APPENDIX G

HYDROLOGY DATA

Snowcreek VIII
Mammoth Lakes
Mono County, California

Preliminary Drainage Study

Project 36.1

March 2007

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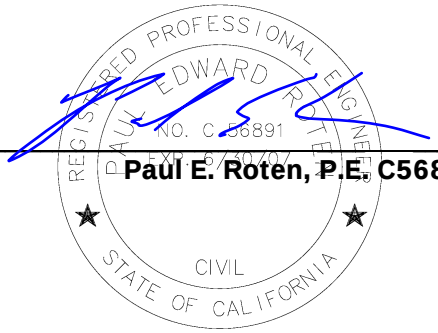


March 27, 2007

Paul E. Roten, P.E. C56891 **Date**

Preliminary Drainage Study

SNOWCREEK VIII
Mammoth Lakes
Mono County, California

INDEX

APPENDIX

1. Design Manual, Mammoth Lakes Storm Drainage and Erosion Control, 1984

2. Mammoth Lakes Storm Drainage Master Plan, 1984

3. Water Quality Control Plan for the Lahontan Region

4. The Town of Mammoth Lakes 2005 Storm Drain Master Plan Update, 2005

PRELIMINARY DRAINAGE STUDY – SNOWCREEK VIII

1 - Project

The Snowcreek VIII property is located along the southern portion of the developable lands in Mammoth Lakes, in Mono County, California as shown in Appendix A, Figure 1. The property is bordered on the south and east by USFS land and on the north across Old Mammoth Road by undeveloped property.

The property lies within a "Resort" zoning designation. The existing 9-hole Snowcreek Golf Course is located directly west of the site, Old Mammoth Road and Mammoth Creek are situated to the north; Snowcreek V lies southwest of the site; Sherwin Creek Road borders the site on the east.

The project area includes approximately 161-acres, ninety-four of which were acquired during a USFS land exchange. The ninety-four acres are designated for the golf course expansion to an 18-hole course. The residential/commercial development component of the project lies between the ninety-four acre exchange parcel and the existing 9-hole course.

The existing golf course (not included in the 161-acre parcel) may have some modifications to fit with the new holes in the course expansion, such as modification to the irrigation system or increasing native vegetation in the "rough." However, major recontouring and reconfiguration is not anticipated. This area is entirely tributary to the existing golf course lakes and is included in the drainage considerations, such as the overall existing and proposed runoff through the site. Additionally, offsite runoff is also included from Snowcreek 6, part of Snowcreek 7, plus many other developed and undeveloped areas, as shown in Basin 2.4 and 2.5, Mammoth Lakes Master Plan, 2005[1] Exhibits 8.6 and 8.7 (Appendix D).

At full build-out, the residential/commercial components of Snowcreek VIII will include approximately 43 acres of impervious surfaces consisting of roofs, drives and parking. Twenty four acres of the site is proposed to be landscaped.

2- Observations

Overall topography on the site is characterized by both relatively flat and shallow sloping hillside terrain, with elevations ranging between 7835 and 7930-feet mean sea level (MSL). Shallow drainages flow east and northeast towards Mammoth Creek. Vegetation consists of abundant sagebrush and grasses as well as a few pine trees. The terrain steeply climbs to the ridge south of the project site at an approximate rate of 21%.

The project as proposed will not disturb any wetlands. Soils are Type "B" and "D" based on Figure 1-7 in the Town of Mammoth Lakes Design Manual[2] (Appendix D).

For this study, we shall separate the project site into the portion south of Old Mammoth Road (indicated as Areas A, B, C, E, and F on the Figures in Appendix A) and the very small portion north of Old Mammoth Road (indicated as Area D on the Figures in Appendix A).

During the existing conditions, runoff from Areas A, B, C, and E is collected in the series of golf course lakes. Generally runoff is contained in these lakes and does not exit. In significant storms, runoff travels through natural dirt with scattered vegetation and rocks, and outlets to an existing culvert under Sherwin Creek Road. From the outlet of the existing culvert in storms with large precipitation quantities; stormwater is conveyed in a natural channel for approximately 200' before it outlets into Mammoth Creek.

Runoff from Area F travels approximately 3,000' northwest away from the site through natural dirt with scattered vegetation and rocks in the general direction towards Mammoth Creek. There is no apparent channelization of this runoff. There are no signs of runoff from this area reaching Mammoth Creek.

The north portion of property, north of Old Mammoth Road, Area D, is adjacent to Mammoth Creek. Generally rainfall that hits this site infiltrates without concentrating. In significant storms runoff from this site may enter Mammoth Creek.

There is no 100 year flood zone south of Old Mammoth Road and west of Sherwin Road where most of this project is located. The small portion of the project north of Old Mammoth Road is affected by the 100-year Flood Zone. A detail of the flood zone limits for the portion of the project north of Old Mammoth Road and west of Minaret Road is shown in Figure 5. Construction shall be outside of the flood zone in this area.

3 - Objective

The objective of this drainage report is to identify localized sources of storm water runoff, and estimate quantities of storm water runoff rates and volumes for both pre- and post-development conditions for 20 and 100-year intensity storm events. The report presents preliminary design requirements and capacities for storm drainage facilities to collect, convey and retain storm water runoff—generated from both off-site and on-site--at required levels. It is further the intention of this facilities' design to have minimal effect on existing drainage conditions.

4 - Design Methods and Assumptions

Storm water runoff rates have been calculated for preliminary sizing of drainage facilities, using the hydrology methods based on "Procedure A" of the Town of Mammoth Lakes Design Manual, 1984[2]. Runoff rates are calculated for each on-site and off-site areas tributary to the residential/commercial site. Hydrology calculation spreadsheets interpolate Procedure A design curves to calculate design values. Input to hydrology calculation spreadsheets includes lengths of overland and channelized flows, flow slopes, reduction factors for slope and soil type, and acreages by development surface type. Spreadsheet output includes design intensities, times of concentration and flow rates. Using the 1984 Design Manual[2] methods provides for conservative sizing of local/immediate drainage facilities.

Storm water runoff rates for the entire Basins 2.4 and 2.5 have been calculated for pre- and post-development conditions using the hydrology methods based on the Town of Mammoth Lakes Master Plan, 2005[1].

Hydraulic Calculations and subsequent design of storm water collection, transport and retention facilities are based on Manning's, Darcy-Weisbech, and Bernoulli's equations. Excel Spreadsheet programs are used for hydraulic calculations. Conveyance systems are designed to convey a storm of 20-year intensity as defined by Design Manual, 1984[2], Procedure A.

Consistent with requirements of the Water Quality Control Plan[3] for the Lahontan Region for the Mammoth Lakes area, retention / infiltration systems are designed to retain storm water runoff from a 20 year, 1 hour design storm, which has been identified in said study as 1.0 inch of rainfall.

Coefficients and Tc's are based on the preliminary plan attached in Appendix A. Hydrologic and Hydraulic Calculations are presented in Appendix B. References are included in Appendix D.

The Mammoth Lakes Master Plan, 1984[4], Plate 1 indicates that perforated pipe may be used for runoff conveyance. At this preliminary stage of design perforated pipes are not recommended since additional infiltration could increase the amount of ground water and have a negative effect on building foundations. This recommendation could be revised depending upon additional information learned during the design process.

5- Off Site Drainage Tributary to Residential/Commercial Site

Existing and proposed conditions have been evaluated for the entire Basin 2.4 and 2.5 as delineated in the Master Plan, 2005[1]. The existing runoff for the 100-year storm is 131 cfs, which is conveyed to Mammoth Creek via 60" culvert located under Sherwin Creek Road. With the new construction, the runoff volume is increased to 139 cfs. This increase may be reduced if runoff is not allowed from golf course areas. Calculations included in Appendix B show that the existing 60" culvert is adequate to convey this increased runoff.

Conveyance systems shall be designed for a storm of 100-year intensity. Off site tributary areas are located south of the project site as shown in Appendix A, Figure 3 and are subdivided into four sub-areas: E1 (9.2 acres), E2 (12.6 acres), E3 (4.7 acres), and E4 (37.7 acres). Areas E2 and E4 are part of the future golf course. Area E4 is not tributary to residential/commercial site.

Runoff from Areas E1, E2, and E3 shall be conveyed via combination of vegetated swale and storm drains and contained in Area E3, south of the residential/commercial site in retention facilities with the capacity to retain approximately 46,200 cf for a storm of 100-year intensity or 31,000 cf for a storm of 20-year intensity. These retention facilities may be sand traps and/or natural and man-made depressions. The final determination of retention/infiltration requirements will be made during the final design in coordination with the RWQCB and other applicable agencies.

Areas E4 and F are part of the Golf Course expansion but are not tributary to the residential/commercial site, refer to Section 8 – Golf Course Expansion.

6- On Site Drainage within the Residential/Commercial Site

Post development drainage shall be conveyed by road side swales, drop inlets, and storm drain pipes to the existing golf course lakes west of the residential/commercial site, new retention basins further defined in Section 7, and other facilities. The onsite drainage facilities are preliminary sized to convey the flows generated during a storm of 20-year intensity. Refer to Appendix A, Figure 2 for on-site drainage map.

The residential/commercial site is divided into four areas: Areas A, B, C, and D. Area A is 15.6 acres and drains primary to south-west, Area B is 7.7 acres and drains to the west, area C is 43.1 acres and drains to the north, and area D (located north of Old Mammoth Road) is 0.5 acres and drains predominantly to the north. Additionally, Areas A, B, and C are divided into smaller subareas (A1-A8, B1-B4, and C1-C16) as shown in Figure 2, Appendix A, in order to preliminary size the on-site drainage facilities.

On-site runoff shall be collected and conveyed via swales, inlets and pipe networks. Typical inlet size required is 16"x16", with several 24"x24" inlets as shown in Appendix A, Figure 2 and calculations included in Appendix B. These inlets shall be conveyed to the golf course lakes system with a series of pipes outletting at locations identified on Figure 2, Appendix A as A, B, and C. If potential pollutants are identified stormwater facilities designed for the removal of identified pollutants may be provided, depending upon specific requirements.

Area D is bounded by Old Mammoth Road on the south, Minaret Road on the east, and a proposed bike path on the north and west. The bike path is part of conditions of approval for Snowcreek VII development and has been preliminary designed to function as a berm. This berm will keep the on-site runoff from entering Mammoth Creek directly. On-site runoff from Area D shall be directed toward a retention/infiltration basin with a capacity of approximately 1,500 cf for an entire storm of 100 year intensity (Appendix C).

7 – Retention / Infiltration System for Residential/Commercial Site

New retention / infiltration system shall be installed south of Old Mammoth Rd and west of Sherwin Creek Rd as shown in Appendix A, Figure 4. The preliminary design includes an existing basin and 6 new basins with spillways. The present location for stormwater retention is less than ideal in heavy runoff years as a portion of fairway #9 can be flooded, impacting golf play. The Snowcreek VIII project proposes to reduce the stormwater retention in this existing basin to approximately 71,200 cf. The series of 6 unlined basins

as shown in Appendix A, Figure 4 shall provide 262,440 cf of retention/infiltration storage. The total capacity is approximately 333,600 cf. When full, the basins will be a golf "water hazard" on the course, but will not impact normal golf hole landing areas.

This project requires approximately 169,200 cf of storage. Existing projects from surrounding sites, including Snowcreek VI and VII, require about 150,000 cf of storage currently being provided on the existing 9-hole golf course at the lower pond on both sides of Minaret Road. The total of these two requirements is 319,200 cf, which allows approximately an extra 14,400 cf of remaining capacity after all planned uses. Retention / infiltration calculations are included in Appendix C.

An 18'-wide vegetative swale is proposed connecting the new basins to an existing 60" culvert under Sherwin Creek Road. During a 20-year storm, the velocity in the swale is 3.5 ft/s (Appendix B). Since the "cleansing" of the runoff occurs mostly during storms of 2 years or less, the velocity will be even lower allowing for the proper performance of the swale. In addition, the proposed swale shall be heavily vegetated as opposed to the existing dirt with scattered vegetation, which shall further increase the "cleansing" of the storm water runoff. The system of basins is tributary to Mammoth Creek about 300' northeast of Basin 6 after flowing through the new vegetative swale for a distance equal to the length of the existing swale.

8 – Golf Course Expansion

Included in this project is the expansion of the existing golf course. These areas are shown as E2, E4, and F on the figures included in Appendix A. In general Golf Course runoff will be contained on-site on Golf Course lakes sand traps and low areas.

Based on the Water Quality Control Plan for the Lahontan Basin, the Golf Course would be required to retain 1" of precipitation (generally considered to be a storm of 20 year intensity) mulitiplied by the average C value. This would equate to approximately 1,000 cf of retention per acre of golf course area. This retention could consist of facilities such as depressions, basins, sand traps, or pond freeboard, and must include all of the new golf course up to the point where it overflows to the basins per Figure 4 or otherwise leaves the site.

It is anticipated that the golf course expansion (Areas E2, E4, and F) may be irrigated with reclaimed or potable water. At this time mitigation requirements for the use of reclaimed water have not been determined.

If reclaimed water is used for irrigation, options that could be explored to limit reclaimed water from entering the tributary area that flows toward Mammoth Creek include:

- Retention basins and the swale from the retention basins shown in Figure 4 could be irrigated with potable water.
- Any landscaping within or directly tributary to these features which requires irrigation could use potable water. Golf course areas immediately south of the basins could retain their stormwater at the appropriate quantity prior to overflowing to the basins.
- On-site retention for the Golf course areas irrigated with reclaimed water could be increased to include capacity for a storm of 100 year intensity.
- Southeasterly limits of the golf course expansion may need to be graded in some locations to block tributary drainage from the south and direct it east toward Sherwin Creek Road.

At this stage, we do not know if it will be required to limit reclaimed water from entering the tributary area that flows toward Mammoth Creek. The final determination of outflow conditions if reclaimed water is used will be made during the final design in coordination with the RWQCB and other applicable agencies.

9 – Subdrainage

Based on the Preliminary Geotechnical Investigation (Geotechnical Report) for Snowcreek 8 Development prepared by Sierra Geotechnical Services, Inc. this site is subject to groundwater. As recommended by the Geotechnical Report, all facilities including but not be limited to golf course greens, tee boxes, underground structures, parking garages, basements, underslabs, and crawl spaces shall be protected from snowpack melt and seasonal high groundwater.

Subdrains shall be designed with outlet systems that have maximum water surface elevations lower than the bottom elevations of the subdrains. This will insure that subdrains cannot be inundated by said outlet systems. During the final design it will be determined if separate retention basins are required for the outlet. We will consult with Sierra Geotechnical Services, Inc. to quantify subdrainage and incorporate their recommendations into our final subdrainage design.

10 - Summary and Conclusion

Existing flow patterns shall be generally maintained and permanent conditions shall be erosion resistant. Collection and conveyance systems shall have capacity for a storm of 100-year intensity from off-site tributary area and a storm of 20-year intensity from on-site tributary areas.

Both the onsite and offsite storm drainage facilities must be maintained to continue to work as designed. Particular items requiring maintenance include, but are not limited to, cleaning of the grates, removal of foreign materials from storm drainage pipes, maintenance as necessary to outlet facilities and retention basins, and repairs as necessary to damaged facilities.

Retention/Infiltration basins shall be designed to collect runoff as required by the Town of Mammoth Lakes and Lahontan Regional Water Quality Control Board. Presently, these basins are planned to be man-made lakes.

The area of disturbance for this project is greater than 1 acre, so this project is subject to the requirements of the National Pollution Discharge Elimination System (NPDES) requirements for construction projects, General Permit number CAS000002, enforced by the State Water Quality Control Board – Lahontan Region. The Owner must submit a Notice of Intent to associate this project with the General Permit, then prepare, have on site and conform to a Storm Water Pollution Prevention Plan (SWPPP) during construction. Any work done in this area shall conform to Federal, State, and local permit requirements.

The designs and calculations included in this preliminary report are for planning purposes. The final location and details of drainage facilities will be determined during the design process in preparation of the improvement plans. The criteria followed during the design process should address issues such as safety, erosion protection and water quality, as well as conforming to the requirements of the Clean Water Act and the Lahontan Regional Water Quality Control Board. The final determination of drainage facility design requirements for the Project shall be made in compliance with RWQCB, Town, and other relevant agencies, policies and regulations during the final design process.

