FOUNTAIN HILLS
FLOOD RESPONSE PLAN

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TECHNICAL MEMORANDUM

Prepared For:

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NOTE:

THE USER SHOULD READ THE ENTIRE FLOOD RESPONSE PLAN CAREFULLY AND SHOULD BE AWARE OF ALL ELEMENTS OF THIS PLAN, INCLUDING STRENGTHS AND LIMITATIONS, AND INDIVIDUAL RESPONSIBILITIES. THE FLOOD WARNING/ RESPONSE PLAN PRESENTED HEREIN, AND IN THE DISPATCHER ATLAS AND THE EMERGENCY ACCESS MAP, IS USEFUL AS ONE STEP IN DEVELOPING A FLOOD WARNING SYSTEM FOR THE RESIDENTS WITHIN THE FOUNTAIN HILLS WARNING AREA. HOWEVER, THE POSSIBILITY OF INADVERTENT ERROR IN DESIGN OR FAILURE OF EQUIPMENT FUNCTION EXISTS AND MAY PREVENT THE SYSTEM FROM OPERATING PERFECTLY AT ALL TIMES. THEREFORE, NOTHING CONTAINED HEREIN MAY BE CONSTRUED AS A GUARANTEE OF THE SYSTEM OR ITS OPERATION, OR CREATE ANY LIABILITY ON THE PART OF ANY PARTY OR ITS DIRECTORS, OFFICERS, EMPLOYEES OR AGENTS FOR ANY DAMAGE THAT MAY BE ALLEGED TO RESULT FROM THE OPERATION, OR FAILURE TO OPERATE, OF THE SYSTEM OR ANY OF ITS COMPONENT PARTS. THIS CONSTITUTES NOTICE TO ANY AND ALL PERSONS OR PARTIES THAT THE NATIONAL WEATHER SERVICE, FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, MARICOPA COUNTY DEPARTMENT OF EMERGENCY MANAGEMENT, MARICOPA COUNTY SHERIFF'S OFFICE, FOUNTAIN HILLS MARSHALS DEPARTMENT, RURAL METRO FIRE DEPARTMENT, FOUNTAIN HILLS PUBLIC WORKS DEPARTMENT, AND JE FULLER/ HYDROLOGY & GEOMORPHOLOGY, INC. OR ANY OFFICER, AGENT OR EMPLOYEE THEREOF, SHALL NOT BE LIABLE FOR ANY DEATHS, INJURIES, OR DAMAGES OF WHAT EVER KIND THAT MAY RESULT FROM RELIANCE ON THE TERMS AND CONDITIONS OF THIS SYSTEM.

FOUNTAIN HILLS FLOOD RESPONSE PLAN
TECHNICAL MEMORANDUM

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LIST OF ACRONYMS

ADWR	Arizona Department of Water Resources
ALERT	Automated Local Evaluation in Real Time
CCWC	Chapparal City Water Company
CP	Concentration Point
District	Flood Control District of Maricopa County
EAM	Emergency Access Map
EAP	Emergency Action Plan
EOP	Emergency Operations Plan
FCDMC	Flood Control District of Maricopa County
FDS	Floodplain Delineation Study
FHFRP	Fountain Hills Flood Response Plan
FHMD	Fountain Hills Marshals Department
FHPW	Fountain Hills Public Works/ Engineering Department
FHSD	Fountain Hills Sanitary District
FHUSD	Fountain Hills Unified School District
FRP	Flood Response Plan
JEF	JE Fuller/ Hydrology & Geomorphology, Inc.
MCDEM	Maricopa County Department of Emergency Management
MCSO	Maricopa County Sheriff's Office
MSP	Meteorological Services Program
NWS	National Weather Service
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
QPF	Quantitative Precipitation Forecast
RMFD	Rural Metro Fire Department
SOP	Standard Operation Procedure
TOFH or Town	Town of Fountain Hills

PREFACE

The Fountain Hills Flood Response Plan consists of four primary components, including the Dispatcher Atlas, Emergency Access Map, Reference Wall Map and Technical Memorandum. Digital files for all deliverables, including hydrologic and hydraulic models, are provided herein on CD in multiple formats (Appendix I). Digital files are provided to facilitate future updates to the plan and for incorporation into the FCDMC ALERT web site.

