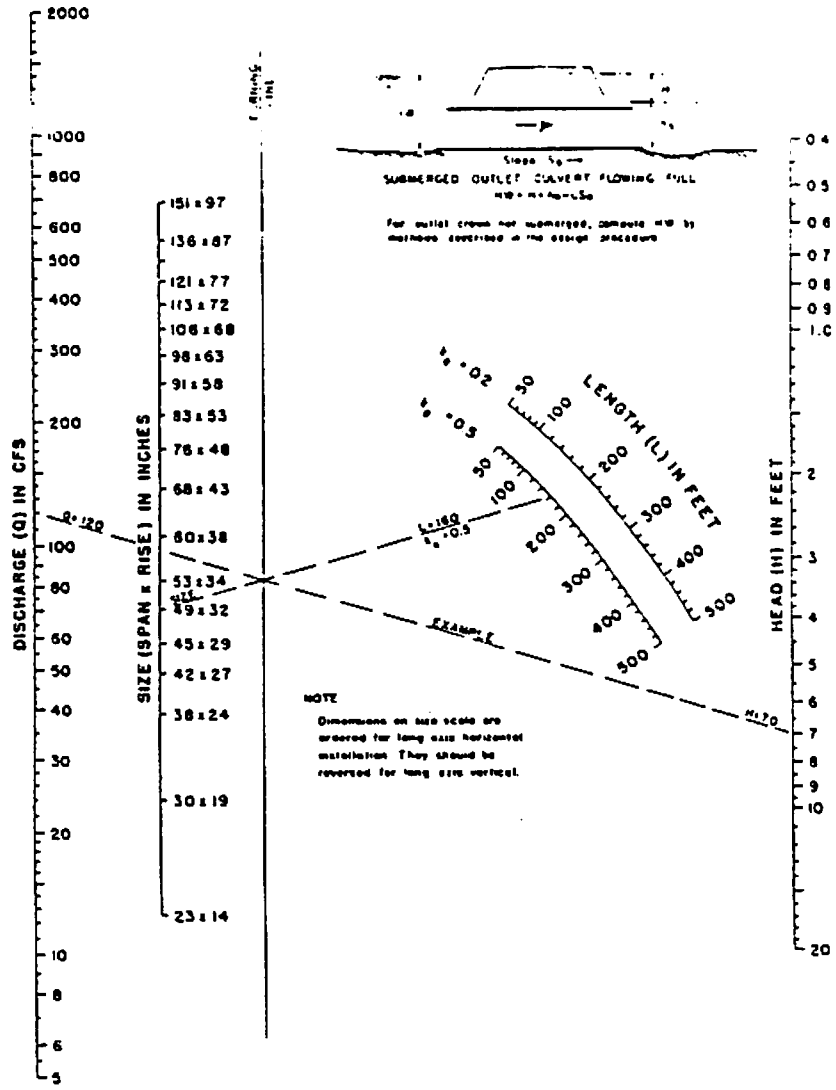
FIG 7-



BUREAU OF PUBLIC ROADS JAN. 1963

HEAD FOR
CONCRETE BOX CULVERTS
FLOWING FULL
n = 0.012

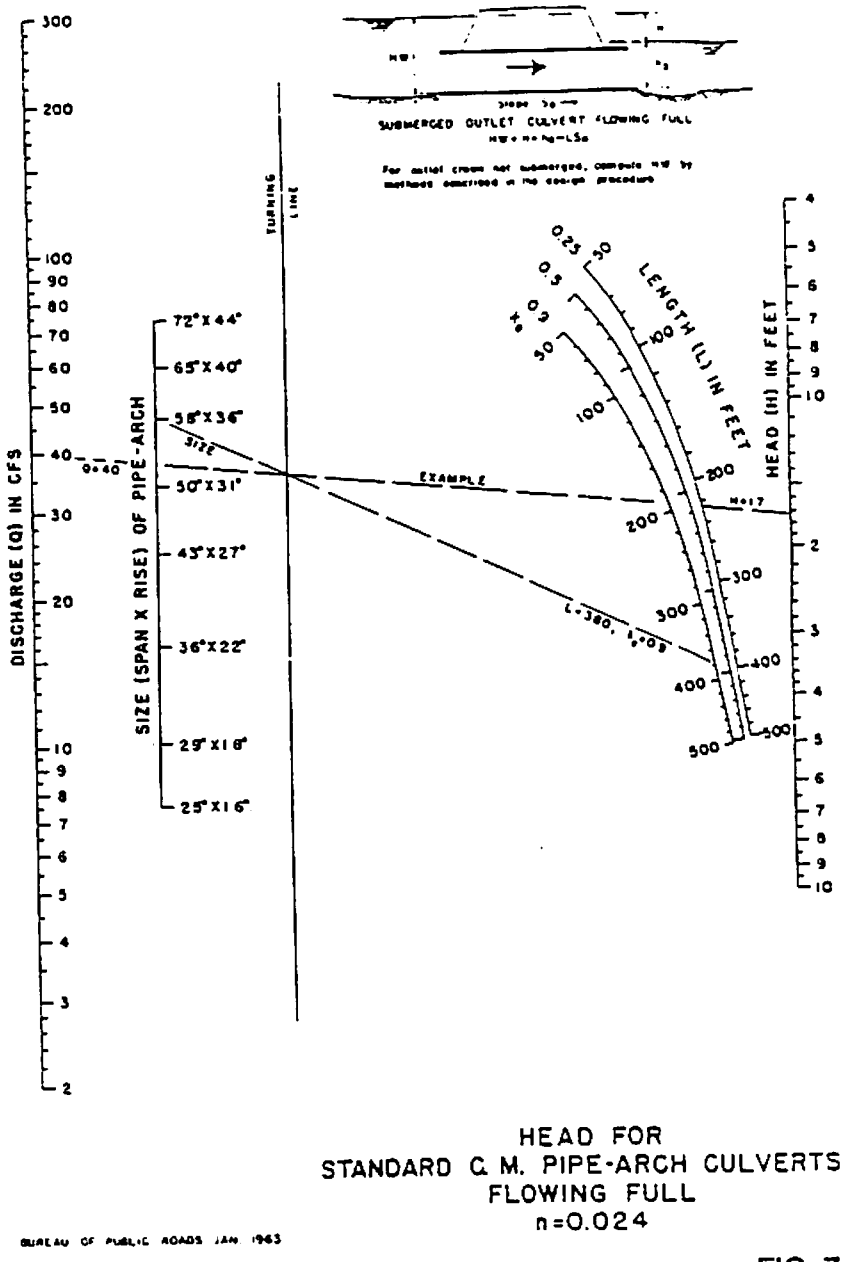
FIG. 7-9



HEAD FOR
OVAL CONCRETE PIPE CULVERTS
LONG AXIS HORIZONTAL OR VERTICAL
FLOWING FULL
n = 0.012

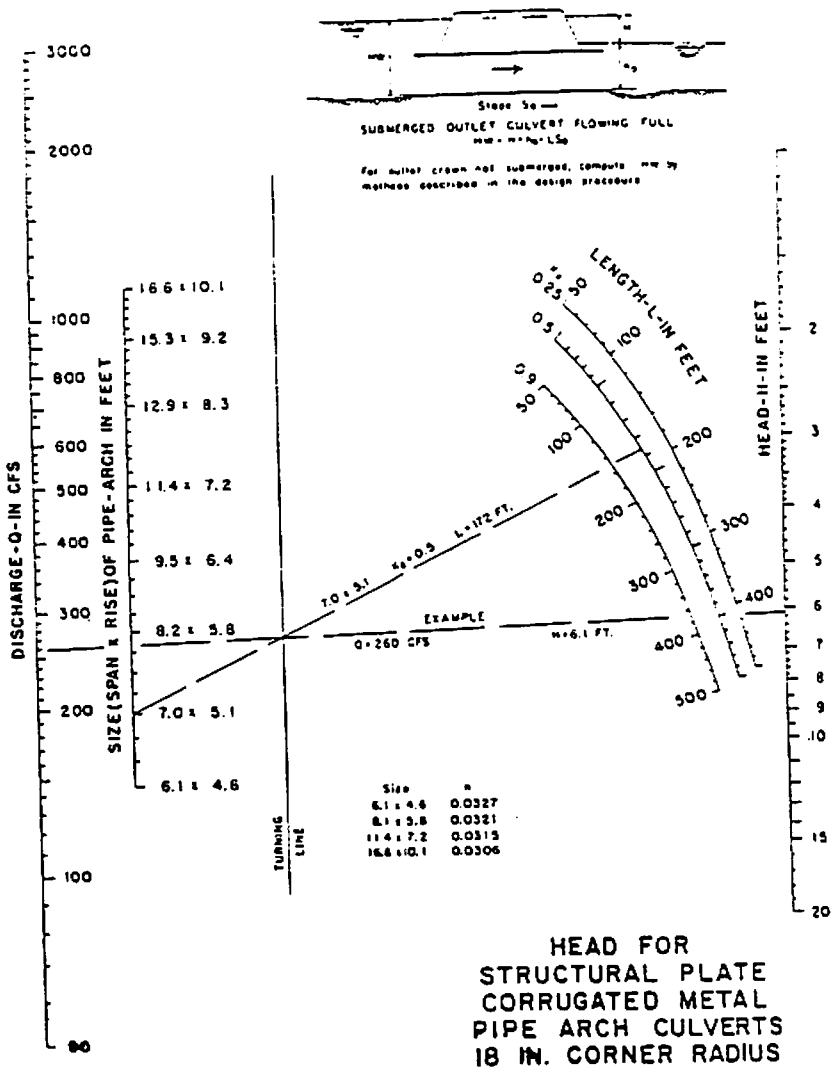
BUREAU OF PUBLIC ROADS JAN. 1963

FIG. 7-1



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

FIG. 7-1



HEAD FOR STRUCTURAL PLATE CORRUGATED METAL PIPE ARCH CULVERTS 18 IN. CORNER RADIUS FLOWING FULL n = 0.0327 TO 0.0306

BUREAU OF PUBLIC ROADS JAN. 1963

FIG. 7-14