[1]The Town of Mammoth Lakes 2005 Storm Drain Master Update, May 2005, Boyle Engineering Corporation.

[2]Design Manual, Mammoth Lakes Storm Drainage and Erosion Control, Prepared for Mono County Public Works Department, July 1984, Brown and Caldwell and Triad Engineering

[3]Water Quality Control Plan for the Lahontan Region, North and South Basins, prepared by the State of California, Regional Water Quality Control Board, Lahontan Region.

[4]Mammoth Lakes Storm Drainage Master Plan, Prepared fro Mono County Public Works Department, July 1984, Brown and Caldwell and Triad Engineering.

Preliminary Drainage Study

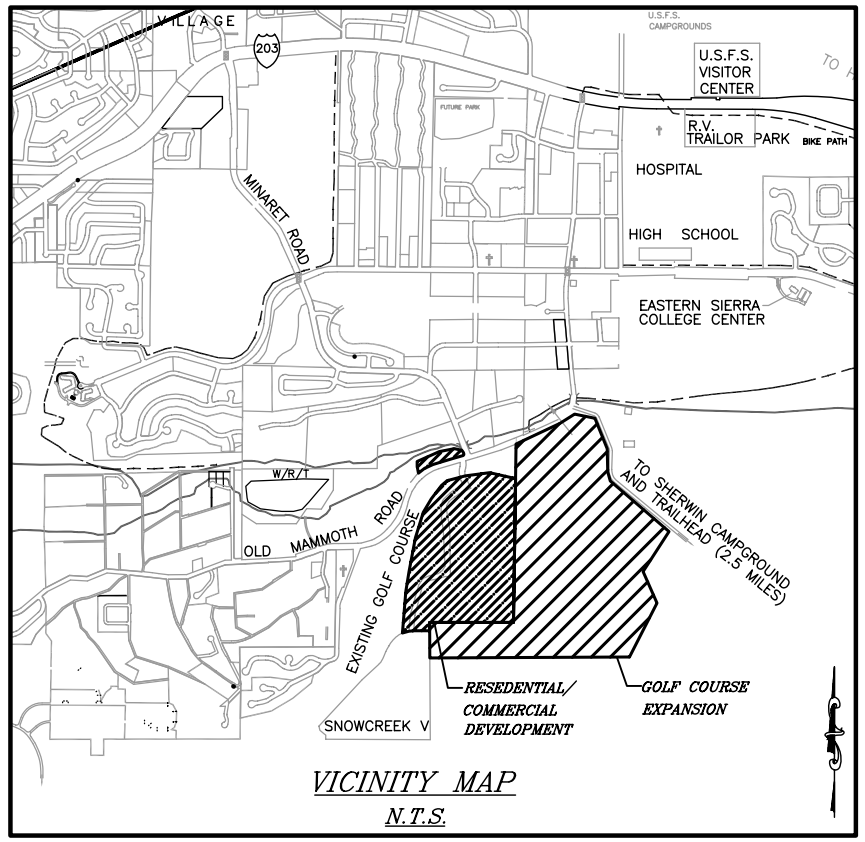
Snowcreek VIII

Appendix A
Figures

GOLF COURSE EXPANSION

RESIDENTIAL/COMMERCIAL DEVELOPMENT

EXISTING SNOWCREEK GOLF COURSE



VICINITY MAP

N.T.S.

SCALE:

1" = 400' (11"X17" PLOT SIZE)

CONTOUR INTERVAL: 1'

triad/holmes assoc.
civil engineering
land surveying

MAMMOTH LAKES
BISHOP
LOMPOC
NAPA
PLEASANTON
REDWOOD CITY
SAN LUIS OBISPO

PROJECT SITE - DISPLAY MAP

SNOWCREEK VIII

PREPARED FOR: CHADMAR

DATE	01/18/07
SCALE	AS NOTED
DRAWN	MP
JOB NO.	36.1
DWG	36.1drainage rev1
SHEET	1
OF	5 SHEETS

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LEGEND

- DRAINAGE BOUNDARY
- A1 PROPOSED INLET
- PROPOSED RETENTION BASIN
- PROPOSED STORM DRAIN
- DIRECTION OF FLOW
- A1 DRAINAGE SUB AREA

ON SITE TRIBUTARY

AREAS	Q20 (CFS)	INLET SIZE (IN)
A1	0.4	16X16
A2	1.0	16X16
A3	2.1	24X24
A4	1.9	24X24
A5	2.0	24X24
A6	0.9	16X16
A7	2.9	24X24
A8	0.3	16X16
B1	2.4	24X24
B2	1.7	16X16
B3	0.9	16X16
B4	1.3	16X16
C1	1.2	16X16
C2	0.8	16X16
C3	2.1	24X24
C4	1.1	16X16
C5	0.7	16X16
C6	0.9	16X16
C7	1.3	16X16
C8	0.7	16X16
C9	2.1	24X24
C10	2.4	24X24
C11	2.5	24X24
C12	0.7	16X16
C13	2.6	24X24
C14	0.4	16X16
C15	2.3	24X24
C16	2.6	24X24

100-YEAR FLOOD LIMIT

C
Q20=20.3cfs
Q100=33.9cfs

B
Q20=6.3cfs
Q100=8.9cfs

A
Q20=7.9cfs
Q100=12.8cfs

TYPE "D" SOILS

TYPE "B" SOILS

NATURAL AREA TO BE USED AS DISPOSAL SITE

SCALE: 1" = 200' (11"X17" PLOT SIZE)

CONTOUR INTERVAL: 1'

triad/holmes assoc.
civil engineering
land surveying

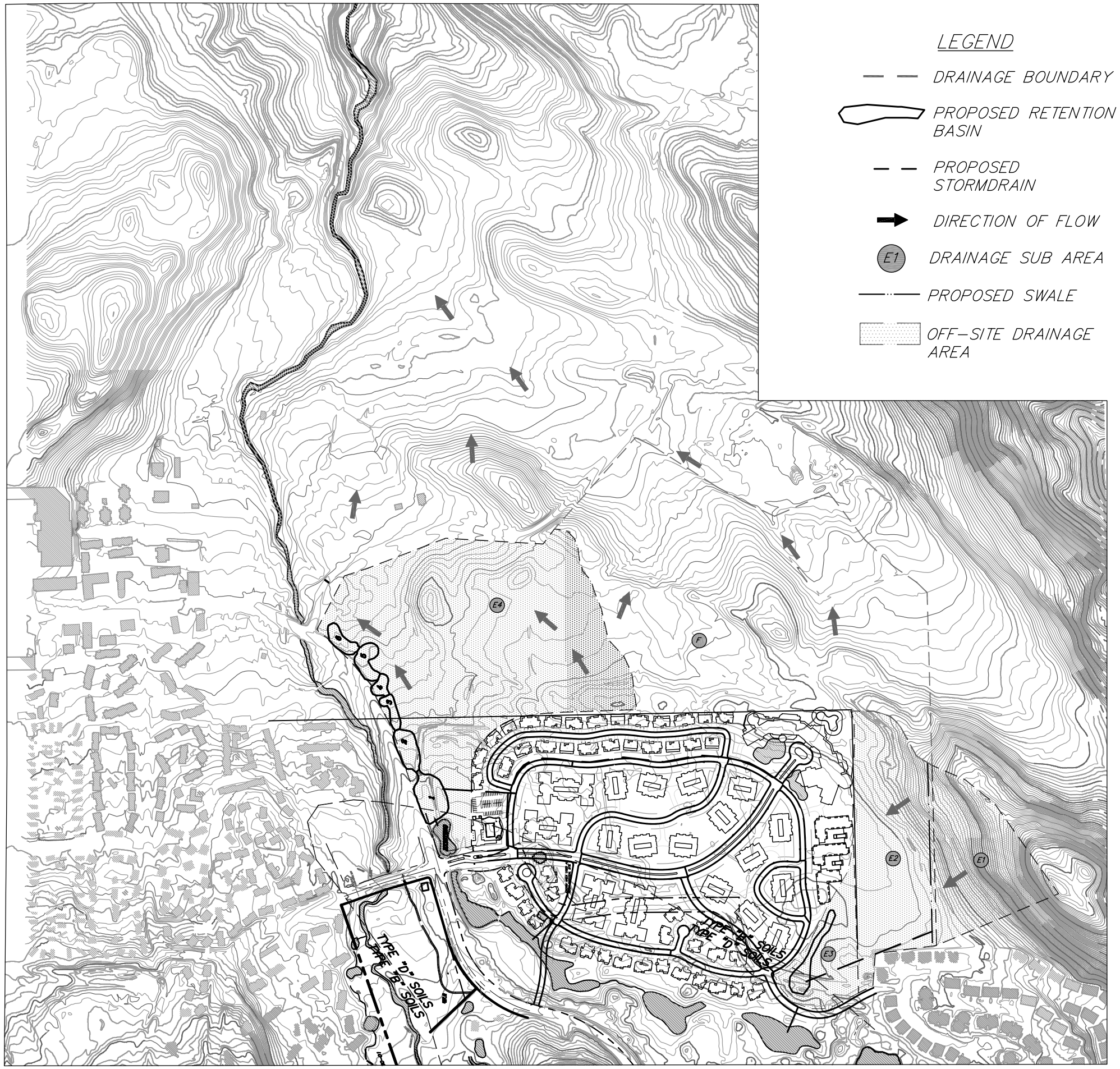
MAMMOTH LAKES
BISHOP
LOMPOC
NAPA
PLEASANTON
REDWOOD CITY
SAN LUIS OBISPO

ON SITE DRAINAGE MAP-RESIDENTIAL/COMMERCIAL SITE

SNOWCREEK VIII

PREPARED FOR: CHADMAR

DATE 01/18/07
SCALE AS NOTED
DRAWN MP
JOB NO. 36.1
DWG 36.1drainage rev1
SHEET 2 OF 5 SHEETS



LEGEND

- DRAINAGE BOUNDARY
- PROPOSED RETENTION BASIN
- PROPOSED STORMDRAIN
- DIRECTION OF FLOW
- E1 DRAINAGE SUB AREA
- PROPOSED SWALE
- OFF-SITE DRAINAGE AREA

SCALE: 1" = 600' (11"X17" PLOT SIZE)

CONTOUR INTERVAL: 1'

POST-DEVELOPMENT CONDITIONS

OFF SITE

AREAS (AC)		Q20 (CFS)	Q100 (CFS)
E1	0.3	3.4	6.8
E2	13.8	4.1	8.2
E3	4.7	1.7	3.1
E4	37.7	10.6	21.0
ETOT	64.3	21.6	42.3

F	49.4	13.7	27.5

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OFF SITE DRAINAGE MAP

SNOWCREEK VIII

PREPARED FOR: CHADMAR

DATE 01/18/07
SCALE AS NOTED
DRAWN MP
JOB NO. 36.1
DWG. 36.1drainage rev1
SHEET 3 OF 5 SHEETS

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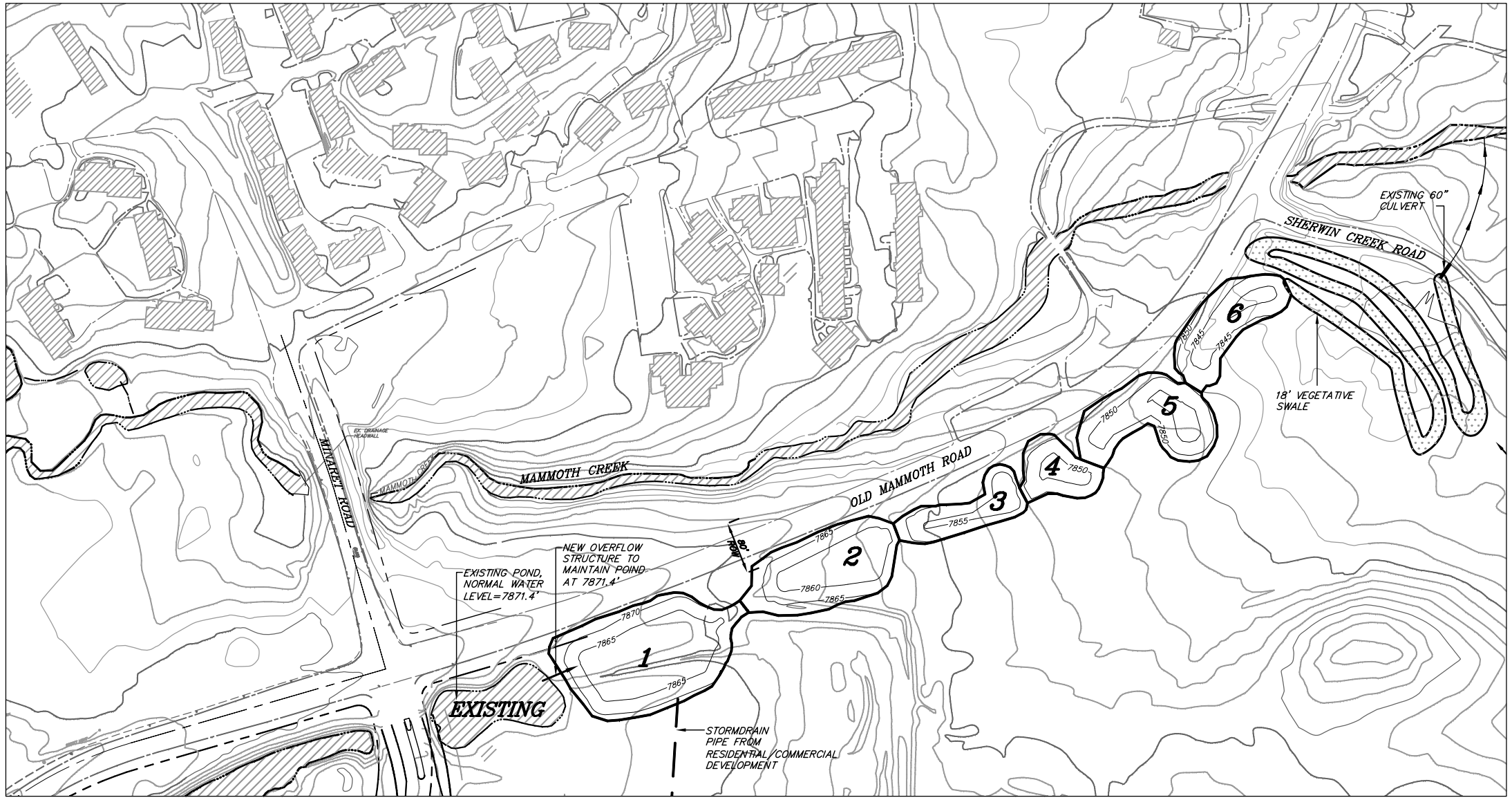


SPILLWAY ELEVATIONS

BASIN	ELEVATION
1	7869.0
2	7862.0
3	7856.0
4	7854.0
5	7850.0
6	7844.0

RETENTION PROVIDED

BASIN	CAPACITY (CF)
1	140,049
2	43,038
3	8,235
4	18,495
5	35,451
6	17,172
EXISTING	71,199
TOTAL	333,639 (12,357 CY)

SCALE:
1" = 200' (11"X17" PLOT SIZE)
CONTOUR INTERVAL: 1'

triad/holmes assoc.
civil engineering
land surveying
MAMMOTH LAKES
BISHOP
LOMPOC
NAPA
PLEASANTON
REDWOOD CITY
SAN LUIS OBISPO

RETENTION / INFILTRATION SYSTEM
SNOWCREEK VIII
PREPARED FOR: CHADMAR

DATE 01/18/07
SCALE AS NOTED
DRAWN MP
JOB NO. 36.1
DWG 36.1drainage rev1
SHEET 4 OF 5 SHEETS

SCALE:

1" = 200' (11"X17" PLOT SIZE)

