Chapter 5

Precipitation Losses

Introduction

Effective Precipitation

The Sacramento method derives the direct runoff from the effective precipitation. Effective precipitation is the total precipitation minus the losses due to interception, evaporation, transpiration, depression storage and infiltration. Infiltration accounts for the greatest portion of precipitation losses.

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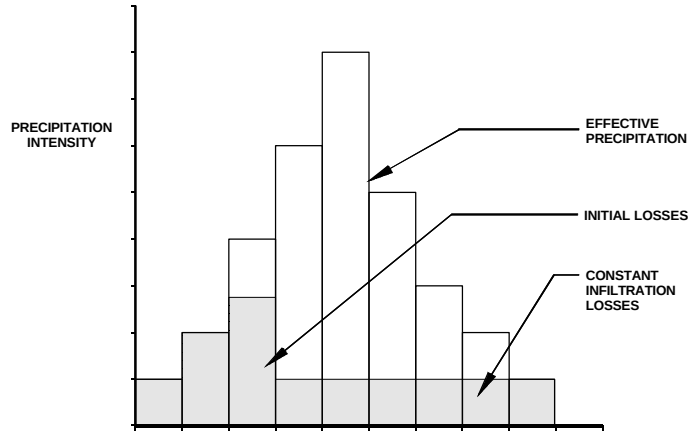
Introduction (continued)

The Sacramento Method

There are several methods for calculating precipitation losses due to infiltration. The method selected for the City and County of Sacramento accounts for losses on pervious areas using two parameters, an initial loss depth, and a constant loss rate. With this method, all precipitation is lost until the initial loss depth is satisfied. After the initial loss is satisfied, rainfall is lost at a constant rate. The following illustration depicts this method.



EFFECTIVE PRECIPITATION HYETOGRAPH

More information on infiltration losses in the City and County of Sacramento is included in the Appendix.

Precipitation Losses in HEC-1 and SACPRE

The HEC-1 program includes an option to calculate the infiltration losses. The program requires the percent impervious, the initial loss, and the constant loss rate as input for each basin. SACPRE can be used to create the HEC-1 input. SACPRE provides input menus for calculating the weighted percent impervious of the basin and a weighted constant loss rate. SACPRE uses default initial loss values dependent on the recurrence interval of the design storm.

Infiltration

Initial Losses

The initial loss depth in the infiltration calculations represents the higher infiltration capacity of the unsaturated soil at the beginning of a storm. All precipitation is assumed to infiltrate until the initial loss depth is satisfied.

Initial losses are dependent on the soil condition. Dry soil infiltrates significantly greater amounts of precipitation than moist soil. There is also a correlation between the recurrence frequency of a storm and the initial loss. Calibration modelling with HEC-1 in the Sacramento area has shown that higher initial losses were appropriate for the more frequent events. Initial losses recommended for the City and County of Sacramento are shown in Table 5-1.

Table 5-1. Initial Losses

Recurrence Interval	Loss inches (millimeters)
2	0.40 (10.2)
5	0.25 (6.4)
10	0.20 (5.1)
25	0.15 (3.8)
50	0.12 (3.1)
100	0.10 (2.5)
200	0.08 (2.0)
500	0.06 (1.5)

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Infiltration (continued)

Constant Losses

The constant loss is an infiltration rate in inches per hour based upon the infiltration rate of saturated soil. The infiltration potential of pervious areas is dependent on the soil type, land use and vegetation cover.

The U.S. Soil Conservation Service (SCS), has classified soils into four hydrologic categories (A, B, C, and D) based on infiltration rates after prolonged wetting. Type A soils exhibit low runoff potential while type D soils exhibit high runoff potential. The SCS hydrologic soil types are shown on the maps included with this volume. The soil maps also contain type E and F soils, these areas are either urban land with significant imperviousness or a mixture of soil types due to fill material. The infiltration capacity of these soils was not determined by the SCS but is assumed to have similar infiltration rates as type D soils. Average infiltration rates for combinations of hydrologic soil type and cover for Sacramento City and County are provided in Table 5-2.

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Infiltration (continued)

Constant Losses (Cont.)

