CITY OF LEBANON
Storm Drainage Master Plan

CHAPTER 4

4.0 BASIN DELINEATION AND MODEL PARAMETERS

This chapter describes each major drainage basin and sub-basin and the methodology used to delineate them. It also explains the convention used for referencing the sub-basins (coding). Sections 4.4, 4.5 and 4.6 describe how the parameters of Effective Impervious Area (EIA), Soil Loss Parameters and Lag time were developed. the tables included in Section 4.7 summarize and quantify those parameters.

4.1 MAJOR DRAINAGE BASINS

The major drainage basins are shown in Figure 4.1, "Major Basin and Sub-Basin Map." Seven major drainage basins were defined according to existing major drainage routings within the watershed:

- **Cox Creek (C) Basin** - This major basin contains all lands within the UGB draining to Cox Creek and includes the lands south and west of Cheadle Lake, the older residential areas in the middle of town west of the Lebanon-Albany Canal and the industrial lands surrounding the Hansard Avenue project. Runoff within the fully developed mid-town area is carried to Cox Creek by storm drain systems, while the upper portion of the basin near Cheadle Lake is mostly undeveloped and drains to Cox Creek via open fields and poorly defined ditches. The northwestern portion of the basin is currently undeveloped and drains to Cox Creek in a system of shallow swales and natural ditches. The drainage area north of the railroad contains the Hansard Avenue project area which is currently under construction. Drainage for the Hansard Avenue area discharges into Cox Creek outside the UGB at the Southern Pacific Railroad Crossing.

- **Lebanon-Albany Canal (L) Basin** - The southern portion of this basin is fully developed and discharges into the Lebanon-Albany Canal at Park Street. The northern portion of the basin is moderately to fully developed and discharges into the canal through outfalls located at Maple Street and Cleveland Street. The canal is currently used as a drinking water supply by the City of Albany. In order to preserve the canal for use as a drinking water source, drainage from this basin may need to be rerouted to the South Santiam River.

- **Oak Creek (O) Basin** - This basin includes the undeveloped lands south of the UGB forming the headwaters of Oak Creek, the largely undeveloped lands in the portion of the UGB south of Oak Creek, the moderately developed areas along 8th Street and 10th Street and the fully developed residential lands near Violet Street and Columbine Street. Oak Creek is well defined in the vicinity of the UGB and receives a majority of its flow from the large undeveloped lands south of the city. Drainage from the lands within the UGB contributes only a small percentage of the total flow in the creek.

- **South Santiam River (S) Basin** - This basin contains the lands within the UGB which are adjacent to the South Santiam River and includes the Ridgeway Butte area, the industrial lands near Cheadle Lake and Champion Building Products, the Willamette Industries industrial area and residential areas adjacent to Willamette Industries. This basin is primarily undeveloped. Drainage paths are poorly defined, with many areas draining to mill ponds and roadway ditches. The residential areas west of Willamette Industries currently drain to sumps.

- **Crown Creek (X) Basin** - This major basin includes the mixed density residential areas along 2nd Street north of the Lebanon Highway and the industrial area adjacent to the Santiam Highway south of the hospital. Piped systems drain the fully developed residential areas in the southern portion of the basin to a culvert underneath the Lebanon-Albany Canal that outfalls into Crown Creek flowing north out of the UGB. The northern portion of the basin is undeveloped with poorly defined drainage paths.

- **Marx Slough (M) Basin** - The southern portion of this basin is fully developed and includes the commercial area along Main Street and the residential areas south of Wheeler and west of Main. Runoff is collected by storm drain systems, piped underneath the Lebanon-Albany Canal in a trunk line and discharged into Marx Slough. The northern portion of the basin is mostly undeveloped and drains overland to the slough.

- **Little Oak Creek (LO) Basin** - This basin includes the airport and the undeveloped lands outside the existing city limits at the western edge of the UGB. These lands are drained by natural ditches that form a small tributary to Oak Creek.

Each of the seven major drainage basins was assigned a prefix to facilitate sub-basin coding (C, L, O, S, X, M, and LO). The major drainage basins, their abbreviated prefix, and approximate acreage are listed in Table 4.1, "Major Drainage Basin Areas".