GOLF COURSE EXPANSION

100-YEAR FLOOD LIMIT

RESIDENTIAL/COMMERCIAL DEVELOPMENT

EXISTING

9 7845 7845 7850

5 7850 7850

4 7850

3 7855

2 7865 7860

1 7865 7870 7865

BUS STOP SHELTER

EX. DRAINAGE HEADWALL

triad/holmes assoc.
civil engineering
land surveying

MAMMOTH LAKES
BISHOP
LOMPOC
NAPA
PLEASANTON
REDWOOD CITY
SAN LUIS OBISPO

FLOOD LIMITS

SNOWCREEK VIII

PREPARED FOR: CHADMAR

DATE 01/18/07

SCALE AS NOTED

DRAWN MP

JOB NO. 36.1

DWG 36.1drainage rev1

SHEET 5 OF 5 SHEETS

Preliminary Drainage Study
Snowcreek VIII

Appendix B
Hydrology/Hydraulic Calculations

SNOWCREEK VIII

Hydrology Calculations - Summary
20-Year Intensity Storm
(Post Develompent Conditions)

Area	Design Q (cfs)	Exceedence Interval for Design (years)	Winter Q at Exceedence Interval (cfs)	Winter Intensity (inches / hour)	Winter Average "C" factor	Summer Q at Exceedence Interval (cfs)	Summer Intensity (inches / hour)	Summer Average "C" factor	Acres	Calc Page	Comments
Area E Total	**21.6**	Q20	21.6	0.9	0.4	15.5	1.3	0.2	64.3	3	Off Site/Tributary to Lakes
Area E1	**3.1**	Q20	3.1	0.9	0.3	2.1	1.4	0.2	9.2	5	
Area E2	**3.8**	Q20	3.8	0.8	0.3	2.1	1.0	0.2	12.6	7	
Area E3	**1.7**	Q20	1.7	0.9	0.4	1.4	1.1	0.3	4.7	9	
Area E2+E3	**6.3**	Q20	6.3	0.9	0.4	4.7	1.3	0.2	18.5	11	
Area E4	**10.6**	Q20	10.6	0.8	0.4	5.5	0.8	0.2	37.7	13	
Area A Total	**7.9**	Q20	7.9	0.8	0.6	7.7	1.0	0.5	15.5	15	Tributary to Outlet A
Area A1	**0.4**	Q20	0.3	0.9	0.7	0.4	1.1	0.7	0.5	17	
Area A2	**1.0**	Q20	1.0	0.9	0.7	1.0	1.0	0.6	1.8	19	
Area A3	**2.1**	Q20	1.7	0.9	0.8	2.1	1.1	0.8	2.5	21	
Area A4	**1.9**	Q20	1.6	0.9	0.7	1.9	1.1	0.7	2.5	23	
Area A5	**2.0**	Q20	2.0	0.9	0.6	1.9	1.0	0.5	4.0	25	
Area A6	**0.9**	Q20	0.8	0.9	0.6	0.9	1.1	0.5	1.5	27	
Area A7	**2.9**	Q20	2.7	0.9	0.6	2.9	1.1	0.5	5.0	29	
Area A8	**0.3**	Q20	0.3	0.9	0.5	0.3	1.0	0.4	0.7	31	
Area B Total	**6.3**	Q20	5.2	0.9	0.8	6.3	1.1	0.8	7.7	33	Tributary to Outlet B
Area B1	**2.4**	Q20	2.0	0.9	0.8	2.4	1.1	0.8	3.0	35	
Area B2	**1.7**	Q20	1.4	0.9	0.7	1.7	1.1	0.7	2.2	37	
Area B3	**0.9**	Q20	0.7	0.9	0.8	0.9	1.1	0.8	1.0	39	
Area B4	**1.3**	Q20	1.1	0.9	0.8	1.3	1.1	0.8	1.6	41	
Area C Total	**20.3**	Q20	20.3	0.8	0.6	18.4	0.9	0.5	43.1	43	Tributary to Outlet C
Area C1	**1.2**	Q20	1.2	0.8	0.4	0.9	1.0	0.3	3.2	45	
Area C2	**0.8**	Q20	0.8	0.9	0.7	0.8	1.1	0.6	1.2	47	
Area C3	**2.1**	Q20	2.1	0.8	0.5	1.9	0.9	0.4	4.7	49	
Area C4	**1.1**	Q20	1.1	0.9	0.6	1.1	1.1	0.5	2.0	51	
Area C5	**0.7**	Q20	0.7	0.9	0.6	0.7	1.1	0.5	1.2	53	
Area C6	**0.9**	Q20	0.8	0.9	0.6	0.9	1.1	0.5	1.5	55	
Area C7	**1.3**	Q20	1.3	0.9	0.5	1.2	1.1	0.4	3.0	57	
Area C8	**0.7**	Q20	0.7	0.9	0.5	0.7	1.2	0.4	1.5	59	
Area C9	**2.1**	Q20	2.1	0.9	0.6	2.0	1.0	0.4	4.3	63	
Area C10	**2.4**	Q20	2.4	0.9	0.7	2.4	1.0	0.6	4.2	65	
Area C11	**2.5**	Q20	2.2	0.9	0.7	2.5	1.0	0.7	3.5	67	
Area C12	**0.7**	Q20	0.6	0.9	0.8	0.7	1.2	0.8	0.8	69	
Area C13	**2.6**	Q20	2.6	0.9	0.5	2.4	1.0	0.4	5.5	71	
Area C14	**0.4**	Q20	0.4	0.9	0.4	0.3	1.1	0.3	1.0	73	
Area C15	**2.3**	Q20	2.1	0.9	0.7	2.3	1.1	0.6	3.6	75	
Area C16	**1.4**	Q20	1.2	0.9	0.8	1.4	1.1	0.7	1.7	77	
Area D Total	**0.5**	Q20	0.4	0.9	0.8	0.5	1.2	0.8	0.5	79	On Site
Area F Total	**13.7**	Q20	13.7	0.8	0.3	6.8	0.8	0.2	49.4	81	Off Site

SNOWCREEK VIII

Hydrology Calculations - Summary
100-Year Intensity Storm
(Post Develompent Conditions)

Area	Design Q (cfs)	Exceedence Interval for Design (years)	Winter Q at Exceedence Interval (cfs)	Winter Intensity (inches / hour)	Winter Average "C" factor	Summer Q at Exceedence Interval (cfs)	Summer Intensity (inches / hour)	Summer Average "C" factor	Acres	Calc Page	Comments
Area E Total	**42.3**	Q100	42.3	1.3	0.5	27.6	1.7	0.2	64.3	3	Off Site/Tributary to Lakes
Area E1	**6.1**	Q100	6.1	1.4	0.5	3.9	1.8	0.2	9.2	5	
Area E2	**7.5**	Q100	7.5	1.2	0.5	3.9	1.4	0.2	12.6	7	
Area E3	**3.1**	Q100	3.1	1.3	0.5	2.3	1.5	0.3	4.7	9	
Area E2+E3	**12.3**	Q100	12.3	1.4	0.5	8.3	1.8	0.3	18.5	11	
Area E4	**21.0**	Q100	21.0	1.1	0.5	10.2	1.1	0.2	37.7	13	
Area A Total	**12.8**	Q100	12.8	1.2	0.7	11.4	1.3	0.5	15.5	15	Tributary to Outlet A
Area A1	**0.6**	Q100	0.5	1.3	0.8	0.6	1.5	0.7	0.5	17	
Area A2	**1.6**	Q100	1.6	1.3	0.7	1.5	1.4	0.6	1.8	19	
Area A3	**2.9**	Q100	2.5	1.3	0.8	2.9	1.5	0.8	2.5	21	
Area A4	**2.7**	Q100	2.4	1.3	0.8	2.7	1.5	0.7	2.5	23	
Area A5	**3.3**	Q100	3.3	1.3	0.6	2.9	1.4	0.5	4.0	25	
Area A6	**1.3**	Q100	1.3	1.3	0.7	1.3	1.5	0.6	1.5	27	
Area A7	**4.5**	Q100	4.5	1.3	0.7	4.2	1.5	0.5	5.0	29	
Area A8	**0.6**	Q100	0.6	1.3	0.6	0.4	1.4	0.4	0.7	31	
Area B Total	**8.9**	Q100	7.8	1.3	0.8	8.9	1.5	0.8	7.7	33	Tributary to Outlet B
Area B1	**3.4**	Q100	3.0	1.3	0.8	3.4	1.5	0.8	3.0	35	
Area B2	**2.4**	Q100	2.1	1.3	0.8	2.4	1.5	0.8	2.2	37	
Area B3	**1.2**	Q100	1.0	1.3	0.8	1.2	1.5	0.8	1.0	39	
Area B4	**1.9**	Q100	1.6	1.3	0.8	1.9	1.5	0.8	1.6	41	
Area C Total	**33.9**	Q100	33.9	1.2	0.6	27.7	1.3	0.5	43.1	43	Tributary to Outlet C
Area C1	**2.2**	Q100	2.2	1.2	0.5	1.5	1.3	0.3	3.2	45	
Area C2	**1.2**	Q100	1.2	1.3	0.8	1.2	1.5	0.7	1.2	47	
Area C3	**3.6**	Q100	3.6	1.2	0.6	2.8	1.3	0.5	4.7	49	
Area C4	**1.8**	Q100	1.8	1.3	0.7	1.6	1.5	0.5	2.0	51	
Area C5	**1.1**	Q100	1.1	1.3	0.7	1.1	1.5	0.6	1.2	53	
Area C6	**1.4**	Q100	1.4	1.3	0.7	1.3	1.5	0.6	1.5	55	
Area C7	**2.3**	Q100	2.3	1.3	0.6	1.8	1.5	0.4	3.0	57	
Area C8	**1.2**	Q100	1.2	1.3	0.6	1.1	1.6	0.5	1.5	59	
Area C9	**3.5**	Q100	3.5	1.3	0.6	3.0	1.4	0.5	4.3	63	
Area C10	**3.8**	Q100	3.8	1.3	0.7	3.6	1.4	0.6	4.2	65	
Area C11	**3.5**	Q100	3.4	1.2	0.8	3.5	1.4	0.7	3.5	67	
Area C12	**1.0**	Q100	0.8	1.3	0.8	1.0	1.6	0.8	0.8	69	
Area C13	**4.3**	Q100	4.3	1.3	0.6	3.6	1.4	0.5	5.5	71	
Area C14	**0.7**	Q100	0.7	1.3	0.5	0.5	1.6	0.3	1.0	73	
Area C15	**3.4**	Q100	3.4	1.3	0.7	3.3	1.5	0.6	3.6	75	
Area C16	**2.0**	Q100	1.8	1.3	0.8	2.0	1.5	0.7	1.7	77	
Area D Total	**0.7**	Q100	0.5	1.3	0.8	0.7	1.6	0.8	0.5	79	On Site
Area F Total	**27.5**	Q100	27.5	1.2	0.5	12.9	1.1	0.2	49.4	81	Off Site

Snowcreek VIII

Existing and Proposed Total Runoff Volumes

(Per The Town of Mammoth Lakes 2005 Storm Drain Master Plan Update)

Condition	Basin	Total Area (Acres)	% Natural	% HD Residential	% LD Residential	% Commercial	20-yr (cfs/acre)	100 yr (cfs/acre)	Area Runoff 20-yr (cfs)	Total Runoff 20-yr (cfs)	Area Runoff 100-yr (cfs)	Total Runoff 100-yr (cfs)	Total Contributing Area (acres)	Sub-Area Area Adjustment	Cumulative Area Adjustment	Adjusted Area Runoff 20-yr (cfs)	Adjusted Total Runoff 20-yr (cfs)	Adjusted Area Runoff 100-yr (cfs)	Adjusted Total Runoff 100-yr (cfs)
Existing	2.4	871	97%	3%	0%	0%	0.05	0.10	47	111	86	207	1162	0.69	0.63	32	**70**	60	**131**
Proposed	2.4	871	92%	8%	0%	0%	0.06	0.11	55	119	100	221	1162	0.69	0.63	38	**75**	69	**139**

Land Use Type		20-Year	100-Year
Commercial	C	1.22	1.93
High Density Residence	H	1.14	1.90
Natural	N	0.23	0.43
Single Family Residence	S	0.65	1.30

Pipe Capacity

	Area A		Area B		Area C		Lateral		Area E1 (Off Site)	
	enter	calced	enter	calced	enter	calced	enter	calced	enter	calced
Pipe Diameter (inches)	24	24	18	18	30	30	12	12	18	18
Pipe Diameter (feet)		2.00		1.50		2.50		1.00		1.50
Slope (s)	0.01		0.01		0.01		0.01		0.01	
Friction Factor(n)	0.012		0.012		0.012		0.012		0.012	
Depth (inches)		14.4		10.8		18		8.4		12.6
Depth (feet)		1.20		0.90		1.50		0.70		1.05
Depth (percentage)	60%	60%	60%	60%	60%	60%	70%	70%	70%	70%
Area		1.97		1.11		3.08		0.59		1.32
Wetted Perimeter		3.54		2.66		4.43		1.98		2.97
Hydraulic radius		0.56		0.42		0.69		0.30		0.44
Number of Pipes	1		1		1		1		1	
Pipe Capacity(cfs)		**16.47**		**7.65**		**29.85**		**3.23**		**9.53**
Required Capacity(cfs)		7.9		6.3		20.3		2.9		6.8
Capacity greater than Q		yes		yes		yes		yes		yes
Velocity (fps)		**8.37**		**6.91**		**9.71**		**5.50**		**7.21**
radius		1.00		0.75		1.25		0.50		0.75
cos length		-0.20		-0.15		-0.25		-0.20		-0.30
angle (radians)		1.77		1.77		1.77		1.98		1.98
angle degrees		101.5		101.5		101.5		113.6		113.6
sin length		0.98		0.73		1.22		0.46		0.69
two triangle areas		-0.20		-0.11		-0.31		-0.09		-0.21
sector area		1.77		1.00		2.77		0.50		1.12
total area of pipe		3.14		1.77		4.91		0.79		1.77
area at depth		1.97		1.11		3.08		0.59		1.32
Wetted Perimeter at depth		3.54		2.66		4.43		1.98		2.97
Circumfirence		6.28		4.71		7.85		3.14		4.71

Pipes have adequate capacity for all flows.

Catch Basin Inlet Capacity

			Size						
Inlet	Q(cfs) capacity required		Width	Length	SIDES	clogging factor	Inlet Capacity (y<0.4 feet), $Q=3Py^{3/2}$	y=depth of flow at inlet, ft	Capacity Greater than Q
A1	**0.4**	Rect	16	16	4	0.5	0.4	0.13	**yes**
A2	**1.0**	Rect	16	16	4	0.5	1.0	0.26	**yes**
A3	**2.1**	Rect	24	24	4	0.5	2.1	0.31	**yes**
A4	**1.9**	Rect	24	24	4	0.5	1.9	0.29	**yes**
A5	**2.0**	Rect	24	24	4	0.5	2.0	0.30	**yes**
A6	**0.9**	Rect	16	16	4	0.5	0.9	0.23	**yes**
A7	**2.9**	Rect	24	24	4	0.5	2.9	0.39	**yes**
A8	**0.3**	Rect	16	16	4	0.5	0.3	0.12	**yes**
B1	**2.4**	Rect	24	24	4	0.5	2.4	0.35	**yes**
B2	**1.7**	Rect	16	16	4	0.5	1.7	0.36	**yes**
B3	**0.9**	Rect	16	16	4	0.5	0.9	0.23	**yes**
B4	**1.3**	Rect	16	16	4	0.5	1.3	0.30	**yes**
C1	**1.2**	Rect	16	16	4	0.5	1.2	0.28	**yes**
C2	**0.8**	Rect	16	16	4	0.5	0.8	0.22	**yes**
C3	**2.0**	Rect	24	24	4	0.5	2.1	0.32	**yes**
C4	**1.1**	Rect	16	16	4	0.5	1.1	0.26	**yes**
C5	**0.7**	Rect	16	16	4	0.5	0.7	0.20	**yes**
C6	**0.9**	Rect	16	16	4	0.5	0.9	0.23	**yes**
C7	**1.3**	Rect	16	16	4	0.5	1.3	0.30	**yes**
C8	**0.7**	Rect	16	16	4	0.5	0.7	0.20	**yes**
C9	**2.1**	Rect	24	24	4	0.5	2.1	0.31	**yes**
C10	**2.4**	Rect	24	24	4	0.5	2.4	0.35	**yes**
C11	**2.5**	Rect	24	24	4	0.5	2.5	0.35	**yes**
C12	**0.7**	Rect	16	16	4	0.5	0.7	0.20	**yes**
C13	**2.6**	Rect	24	24	4	0.5	2.6	0.36	**yes**
C14	**0.4**	Rect	16	16	4	0.5	0.4	0.15	**yes**
C15	**2.3**	Rect	24	24	4	0.5	2.3	0.33	**yes**
C16	**1.4**	Rect	24	24	4	0.5	1.4	0.24	**yes**

These calculations are based on the Hydraulic Engineering Circular No. 12, Chapter 8.1. Generally, under 0.4 feet of depth it is assumed that a catch basin operates under weir conditions. At depths over 1.4 feet catch basins operate under orifice conditions. In between, the typical assumption is to calculate both considerations and use the more conservative. Under sump conditions, the perimeter is the entire perimeter of the catch basin. Under non sump conditions, the perimeter is the leading edge, and the sides reduced by a side flow efficiency factor.

