APPENDIX I EXCERPT FROM CITY OF MARINA'S STANDARDS AND SPECIFICATIONS

II. STORM DRAIN DESIGN

A. GENERAL

Storm drainage facilities shall be designed to retain runoff water within the boundaries of the project and shall conform to the City's Standard Specifications. The determination of storm runoff and required facilities shall be as outlined herein. The storm drainage system shall follow natural drainage patterns as much as possible, within the constraints of the development needs and City requirements. All channels shall be maintained in their natural state to the maximum extent practical.

Storm drainage facilities for new development retention areas shall typically be reinforced concrete with pipe strength of Class III RCP or high density polyethylene pipe HDPE-DR25. Drainage ditches or open channel conveyance shall only be used if approved by the City Engineer.

Retention of storm water runoff from new development or redevelopment shall be implemented as specified herein.

The design of storm drainage facilities is subject to final determination and approval of the City Engineer.

B. STORM DESIGN CRITERIA

A ten (10) year design storm shall be used for design of conduits and inlets. A hundred (100) year storm design shall be used for all channels, retention facilities, surface structures and underground structures. Rainfall intensities shall be based on the Monterey County Standard Details "Rainfall Intensities." Storm Calculations used to design storm facilities shall be submitted with improvement plans. Calculations shall include HGL and EGL elevations.

C. HYDROLOGY-SURFACE RUNOFF

Two methods are described in this section to estimate peak runoff for storm drainage facility sizing:

- C.1 Rational Method for drainage areas of three hundred twenty (320) acres of less. At the option of the City Engineer, the Rational Method may be used for larger areas.
- C.2 Computer simulation method for drainage areas of any size, but generally required for developments larger than three hundred twenty (320) acres.

C.1 Rational Method:

The "Rational Method" can be used to determine peak discharges for drainage areas up to three hundred twenty (320) acres in size. At the option of the City Engineer, use of the Rational Method may be approved for larger drainage areas.

The Rational Method approach is represented by the formula:

O=CiA

Where:

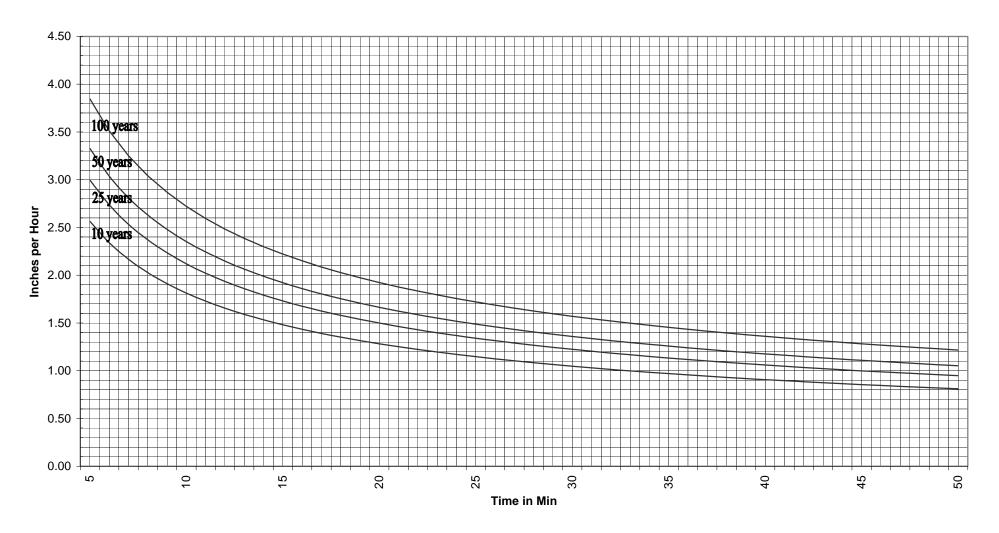
Q: Design peak runoff/discharge I cubic feet per second (cfs)

C: Coefficient of runoff, representing the ratio of runoff to rainfall

- i: Average rainfall intensity expressed in inches per hour for a duration equal to the time of concentration*
- A: Size of the tributary drainage area in acres

*The time of concentration is considered as the time required for water to flow overland to reach established surface drainage channels such as street gutters, and channel flow time required for water to flow through established drainage channels to the point of inlet of the City's storm drain system. A minimum inlet time of fifteen (15) minutes is used. Subsequent time of concentration in the drainage system shall be determined by the time of flow in the conduit.

