50 GENERAL DRAINAGE DESIGN GOALS AND ACCEPTABLE PROCEDURES

The following general drainage design criteria are applied to the development design to assure consistent performance meeting the requirements of drainage standards.

50-1 All development will be required to accept the storm runoff from the upstream tributary watershed, and convey it, with the additional runoff, generated from said development, to the nearest watercourse.
When required, new facilities within the development will be sized to accept runoff from a fully developed watershed. In addition, the development will be required to upgrade or provide adequate facilities to convey the existing Q_{10} from the existing watershed together with the additional runoff from the development, through the development and to the nearest watercourse.

50-2 Ditches, channels, drains, road improvements and all other storm water carrying facilities shall be designed and constructed to the standards established by the Public Works Department, generally at 10%- storm for roads, and 2% - storm for red-line channels.

50-3 Ventura County Flood Control District standards shall be observed for all facilities within this jurisdiction, and the approval of the District shall be obtained on all improvement plans for such facilities.

50-4 Storm water acceptance deeds must be obtained whenever diversion or concentration of waters is involved.

50-5 Overland flow shall be intercepted at the boundaries and conveyed through or around said development.

50-6 Manholes will generally be required (for access for inspection and maintenance) at angle points greater than 10 degrees, at junctions, at intervals not exceeding 400 feet, at locations where the conduit changes in size, and points where an abrupt flattening or steepening of the grade occurs.

50-7 Drainage calculations, signed or sealed by a registered civil engineer in California, shall be clearly and completely presented, and that there be a clear determination that design standards have been met.

50-8 The Cook's Method shall be used in Hydrology calculations on City's street and drainage facilities.

50-9 15' wide access road shall be provided for all open channel and ditches. The surface of access road shall be paved with 4 inches agg. base and oil penetration treatment.

REV. APPR. BY DATE

CITY OF Oxnard	GENERAL REQUIREMENTS – DRAINAGE	STANDARD PLAN
	DRAWN: SOHER CKD Jay Patel APPR. BY Benjamen Y. Wong	PLATE 54
Public Works Department		SHEET OF

51 STREET DRAINAGE CRITERIA

51-1 Street cross-sections are not to be designed for use as a substitute for storm drains in conveying drainage water from offsite area to disposal channels.
They may be used to convey water originating from the street and from adjoining lots or unimproved areas, providing that vehicle and pedestrian use of the streets is not unreasonably restricted.
Flow from unimproved areas shall have facilities to remove debris and/or silt from the flow before entering the street.

51-2 The storm runoff to be used in calculating the capacity of street drainage facilities will be Q_{10} providing the adjacent lot pads shall not be flooded by the storm runoff from Q_{50}
Wherever the road forms a sump, the drainage facilities at this location shall be designed for Q_{50} in such a manner that the water level will not encroach on building pads even at times of plugging of the facilities.
Drainage facilities in sumps may be designed for Q_{10} only if it is constructed with an overflow channel(s) for exess flow approved by the city.

51-3 In computing design capacity of the street, a provision of A.C. overlay of 0.10 feet thickness over the entire travelled and parking lanes should be made. This will provide the capacity which represents the actual condition subsequent to the overlay.

51-4 To prevent undue hazard, restriction, and interference with vehicular and pedestrian traffic on local, collector and arterial streets, the Q_{10} runoff shall be conveyed in the following manner :

51-4.1 RESIDENTIAL STREET (PLATE 100), LOCAL COMMERCIAL / INDUSTRIAL STREET (PLATE 101) INCLUDING SERVICE ROAD AND ALLEY.
Flow shall be contained between curb faces. Cross-gutter will be allowed only on these streets and service roads and where the traffic would normally stop.

51-4.2 COLLECTOR COMMERCIAL / INDUSTRIAL STREET (PLATE 101)
Shall be designed to maintain 24 feet of pavement nearest the centerline of the travelled way free of longitudinally flowing drainage water. No cross-gutter will be allowed on collector streets.

51-4.3 LOCAL AND SECONDARY ARTERIALS
Shall be designed to maintain 14 feet of pavement in each direction free of longitudinal flowing drainage water. No cross-gutter will be allowed on local and secondary arterials.

51-4.4 PRIMARY ARTERIALS
Shall be designed to maintain 26 feet of pavement in each direction free of longitudinal flowing drainage water. No cross-gutter will be allowed on primary arterials.

