APPENDIX O

Mariposa Lakes Master Drainage Plan –
Part B, Numerical Modeling of Stormwater Facilities

Mariposa Lakes
Master Drainage Plan
Part B - Numerical Modeling of Stormwater Facilities

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Table of Contents

1 Executive Summary 1
2 Site Description 1
3 Proposed Plan 2
4 Stormwater Modeling Results 4
5 Discussion 8
6 Conclusions 10

List of Tables

Table A: Rain Gages in the Duck Creek/Little Johns Creek Area
Table 1: Rainfall Used in Hydraulic Modeling (100-Year Storm)
Table 2: Subwatershed Characteristics Used in Runoff Modeling
Table 3: Lake Characteristics
Table 4: Detention Basin Characteristics
Table 5: Stormwater Pump Station Characteristics
Table 6: Characteristics of Creeks
Table 7: Runoff from Onsite Watersheds

List of Figures

Figure A: Annual Rainfall Data for Three Nearby Rain Gages
Figure 1: Vicinity Map
Figure 2: Land Use Plan
Figure 3: Drainage Areas
Figure 4A: Duck Creek Drainage Network
Figure 4B: Branch Creek Drainage Network
Figure 4C: North Little Johns Drainage Network
Figure 5: Downstream Receiving Waters
Figure 6: Offsite Hydrograph for Duck Creek
Figure 7: Offsite Hydrograph for North Little Johns Creek
Figure 8: Lake Water Surface Fluctuations
Figure 9: Lake Inflow and Outflow Hydrographs
Figure 10: Detention Basin Water Surface Fluctuations
Figure 11: Pump Station Operation During the Design Flood
Figure 12: Duck Creek Outflow Hydrograph Proposed and Existing Conditions
Figure 13: North Little John Creek Outflow Hydrograph Proposed and Existing Conditions
Figure 14: Branch Creek Outflow Hydrograph Proposed and Existing Conditions

1 Executive Summary

This report presents the results of hydrologic and hydraulic modeling of the onsite drainage system for the proposed Mariposa Lakes project in Stockton, CA. The performance of the drainage system during the design flood (the flow caused by the 100-year, 24-hour storm event) is modeled using XP-SWMM hydrologic and hydraulic modeling software to simulate rainfall runoff within the site and the routing of both onsite and offsite runoff. The approximately 3000-acre project site receives runoff from three significant offsite drainage areas (Duck Creek, Branch Creek, and Little Johns Creek) and discharges runoff to the same three creeks. The project is proposed to include a stormwater management system consisting of man-made lakes and detention basins to capture and detain runoff from the site to provide stormwater quality treatment and regulate flows leaving the site.

This report is part B of a two-part study. Part A of the report (under separate cover) provided narrative descriptions of the proposed drainage facilities. Part B presented herein describes the numerical model of the onsite drainage system and discussion of results.

The Mariposa Lakes onsite drainage system is designed to meet two primary flood control goals: 1) Safely convey onsite and offsite flows through the project site; 2) prevent impacts on downstream areas by limiting peak discharges to pre-project levels. The system modeled for this report achieves each of these goals. All onsite and offsite flows resulting from the 100-year return interval, 24-hour duration rainfall are safely routed through lakes, detention basins, and creeks. The model results include peak water levels in each water body within the site, which will determine elevations of constructed improvements such as building pads and roads. The second goal is also met for all three creeks; peak 100-year, 24-hour storm flood flows are lower in each receiving water under proposed conditions than under existing conditions. By lowering peak flows, the project avoids creating any increased threat of flooding downstream. Peak flows are reduced by the effects of flood detention within the many lakes and detention basins of the site.

The results presented herein outline a variety of onsite and offsite improvements that must be completed in order for the drainage system to operate as modeled. Onsite improvements include lakes and detention basins, gravity-driven hydraulic connections such as weirs and channels between many of the lakes, pump stations to carry flow from several detention basins and lakes to receiving waters, and modifications to each of the three creek channels that cross the site. Offsite improvements include channel widening in each creek and maintenance of hydraulic structures such as bridges and culverts in the creeks.

Offsite hydrographs and existing conditions hydrographs used in the modeling in this report are taken from a report entitled "Off-Site Regional Hydrologic Investigation, April 7, 2006" by PACE.

2 Site Description

The Mariposa Lakes project site is located in Stockton CA (Figure 1). The project site is bounded by Mariposa Road to the west and south, US Route 4 to the north, and Kaiser Road to the east. The project site consists of agricultural lands with relatively flat gradients. Currently, the project site is occupied mostly by nut and fruit orchards and farmland. Three creeks cross the project site. Duck Creek and North Little Johns Creek each have extensive

offsite watersheds that produce significant hydrographs which must be conveyed across the project site. The third creek, Branch Creek, has a much smaller watershed upstream of the project site. Offsite flows from Branch Creek will be routed through project infrastructure and combined with onsite flows, then discharged to the existing Branch Creek channel downstream of the project.

The three creeks that cross the project site drain significant offsite watersheds. Duck Creek drains a watershed of approximately 47.3 square miles, with approximately 36.4 square miles of the watershed upstream of the Mariposa Lakes project site. Peak elevation within the Duck Creek watershed is 466 feet above sea level and land within the watershed consists primarily of Central Valley farmland, with mixed oak woodlands in upper portions of the watershed. The North Little Johns Creek watershed consists of approximately 218.9 square miles, with 216 square miles above the Mariposa Lakes project boundary. The North Little Johns Creek watershed reaches a peak elevation of 2592 feet above sea level, and encompasses farmland, woodlands, and rangeland in the Central Valley and Sierra Nevada foothills. Branch Creek drains a small watershed near the project site consisting of 1.678 on-site and 4.045 square miles off-site. The land use is cropland, pasture, and orchard.

Downstream of the project site, each of the three creeks passes through bridges, culverts, and similar hydraulic structures. Within each of the creeks, certain hydraulic structures are in need of maintenance such as removal of accumulated sediments in order to allow the creeks to operate as modeled in this report. In addition, certain segments of each creek channel may require widening or other improvements to pass flows without flooding. All three creeks pass through the project site in channels that are highly modified from natural conditions. In many places the existing channels are significantly undersized to carry large floods such as the design storm modeled in this report.

The project site is currently farmland. Some of the farmland is vacant (not currently farmed) while other areas support fruit and nut orchards. Site slopes are gradual, which is typical of conditions in the area.

3 Proposed Plan

Land uses for the proposed land plan are shown in the project Site Plan (Figure 3). Land uses proposed for the site include residential, commercial, and industrial areas as well as lakes, open space, parkland, roads, and other land uses associated with urban and residential development.

The project site will comprise three separate watersheds when construction is completed. The onsite Duck Creek watershed will include lakes and detention basins and the onsite watersheds draining to each as shown in Figure 3. The area represented by this watershed will be approximately the same as the onsite area of land currently draining to Duck Creek. Much of the proposed industrial areas will be included in the Duck Creek watershed. These areas drain through Detention Basins then into Duck Creek.

The proposed Branch Creek watershed will contain the largest number of project lakes among the three watersheds (Table 3), as well as several detention basins (Table 4). Branch Creek includes a small watershed area upstream of the project site. Flows from this

offsite area will be carried through the manmade lake system then discharged with runoff generated onsite to the existing Branch Creek channel downstream of the site.

North Little Johns Creek drains a large offsite watershed and carries offsite flows across the project site. In the proposed condition, these flows will continue to cross the project site in a reconstructed, naturalized North Little Johns Creek channel. Runoff generated onsite will be discharged to North Little Johns Creek after passing through lakes and detention basins.

Flood Control Performance Standards

The stormwater control system at Mariposa Lakes is designed to convey floodwaters safely through the project site, maintain or reduce the peak discharges at downstream project boundaries as compared to pre-project conditions, and to return to its pre-storm state quickly after the design event, which is the 24-hour, 100-year flood. These three requirements are quantified this way:

1. The 100-year, 24-hour flood flow shall be conveyed through the project site without flooding any structures or causing damage beyond typical maintenance requirements.

2. Peak discharges at the three outlet points (Duck Creek, Branch Creek, North Little Johns Creek) shall not exceed the pre-project peak discharge rate during the 100-year, 24-hour flood event.

Conditions 1 and 2 (above) are flood control standards that are widely applied to projects throughout the US. Condition 1 is met by proper site design, and can only be verified by review of the final improvement plans. At this point in the design process, Condition 1 is satisfied by preliminary sizing of weirs, pump stations, and channels and by limiting the flood-induced rise in lake levels.

Condition 2 can be verified by examining the pre-project (existing conditions) and post-project hydrographs for each of the three creeks receiving drainage. Figures 12, 13, and 14 verify that the project does not increase the peak flows received downstream.

Mariposa Lakes will utilize standard curb and gutter street designs and standard underground storm drains to collect urban stormwater and convey the stormwater to lakes and detention basins. The storm drains are not explicitly included in the computer model of the site.

Mariposa Lakes will include approximately 11 lakes. The function of these lakes is described in detail in Part A (under separate cover). In the computer model, each of these lakes receives runoff from at least two onsite watersheds. The lake itself is one watershed. The surrounding development represents another.

Each lake begins the design storm in a full condition, representing normal operating water level for the lake. The lake receives runoff from onsite watersheds and in some cases from upstream lakes, and water level rises. As water level rises, outflow from the lake occurs as water passes over a weir. Eventually, inflows diminish and lake water level recedes to normal operating water level. This process may take several days as indicated in Figure 8 and 9.

4 Stormwater Modeling Results

The modeling presented in this report simulates rainfall runoff from the project site and routing of offsite flows across the project site. Modeling utilizes the XP-SWMM hydrologic and hydraulic software. XP-SWMM simulates stormwater runoff and routes the runoff through pipes, channels, basins, and lakes as gradually varied, one-dimensional unsteady flow throughout the drainage network. The model simulates storage in lakes, detention ponds, channels and other conduits.

The Runoff and Hydraulics modules of XP-SWMM are utilized. The runoff module simulates runoff, then the hydraulics module simulates flow routing within the site. Both modules are used to simulate hydrographs for the project. Runoff creates runoff hydrographs for each subwatershed. These hydrographs are routed through lakes, channels, detention basins, and pump stations by the hydraulics module. Offsite flows are routed through project facilities and combined with onsite hydrographs by the hydraulics module.

Three separate XP-SWMM models are used to simulate runoff and flows in the three separate watersheds on the site, which are Duck, Branch, and North Little Johns Creeks. The use of three models is solely for convenience. Three smaller models allow easier modification and faster run times than a single model. However, results would be identical using a single model. Within the area modeled, the three creeks are independent of one another; flow in one creek does not affect flow in another.

Throughout this report, the design storm is the 100-year, 24-hour storm event, and the corresponding design flood is the runoff resulting from the 100-year, 24-hour storm event. All models presented herein utilize the design storm to generate onsite runoff and route the design flood from both onsite and offsite tributary areas through project drainage improvements. For this report the 100-year, 24-hour storm is defined as 3.22 inches of rain distributed over a 24-hour period. The basis for the design storm is explained fully within this report. Runoff from offsite tributary areas is from a separate modeling effort completed by PACE and reported in "Mariposa Lakes: Offsite Regional Hydrologic Investigation," PACE, August 2006. Rainfall data used in the computer modeling is shown in Table 1. The same rainfall has been utilized in generating offsite hydrographs. Offsite hydrographs and the models used to generate them are presented in a separate report.

USGS Rainfall data were used to create the design storm, which is a hypothetical 100-year return interval, 24-hour duration rainfall event following procedures outlined in the San Joaquin County Hydrology Manual. In addition, historical records from several nearby gages were examined for comparison. The remainder of this section is excerpted from "Mariposa Lakes Off-site Regional Hydrologic Investigation" by PACE, dated August 2006.

Historical Rain Gage Data

Though design storms are utilized in hydrologic modeling, it is always valuable to collect historical rainfall data to use as a comparison and verification of design storm data. For this analysis, data from three separate rain gages were collected. All rain data comes from the California Data Exchange Center (CDEC). CDEC collects and houses USGS rainfall and stream gage data for the entire State of California.

Figure 15 shows the location of the three rainfall gages. The Farmington Dam gage (CDEC station FRM) is located on the north side of the reservoir spillway and has collected

incremental data since August of 1988. The Sanguinetti Ranch rain gage (CDEC station SNR) is located on the valley floor just north of the Duck Creek watershed and has been active since February of 1989. Lastly, the Flower Mountain rain gage (CDEC station FLW) is located in the headwaters of the Little Johns Creek watershed at elevation 1480 ft and has been active since February of 1989. Table A lists important data associated with each gage.

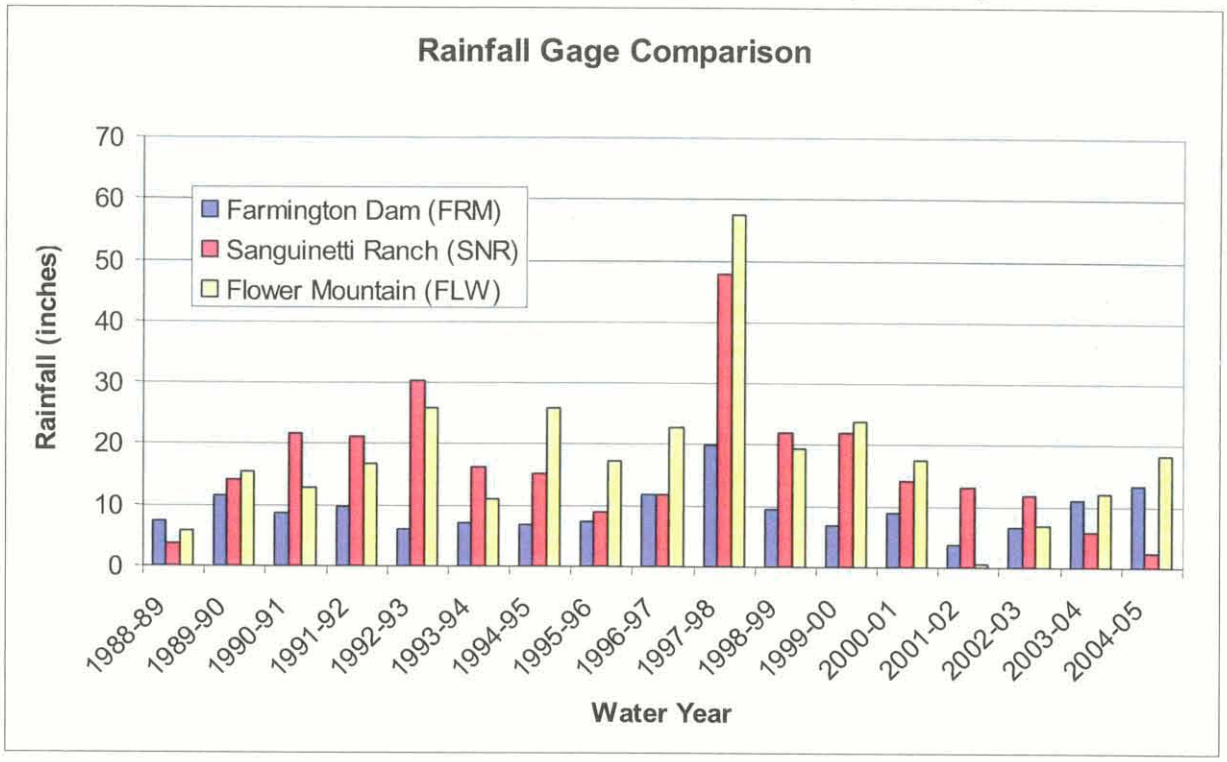
Table A: Rain Gages in the Duck Creek/Little Johns Creek Area.

Station	Name	Latitude	Longitude	Elev. (ft.)	Yearly Average (in.)	Period of Coverage
FRM	Farmington Dam	37.915° N	120.935° W	180	9.25	8/7/88-present
SNR	Sanguinetti Ranch	37.993° N	120.981° W	238	17.39	1/31/89-present
FLW	Flower Mountain	37.920° N	120.677° W	1480	18.99	2/6/89-present

There are significant differences in the datasets from the three gages listed in Table A. As seen in Figure A, yearly totals vary considerably between the three gages. Note that the 1988-89 water year is incomplete for all three gages.

Figure A illustrates important issues regarding the variability of rain gage data. First, collecting rainfall data accurately and measuring rainfall volumes or intensities is extremely difficult. Most rain gages operate by using a tipping bucket. After a small amount of water, typically 0.06 inches of rainfall, collects in the tipping bucket, the bucket will spill its contents and return to vertical until another unit of rain is collected. Small variations in the actual amount collected can vary before the bucket actually tips. These small variations, multiplied out over the course of a rain event or an entire water year, can add up to significant amounts of water. Proper calibration of rainfall gages is both difficult yet extremely important.

Figure A: Annual Rainfall Data for Three Nearby Rain Gages.



Two other factors affecting the variability of rainfall totals are the type of storm systems (e.g., convective, cyclonic) and the elevation of the gage. Convective storm systems are typically very intense but localized in area. A convective storm can release a deluge of precipitation in one area while leaving nearby areas dry.

Cyclonic storm events tend to affect larger areas. As cyclonic Pacific storm systems move east against the mountains, they rise in elevation. As the rising air masses cool, they have less ability to hold water vapor. High elevation areas typically receive much more rainfall than low-elevation areas because of this orographic rainfall effect. Nowhere are these orographic rainfall patterns more pronounced than along the west slope of the Sierra Nevada Mountains.

The Flower Mountain gage has an average of 18.99 inches annually, the largest annual average. This is to be expected, considering the Flower Mountain's elevation. What is surprising is the discrepancy between the Farmington Dam gage and the Sanguinetti Ranch gage. Similar in elevation and in position on the floor of the San Joaquin Valley, it would be expected that the gage results would be similar. However, in nearly every year, the Farmington Dam records significantly less rainfall than the Sanguinetti Ranch does. It is not known what causes these discrepancies, either a hydrometeorologic occurrence or some type of gage error.

Some of the data in Figure A are questionable. For example, it is difficult to imagine that the Sanguinetti gage received only 2.4 inches of rainfall in the relatively wet winter of 2004-05. Also curious is the 0.5 inches of rain that fell in the winter of 2001-02 at the Flower Mountain gage. Again, it is not known what caused these abnormally low yearly totals.

Rainfall runoff from the project site under proposed (post-development) conditions is simulated for the 100-year, 24-hour design rainfall event using the SCS Unit Hydrograph method. For each subwatershed, a subwatershed area and percent of the subwatershed that will be impervious are input into the model. All proposed industrial areas are modeled at 92% impervious coverage, while residential areas are modeled as 42% impervious. These impervious coverage percentages are based on the Los Angeles County Hydrology Design Manual. At the current preliminary stage of design no estimates of impervious areas base on actual project design is available. All surface slopes are simulated as 1% slopes. The existing project site is sloped at less than 1%, and as a result, pre-construction grading operations will be necessary to create minimum slopes of 1% for all land surfaces

One lake, Lake 8, will be drained by a pump station into its receiving water. The remainder of the lakes are currently modeled as draining by gravity. Each lake is modeled with a single gravity-flow weir outfall located at normal lake surface elevation except for Lake 3. As soon as flow enters the lake and lake water surface rises, discharge over the weir begins. Lake 3 is modeled with two overflow weirs. Each one is 30 feet long. One is set at normal lake operating level, while the second is located one foot higher. Weirs for lakes and detention basins are rectangular notch weirs with a discharge coefficient of 3.1. Weir lengths vary depending on the size of the watershed feeding each lake.

Detention basins are modeled as dry detention basins. Each basin is assigned a land area as indicated in current project land plans. Water entering the basin is detained based on the characteristics of the outflow device for the basin. Several basins are modeled as draining via gravity weirs, others are modeled as pumped discharge. Figure 10 shows water surface fluctuations for each detention basin, and Figure 11 shows the characteristics of the pumped discharges.

The final design of detention basins will include enhancements that will improve water quality treatment and aesthetics of the basins. These enhancements may include permanent pools, wetland vegetation, forebays, and others. None of the proposed enhancements will significantly impact the flood detention function of the basins and therefore are not included in the computer models presented in this report. Any proposed enhancement will be located below the basin bottom elevation represented in the models and will therefore not reduce available flood detention.

Each pump station is modeled as four separate pumps. Each pump is represented by a constant pumping rate. Each pump turns on at a pre-set water level. Typically, the first pump begins pumping as soon as water level in the lake or detention basin rises. As water level continues to rise, additional pumps begin pumping. Generally, water levels that initiate pumping in each pump are separated by either 0.5 foot or 1.0 foot elevation difference. When a pump is on a constant pumping rate is simulated. All pumps turn off when the water level in the lake or detention basin returns to normal lake operating level or basin bottom elevation. The pumping rates vary based on the amount of flow to be pumped. Not four pumps at a single station may have the same pumping capacity. In some cases, not all four pumps are needed to convey the design storm as indicated in Figure

The XP-SWMM models created for this project include extensive reaches of Duck, Branch, and North Little Johns Creeks. Creek channels are simulated based on surveyed cross sections of the channels, typical proposed cross sections of areas that are to be modified and projected roughness in the proposed condition.

The runoff from onsite watersheds is shown as inflow to each lake (Figure 9b). Each onsite watershed responds to the design rainfall (Table 1) by producing runoff that is routed to the lakes. Additional similar onsite watersheds provide runoff to detention basins (hydrographs not shown). The onsite tributary area fort each lake is modeled in two pieces. The lake itself is represented as a watershed with a Curve Number of 98, representing an impervious surface, and a Time of Concentration of 5 minutes, representing the quick response time of the lake surface watershed. A Curve Number of 78 and a Time of Concentration of 30 minutes represent the remainder of the tributary area for each lake. This simulates the runoff from a typical developed condition, including the hydraulic routing of flows through storm drains. In addition to direct runoff from its tributary area, many of the lakes receive inflow from upstream lakes as indicated in Figures 3 and 4.

Inflow and outflow hydrographs for each lake are shown in Figure 9. The inflow hydrographs represent runoff from surrounding watersheds and rainfall input to the lake itself. Additional inflow is represented by the outflow hydrograph from lakes located upstream (Figure 3 and 4).

Outflow hydrographs from each lake represent the effects of inflow plus in-lake storage, which delays outflow and reduces peak discharges. The acreage of each lake is indicated in Table 2.

The water surface of each lake will fluctuate in response to differences between inflow and outflow as indicated in Figure 8. Peak water level elevations for each lake are shown. The development surrounding each lake will be elevated a minimum of one foot higher than the peak 100-year water surface elevation of the adjacent lake to meet federal and state guidelines for flood protection.

Water level fluctuations in detention basins (Figure 10) will be similar to those shown for lakes. However, in general detention basins are designed for much larger fluctuations in water surface elevation as indicated in the Figures.

Model results for the creeks indicate that peak flows in the proposed condition will be lower than peaks in the existing condition (Figures 12, 13, 14). The creek geometry simulated in the model is shown in Table 6. With the exception of certain portions of Branch Creek, all of the creek sections within the project boundaries represent modifications of the existing creeks. The bank elevations shown in the model represent the elevation that levee tops or adjacent ground will have to meet in order to contain creek flows.

5 Discussion

There are two primary goals for the Mariposa Lakes onsite drainage system. First, the system must safely convey onsite and offsite flows through the project site. Second, the system must release peak flows at or below the pre-development peak discharge rate. The modeling results presented herein demonstrate that the onsite drainage system proposed for Mariposa Lakes project meets both of these conditions.

The onsite drainage system safely conveys both onsite and offsite runoff safely through the project site. The onsite drainage system modeled in this report collects onsite runoff in detention basins and lakes, passes the flows between basins and lakes, and discharges flow to one of three onsite creeks. The system also passes offsite flows through the site.

Flows in Duck Creek and North Little Johns Creek are passed through the project site in improved creek channels. Flows from the small offsite watershed of Branch Creek are passed through the site in manmade lakes and other hydraulic conveyance structures. In every case, the model shows that flood flows can be passed through the project site safely. The water surface elevation in project lakes is another aspect of safe water conveyance – excessive or uncontrolled water surface fluctuation could endanger lakeside building or other improvements. However, as indicated in Figure 8, lake water surface fluctuations are limited to less than 2 feet in most cases, even during the 100-yr, 24-hr design storm.

The project will not result in any increased peak discharges downstream during the design flood, the 100-year, and 24-hour rainfall described above. Figures 12, 13 and 14 show that for each of the three creeks crossing the project site, peak discharge will be reduced compared to the existing conditions. The reduction in peak flow is achieved by detaining onsite runoff and releasing it slowly, and by improvements in the creek channels. The creek channels modeled for this report are wider and deeper than the existing channels, and therefore provide a greater level of flood peak attenuation. This helps to reduce the peak discharge reaching downstream areas.

Duck Creek and North Little Johns Creek channels will be reconstructed within the project site. Both of these creeks currently flow in channels that have been greatly altered from a natural condition by agriculture and other human activities. The existing channels offer little wildlife habitat, flood control, or aesthetic value, and are insufficiently sized to carry large flood flows. Undersized channels are common in farming areas, where temporary flooding during rare large storm events is acceptable. In developed areas, however, flooding is far less acceptable, and improvements to the channels must therefore be undertaken. The models presented in this report simulate the effects of widening and lowering the invert elevation of both of these creek channels through the project site. The channels are proposed to be built to resemble natural channels with wetlands, riparian vegetation, and other features that will provide wildlife habitat and enhance the flood control, water quality and aesthetic value of the channels. The models presented in this report simulate the effects of renaturalized channels through the project area for both Duck and North Little Johns Creeks.

Portions of all three creeks located offsite may require modifications may require modifications to function as modeled in this report. Modifications may include widening or deepening of channels. In addition, all three creeks contain hydraulic structures such as bridges and culverts that will require ongoing maintenance to perform as they were designed to perform. Currently many of the bridges and culverts downstream of the site are clogged with accumulated sediment. This sediment impedes water flow and creates an existing flood potential for many areas near the project site. The removal of this sediment and ongoing monitoring of the hydraulic structures should be a regular part of the maintenance program for these structures

Pump stations are proposed for discharge of water from several detention basins and lakes as indicated in Table 5. The pump stations modeled in this report include four pumps each. One pump is sets to turn on when water level rises above normal operating level, and additional pumps begin pumping as water level rises past pre-set elevations. All pumps continue to operate until water level returns to normal. This operating method is very simple and serves to demonstrate that the pump stations can adequately release water into the creeks. The actual pump stations designed for the project may have more or fewer pumps, and may operate differently from the model in order to achieve flood control goals.

However, the model does serve to verify that pumped discharge can work successfully with pump stations of reasonable size.

Pumped discharge is proposed wherever ground surface elevations in the project site are below peak flood elevation in the adjacent receiving water. In other words, pumping is proposed wherever a levee condition exists in the project. Where land surface in the project is higher than adjacent flood surface elevation, gravity-driven discharge will be utilized. The model presented herein represents the current land plan and estimated finish ground surfaces and lake normal operating elevations. The final plan may utilize more or fewer pumped discharges than are simulated here.

6 Conclusions

The modeling presented in this report demonstrates that the onsite drainage system for the proposed Mariposa Lakes development will meet the two primary flood control goals for the project. These are:

1. The 100-year, 24-hour flood flow shall be conveyed through the project site without flooding any structures or causing damage beyond typical maintenance requirements.

2. Peak discharges at the three outlet points (Duck Creek, Branch Creek, North Little Johns Creek) shall not exceed the pre-project peak discharge rate during the 100-year, 24-hour flood event.

Runoff from the project site for proposed conditions is simulated using XP-SWMM hydrologic and hydraulic modeling software. Offsite flows and flows from the project site under existing conditions are from a report entitled "Off-Site Regional Hydrologic Investigation, April 7, 2006 by Pacific Advanced Civil Engineering. Offsite flows from the previous report are added into the XP-SWMM model of the proposed site and routed by XP-SWMM software to produce combined onsite and offsite hydrographs. The combined hydrographs at each project discharge point are compared to existing conditions hydrographs for the same locations from the previous report.

These comparisons demonstrate that the project drainage system of lakes, detention basins, pump stations, and creek channels can safely convey onsite and offsite runoff during the 100-year flood and will not result in any increase in peak discharge to downstream reaches of Duck Creek, Branch, or North Little Johns Creek. The models also demonstrate that the project site will remain free of flooding during the design storm event.

Table 1, Rainfall used in Hydraulic Modeling (100-Year Storm)

Time (min)	Cumulative total (in)
0	0.0000
15	0.0163
30	0.0325
45	0.0488
60	0.0650
75	0.0813
90	0.0975
105	0.1138
120	0.1300
135	0.1463
150	0.1625
165	0.1788
180	0.1950
195	0.2113
210	0.2275
225	0.2438
240	0.2600
255	0.2763
270	0.2925
285	0.3088
300	0.3250
315	0.3413
330	0.3575
345	0.3738
360	0.3900
375	0.4063
390	0.4225
405	0.4388
420	0.4550
435	0.4713
450	0.4875
465	0.5038
480	0.5285
495	0.5533
510	0.5780
525	0.6028
540	0.6275
555	0.6523
570	0.6770
585	0.7018
600	0.7265
615	0.7513
630	0.7760
645	0.8008
660	0.8255
675	0.8503

690	0.8750
705	0.8998
720	0.9370
735	0.9743
750	1.0115
765	1.0488
780	1.0860
795	1.1233
810	1.1605
825	1.1978
840	1.2605
855	1.3233
870	1.3860
885	1.4488
900	1.5115
915	1.5743
930	1.7995
945	2.0248
960	2.2500
975	2.4753
990	2.5380
1005	2.6008
1020	2.6635
1035	2.7008
1050	2.7380
1065	2.7753
1080	2.8125
1095	2.8373
1110	2.8620
1125	2.8868
1140	2.9115
1155	2.9363
1170	2.9610
1185	2.9858
1200	3.0105
1215	3.0268
1230	3.0430
1245	3.0593
1260	3.0755
1275	3.0918
1290	3.1080
1305	3.1243
1320	3.1405
1335	3.1568
1350	3.1730
1365	3.1893
1380	3.2055
1395	3.2218
1410	3.2380

1425	3.2543
1440	3.2705

Table 2. Subwatershed Characteristics Used in Runoff Modeling

a) Subwatershed Characteristics Used in Runoff Modeling: Branch Creek Watershed

Name	Subcatchment	Node Name	Catchment Number	Area ac	Impervious Percentage %	Hydrograph Shape	Pervious Area Curve Number	Initial Abstraction Method	Initial Abstraction Fraction min	Rainfall Reference
DB-09	1	DB-09	1	9	0	Curvilinear	98	Fraction	0.2	rain1
DB-09	2		2	200.6	0	Curvilinear	78	Fraction	0.2	rain1
DB-11	1	DB-11	1	2	0	Curvilinear	98	Fraction	0.2	rain1
DB-11	2		2	89.5	0	Curvilinear	78	Fraction	0.2	rain1
L-01	1	L-01	1	33.6	0	Curvilinear	98	Fraction	0.2	rain1
L-01	2		2	290.6	0	Curvilinear	78	Fraction	0.2	rain1
L-02	1	L-02	1	18	0	Curvilinear	98	Fraction	0.2	rain1
L-02	2		2	120.5	0	Curvilinear	78	Fraction	0.2	rain1
L-03	1	L-03	1	14.5	0	Curvilinear	98	Fraction	0.2	rain1
L-03	2		2	83	0	Curvilinear	78	Fraction	0.2	rain1
L-04	1	L-04	1	17.9	0	Curvilinear	98	Fraction	0.2	rain1
L-04	2		2	184.1	0	Curvilinear	78	Fraction	0.2	rain1
L-09	1	L-09	1	1.2	0	Curvilinear	98	Fraction	0.2	rain1
L-09	2		2	10.4	0	Curvilinear	78	Fraction	0.2	rain1

b) Subwatershed Characteristics Used in Runoff Modeling: Duck Creek Watershed

Name	Subcatchment	Node Name	Catchment Number	Area ac	Impervious Percentage %	Pervious Area Curve Number	Hydrograph Shape	Initial Abstraction Method	Initial Abstraction Depth in	Rainfall Reference
DB-1	1	DB-1	1	4.8	0	98	Curvilinear	Fraction	0.04	rain1
DB-1	2		2	105	0	78	Curvilinear	Fraction	0.04	rain1
DB-2	1	DB-2	1	2.5	0	98	Curvilinear	Fraction	0.04	rain1
DB-2	2		2	112.4	0	78	Curvilinear	Fraction	0.04	rain1
DB-3	1	DB-3	1	6.7	0	98	Curvilinear	Fraction	0.04	rain1
DB-3	2		2	137.2	0	78	Curvilinear	Fraction	0.04	rain1
DB-4	1	DB-4	1	4.3	0	98	Curvilinear	Fraction	0.04	rain1
DB-4	2		2	173.7	0	78	Curvilinear	Fraction	0.04	rain1
DB-5	1	DB-5	1	7.3	0	98	Curvilinear	Fraction	0.04	rain1
DB-5	2		2	241	0	78	Curvilinear	Fraction	0.04	rain1
DB-6	1	DB-6	1	4.1	1	98	Curvilinear	Fraction	0.04	rain1
DB-6	2		2	62.2	0	78	Curvilinear	Fraction	0.04	rain1
DB-7	1	DB-7	1	4.5	0	98	Curvilinear	Fraction	0.04	rain1
DB-7	2		2	71.8	0	78	Curvilinear	Fraction	0.04	rain1
DB-8	1	DB-8	1	7.7	0	98	Curvilinear	Fraction	0.04	rain1
DB-8	2		2	186.9	0	78	Curvilinear	Fraction	0.04	rain1
DB-12	1	DB-12	1	3	0	98	Curvilinear	Fraction	0.04	rain1
DB-12	2		2	42.5	0	78	Curvilinear	Fraction	0.04	rain1
L-5	1	L-5	1	25.8	0	98	Curvilinear	Fraction	0.04	rain1
L-5	2		2	79.7	0	78	Curvilinear	Fraction	0.04	rain1
L-6	1	L-6	1	25.8	0	98	Curvilinear	Fraction	0.04	rain1
L-6	2		2	235.7	0	78	Curvilinear	Fraction	0.04	rain1
L-7	1	L-7	1	26.9	0	98	Curvilinear	Fraction	0.04	rain1
L-7	2		2	314.9	0	78	Curvilinear	Fraction	0.04	rain1
L-8	1	L-8	1	5.9	0	98	Curvilinear	Fraction	0.04	rain1
L-8	2		2	107.2	0	78	Curvilinear	Fraction	0.04	rain1

c) Subwatershed Characteristics Used in Runoff Modeling: North Little John Creek

Name	Subcatchment	Node Name	Catchment Number	Area ac	Impervious Percentage %	Pervious Area Curve Number	Hydrograph Shape	Initial Abstraction Method	Initial Abstraction Fraction min	Rainfall Reference
DB-10	1	DB-10	1	1.4	0	98	Curvilinear	Fraction	0.2	rain1
DB-10	2		2	121	0	78	Curvilinear	Fraction	0.2	rain1
L-10	1	L-10	1	1.6	0	98	Curvilinear	Fraction	0.2	rain1
L-10	2		2	18.7	0	78	Curvilinear	Fraction	0.2	rain1
L-11	1	L-11	1	3.4	0	98	Curvilinear	Fraction	0.2	rain1
L-11	2		2	140.7	0	78	Curvilinear	Fraction	0.2	rain1