Dispatcher Atlas

The Dispatcher Atlas contains a flood alert decision flowchart, warning message suites issued by various agencies, flood detection criteria for measured rain and water levels, communication flowchart, resident and agency contact information, agency action plans, and the Emergency Access Map sectioned by Town grid.

The FHFRP Dispatcher Atlas is intended for use by the Fountain Hills Marshals Department (FHMD) Dispatcher to issue flood alert messages, to coordinate flood response activities, and to disseminate those messages to the emergency responders and impacted residents. The FHFRP Dispatcher Atlas will be distributed to the TOFH Marshals dispatch center in a Tarifold® desktop unit. The Atlas is provided herein for FCDMC and MCDEM use.

Emergency Access Map

The FHFRP Emergency Access Map includes base aerial photographs (photo date: January 2001) showing identified potential trouble areas in the flood vulnerable zones, accessible and inaccessible routes during flood emergencies, temporal priority ranking for impassable roadway crossings, shelter sites for evacuated residents, and agency contact information. The Emergency Access Map is intended for use by the emergency response community, including the FHMD, TOFH Public Works/ Engineering Department (FHPW), MCSO, Rural Metro Fire Department (RMFD), and Fountain Hills Unified School District (FHUSD) personnel.

Reference Wall Map

The Reference Wall Map shows ALERT sensor locations, watershed boundaries, roadway crossings impacted during floods, emergency access routes, and evacuation sites. It is intended for use in the FHMD dispatch center, FHPW, MCDEM, and the FCDMC ALERT Room for informational purposes during imminent and occurring flood events. The Reference Wall Map is mounted on foam-core board and provided under separate cover.

Technical Memorandum

This document is the Technical Memorandum and is intended for use by personnel of the TOFH Public Works/ Engineering Department, FCDMC Flood Warning Branch and Meteorological Services Program (MSP), to support decisions regarding dissemination of flood alert messages, and implementation of the flood response action plans during flood events in Fountain Hills.

SECTION 1: INTRODUCTION

1.1 Purpose

The Flood Control District of Maricopa County contracted with JE Fuller/ Hydrology & Geomorphology, Inc. (JEF) to prepare a comprehensive Flood Response Plan (FRP) for the Town of Fountain Hills, Arizona (Contract No. FCD2000C013). The purpose of the Fountain Hills Flood Response Plan (FHFRP) is to reduce the potential for property damage and loss of life resulting from floods on identified hazardous watercourses.

The FHFRP was developed under the guidance of the Flood Control District of Maricopa County (District or FCDMC) and the Town of Fountain Hills (Town or TOFH) Public Works/ Engineering Department (FHPW) and Marshals Department (FHMD). In addition, the Maricopa County Department of Emergency Management (MCDEM), Maricopa County Sheriff's Office (MCSO), Rural Metro Fire Department (RMFD), and Ft. McDowell Indian Community Fire Department provided input about local emergency response resources. The FRP is intended to function independently as a stand-alone document, and to be added as an Appendix to the FCDMC Flood Emergency Response Manual, MCDEM Maricopa County Emergency Operations Plan (1999) , and TOFH Emergency Operations Plan (1999).

1.2 Project Description

The work plan for the preparation of the FHFRP is comprised of the following phases:

Phase 1 – Data Collection (FCD2000C013 Assignment #7)
The most current references, resources and decision aids were collected from FCDMC, TOFH, and other entities impacted by flood emergencies in the study area during Phase 1. Phase 1 was completed in March 2001. These materials were evaluated for adequacy and data gaps identified. The primary work products for Phase 1 are a summary of these reference materials, provided in Appendix A, and a scope of work for Phase 2 incorporating work tasks to address identified data gaps.

Phase 2 – Draft FRP Preparation (FCD2000C013 Assignment #10)

The work product for Phase 2 is a comprehensive draft flood response plan for specific watercourses in the Fountain Hills area. The watercourses included in the FHFRP are listed in Section 1.4.2. The FHFRP is provided in four separate deliverables as described in Section 1.5; including a Dispatcher Atlas, Emergency Access Map, Reference Wall Map, and Technical Memorandum.