TABLE 8-2
CURB INLET CAPACITY
FOR
11.5-FOOT GUTTER SPREAD

GUTTER SLOPE IN PERCENT	GUTTER CAPACITY C.F.S.	CURB INLET DESIGN CAPACITY C.F.S. FOR INLET LENGTH						
		4 FOOT	5 FOOT	6 FOOT	8 FOOT	10 FOOT	11 FOOT	12 FOOT
0.5	2.4	G	G	G	G	G	G	G
1	3.3	G	G	G	G	G	G	G
2	4.7	G	G	G	G	G	G	G
3	5.7	5.5	G	G	G	G	G	G
4	6.6	5.3	5.9	6.0	6.3	6.6	6.6	6.6
6	8.1	5.1	6.1	6.5	7.2	7.9	8.1	8.1
8	9.4	5.7	6.3	6.9	8.0	8.9	9.1	9.2
10	10.5	6.3	7.0	7.7	8.9	9.9	10.1	10.3
12	11.5	6.9	7.7	8.4	9.7	10.8	11.1	11.4
14	12.4	7.6	8.5	9.3	10.3	12.0	12.4	12.4

NOTES & REFERENCES:

1. Inlet capacities derived from "The Design of Stormwater Inlets" Johns Hopkins University, 1956

2. Gutter capacity calculated by Izzard's Equation

3. Inlet capacity is for ¼" per foot street crown and inlet throat and transition geometry per Figure 8-0

4. Gutter deflectors are required for inlets on slopes of 4 percent and steeper.

5. Linear interpolation within the range of the table is permitted for slopes and corresponding capacities not shown.

6. Reduce above theoretical capacities by 20% for clogging allowance per Section 5603.1.B.

7. "G" indicates inlet capacity is greater than gutter capacity and the 20% capacity reduction is not required.