Table 3. Lake Characteristics

a) Lake Characteristics: North Little John Creek

Name	Normal Lake Elevation	Max Lake Depth	Max Water Elevation ft	Lake Outlet
L-10	51	0.476	51.476	Weir
L-11	51	1.43	52.43	Weir

d) Lake Characteristics: Branch Creek

Name	Normal Lake Elevation	Max Lake Depth (ft)	Max Water Elevation ft	Lake Outlet	Initial Depth ft	Invert Elevation ft
L-01	46	0.944	46.944	Weir	10	36
L-02	47	0.744	47.744	Weir	10	37
L-03	37	2.028	39.028	Weir	10	27
L-04	45	1.063	46.063	Weir	10	35
L-09	47	0.578	47.578	Weir	10	37

e) Lake Characteristics: Duck Creek

Node Name	Normal Lake Elevation	Max Lake Depth ft	Max Water Elevation ft	Lake Outlet
L-5	42	0.91	42.91	Weir
L-6	45	1.06	46.06	Weir
L-7	49	0.89	49.89	Weir
L-8	39	1.67	40.67	Pump

Table 4. Detention Basin Characteristics

a) Detention Basin Characteristics: Duck Creek

Node Name	Normal Lake Elevation	Max Lake Depth ft	Max Water Elevation ft	Lake Outlet
DB-1	38	1.62	39.62	Pump
DB-2	38	2.96	40.96	Pump
DB-3	35	1.57	36.57	Pump
DB-4	35	3.23	38.23	Pump
DB-5	30	2.37	32.37	Pump
DB-6	30	1.38	31.38	Pump
DB-7	35	1.23	36.23	Pump
DB-8	30	1.91	31.91	Pump
DB-12	30	1.53	31.53	Pump

b) Detention Basin Characteristics: Branch Creek

Name	Normal Lake Elevation	Max Lake Depth (ft)	Max Water Elevation ft	Lake Outlet	Initial Depth ft	Invert Elevation ft
DB-09	40	1.784	41.784	Pump	9	31
DB-11	43	2.431	45.431	Pump	9	34

c) Detention Basin Characteristics: North Little John Creek

Name	Normal Lake Elevation	Max Lake Depth	Max Water Elevation ft	Lake Outlet
DB-10	46	1.47	47.47	Weir

Table 5. Stormwater Pump Station Characteristics
a) Pump Station Characteristics: Duck Creek

Link Name	Upstream Node Name	Downstream Node Name	Pump Run Time hr	Pump Minimum Head ft	Pump Minimum Flow Rate ft^3/s	Pump Maximum Head ft	Pump Minimum Flow Rate ft^3/s	Pump Maximum Flow Rate ft^3/s
DB-1Pump	DB-1	DCN1a	26.951	9	2.0	10.619	2.0	2.0
DB-1Pump	DB-1	DCN1a	26.951	9	2.0	10.619	2.0	2.0
DB-1Pump	DB-1	DCN1a	26.951	9	2.0	10.619	2.0	2.0
DB-1Pump	DB-1	DCN1a	0	9	0.0	10.619	0.0	0.0
DB-1Pump	DB-1	DCN1a	26.169	0.737	2.0	9.079	2.0	2.0
DB-1Pump	DB-1	DCN1a	24.834	0.737	2.0	9.079	2.0	2.0
DB-2Pump	DB-2	DCN2	27.75	9	1.5	11.956	1.5	1.5
DB-2Pump	DB-2	DCN2	27.75	9	1.5	11.956	1.5	1.5
DB-2Pump	DB-2	DCN2	26.408	9	1.5	11.956	1.5	1.5
DB-2Pump	DB-2	DCN2	26.013	9	1.5	11.956	1.5	1.5
DB-2Pump	DB-2	DCN2	25.684	9	1.5	11.956	1.5	1.5
DB-3Pump	DB-3	DCN5	27.087	9	2.0	10.569	2.0	2.0
DB-3Pump	DB-3	DCN5	27.087	9	2.0	10.569	2.0	2.0
DB-3Pump	DB-3	DCN5	26.316	9	2.0	10.569	2.0	2.0
DB-3Pump	DB-3	DCN5	24.558	9	4.0	10.569	4.0	4.0
DB-3Pump	DB-3	DCN5	0	9	0.0	10.569	0.0	0.0
DB-4Pump	DB-4	DCN6	50.564	9	1.3	12.225	1.3	1.3
DB-4Pump	DB-4	DCN6	50.564	9	1.3	12.225	1.3	1.3
DB-4Pump	DB-4	DCN6	49.321	9	1.3	12.225	1.3	1.3
DB-4Pump	DB-4	DCN6	48.923	9	1.3	12.225	1.3	1.3
DB-4Pump	DB-4	DCN6	48.57	9	1.3	12.225	1.3	1.3
DB-5Pump	DB-5	DCN8	30.281	9	2.0	11.372	2.0	2.0
DB-5Pump	DB-5	DCN8	30.281	9	2.0	11.372	2.0	2.0
DB-5Pump	DB-5	DCN8	29.196	9	2.0	11.372	2.0	2.0
DB-5Pump	DB-5	DCN8	28.761	9	4.0	11.372	4.0	4.0
DB-5Pump	DB-5	DCN8	28.105	9	4.0	11.372	4.0	4.0
DB-6Pump	DB-6	D049+50	49.037	9	1.0	10.381	1.0	1.0

DB-6Pump	DB-6	D049+50	49.037	9	1.0	10.381	1.0	1.0
DB-6Pump	DB-6	D049+50	48.037	9	1.0	10.381	1.0	1.0
DB-6Pump	DB-6	D049+50	0	9	0.0	10.381	0.0	0.0
DB-6Pump	DB-6	D049+50	0	9	0.0	10.381	0.0	0.0
DB-7Pump	DB-7	DCN6	28.072	9	2.0	10.23	2.0	2.0
DB-7Pump	DB-7	DCN6	28.072	9	2.0	10.23	2.0	2.0
DB-7Pump	DB-7	DCN6	28.072	9	2.0	10.23	2.0	2.0
DB-7Pump	DB-7	DCN6	27.109	9	2.0	10.23	2.0	2.0
DB-7Pump	DB-7	DCN6	0	9	0.0	10.23	0.0	0.0
DB-7Pump	DB-7	DCN6	0	9	0.0	10.23	0.0	0.0
DB-8Pump	DB-8	DCN8	35.332	9	2.0	10.91	2.0	2.0
DB-8Pump	DB-8	DCN8	35.332	9	2.0	10.91	2.0	2.0
DB-8Pump	DB-8	DCN8	34.517	9	2.0	10.91	2.0	2.0
DB-8Pump	DB-8	DCN8	33.806	9	4.0	10.91	4.0	4.0
DB-8Pump	DB-8	DCN8	0	9	0.0	10.91	0.0	0.0
DB-12Pump	DB-12	DCN7	66.358	9	1.0	10.525	1.0	1.0
DB-12Pump	DB-12	DCN7	66.358	9	1.0	10.525	1.0	1.0
DB-12Pump	DB-12	DCN7	66.358	9	1.0	10.525	1.0	1.0
DB-12Pump	DB-12	DCN7	0	9	0.0	10.525	0.0	0.0
DB-12Pump	DB-12	DCN7	0	9	0.0	10.525	0.0	0.0
DB-12Pump	DB-12	DCN7	0	9	0.0	10.525	0.0	0.0
L-08Pump	L-8	DCN5	76.51	10	5.0	11.673	5.0	5.0
L-08Pump	L-8	DCN5	76.51	10	5.0	11.673	5.0	5.0
L-08Pump	L-8	DCN5	76.51	10	5.0	11.673	5.0	5.0
L-08Pump	L-8	DCN5	38.414	10	10.0	11.673	10.0	10.0
L-08Pump	L-8	DCN5	36.62	10	10.0	11.673	10.0	10.0
L-08Pump	L-8	DCN5	0	10	0.0	11.673	0.0	0.0

b) Pump Station Characteristics: Branch Creek

Link Name	Upstream Node Name	Downstream Node Name	Pump Run Time hr	Pump Minimum Head ft	Pump Minimum Flow Rate ft^3/s	Pump Maximum Head ft	Pump Maximum Flow Rate ft^3/s
DB11-a	DB-11	B027+50	14.119	9	2	11.431	2
DB11-b	DB-11	B027+50	12.745	9	2	11.431	2
DB11-d	DB-11	B027+50	11.997	9	4	11.431	4
DB9-a	DB-09	B064+50	33.87	9	3	10.784	3
DB9-b	DB-09	B064+50	33.079	9	3	10.784	3
DB9-c	DB-09	B064+50	32.115	9	3	10.784	3
DB-c	DB-11	B027+50	12.347	9	2	11.431	2

Table 6. Characteristics of Creeks
a) Characteristics of Duck Creek

Name	Link Name	Shape	Roughness	Bottom Width ft	Diameter (Height) ft	Left-hand Side Slope ft	Right-hand Side Slope	Left Channel Length ft	Right Channel Length ft	Length ft	Max Flow cfs	US Max Water Elevation ft	DS Max Water Elevation ft
10BRG	D020+76	Rectangular	0.015	13	8	0	0	0	0	67	1030.98	0	0
10WIER	D020+76	Circular	0.014	0	0.05	0	0	0	0	0	0	0	0
11LEFT	D043+72	User Defined	0.015	0	0	0	0	0	0	35	567.87	0	0
11RIGHT	D043+72	User Defined	0.015	0	0.16	0	0	0	0	35	463.27	0	0
11WEIR	D043+72	Circular	0.014	0	0.05	0	0	0	0	0	0	0	0
7BRG	D002+02_7BRG	Rectangular	0.015	13	7	0	0	0	0	245	1030.92	0	0
7WEIR	D002+02_7BRG	Circular	0.014	0	0.05	0	0	0	0	0	0	0	0
9LEFT	D012+95	User Defined	0.015	0	0	0	0	0	0	40	259.02	0	0
9MIDDLE	D012+95	User Defined	0.015	0	0.16	0	0	0	0	40	517.98	0	0
9RIGHT	D012+95	User Defined	0.015	0	0.16	0	0	0	0	40	253.94	0	0
9WEIR	D012+95	Circular	0.014	0	0.05	0	0	0	0	0	0	0	0
D004	D004	Natural	0.014	0	0	0	0	125	125	125	1030.92	22.846	22.77
D-004+15	D-004+15	Natural	0.014	0	0	0	0	545	545	545	1030.92	22.668	19.732
D005	D005	Natural	0.014	0	0	0	0	100	100	100	1030.92	22.89	22.846
D006	D006	Natural	0.014	0	0	0	0	100	100	100	1030.92	22.944	22.89
D007	D007	Natural	0.014	0	0	0	0	100	100	100	1030.93	23.013	22.944
D008	D008	Natural	0.014	0	0	0	0	100	100	100	1030.93	23.114	23.013
D009	D009	Natural	0.014	0	0	0	0	100	100	100	1030.93	23.264	23.114
D010	D010	Natural	0.014	0	0	0	0	102	98	100	1030.93	23.432	23.264
D011	D011	Natural	0.014	0	0	0	0	100	100	100	1030.94	23.585	23.432
D012+12	D012+12	Natural	0.014	0	0	0	0	125	125	125	1030.94	23.634	23.585
D013+82	D013+82	Natural	0.014	0	0	0	0	128	143	135	1030.94	23.797	23.662
D015	D015	Natural	0.014	0	0	0	0	100	100	100	1030.95	23.873	23.797
D016	D016	Natural	0.014	0	0	0	0	100	100	100	1030.95	23.948	23.873
D017	D017	Natural	0.014	0	0	0	0	100	100	100	1030.96	24.025	23.948
D018	D018	Natural	0.014	0	0	0	0	100	100	100	1030.96	24.104	24.025

D019	D019	Natural	0.014	0	0	0	0	100	100	100	1030.97	24.156	24.104
D019+97	D019+97	Natural	0.014	0	0	0	0	93	93	93	1030.97	24.274	24.156
D021+80	D021+80	Natural	0.014	0	0	0	0	140	140	140	1030.99	24.357	24.277
D023	D023	Natural	0.014	0	0	0	0	100	100	100	1031.02	24.407	24.357
D024	D024	Natural	0.014	0	0	0	0	100	100	100	1031.04	24.455	24.407
D025	D025	Natural	0.014	0	0	0	0	100	100	100	1031.06	24.595	24.455
D026	D026	Natural	0.014	0	0	0	0	100	100	100	1031.07	24.716	24.595
D027	D027	Natural	0.014	0	0	0	0	100	100	100	1031.07	24.837	24.716
D028	D028	Natural	0.014	0	0	0	0	100	100	100	1031.08	24.967	24.837
D029	D029	Natural	0.014	0	0	0	0	100	100	100	1031.09	25.089	24.967
D030	D030	Natural	0.014	0	0	0	0	100	100	100	1031.1	25.187	25.089
D031	D031	Natural	0.014	0	0	0	0	100	100	100	1031.11	25.505	25.187
D032	D032	Natural	0.014	0	0	0	0	100	100	100	1031.11	25.979	25.505
D033	D033	Natural	0.014	0	0	0	0	100	100	100	1031.12	26.303	25.979
D034	D034	Natural	0.014	0	0	0	0	100	100	100	1031.12	26.537	26.303
D035	D035	Natural	0.014	0	0	0	0	100	100	100	1031.12	26.806	26.537
D036	D036	Natural	0.014	0	0	0	0	100	100	100	1031.12	27.003	26.806
D037	D037	Natural	0.014	0	0	0	0	100	100	100	1031.13	27.179	27.003
D038	D038	Natural	0.014	0	0	0	0	100	100	100	1031.13	27.322	27.179
D039	D039	Natural	0.014	0	0	0	0	100	100	100	1031.13	27.439	27.322
D040	D040	Natural	0.014	0	0	0	0	100	100	100	1031.13	27.621	27.439
D041	D041	Natural	0.014	0	0	0	0	100	100	100	1031.13	27.809	27.621
D042	D042	Natural	0.014	0	0	0	0	100	100	100	1031.14	27.958	27.809
D043+53	D043+53	Natural	0.014	0	0	0	0	107	102	105	1031.14	28.095	27.958
D044+70	D044+70	Natural	0.014	0	0	0	0	152	168	160	1031.14	28.22	28.109
D046	D046	Natural	0.014	0	0	0	0	100	100	100	1031.15	28.341	28.22
D047	D047	Natural	0.014	0	0	0	0	100	100	100	1031.15	28.493	28.341
D048	D048	Natural	0.014	0	0	0	0	105	95	100	1031.15	28.587	28.493
D049	D049	Natural	0.014	0	0	0	0	105	95	100	1031.16	28.662	28.587
D050	D050	Natural	0.014	0	0	0	0	102	98	100	1029.16	28.734	28.662
D051	D051	Natural	0.014	0	0	0	0	100	100	100	1029.17	28.88	28.734
D052	D052	Natural	0.014	0	0	0	0	100	100	100	1029.17	29.128	28.88
D053	D053	Natural	0.014	0	0	0	0	74	70	71.9	1029.18	29.262	29.128
D053+43.80	D053+43.80	Natural	0.014	0	0	0	0	29	27	28.1	1029.18	29.313	29.262
DC1	DC1	Natural	0.23	100	0	4	4	2600	2600	2600	1030.81	51.231	47.684

DC1a	DC1a	Natural	0.23	100	0	4	4	1000	1000	1000	1008.87	47.684	46.322
DC2	DC2	Trapezoidal	0.23	100	15	4	4	0	0	1000	1003.27	46.322	45.055
DC3	DC3	Trapezoidal	0.23	100	15	4	4	0	0	1100	994.74	45.055	43.665
DC4	DC4	Trapezoidal	0.23	100	15	4	4	0	0	500	988.97	43.665	43.042
DC5	DC5	Trapezoidal	0.23	100	15	4	4	0	0	2300	1004.38	43.042	39.836
DC6	DC6	Trapezoidal	0.23	100	15	4	4	0	0	2000	1009.96	39.836	36.169
DC7	DC7	Natural	0.23	100	0	4	4	1800	1800	1800	1009.25	36.169	33.38
DC8	DC8	Natural	0.23	100	8	4	4	1000	1000	1000	1029.18	33.38	29.313

b) Characteristics of Branch Creek

Name	Link Name	Shape	Roughness	Bottom Width ft	Diameter (Height) ft	Left-hand Side Slope ft	Right-hand Side Slope	Left Channel Length ft	Length ft	Right Channel Length ft	Max Flow cfs	US Max Water Elevation ft	DS Max Water Elevation ft
1320.1	L-02weir	Circular	0.014	0	0.05	0	0	0	10	0	6.97	0	0
3RR	B035+73_3R	Circular	0.024	0	3.83	0	0	165	60	145	60.28	0	0
3WeirRR	B035+73_3R	Circular	0.014	0	0.05	0	0	0	10	0	0	0	0
4BRG_LFT	B093+48_4B	Rectangular	0.015	10	5.5	0	0	100	135	100	34.63	0	0
4BRG_RGHT	B093+48_4B	Rectangular	0.015	10	5.5	0	0	0	135	0	34.63	0	0
4WEIR	B093+48_4B	Circular	0.014	0	0.05	0	0	0	10	0	0	0	0
5BRG	B106+65	Rectangular	0.015	13	5.5	0	0	100	40	100	69.26	0	0
5WEIR	B106+65	Circular	0.014	0	0.05	0	0	0	10	0	0	0	0
6LEFT	B126+10	User Defined	0.015	0	0	0	0	100	33	100	2.19	0	0
6MIDDLE	B126+10	User Defined	0.015	0	0.16	0	0	0	33	0	66.26	0	0
6RIGHT	B126+10	User Defined	0.015	0	0.16	0	0	0	33	0	0.81	0	0
6WEIR	B126+10	Circular	0.014	0	0.05	0	0	0	10	0	0	0	0
B020	B020	Natural	0.014	0	0	0	0	100	100	100	50.33	36.152	36.108
B021	B021	Natural	0.014	0	0	0	0	100	100	100	50.32	36.108	36.028
B022	B022	Natural	0.014	0	0	0	0	100	100	100	50.32	36.028	35.927
B023	B023	Natural	0.014	0	0	0	0	100	100	100	50.32	35.927	35.808
B024	B024	Natural	0.014	0	0	0	0	100	100	100	50.32	35.808	35.678
B025	B025	Natural	0.014	0	0	0	0	100	100	100	50.32	35.678	35.43
B026	B026	Natural	0.014	0	0	0	0	100	100	100	50.32	35.43	35.378
B027	B027	Natural	0.014	0	0	0	0	100	100	100	50.32	35.378	35.359
B028	B028	Natural	0.014	0	0	0	0	100	100	100	60.31	35.359	35.319
B029	B029	Natural	0.014	0	0	0	0	100	100	100	60.3	35.319	35.285
B030	B030	Natural	0.014	0	0	0	0	100	100	100	60.29	35.285	35.221
B031	B031	Natural	0.014	0	0	0	0	100	100	100	60.29	35.221	35.024
B032	B032	Natural	0.014	0	0	0	0	100	100	100	60.29	35.024	34.927
B033	B033	Natural	0.014	0	0	0	0	100	100	100	60.29	34.927	34.781
B034	B034	Natural	0.014	0	0	0	0	100	100	100	60.28	34.781	34.646
B034+97	B034+97	Natural	0.014	0	0	0	0	102	93	89	60.28	34.646	34.615

B037	B037	Natural	0.014	0	0	0	0	163	147	144	60.28	34.608	34.593
B038	B038	Natural	0.014	0	0	0	0	100	100	100	60.27	34.593	34.573
B039	B039	Natural	0.014	0	0	0	0	100	100	100	60.27	34.573	34.547
B040	B040	Natural	0.014	0	0	0	0	100	100	100	60.27	34.547	34.494
B041	B041	Natural	0.014	0	0	0	0	100	100	100	60.27	34.494	34.423
B042	B042	Natural	0.014	0	0	0	0	100	100	100	60.27	34.423	34.353
B043	B043	Natural	0.014	0	0	0	0	100	100	100	60.27	34.353	34.285
B044	B044	Natural	0.014	0	0	0	0	100	100	100	60.27	34.285	34.219
B045	B045	Natural	0.014	0	0	0	0	100	100	100	60.27	34.219	34.152
B046	B046	Natural	0.014	0	0	0	0	100	100	100	60.27	34.152	34.083
B047	B047	Natural	0.014	0	0	0	0	100	100	100	60.27	34.083	33.992
B048	B048	Natural	0.014	0	0	0	0	100	100	100	60.27	33.992	33.919
B049	B049	Natural	0.014	0	0	0	0	100	100	100	60.27	33.919	33.833
B050	B050	Natural	0.014	0	0	0	0	100	100	100	60.27	33.833	33.705
B051	B051	Natural	0.014	0	0	0	0	100	100	100	60.27	33.705	33.508
B052	B052	Natural	0.014	0	0	0	0	100	100	100	60.27	33.508	33.273
B053	B053	Natural	0.014	0	0	0	0	100	100	100	60.27	33.273	33.16
B054	B054	Natural	0.014	0	0	0	0	100	100	100	60.27	33.16	33.086
B055	B055	Natural	0.014	0	0	0	0	100	100	100	60.27	33.086	33.001
B056	B056	Natural	0.014	0	0	0	0	100	100	100	60.27	33.001	32.772
B057	B057	Natural	0.014	0	0	0	0	100	100	100	60.27	32.772	32.61
B058	B058	Natural	0.014	0	0	0	0	100	100	100	60.27	32.61	32.469
B059	B059	Natural	0.014	0	0	0	0	100	100	100	60.27	32.469	32.24
B060	B060	Natural	0.014	0	0	0	0	100	100	100	60.27	32.24	32.128
B061	B061	Natural	0.014	0	0	0	0	100	100	100	60.27	32.128	31.883
B062	B062	Natural	0.014	0	0	0	0	100	100	100	60.27	31.883	31.761
B063	B063	Natural	0.014	0	0	0	0	100	100	100	60.27	31.761	31.714
B064	B064	Natural	0.014	0	0	0	0	100	100	100	60.27	31.714	31.671
B065	B065	Natural	0.014	0	0	0	0	100	100	100	69.27	31.671	31.586
B066	B066	Natural	0.014	0	0	0	0	100	100	100	69.27	31.586	31.475
B067	B067	Natural	0.014	0	0	0	0	100	100	100	69.27	31.475	31.455
B068	B068	Natural	0.014	0	0	0	0	100	100	100	69.27	31.455	31.018
B069	B069	Natural	0.014	0	0	0	0	100	100	100	69.27	31.018	30.89
B070	B070	Natural	0.014	0	0	0	0	100	100	100	69.27	30.89	30.823
B071	B071	Natural	0.014	0	0	0	0	100	100	100	69.27	30.823	30.166

B072	B072	Natural	0.014	0	0	0	0	100	100	100	69.27	30.166	30
B073	B073	Natural	0.014	0	0	0	0	100	100	100	69.27	30	29.731
B074	B074	Natural	0.014	0	0	0	0	100	100	100	69.27	29.731	29.625
B075	B075	Natural	0.014	0	0	0	0	100	100	100	69.26	29.625	29.54
B076	B076	Natural	0.014	0	0	0	0	100	100	100	69.26	29.54	29.5
B077	B077	Natural	0.014	0	0	0	0	100	100	100	69.26	29.5	29.472
B078	B078	Natural	0.014	0	0	0	0	100	100	100	69.26	29.472	29.438
B079	B079	Natural	0.014	0	0	0	0	100	100	100	69.26	29.438	29.386
B080	B080	Natural	0.014	0	0	0	0	100	100	100	69.26	29.386	28.99
B081	B081	Natural	0.014	0	0	0	0	100	100	100	69.26	28.99	28.811
B082	B082	Natural	0.014	0	0	0	0	100	100	100	69.26	28.811	28.731
B083	B083	Natural	0.014	0	0	0	0	200	200	200	69.26	28.731	28.613
B086	B086	Natural	0.014	0	0	0	0	200	200	200	69.26	28.613	28.197
B087	B087	Natural	0.014	0	0	0	0	100	100	100	69.26	28.197	28.029
B088	B088	Natural	0.014	0	0	0	0	100	100	100	69.26	28.029	27.946
B089	B089	Natural	0.014	0	0	0	0	100	100	100	69.26	27.946	27.885
B090	B090	Natural	0.014	0	0	0	0	100	100	100	69.26	27.885	27.811
B091	B091	Natural	0.014	0	0	0	0	100	100	100	69.26	27.811	27.763
B092+15	B092+15	Natural	0.014	0	0	0	0	130	130	130	69.26	27.763	27.737
B094+82	B094+82	Natural	0.014	0	0	0	0	135	135	135	69.26	27.733	27.7
B096	B096	Natural	0.014	0	0	0	0	100	100	100	69.26	27.7	27.641
B097	B097	Natural	0.014	0	0	0	0	100	100	100	69.26	27.641	27.568
B098	B098	Natural	0.014	0	0	0	0	100	100	100	69.26	27.568	27.478
B099	B099	Natural	0.014	0	0	0	0	100	100	100	69.26	27.478	27.394
B100	B100	Natural	0.014	0	0	0	0	100	100	100	69.26	27.394	27.289
B101	B101	Natural	0.014	0	0	0	0	100	100	100	69.26	27.289	27.176
B102	B102	Natural	0.014	0	0	0	0	100	100	100	69.26	27.176	27.042
B103	B103	Natural	0.014	0	0	0	0	100	100	100	69.26	27.042	26.869
B104	B104	Natural	0.014	0	0	0	0	100	100	100	69.26	26.869	26.587
B105	B105	Natural	0.014	0	0	0	0	100	100	100	69.26	26.587	26.189
B105+98	B105+98	Natural	0.014	0	0	0	0	95	95	95	69.26	26.189	25.675
B107+18	B107+18	Natural	0.014	0	0	0	0	100	65	100	69.26	25.67	25.559
B108	B108	Natural	0.014	0	0	0	0	100	100	100	69.26	25.559	25.351
B109	B109	Natural	0.014	0	0	0	0	100	100	100	69.26	25.351	25.232
B110	B110	Natural	0.014	0	0	0	0	100	100	100	69.26	25.232	25.1

B111	B111	Natural	0.014	0	0	0	0	100	100	100	69.26	25.1	24.948
B112	B112	Natural	0.014	0	0	0	0	100	100	100	69.26	24.948	24.76
B113	B113	Natural	0.014	0	0	0	0	100	100	100	69.26	24.76	24.556
B114	B114	Natural	0.014	0	0	0	0	100	100	100	69.26	24.556	24.318
B115	B115	Natural	0.014	0	0	0	0	100	100	100	69.26	24.318	24.073
B116	B116	Natural	0.014	0	0	0	0	100	100	100	69.26	24.073	23.841
B117	B117	Natural	0.014	0	0	0	0	100	100	100	69.26	23.841	23.671
B118	B118	Natural	0.014	0	0	0	0	100	100	100	69.26	23.671	23.607
B119	B119	Natural	0.014	0	0	0	0	100	100	100	69.26	23.607	23.561
B120	B120	Natural	0.014	0	0	0	0	100	100	100	69.26	23.561	23.53
B121	B121	Natural	0.014	0	0	0	0	100	100	100	69.26	23.53	23.477
B122	B122	Natural	0.014	0	0	0	0	100	100	100	69.26	23.477	23.396
B123	B123	Natural	0.014	0	0	0	0	100	100	100	69.26	23.396	23.304
B124	B124	Natural	0.014	0	0	0	0	100	100	100	69.26	23.304	23.129
B125+47	B125+47	Natural	0.025	0	0	0	0	143	143	143	69.26	23.129	22.777
B126+88	B126+88	Natural	0.014	0	0	0	0	124	124	124	69.26	22.76	22.405
B128	B128	Natural	0.014	0	0	0	0	100	100	100	69.25	22.405	22.308
B129	B129	Natural	0.014	0	0	0	0	100	100	100	69.25	22.308	22.126
B130	B130	Natural	0.014	0	0	0	0	100	100	100	69.25	22.126	21.998
B131	B131	Natural	0.014	0	0	0	0	100	100	100	69.25	21.998	21.908
B132	B132	Natural	0.014	0	0	0	0	100	100	100	69.25	21.908	21.832
B133	B133	Natural	0.014	0	0	0	0	100	100	100	69.25	21.832	21.75
B134	B134	Natural	0.014	0	0	0	0	100	100	100	69.25	21.75	21.602
B135	B135	Natural	0.014	0	0	0	0	100	100	100	69.25	21.602	21.352
B136	B136	Natural	0.014	0	0	0	0	100	100	100	69.25	21.352	21.172
B137	B137	Natural	0.014	0	0	0	0	100	100	100	69.25	21.172	21.036
B138	B138	Natural	0.014	0	0	0	0	100	100	100	69.25	21.036	20.945
B139	B139	Natural	0.014	0	0	0	0	100	100	100	69.25	20.945	20.82
B140	B140	Natural	0.014	0	0	0	0	100	100	100	69.25	20.82	20.691
B141	B141	Natural	0.014	0	0	0	0	100	100	100	69.25	20.691	20.543
B142	B142	Natural	0.014	0	0	0	0	100	100	100	69.25	20.543	20.355
B143	B143	Natural	0.014	0	0	0	0	100	100	100	69.25	20.355	20.066
B144	B144	Natural	0.014	0	0	0	0	100	100	100	69.25	20.066	19.314
B145	B145	Natural	0.014	0	0	0	0	75	75	75	69.25	19.314	18.285
B145+51.82	B145+51.82	Natural	0.014	0	0	0	0	50	50	50	69.25	18.285	17.201

C-01chan	C-01chan	Trapezoidal	0.014	5	0	4	4	0	500	0	48.75	39.028	39.028
C-02Chan	C-02Chan	Trapezoidal	0.014	5	0	4	4	0	500	0	59.9	39.028	39.028
C-03Chan	C-03Chan	Trapezoidal	0.014	20	0	4	4	0	1000	0	57.81	39.028	39.028
L-4chan	L-4chan	Trapezoidal	0.014	20	0	4	4	0	1000	0	87.98	39.028	39.028
L-5chan	L-5chan	Trapezoidal	0.014	20	0	4	4	0	500	0	88.84	39.028	39.028

c) Characteristics of North Little John Creek

Name	Link Name	Shape	Roughness	Bottom Width ft	Diameter (Height) ft	Left-hand Side Slope	Right-hand Side Slope	Length ft	Left Channel Length ft	Right Channel Length ft	Max Water Elevation ft	Max Water Elevation ft	Max Depth ft
LJ-003	LJ-003	Natural	0.015	0	0	0	0	2500	2500	2500	45.198	42.854	6.074
LJ010	LJ010	Natural	0.014	0	0	0	0	100	90	110	42.854	42.773	6.233
LJ011	LJ011	Natural	0.014	0	0	0	0	100	100	100	42.773	42.703	6.503
LJ012	LJ012	Natural	0.014	0	0	0	0	100	100	100	42.703	42.643	6.533
LJ013	LJ013	Natural	0.014	0	0	0	0	100	100	100	42.643	42.584	6.533
LJ014	LJ014	Natural	0.014	0	0	0	0	100	100	100	42.584	42.521	6.474
LJ015	LJ015	Natural	0.014	0	0	0	0	100	100	100	42.521	42.455	6.411
LJ016	LJ016	Natural	0.014	0	0	0	0	100	100	100	42.455	42.387	6.345
LJ017	LJ017	Natural	0.014	0	0	0	0	100	100	100	42.387	42.314	6.277
LJ018	LJ018	Natural	0.014	0	0	0	0	100	100	100	42.314	42.237	6.204
LJ019	LJ019	Natural	0.014	0	0	0	0	100	100	100	42.237	42.156	6.127
LJ020	LJ020	Natural	0.014	0	0	0	0	100	100	100	42.156	42.069	6.046
LJ021	LJ021	Natural	0.014	0	0	0	0	100	100	100	42.069	41.975	5.959
LJ022	LJ022	Natural	0.014	0	0	0	0	100	100	100	41.975	41.874	5.865
LJ023	LJ023	Natural	0.014	0	0	0	0	100	100	100	41.874	41.774	6.164
LJ024	LJ024	Natural	0.014	0	0	0	0	100	100	100	41.774	41.7	6.59
LJ024+82	LJ024+82	Natural	0.014	0	0	0	0	63	100	100	41.7	41.659	6.549
LJ025+67	LJ025+67	Natural	0.014	0	0	0	0	41	105	95	41.646	41.607	6.107
1BRG1	LJ026+08_1	Rectangular	0.015	10	5.65	0	0	40	105	95	0	0	6.102
LJ026+08w	LJ026+08_1	Circular	0.014	0	0.05	0	0	10	0	0	0	0	0
LJ026+33	LJ026+33	Natural	0.014	0	0	0	0	33	105	95	41.602	41.574	6.104
LJ027	LJ027	Natural	0.014	0	0	0	0	100	100	100	41.574	41.494	6.384
LJ028	LJ028	Natural	0.014	0	0	0	0	100	100	100	41.494	41.426	6.384
LJ029	LJ029	Natural	0.014	0	0	0	0	100	100	100	41.426	41.353	6.316
LJ030	LJ030	Natural	0.014	0	0	0	0	100	100	100	41.353	41.276	6.243
LJ031	LJ031	Natural	0.014	0	0	0	0	100	100	100	41.276	41.197	6.177
LJ032	LJ032	Natural	0.014	0	0	0	0	100	100	100	41.197	41.117	6.177
LJ033	LJ033	Natural	0.014	0	0	0	0	100	100	100	41.117	41.033	6.053
LJ034	LJ034	Natural	0.014	0	0	0	0	100	100	100	41.033	40.94	5.99
LJ035	LJ035	Natural	0.014	0	0	0	0	100	100	100	40.94	40.855	6.405
LJ036	LJ036	Natural	0.014	0	0	0	0	100	100	100	40.855	40.791	6.681