FRP 2002/2003 Test Period (by FCDMC and TOFH)

The Phase 2 draft FHFRP will be used by the Town and the District for the monsoon season of 2002 and possibly the winter rainy season of 2002/2003. The purpose of producing a draft document is to allow the Town and the District the opportunity to utilize the plan and field test the work products during actual flood events. This test will identify shortcomings and/or refinement needs of the Flood Response Plan which should be addressed in a final version of the FHFRP.

Phase 3 – FRP Finalization (by FCDMC)

The objective of the Phase 3 work tasks will be to produce a final version of the FHFRP which incorporates the knowledge gained from the use of the draft Flood Response Plan during the test period.

1.3 Project Location

Fountain Hills is located in northeastern Maricopa County, Arizona and is bounded by McDowell Mountain Regional Park to the north, Fort McDowell Indian Reservation to the east, Salt River Pima-Maricopa Indian Community to the south, and Scottsdale to the west (Figure 1-1). The development of the community began in the 1960s on the former site of one of Arizona's largest cattle ranches. The Town of Fountain Hills was incorporated in 1989. Fountain Hills is approximately 19 square miles in size and has multiple land uses comprised of commercial, residential, light industrial, and open space.

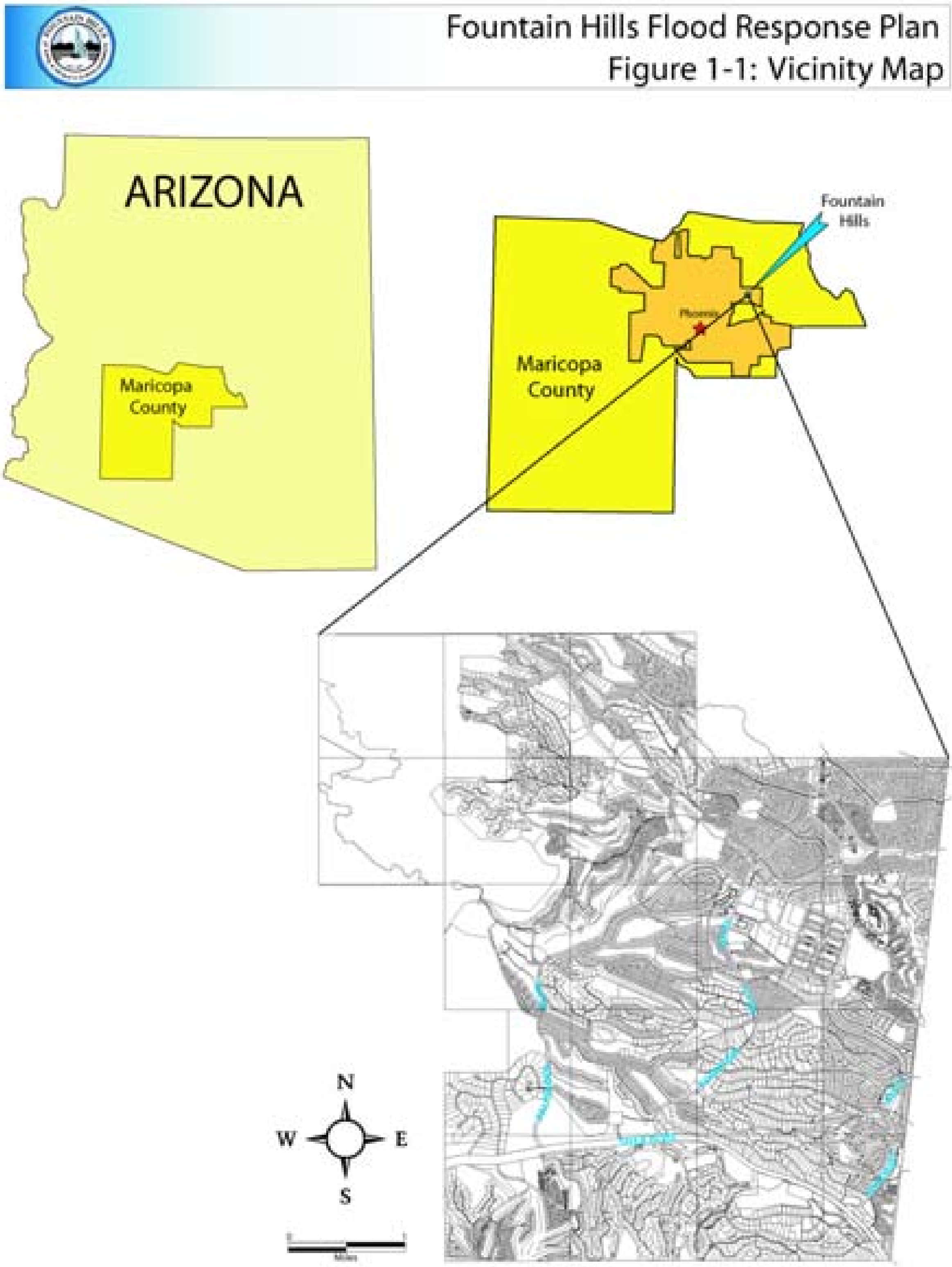


Figure 1-1: Vicinity Map

1.4 Study Area Description

1.4.1 Geology

Surficial geology of the Fountain Hills area was mapped and described by the Arizona Geological Survey (Figure 1-2). The geologic descriptions below are taken directly from the 1997 Surficial Geologic Map of Theodore Roosevelt Lake 30’ x 60’ Quadrangle, Arizona (Pearthree et al., 1997).

Qy (<10 ka)[1] *Holocene alluvial deposits.*

Unit Qy consists primarily of small active channels and low terraces along them in the montane and upper piedmont areas and broad alluvial fans on middle and lower piedmonts. Drainage networks on Qy alluvial-fan surfaces on middle and lower piedmonts typically are distributary or anastomosing, with discontinuous entrenched and unentrenched reaches. Qy may be subject to inundation during large floods and should be considered as potentially flood prone unless geomorphologic or hydrologic/hydraulic analyses indicate they are not. Due to relatively high permeability and the variable potential for inundation, areas mapped as Qy have moderate to high potential for groundwater recharge.