Basins shown as 4 sided are located in sumps. Basins shown with 1, 2 or three sides are those that storm water runoff enters basin on less than all sides.

*Inlets with this designation have been designed to take all of the runoff from their area, even though there are other basins in that area also designed for full runoff.

These inlets will be depressed approximately 0.1 foot. Side flow efficiency is based on chart 8 from HEC 12. This side flow efficiency is as a factor to reduce the perimeter, applied to the length of the basin. Round basins in non sump conditions are only considered to accept runoff on the leading edge.

Snowcreek VIII
Culvert Calculator (60" Existing Conditions)

Entered Data:

Shape	Circular
Number of Barrels	1
Solving for	Headwater
Chart Number	1
Scale Number	1
Chart Description	CONCRETE PIPE CULVERT; NO BEVELED RING ENTRANCE
Scale Decsription	SQUARE EDGE ENTRANCE WITH HEADWALL
Overtopping	Off
Flowrate	131.0000 cfs
Manning's n	0.0120
Roadway Elevation	7856.0000 ft
Inlet Elevation	7837.5000 ft
Outlet Elevation	7835.6800 ft
Diameter	60.0000 in
Length	108.0000 ft
Entrance Loss	0.5000
Tailwater	1.0000 ft

Computed Results:

Headwater	7842.6046 ft Inlet Control
Slope	0.0169 ft/ft
Velocity	17.1265 fps

DIS-CHARGE Flow cfs	HEAD-WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH in	CRITICAL DEPTH in	OUTLET VEL. fps	OUTLET DEPTH ft	TAILWATER VEL. fps	TAILWATER DEPTH ft
5.00	7838.28	0.78	0.00	NA	4.90	7.31	6.59	0.41	0.00	1.00
10.00	7838.63	1.13	0.00	NA	6.81	10.39	8.12	0.57	0.00	1.00
15.00	7838.90	1.40	0.11	NA	8.28	12.78	9.17	0.69	0.00	1.00
20.00	7839.14	1.64	0.37	NA	9.51	14.81	9.99	0.79	0.00	1.00
25.00	7839.35	1.85	0.61	NA	10.61	16.61	10.68	0.88	0.00	1.00
30.00	7839.55	2.05	0.82	NA	11.60	18.25	11.27	0.97	0.00	1.00
35.00	7839.74	2.24	1.03	NA	12.52	19.76	11.79	1.04	0.00	1.00
40.00	7839.91	2.41	1.22	NA	13.38	21.17	12.26	1.11	0.00	1.00
45.00	7840.08	2.58	1.40	NA	14.19	22.51	12.68	1.18	0.00	1.00
50.00	7840.24	2.74	1.58	NA	14.96	23.78	13.08	1.25	0.00	1.00
55.00	7840.40	2.90	1.75	NA	15.70	24.99	13.44	1.31	0.00	1.00
60.00	7840.56	3.06	1.92	NA	16.41	26.15	13.78	1.37	0.00	1.00
65.00	7840.71	3.21	2.08	NA	17.09	27.26	14.10	1.42	0.00	1.00
70.00	7840.86	3.36	2.23	NA	17.76	28.34	14.40	1.48	0.00	1.00
75.00	7841.01	3.51	2.39	NA	18.40	29.38	14.68	1.53	0.00	1.00
80.00	7841.15	3.65	2.54	NA	19.03	30.39	14.95	1.59	0.00	1.00
85.00	7841.30	3.80	2.69	NA	19.64	31.37	15.21	1.64	0.00	1.00
90.00	7841.44	3.94	2.84	NA	20.24	32.33	15.45	1.69	0.00	1.00
95.00	7841.58	4.08	2.98	NA	20.83	33.26	15.69	1.74	0.00	1.00
100.00	7841.72	4.22	3.13	NA	21.40	34.16	15.91	1.78	0.00	1.00
105.00	7841.87	4.37	3.27	NA	21.97	35.04	16.13	1.83	0.00	1.00
110.00	7842.01	4.51	3.41	NA	22.52	35.90	16.34	1.88	0.00	1.00
115.00	7842.15	4.65	3.55	NA	23.07	36.75	16.53	1.92	0.00	1.00
120.00	7842.29	4.79	3.70	NA	23.61	37.57	16.73	1.97	0.00	1.00
125.00	7842.43	4.93	3.84	NA	24.14	38.37	16.91	2.01	0.00	1.00
130.00	7842.58	5.08	3.98	NA	24.66	39.16	17.09	2.06	0.00	1.00
135.00	7842.72	5.22	4.12	NA	25.18	39.93	17.26	2.10	0.00	1.00

Snowcreek VIII
Culvert Calculator (60" proposed conditions)

Entered Data:

Shape	Circular
Number of Barrels	1
Solving for	Headwater
Chart Number	1
Scale Number	1
Chart Description	CONCRETE PIPE CULVERT; NO BEVELED RING ENTRANCE
Scale Decsription	SQUARE EDGE ENTRANCE WITH HEADWALL
Overtopping	Off
Flowrate	138.0000 cfs
Manning's n	0.0120
Roadway Elevation	7856.0000 ft
Inlet Elevation	7837.5000 ft
Outlet Elevation	7835.6800 ft
Diameter	60.0000 in
Length	108.0000 ft
Entrance Loss	0.5000
Tailwater	1.0000 ft

Computed Results:

Headwater	7842.8051 ft Inlet Control
Slope	0.0169 ft/ft
Velocity	17.3657 fps

DIS-CHARGE Flow cfs	HEAD-WATER ELEV. ft	INLET CONTROL DEPTH ft	OUTLET CONTROL DEPTH ft	FLOW TYPE	NORMAL DEPTH in	CRITICAL DEPTH in	OUTLET VEL. fps	OUTLET DEPTH ft	TAILWATER VEL. fps	TAILWATER DEPTH ft
5.00	7838.28	0.78	0.00	NA	4.90	7.31	6.59	0.41	0.00	1.00
10.00	7838.63	1.13	0.00	NA	6.81	10.39	8.12	0.57	0.00	1.00
15.00	7838.90	1.40	0.11	NA	8.28	12.78	9.17	0.69	0.00	1.00
20.00	7839.14	1.64	0.37	NA	9.51	14.81	9.99	0.79	0.00	1.00
25.00	7839.35	1.85	0.61	NA	10.61	16.61	10.68	0.88	0.00	1.00
30.00	7839.55	2.05	0.82	NA	11.60	18.25	11.27	0.97	0.00	1.00
35.00	7839.74	2.24	1.03	NA	12.52	19.76	11.79	1.04	0.00	1.00
40.00	7839.91	2.41	1.22	NA	13.38	21.17	12.26	1.11	0.00	1.00
45.00	7840.08	2.58	1.40	NA	14.19	22.51	12.68	1.18	0.00	1.00
50.00	7840.24	2.74	1.58	NA	14.96	23.78	13.08	1.25	0.00	1.00
55.00	7840.40	2.90	1.75	NA	15.70	24.99	13.44	1.31	0.00	1.00
60.00	7840.56	3.06	1.92	NA	16.41	26.15	13.78	1.37	0.00	1.00
65.00	7840.71	3.21	2.08	NA	17.09	27.26	14.10	1.42	0.00	1.00
70.00	7840.86	3.36	2.23	NA	17.76	28.34	14.40	1.48	0.00	1.00
75.00	7841.01	3.51	2.39	NA	18.40	29.38	14.68	1.53	0.00	1.00
80.00	7841.15	3.65	2.54	NA	19.03	30.39	14.95	1.59	0.00	1.00
85.00	7841.30	3.80	2.69	NA	19.64	31.37	15.21	1.64	0.00	1.00
90.00	7841.44	3.94	2.84	NA	20.24	32.33	15.45	1.69	0.00	1.00
95.00	7841.58	4.08	2.98	NA	20.83	33.26	15.69	1.74	0.00	1.00
100.00	7841.72	4.22	3.13	NA	21.40	34.16	15.91	1.78	0.00	1.00
105.00	7841.87	4.37	3.27	NA	21.97	35.04	16.13	1.83	0.00	1.00
110.00	7842.01	4.51	3.41	NA	22.52	35.90	16.34	1.88	0.00	1.00
115.00	7842.15	4.65	3.55	NA	23.07	36.75	16.53	1.92	0.00	1.00
120.00	7842.29	4.79	3.70	NA	23.61	37.57	16.73	1.97	0.00	1.00
125.00	7842.43	4.93	3.84	NA	24.14	38.37	16.91	2.01	0.00	1.00
130.00	7842.58	5.08	3.98	NA	24.66	39.16	17.09	2.06	0.00	1.00
135.00	7842.72	5.22	4.12	NA	25.18	39.93	17.26	2.10	0.00	1.00
140.00	7842.86	5.36	4.26	NA	25.70	40.68	17.43	2.14	0.00	1.00

Channel Calculator (vegetative swale)

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	75.0000 cfs
Slope	0.0058 ft/ft
Manning's n	0.0350
Height	20.0000 in
Bottom width	96.0000 in
Left slope	0.3333 ft/ft (V/H)
Right slope	0.3333 ft/ft (V/H)

Computed Results:

Depth	19.6325 in
Velocity	3.5513 fps
Full Flowrate	77.7279 cfs
Flow area	21.1191 ft2
Flow perimeter	220.1782 in
Hydraulic radius	13.8122 in
Top width	213.8070 in
Area	21.6675 ft2
Perimeter	222.5025 in
Percent full	98.1627 %

Preliminary Drainage Study

Snowcreek VIII

Appendix C

Retention / Infiltration System Calculations

Triad/Holmes Associates

Job No. **36.1**

Date: **1/18/2007**

Bishop	Fax: (760) 873-8024	Napa	Fax: (707) 251-9108
Mammoth Lakes	Fax: (760) 934-5619	Redwood City	Fax: (650) 366-0298
San Luis Obispo	Fax: (805) 544-8932		

Runoff Volume Calulation (required for this project)

based on Lahontan RWQCB Design Parameters

Input

Rainfall (First Inch) 1 in/hr = 0.083 ft/hr

Tributary Area				Runoff Coefficient	
Roof Area	808,603	S.F.	27%	0.95	Roof Area
Pavement Area	1,110,862	S.F.	37%	0.9	Pavement Area
Gravel/Aggregate Area	0	S.F.	0%	0.8	Gravel/Aggregate Area
Unpaved Industrial Area	0	S.F.	0%	0.75	Unpaved Industrial Area
Landscaping Area	1,052,664	S.F.	35%	0.25	Landscaping Area
Total Area	2972128	S.F.		0.68	Average Runoff Coefficient

Average Runoff Volume = Total Area * Average Runoff Coefficient * Rainfall (First Inch)

Average Runoff Volume = **169260 C.F.** **Storage capacity required**

Retention Storage Area D1 100year
HYDROLOGY

	Proposed Conditions				
	Acres				0.5
	Storm Frequency Level				100 year
	time of concentration	*(largest case)*	1.10 hours		
	D=0.133tc		*0.1463*		
	Tp=D/2+0.6tc		*0.73315*		
	storm duration (return period)		3.67 hours		
	A (area square miles)		0.0008		
	Runoff Rates	Into System			2.20 cfs
		Out of System			0.00 cfs
	Storm Return Period				3.67 hours
	Runoff Volume	(from IDF curves)			3.20 inches
	Average Coefficient	Post		C_P	0.25
	Runoff Volume Exiting Site Post				0.80 inches
	Precipitation Quantity	(Runoff Volume * Acres*43560)		*PQ*	5808
x	Runoff Quantity (into Detention Facility)			*(PQ*C)*	1452
	Average Coefficient	Pre		C_P	0.25
	Runoff Volume Existing				0.80 inches
	Runoff Quantity (existing based on C)			*(PQ*C)*	1452
y	Runoff Quantity (out of Detention Facility at existing rate based on adjusted Qi/Qp at rate calc, using more conservative ex rate)				0
	Storage requirement	(x-y)			**1,452 cf**

Retention Storage 100-year storm
Area E1, E2, E3

HYDROLOGY

	Proposed Conditions				
	Acres				26.5
	Storm Frequency Level				100 year
	time of concentration	*(largest case)*	1.03 hours		
	D=0.133tc		*0.13699*		
	Tp=D/2+0.6tc		*0.686495*		
	storm duration (return period)		3.43 hours		
	A (area square miles)		0.0414		
	Runoff Rates	Into System			16.70 cfs
		Out of System			0.00 cfs
	Storm Return Period				3.43 hours
	Runoff Volume	(from IDF curves)			3.20 inches
	Average Coefficient	Post		C_P	0.15
	Runoff Volume Exiting Site Post				0.48 inches
	Precipitation Quantity	(Runoff Volume * Acres*43560)		*PQ*	307824
x	Runoff Quantity (into Detention Facility)			*(PQ*C)*	46174
	Average Coefficient	Pre		C_P	0.15
	Runoff Volume Existing				0.48 inches
	Runoff Quantity (existing based on C)			*(PQ*C)*	46174
y	Runoff Quantity (out of Detention Facility at existing rate based on adjusted Qi/Qp at rate calc, using more conservative ex rate)				0
	Storage requirement	(x-y)			**46,174 cf**

Retention Storage 20-year storm

Area E1, E2, E3

	Proposed Conditions				
	Acres				26.5
	Storm Frequency Level				20 year
	time of concentration	*(largest case)*	1.03 hours		
	D=0.133tc		*0.13699*		
	Tp=D/2+0.6tc		*0.686495*		
	storm duration (return period)		3.43 hours		
	A (area square miles)		0.0414		
	Runoff Rates	Into System			9.60 cfs
		Out of System			0.00 cfs
	Storm Return Period				3.43 hours
	Runoff Volume	(from IDF curves)			2.20 inches
	Average Coefficient	Post		C_P	0.15
	Runoff Volume Exiting Site Post				0.33 inches
	Precipitation Quantity	(Runoff Volume * Acres*43560)		*PQ*	211629
x	Runoff Quantity (into Detention Facility)			*(PQ*C)*	31744
	Average Coefficient	Pre		C_P	0.15
	Runoff Volume Existing				0.33 inches
	Runoff Quantity (existing based on C)			*(PQ*C)*	31744
y	Runoff Quantity (out of Detention Facility at existing rate based on adjusted Qi/Qp at rate calc, using more conservative ex rate)				0
	Storage requirement	(x-y)			**31,744 cf**

Retention Storage Area 100-year per 1 acre
HYDROLOGY

	Proposed Conditions				
	Acres				1
	Storm Frequency Level				100 year
	time of concentration	*(largest case)*	1.02 hours		
	D=0.133tc		*0.13566*		
	Tp=D/2+0.6tc		*0.67983*		
	storm duration (return period)		3.40 hours		
	A (area square miles)		0.0016		
	Runoff Rates	Into System			12.30 cfs
		Out of System			0.00 cfs
	Storm Return Period				3.40 hours
	Runoff Volume	(from IDF curves)			3.20 inches
	Average Coefficient	Post		C_P	0.25
	Runoff Volume Exiting Site Post				0.80 inches
	Precipitation Quantity	(Runoff Volume * Acres*43560)		*PQ*	11616
x	Runoff Quantity (into Detention Facility)			*(PQ*C)*	2904
	Average Coefficient	Pre		C_P	0.25
	Runoff Volume Existing				0.80 inches
	Runoff Quantity (existing based on C)			*(PQ*C)*	2904
y	Runoff Quantity (out of Detention Facility at existing rate based on adjusted Qi/Qp at rate calc, using more conservative ex rate)				0
	Storage requirement	(x-y)			**2,904 cf**

Snowcreek VIII

Existing Lake Detention Calculations

Depth, feet	Surface Elevation	Lake 1		Lake 2		Surface Area, ft^2	Average Surface Area, ft^2	Volume at Section, cf	Total Volume at Elevation, cf
		Surface Area, ft^2	Acres	Surface Area, ft^2	Acres				
0	71.4	15,625	0.359	69,003	1.584	84,628			
							104,653		
0.7	72.1	17,424	0.400	107,254	2.462	124,677		71,199	**71,199**
							134,086		
1	72.4	18,269	0.419	125,226	2.875	143,495		42,863	114,062

Preliminary Drainage Study
Snowcreek VIII

Appendix D
References

4.8 LAND DEVELOPMENT

The construction and maintenance of urban and commercial developments can impact water quality in many ways. Construction activities inherently disturb soil and vegetation, often resulting in accelerated erosion and sedimentation. Stormwater runoff from developed areas can also contain petroleum products, nutrients, and other contaminants.