LJ037	LJ037	Natural	0.014	0	0	0	0	100	100	100	40.791	40.736	6.681
LJ038	LJ038	Natural	0.014	0	0	0	0	100	100	100	40.736	40.678	6.626
LJ039	LJ039	Natural	0.014	0	0	0	0	100	100	100	40.678	40.618	6.568
LJ040	LJ040	Natural	0.014	0	0	0	0	100	100	100	40.618	40.555	6.508
LJ041	LJ041	Natural	0.014	0	0	0	0	100	100	100	40.555	40.49	6.445
LJ042	LJ042	Natural	0.014	0	0	0	0	100	100	100	40.49	40.421	6.38
LJ043	LJ043	Natural	0.014	0	0	0	0	100	100	100	40.421	40.348	6.311
LJ044	LJ044	Natural	0.014	0	0	0	0	100	100	100	40.348	40.271	6.238
LJ045	LJ045	Natural	0.014	0	0	0	0	100	100	100	40.271	40.19	6.161
LJ046	LJ046	Natural	0.014	0	0	0	0	100	100	100	40.19	40.102	6.08
LJ047	LJ047	Natural	0.014	0	0	0	0	100	100	100	40.102	40.013	6.083
LJ048	LJ048	Natural	0.014	0	0	0	0	100	100	100	40.013	39.93	6.14
LJ049	LJ049	Natural	0.014	0	0	0	0	100	100	100	39.93	39.843	6.053
LJ050	LJ050	Natural	0.014	0	0	0	0	100	100	100	39.843	39.735	5.755
LJ051	LJ051	Natural	0.014	0	0	0	0	100	100	100	39.735	39.606	5.625
LJ052	LJ052	Natural	0.014	0	0	0	0	100	100	100	39.606	39.469	5.529
LJ053	LJ053	Natural	0.014	0	0	0	0	100	100	100	39.469	39.339	5.699
LJ054	LJ054	Natural	0.014	0	0	0	0	100	100	100	39.339	39.221	5.699
LJ055	LJ055	Natural	0.014	0	0	0	0	100	100	100	39.221	39.087	5.497
LJ056	LJ056	Natural	0.014	0	0	0	0	100	100	100	39.087	38.907	5.167
LJ057	LJ057	Natural	0.014	0	0	0	0	100	100	100	38.907	38.647	4.847
LJ058	LJ058	Natural	0.014	0	0	0	0	100	100	100	38.647	38.304	4.694
LJ059	LJ059	Natural	0.014	0	0	0	0	100	100	100	38.304	38.007	4.897
LJ060	LJ060	Natural	0.014	0	0	0	0	100	100	100	38.007	37.772	5.162
LJ061	LJ061	Natural	0.014	0	0	0	0	100	100	100	37.772	37.594	5.484
LJ062	LJ062	Natural	0.014	0	0	0	0	100	95	105	37.594	37.446	5.484
LJ063	LJ063	Natural	0.014	0	0	0	0	100	100	100	37.446	37.275	5.336
LJ064	LJ064	Natural	0.014	0	0	0	0	100	100	100	37.275	37.07	5.165
LJ065	LJ065	Natural	0.014	0	0	0	0	100	100	100	37.07	36.846	5.126
LJ066	LJ066	Natural	0.014	0	0	0	0	100	100	100	36.846	36.662	5.442
LJ067	LJ067	Natural	0.014	0	0	0	0	100	100	100	36.662	36.515	5.442
LJ068	LJ068	Natural	0.014	0	0	0	0	100	100	100	36.515	36.374	5.744
LJ069	LJ069	Natural	0.014	0	0	0	0	100	105	95	36.374	36.259	5.744
LJ070	LJ070	Natural	0.014	0	0	0	0	100	100	100	36.259	36.112	5.482
LJ071	LJ071	Natural	0.014	0	0	0	0	100	101	99	36.112	35.877	5.002

LJ072	LJ072	Natural	0.014	0	0	0	0	100	100	100	35.877	35.63	5.02
LJ073	LJ073	Natural	0.014	0	0	0	0	100	100	100	35.63	35.425	5.345
LJ074	LJ074	Natural	0.014	0	0	0	0	100	100	100	35.425	35.272	5.482
LJ075	LJ075	Natural	0.014	0	0	0	0	100	100	100	35.272	35.132	5.482
LJ076	LJ076	Natural	0.014	0	0	0	0	100	100	100	35.132	34.989	5.462
LJ077	LJ077	Natural	0.014	0	0	0	0	100	100	100	34.989	34.844	5.439
LJ078	LJ078	Natural	0.014	0	0	0	0	100	101	99	34.844	34.695	5.414
LJ079	LJ079	Natural	0.014	0	0	0	0	100	99	101	34.695	34.544	5.385
LJ080	LJ080	Natural	0.014	0	0	0	0	100	100	100	34.544	34.394	5.464
LJ081	LJ081	Natural	0.014	0	0	0	0	100	102	98	34.394	34.257	5.587
LJ082	LJ082	Natural	0.014	0	0	0	0	100	100	100	34.257	34.134	5.734
LJ083	LJ083	Natural	0.014	0	0	0	0	100	100	100	34.134	34.026	5.896
LJ084	LJ084	Natural	0.014	0	0	0	0	100	100	100	34.026	33.933	6.163
LJ085	LJ085	Natural	0.014	0	0	0	0	100	100	100	33.933	33.856	6.296
LJ086	LJ086	Natural	0.014	0	0	0	0	100	100	100	33.856	33.784	6.286
LJ087	LJ087	Natural	0.014	0	0	0	0	100	100	100	33.784	33.707	6.204
LJ088	LJ088	Natural	0.014	0	0	0	0	100	98	102	33.707	33.625	6.117
LJ089	LJ089	Natural	0.014	0	0	0	0	100	100	100	33.625	33.536	6.035
LJ090	LJ090	Natural	0.014	0	0	0	0	100	105	95	33.536	33.445	5.975
LJ091	LJ091	Natural	0.014	0	0	0	0	100	99	101	33.445	33.358	6.198
LJ092	LJ092	Natural	0.014	0	0	0	0	100	95	105	33.358	33.286	6.626
LJ093	LJ093	Natural	0.014	0	0	0	0	100	98	102	33.286	33.232	6.812
LJ094	LJ094	Natural	0.014	0	0	0	0	100	100	100	33.232	33.182	6.772
LJ095	LJ095	Natural	0.014	0	0	0	0	100	100	100	33.182	33.129	6.682
LJ096	LJ096	Natural	0.014	0	0	0	0	100	100	100	33.129	33.072	6.589
LJ097	LJ097	Natural	0.014	0	0	0	0	100	100	100	33.072	33.012	6.502
LJ098	LJ098	Natural	0.014	0	0	0	0	100	100	100	33.012	32.947	6.442
LJ099	LJ099	Natural	0.014	0	0	0	0	100	100	100	32.947	32.882	6.397
LJ100	LJ100	Natural	0.014	0	0	0	0	100	100	100	32.882	32.816	6.392
LJ101	LJ101	Natural	0.014	0	0	0	0	100	100	100	32.816	32.75	6.386
LJ102	LJ102	Natural	0.014	0	0	0	0	100	100	100	32.75	32.684	6.38
LJ103	LJ103	Natural	0.014	0	0	0	0	100	100	100	32.684	32.617	6.374
LJ104	LJ104	Natural	0.014	0	0	0	0	100	100	100	32.617	32.55	6.367
LJ105	LJ105	Natural	0.014	0	0	0	0	100	100	100	32.55	32.481	6.35
LJ106	LJ106	Natural	0.014	0	0	0	0	100	105	95	32.481	32.411	6.321

LJ107	LJ107	Natural	0.014	0	0	0	0	100	100	100	32.411	32.338	6.271
LJ108	LJ108	Natural	0.014	0	0	0	0	100	100	100	32.338	32.263	6.228
LJ109	LJ109	Natural	0.014	0	0	0	0	100	100	100	32.263	32.184	6.173
LJ110	LJ110	Natural	0.014	0	0	0	0	100	100	100	32.184	32.103	6.124
LJ111	LJ111	Natural	0.014	0	0	0	0	100	100	100	32.103	32.019	6.083
LJ112	LJ112	Natural	0.014	0	0	0	0	100	99	101	32.019	31.932	6.049
LJ113	LJ113	Natural	0.014	0	0	0	0	100	98	102	31.932	31.838	5.922
LJ114	LJ114	Natural	0.014	0	0	0	0	100	105	95	31.838	31.731	5.758
LJ115	LJ115	Natural	0.014	0	0	0	0	100	105	95	31.731	31.61	5.651
LJ116	LJ116	Natural	0.014	0	0	0	0	100	100	100	31.61	31.479	5.57
LJ117	LJ117	Natural	0.014	0	0	0	0	100	100	100	31.479	31.337	5.489
LJ118	LJ118	Natural	0.014	0	0	0	0	100	100	100	31.337	31.18	5.387
LJ119	LJ119	Natural	0.014	0	0	0	0	100	100	100	31.18	31.004	5.27
LJ120	LJ120	Natural	0.014	0	0	0	0	100	100	100	31.004	30.799	5.134
LJ121	LJ121	Natural	0.014	0	0	0	0	100	100	100	30.799	30.563	4.959
LJ122	LJ122	Natural	0.014	0	0	0	0	100	102	98	30.563	30.319	4.939
LJ123	LJ123	Natural	0.014	0	0	0	0	100	105	95	30.319	30.091	5.031
LJ124	LJ124	Natural	0.014	0	0	0	0	100	100	100	30.091	29.884	5.144
LJ125	LJ125	Natural	0.014	0	0	0	0	100	100	100	29.884	29.701	5.291
LJ126	LJ126	Natural	0.014	0	0	0	0	100	100	100	29.701	29.542	5.462
LJ127	LJ127	Natural	0.014	0	0	0	0	100	100	100	29.542	29.406	5.616
LJ128	LJ128	Natural	0.014	0	0	0	0	100	100	100	29.406	29.286	5.676
LJ129	LJ129	Natural	0.014	0	0	0	0	100	100	100	29.286	29.169	5.676
LJ130	LJ130	Natural	0.014	0	0	0	0	100	100	100	29.169	29.051	5.649
LJ131	LJ131	Natural	0.014	0	0	0	0	100	100	100	29.051	28.93	5.631
LJ132	LJ132	Natural	0.014	0	0	0	0	100	100	100	28.93	28.807	5.61
LJ133	LJ133	Natural	0.014	0	0	0	0	100	100	100	28.807	28.68	5.587
LJ134	LJ134	Natural	0.014	0	0	0	0	100	100	100	28.68	28.55	5.55
LJ135	LJ135	Natural	0.014	0	0	0	0	100	100	100	28.55	28.416	5.52
LJ136	LJ136	Natural	0.014	0	0	0	0	100	100	100	28.416	28.278	5.486
LJ137	LJ137	Natural	0.014	0	0	0	0	136	130	145	28.278	28.098	5.898
8BRG1	LJ139+09_8	Rectangular	0.015	10.5	3.95	0	0	246	0	0	0	0	5.528
AREA8_BRG	LJ139+09_8	Circular	0.014	0	0.05	0	0	10	0	0	0	0	0
LJ143+29	LJ143+29	Natural	0.014	0	0	0	0	594	594	594	27.728	24.28	4.728
1Brg_2	LJ25+30_1B	User	0.015	10	0	0	0	34	105	95	0	0	6.159

Brg#2_RR	LJ25+30_1B	Defined Circular	0.014	0	0.05	0	0	10	0	0	0	0	0

Table 7. Runoff from Onsite Watersheds

a. Runoff from Onsite Watersheds: Duck Creek

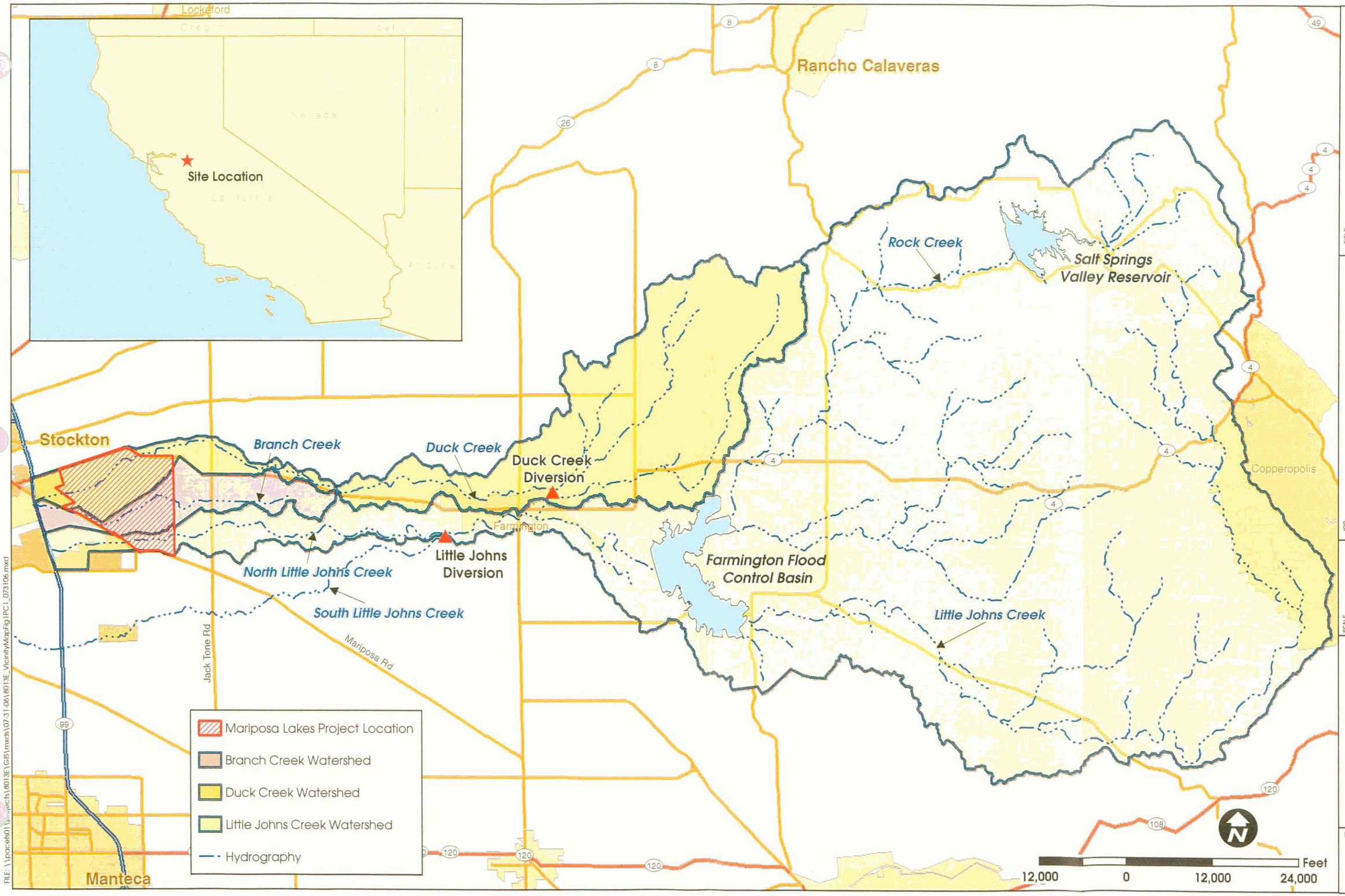
Name	Total Rainfall in	Total Runoff Depth in	Total Infiltration in	Max Infil. Rate in/hr	Max Flow cfs
DB-1	3.271	1.333	1.938	0.486	58.412
DB-2	3.271	1.333	1.938	0.486	60.412
DB-3	3.271	1.333	1.938	0.486	76.679
DB-4	3.271	1.333	1.938	0.486	93.635
DB-5	3.271	1.333	1.938	0.486	131.011
DB-6	3.271	1.346	1.924	0.482	35.987
DB-7	3.271	1.333	1.938	0.486	41.014
DB-8	3.271	1.333	1.938	0.486	24.577
DB-12	3.271	1.333	1.938	0.486	103.279
L-5	3.271	1.333	1.938	0.486	64.178
L-6	3.271	1.333	1.938	0.486	144.472
L-7	3.271	1.333	1.938	0.486	186.267
L-8	3.271	1.333	1.938	0.486	60.505

b. Runoff from Onsite Watersheds: Branch Creek

Name	Total Rainfall in	Total Runoff Depth in	Total Infiltration in	Max Flow cfs
DB-09	3.271	1.333	1.938	111.455
DB-11	3.271	1.333	1.938	48.107
L-01	3.271	1.333	1.938	179.72
L-02	3.271	1.333	1.938	79.344
L-03	3.271	1.333	1.938	55.704
L-04	3.271	1.333	1.938	110.836
L-09	3.271	1.333	1.938	6.43

c. Runoff from Onsite Watersheds: North Little John Creek

Name	Total Rainfall in	Total Runoff Depth in	Total Infiltration in	Max Infil. Rate in/hr	Max Flow cfs
DB-10	3.271	1.333	1.938	0.486	64.624
L-10	3.271	1.333	1.938	0.486	11.064
L-11	3.271	1.333	1.938	0.486	75.783



TITLE REGIONAL VICINITY MAP

JOB MARIPOSA LAKES

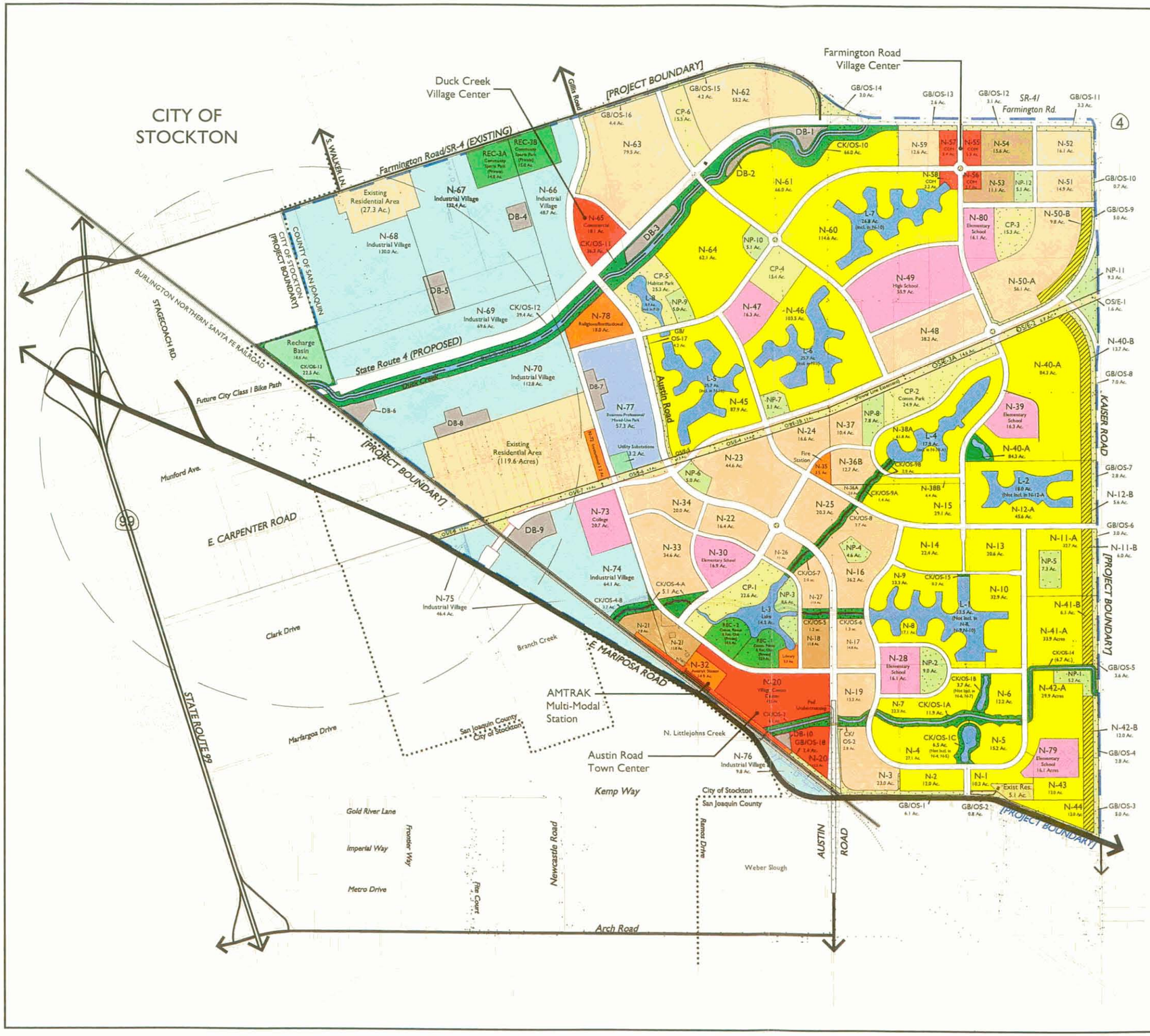
SAN JOAQUIN COUNTY CA

SCALE 1" = 12,000'
DESIGNED JC
DRAWING 8013 VicinityMap_pc092605.mxd
CHECKED
DATE 10/26/05
JOB NO. 8013-E

PACE
PACIFIC ADVANCED CIVIL ENGINEERING
17550 NEWHOPE STREET, SUITE 200
FOUNTAIN VALLEY, CA 92708
PH (714) 481-7300 FAX (714) 481-7399

FIGURE 1

FILE: \\pacefs01\projects\8013E\GIS\mxds\07-31-06\8013E_VicinityMapFig1PC1_073106.mxd



Land Use Legend

Key	Land Use	Acres
	Village Residential Estate	53 ac
	Village Low Density Residential	1,016 ac
	Village Medium Density Residential	536 ac
	Village High Density Residential	59 ac
	Village Center/Commercial	93 ac
	Industrial	614 ac
	Business-Professional	57 ac
	Institutional	43 ac
	Elementary/High Schools	154 ac
	College	21 ac
	Parks & Open Space	508 ac
	Private Recreation Center	52 ac
	Existing Residential	152 ac
	Public Utilities	22 ac
	Lakes 1, 2, & 3	66 ac
	Major Circulation (Roads & R.R.)	364 ac
	Total:	3,810 acres

TITLE
LAND USE PLAN

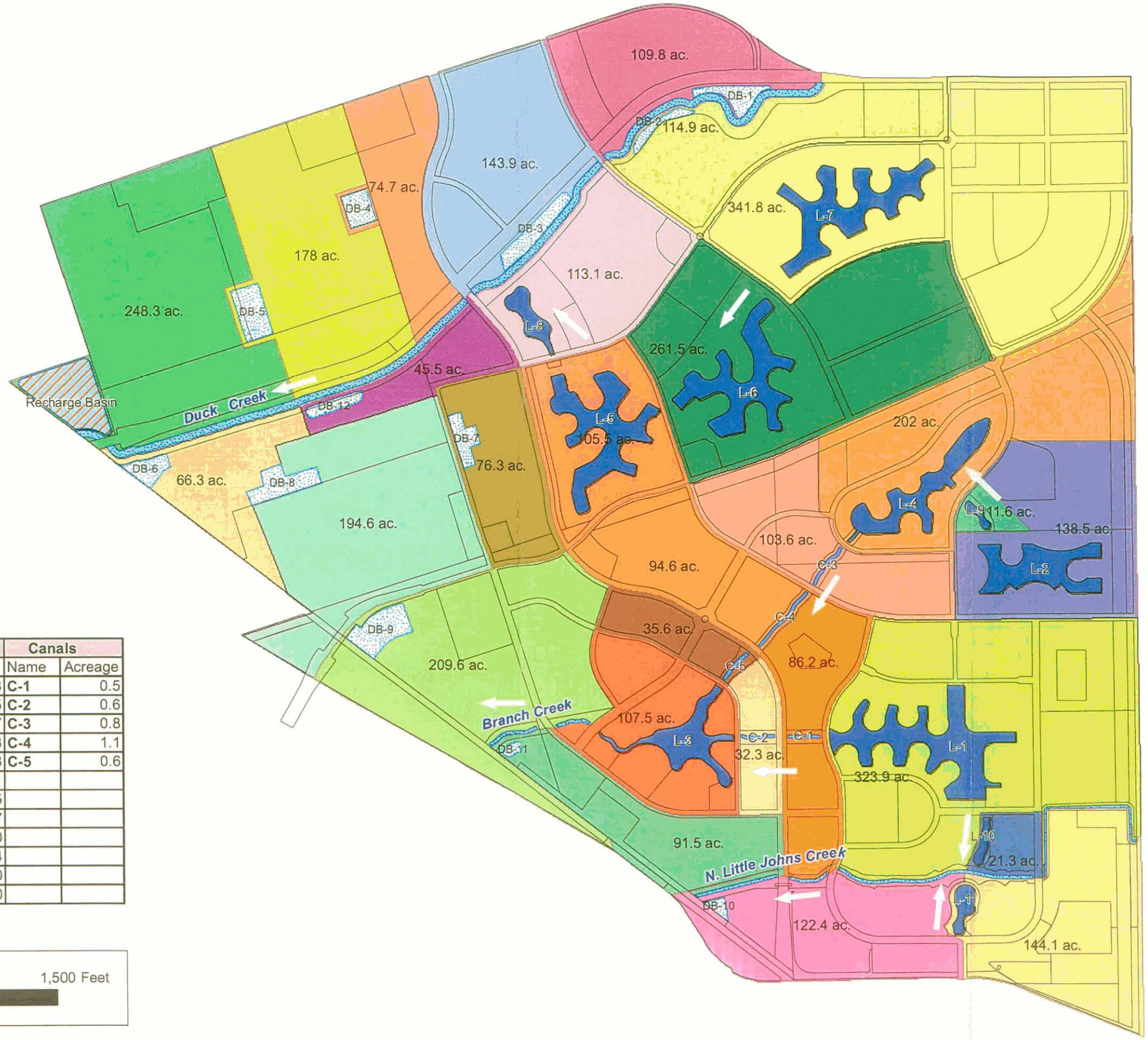
JOB
MARIPOSA LAKES
SAN JOAQUIN COUNTY CA

SCALE	AS SHOWN
DESIGNED	JC
DRAWN	X.X
CHECKED	X.X
DATE	08/01/06
JOB NO.	8013-E

PACE
PACIFIC ADVANCED CIVIL ENGINEERING
17520 NEWHOPE STREET, SUITE 200
FOUNTAIN VALLEY, CA 92708
PH (714) 481-7300 FAX (714) 481-7299

FIGURE
2

\\pacefs01\projects\8013E\Engineering\Received\07-05-06 Greg Randall (Updated LUP files)\MPL_LUD-etrans_7-5-06\LAND USE_7-5-06 (11X17).dwg - Tab: 11x17 LAND USE PLAN By: ltran on Au



Legend

- Lakes
- Restored Stream Channels
- Canals
- Recharge Basin
- Wet Pond Detention Basins
- Drainage Areas (color varies)
- Direction of Flow

Lakes		Detention Basins		Canals	
Name	Acreage	Name	Acreage	Name	Acreage
L-1	33.6	DB-1	4.8	C-1	0.5
L-2	18.0	DB-2	2.5	C-2	0.6
L-3	14.5	DB-3	6.7	C-3	0.8
L-4	17.9	DB-4	4.3	C-4	1.1
L-5	25.8	DB-5	7.3	C-5	0.6
L-6	25.8	DB-6	4.1		
L-7	26.9	DB-7	4.5		
L-8	5.9	DB-8	7.7		
L-9	1.2	DB-9	9.0		
L-10	1.6	DB-10	1.4		
L-11	3.4	DB-11	1.0		
		DB-12	3.0		

1,500 0 1,500 Feet

TITLE
DRAINAGE AREAS

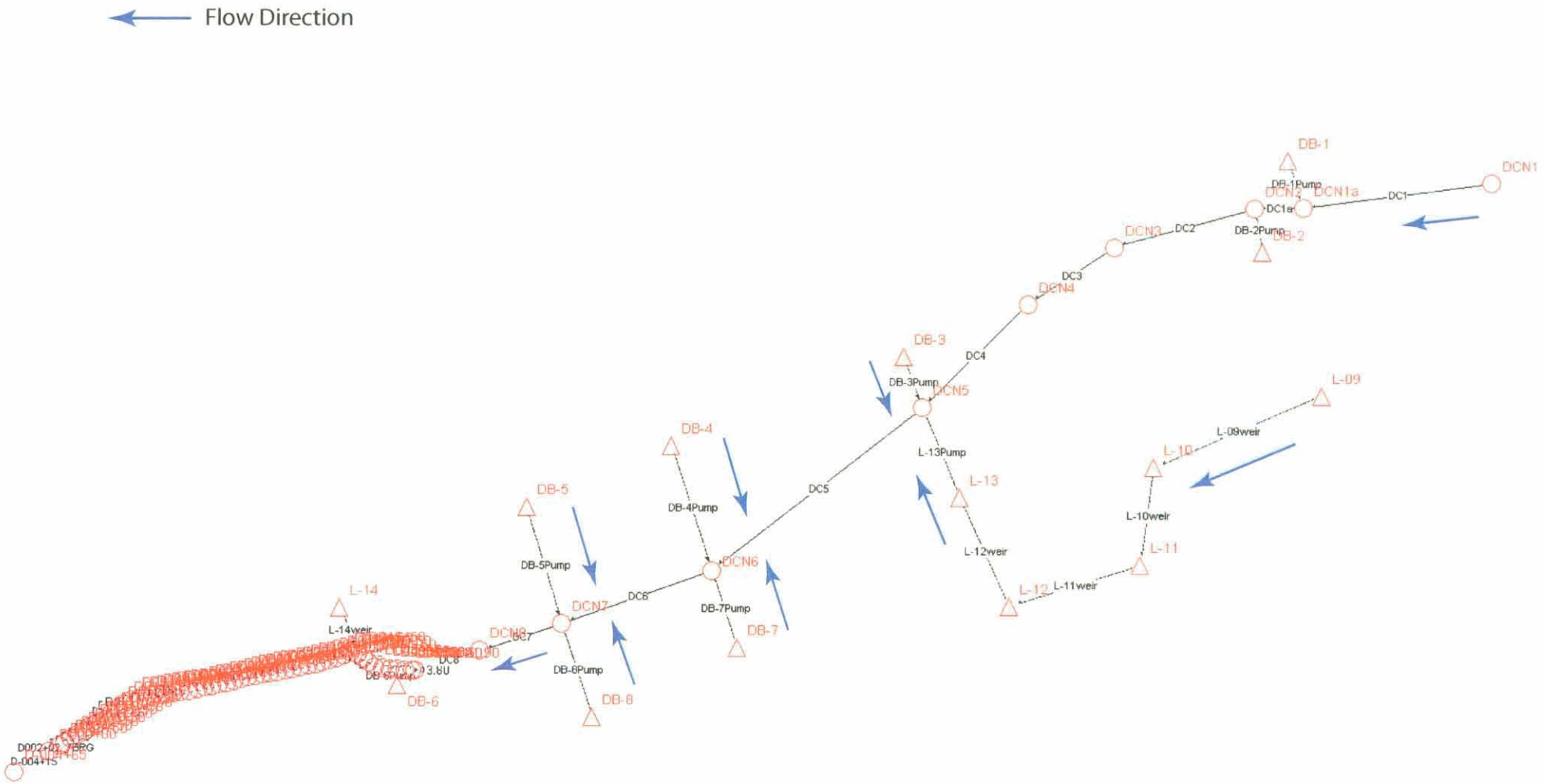
JOB
MARIPOSA LAKES
SAN JOAQUIN CNTY CA

SCALE 1"= 1500'
DESIGNED BJ
DRAWING RS
CHECKED BJ
DATE 07/17/06
JOB NO. 8013-E

PACE
PACIFIC ADVANCED CIVIL ENGINEERING
17520 NEWHOPE STREET, SUITE 200
FOUNTAIN VALLEY, CA 92708
PH (714) 481-9300 FAX (714) 481-7299