TABLE 8-3
CURB INLET CAPACITY
FOR
10.5-FOOT GUTTER SPREAD

GUTTER SLOPE IN PERCENT	GUTTER CAPACITY C.F.S.	CURB INLET DESIGN CAPACITY C.F.S. FOR INLET LENGTH						
		4 FOOT	5 FOOT	6 FOOT	8 FOOT	10 FOOT	11 FOOT	12 FOOT
0.5	1.8	G	G	G	G	G	G	G
1	2.6	G	G	G	G	G	G	G
2	3.7	G	G	G	G	G	G	G
3	4.5	G	G	G	G	G	G	G
4	5.1	4.6	4.8	5.1	G	G	G	G
6	6.3	4.9	5.3	5.7	6.3	7.2	G	G
8	7.3	5.1	5.7	6.3	7.2	G	G	G
10	8.2	5.9	6.6	7.2	8.1	G	G	G
12	8.9	6.3	7.1	7.8	8.9	G	G	G
14	9.6	6.9	7.7	8.4	9.6	G	G	G

NOTES & REFERENCES:

1. Inlet capacities derived from "The Design of Stormwater Inlets" Johns Hopkins University, 1956

2. Gutter capacity calculated by Izzard's Equation

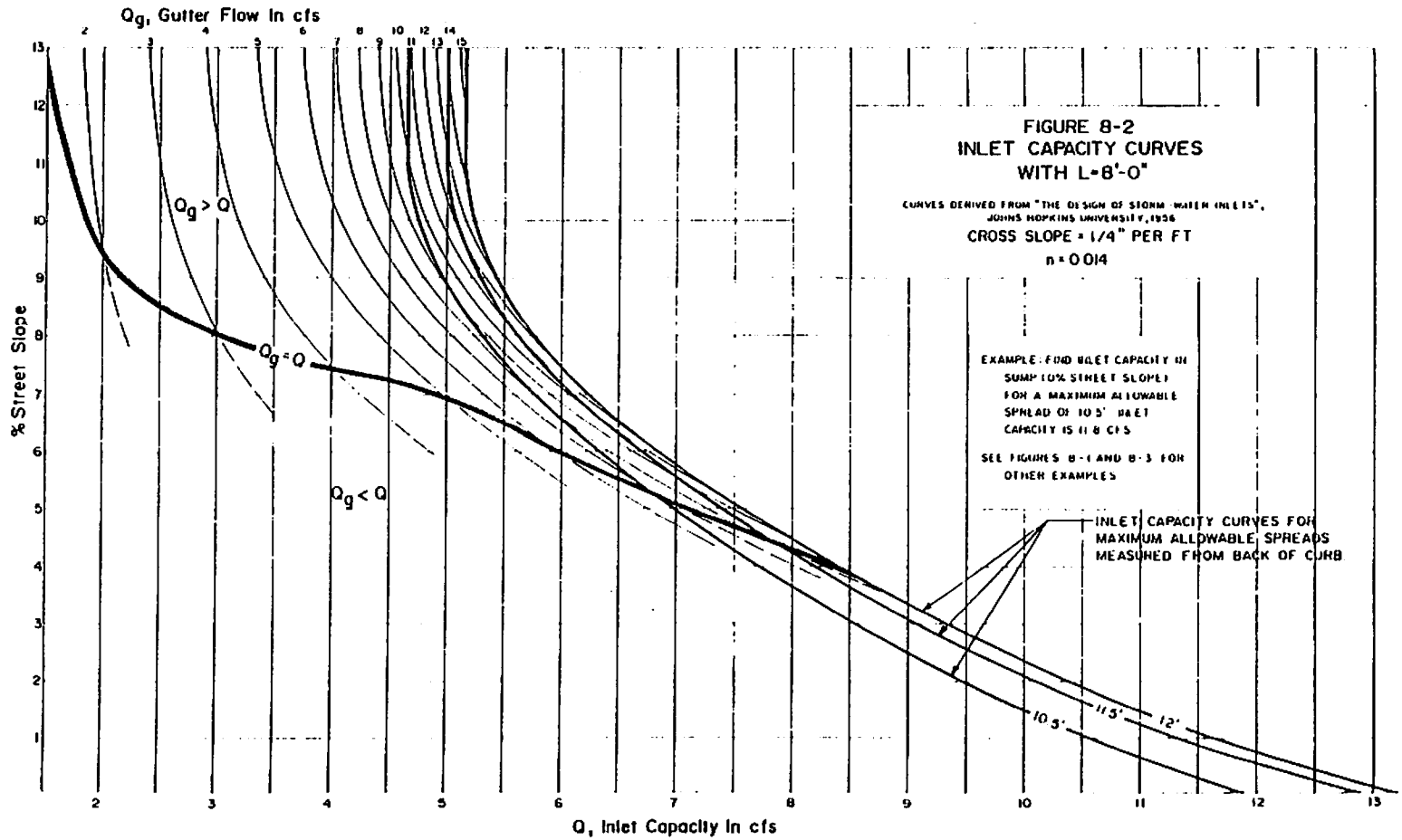
3. Inlet capacity is for ¼" per foot street crown and inlet throat and transition geometry per Figure 8-0