4.2 SUB-BASIN DELINEATION METHODOLOGY

To refine the modeling analysis and facilitate identification of potential drainage problems and improvements, each major drainage way was further delineated into sub-basins. The factors which contributed to how the sub-basins within each major basin were delineated included:

- **Size generally between 30 and 100 acres** - Sub-basin areas within this range increase the modeling accuracy of peak flow analysis and are typically used in drainage master planning.

- **Similar zoning or land uses within sub-basin** - Since runoff rates and amounts are significantly impacted by impervious surface areas and since the amount of impervious surfaces is largely a function of zoning intensity, delineating sub-basins with relatively uniform land uses allows more meaningful runoff parameters to be estimated.

- **Consistent topography** - Since the time for runoff to reach the outfall of a sub-basin from the furthest reaches of the sub-basin is an important factor in the determination of peak flows and since flow time is related directly to slope, accuracy is improved if the sub-basin is drawn to include areas of relatively uniform slope. Since most of the topography within the study limits was relatively flat, this was not a crucial factor.

- **Consistent soil type** - Since runoff is that portion of precipitation that is not absorbed by the soil or otherwise retained and since the type of soil is directly related to how much water infiltrates through the soil, the estimation of sub-basin flows is more realistic if the sub-basins are drawn to include areas of relatively uniform soils.

- **Common Outfall** - Generally, the sub-basin should be drawn so that all flow from the sub-basin discharges at one point, i.e., one storm drain outfall or one point in a creek. For those sub-basins which lie along major waterways (Cox Creek, South Santiam River, etc), actual discharges into the waterway are often numerous and sometimes indistinct. However, these sub-basins which discharge along drainageways can generally be considered as if they discharged at a single outfall into the waterway.

Clearly, not all of these criteria can be met for delineation of each drainage sub-basin, but they do provide guidelines for defining these areas. Using the above criteria, this delineation process resulted in 64 sub-basins. The location of these sub-basins are shown on Figure 4.1, "Major Basin and Sub-Basin Map."

The coding conventions and drainage parameters of these sub-basins are described below.

4.3 SUB-BASIN CODING CONVENTION

Sub-basin coding is required as a means of referencing the branching relationships of the drainageways in the stormwater computer models.

To describe the sub-basin coding convention used in this Drainage Master Plan, a portion of the "C" Drainageway Basin is used as an example. See Figure 4.2, "Sub-Basin Coding Convention".

The sub-basins within the "C" Drainageway are coded with the prefix "C". Each sub-basin has only one node where the runoff collected within the sub-basin is discharged either into the Cox Creek or the next downstream sub-basin. The downstream node number and the sub-basin designation are the same. The node at the most downstream point within the "C" Basin is numbered "0". Moving upstream along the basin's main waterway, each node is numbered sequentially in increments of ten, For example, sub-basins C-0, C-10, C-20, and C-30, etc., lie along the main drainageway.

Sub-basins which do not lie directly along the main drainageway, but which are contributing sub-basins, are denoted with an "R" or a "L" appended to the receiving sub-basin number, depending on whether the outlet into main drainageway lies to the Right or Left (facing upstream). For example, Sub-basin C-30L drains a downtown area bounded by Rose, Grant, 7th and 10th Streets and empties into sub-basin C-30 from the left (facing upstream). The sub-basin which discharges into C-30L would be called C-30L1, so as to alternate between numbers and letters in the coding. If two sub-basins both discharge from one side into the main drainageway (such as C-20L and C-20LL) a second letter is added.

The coding convention used in this Drainage Master Plan has several advantages over arbitrarily labeling sub-basins from 1 to 64. These advantages include:

(1) Sub-basin numbers have some physical meaning because they are based on drainage routing.

(2) The HEC-1 model limits node names to 6 characters. When the hyphen is dropped from the sub-basin names, all sub-basin codes are within 6 characters.

(3) The node references and sub-basin names can be the same, thereby eliminating the need for cross-referencing, i.e., nodes are named after their upstream sub-basins.

4.4 EFFECTIVE IMPERVIOUS AREA

The amount of runoff is increased substantially by increased impervious areas within the sub-basins. Impervious areas, such as streets, parking lots, rooftops, sidewalks, and loading areas, increase the volume by preventing infiltration. Further, these impervious area tend to concentrate the runoff into storm drains or ditches which more rapidly convey the runoff to the receiving stream. This decreased time of conveyance decreases the time of concentration and generally increases peak rates of runoff downstream. Transformation of agricultural lands to highly urbanized lands can increase the rates and volumes of storm runoff by a factor of 2 to 4 times. Impervious area is a very significant factor in the analysis of storm drainage systems.