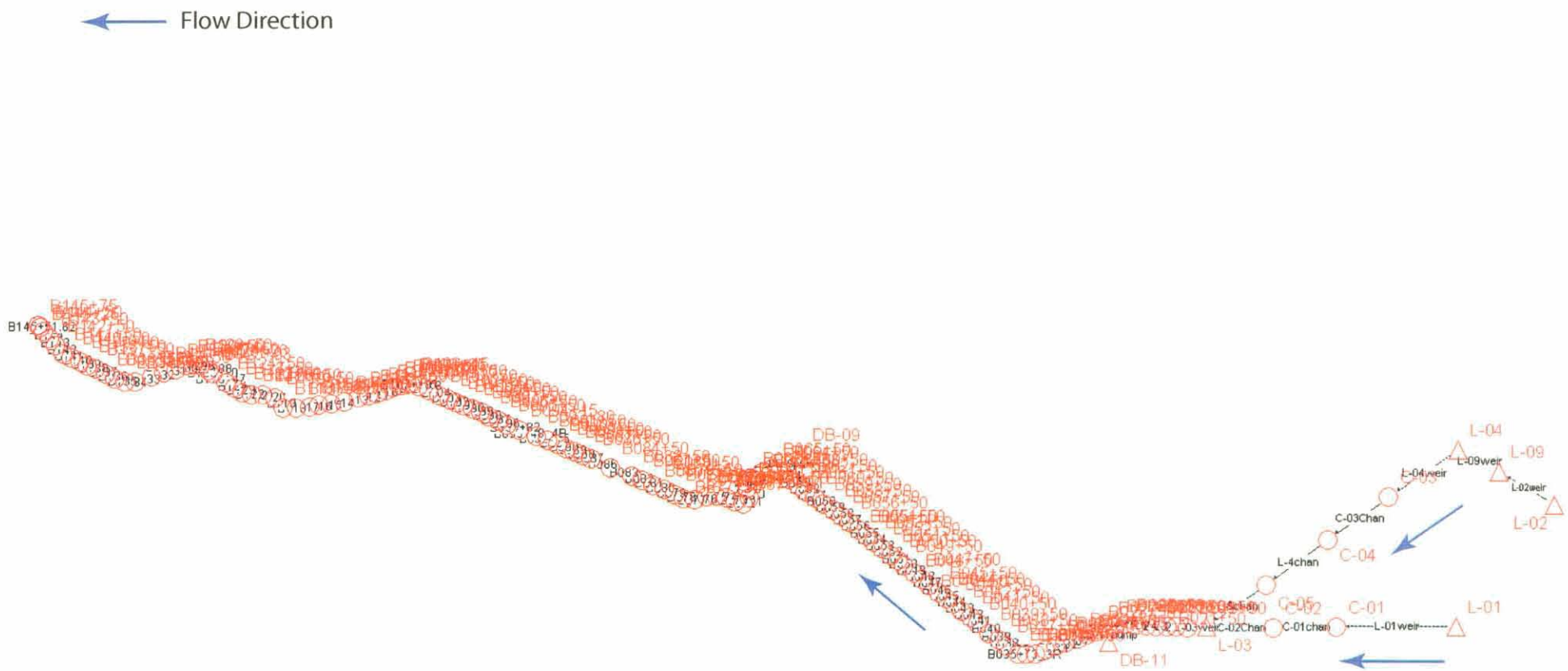
FIGURE
3

FILE: \\pacefs01\projects\8013E\GIS\mxds\07-31-06\8013E_LakeDrainAreasFig4PC1_073106.mxd



Duck Creek Drainage Network

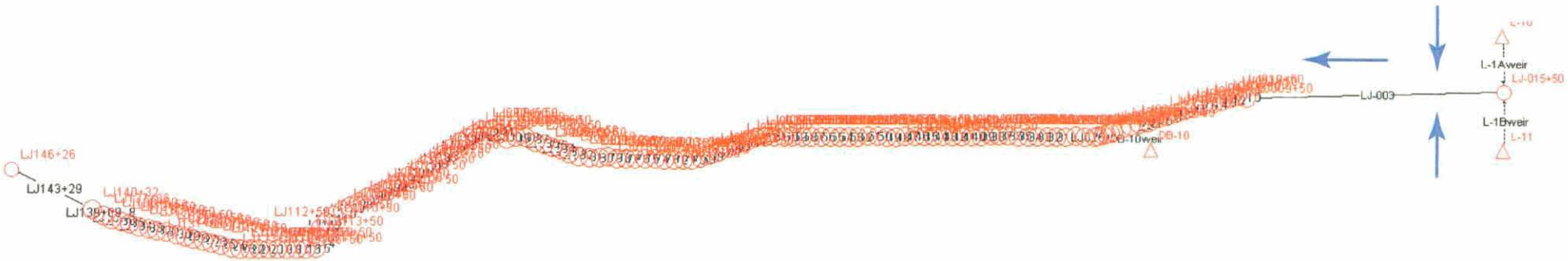
Fig 4A



Branch Creek Drainage Network

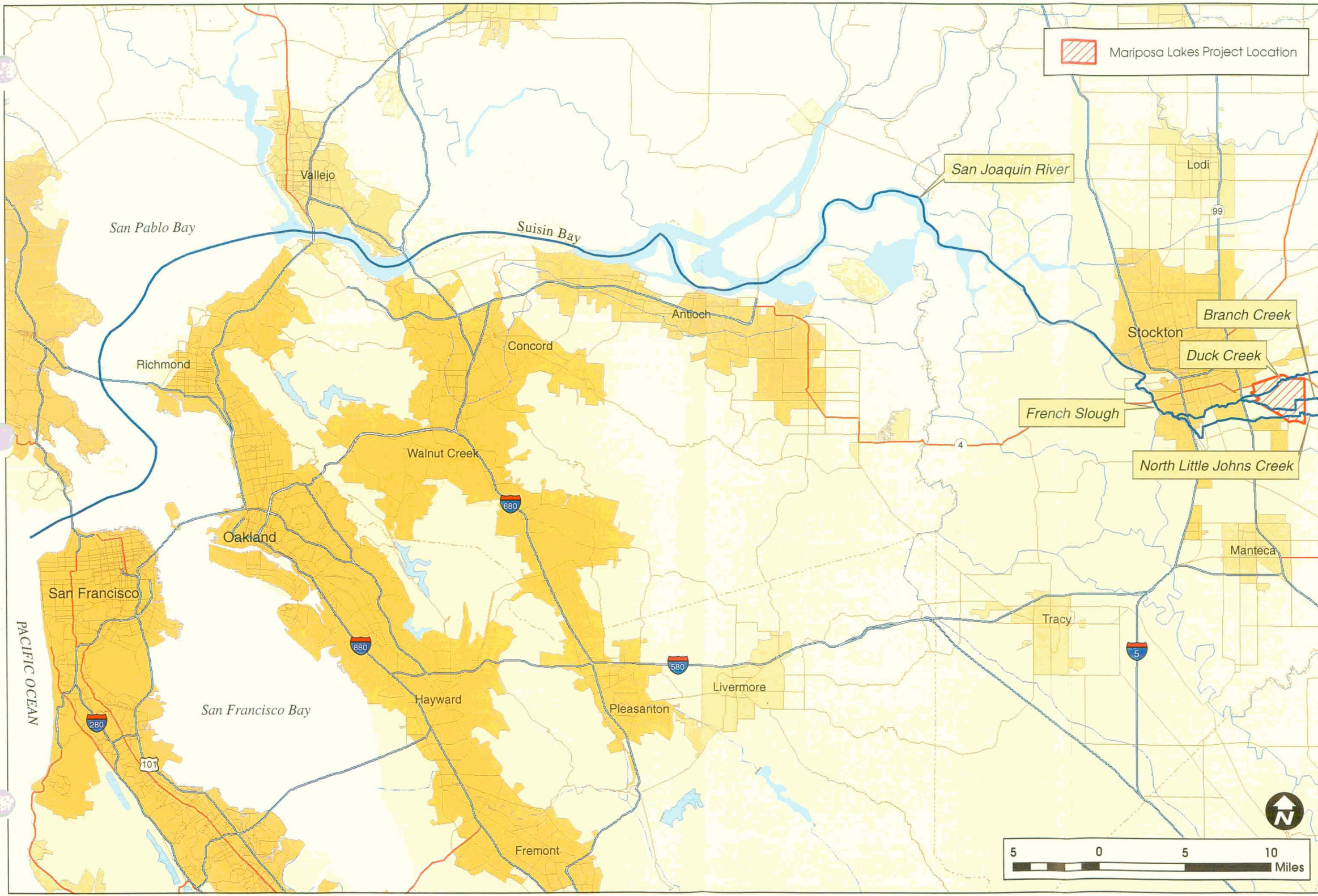
Fig 4B

Flow Direction



North Little Johns Drainage Network

Fig 4C



DOWNSTREAM RECEIVING WATERS

TITLE

MARIPOSA LAKES

CA

SAN JOAQUIN COUNTY

JOB

SCALE	1"=5 Miles
DESIGNED	JC
DRAWING	8013E RainAndStreamGages_101405.mxd
CHECKED	
DATE	10/26/05
JOB NO.	8013.E

PACE

PACIFIC ADVANCED CIVIL ENGINEERING

17520 NEWHOPE STREET, SUITE 200
FOUNTAIN VALLEY, CA 92708
PH (714) 481-7300 FAX (714) 481-7299

FIGURE

5

Figure 6: Offsite Hydrograph for Duck Creek

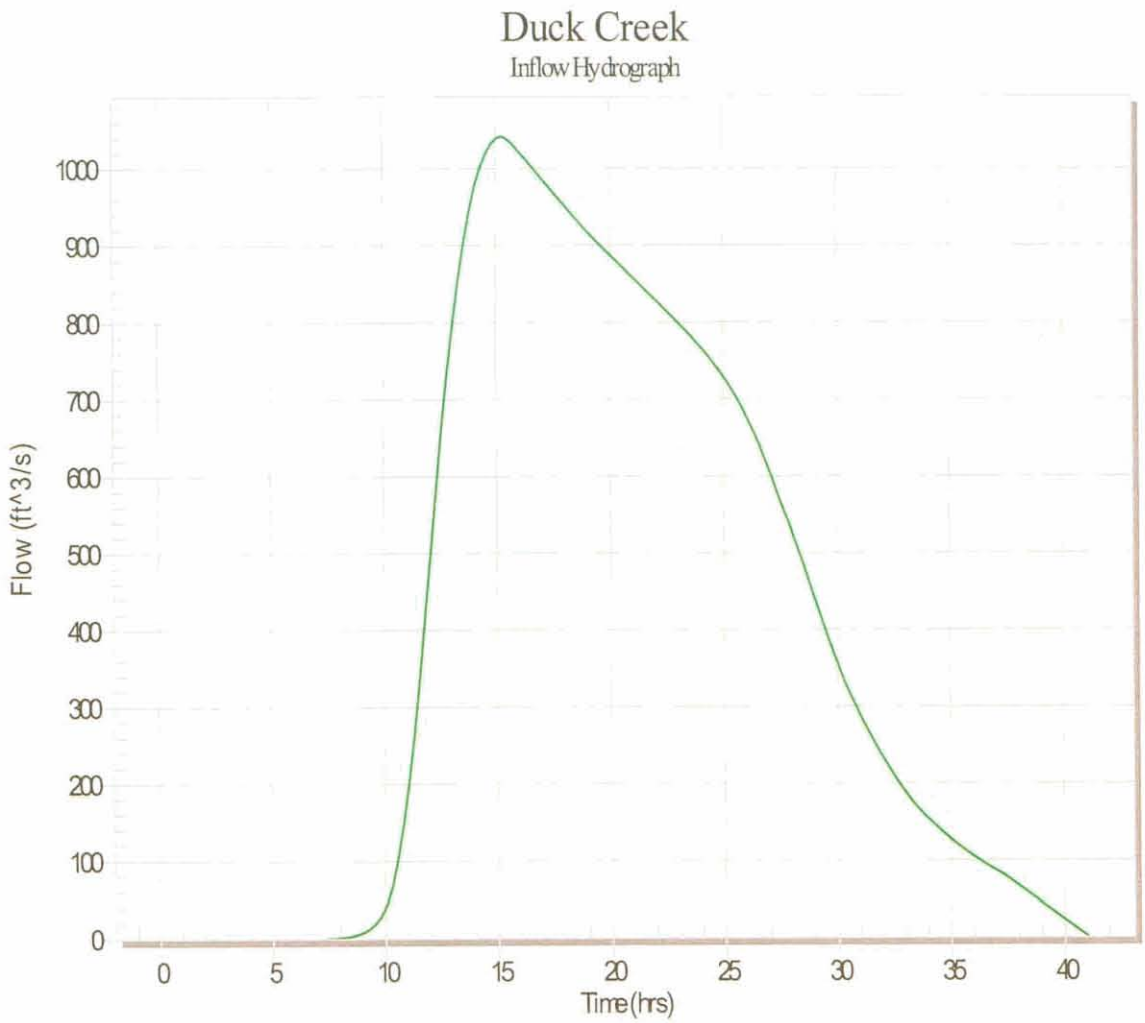


Figure 7: Offsite Hydrograph for North Little John Creek

a) Little John Creek

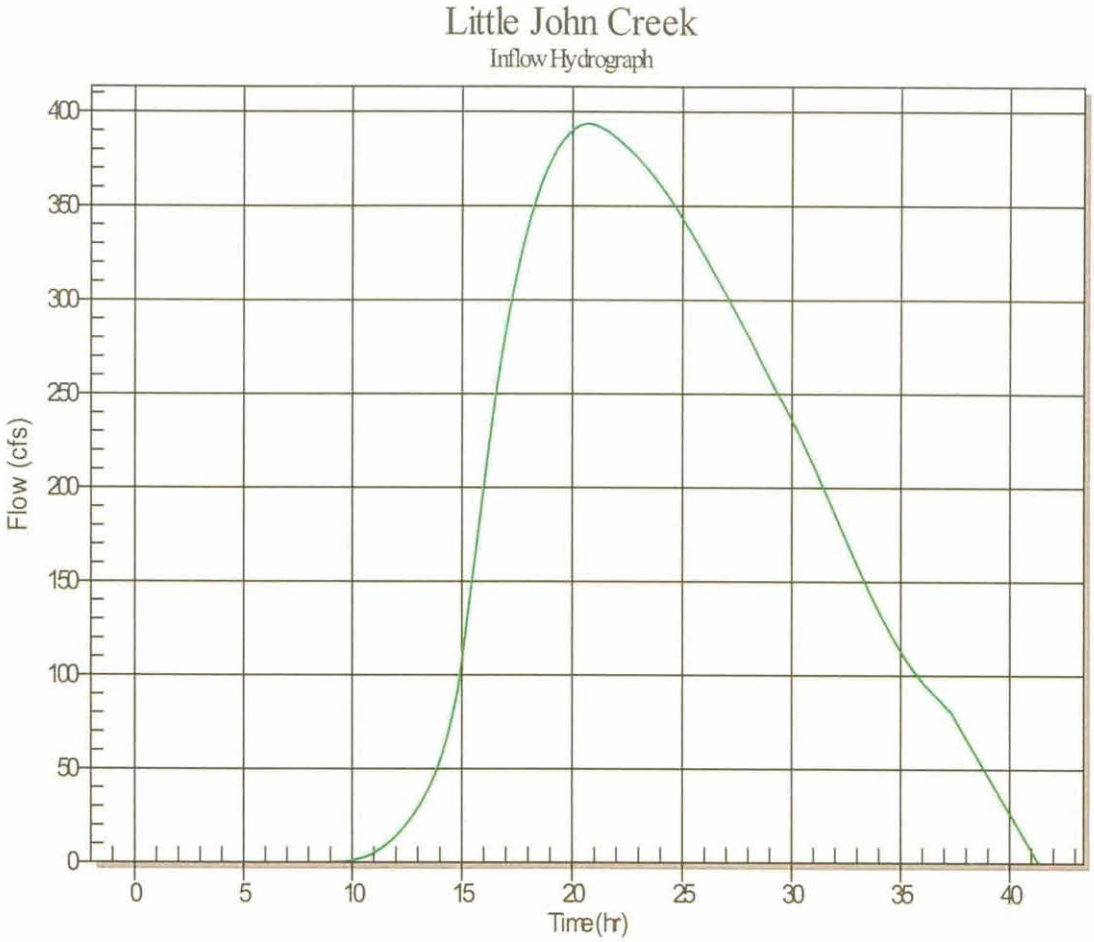
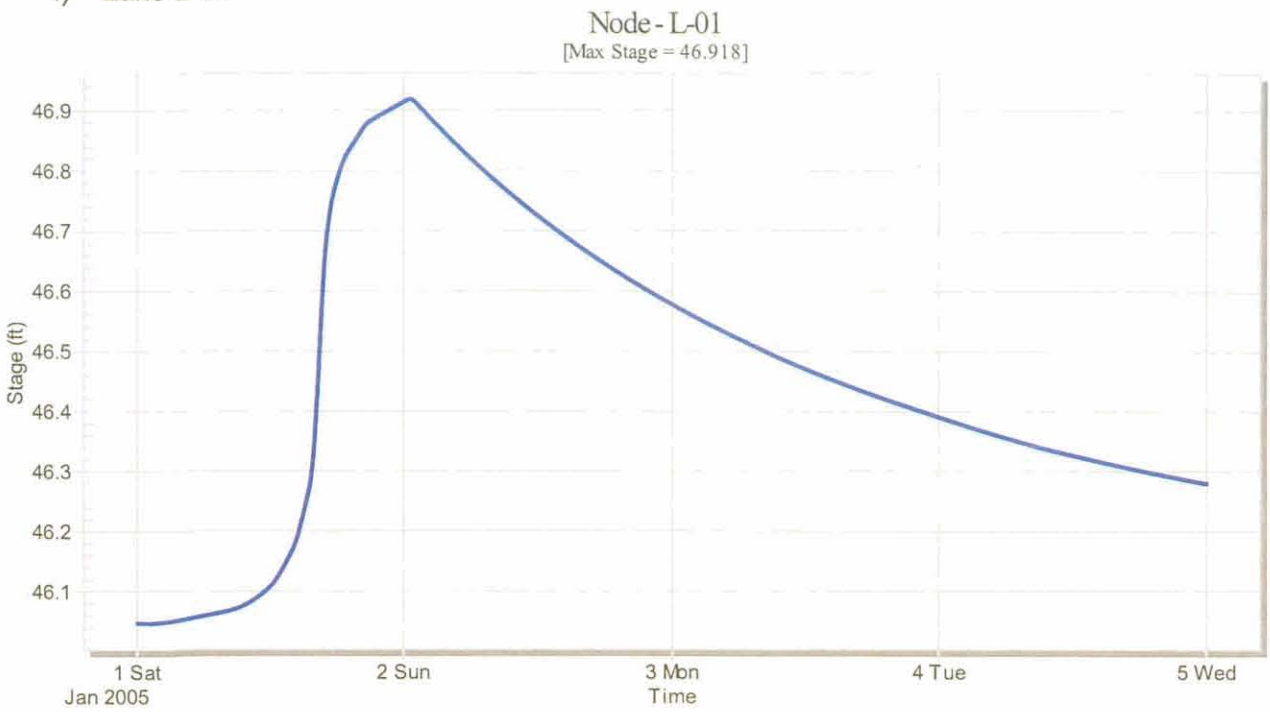


Figure 8: Lake Water Surface Fluctuations

i) Lake L-01



ii) Lake L-02

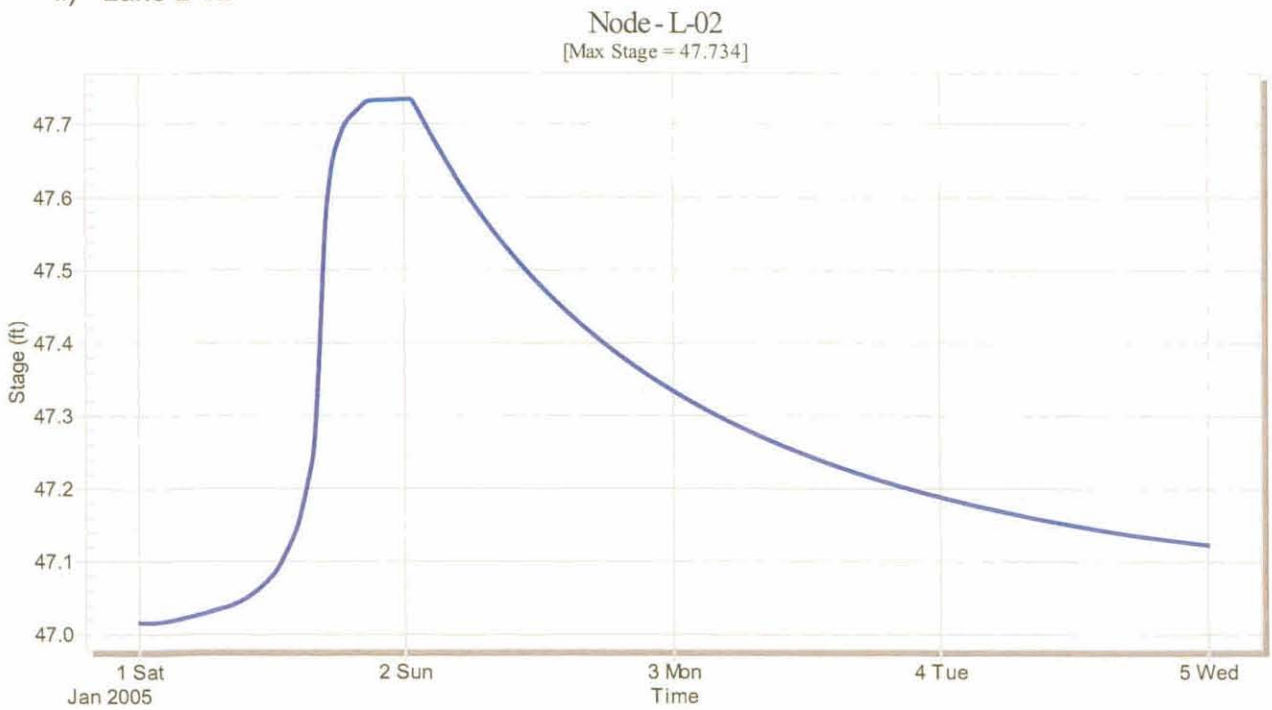
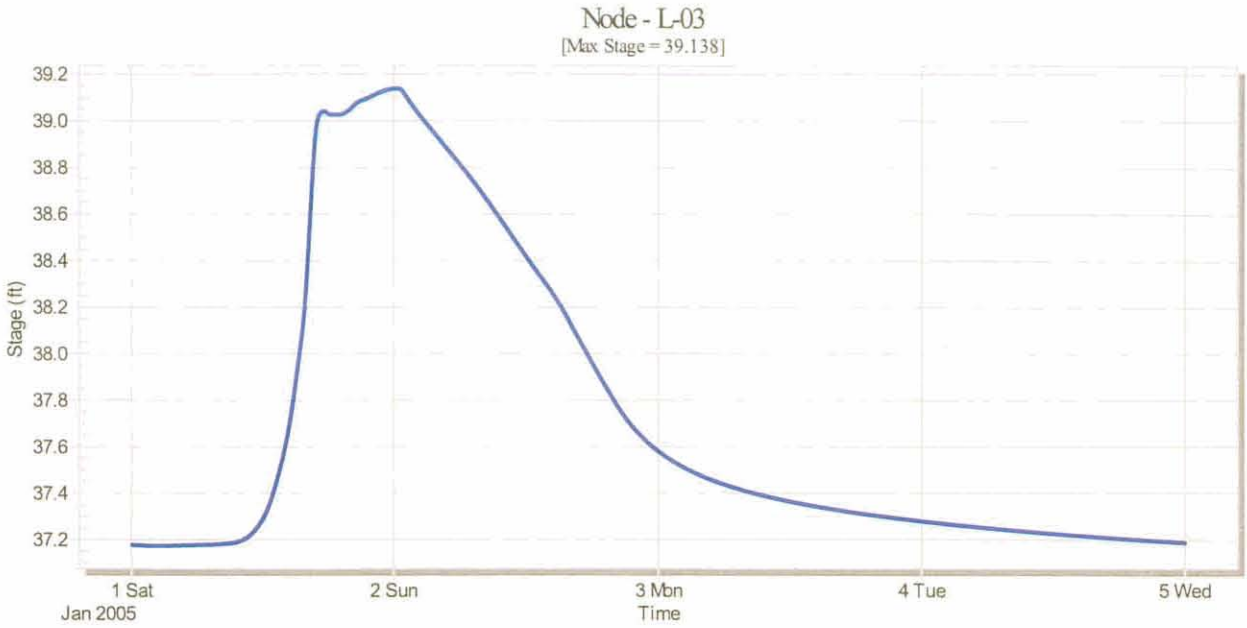


Figure 8: Lake Water Surface Fluctuations Continued

iii) Lake L-03



iv) Lake L-04

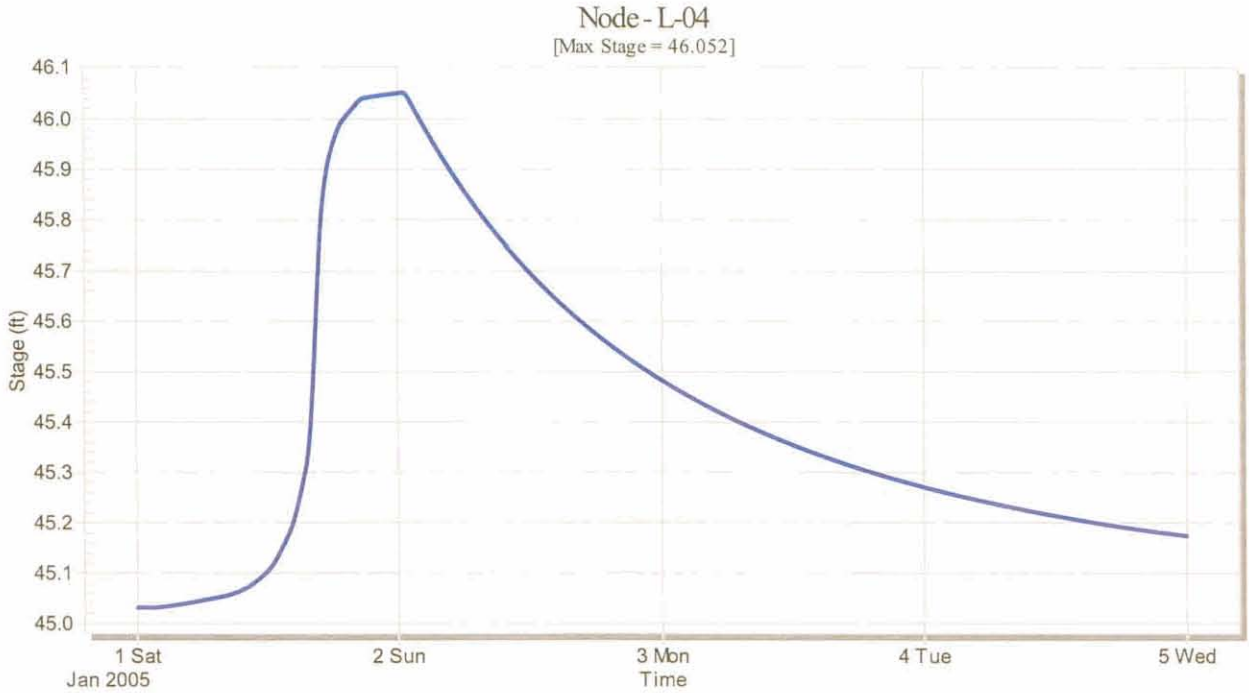
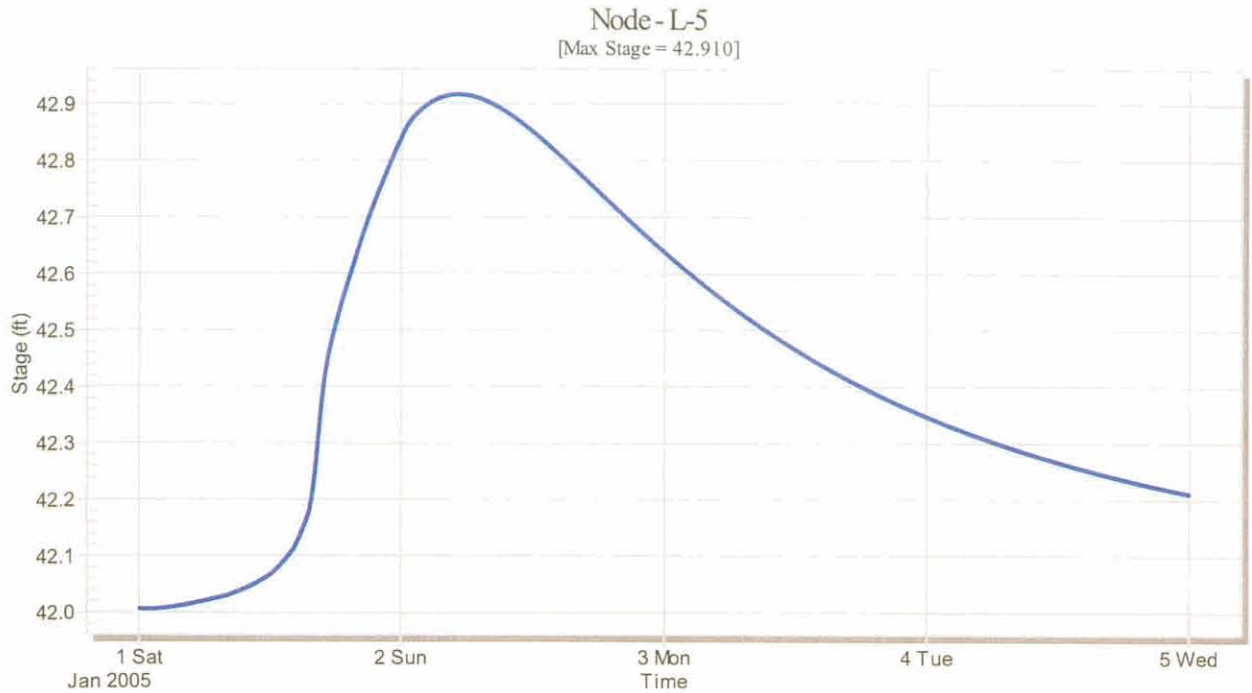


Figure 8: Lake Water Surface Fluctuations Continued

v) Lake L-05



vi) Lake L-06

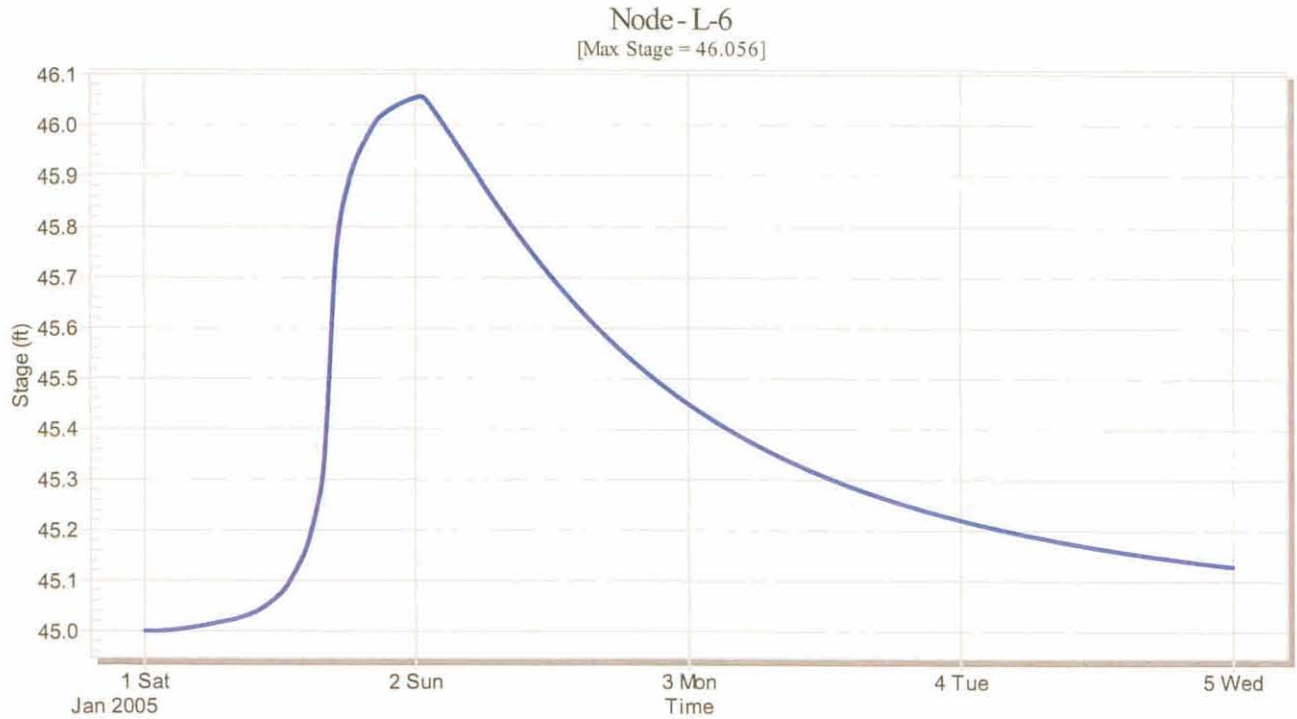
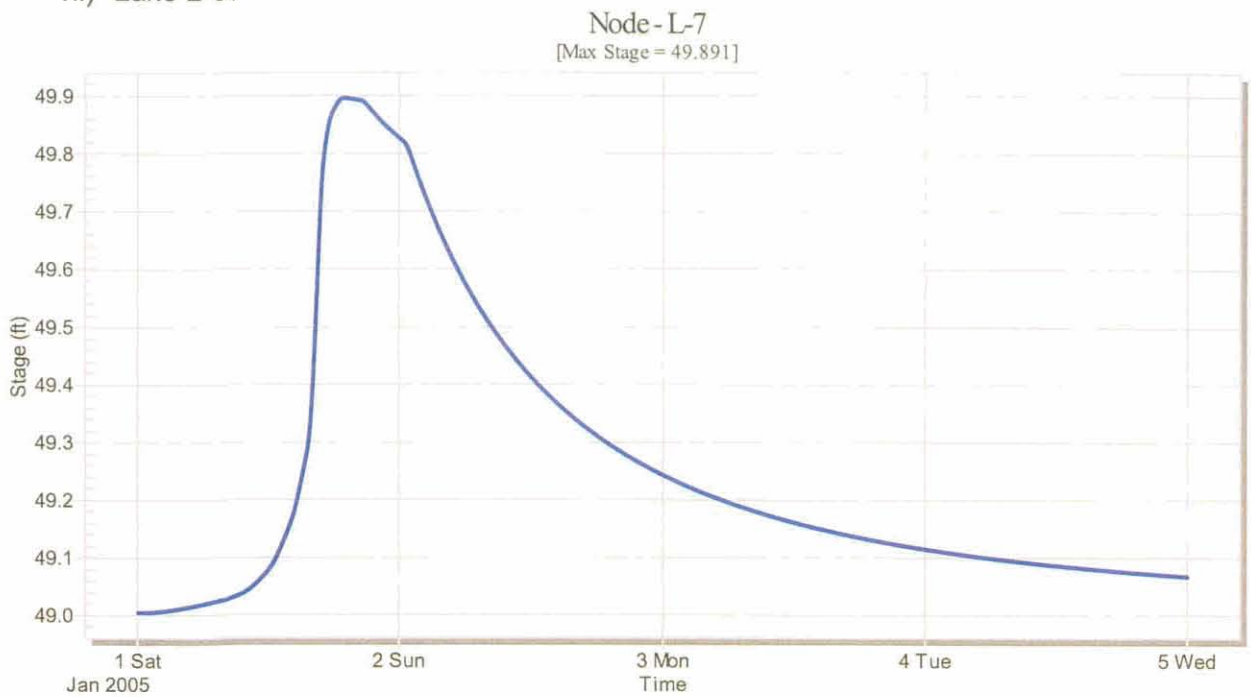