REV. APPR. BY DATE

CITY OF Oxnard	GENERAL REQUIREMENTS – DRAINAGE			STANDARD PLAN
	DRAWN: SOHER	CKD. Jay Patel	APPR. BY Benjamen Y. Wong	PLATE 55
	Public Works Department			SHEET OF

51-5 Where the design storm runoff exceeds the permitted hydraulic capacity of the street section, the design storm runoff must be removed from the street and conveyed in an underground storm drain to a drain outlet or natural watercourse. Minimum size of drain shall be 18 inches in diameter.

51-6 When in the opinion of the City a serious silt or debris deposition on the streets or property will result, the debris hazard shall be eliminated by providing a debris basin, outlet works and/or trash rack as directed by the City.

51-7 For design plans, hydraulic grade lines shall be at least 8" below the furnished grade over underground conduits and at least 12" below the top of bank for open channels. Freeboard of 0.5'+0.1×flow depth for open channels will be required.

51-8 For all drainage facilities located outside of Ventura County Flood Control District's jurisdiction, the quantity of Q_{10} shall be based on the Cook's Method and latest VCFCD isohyetal and soil maps issued by the District.

51-9 Capacity of all inlets shall be based on the design runoff.
At public school sites, catch basins shall be located at the near or far street gutter to collect the storm flow prior to the pedestrian walk.
Catch basins shall be located prior to pedestrian cross-walk in the urban, commercial, or industrial street system.
Side opening inlets are preferable in urban areas in order to minimize hazard to pedestrians and bicycle riders from grate basins and debris unsightliness.

51-10 Deviations from the street drainage criteria may be made only upon the approval of the Public Works Director subsequent to the review and approval of sufficient supporting data furnished by the person requesting the deviations, or upon approval of the City Council.

REV. APPR. BY DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

STANDARD PLAN

DRAWN: SOHER CKD. Jay Patel APPR. BY Benjamin Y. Wong

Public Works Department

PLATE 56

SHEET OF

52 MODIFIED RATIONAL FORMULA – COOK'S METHOD

52-1 BACKGROUND

This method was adopted for use for the hydrologic design of City drainage facilities in the City of oxnard on March, 1977.

The method was originally prepared for use in Ventura County. It was adapted by the County from a similar presentation for nationwide use published in the U.S. Navy Manual, " Soil Conservation - NAVDOCKS TP -Pw- 5 ". The presentation was originally prepared by the U.S. Soil Conservation Service.

The method takes into account the drainage area, relief and surface storage of the area, type of soil, extent of vegetal cover, shape of the watershed, rainfall intensity to be expected, and the frequency of occurrence.

The adapted method was verified by the County by comparing the computed runoffs with the available runoff data and was found to give reasonable results. The City has analytically compared this method with other known methods and found it to yield relatively reasonable answers.

52-2 REFERENCE COUNTY MAPS

The following County maps shall be used with this method :

1) "Hydrologic Soil-Type Map " - Ventura County Flood Control District's Hydrology Manual, August, 1966, Figures 5,6,&7.
2) " Isohyetal Map - 24 Hour Rainfall with probable 50-Year Frequency ", Ventura County Flood Control District, March, 1966, Dwg. No. D-3-3d.

52-3 ASSUMPTIONS

On the basis that a) the City of Oxnard area consists primarily of type B soil and flat terrain, b) the average 24-hour 50-year frequency rainfall is six (6) inches, and c) the effect of the differences in vegetal cover between various types of residential development, as well as between commercial and industrial developments , is minor, the following simplifying assumptions may be made in using this method:

1) Rainfall-intensity correction factor of 123% may be used throughout the City.
2) The types of development may be grouped into three (3) major categories with the corresponding "C" factor shown.

TYPE OF DEVELOPMENT	"C"- FACTORS
Undeveloped	40 - 45*
Residential	60
Commercial & Industrial	70

* Depends on soil-type

52-4 LIMITATIONS

This method shall be used only in the hydrologic design of City facilities with watershed area of not larger than 100 acres. (Ventura County Flood Control District's hydrology method shall be used in all District's facilities).

REV. APPR. BY DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

DRAWN: SCHER | CKD. Jay Patel | APPR. BY Benjamen Y. Wong

Public Works Department

STANDARD PLAN

PLATE 57

SHEET OF

52-5 COMPUTATION PROCEDURE

(Refer to computation form and appropriate charts & graphs)

1) Delineate and measure the drainage area in acres.
2) Measure travel length , L, in feet.
3) Compute average width of watershed in feet.
4) Compute length to width ratio and determine the shape correction factor from the given chart.
5) Determine soil type from hydrologic soils map, vegetal cover from field observation , relief and surface storage from topographic map and/or field observation, as required.
6) Compute "C" factor from given chart.
7) Using computed "C" factor and measured drainage area obtain the uncorrected Q_{10} from the graph.
8) Multiply the Q_{10} in item (7) by both the shape correction and rainfall intensity correction factor to obtain corrected Q_{10} peak runoff.
9) For other frequencies , multiply the corrected Q_{10} by the appropriate frequency correction factor from the chart.