4. Gutter deflectors are required for inlets on slopes of 4 percent and steeper.

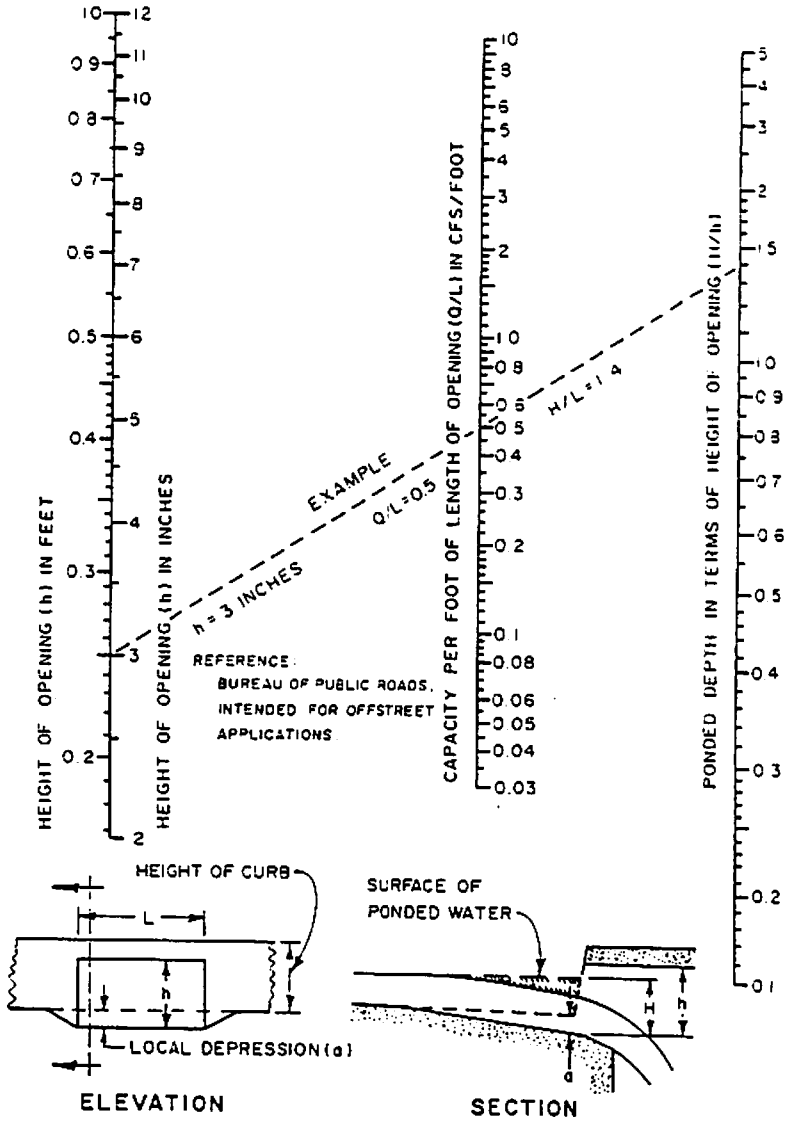
5. Linear interpolation within the range of the table is permitted for slopes and corresponding capacities not shown.

6. Reduce above theoretical capacities by 20% for clogging allowance per Section 5603.1.B.

7. "G" indicates inlet capacity is greater than gutter capacity and the 20% capacity reduction is not required.