Ql (10 to 250 ka) Late Pleistocene alluvial fan surfaces and terraces with moderate soil development.

Alluvial sediment sized range from sand to cobbles and boulders, coarser in upper piedmont and mountain areas. Drainage patterns are dendritic, with surface dissection varying from about 1 to 4 meters. Ql units generally are not flood prone, except immediately adjacent to active washes. Areas mapped as Ql generally have low recharge potential; their soils have moderate permeability but they are isolated from major washes.

Qm (250 to 750 ka) Dissected middle Pleistocene alluvial fan and terrace deposits with moderate to strong soil development.

Sediment grain sizes range from sand to bounders, fining downstream. Qm alluvial fan surfaces typically have dendritic drainage and are heavily dissected by streams that head on

[1] ka = thousands of years before present; e.g. 10 ka is equivalent to 10,000 years before the present.

them. Areas mapped as Qm are generally not flood prone except in and adjacent to washes. Because of their relatively impermeable argillic and petrocalcic horizons, Qm surfaces are not areas of significant groundwater recharge.

Qo (750 ka to 2 Ma)[2] *Deeply dissected remnants of very old Quaternary to late Pliocene alluvial fans with strong soil development.*

Qo deposits are typically are cobbly to bouldery and are very poorly sorted, with grain sizes ranging from sand to boulders. Areas mapped as Qo are not flood prone. Impermeable argillic and petrocalcic horizons, high topographic positions, and relatively steep slopes associated with unit Qo severely limit the amount of groundwater recharge in these areas.

Ts (2 to 38 Ma) Late Tertiary alluvial sediment.

Unit Ts consist primarily of late Tertiary alluvial sediment that was deposited in basins formed during extensional tectonism. Dissection of these deposits is variable, but they typically are deeply eroded into ridges and intervening valleys with as much as 100 meters of local relief between modern stream channels and the highest levels of unit Ts. Ts deposits are poorly to extremely poorly sorted, subangular to subrounded pebbles, cobbles, and boulders, with a sand, silt and clay matrix.