To estimate existing and future impervious conditions, current aerial photographs, current city zoning maps and comprehensive plan land use maps were used in the following manner.

Based on recent aerial photography and on known recent development, the areas of land currently developed were delineated. These areas of developed land were then compared to the current zoning map. For each zoning classification, an impervious area percentage was estimated for land developed for that zoning type. See Table 4.2, "Mapped Impervious Area Factors". The developed areas were then multiplied by these assumed factors to estimate the current Mapped Impervious Areas (MIA's) within each sub-basin.

MIA's were converted to directly connected or "Effective" Impervious Areas (EIA's) using the equation:

$$EIA = 0.1 \times (MIA)^{1.5}$$

This equation is based on regression analysis results. The value difference between mapped and effective impervious area accounts for those impervious areas that contribute to rainfall losses, such as depression storage, and those areas which flow overland from impervious areas across permeable surfaces before reaching a defined drainageway.

Future Mapped Impervious Areas were estimated using the City's Comprehensive Land Use Plans. Lands which are not currently developed were assumed to be developed according to their Comprehensive Land Use designations within the planning period of 15 years. Lands which are partially developed were assumed to be re-developed and to infill to the approximate densities of their Comprehensive Land Use Plan designations. The percent of impervious area for these future land uses was estimated to be that shown in Table 4.2, "Mapped Impervious Area Factors".

The results of the impervious area analysis for both present and future conditions is summarized in Table 4.6, "Sub-basin Parameter Summary".

4.5 SOIL LOSS PARAMETER

The effective impervious area method described above is used to determine the volume of runoff due to the impervious portions of the basin. For the pervious areas within the basin, infiltration significantly reduces runoff. The degree of infiltration can be estimated using a soil loss parameter developed by the Soil Conservation Service (SCS). This parameter, called the Runoff Curve Number, depends on the soil type, ground cover and antecedent moisture of the area.

Soil type can be determined from the SCS Linn County Soil Survey (1976). In addition to classifying soils and mapping the soil type distribution throughout the region, the Soil Survey characterizes the soils according to various parameters. For drainage purposes, each soil type in the Soil Survey is given a hydrologic classification (A, B, C, or D), as noted in Section 4.2.

The SCS TR-55 Technical Release Manual, Urban Hydrology for Small Watersheds, lists the Runoff Curve Number associated with hydrologic soil groups A,B,C, and D for varying ground cover conditions. The Curve Number assigned to each of the hydrologic soil groups throughout the Lebanon area for applicable ground cover conditions are listed in Table 4.3, "Hydrologic Soil Group Curve Numbers". Moderate antecedent moisture conditions were assumed.

These numeric values were applied to the areas of mapped soil types within each sub-basin and a composite average Curve Number (weighted by area) developed for each sub-basin.

The results of the soil loss parameter evaluation is presented in Table 4.6, "Sub-Basin Parameter Summary".

4.6 LAG TIME

For a majority of the basins, Lag Time for the SCS unit hydrograph method was estimated using the relationship between time of concentration (T_c) and lag determined by the SCS:

$$\text{LAG TIME} = 0.6 \times T_c$$

The time of concentration is the travel time from the most hydraulically remote point in the sub-basin to the sub-basin outlet. The total travel time can be computed by summing the time of travel required for each of the following components of runoff: overland flow, shallow concentrated flow (overland flow in shallow swales), gutter flow, channel flow, and pipe flow. For each sub-basin, the length and velocity of flow for each component of runoff applicable to the sub-basins flow path was estimated based on the assumptions summarized in Table 4.4, "Lag Time Assumptions." The time of travel for each component was computed using the equations given in Table 4.5, "Time of Concentration Equations".

The above method of computing Lag Time works well for small urbanized basins in which the runoff path can be easily subdivided into its overland and channel segments. In large undeveloped basins, however, it becomes difficult to determine which portions of the basin control the time of concentration and where overland flow ceases and shallow concentrated flow begins. For basins greater than 150 acres, an empirical SCS Lag Time equation based on the average basin slope and ground cover produces more consistent results. This equation is included in Table 4.5, "Time of Concentration Equations."

4.7 SUMMARY OF PARAMETERS

The HEC-1 input parameters for each sub-basin are presented for both existing and future conditions in Table 4.6, "Sub-Basin Parameter Summary".