Rain Fall Intensities For Marina



	Intensit	ies (inches p	er hour)	
Min	10 yr	25 yr	50 yr	100 yr
5	2.56	3.00	3.33	3.85
6	2.34	2.74	3.04	3.51
7	2.17	2.53	2.81	3.25
8	2.03	2.37	2.63	3.04
9	1.91	2.23	2.48	2.87
10	1.81	2.12	2.35	2.72
11	1.73	2.02	2.24	2.59
12	1.66	1.94	2.15	2.48
13	1.59	1.86	2.06	2.39
14	1.53	1.79	1.99	2.30
15	1.48	1.73	1.92	2.22
16	1.43	1.68	1.86	2.15
17	1.39	1.63	1.80	2.09
18	1.35	1.58	1.75	2.03
19	1.32	1.54	1.71	1.97
20	1.28	1.50	1.66	1.92
21	1.25	1.46	1.62	1.88
22	1.22	1.43	1.59	1.83
23	1.20	1.40	1.55	1.79
24	1.17	1.37	1.52	1.76
25	1.17	1.34	1.49	1.72
26	1.13	1.31	1.49	1.69
27	1.12	1.29	1.43	1.66
28	1.08	1.27	1.43	1.63
29	1.06	1.24	1.38	1.60
30	1.05			
31		1.22 1.20	1.36 1.34	1.57 1.55
32	1.03 1.01	1.19	1.34	1.52
33		1.19	1.32	1.52
34	1.00 0.98	1.17	1.28	1.48
35				
	0.97	1.13	1.26	1.45
36	0.96	1.12	1.24	1.43
37	0.94	1.10	1.22 1.21	1.41
38	0.93	1.09		1.40
39	0.92	1.07	1.19	1.38
40 41	0.91	1.06	1.18	1.36
	0.90	1.05	1.16	1.34
42	0.88	1.03	1.15	1.33
43	0.87	1.02	1.13	1.31
44	0.86	1.01	1.12	1.30
45	0.85	1.00	1.11	1.28
46	0.85	0.99	1.10	1.27
47	0.84	0.98	1.09	1.25
48	0.83	0.97	1.07	1.24
49	0.82	0.96	1.06	1.23
50	0.81	0.95	1.05	1.22
51	0.80	0.94	1.04	1.20
52	0.80	0.93	1.03	1.19
53	0.79	0.92	1.02	1.18
54	0.78	0.91	1.01	1.17
55	0.77	0.90	1.00	1.16
56	0.77	0.90	0.99	1.15
57	0.76	0.89	0.99	1.14
58	0.75	0.88	0.98	1.13
59	0.75	0.87	0.97	1.12
60	0.74	0.87	0.96	1.11
61	0.73	0.86	0.95	1.10
62	0.73	0.85	0.94	1.09
63	0.72	0.84	0.94	1.08
64	0.72	0.84	0.93	1.08
65	0.71	0.83	0.92	1.07