Figure 8: Lake Water Surface Fluctuations Continued

vii) Lake L-07



viii) Lake L-08

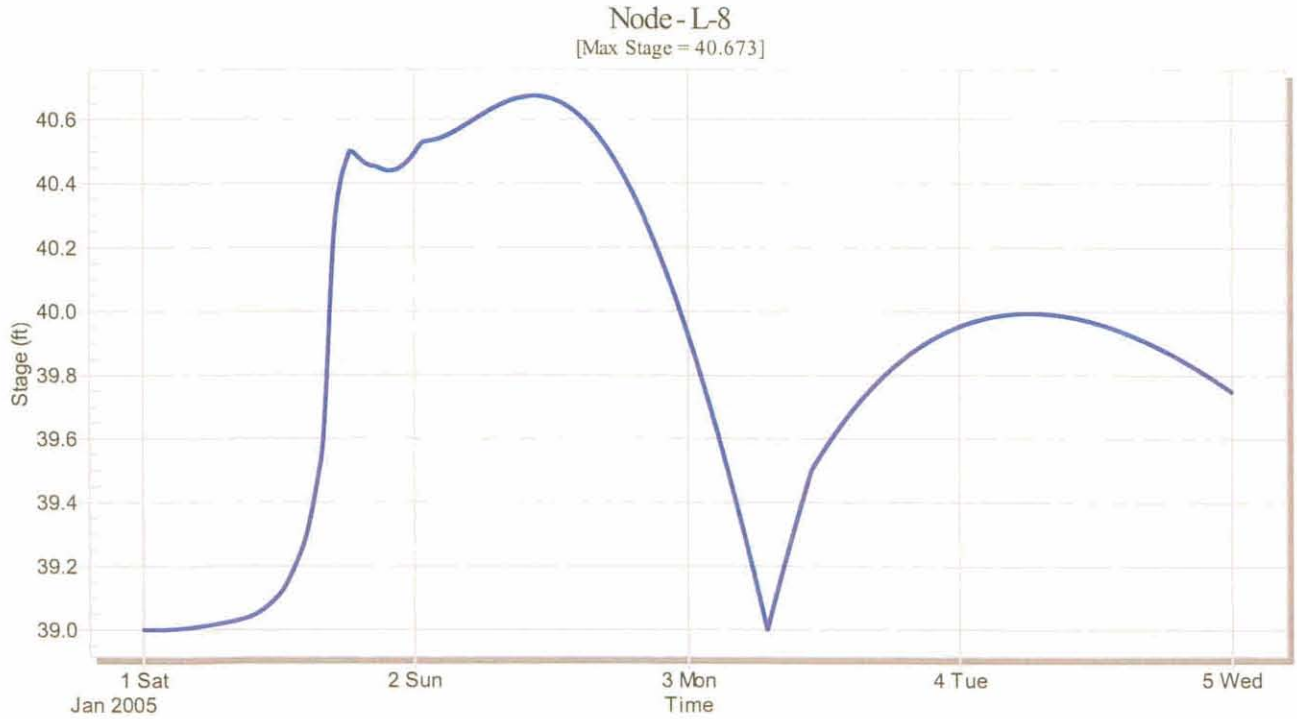
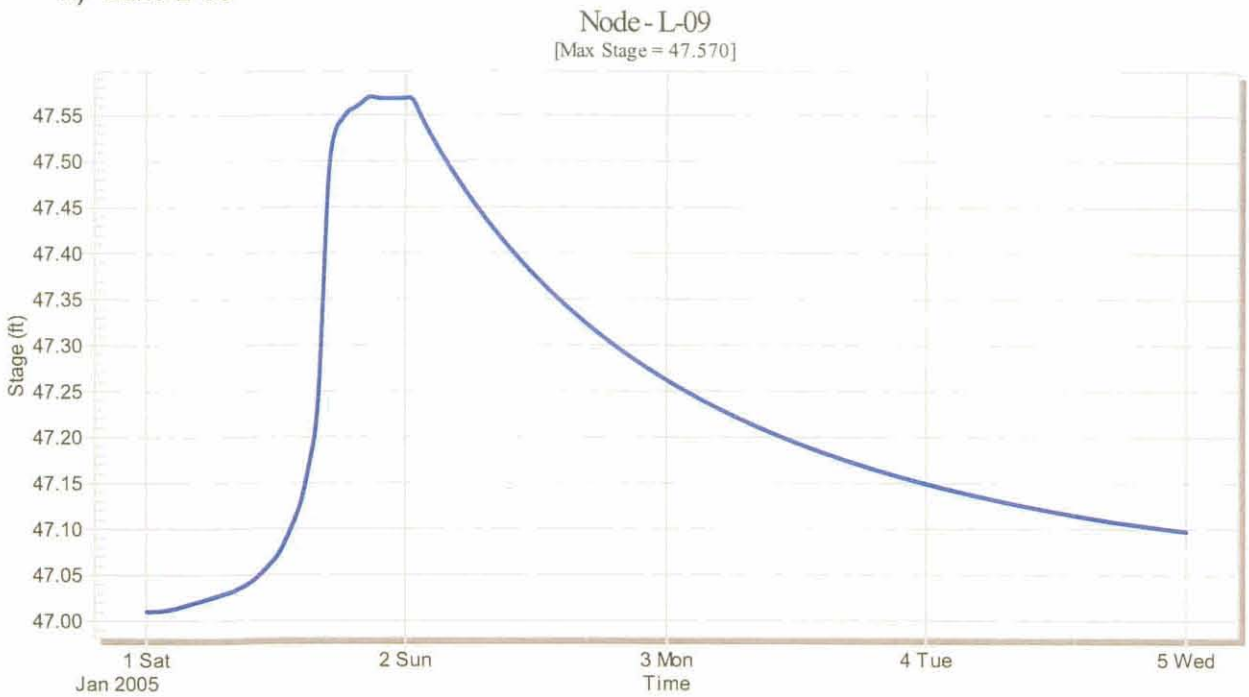


Figure 8: Lake Water Surface Fluctuations Continued

ix) Lake L-09



x) Lake L-10

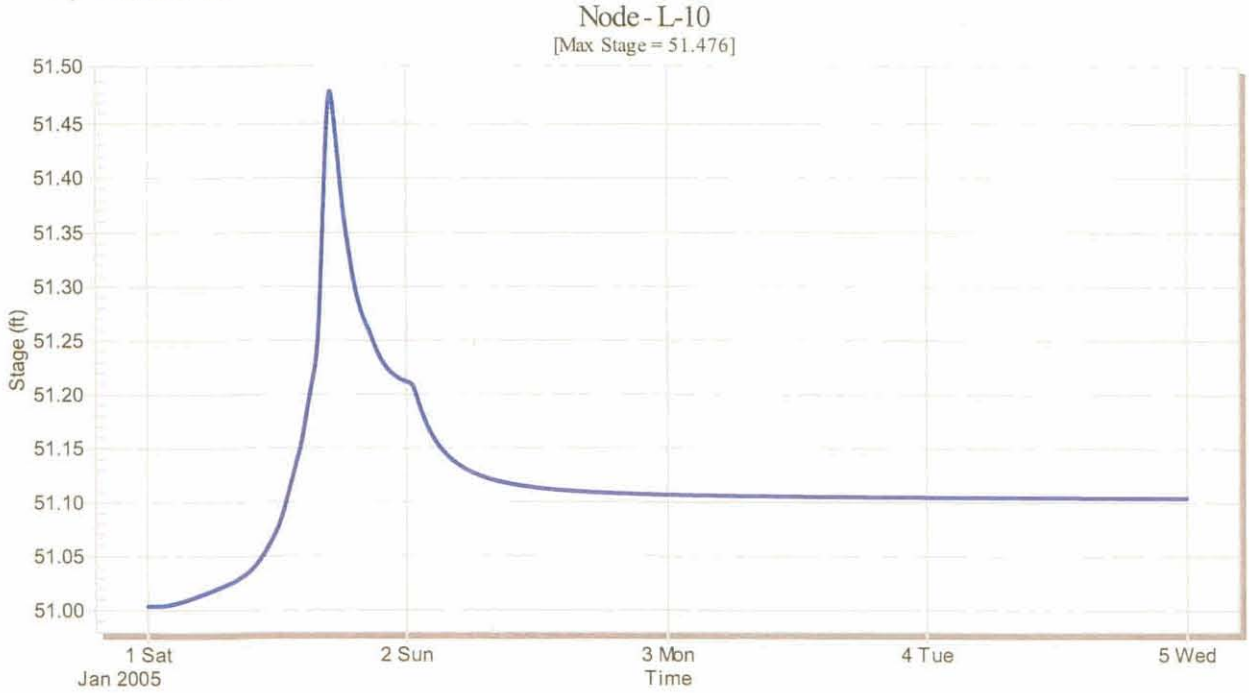


Figure 8: Lake Water Surface Fluctuations Continued

xi) Lake L-11

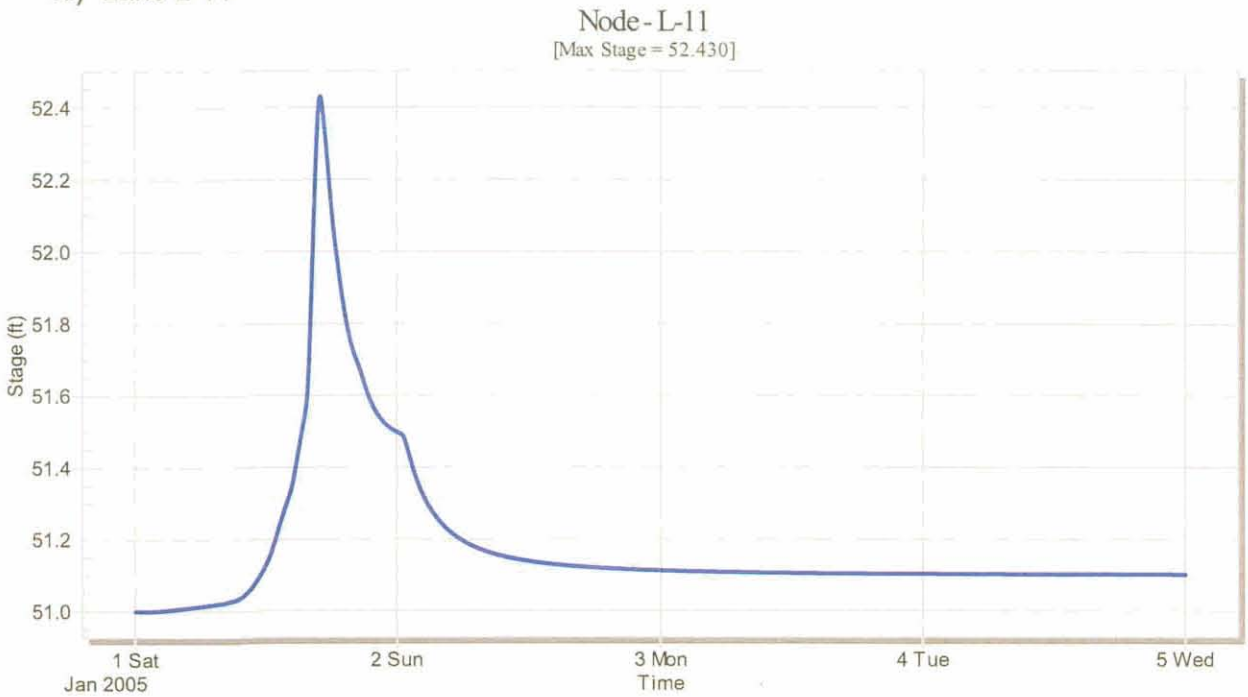
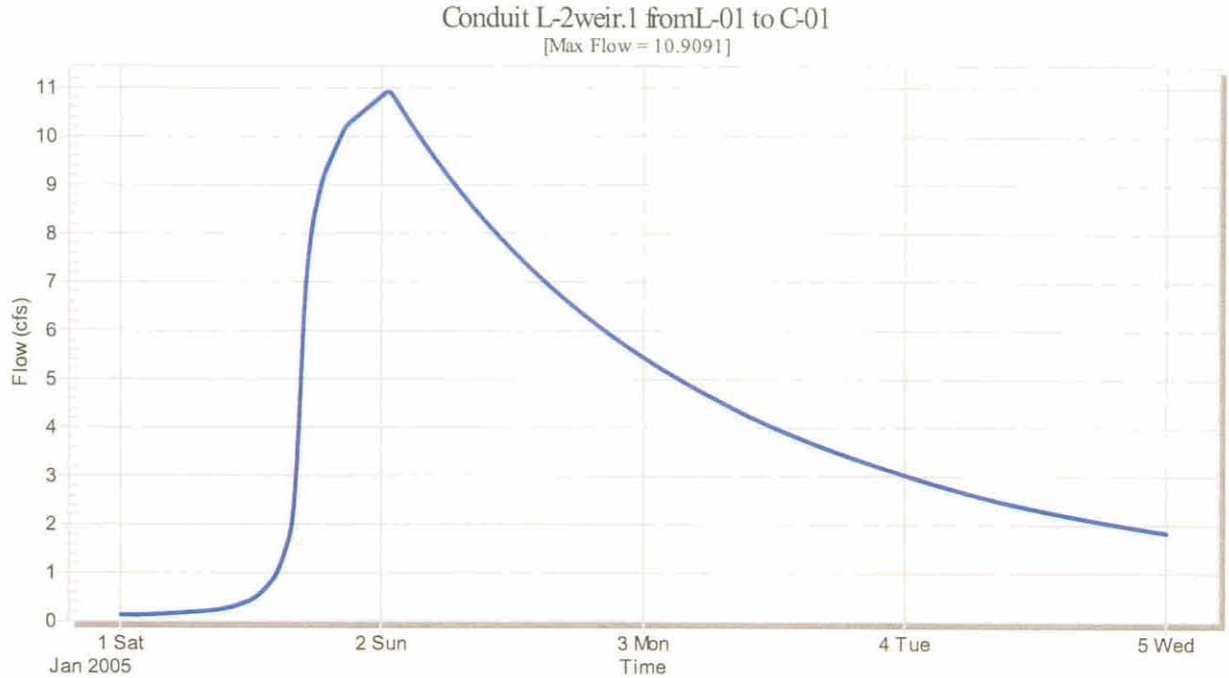


Figure 9: Lake Inflow and Outflow Hydrographs

a) Outflow Hydrographs

i) Lake L-01



ii) Lake L-02

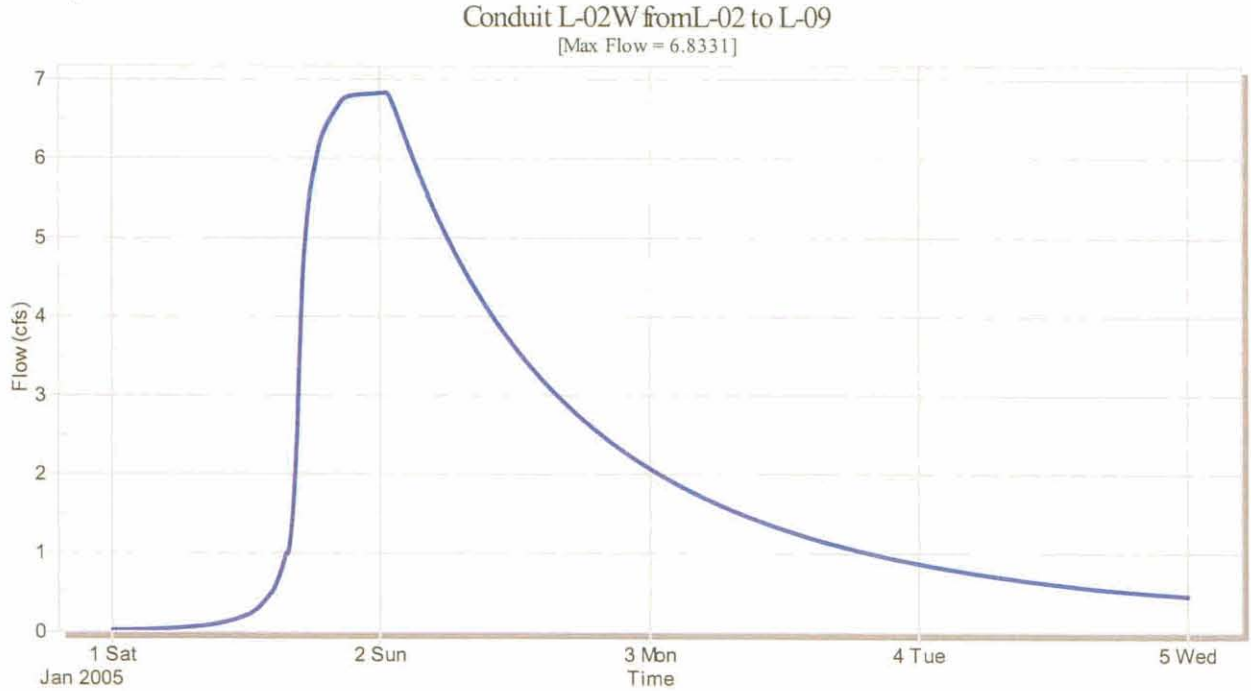
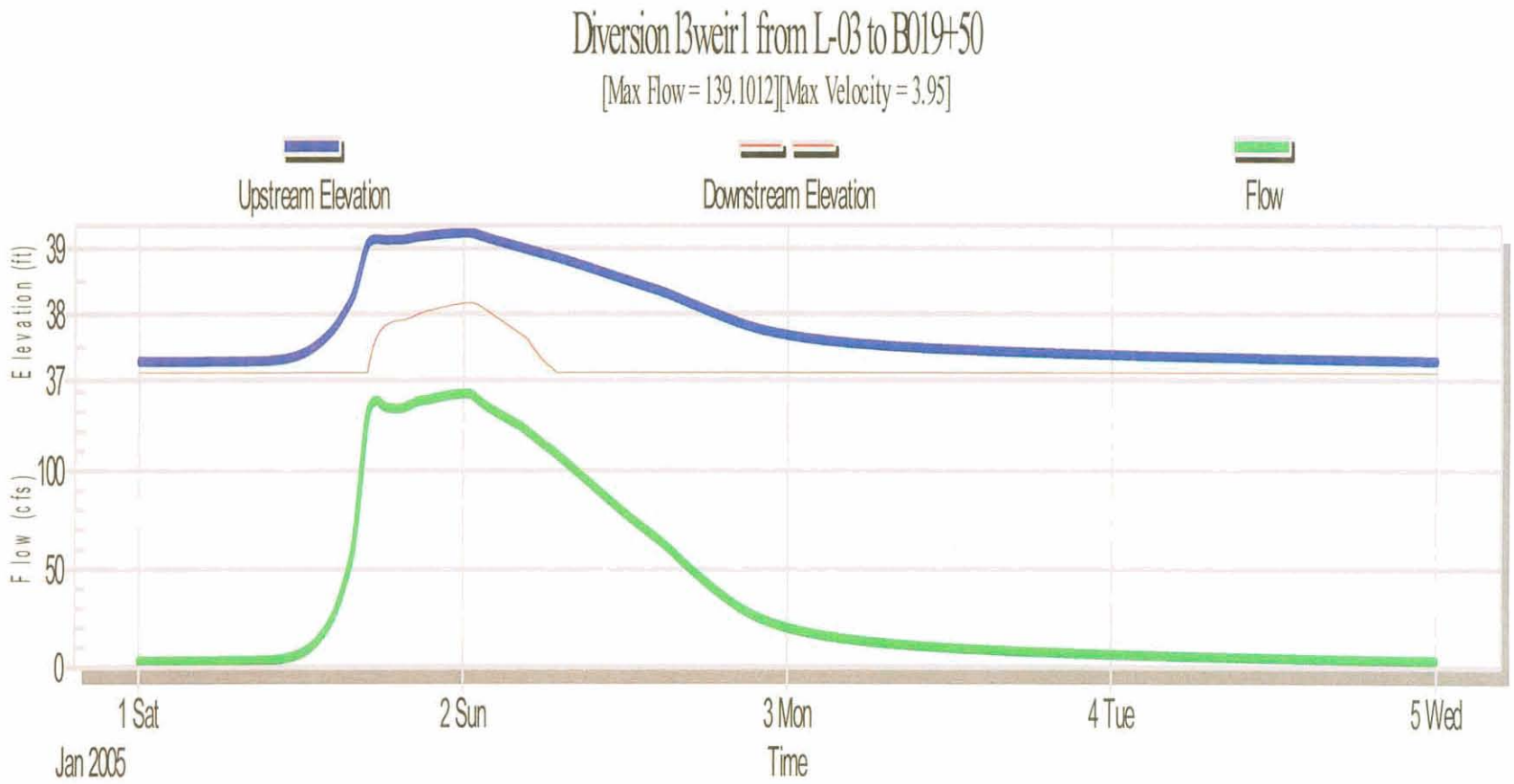
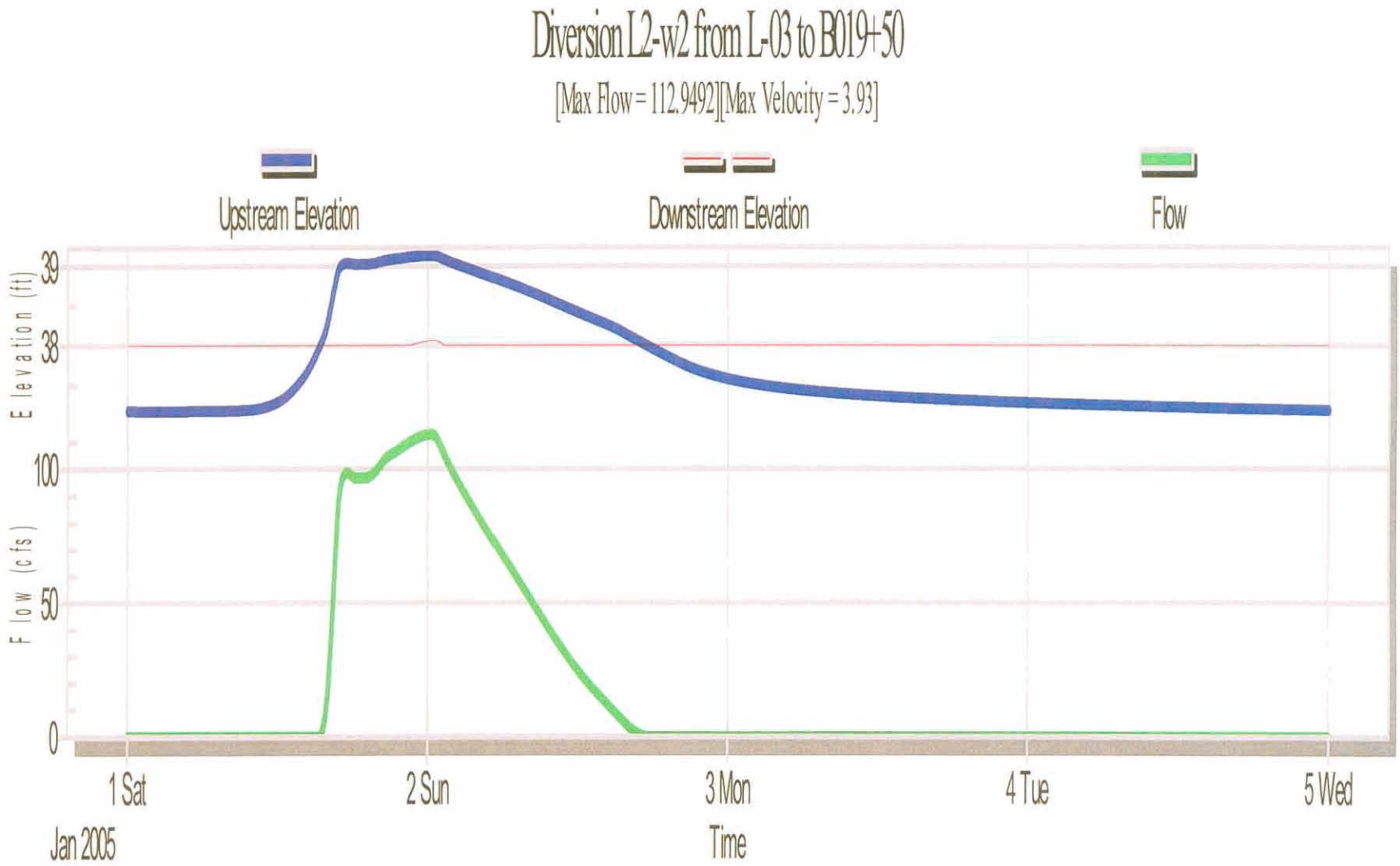


Figure 9: Lake Inflow and Outflow Hydrographs Continued
iii) Lake L-03




Diversion L2-w2 from L-03 to B019+50
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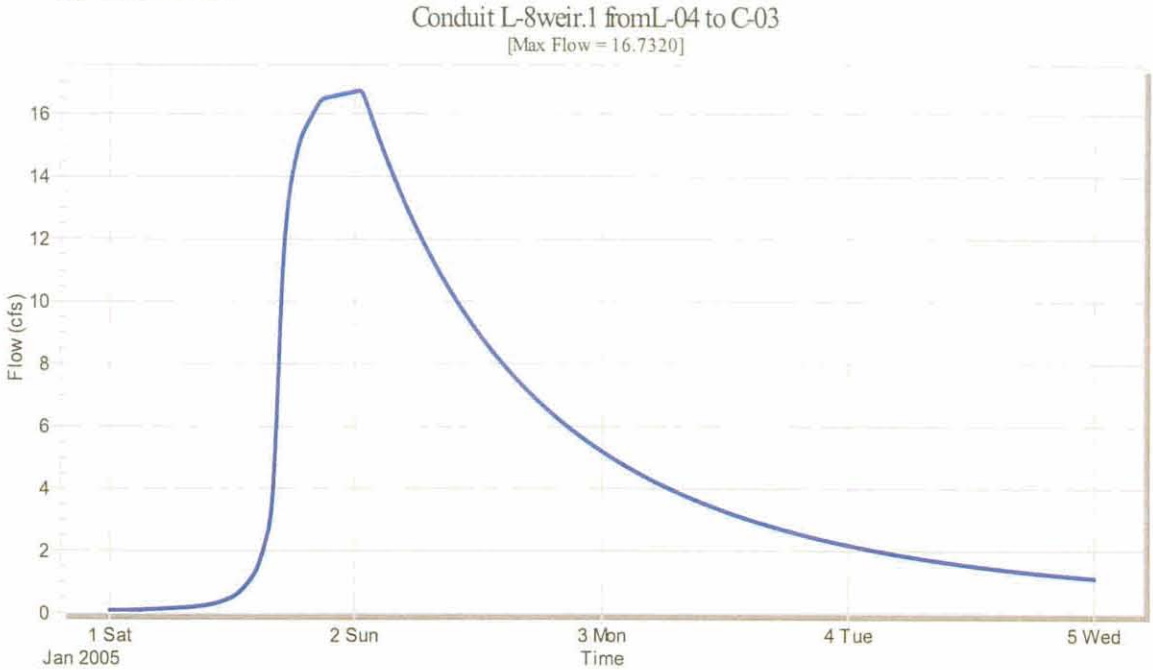
Upstream Elevation
Downstream Elevation
Flow
Elevation (ft)
39
38
Flow (cfs)
100
50
0
1 Sat
Jan 2005
2 Sun
3 Mon
Time
4 Tue
5 Wed

Figure 9: Lake Inflow and Outflow Hydrographs Continued

iv) Lake L-04



v) Lake L-05

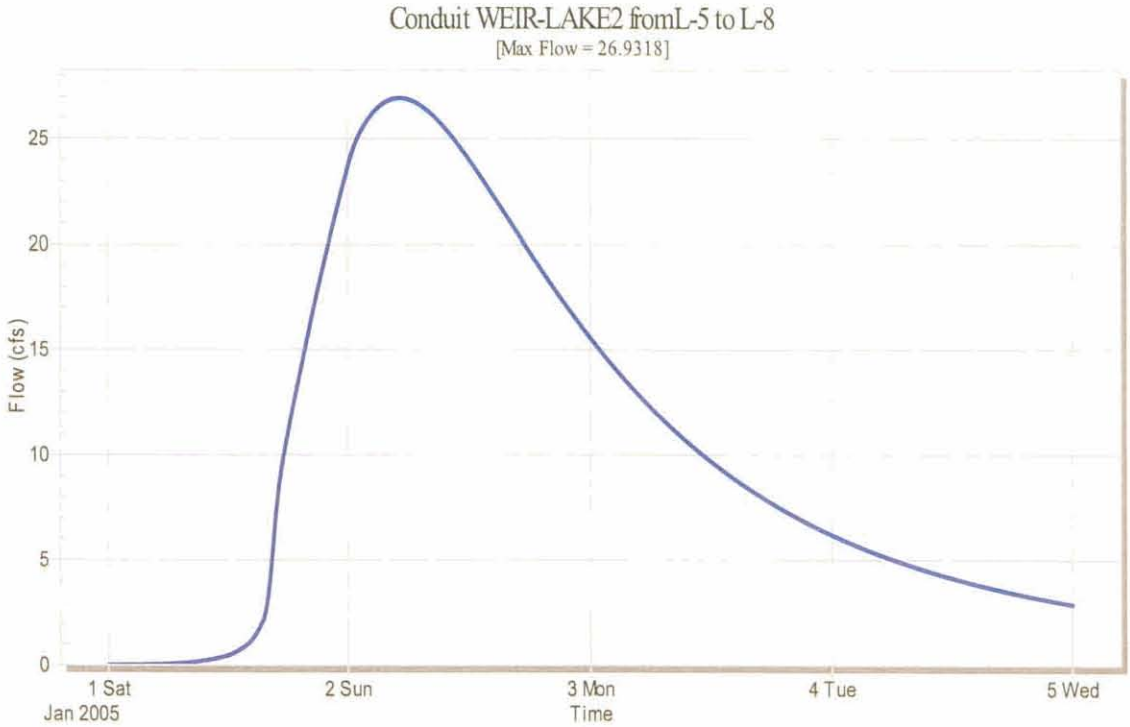
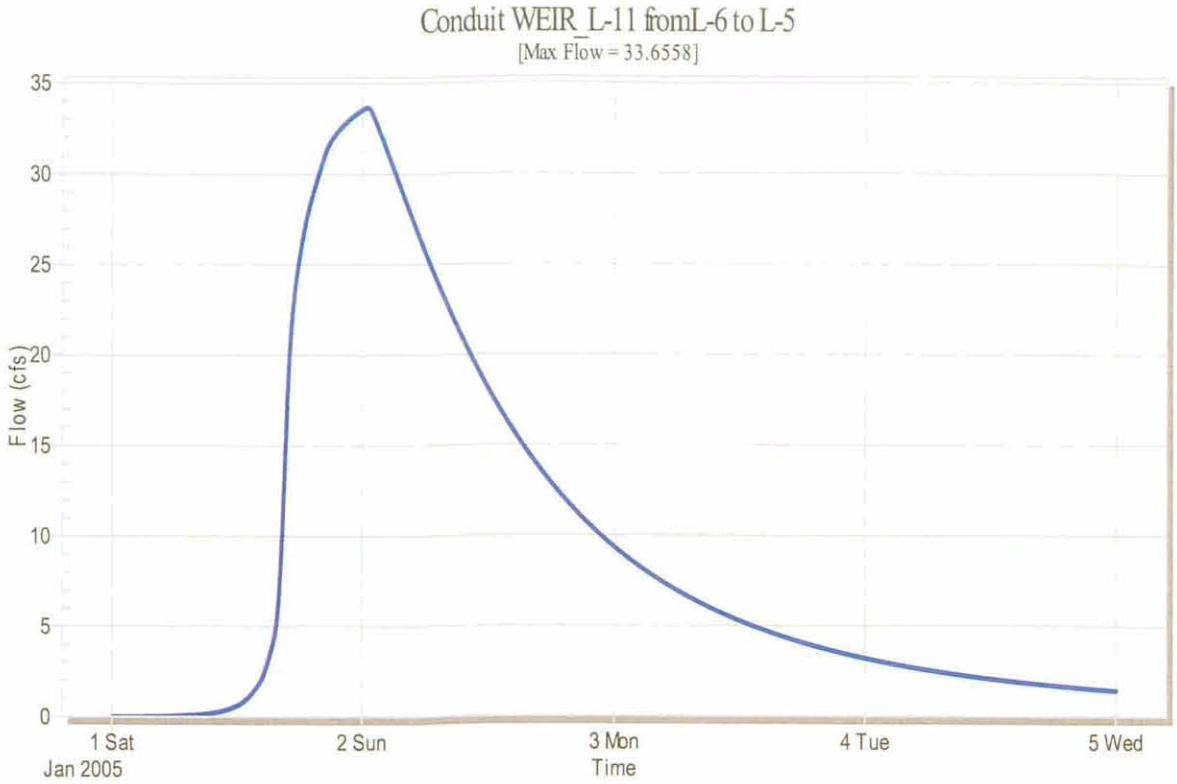