R (bedrock)

Bedrock lithologies are not differentiated in Figure 1-2.

All the described geologic units (with exception of Qy and Ts) are described as relatively impermeable with little allowance for groundwater recharge. This results in significant runoff volumes and relatively quick hydrologic response times for washes within the Fountain Hills as discussed in Section 2.

[2] Ma = millions of years before present.

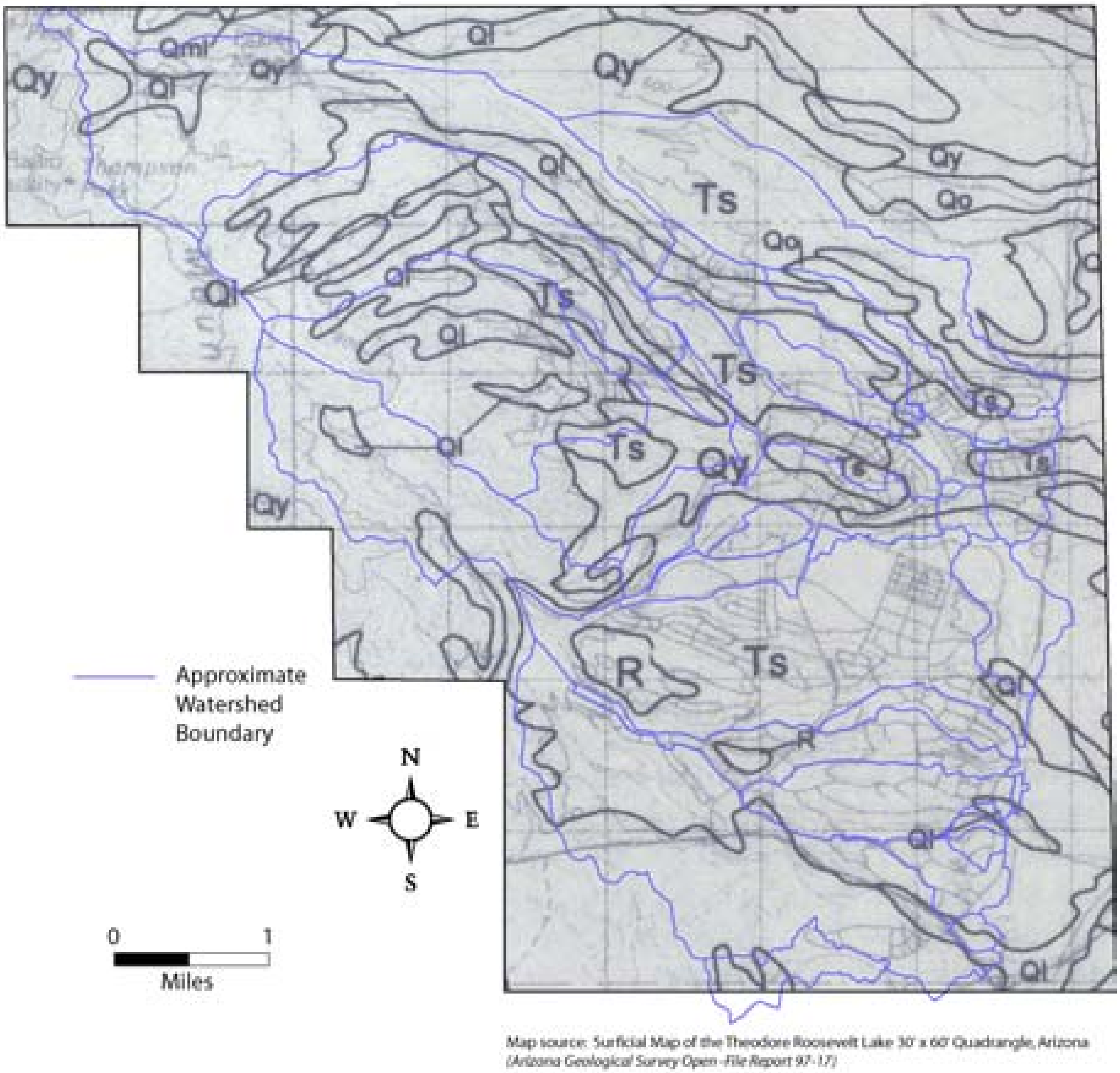


Figure 1-2 Surficial Geologic Map of the Fountain Hills Area

1.4.2 Hydrology

The watercourses included in the FHFRP are grouped into four systems as listed below:

Ashbrook Wash System	*Study Limits*
• Ashbrook Wash	Eastern Town limit to the northern Town limit
• Hesperus Wash	Greenbrook Blvd. to the northern Town limit
• Balboa Wash	Ashbrook Wash to Hesperus Wash (Glenbrook)
• Oxford Wash	Balboa Wash to headwaters (Boulder Drive)
• Tulip/ Legend Wash	Ashbrook Wash to headwaters (Richwood)
• Bristol Wash	Golden Eagle Park Dam to headwaters
• Cholula Wash	Bristol Wash to headwaters
• Zapata Wash	Bristol Wash to headwaters
• Montezuma Wash	Bristol Wash to headwaters
• Longmont Wash	Bristol Wash to headwaters
• Cloudburst Wash	Ashbrook Wash to Sunridge Drive
• Arrow Wash	Ashbrook Wash to headwaters
• Sunflower Wash	Ashbrook Wash to headwaters
• Escalante Wash	Eastern Town limit to northern Town limit
• Caliente Wash	Eastern Town limit to northern Town limit

Colony Wash System

• Colony Wash	Eastern Town limit to Stoneridge Dam
• North Colony Wash	Colony Wash to Mimosa Drive
• Fountain Channel	Colony Wash to Fountain Lake
• Ironwood Wash	Colony Wash to Chicory Drive
• Sycamore Wash	Stoneridge Dam to headwaters
• Greystone Wash	Stoneridge Dam to headwaters
• Sunburst Wash	Stoneridge Dam to headwaters
• Panorama Wash	Eastern Town limit to headwaters

Malta Drain / Jacklin Wash System

• Malta Drain	Eastern Town limit to headwaters
• Emerald Wash	Malta Drain to headwaters
• Cyprus Point Wash	Eastern Town limit to headwaters
• Jacklin Wash	Eastern Town limit to headwaters
• Mangrum Wash	Jacklin Wash to headwaters
• Kingstree Wash	Jacklin Wash to headwaters

Cereus Wash System

- Cereus Wash — Eastern Town limit to headwaters
- Walnut Wash — Cereus Wash to headwaters
- Chukar Wash — Cereus Wash to headwaters
- Powder Wash — Cereus Wash to headwaters
- Laser Drain — Cereus Wash to headwaters
- Logan Wash — Southern Town limit to southern Town limit

The total drainage area of the watercourses included in the FHFRP is approximately 24 square miles. Fountain Hills ranges in elevation from 1,200 to 1,600 feet above mean sea level. Drainage channels flow generally to the east and are typically deeply incised between steeply sloped ridges in the upper watershed. The channels transition to less steep, broader watercourses in the eastern portion of Fountain Hills. These watercourses flow eastward from the town limits, across the Fort McDowell Indian Reservation, and outfall at the Verde River. During the period from 1970 through 1976, six flood retarding structures were constructed in the watershed in the western portion of Fountain Hills. The Reference Wall Map (under separate cover) and Figure 3-1 show the watersheds and the locations of the dams. Additional dams were subsequently constructed by the Fountain Hills Sanitary District (FHSD) for containment of effluent water.

During 1994 and 1995, the District worked jointly with the Town and the Arizona Department of Water Resources (ADWR) to share the installation costs of a network of Automated Local Evaluation in Real Time (ALERT) sensors in watersheds affecting the Town. The ALERT flood detection instrumentation currently includes nine rain gages, six pressure transducers in the impoundment areas behind the dams, and two temperature and humidity stations. These are summarized in Table 3-1; locations are shown in Figure 3-1 and the Reference Wall Map.