This section contains a discussion of the potential water quality impacts expected to result from land development activities, followed by control measures to reduce or offset water quality impacts from such activities.

Construction Activities and Guidelines

Construction activities often produce erosion by disturbing the natural ground surface through scarifying, grading, and filling. Floodplain and wetland disturbances often reduce the ability of the natural environment to retain sediment and assimilate nutrients. Construction materials such as concrete, paints, petroleum products, and other chemicals can contaminate nearby water bodies. Construction impacts such as these are typically associated with subdivisions, commercial developments, and industrial developments.

Control Measures for Construction Activities

The Regional Board regulates the construction of subdivisions, commercial developments, industrial developments, and roadways based upon the level of threat to water quality. The Regional Board will request a Report of Waste Discharge and consider the issuance of an appropriate permit for any proposed project where water quality concerns are identified in the California Environmental Quality Act (CEQA) review process. Any construction activity whose land disturbance activities exceed five acres must also comply with the statewide general NPDES permit for stormwater discharges (see "Stormwater" section of this Chapter).

The following are guidelines for construction projects regulated by the Regional Board, particularly for projects located in portions of the Region where erosion and stormwater threaten sensitive watersheds. The Regional Board recommends that each county within the Region adopt a grading/erosion control ordinance to require implementation of these same guidelines for all soil disturbing activities:

1. Surplus or waste material should not be placed in drainageways or within the 100-year floodplain of any surface water.

2. All loose piles of soil, silt, clay, sand, debris, or other earthen materials should be protected in a reasonable manner to prevent any discharge to waters of the State.

3. Dewatering should be performed in a manner so as to prevent the discharge of earthen material from the site.

4. All disturbed areas should be stabilized by appropriate soil stabilization measures by October 15th of each year.

5. All work performed during the wet season of each year should be conducted in such a manner that the project can be winterized (all soils stabilized to prevent runoff) within 48 hours if necessary. The wet season typically extends from October 15th through May 1st in the higher elevations of the Lahontan Region. The season may be truncated in the desert areas of the Region.

6. Where possible, existing drainage patterns should not be significantly modified.

7. After completion of a construction project, all surplus or waste earthen material should be removed from the site and deposited in an approved disposal location.

8. Drainage swales disturbed by construction activities should be stabilized by appropriate soil stabilization measures to prevent erosion.

9. All non-construction areas should be protected by fencing or other means to prevent unnecessary disturbance.

10. During construction, temporary protected gravel dikes, protected earthen dikes, or sand bag dikes should be used as necessary to prevent discharge of earthen materials from the site during periods of precipitation or runoff.

11. Impervious areas should be constructed with infiltration trenches along the downgradient sides to dispose of all runoff greater than background levels of the undisturbed site. Infiltration trenches are not recommended in areas where infiltration poses a risk of ground water contamination.

12. Infiltration trenches or similar protection facilities should be constructed on the downgradient side of all structural drip lines.

13. Revegetated areas should be continually maintained in order to assure adequate growth and root development. Physical erosion control facilities should be placed on a routine maintenance and inspection program to provide continued erosion control integrity.

14. Waste drainage waters in excess of that which can be adequately retained on the property should be collected before such waters have a chance to degrade. Collected water shall be treated, if necessary, before discharge from the property.

15. Where construction activities involve the crossing and/or alteration of a stream channel, such activities should be timed to occur during the period in which stream flow is expected to be lowest for the year.

16. Use of materials other than potable water for dust control (i.e., reclaimed wastewater, chemicals such as magnesium chloride, etc.) is strongly encouraged but must have prior Regional Board approval before its use.

Specific Policy and Guidelines for Mammoth Lakes Area

To control erosion and drainage in the Mammoth Lakes watershed at an elevation above 7,000 feet (Figure 4.8-1), the following policy and guidelines apply:

Policy:

A Report of Waste Discharge is required not less than 90 days before the intended start of construction activities of a **new development** of either (a) six or more dwelling units, or (b) commercial developments involving soil disturbance on one-quarter acre or more.

The Report of Waste Discharge shall contain a description of, and time schedule for implementation, for both the **interim erosion control measures** to be applied during project construction, and **short- and long-term erosion control measures** to be employed after the construction phase of the project. The descriptions shall include appropriate engineering drawings, criteria, and design calculations.

Guidelines:

1. Drainage collection, retention, and infiltration facilities shall be constructed and maintained to prevent transport of the runoff from a 20-year, 1-hour design storm from the project site. A 20-year, 1-hour design storm for the Mammoth Lakes area is equal to 1.0 inch (2.5 cm) of rainfall.

2. Surplus or waste materials shall not be placed in drainageways or within the 100-year flood plain of surface waters.

3. All loose piles of soil, silt, clay, sand, debris, or earthen materials shall be protected in a reasonable manner to prevent any discharge to waters of the State.

4. Dewatering shall be done in a manner so as to prevent the discharge of earthen materials from the site.

5. All disturbed areas shall be stabilized by appropriate soil stabilization measures by October 15 of each year.

6. All work performed between October 15th and May 1st of each year shall be conducted in such a manner that the project can be winterized within 48 hours.

7. Where possible, existing drainage patterns shall not be significantly modified.

8. After completion of a construction project, all surplus or waste earthen material shall be removed from the site and deposited at a legal point of disposal.

9. Drainage swales disturbed by construction activities shall be stabilized by the addition of crushed rock or riprap, as necessary, or other appropriate stabilization methods.

10. All nonconstruction areas shall be protected by fencing or other means to prevent unnecessary disturbance.

11. During construction, temporary erosion control facilities (e.g., impermeable dikes, filter fences, hay bales, etc.) shall be used as necessary to prevent discharge of earthen materials from the site during periods of precipitation or runoff.

12. Revegetated areas shall be regularly and continually maintained in order to assure adequate growth and root development. Physical erosion control facilities shall be placed on a routine maintenance and inspection program to provide continued erosion control integrity.

13. Where construction activities involve the crossing and/or alteration of a stream channel, such activities shall be timed to occur during the period in which streamflow is expected to be lowest for the year.

Land Development/Urban Runoff Control Actions for Susan River Watershed

1. To protect riparian vegetation and wetlands from land disturbance activities, the Regional Board shall recommend that Lassen County and the City of Susanville require new development or any land disturbing activities to include buffer strips of undisturbed land, especially along the Susan River and its tributaries.

2. The Regional Board, with assistance from the City of Susanville and the California Department of Transportation (Caltrans), should conduct monitoring of the Susan River and Piute Creek within the City of Susanville to assess impacts from urban runoff. Control measures should be planned and implemented based on the results of the monitoring. The monitoring plan should be developed to identify nonpoint sources needing control. Monitoring proposals will be submitted by the Regional Board, and work will be conducted as resources allow and as the Susan River gains priority.

3. The Regional Board shall encourage and assist other agencies in watershed restoration efforts along the Susan River.

4. The Regional Board shall encourage the City of Susanville and Lassen County to adopt a comprehensive grading ordinance. These ordinances should require, for all proposed land disturbing activities, the use of Best Management Practices to reduce erosion and stormwater runoff, including but not limited to temporary and permanent erosion control measures.

5. The Regional Board shall encourage the City of Susanville, Lassen County and Caltrans to implement Best Management Practices to reduce erosion and stormwater runoff when constructing and maintaining roads, both paved and unpaved, under their jurisdiction.

Road Construction and Maintenance

Road construction activities often involve extensive earth moving, including clearing, scarifying, excavating for bridge abutments, disturbing or modifying floodplains, cutting, and filling. Additionally, the potential for land disturbance exists from construction materials, equipment maintenance, fuel storage facilities, and general equipment use.

Once constructed, impervious road surfaces create another source of water pollution. Oils, greases, and other petroleum products, along with such toxic materials as battery acid, antifreeze, etc., may be deposited along the road surfaces. These contaminants become suspended or dissolved in any stormwater runoff that is generated on the road surfaces. Unless otherwise treated, these contaminants will flow toward local surface or ground waters. (See "Stormwater" section of this Chapter.)

Road maintenance can be potentially threatening to water quality in a number of ways. Below-grade culverts slowly fill with sediment and are cleaned out periodically, sometimes by flushing accumulated sediment into downstream drainageways. Grading of shoulders and drainageways can detach sediments and increase the risk of erosion into nearby surface waters. Road surfaces may be repainted or resealed

with materials that harden quickly, but which can be washed off while still fresh by stormwater runoff.

In the winter, roads are often snowy, icy, or wet. To reduce winter road hazards, maintenance crews may remove the snow or ice, apply sand to provide added traction, and/or apply deicing chemicals to melt the snow and ice. Sand is rapidly dissipated or crushed by the traffic, and must be replaced frequently. Great quantities of sediment enter drainageways and/or surface waters due to this practice. Snow may be removed mechanically via snowplow or snowblower. This practice is not particularly detrimental to water quality in itself, but the snow often carries substances from the roadway when removed. Sediments, chemical deicers, and vehicle fluids may travel much farther than they would otherwise, possibly reaching area surface waters. Ice and small accumulations of snow may be removed with chemical deicers. The deicer in widest use is rock salt (sodium chloride), due to its low cost, high availability, and predictable results.

Winter road maintenance was brought to the forefront in 1989 when significant numbers of roadside trees in the Lake Tahoe Basin suddenly started dying. The public outcry caused many environmental groups and regulatory agencies, including the Regional Board, to look more closely at what had been a more or less unscrutinized, unregulated process in the past. Data began to show that Caltrans was using very high amounts of salt each winter, and the figure seemed to increase from one year to the next. The consensus of the various regulatory agencies was that Caltrans should reduce salt use, explore various alternate deicers, and monitor the impacts of salt applications on soil, water, and vegetation. Salt use decreased significantly from 1989-1992, due to more careful application procedures and to drought conditions.

At least three alternate deicers have been explored: calcium magnesium acetate, potassium acetate, and magnesium chloride with corrosion inhibitors. These products have shown some promise, but further study is required. The cost to switch to an alternate deicer will be significant. The road departments are unwilling to make the switch unless an alternate deicer is demonstrably better environmentally, will not require too much adjustment on the part of the maintenance crews and equipment, and will actually do an effective and predictable job when applied.

However, Caltrans' monitoring of vegetation showed minimal and temporary salt accumulation within the vegetation. During the spring, any salt that had accumulated in the vegetation was flushed out from the plant material. The impacts of chemical deicers on fish and wildlife within the Lahontan Region have not been studied.

Control Measures for Road Construction and Maintenance

(Additional control measures for roads are included in the "Stormwater" section of this Chapter.)

The Regional Board regulates road construction and maintenance projects within the Lahontan Region, concentrating efforts on major construction and construction in sensitive areas. Major construction projects and those projects in sensitive areas are most often regulated under individual WDRs, and are routinely inspected. Less significant projects may be issued conditional waivers of WDRs. The Regional Board has also adopted road maintenance waste discharge requirements for some county governments in the Region. Road construction and maintenance in the Lake Tahoe Basin is also regulated under municipal NPDES Stormwater Permits (see Chapter 5).

For all road projects, the Board requires that construction be conducted in a manner which is protective to water quality, and that, at the end of a given project, the site be restabilized and revegetated. These requirements are detailed in a Management Agency Agreement with Caltrans regarding the implementation of BMPs. Additionally, all road projects are to be in compliance with the Caltrans Statewide 208 Plan (CA Dept. of Transportation 1980), which was approved by the State Board in 1979. This Plan contains a commitment to implement BMPs, but does not include great detail on the BMPs themselves. The State Board should encourage Caltrans to update its 208 plan to provide such detail, with particular attention to:

- stormwater/erosion control along existing highways
- erosion control during highway construction and maintenance

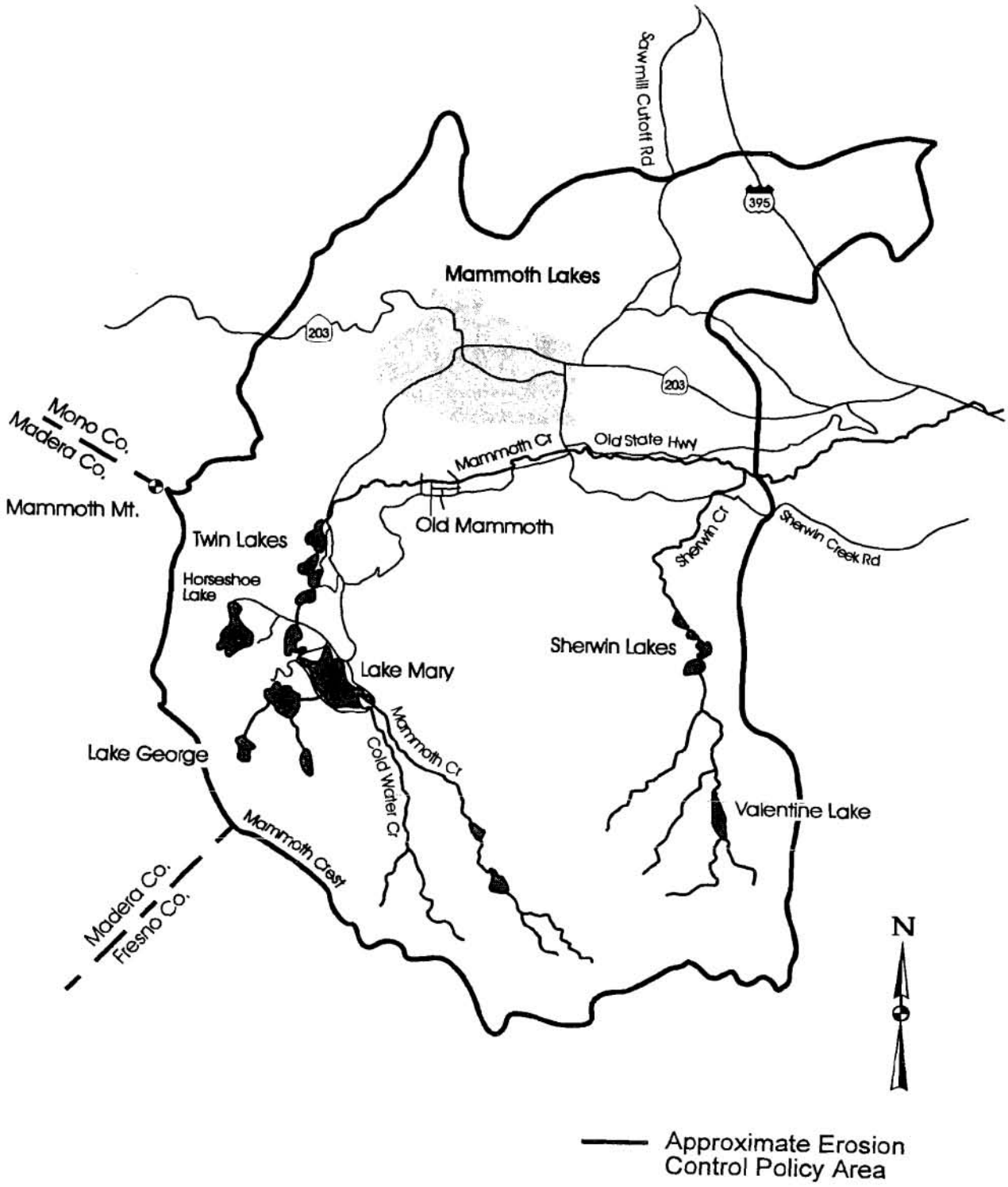
- reduction of direct discharges (e.g., through culverts)
- reduction of runoff velocity
- infiltration, detention and retention practices
- management of deicing compounds, fertilizer, and herbicide use
- spill cleanup measures
- treatment of toxic stormwater pollutants

Since much of the implementation of BMPs on highways is done by Caltrans' contractors, the selection of qualified contractors and ongoing education of construction and maintenance personnel on BMP techniques are particularly important.