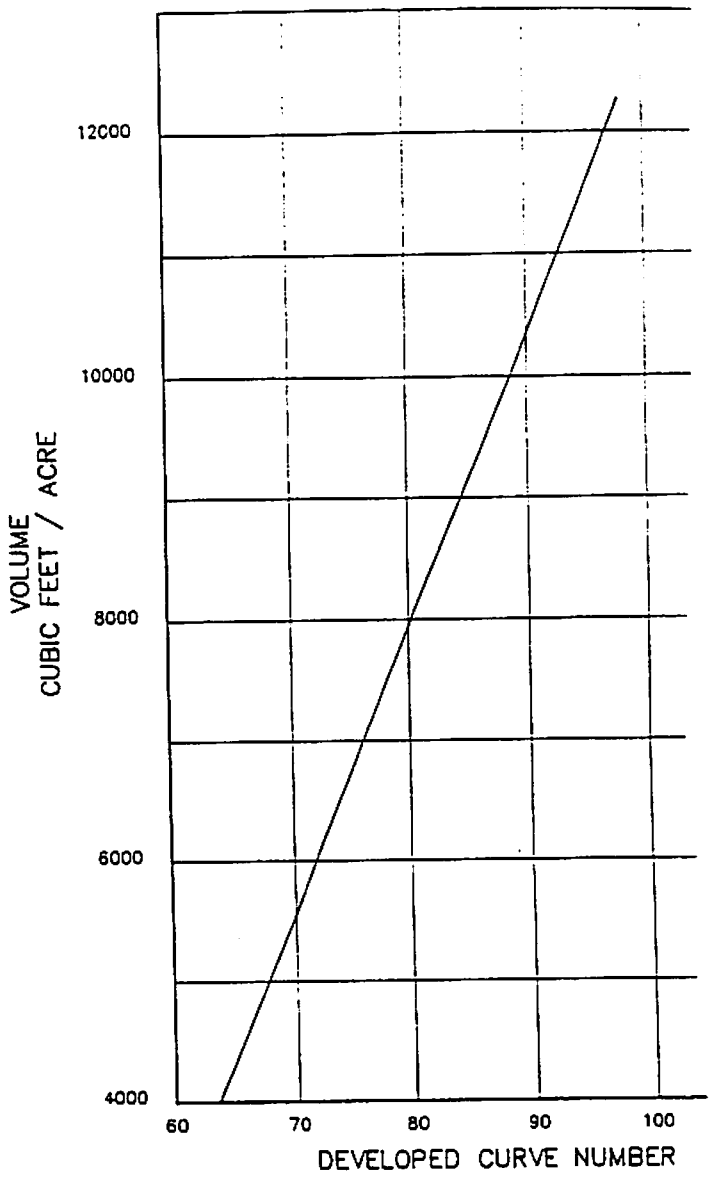


Reduce above theoretical capacities by 20% for clogging allowance per Section 5603.1.B



CAPACITY OF CURB OPENING INLET AT LOW POINT IN GRADE.

FIGURE 8-4



STORM WATER DETENTION
VOLUME REQUIREMENT
(SIMPLIFIED OPTION)

NOTES:

1. For Release Rates - See Section 5606.4.B.
2. The developed curve number for the site is to be determined in accordance with TR-55 "Urban Hydrology for Small Watersheds.

SIMPLIFIED VOLUME CHART
FOR DETENTION FACILITIES

FIG. 11

RESOLUTION

Be it resolved by the Director of Public Works of Kansas City, Missouri that the following listed Section of Division V, Design Criteria, approved and adopted March 21, 1990 by the Kansas City Metropolitan Chapter of the American Public Works Association are hereby approved and adopted as the Official Design Criteria for the Department of Public Works of Kansas City, Missouri with like section numbers except as modified by the attached supplement.

Section 5600 Storm Drainage Systems and Facilities

A copy of said criteria and supplement are attached hereto and incorporated herein by reference.

The criteria shall become effective January 1, 1991 and shall supercede previously adopted standard design criteria for the same topics.

Approved and adopted as Official Document No. 900780 this 18th Day of December, 1990.

George L. Satterlee
Director of Public Works
of Kansas City, Missouri