Figure 9: Lake Inflow and Outflow Hydrographs Continued

vi) Lake L-06



vii) Lake L-07

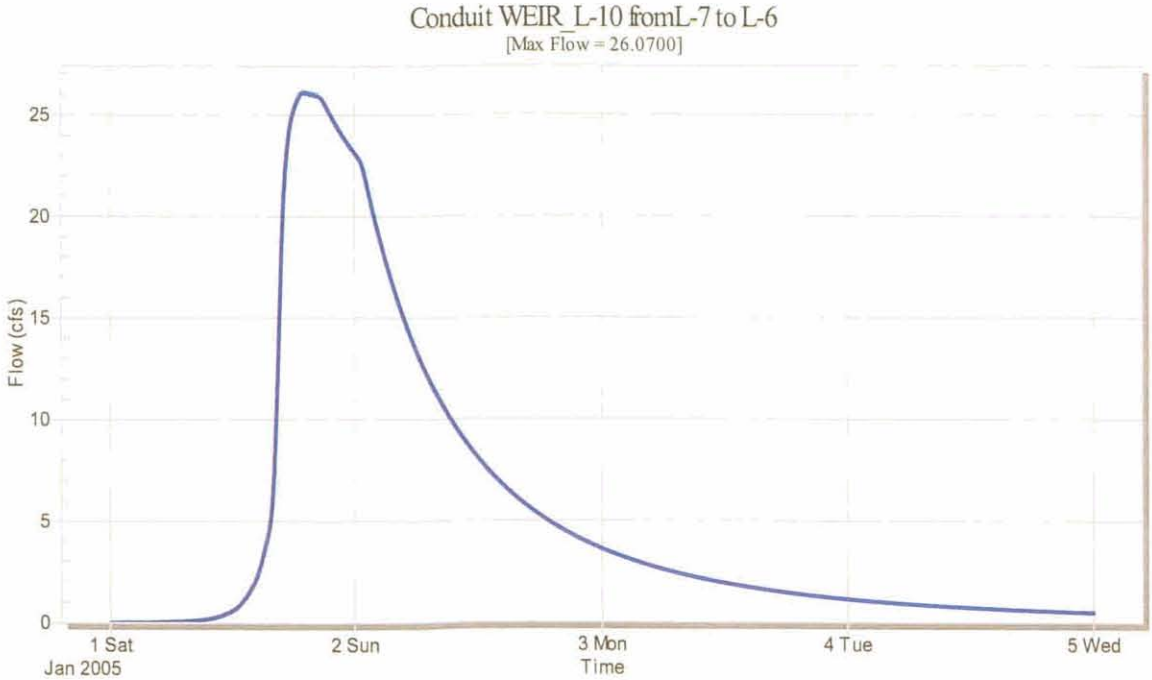
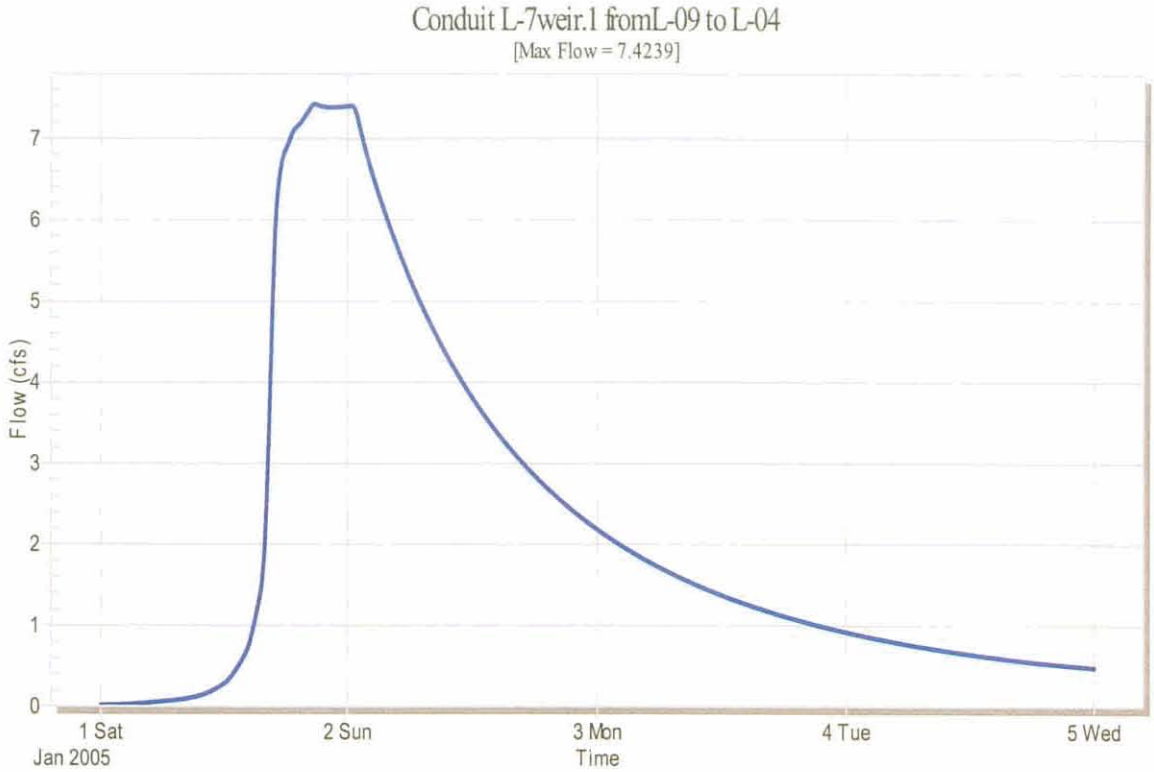


Figure 9: Lake Inflow and Outflow Hydrographs Continued

viii) Lake L-09



ix) Lake L-10

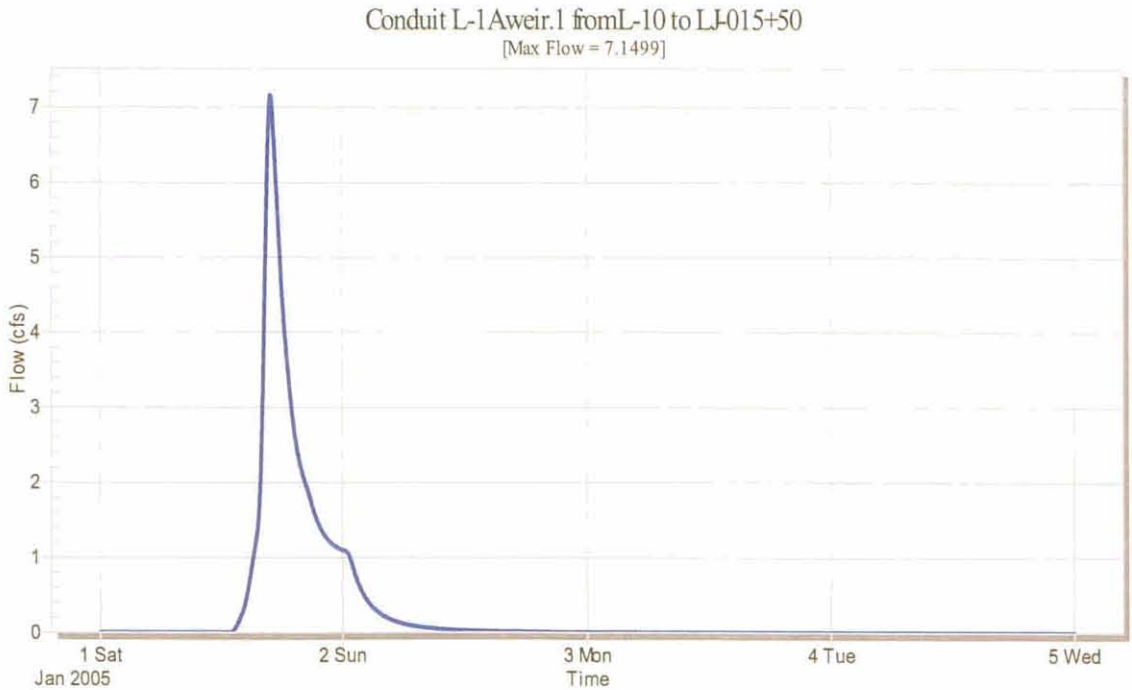
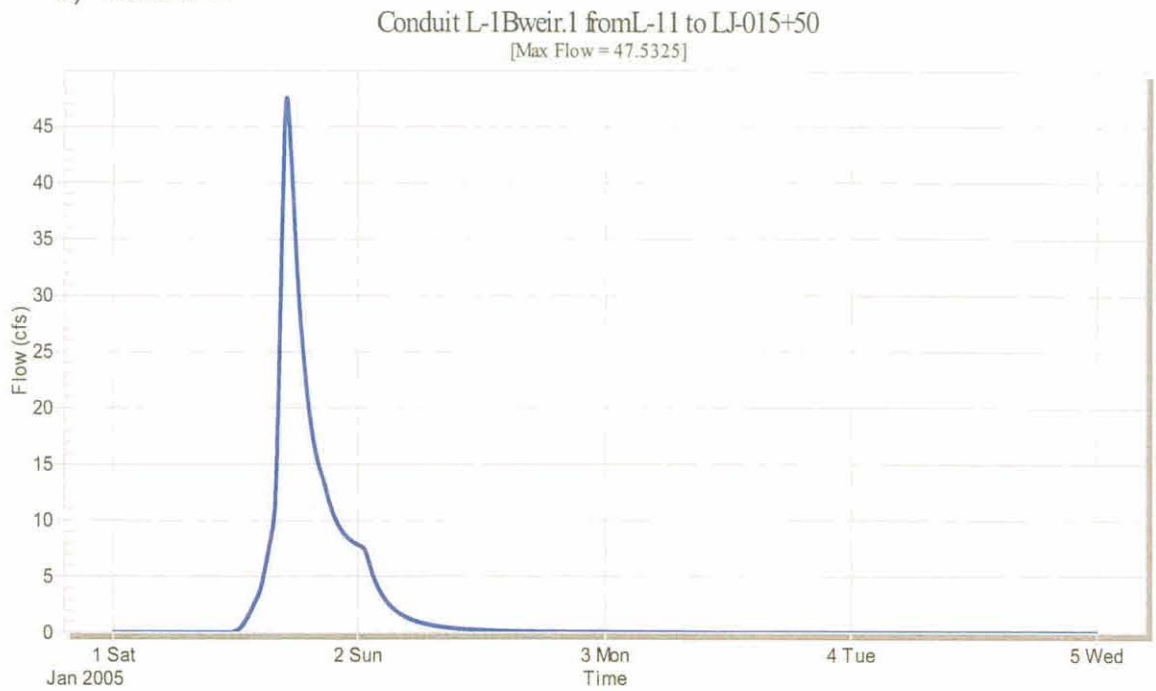


Figure 9: Lake Inflow and Outflow Hydrographs Continued

x) Lake L-11



b) Lake Inflows (Runoff)

i) Lake L-01

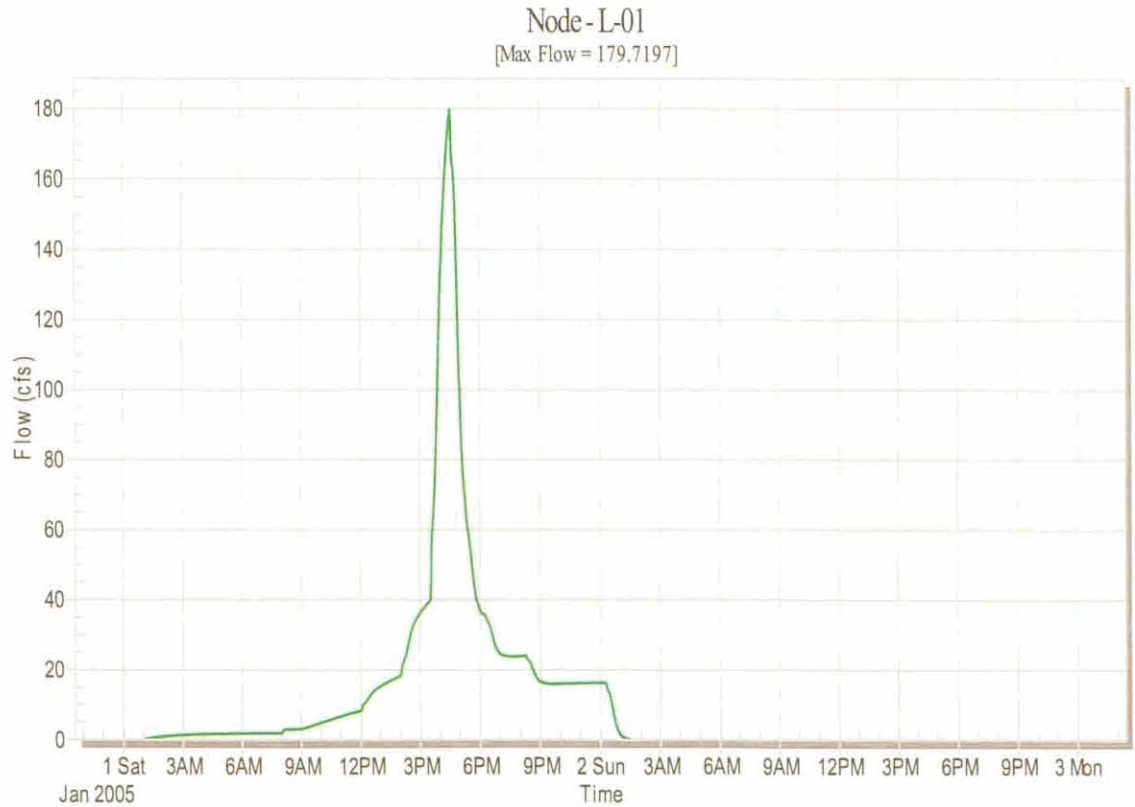
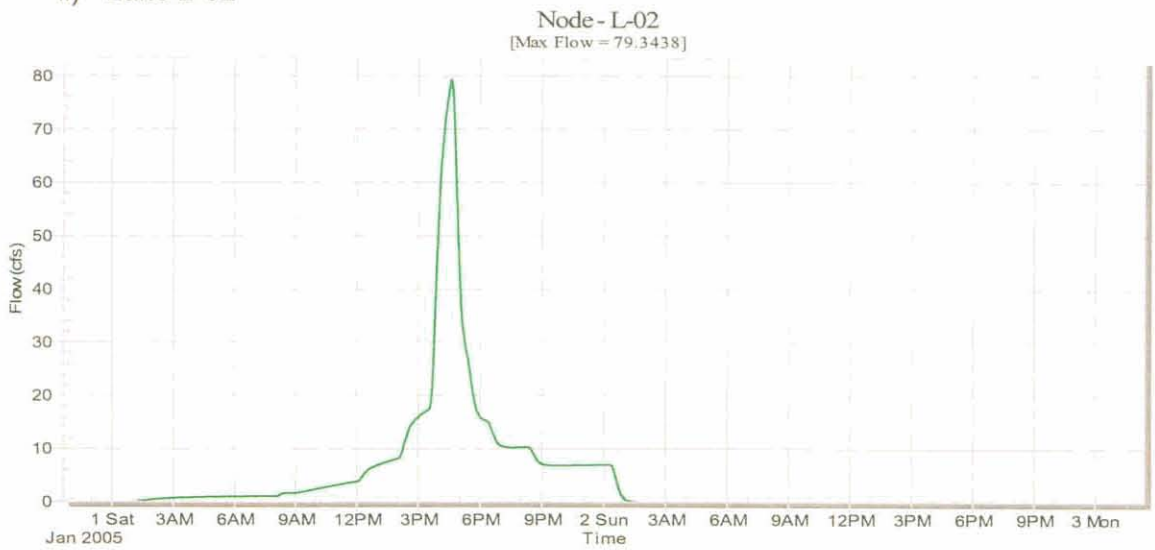
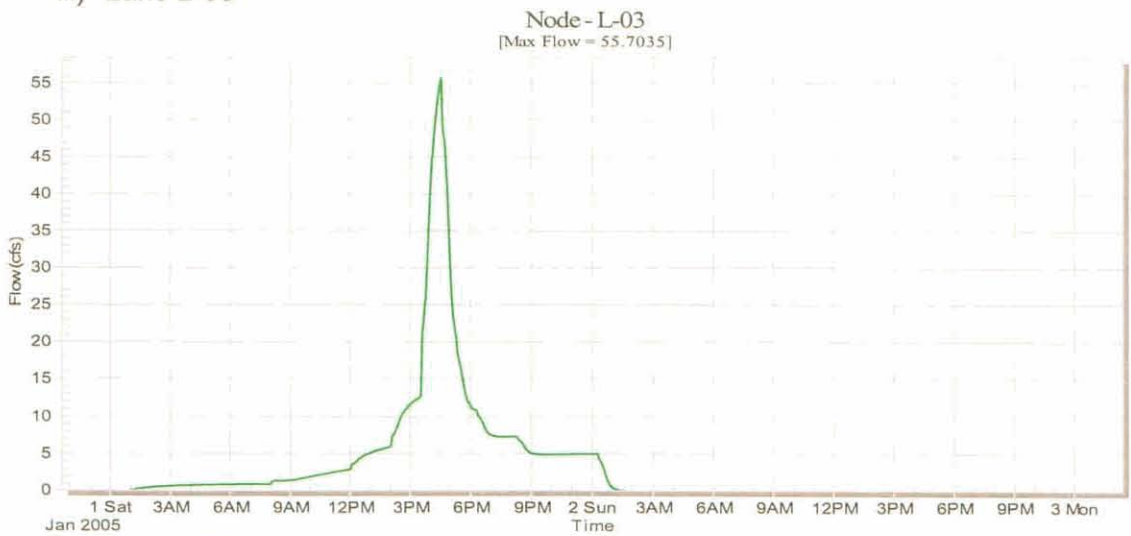


Figure 9: Lake Inflow and Outflow Hydrographs Continued

ii) Lake L-02



iii) Lake L-03



iv) Lake L-04

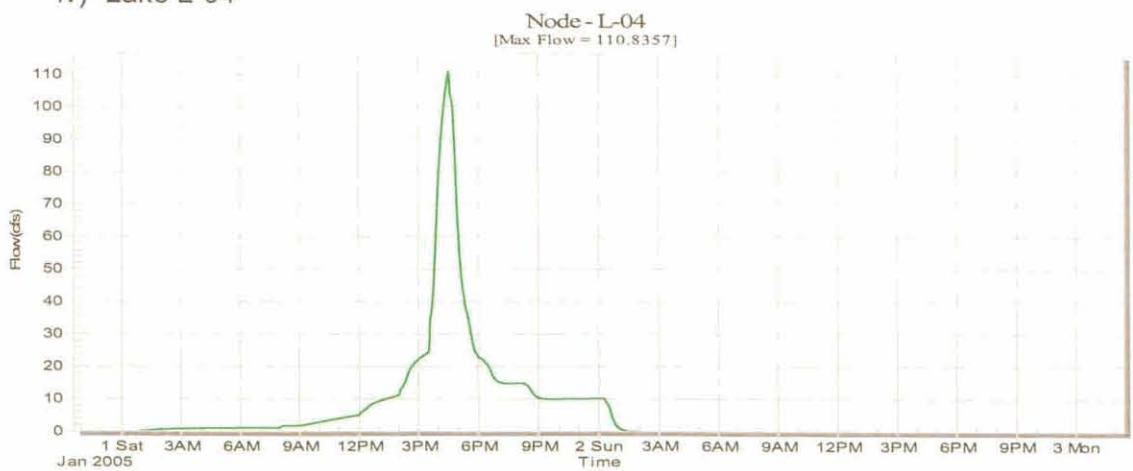
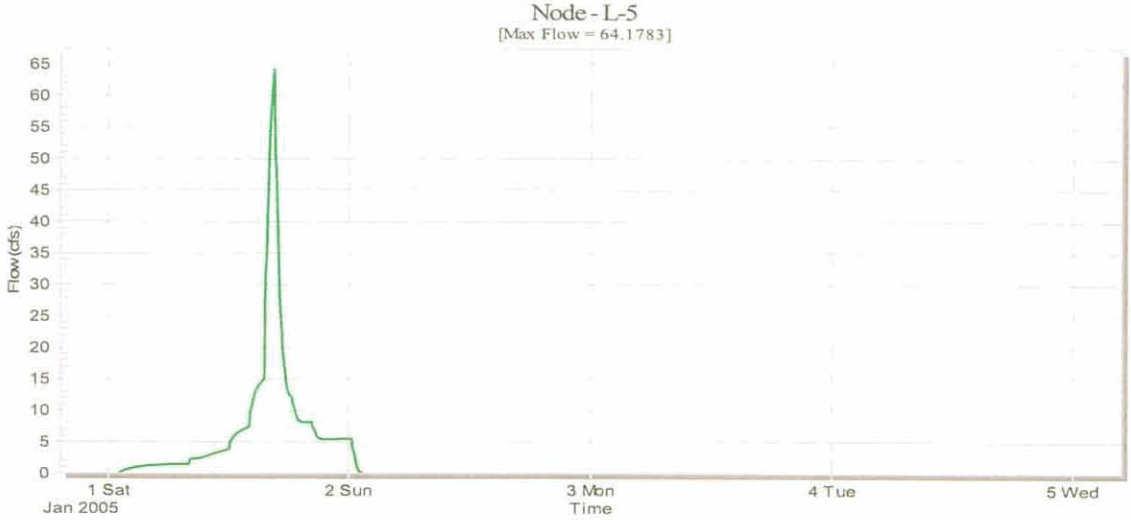
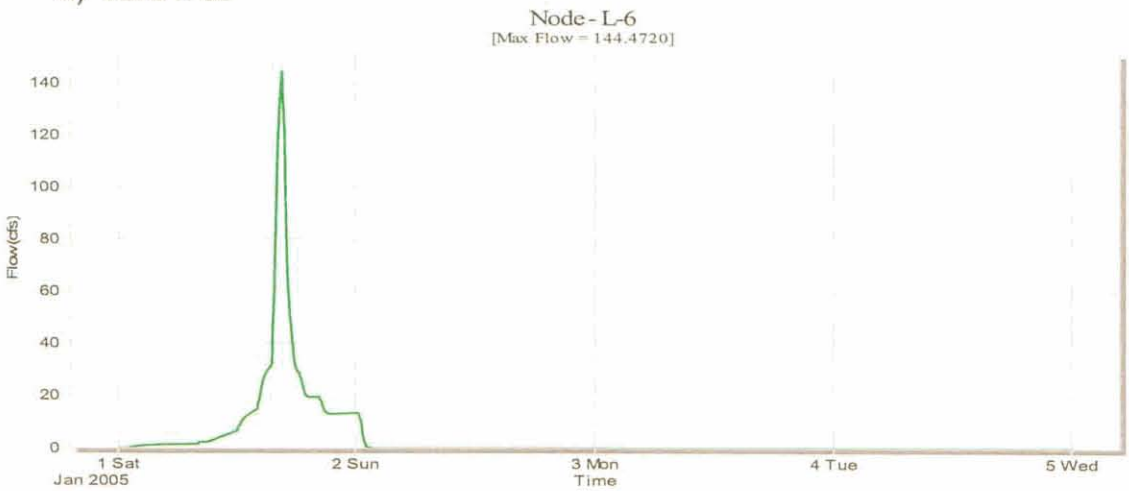


Figure 9: Lake Inflow and Outflow Hydrographs Continued

v) Lake L-05



vi) Lake L-06



vii) Lake L-07

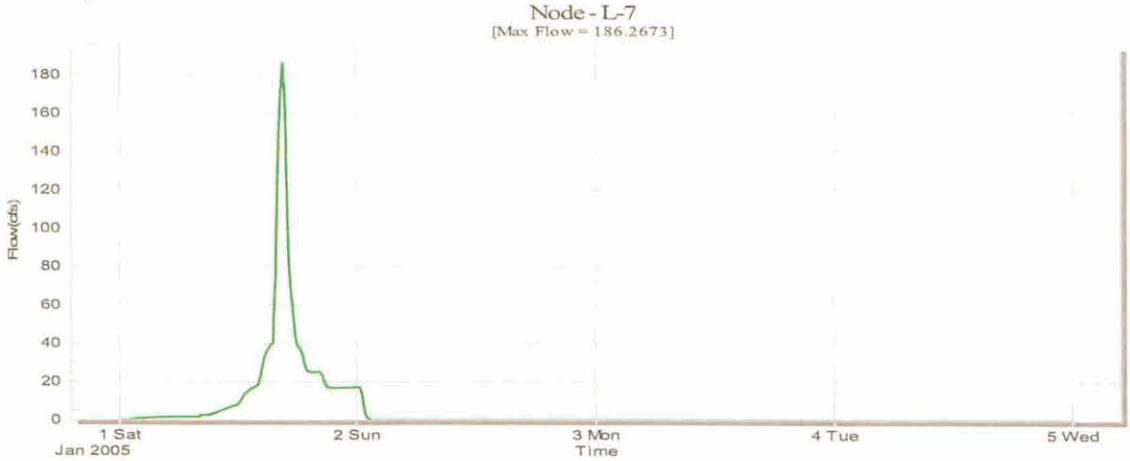
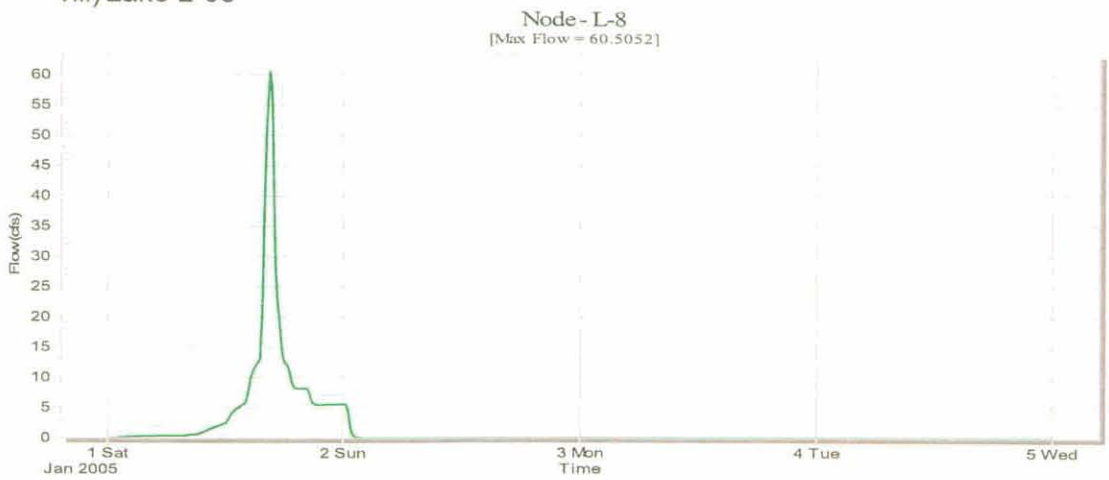
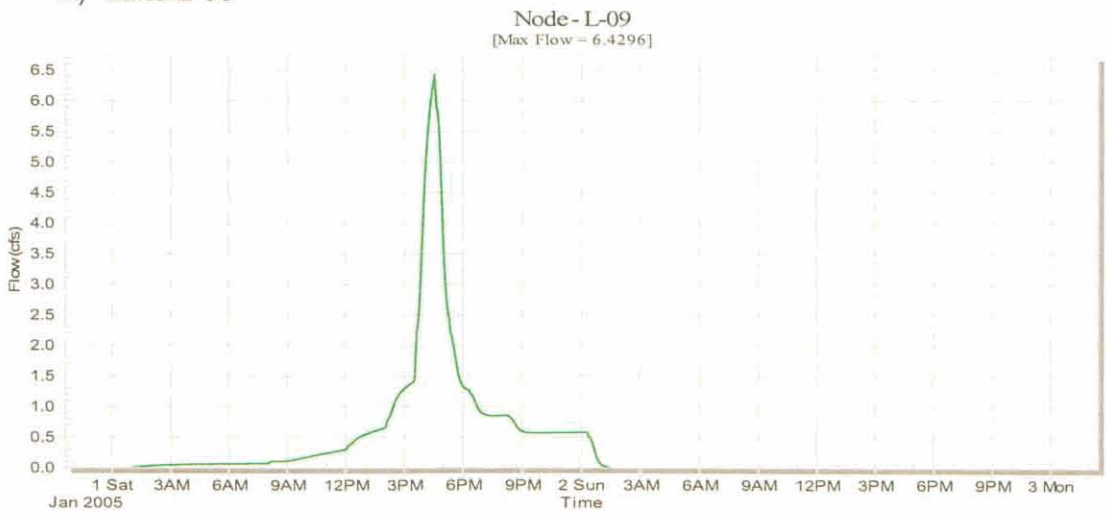


Figure 9: Lake Inflow and Outflow Hydrographs Continued

viii) Lake L-08



ix) Lake L-09



x) Lake L-10

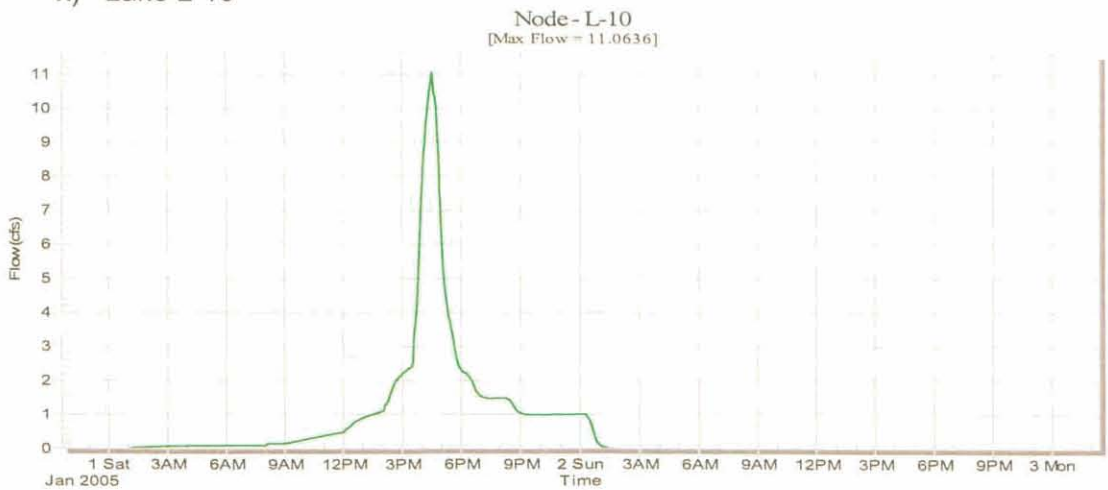


Figure 9: Lake Inflow and Outflow Hydrographs Continued
xi) Lake L-11

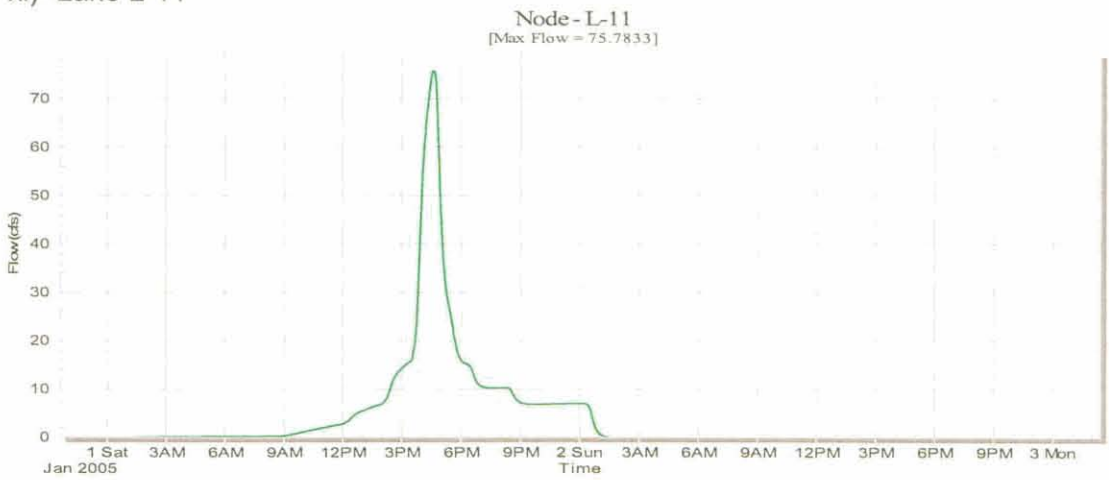
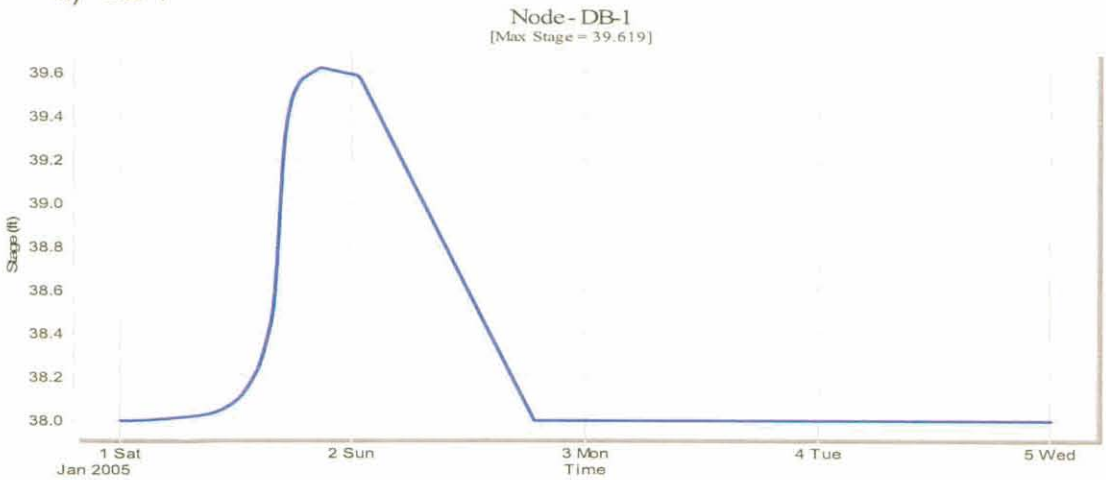
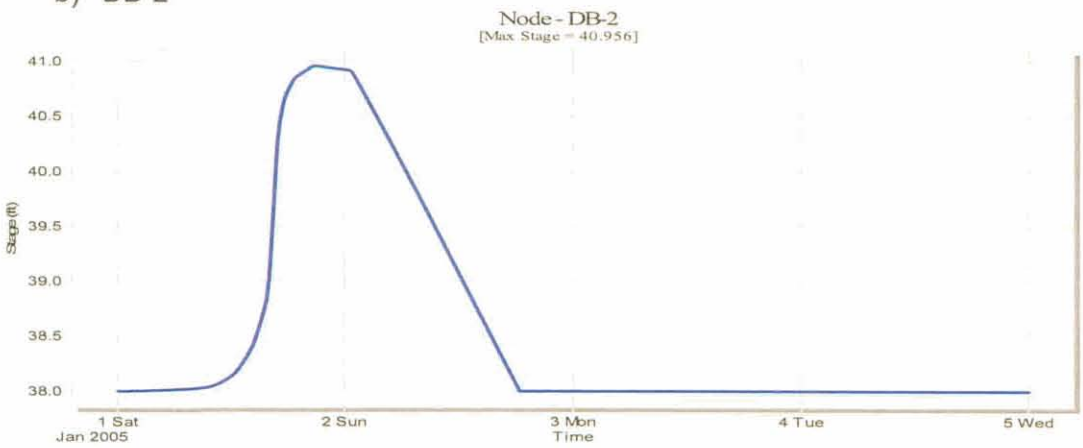