REV. APPR BY DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

STANDARD PLAN

DRAWN: SOHER CKD. Jay Patel APPR. BY Benjamin Y. Wong

Public Works Department

PLATE 58

SHEET OF

53 MODIFIED COOKS – HYDROLOGIC CALCULATIONS

Project_____ Job No._____ Sheet_____ Of_____

Watershed_____ Designed_____ Date_____

Concentration Point_____ Checked_____ Date_____

Watershed Constants :

Drainage Area _____ Acres

Length _____ feet Fall _____ feet Slope _____ %

Width = $\frac{\text{Area} \times 43560}{\text{Length}}$ = _____ feet

$\frac{\text{Length}}{\text{Width}}$ = _____ Shape Correc. Factor = _____

Soil Type _____ RI-Correc. Factor _____

Computation of "C"

Type of Development	"C" Factor	Present	Future
Undeveloped	40-45		
Residential	60		
Commercial & Industrial	70		

Composite "C" Factor

Runoff : Q from curve = _____ $\times \frac{L}{W}$ Factor _____ × RI-Corr. Factor _____

Frequency	Frequency Factor	Q
20%	65%	_____ cfs
10%	100%	_____ cfs
4%	135%	_____ cfs
2%	170%	_____ cfs
1%	200%	_____ cfs

REV. APPR BY DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

DRAWN: SOHER CKD. Jay Patel APPR. BY Benjamin Y. Wong

Public Works Department

STANDARD PLAN PLATE 59 SHEET OF

54

MODIFIED RATIONAL FORMULA

" C " FACTORS*

ITEMS	RUNOFF PRODUCING CHARACTERISTICS			
RELIEF	40 Steep, slopes exceed 30%	30 Hilly, slopes 10% to 30%	20 Rolling, slopes 5% to 10%	10 Flat, slopes 0 to 5%
SURFACE STORAGE	20 Negligible, surface depressions few and shallow. Drainageways steep & small , no ponds or marshes.	15 Low, well defined system of small drainageways , no ponds or marshes.	10 Normal, considerable surface depression storage, lakes and ponds less than 2% of drainage area.	5 High , surface depression storage high , drainage system not sharply defined.
SOIL	20 Rock or thin soil mantle. Negligible infiltration capacity.	15 Clay or other soil of low infiltration capacity.	10 Normal , deep permeable soils.	5 High , sands, loamy sands & other loose open soils.
SCS CLASS	D	C	B	A
VEGETAL COVER	20 No effective soil cover, bare or very sparse cover.	15 Clean cultivated crops or poor natural cover , less than 10% of drainage area under good cover.	10 50% of drainage area in good grassland or woodland , 50% of area in clean cultivated crops.	5 About 90% of drainage area in good grassland woodland or equivalent cover.

" C " FACTOR
(FOR CITY OF OXNARD)

C =40 - 45	FOR UNDEVELOPED
C = 60	FOR RESIDENTIAL
C = 70	FOR COMMERCIAL AND INDUSTRIAL

NOTE:

In hydrologic Calculations, use values of "C" given in lower table.
Use of values of "C" given in upper table have to be approved by the City Engineer.

REV. APPR. BY DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAWING

DRAWN: SOHER CKD. Jay Patil APPR. BY Benjamin Y. Wong

Public Works Department

STANDARD PLAN

PLATE 60

SHEET OF

FREQUENCY FACTORS – %

RETURN FREQUENCY	RETURN PERIOD	FACTOR
50%	2	25
20%	5	65
10%	10	100
4%	25	135
2%	50	170
1%	100	200
0.1%	1,000	400

RAINFALL INTENSITY CORRECTION FACTOR

OXNARD AREA	=	123%

SHAPE CORRECTION FACTORS – %

L/W \ AREA	0.01 S.M.	0.1 S.M.	1 S.M.	10 S.M.	100 S.M.	1,000 S.M.
1	115	125	132	141	154	172
1.5	112	115	119	124	131	141
2	108	110	110	113	117	122
3	100	100	100	100	100	100
4	98	95	94	91	89	86
5 or greater	95	91	88	85	82	78