TABLE 4.1

MAJOR DRAINAGE BASIN AREAS

MAJOR DRAINAGE BASINS	BASIN PREFIX	TOTAL BASIN ACRES	% OF TOTAL WATERSHED
Cox Creek	C	2,424	14%
"X" Creek	X	164	1%
Lebanon-Albany Canal	L	332	2%
Mark's Slough	M	307	2%
South Santiam within UGB	S	1292	7%
Little Oak Creek	LO	443	3%
Oak Creek			
Inside UGB	O	1,419	8%
Total Upstream Drainage		10,941	63%
STUDY AREA WATERSHED		17,322	100%

TABLE 4.2

MAPPED IMPERVIOUS AREA FACTORS

ZONE	% IMPERVIOUS	ZONE DESCRIPTION
GI	90%	General Industrial
LI	85%	Light Industrial
C	90%	General Commercial
SDD	80%	Special Development District
MD	60%	Mixed-Density Residential
SF	40%	Single Family Residential
P (a)	0%	Public Usage\Service
P (b)	80%	Public Building

TABLE 4.3

HYDROLOGIC SOIL GROUP CURVE NUMBERS

SCS HYDROLOGIC SOIL GROUP	GROUND COVER				RUNOFF POTENTIAL
	FORESTED	CULTIVATED CURVED	CULTIVATED STRAIGHT	LAWNS, PASTURE	
A	30	65	67	49	LOW
B	55	75	78	69	MODERATELY LOW
C	70	82	85	79	MODERATE
D	77	86	89	84	HIGH

Note: Values were obtained from SCS Technical Release No. 55 for average antecedant moisture conditions

TABLE 4.4

LAG TIME ASSUMPTIONS

1. Channel, Gutter and Swale Velocity Assumptions

Velocities, in Feet per Second

Slope	Channel/Pipe	Gutter	Swale
.002 - .005	2.0	1.0	0.5
.005 - .010	3.0	1.5	1.0
.010 - .015	4.0	2.0	1.5
.015 - .020	5.0	2.5	2.0
.020 - .030	6.0	3.0	2.5
.030 - .060	7.0	4.0	3.0
.060 +	8.0	4.5	3.5

2. Manning's "n" for Overland Flow

Surface Description	Manning's "n"
Paved or gravel w/slope > 2%	.02
Lawns, natural grassy areas, uncultivated fields	.24
Cultivated Fields	.18
Trees with light underbrush	.40
Trees with heavy underbrush	.70

3. Assumptions for estimating Future Lagtime

A. Industrial and Commercial Zoning

Length of Overland Flow (OF) = 150'
Manning's "n" for OF = .02 (paved)
Slope for OF = .005 to .03 (depending on existing grade)
Channel Slope = Ground Slope
No Gutter Flow

B. Single Family and Duplex Zoning

Length of Overland Flow (OF) = 150' (1½ lot widths)
Manning's "n" for OF = .24 (lawn)
Slope for OF = existing grade
Length of Gutter = 250'
Channel/Gutter Slope = Ground Slope

C. Apartments

Length of Overland Flow (OF) = 100'
Manning's "n" for OF = .06 (mostly paved)
Slope for OF = .005 to .02 depending on existing grade
Length of Gutter = 250'
Channel/Gutter Slope = Ground Slope

TABLE 4.5

TIME OF CONCENTRATION EQUATIONS*

Overland Flow (Length < 300 ft.)

$$Tc = \frac{.007\ (nL)^{0.8}}{(P2)^{.05}\ (S)^{0.4}}$$

Tc = time of concentration (hr)
n = roughness coefficient (dimensionless)
L = length of flow (feet)
S = slope (dimensionless)
P2 = precipitation (in\hr)

Shallow Concentrated, Gutter, Open Channel and Gravity Pipe Flow

$$Tc = \frac{L}{3600\ (V)}$$

Tc = time of concentration (hr)
L = length of flow (feet)
V = velocity (ft\s)

SCS Lag Time Equation

$$T_L = \frac{L^{.8}(1000/CN - 9)^{.7}}{1900\ \sqrt{Y}}$$

T_L = lag time (hours)
L = hydraulic length of watershed (feet)
CN = runoff curve number
Y = average watershed land slope (percent)