Figure 10: Detention Basin Water Surface Fluctuations

a) DB-1



b) DB-2



c) DB-3

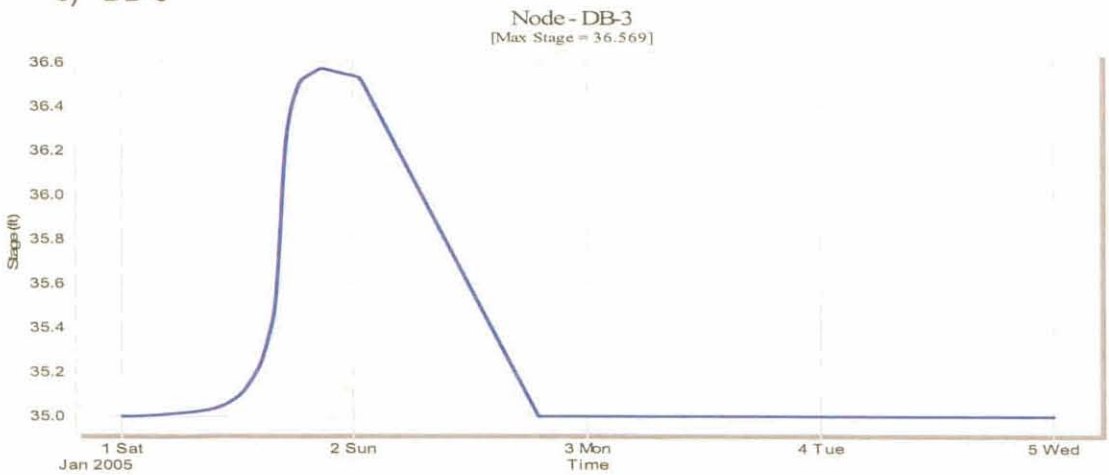
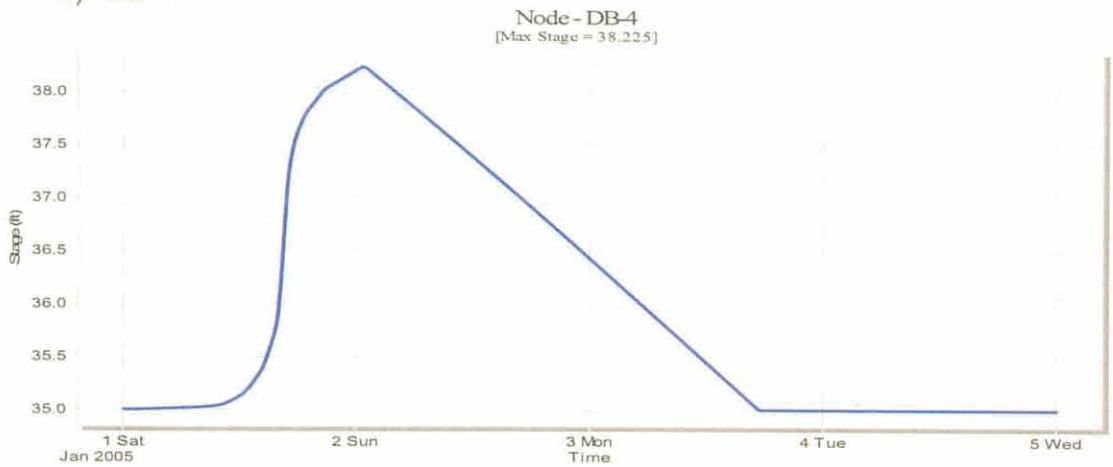
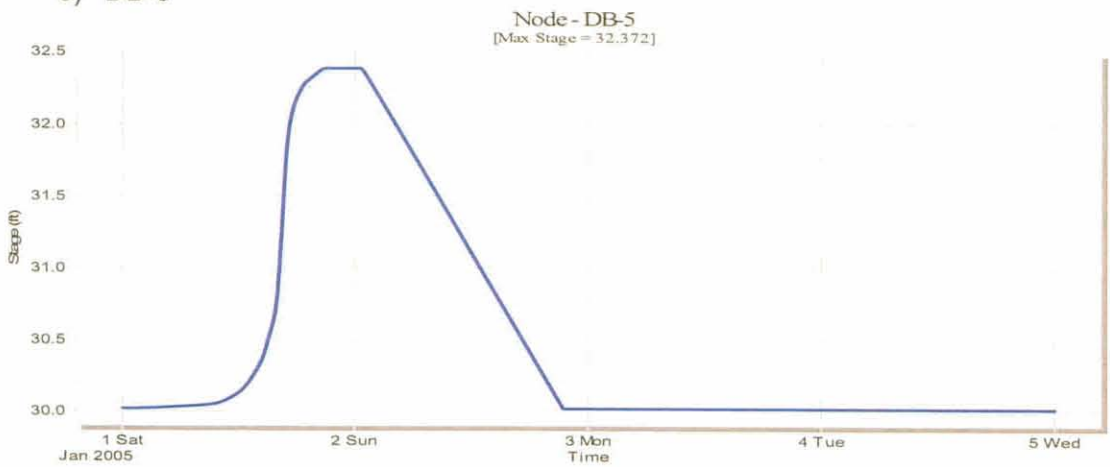


Figure 10: Detention Basin Water Surface Fluctuations Continued

d) DB-4



e) DB-5



f) DB-6

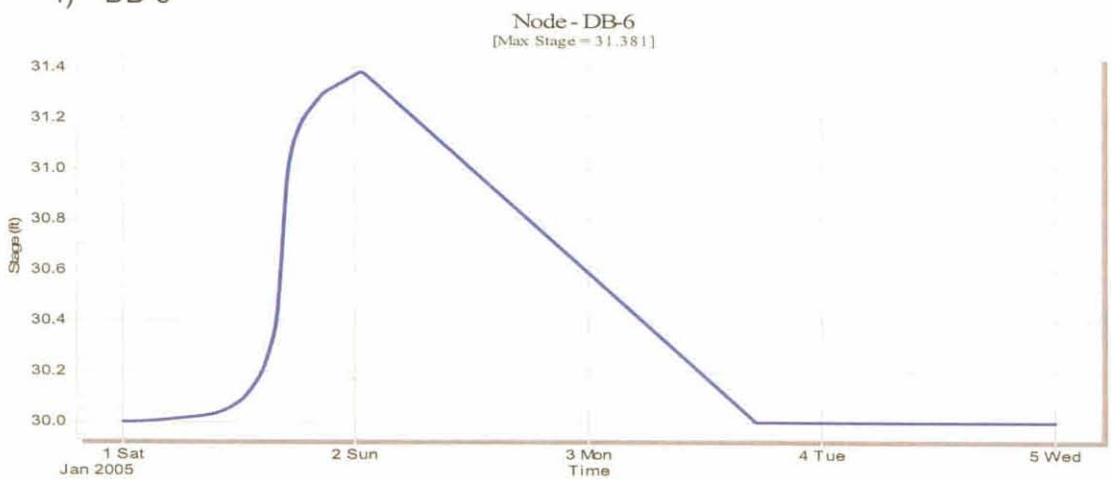
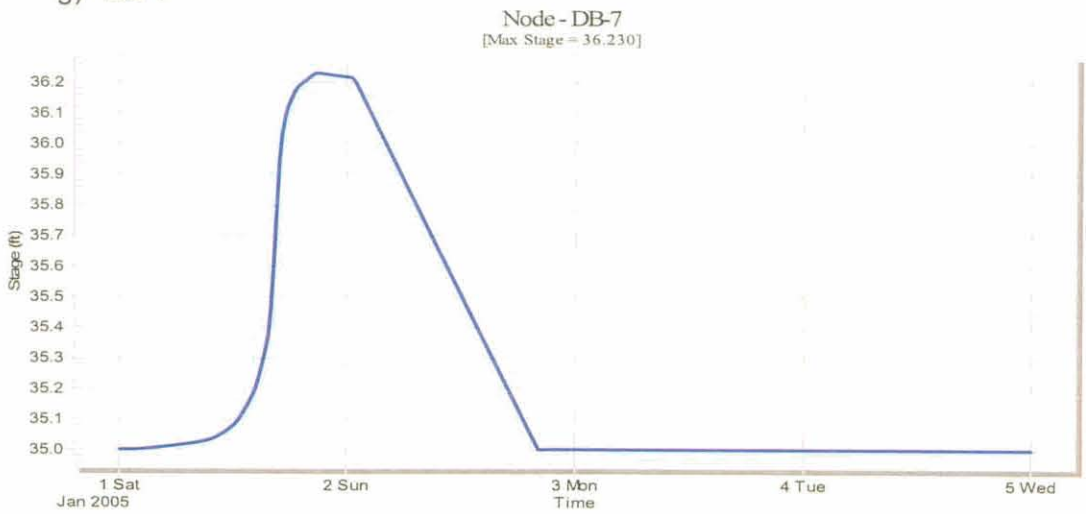
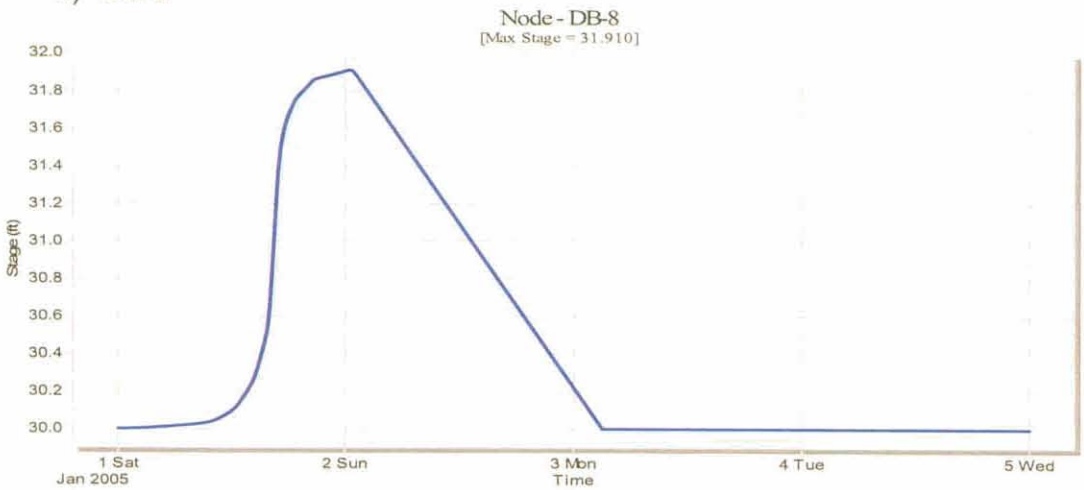


Figure 10: Detention Basin Water Surface Fluctuations Continued

g) DB-7



h) DB-8



i) DB-9

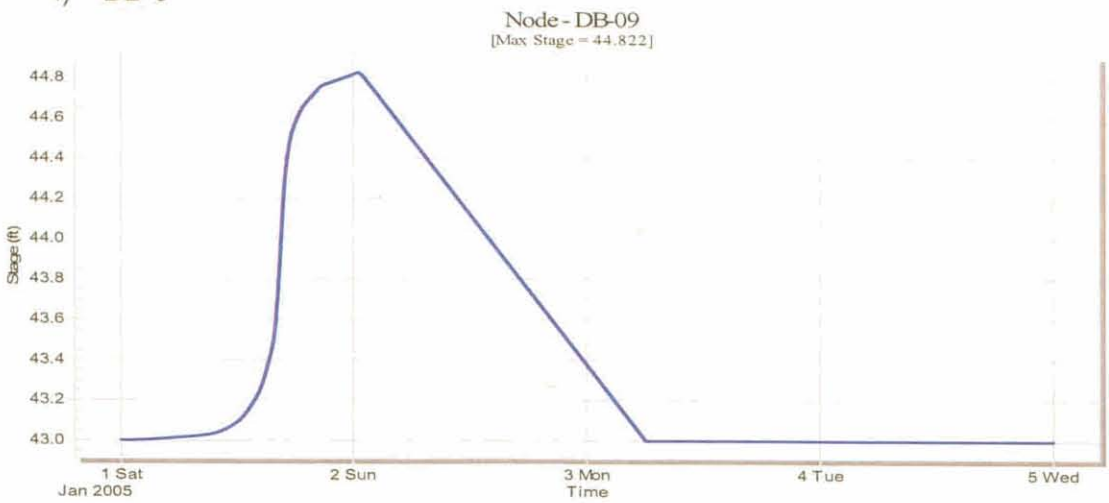
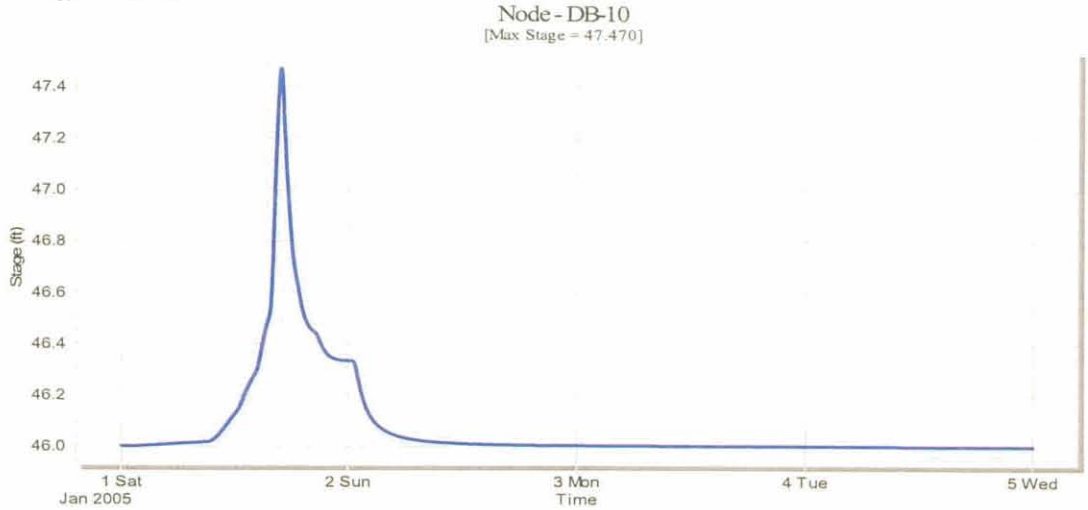
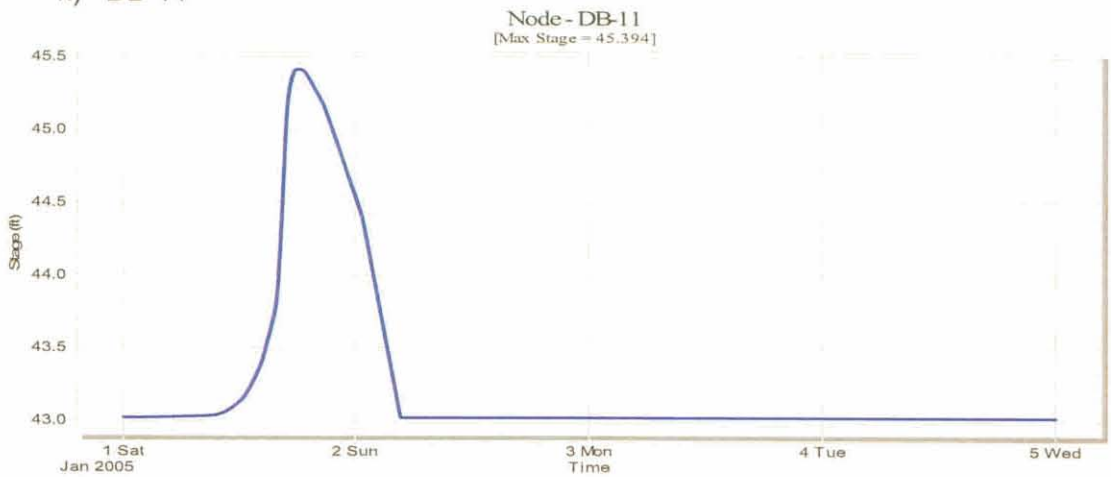


Figure 10: Detention Basin Water Surface Fluctuations Continued

j) DB-10



k) DB-11



l) DB-12

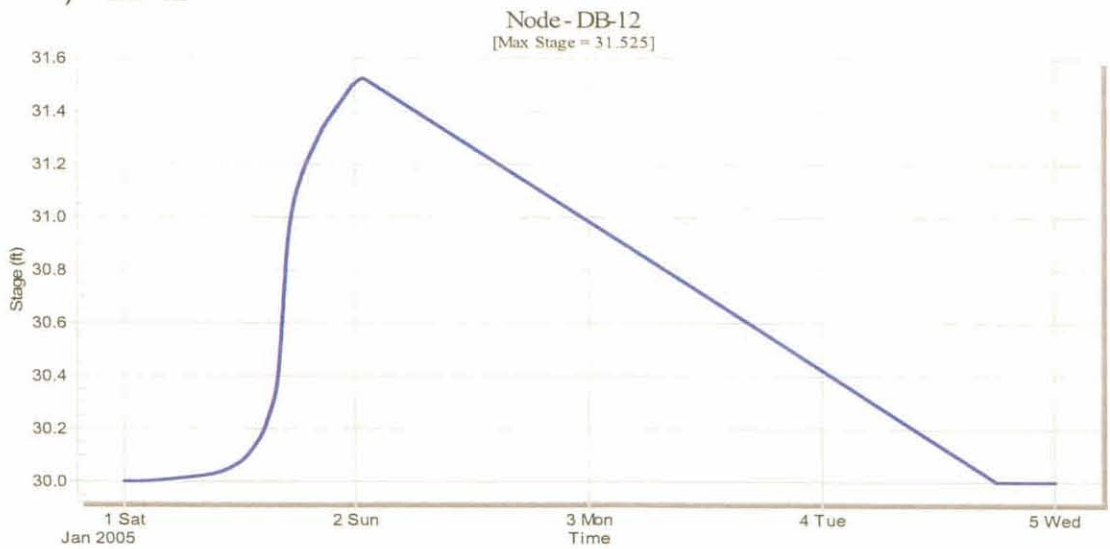


Figure 11: Pump Station Operation During the Design Flood
a) Lake L-08

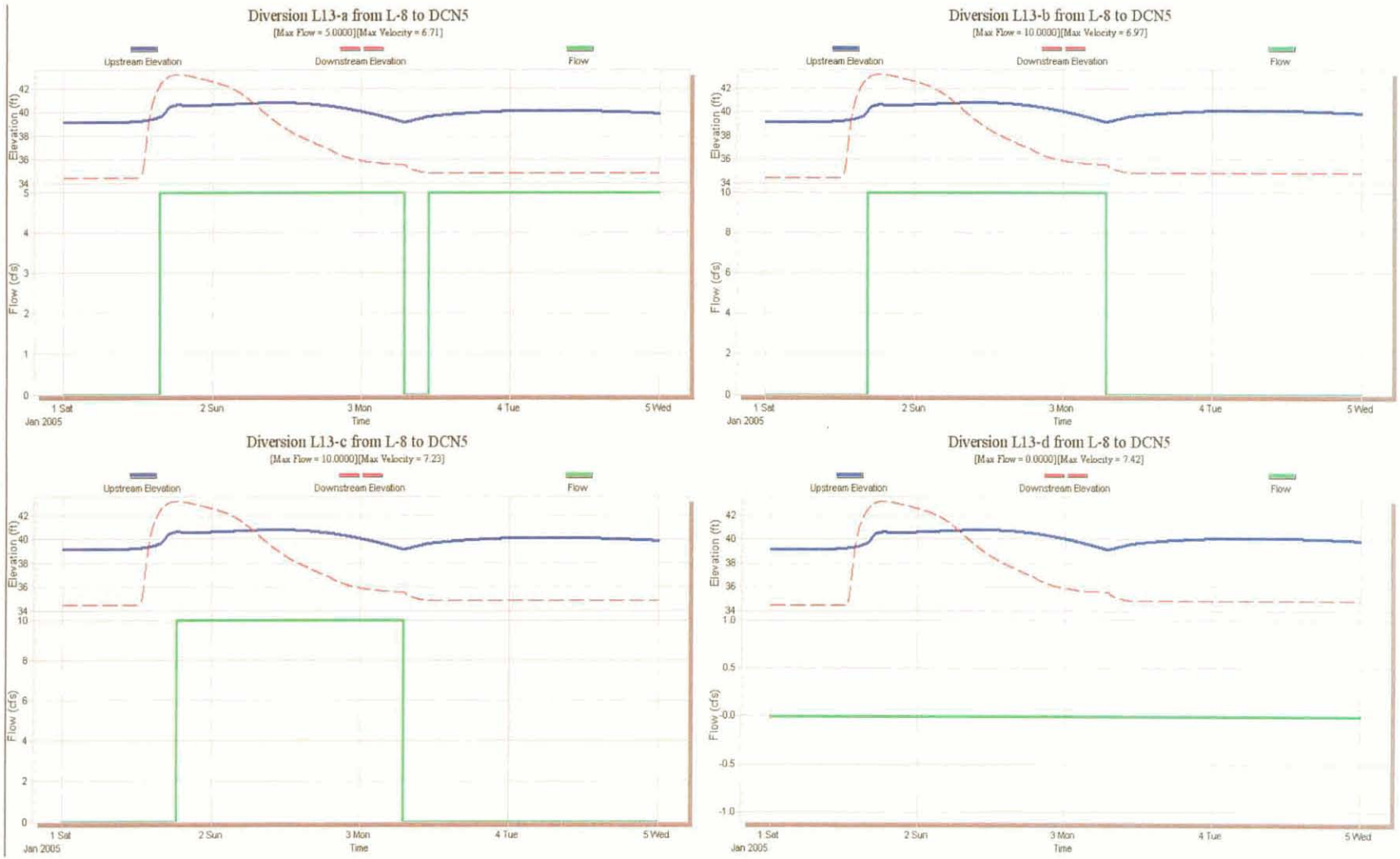


Figure 11: Pump Station Operation During the Design Flood Continued

b) Detention Basin DB-1

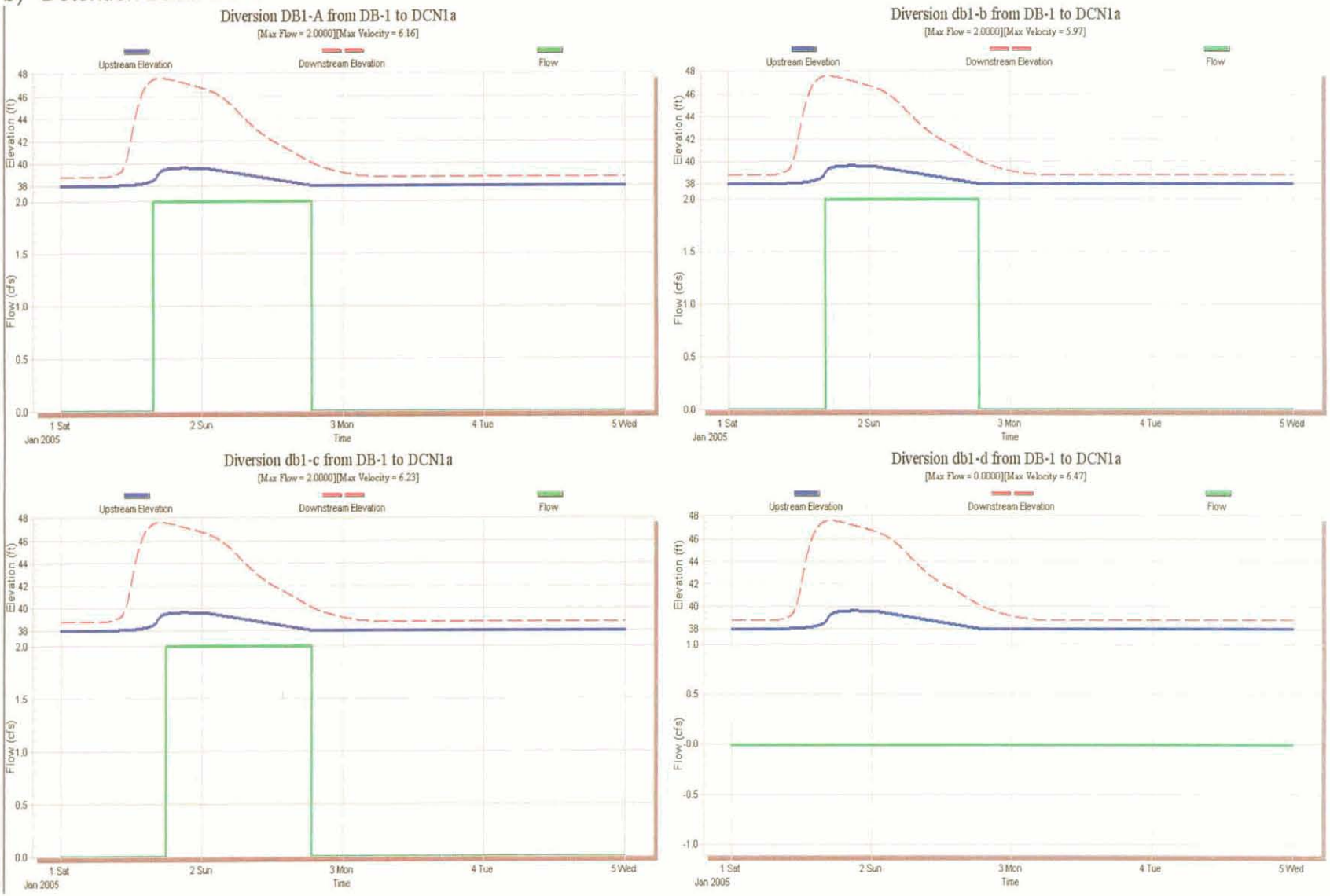
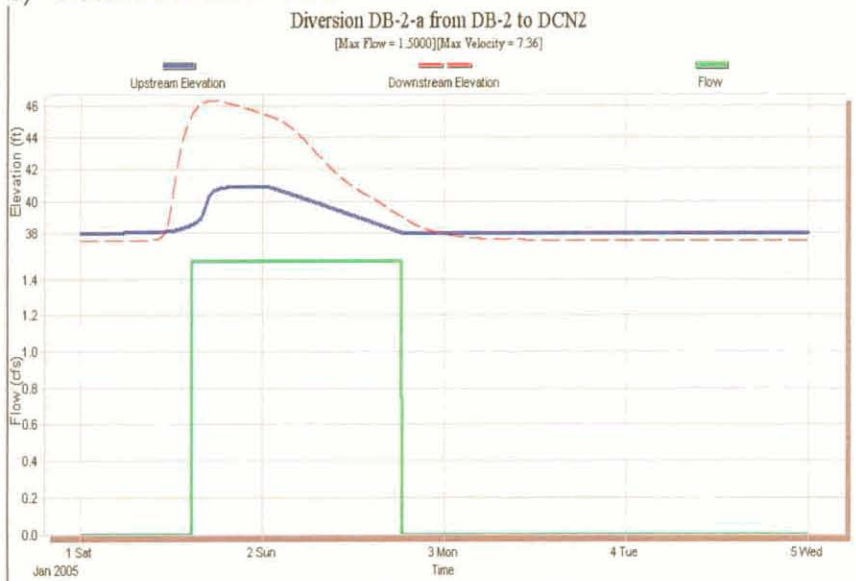
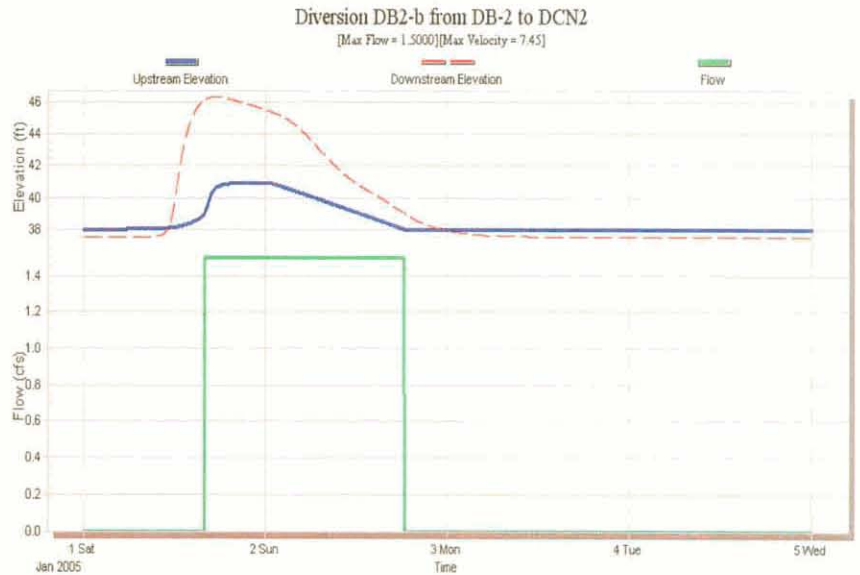