1 S.M. = 1 Square Mile = 640 Acres

Just for information only

REV | APPR BY | DATE

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

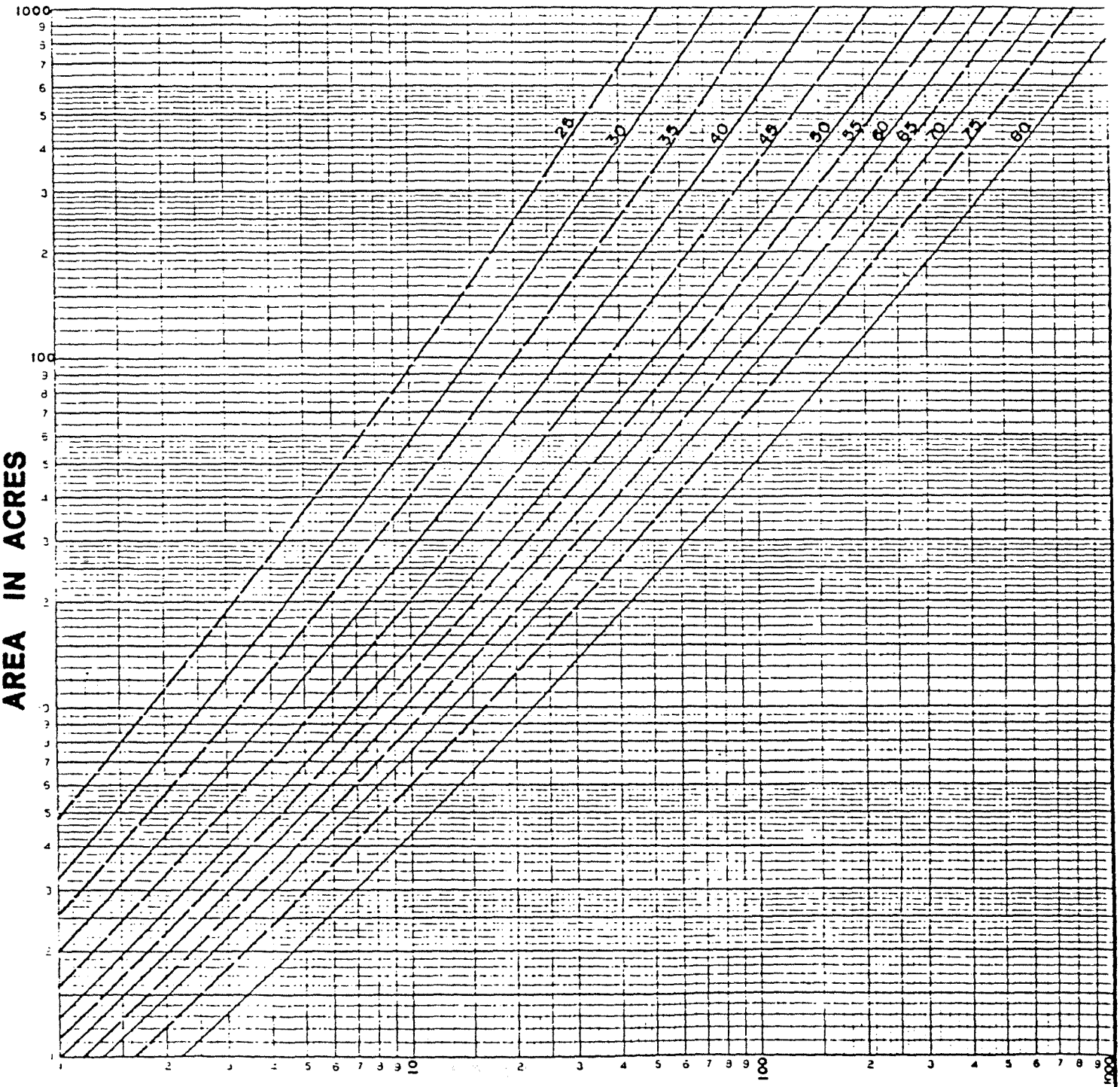
DRAWN: SCHER | CKD. Jay Patel | APPR. BY Benjamin Y. Wong

Public Works Department

STANDARD PLAN

PLATE 61

SHEET OF



PEAK FLOW IN CUBIC FEET PER SECOND

CITY OF Oxnard

GENERAL REQUIREMENTS – DRAINAGE

STANDARD PLAN

PLATE 62

SHEET OF

DRAWN: SQHER | CKD. Jay Patel | APPR. BY Benjamin Y. Uong

Public Works Department