* SCS Technical Report 55
Also see page 4. for lag time assumptions

TABLE 4.6

SUB-BASIN PARAMETER SUMMARY

	EXISTING CONDITIONS						FUTURE CONDITIONS				
SUB-BASIN	DRAINAGE AREA (ACRES)	DRAINAGE AREA (SQ. MI)	CURVE NUMBR	MIA (%)	EIA (%)	LAG TIME (HRS)	MIA (%)	EIA (%)	LAG TIME (HRS)	DECREASE IN LAG (HRS)	INCREASE IN MIA (%)
COX CREEK BASIN											
C-A0	218.8	0.341	83	20%	9%	1.50	78%	69%	0.28	1.22	58%
C-AL	124.0	0.193	83	0%	0%	1.00	78%	69%	0.30	0.70	78%
C-A10	108.0	0.168	73	5%	1%	0.99	76%	66%	0.19	0.80	71%
C-B	74.1	0.116	82	0%	0%	1.10	60%	46%	0.58	0.52	60%
C-BR	52.4	0.082	82	0%	0%	1.10	60%	46%	0.56	0.54	60%
C-0	170.3	0.266	82	0%	0%	1.38	80%	72%	0.26	1.12	80%
C-0R	96.4	0.150	77	6%	2%	1.12	76%	66%	0.21	0.91	70%
C-10	112.1	0.175	83	20%	9%	0.87	80%	72%	0.20	0.67	60%
C-20	80.4	0.125	82	49%	34%	0.58	63%	50%	0.58	0.00	14%
C-20L	72.7	0.113	80	48%	33%	0.57	48%	33%	0.57	0.00	0%
C-20LL	27.5	0.043	84	90%	85%	0.20	90%	85%	0.20	0.00	0%
C-20L1	54.0	0.084	84	54%	40%	0.50	54%	40%	0.50	0.00	0%
C-30	69.1	0.108	81	33%	19%	0.55	54%	40%	0.52	0.02	21%
C-30L	45.2	0.071	84	60%	46%	0.52	60%	46%	0.49	0.02	0%
C-40	47.8	0.075	80	43%	28%	0.56	43%	28%	0.56	0.00	0%
C-50	54.3	0.085	84	28%	15%	0.67	57%	43%	0.51	0.16	28%
C-50L	39.0	0.061	84	51%	36%	0.50	54%	39%	0.50	0.00	3%
C-50L1	41.8	0.065	84	54%	39%	0.55	54%	39%	0.55	0.00	0%
C-60	67.8	0.106	83	17%	7%	0.99	66%	54%	0.55	0.44	49%
C-70	65.7	0.102	83	36%	22%	0.76	65%	52%	0.48	0.28	29%
C-70L	40.4	0.063	84	34%	19%	0.91	36%	22%	0.91	0.00	2%
C-70L1	44.2	0.069	80	87%	80%	0.22	87%	80%	0.22	0.00	0%
C-70L1R	65.9	0.103	80	50%	0%	1.08	50%	0%	1.08	0.00	0%
C-70L2	37.1	0.058	78	21%	0%	1.30	21%	0%	1.30	0.00	0%
C-70L3	150.4	0.235	75	23%	0%	2.30	23%	0%	2.30	0.00	0%
C-80	43.5	0.068	82	24%	12%	0.99	64%	51%	0.56	0.42	40%
C-90	40.0	0.062	83	33%	19%	0.61	46%	31%	0.51	0.10	13%
C-100	69.0	0.108	83	29%	16%	0.49	42%	27%	0.49	0.00	13%
C-110	33.5	0.052	84	50%	35%	0.70	57%	42%	0.48	0.22	7%
C-120	70.5	0.110	84	58%	44%	0.39	68%	56%	0.39	0.00	10%
C-130	74.2	0.116	84	20%	9%	0.78	68%	56%	0.28	0.50	48%
C-130L	51.0	0.080	83	17%	7%	1.08	56%	42%	0.78	0.30	39%
C-140	83.5	0.130	82	22%	10%	0.76	52%	37%	0.52	0.24	30%
X CREEK BASIN											
X-0	41.9	0.065	74	0%	0%	1.23	0%	0%	1.23	0.00	0%
X-10	49.5	0.077	74	0%	0%	0.59	81%	73%	0.48	0.11	81%