Table 5-2. Infiltration Rates by Hydrologic Soil-Cover Groups (inches/hour)

Cover	% Imp	Soil Group		
		B	C	D
Highways, Parking	95	0.14	0.07	0.04
Commercial, Offices	90	0.16	0.08	0.05
Intensive Industrial	85	0.162	0.082	0.052
Apartments, HDR	80	0.165	0.085	0.055
Mobil Home Park	75	0.167	0.087	0.057
Condominiums, MDR	70	0.17	0.09	0.06
Residential: 8-10 du/acre, Ext Indust	60	0.18	0.10	0.07
Residential: 6-8 du/acre, LDR, School	50	0.18	0.10	0.07
Residential: 4-6 du/acre	40	0.18	0.10	0.07
Residential: 3-4 du/acre	30	0.18	0.10	0.07
Residential: 2-3 du/acre	25	0.18	0.10	0.07
Residential: 1-2 du/acre	20	0.18	0.10	0.07
Residential: 0.5-1 du/acre	15	0.18	0.10	0.07
Residential: 0.2-0.5 du/acre, Ag Res	10	0.18	0.10	0.07
Residential: <0.2 du/acre, Recreation	5	0.18	0.10	0.07
Open Space, Grassland, Ag	2	0.18	0.10	0.07
Open Space, Woodland, Natural	1	0.19	0.11	0.08
Dense Oak, Shrubs, Vines	1	0.25	0.16	0.12
*Sacramento County does not contain significant areas of Type "A" soils.				

Impervious Area

Determining Percent Impervious

The percent impervious of a drainage basin is primarily related to landuse. Many drainage studies require the determination of runoff for existing, future, and ultimate development landuse. Descriptions of these development conditions and sources of landuse information are given below.

Existing: The impervious area for existing conditions can be estimated from a combination of the following:

- visual inspection of the basin
- aerial photos
- landuse maps.

Future: Future development is defined as the landuse described by the most recent Sacramento City and County General Plans. The General Plans usually have a planning horizon of approximately 20 years, and are updated approximately every 5 years.

Ultimate: Ultimate development is the landuse beyond the General Plan time horizon which assumes build-out conditions. In the City and County of Sacramento, most areas within the Urban Services Boundary that are designated agricultural/residential, agricultural or open space are assumed to develop to low density residential (50% impervious) in the ultimate condition.

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Impervious Area (continued)

Determining Percent Impervious (cont.)

Table 5-3 provides general land use descriptions and Sacramento City and County zoning designations versus percent impervious.

Table 5-3. Land Use versus Effective Percent Impervious

Land Use from Aerial Photography	Effective % Impervious	General Plan Land Use	
		Sacramento County	City of Sacramento
Highways, Parking	95	Core Area Commercial	Heavy Commercial
Commercial, Offices	90	Commercial/Offices	Commercial/Offices
Industrial	85	Intensive Industrial	Industrial - Employee Intensive
	85	Urban TOD	
Apartments	80	High Dens. Res. (31-50 du/ac)	High Dens. Res. (30+ du/ac)
Mobil Home Park	75	Neighborhood TOD	
Condominiums	70	Medium Dens. Res. (13-30 du/ac)	Medium Dens. Res. (16-29 du/ac)
Residential: 8-10 du/acre (20-25 du/ha)	60	Extensive Industrial	Industrial
Residential: 6-8 du/acre (15-20 du/ha)	50	Low Dens. Res. (1-12 du/ac)	Low Dens. Res. (4-15 du/ac)
	50	School	Schools
Residential: 4-6 du/acre (10-15 du/ha)	40		
Residential: 3-4 du/acre (7.5-10 du/ha)	30		
Residential: 2-3 du/acre (5-7.5 du/ha)	25		
Residential: 1-2 du/acre (2.5-5 du/ha)	20		
Residential: .5-1 du/acre (1-2.5 du/ha)	15		Rural Estates (1 du/0.5-4 ac)
Residential: .2-.5 du/acre (0.5-1 du/ha)	10	Agricultural/Residential	
	10	Public Park/Cemetery	
Residential: <.2 du/acre (0.5 du/ha)	5	Recreational	Parks, Recreation, Open Space
Open Space, Grassland	2	Agricultural/Open Space	Agriculture
Open Space, Woodland	1	Natural	
Dense Oak, Shrubs, Vines	1		

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Impervious Area (continued)

Connected Impervious Area

In estimating the percent impervious of a basin it is important to consider whether the impervious area is connected or unconnected. If runoff from an impervious area flows directly into the stormwater conveyance system it is considered connected. If it flows over a pervious area prior to entering the conveyance system it is unconnected. Impervious values for unconnected areas may be reduced by 20 percent for storm recurrence intervals less than 10 years, to account for infiltration which occurs as the flow crosses the pervious area.