Intensities (inches per hour)						
Min	10 yr	25 yr	50 yr	100 yr		
66	0.71	0.83	0.92	1.06		
67	0.70	0.82	0.91	1.05		
68	0.70	0.81	0.90	1.04		
69	0.69	0.81	0.90	1.04		
70	0.69	0.80	0.89	1.03		
71	0.68	0.80	0.88	1.02		
72	0.68	0.79	0.88	1.01		
73	0.67	0.78	0.87	1.01		
74	0.67	0.78	0.86	1.00		
75	0.66	0.77	0.86	0.99		
76	0.66	0.77	0.85	0.99		
77	0.65	0.76	0.85	0.98		
78	0.65	0.76	0.84	0.97		
79	0.65	0.75	0.84	0.97		
80	0.64	0.75	0.83	0.96		
81	0.64	0.74	0.83	0.96		
82	0.63	0.74	0.82	0.95		
83	0.63	0.74	0.82	0.94		
84	0.63	0.74	0.81	0.94		
85	0.62	0.73	0.81	0.94		
		0.73	0.80	0.93		
86 87	0.62					
	0.61	0.72	0.80	0.92		
88	0.61	0.71	0.79	0.92		
89	0.61	0.71	0.79	0.91		
90	0.60	0.71	0.78	0.91		
91	0.60	0.70	0.78	0.90		
92	0.60	0.70	0.78	0.90		
93	0.59	0.70	0.77	0.89		
94	0.59	0.69	0.77	0.89		
95	0.59	0.69	0.76	0.88		
96	0.59	0.68	0.76	0.88		
97	0.58	0.68	0.76	0.87		
98	0.58	0.68	0.75	0.87		
99	0.58	0.67	0.75	0.86		
100	0.57	0.67	0.74	0.86		
105	0.56	0.65	0.73	0.84		
110	0.55	0.64	0.71	0.82		
115	0.53	0.63	0.69	0.80		
120	0.52	0.61	0.68	0.79		
125	0.51	0.60	0.67	0.77		
130	0.50	0.59	0.65	0.75		
135	0.49	0.58	0.64	0.74		
140	0.48	0.57	0.63	0.73		
145	0.48	0.56	0.62	0.71		
150	0.47	0.55	0.61	0.70		
155	0.46	0.54	0.60	0.69		
160	0.45	0.53	0.59	0.68		
165	0.45	0.52	0.58	0.67		
170	0.44	0.51	0.57	0.66		
175	0.43	0.51	0.56	0.65		
180	0.43	0.50	0.55	0.64		

DESIGN OF STORM WATER DRAINAGE FACILITIES IN MARINA, CALIFORNIA

Hydraulic Design Factors:

A. The 10-year design storm shall be a rainfall expressed by the following formula:

$$i = 5.68 / \sqrt{t}$$

Where: i = intensity of rainfall in inches per hour

t = duration of storm in minutes

B. Runoff Coefficients (for estimation purposes only):

Residential:

	Single Family Areas	0.30-0.60
	Multi Family/Apt. Areas	0.50-0.80
Industria	al:	
	Light	0.50-0.80
	Heavy	0.60-0.90
Parks:		0.10-0.25
Playgrou	unds:	0.20-0.35
Streets:		0.70-0.95
Roofs:		0.75-0.95
Landsca	ped Areas:	0.05-0.10
Undevel	0.05-0.30	

Notes:

- 1. The area to by used in runoff calculation shall include the proposed development and all developed and undeveloped areas draining into the proposed development.
- 2.Runoff coefficients shall be <u>calculated</u> based on actual pervious and impervious areas.
- C. Infiltration rate for percolation pond is 12 inches per hour.

STANDARDS

OPEN PONDS:

- Pond shall be excavated below natural ground with no levees.
- Excavation slopes shall be 3:1 or flatter. If retaining walls are proposed, the design shall be approved by the City Engineer.
- Ponds maintained by the City shall be enclosed with a six (6) foot high chain link fence. The fence shall be located in conformance with subdivision setback lines.
- A six (6) foot wide access path shall be provided around the pond perimeter within the fenced area.
- A sixteen (16) foot wide access gate and paved driveway shall be provided.
- An equipment access ramp eight (8) feet wide and not steeper than 5:1 shall be provided for access to bottom of pond.
- Pond design shall incorporate erosion control measures.