TABLE 4.6

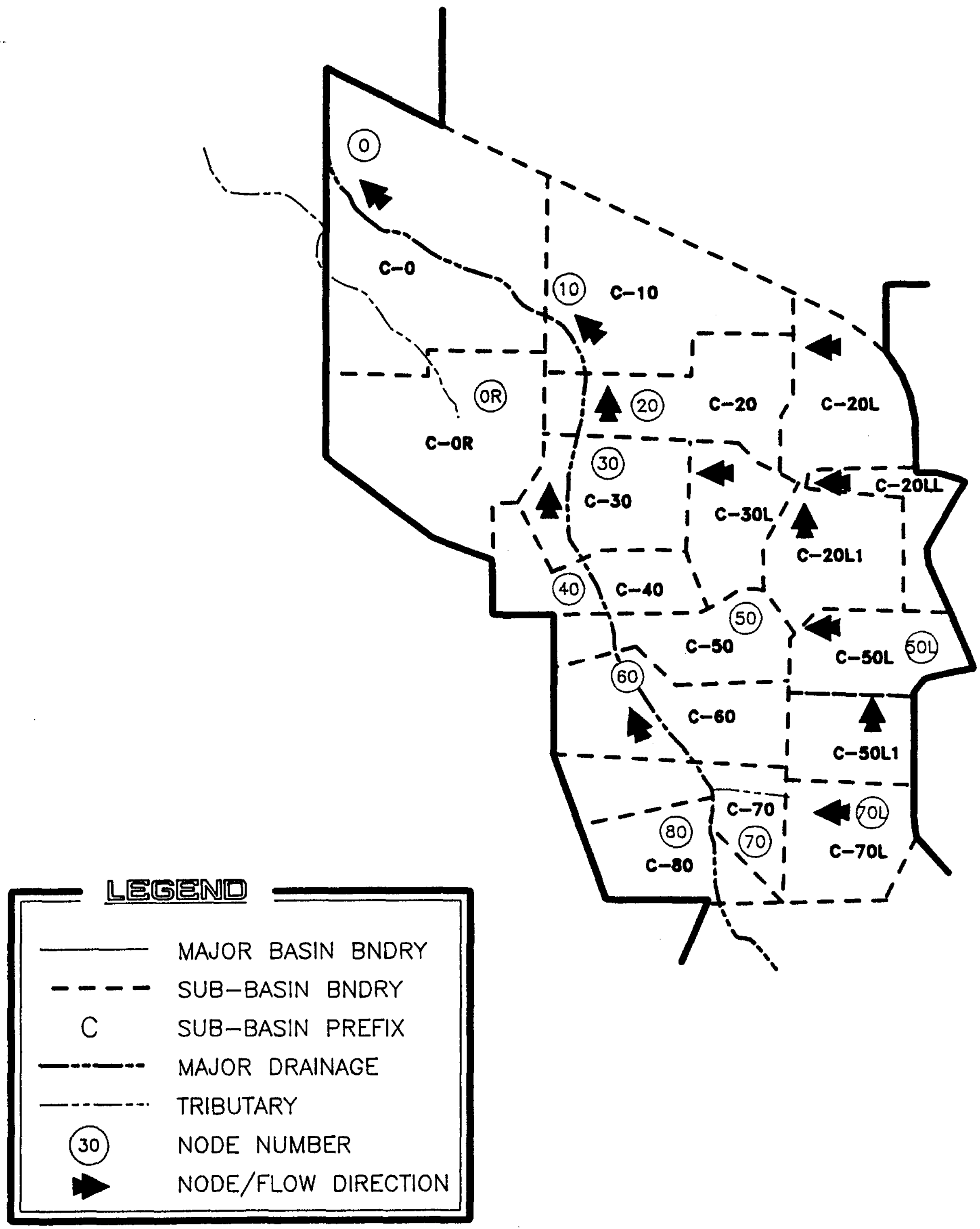
SUB-BASIN PARAMETER SUMMARY

	EXISTING CONDITIONS						FUTURE CONDITIONS				
SUB-BASIN	DRAINAGE AREA (ACRES)	DRAINAGE AREA (SQ. MI)	CURVE NUMBR	MIA (%)	EIA (%)	LAG TIME (HRS)	MIA (%)	EIA (%)	LAG TIME (HRS)	DECREASE IN LAG (HRS)	INCREASE IN MIA (%)
X-10R	30.1	0.047	81	57%	44%	0.57	57%	44%	0.57	0.00	0%
X-20	42.6	0.066	75	55%	40%	0.57	55%	41%	0.57	0.00	0%
LEBANON-ALBANY CANAL											
L-0	74.6	0.116	69	28%	15%	0.67	52%	37%	0.48	0.19	24%
L-10	40.4	0.063	82	74%	64%	0.50	74%	64%	0.50	0.00	0%
L-20	52.5	0.082	80	63%	50%	0.56	63%	50%	0.56	0.00	0%
L-20L	110.2	0.172	78	35%	21%	0.67	44%	29%	0.58	0.09	9%
L-30	54.0	0.084	80	69%	57%	0.61	69%	57%	0.61	0.00	0%
MARKS SLOUGH BASIN											
M-0	137.5	0.215	69	8%	2%	1.92	89%	84%	0.38	1.54	81%
M-10	59.2	0.092	57	47%	32%	0.81	52%	37%	0.71	0.10	5%
M-10L	73.8	0.115	72	52%	37%	0.64	52%	37%	0.64	0.00	0%