In the Lake Tahoe Basin, all governmental agencies assigned to maintain roads are required to bring all roads in the Lake Tahoe Basin into compliance with current "208" standards within a specified time schedule. That is, all existing facilities must be retrofitted to handle the stormwater runoff from the 20-year, 1-hour storm, and to restabilize all eroding slopes. The twenty-year time frame for this compliance process ends in 2008.

The Regional Board should allow salt use to continue as one component of a comprehensive winter maintenance program. However, the Regional Board should continue to require that it be applied in a careful, well-planned manner, by competent, trained crews. Should even the "proper" application of salt be shown to cause adverse water quality impacts, the Regional Board should then require that it no longer be used in environmentally sensitive areas, such as the Lake Tahoe Basin. Similarly, should an alternate deicer be shown to be effective, environmentally safe, and economically feasible, its use should be encouraged in lieu of salt.

Figure 4.8-1
OWENS HYDROLOGIC UNIT



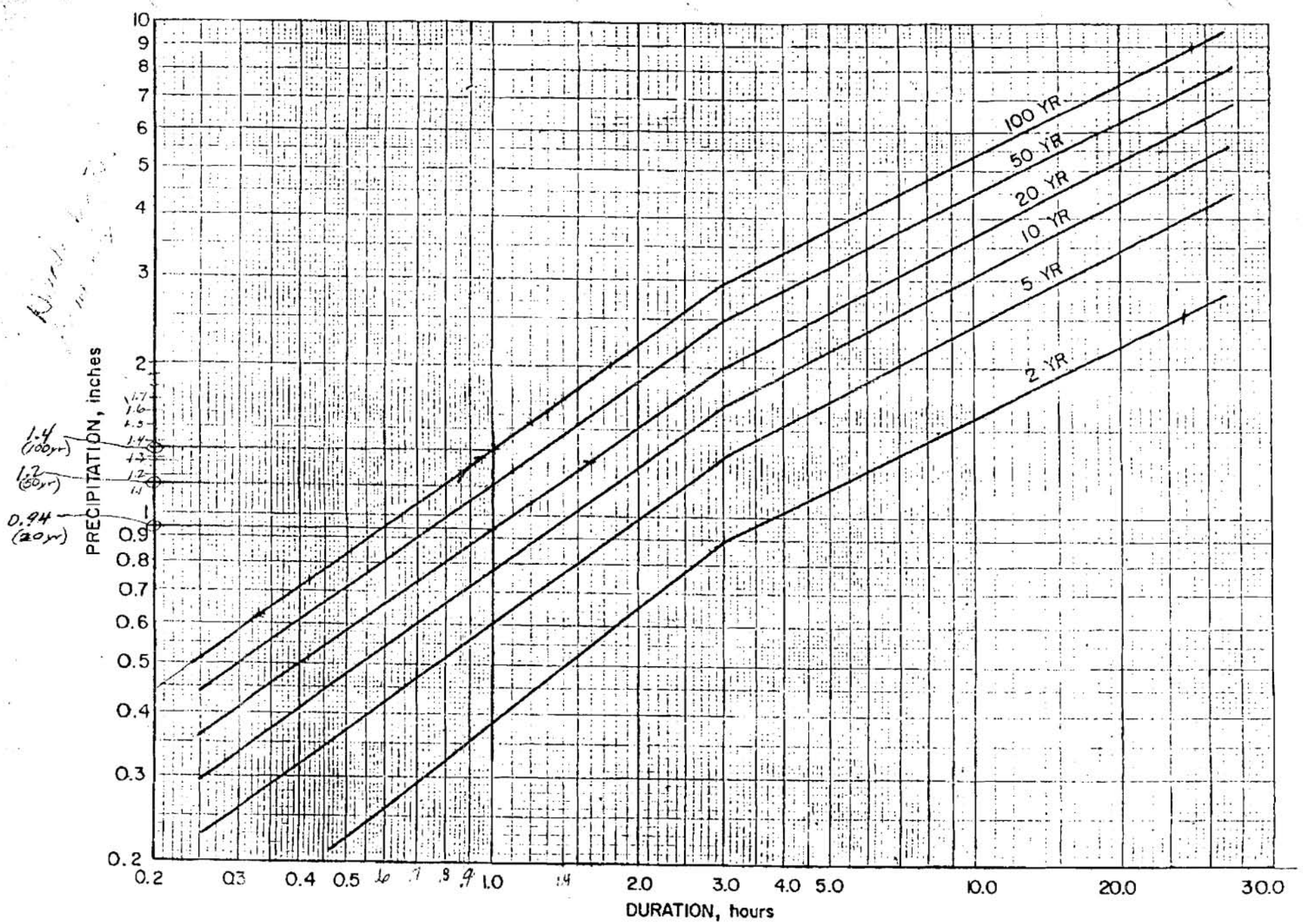


Figure 1-4 Winter Precipitation Design Curve

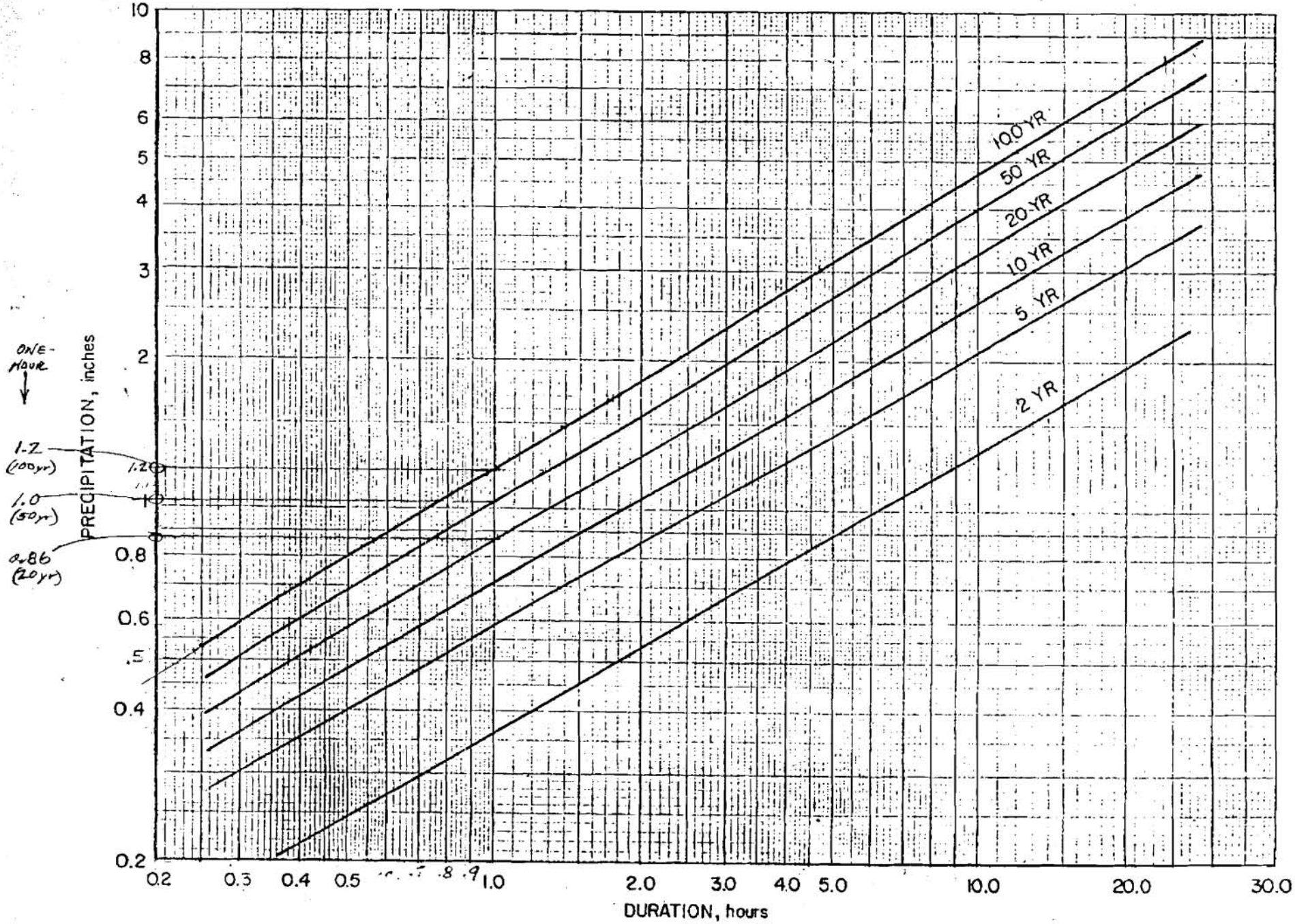


Figure I-5 Summer Precipitation Design Curve

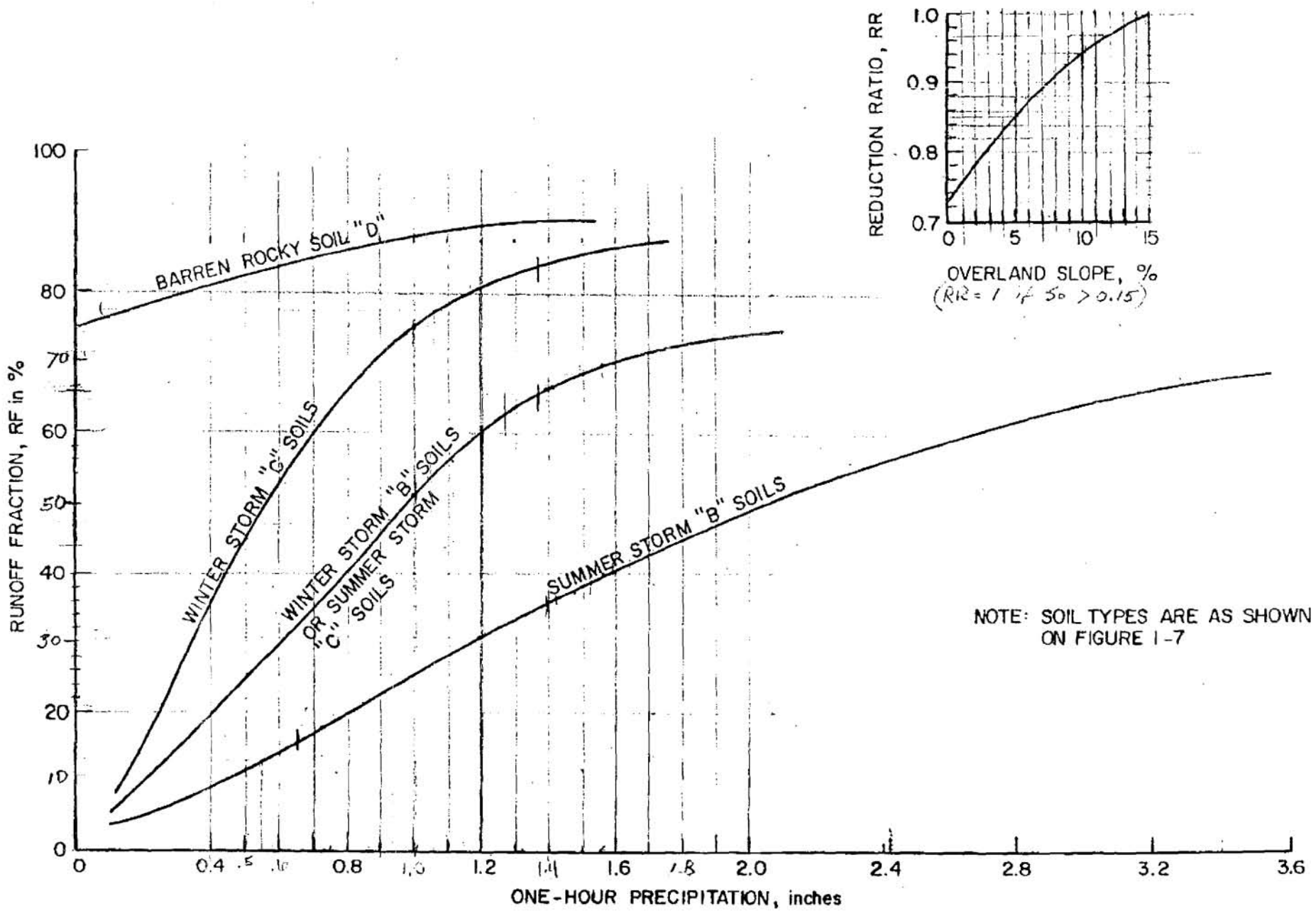


Figure I-6 Natural Area Runoff Factor, RF, and Reduction Ratio, RR

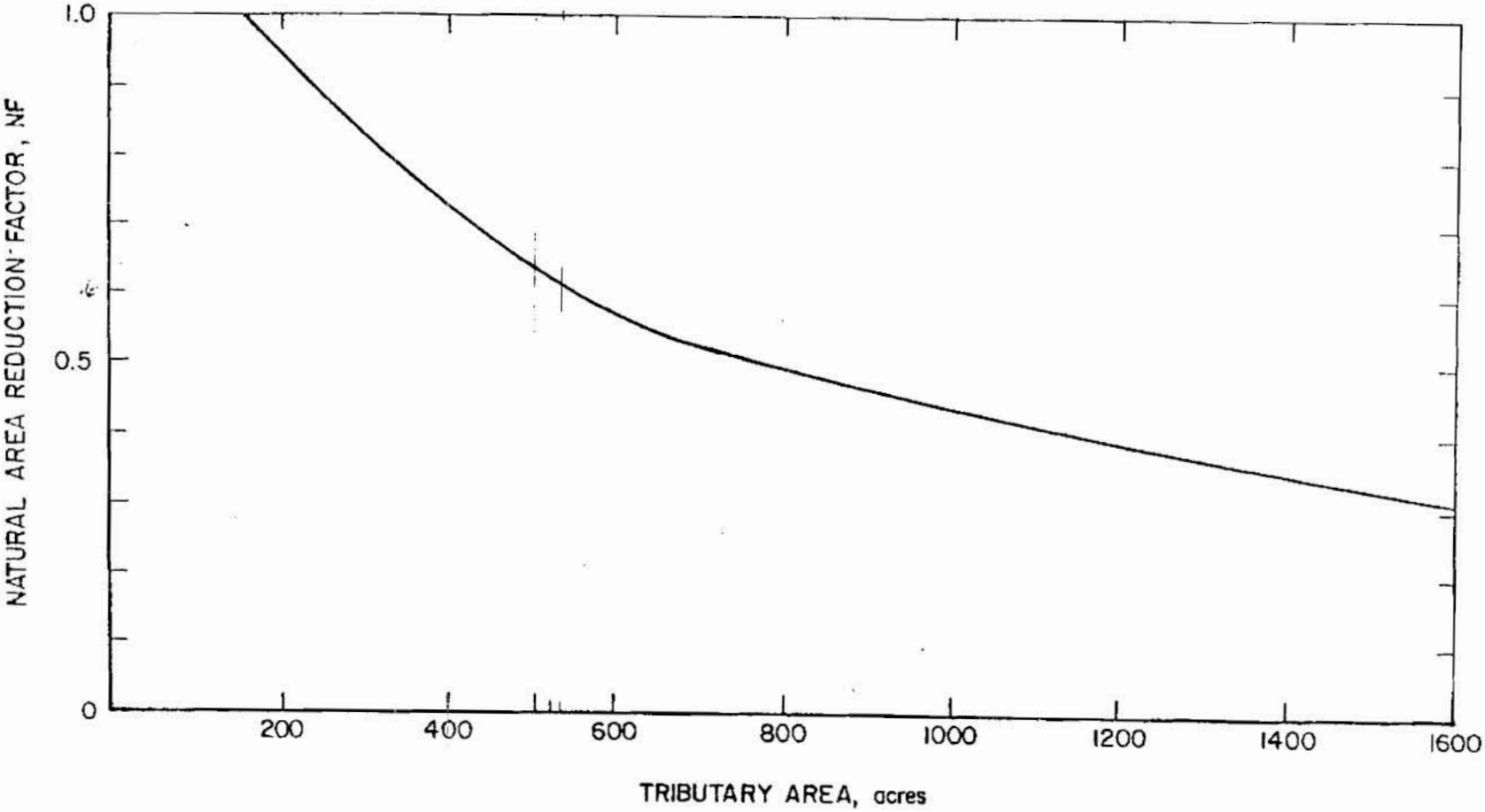


Figure I-8 Natural Area Size Factor, NF

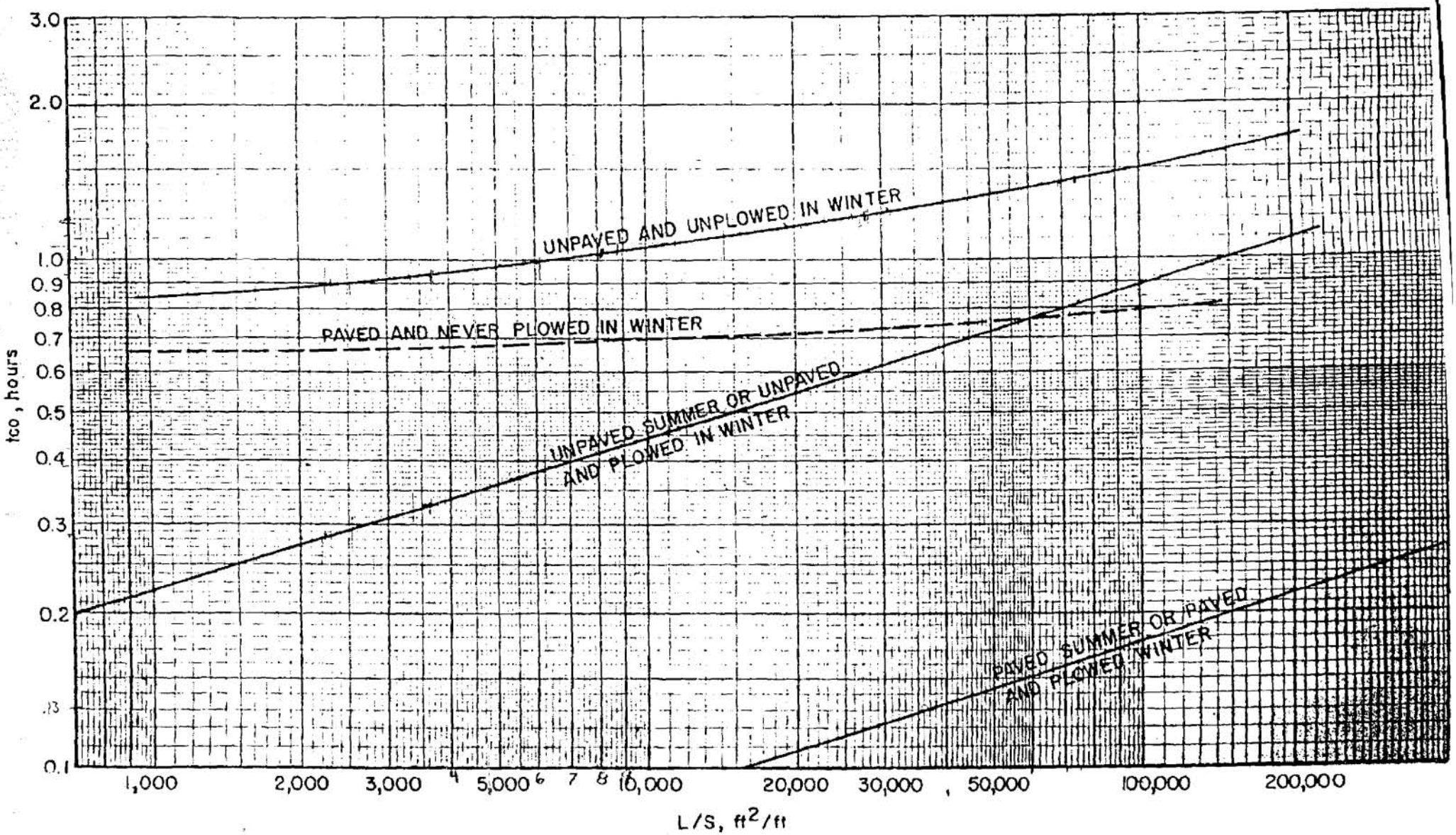


Figure 1-2 Overland Flow tc Component, tco

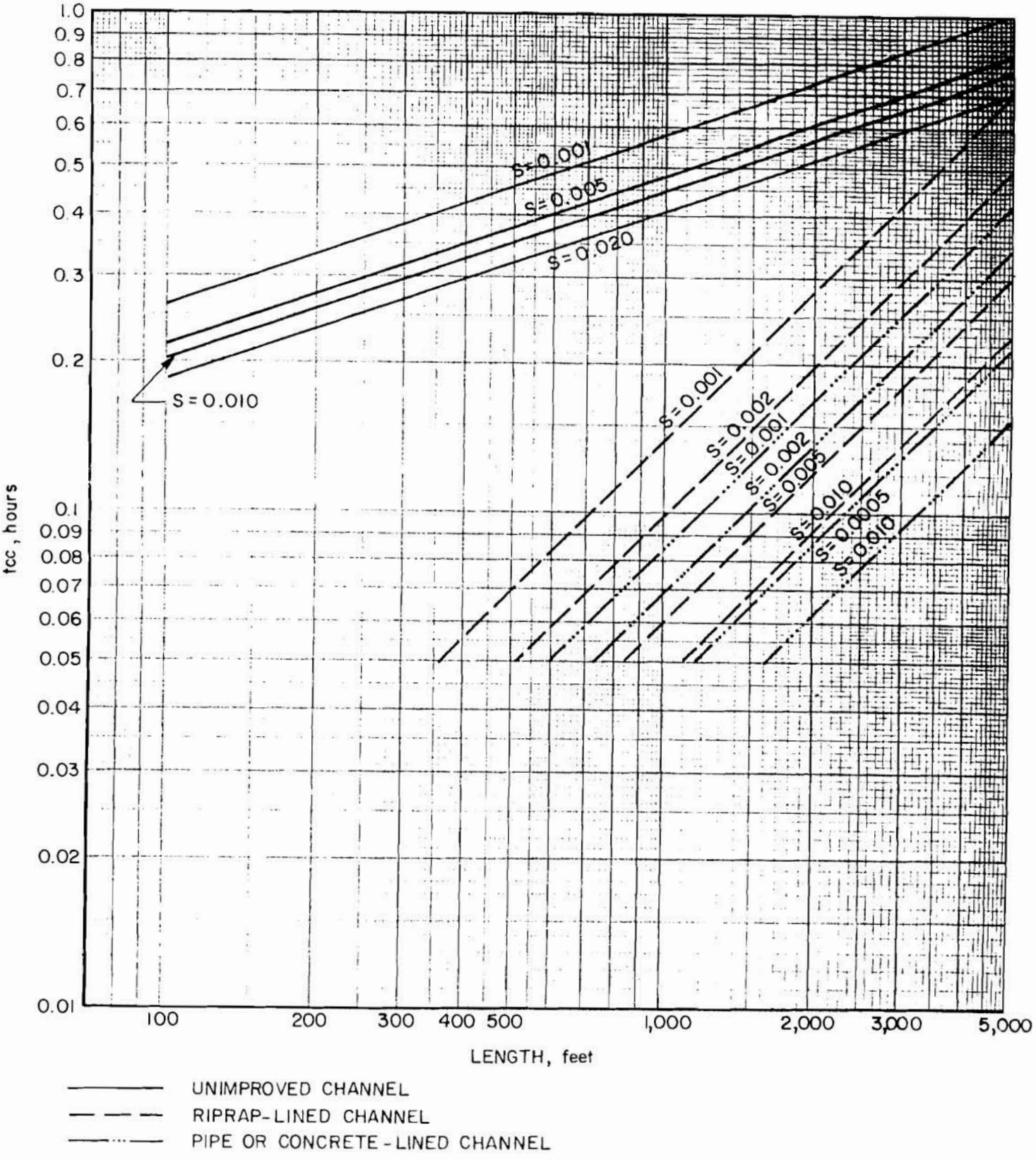
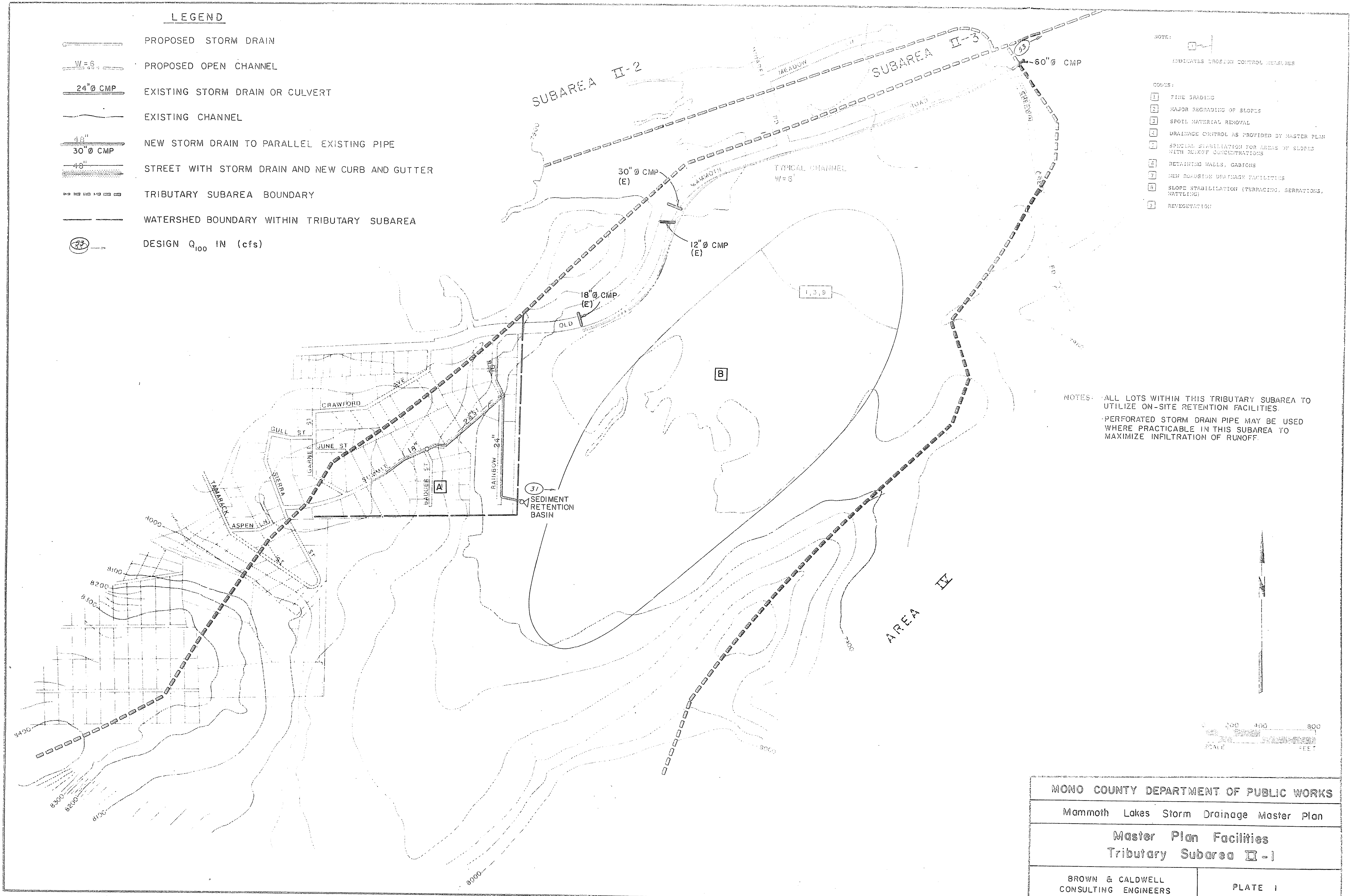


Figure I-3 Channel Flow tc Component, tcc

Hydrologic Table - Existing Conditions

Sub Area Number	Total Area (Acres)	Total Area (mi2)	% Natural	% HD Res	% LD Res	% Commercial	20-yr (cfs/acre)	100-yr (cfs/acre)	Area Runoff 20-yr (cfs)	Total Runoff 20-yr (cfs)	Area Runoff 100-yr (cfs)	Total Runoff 100-yr (cfs)	Total Contributing Area (acres)	Sub-area Area Adjustment	Cumlative Area Adjustment	Adjusted Area Runoff 20-yr (cfs)	Adjusted Total Runoff 20-yr (cfs)	Adjusted Area Runoff 100-yr (cfs)	Adjusted Total Runoff 100-yr (cfs)
2.1	443	0.69	100	0	0	0	0.08	0.15	36	492	68	912	3473	0.77	0.55	28	352	52	667
2.2.1	33	0.05	15	0	0	85	1.07	1.71	35	121	56	202	117	1.00	0.88	35	106	56	178
2.2.2	42	0.07	0	40	45	15	0.93	1.63	39	39	69	69	42	1.00	1.00	39	39	69	69
2.2.3	42	0.07	0	75	10	15	1.10	1.84	46	46	77	77	42	1.00	1.00	46	46	77	77
2.2	117								121	121	202	202	117	0.88	0.88	106	106	178	178
2.3.1	393	0.61	65	10	22	3	0.09	0.16	35	224	65	434	1751	0.77	0.63	27	222	50	439
2.3.2	622	0.97	95	0	5	0	0.07	0.12	41	158	77	310	1042	0.69	0.63	29	180	53	361
2.3.3	316	0.49	100	0	0	0	0.10	0.19	32	32	59	59	316	0.77	0.77	24	24	46	46