Figure 11: Pump Station Operation During the Design Flood Continued

c) Detention Basin DB-2





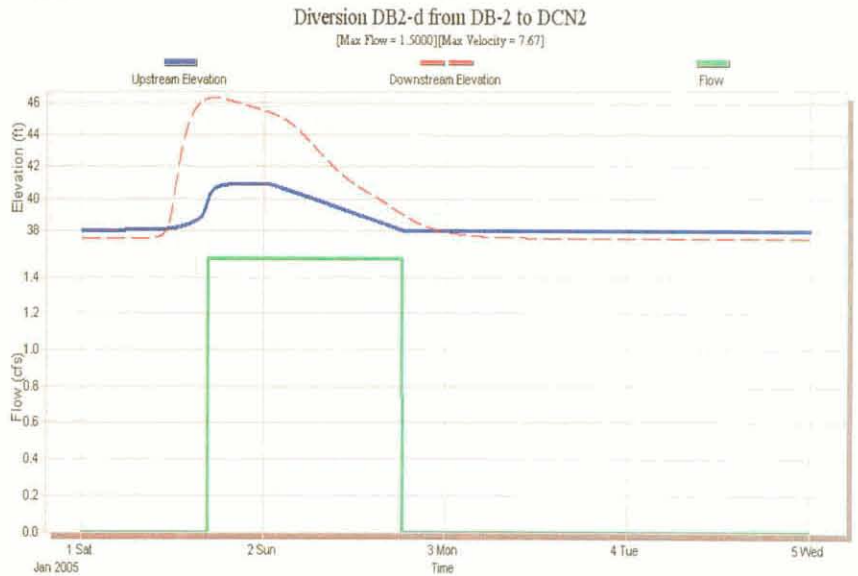


Figure 11: Pump Station Operation During the Design Flood Continued

d) Detention Basin DB-3

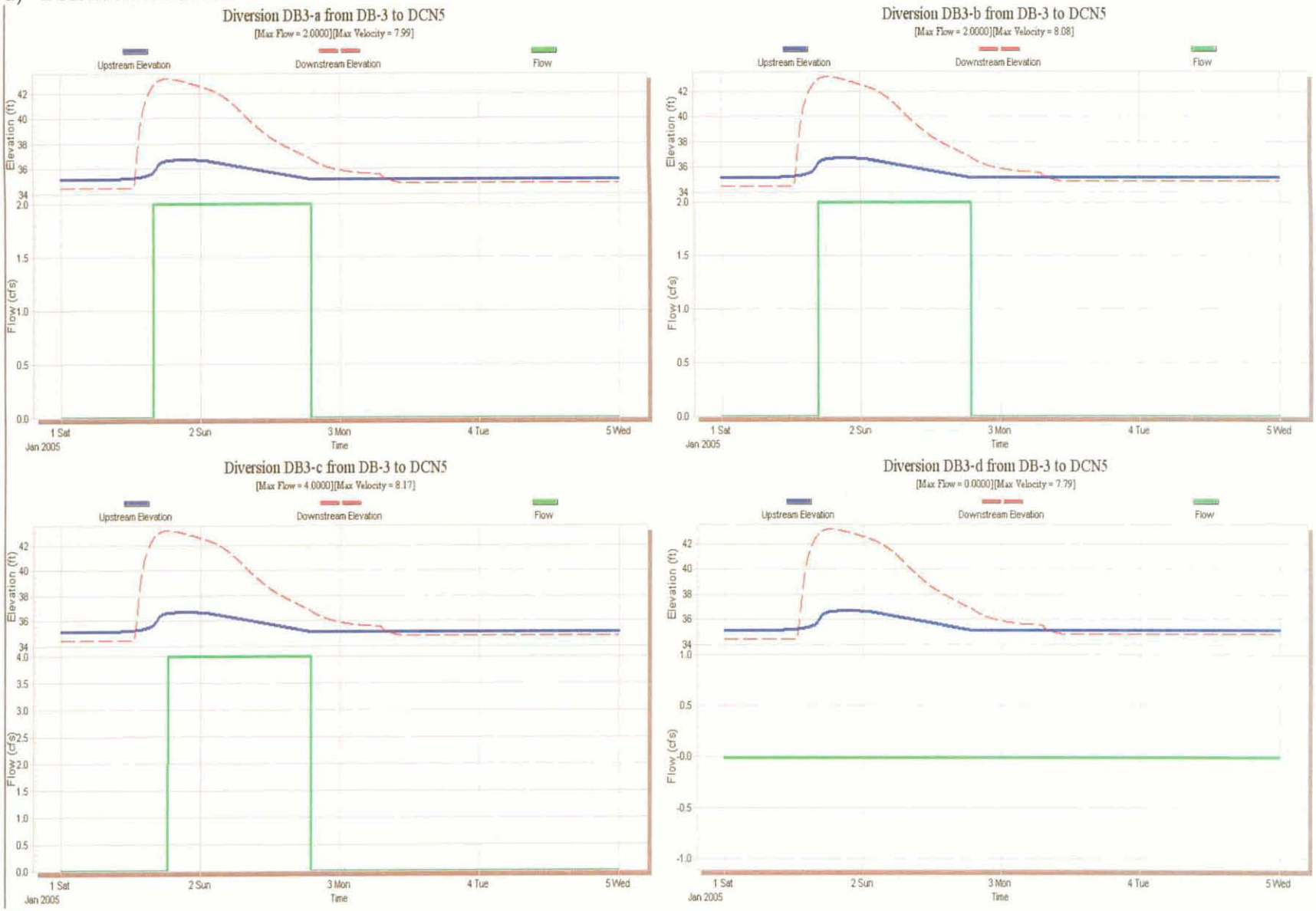


Figure 11: Pump Station Operation During the Design Flood Continued

e) Detention Basin DB-4

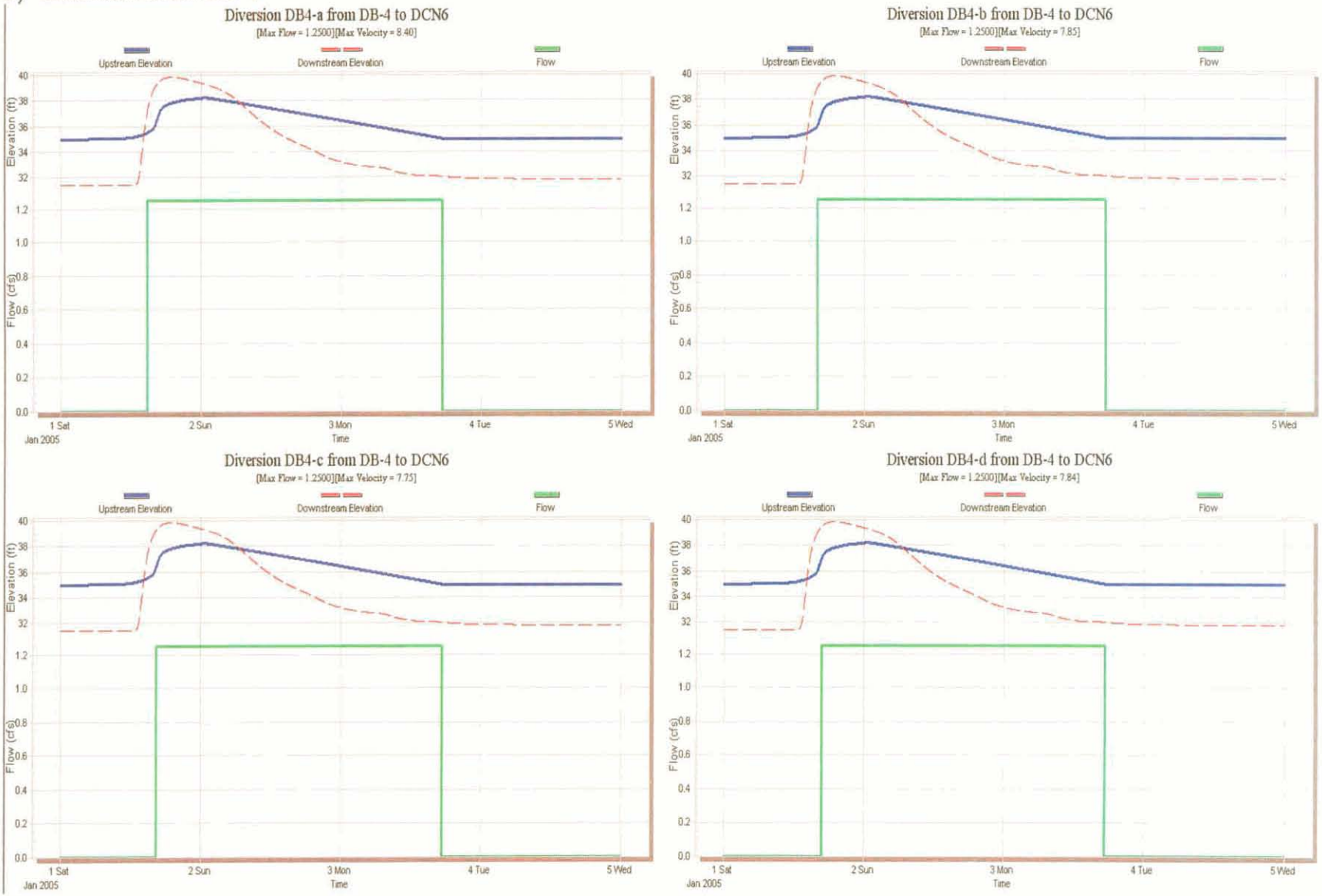


Figure 11: Pump Station Operation During the Design Flood Continued

f) Detention Basin DB-5

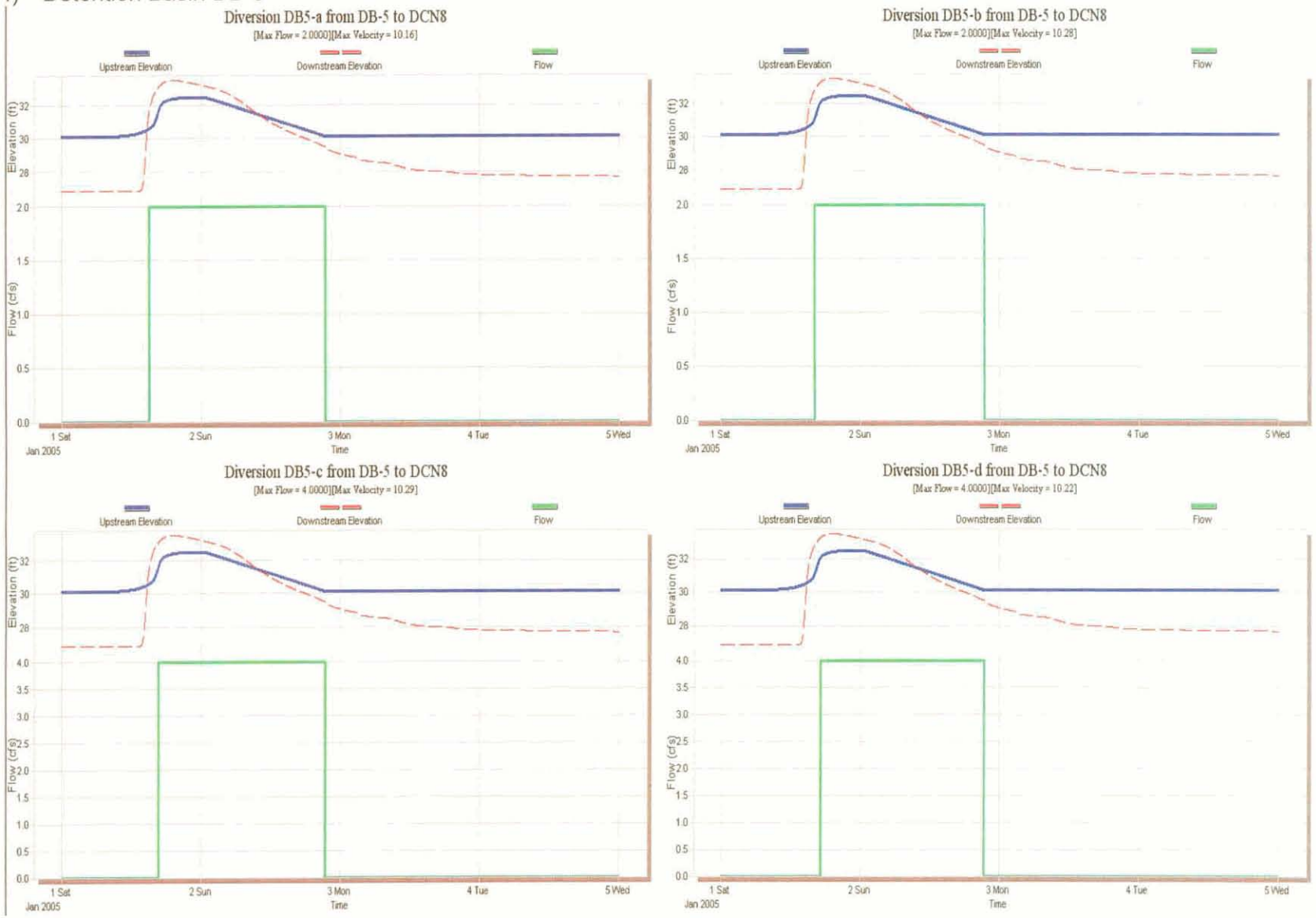
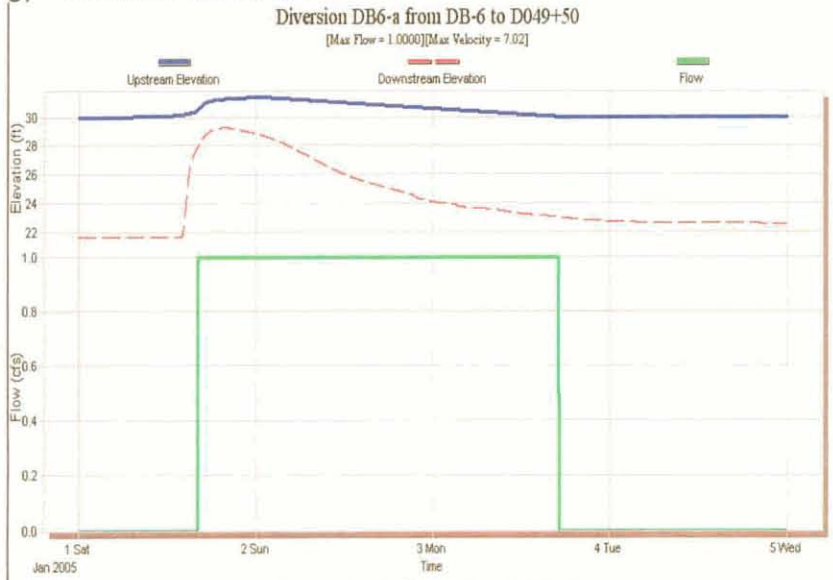
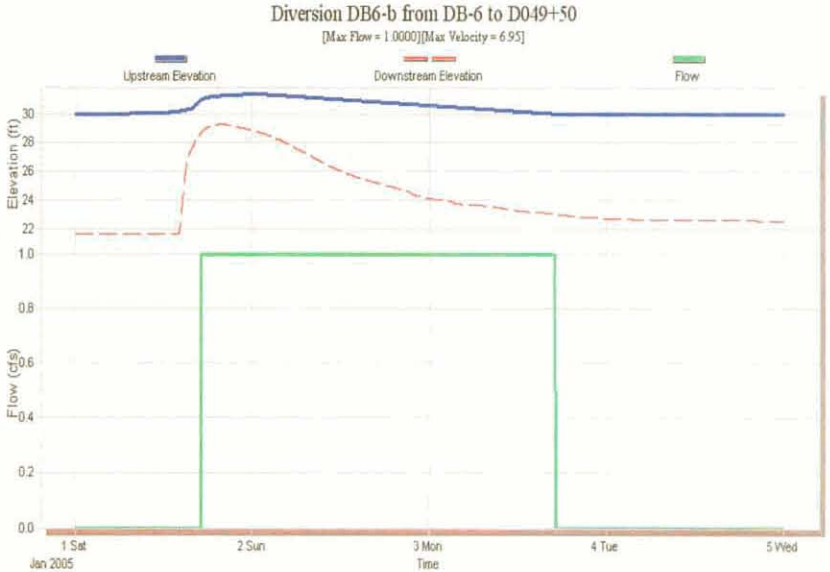


Figure 11: Pump Station Operation During the Design Flood Continued

g) Detention Basin DB-6





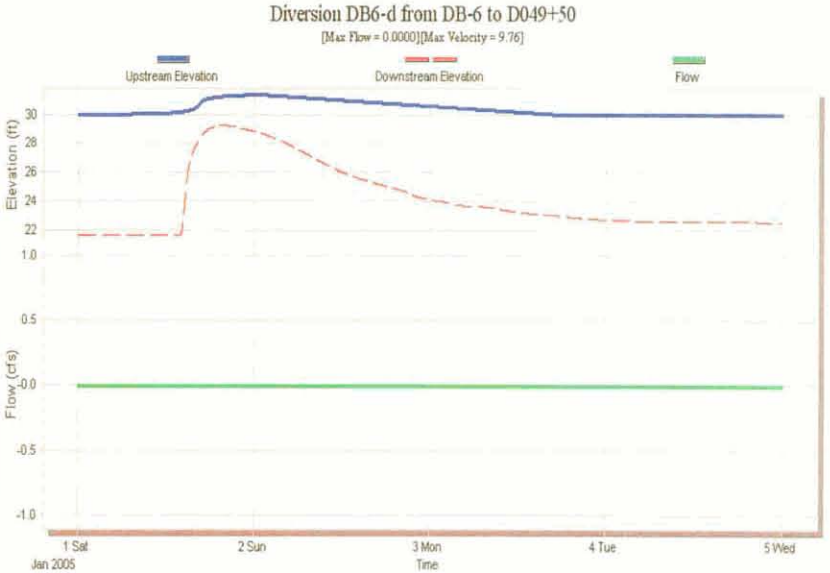


Figure 11: Pump Station Operation During the Design Flood Continued

h) Detention Basin DB-7

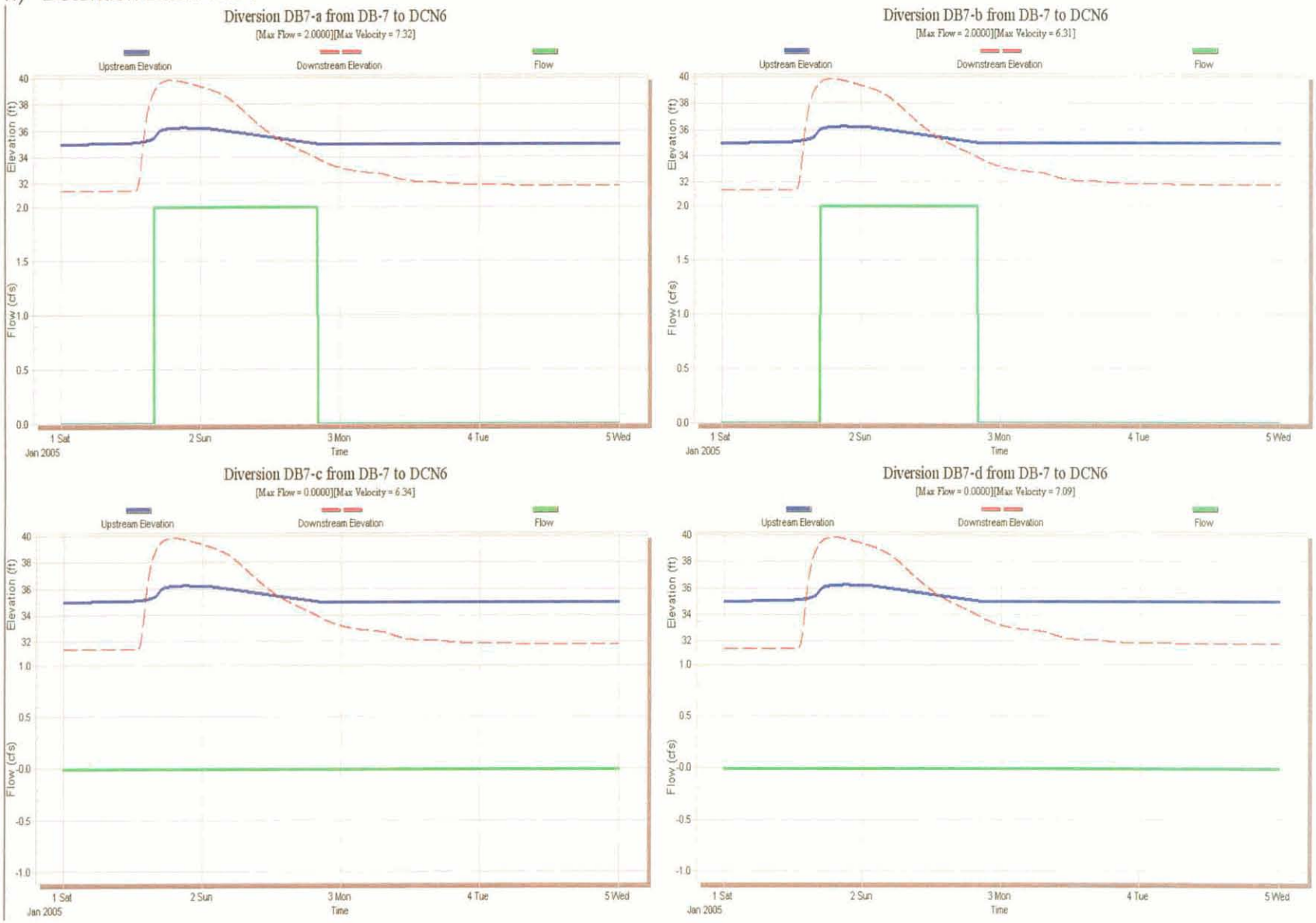


Figure 11: Pump Station Operation During the Design Flood Continued

i) Detention Basin DB-8

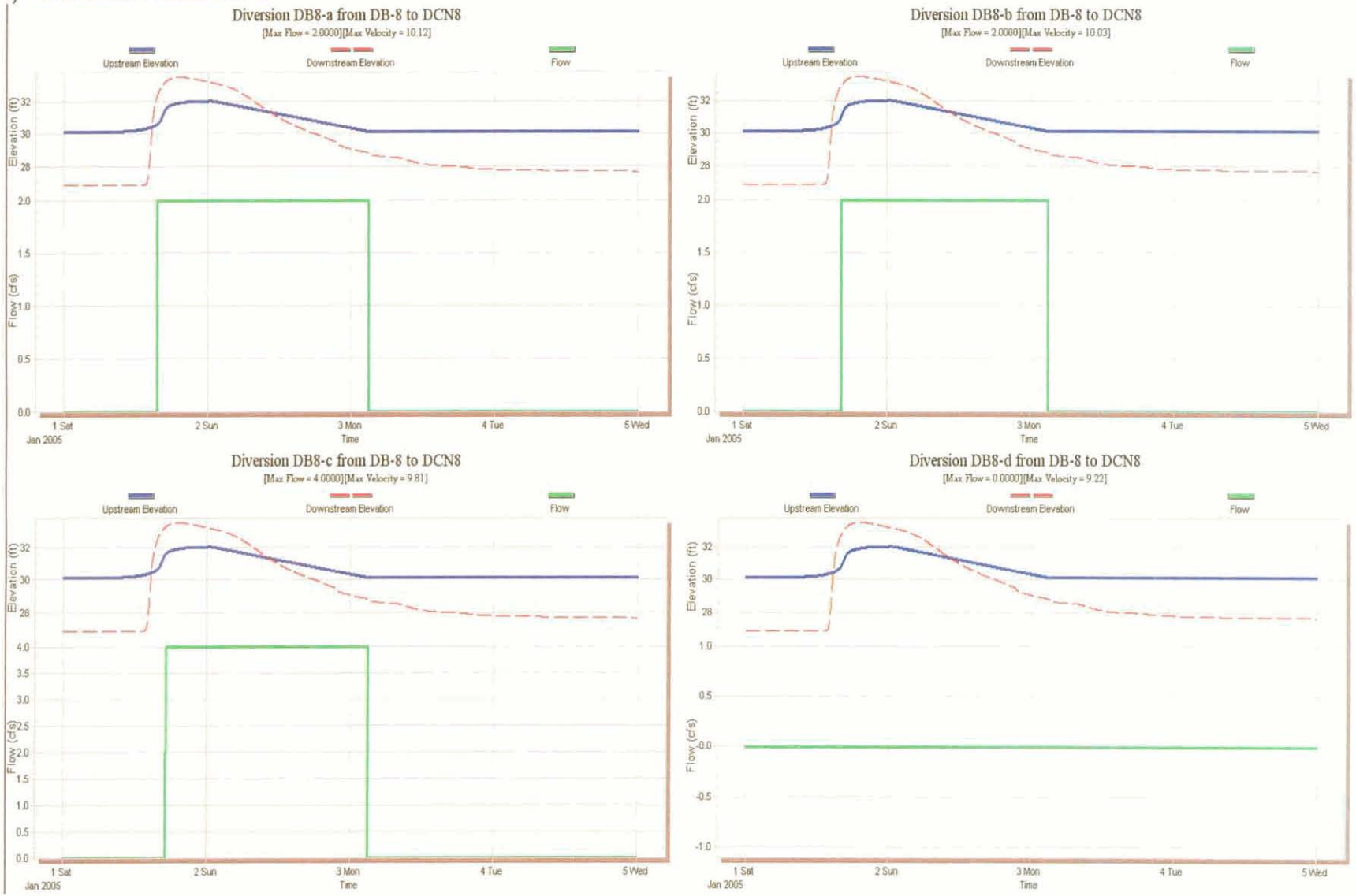


Figure 11: Pump Station Operation During the Design Flood Continued

j) Detention Basin DB-9

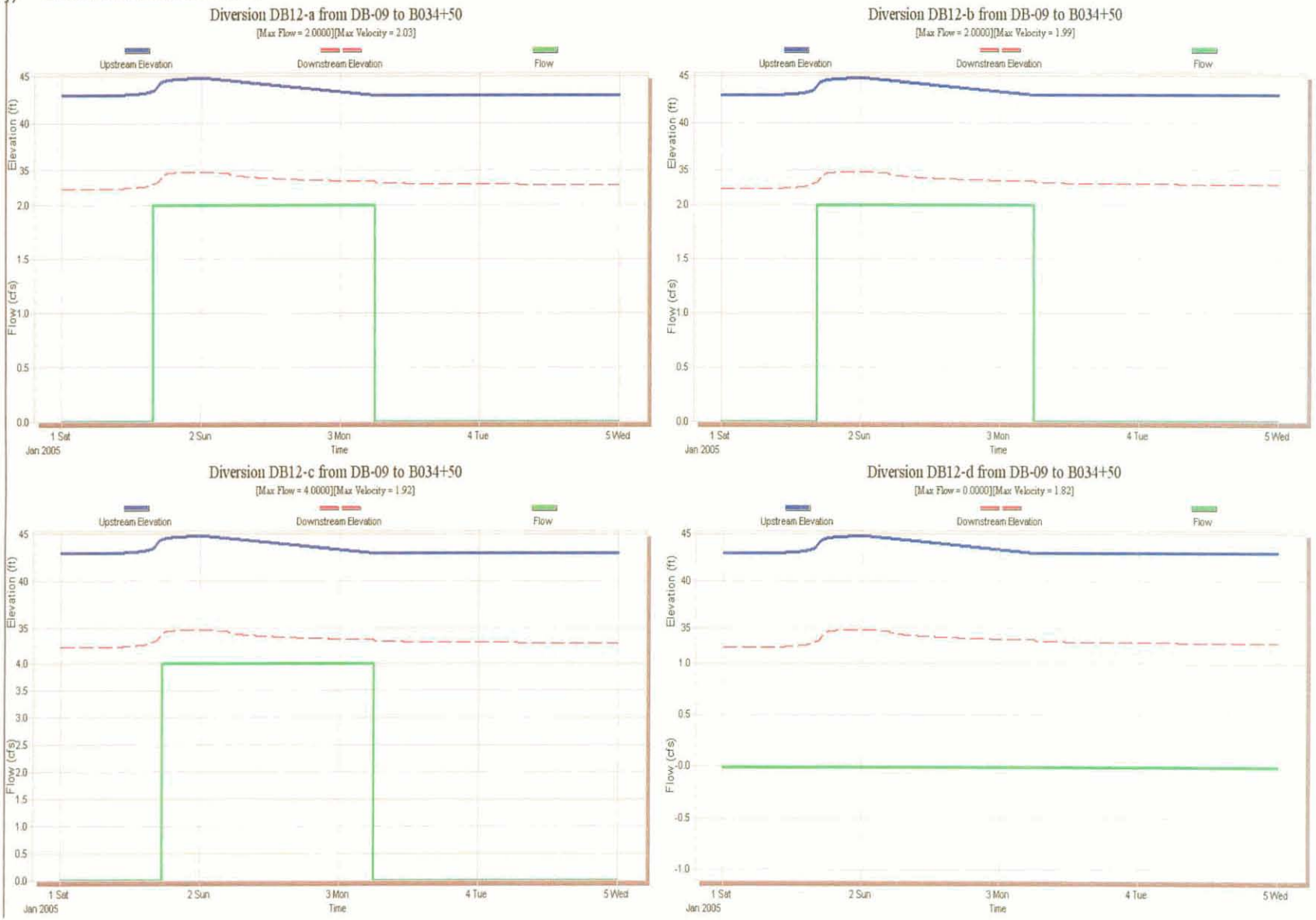


Figure 11: Pump Station Operation During the Design Flood Continued

k) Detention Basin DB-11

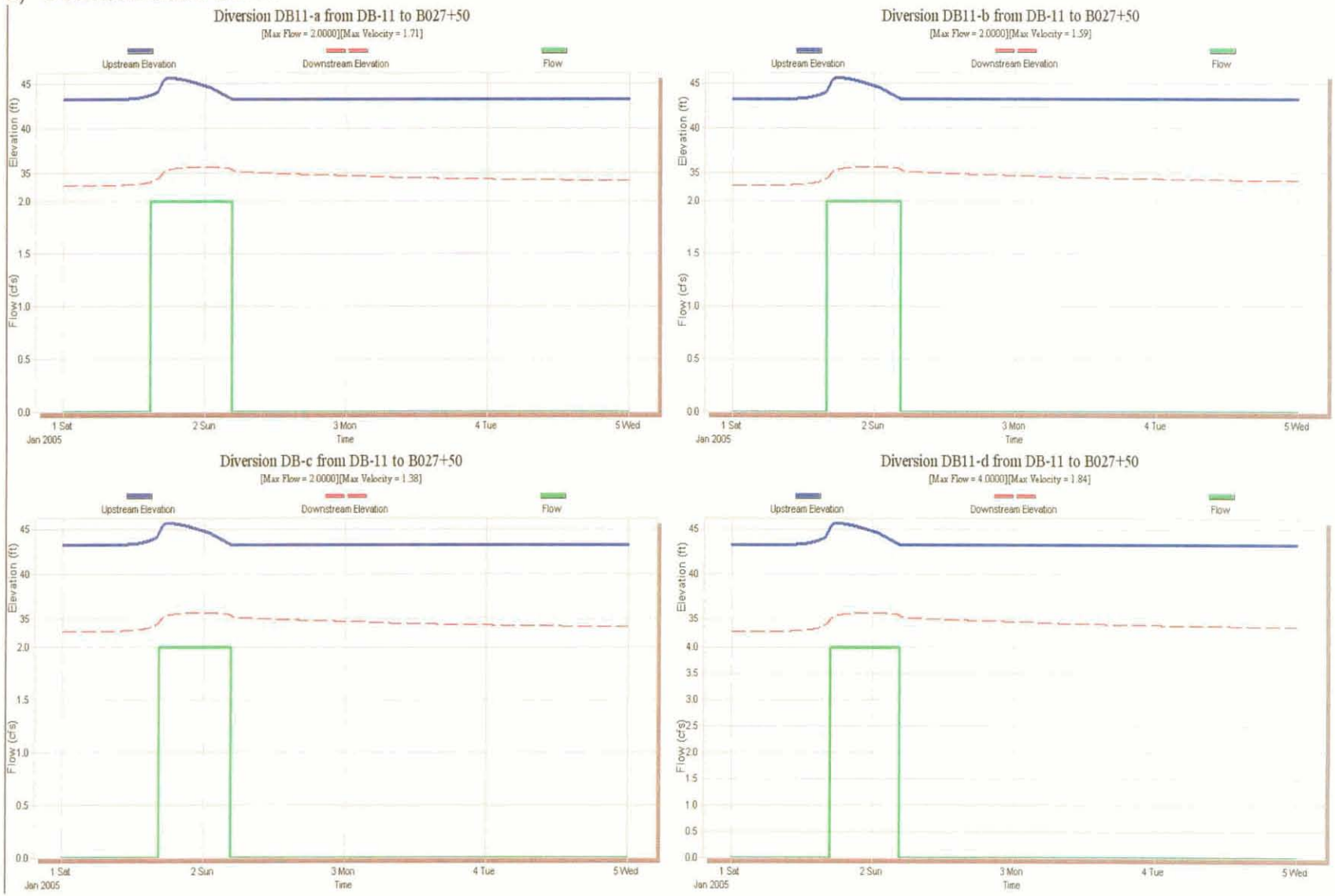


Figure 12: Duck Creek Outflow Hydrograph Proposed and Existing Conditions

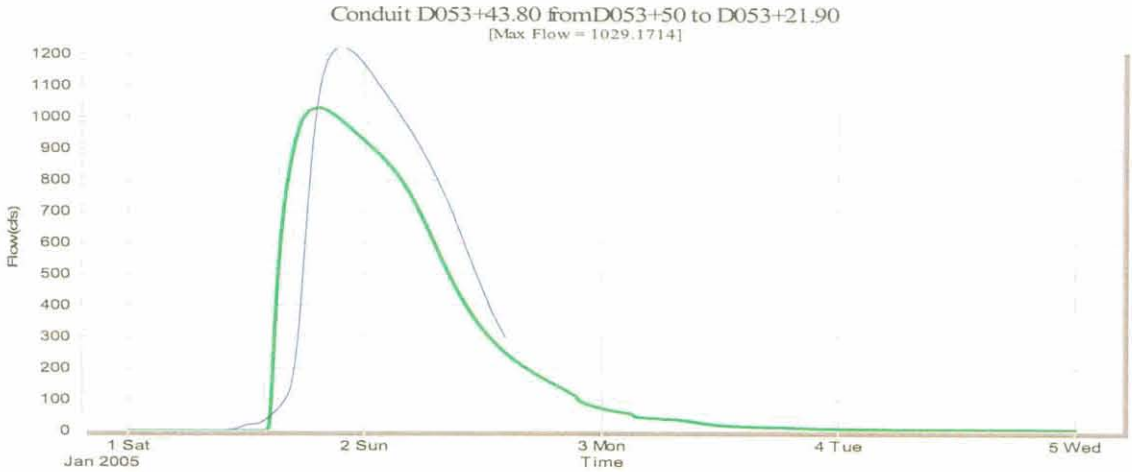


Figure 13: North Little John Creek Outflow Hydrograph Proposed and Existing Conditions

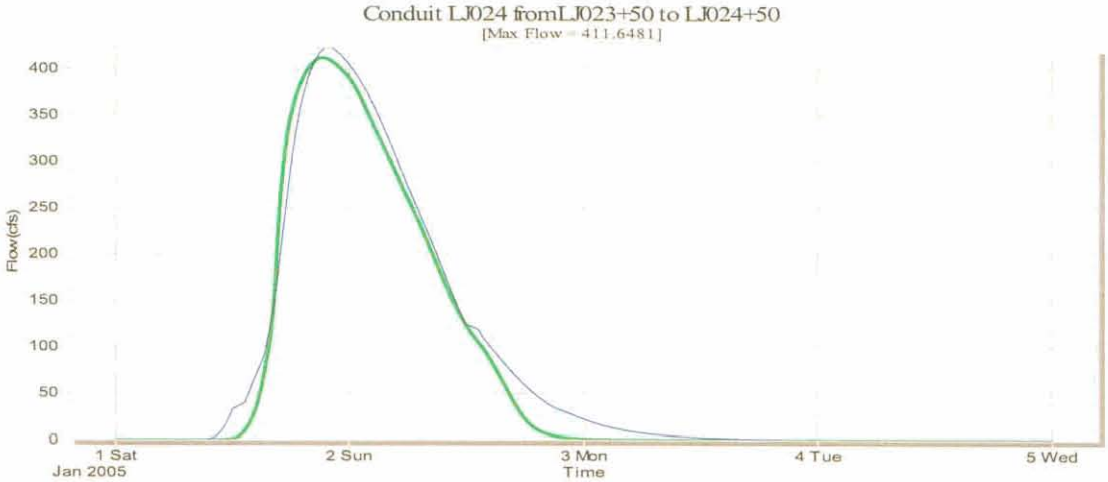
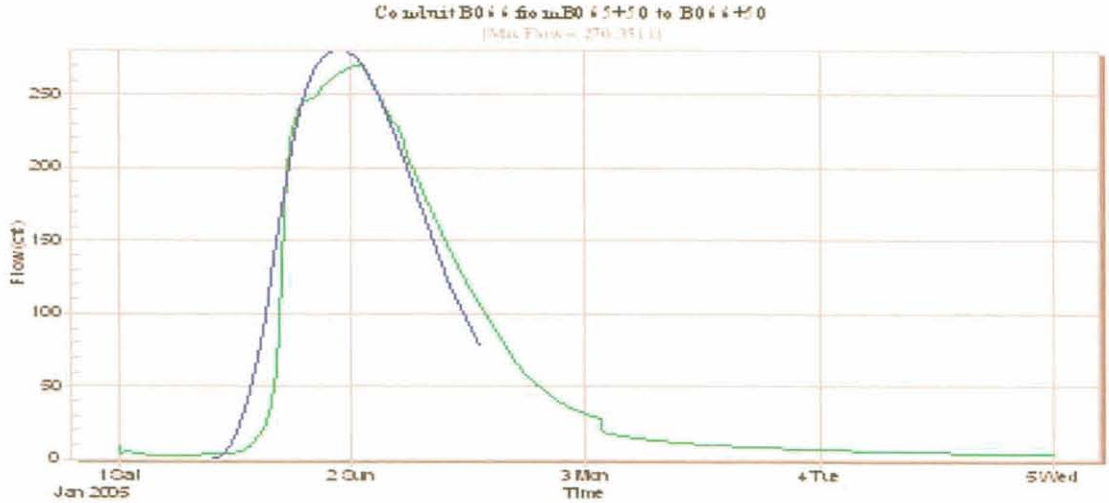



Figure 14: Branch Creek Outflow Hydrograph Proposed and Existing Conditions