M-20	36.7	0.057	84	83%	75%	0.59	83%	75%	0.59	0.00	0%
SANTIAM BASIN											
S-A	41.5	0.065	50	12%	4%	1.17	80%	72%	0.70	0.47	68%
S-B	48.1	0.075	55	38%	24%	0.85	56%	42%	0.60	0.25	18%
S-C	59.1	0.092	70	2%	0%	1.06	45%	30%	0.45	0.61	43%
S-D	133.3	0.208	57	54%	40%	1.58	90%	85%	0.43	1.14	36%
S-E	460.5	0.718	69	0%	0%	0.54	60%	46%	0.54	0.00	60%
S-F	114.0	0.178	69	0%	0%	0.31	60%	46%	0.19	0.12	60%
S-G	123.0	0.192	72	3%	1%	1.36	60%	46%	0.49	0.87	57%
S-H	312.2	0.487	86	67%	55%	0.96	93%	89%	0.88	0.08	26%
LITTLE OAK CREEK BASIN											
LO-A	255.3	0.398	75	24%	12%	1.01	80%	72%	0.29	0.72	56%
LO-B	188.1	0.293	79	3%	1%	1.08	68%	56%	0.54	0.54	65%
OAK CREEK BASIN											
O-A	203.0	0.317	84	0%	0%	0.49	80%	72%	0.15	0.34	80%
O-B	142.1	0.222	89	0%	0%	0.60	60%	46%	0.37	0.23	60%
O-C	51.0	0.080	81	3%	1%	1.06	60%	46%	0.48	0.58	57%
O-D	102.1	0.159	81	15%	6%	1.33	42%	27%	0.96	0.37	27%