2.3.4	420	0.66	100	0	0	0	0.08	0.16	35	35	66	66	420	0.77	0.77	27	27	51	51
2.3	1751								143	224	268	434	1751	0.63	0.63	90	141	169	273
2.4	871	1.36	97	3	0	0	0.05	0.10	47	111	88	208	1162	0.69	0.63	33	70	61	131
2.5.1	171	0.27	75	0	25	0	0.15	0.27	25	63	46	120	291	0.88	0.77	22	49	41	92
2.5.2	22	0.03	10	0	90	0	0.61	1.21	13	39	27	73	120	1.00	0.88	13	34	27	64
2.5.3	98	0.15	97	3	0	0	0.26	0.47	25	25	46	46	98	0.97	0.97	24	24	45	45
2.5	291								63	63	120	120	291	0.77	0.77	49	49	92	92
3.1	359	0.56	100	0	0	0	0.09	0.17	33	1055	62	1878	4531	0.77	0.55	26	580	48	1033
3.2	111	0.17	65	0	0	35	0.58	0.96	64	64	106	106	111	0.88	0.88	56	56	93	93
3.3.1	58	0.09	45	0	10	45	0.72	1.19	42	128	69	213	177	1.00	0.88	42	112	69	187
3.3.2	28	0.04	0	0	5	95	1.19	1.90	33	74	53	122	68	1.00	1.00	33	74	53	122
3.3.3	51	0.08	100	0	0	0	0.23	0.43	12	12	22	22	51	1.00	1.00	12	12	22	22
3.3.4	40	0.06	0	0	35	65	1.02	1.71	41	41	68	68	40	1.00	1.00	41	41	68	68
3.3	177								128	128	213	213	177	0.88	0.88	112	112	187	187
3.4	770	1.20	75	0	10	15	0.06	0.11	45	830	84	1497	3884	0.69	0.55	31	457	58	823
3.5.1	45	0.07	0	40	0	60	1.19	1.92	53	100	86	163	85	1.00	0.97	53	97	86	158
3.5.2	40	0.06	0	75	0	25	1.16	1.91	46	46	76	76	40	1.00	1.00	46	46	76	76
3.5	85								100	100	163	163	85	0.97	0.97	97	97	158	158
3.6.1	99	0.15	15	80	0	5	1.01	1.68	100	334	166	603	713	0.97	0.69	97	230	161	416
3.6.2	55	0.09	30	70	0	0	0.87	1.46	48	134	80	251	244	1.00	0.77	48	103	80	193
3.6.3	47	0.07	100	0	0	0	0.23	0.43	11	11	20	20	47	1.00	1.00	11	11	20	20
3.6.4	45	0.07	100	0	0	0	0.23	0.43	10	65	19	119	247	1.00	0.77	10	50	19	92
3.6.5	76	0.12	80	0	20	0	0.31	0.60	24	24	46	46	76	1.00	1.00	24	24	46	46
3.6.6	55	0.09	100	0	0	0	0.23	0.43	13	87	24	171	189	1.00	0.88	13	76	24	150
3.6.7	40	0.06	20	40	40	0	0.76	1.37	30	55	55	100	202	1.00	0.77	30	42	55	77
3.6.8	52	0.08	60	0	40	0	0.40	0.78	21	21	40	40	52	1.00	1.00	21	21	40	40
3.6.9	82	0.13	0	0	100	0	0.65	1.30	53	53	107	107	82	0.97	0.97	52	52	103	103
3.6.10	162	0.25	80	10	10	0	0.15	0.28	24	24	45	45	162	0.88	0.88	21	21	40	40
3.6	713								310	334	557	603	713	0.69	0.69	214	230	385	416
3.7.1	40	0.06	0	0	80	20	0.76	1.43	31	351	57	647	2316	1.00	0.55	31	193	57	356
3.7.2	79	0.12	0	50	50	0	0.90	1.60	71	301	126	552	2176	1.00	0.55	71	165	126	304
3.7.3	29	0.05	0	35	65	0	0.82	1.51	24	177	44	326	922	1.00	0.69	24	122	44	225
3.7.4	81	0.13	2	38	60	0	0.83	1.51	67	153	122	282	893	0.97	0.69	65	105	119	195
3.7.5	176	0.28	100	0	0	0	0.14	0.27	25	25	47	47	176	0.88	0.88	22	22	41	41
3.7.6	505	0.79	98	0	2	0	0.08	0.14	38	38	71	71	505	0.69	0.69	26	26	49	49
3.7.7	131	0.20	85	0	15	0	0.17	0.32	22	61	42	113	636	0.88	0.69	20	42	37	78
3.7	1041								278	351	510	647	2316	0.63	0.55	175	193	321	356
3.8	1175	1.84	95	0	3	2	0.05	0.08	53	53	100	100	1175	0.63	0.63	34	34	63	63
3.9	100	0.16	90	0	10	0	0.20	0.38	20	20	38	38	100	0.97	0.97	19	19	36	36
L.M.									81	81	166	166							