D. <u>HYRAULIC CONSIDERATIONS</u>

A minimum pipe size of fifteen (15) inch diameter is required for all storm drains. A twelve (12) inch diameter may be used for catch basin laterals, provided it has adequate capacity and will have a one (1) percent minimum slope.

Gradients of pipes shall be sufficient to provide a velocity no less than two (2) feet per second or more than eight (8) feet per second when flowing full. End lines serving a single inlet shall have a one (1) percent minimum slope, although slope should be maximized to minimize maintenance efforts

Drainage inlet type and spacing shall be governed by the capacity of the drainage channel/gutter as well as the capacity of the inlet itself. Generally, channel flow lengths between inlets should be less than one thousand (1,000) feet, with a flowline grade of not less than .0050 of a percent. In designing a structure, the inlet capacity of the pipe draining the inlet structure shall be considered with a minimum of 0.2 of a foot fall around returns.

Manholes or structures providing access to the pipe should be constructed at all changes in pipe size and angle points. Manhole spacings should not exceed six hundred (600) feet. Manholes are required at all lateral pipe junctions with new and existing mains, unless the main pipeline is three times or greater in diameter than the joining pipe. Where grades permit, one-tenth (0.1) of a foot drop in manholes should be included where there is no appreciable change in direction, and two-tenth (0.2) foot drop where turns occur.

Pipelines may be laid on curves by using beveled pipe sections and/or by deflections of straight pipe in accordance with pipe manufacturers recommendations.

Siphons shall not be used at any location within the storm drainage system.

Special consideration shall be given to the design criteria for storm facilities in areas that are historically subject to flooding. Design criteria for flood prone lands shall be in accordance with these standards and specifications, and with the standards of the Monterey County Water Resources Agency. Requirements for storm water retention are discussed in Section E.

For the protection of properties under flooding conditions, flood relief structures, channels or other drainage facilities shall be constructed to accommodate floodwater depths exceeding nine (9) inches above gutter flowlines.

E. RETENTION REQUIREMENTS

New development and redevelopment shall provide storm water retention to mitigate increases in storm water discharges. The post-project runoff shall not leave the site.

F. STORMWATER QUALITY CONSIDERATIONS

Storm drainage system design shall be in compliance with the storm water quality requirements of the City's NPDES Municipal Storm Water Permit and Storm Water Management and Discharge Control Ordinance. Storm water quality best management practices (quality control measures) shall be incorporated as part of all new and redevelopment projects.

The California Stormwater Best Management Practice Handbook for New Development and Redevelopment (2003 or current version) shall be used as the bases for selection and design of

best management practices for storm water quality. This handbook is accessible at www.cabmphandbooks.com.

All catch basins and inlets shall be clearly marked with the message "NO DUMPING," using City-approved methods.

Source control best management practices (BMP), as described in the California Stormwater Best Management Practice Handbook for New Development and Redevelopment and indicated below, shall be incorporated into the design as needed to control sources of potential pollutants.

G. DESIGN SUBMITTAL REQUIREMENTS

The design engineer shall submit a design report on the proposed storm drainage system improvements. This report shall include:

The hydrologic calculations, facility sizing, and hydraulic gradeline calculations for proposed facilities. Hydrologic and hydraulic calculations shall meet the requirements specified in this section. If a computer model is used, a description of the model, the hydrologic and hydraulic parameters used for the analysis findings, and printouts of the computer input and output files for the proposed improvements shall be documented and provided to the City Engineer.

Profiles of each existing and proposed storm drain shall be submitted with the calculations. The profile shall show the following information: beginning water surface elevation and location for hydraulic calculations; storm drain invert and soffit; diameter; design flow; design hydraulic gradeline; existing ground line; proposed ground line if applicable; and locations of street intersections and connections with other storm drains or channels. A plan view map shall also be provided for off-site profiles.

For retention basins, the storage volume calculations, a plan view map showing the location of the basin, a conceptual cross-section showing the depth, and a description of the storm water quality features to be incorporated into the basin design shall be provided.