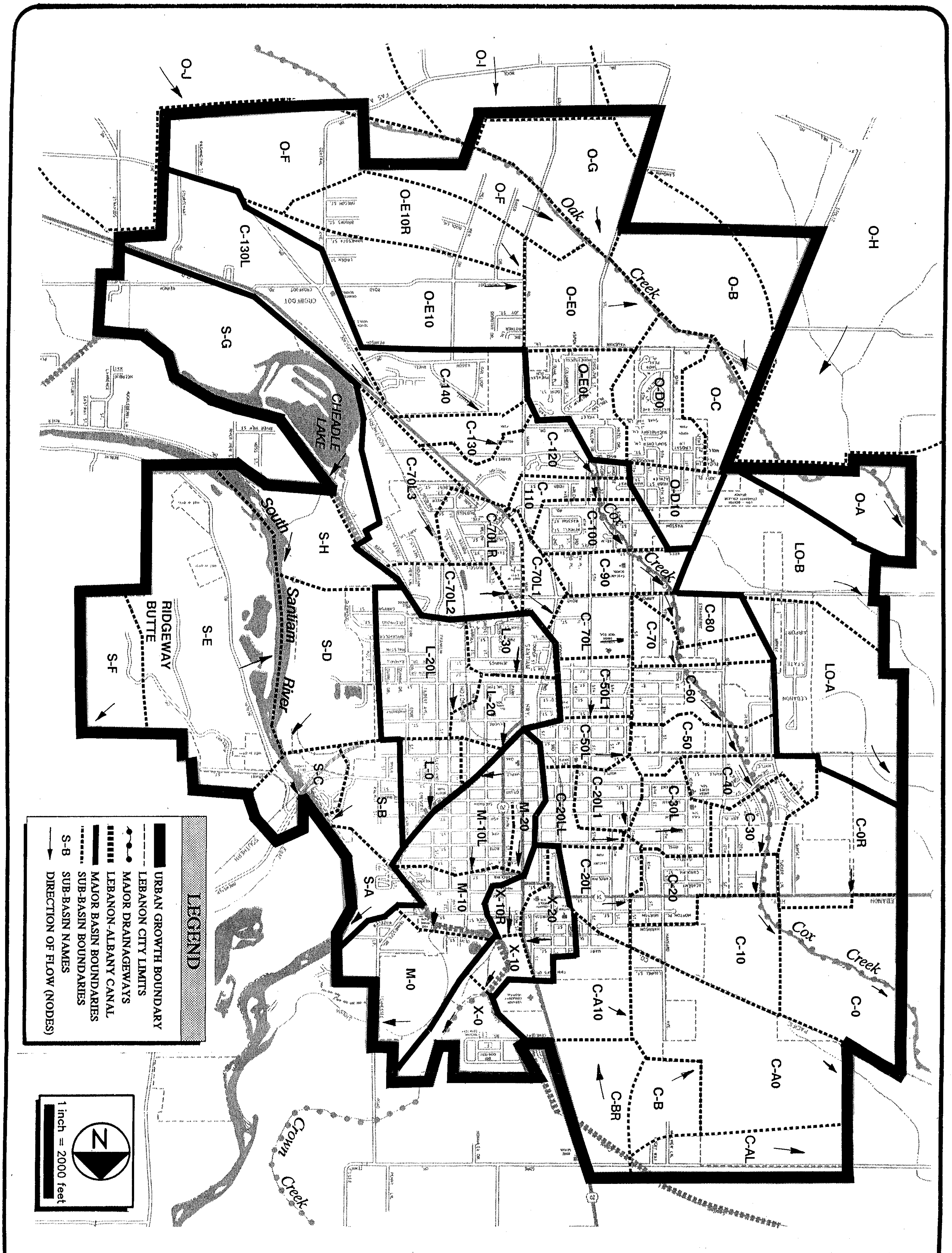
TABLE 4.6

SUB-BASIN PARAMETER SUMMARY

	EXISTING CONDITIONS						FUTURE CONDITIONS				
SUB-BASIN	DRAINAGE AREA (ACRES)	DRAINAGE AREA (SQ. MI)	CURVE NUMBR	MIA (%)	EIA (%)	LAG TIME (HRS)	MIA (%)	EIA (%)	LAG TIME (HRS)	DECREASE IN LAG (HRS)	INCREASE IN MIA (%)
O-D10	71.6	0.112	79	22%	10%	1.15	53%	39%	0.65	0.49	31%
O-E0	96.4	0.150	81	6%	1%	1.49	60%	46%	0.77	0.72	54%
O-E0L	92.8	0.145	81	27%	14%	1.15	45%	30%	0.78	0.37	18%
O-E10	215.1	0.336	79	5%	1%	1.07	48%	33%	0.95	0.12	43%
O-E10R	221.7	0.346	79	6%	1%	1.20	60%	46%	0.71	0.49	54%
O-F	143.9	0.224	75	0%	0%	1.43	60%	46%	0.87	0.56	60%
O-G	138.1	0.215	79	0%	0%	0.47	60%	46%	0.35	0.12	60%
O-H	1932.8	3.015	79	0%	0%	1.96	0%	0%	1.96	0.00	0%
O-I	2240	3.494	79	0%	0%	0.75	0%	0%	0.75	0.00	0%
O-J	5292	8.256	79	0%	0%	2.40	0%	0%	2.40	0.00	0%



DATE MAR 1991 PROJECT NO. 292 DP 11	**DAVID J. NEWTON ASSOCIATES** INCORPORATED CIVIL & GEOLOGICAL ENGINEERING 1201 S.W. 12TH AVE., SUITE 620 PORTLAND, ORE. 97205 • 228-7718	**SUB-BASIN CODING CONVENTIONS** **CITY OF LEBANON** **Storm Drainage Master Plan**	FIGURE **4.2**



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DATE MAR 1991

PROJECT NO. 292 DP 11

MAJOR BASIN AND SUB-BASIN MAP

CITY OF LEBANON

Storm Drainage Master Plan

FIGURE 4.1