LEGEND

- PROPOSED STORM DRAIN
- W=6 — PROPOSED OPEN CHANNEL
- 24"Ø CMP — EXISTING STORM DRAIN OR CULVERT
- EXISTING CHANNEL
- 48" / 30"Ø CMP — NEW STORM DRAIN TO PARALLEL EXISTING PIPE
- 48" — STREET WITH STORM DRAIN AND NEW CURB AND GUTTER
- TRIBUTARY SUBAREA BOUNDARY
- WATERSHED BOUNDARY WITHIN TRIBUTARY SUBAREA
- 53 — DESIGN Q_{100} IN (cfs)

NOTE: [ ] INDICATES EROSION CONTROL MEASURES

CODES:

1. FINE GRADING
2. MAJOR REGRADING OF SLOPES
3. SPOIL MATERIAL REMOVAL
4. DRAINAGE CONTROL AS PROVIDED BY MASTER PLAN
5. SPECIAL STABILIZATION FOR AREAS OF SLOPES WITH RUNOFF CONCENTRATIONS
6. RETAINING WALLS, GABIONS
7. NEW ROADSIDE DRAINAGE FACILITIES
8. SLOPE STABILIZATION (TERRACING, SERRATIONS, WATTLING)
9. REVEGETATION

NOTES: · ALL LOTS WITHIN THIS TRIBUTARY SUBAREA TO UTILIZE ON-SITE RETENTION FACILITIES.
· PERFORATED STORM DRAIN PIPE MAY BE USED WHERE PRACTICABLE IN THIS SUBAREA TO MAXIMIZE INFILTRATION OF RUNOFF.

SCALE 0 200 400 800 FEET

MONO COUNTY DEPARTMENT OF PUBLIC WORKS

Mammoth Lakes Storm Drainage Master Plan

Master Plan Facilities
Tributary Subarea II-1

BROWN & CALDWELL CONSULTING ENGINEERS

PLATE 1

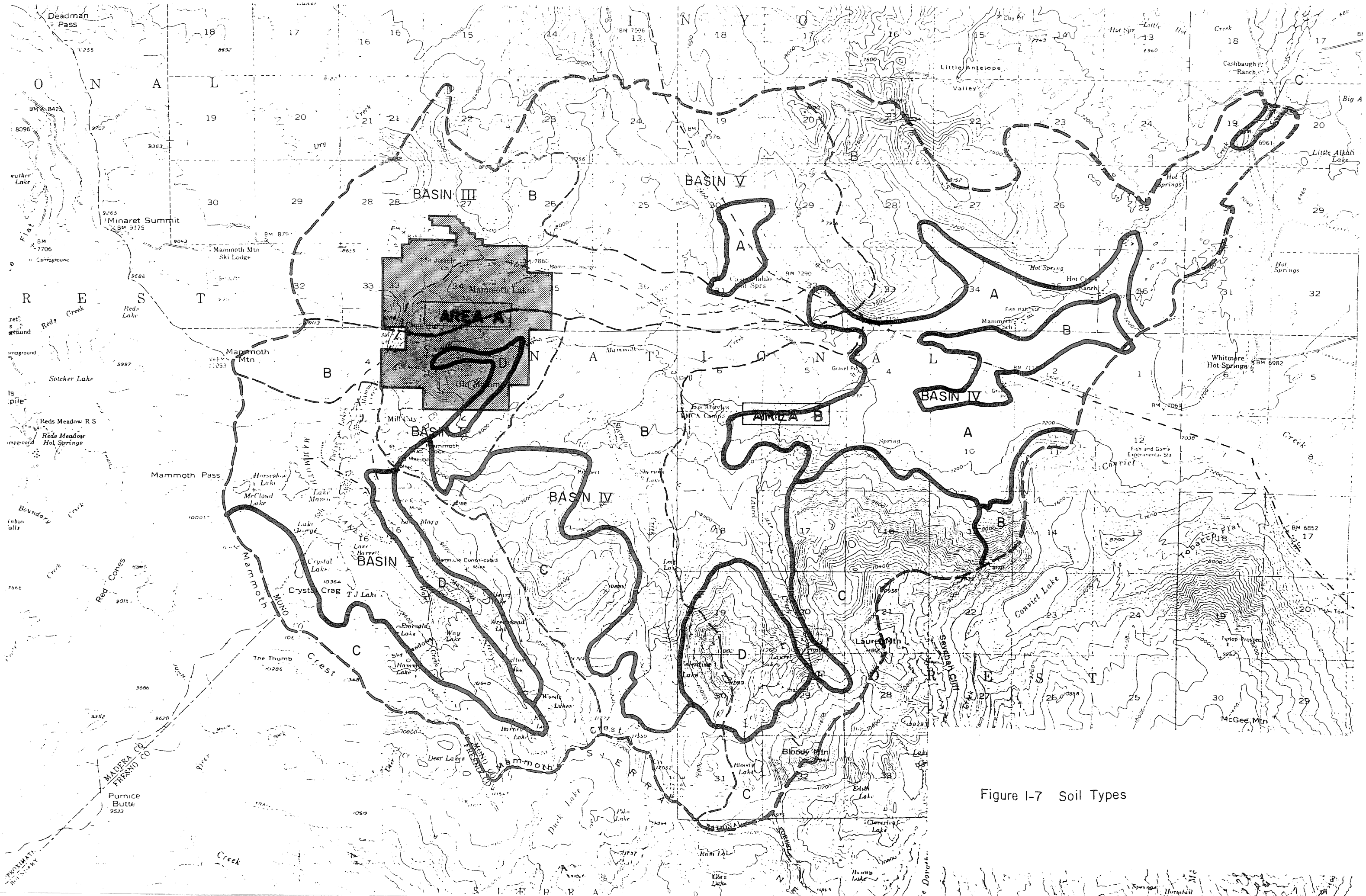
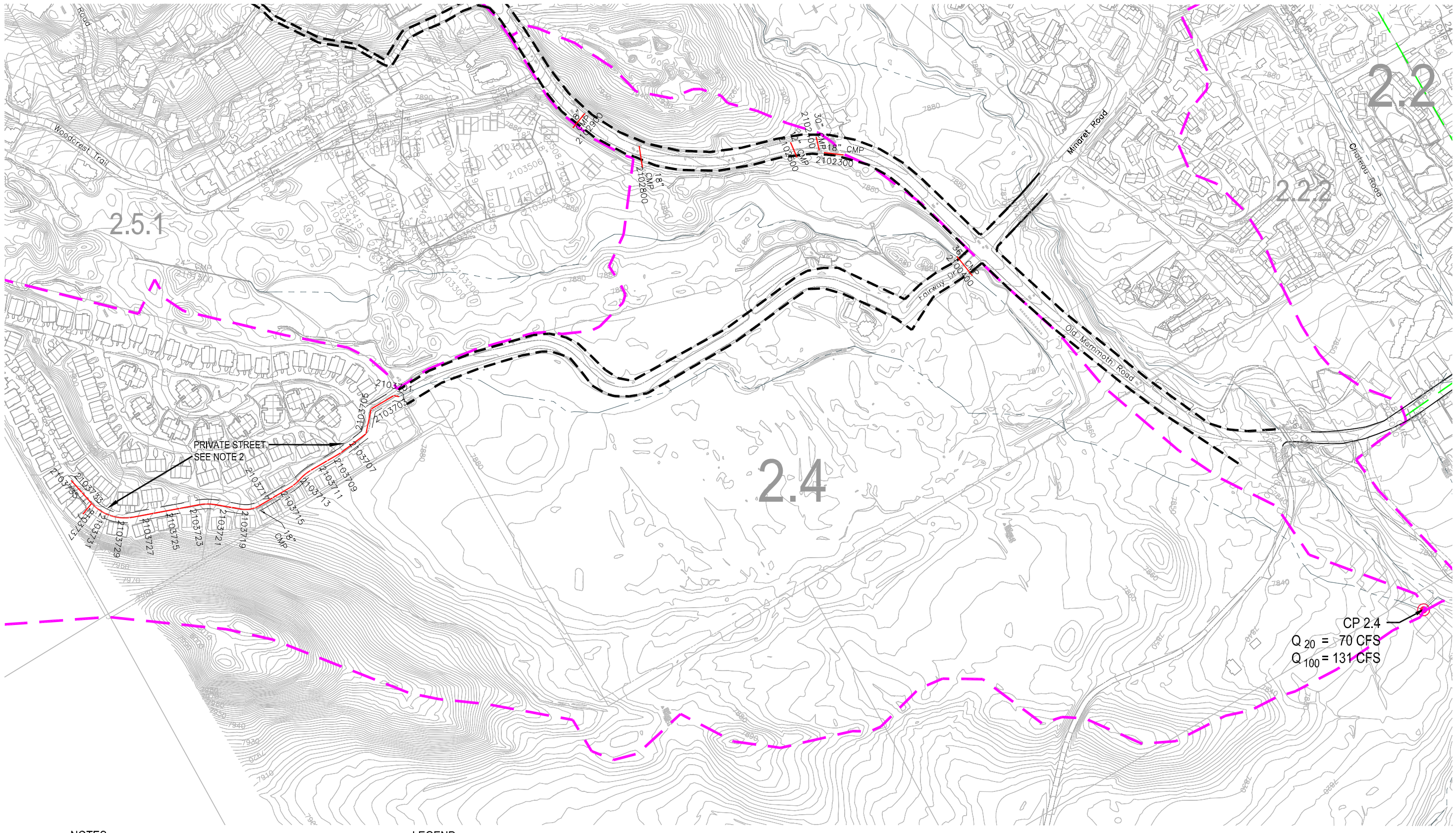


Figure I-7 Soil Types



NOTES:

1. FLOWS SHOWN ARE TOTALS FOR FUTURE BUILD OUT CONDITIONS.
2. UPGRADE RECOMMENDED, BUT COST IS NOT INCLUDED IN CAPITAL IMPROVEMENTS PROGRAM.

BOYLE

LEGEND

- MAJOR WATERSHED BOUNDARY
- DETAILED DRAINAGE WATERSHED BOUNDARIES
- FLOWLINE
- STORM DRAIN, EXISTING
- STORM DRAIN, RECOMMENDED
- CURB AND GUTTER, EXISTING
- CURB AND GUTTER, RECOMMENDED
- WATERSHED COLLECTION POINT, CP
- 30" RECOMMENDED PIPE REPLACEMENT OR NEW PIPE. (RED SHADING = PRIORITY 1, YELLOW SHADING = PRIORITY 2)
- 10 NEW PIPE ID

200' 100' 0 200' 400'
SCALE IN FEET

REV	DATE	DESCRIPTION	APPR
6			
5			
4			
3			
2			
1	–		

TOWN OF MAMMOTH LAKES

AREA 2.4 PLAN

VT-M01-100-01 | MAY 2005 | EXHIBIT 8.6

DWG: F:\ellison\M0110001 - Mammoth Storm\CAD\Exhibits\Area 2.4.dwg New Construction
DATE: Jun 10, 2005 4:44pm XREFS: basemap 2162p3 BLDG ONLY
USER: rherbst 2162p3 TOPO ONLY
Xref System pipe ID
Basins-Hatch (Sub Areas)
Mammoth C&G

CP 2.5.2
Q_{20} = 34 CFS
Q_{100} = 64 CFS

CP 2.5
Q_{20} = 49 CFS
Q_{100} = 92 CFS

CP 2.5.3
Q_{20} = 24 CFS
Q_{100} = 45 CFS

CRUSHED

2.5.3

2.5.2

2.5

2.5.1

Conner Street
Alexander Ave.
Owen Street
Waterford St.
Hill Street
Old Mammoth Road
Mill Street
Cliff Circle
Woodmen Street
Evergreen St.
Crawford Ave.
Turnbeck Street
Ranch Road
Woodcrest Trail
Pine Street
Fir Street
La Verne Street

NOTES:

1. FLOWS SHOWN ARE TOTALS FOR FUTURE BUILD OUT CONDITIONS.

LEGEND

- MAJOR WATERSHED BOUNDARY
- DETAILED DRAINAGE WATERSHED BOUNDARIES
- FLOWLINE
- STORM DRAIN, EXISTING
- STORM DRAIN, RECOMMENDED
- CURB AND GUTTER, EXISTING
- CURB AND GUTTER, RECOMMENDED
- WATERSHED COLLECTION POINT, CP
- 30" RECOMMENDED PIPE REPLACEMENT OR NEW PIPE. (RED SHADING = PRIORITY 1, YELLOW SHADING = PRIORITY 2)
- 10 NEW PIPE ID

200' 100' 0 200' 400'
SCALE IN FEET

REV	DATE	DESCRIPTION	APPR
6			
5			
4			
3			
2			
1	–		

BOYLE

TOWN OF MAMMOTH LAKES

AREA 2.5 PLAN

VT-M01-100-01 | MAY 2005 | EXHIBIT 8.7

DWG: F:\allison\M0110001 – Mammoth Storm\CAD\Exhibits\Area 2.5.dwg
DATE: Jun 10, 2005 5:03pm
XREFS: basemap 2162p3 BLDG ONLY
USER: rherbst 2162p3 TOPO ONLY
Xref System pipe ID
Basins–Hatch (Sub Areas)
Mammoth C&G New Construction