1.4.3 Flood History

Flooding in the Fountain Hills area typically occurs as a result of two types of seasonal storm events. The first type occurs as high intensity, short duration thunderstorms during summer monsoon season; the second type occurs as lower intensity, longer duration general winter storms. Because of the presence of flood retarding structures, the hydraulic capacities of the channel system, and localized storm drain systems; the historical flooding problems since the early 1970s have been limited to overtopping of roadway crossings, longitudinal flow in roadways, and relatively minor structure inundation. District records indicate that since the installation of watershed instrumentation in the mid-1990s three events have occurred during which special warnings were communicated by telephone from FCDMC Flood Warning Branch personnel to the TOFH Public Works Department. Those events occurred on the following dates: February 24, 1998; August 27, 1999; and August 31, 1999.

The history of flooding in Fountain Hills indicates flood preparedness and emergency response rely heavily upon the expertise of FCDMC Flood Warning personnel to interpret real-time hydrometeorological data from the watershed instrumentation, and the long-term local experience of the TOFH, MCSO, and RMFD emergency response community. The need for a comprehensive Flood Response Plan for Fountain Hills is driven, in part, by the need to document this collective knowledge in an easily understood, user-friendly format.

SECTION 2: FLOOD VULNERABILITY

2.1 Flood Alert Levels

A primary purpose of the Fountain Hills Flood Response Plan is to streamline the flood threat recognition and warning dissemination process to maximize time available for emergency response. To achieve this goal, four color-coded flood alert levels were established and are identified in order of increasing flood magnitude: Green, Red, Blue, and Purple. Each flood alert level is associated with a different level of flood hazard severity and with a different emergency action plan.

Green Alert

The Green flood alert level (Green Alert) was established to identify potential flood hazards at roadway crossing locations. As described in Section 1.4.2, each hydrologic system within Fountain Hills is composed of multiple washes. A potential flood hazard exists at each location where a roadway intersects a wash, thus emergency response to a Green Alert primarily involves roadway closures. No structures are impacted at the Green Alert level, thus no evacuations are necessary.

An Emergency Access Plan and Routes Evaluation Study (GVSCE, 1997) established that a flow depth of 6 inches or greater overtopping any individual roadway crossing constituted a hazardous condition for vehicle passage. This flow depth criteria for roadway passability was adopted for the FHFRP. Hydrologic and hydraulic analyses were completed for each roadway crossing within the study area to determine the rainfall amount and discharge associated with a flow depth of 6 inches.

The criteria for the Green Alert are comprised, in part, by the rainfall intensities necessary to trigger the threshold discharges required to overtop the roadway crossings at a depth of 6 inches. The associated times of occurrence of the critical rainfall establish the basin response time for the Green Alert as described in Section 2.3.1. Roadway closures were segregated into three "bins", or sublevels, of the Green Alert level based upon the rainfall amount necessary to close each roadway crossing. For washes downstream of dams, an additional criterion is the critical water level behind the dams necessary to generate the threshold discharge for roadway overtopping. The roadway crossing "binning" process and the development of the rainfall and water level criteria are further described in Section 3.3.

Red Alert

The Red flood alert (Red Alert) is the next, more severe flood warning level and is defined as approximately equal to the 100-year flood event. The criteria for the Red Alert level apply to roadway crossings similar to the Green Alert as described above and in Section 3.3.2. A Red Alert event significantly overtops many roadway crossings with high velocity flows. Rainfall amounts, peak discharges, and associated times of occurrence were calculated for each roadway crossing affected by the 100-year storm. In addition, the Red Alert level includes other potential flood hazards including structure inundation within the 100-year floodplain boundary. Emergency response to a Red Alert includes roadway closures, evacuation of inundated residences and businesses, and/or evacuation of those structures completely surrounded by floodwaters to designated shelter sites.

Blue Alert

A Blue flood alert (Blue Alert) is defined as a dam emergency spillway operating at full, or near-full, capacity and associated with an approximate one-half Probable Maximum Flood (½ PMF) event. There are six flood retarding structures located throughout Fountain Hills with significant commercial and residential development downstream of each dam. Only washes downstream of dams are included in the Blue Alert category. The impacts of a Blue Alert event include significant overtopping of roadway crossings and considerable inundation of downstream floodplains. Threshold rainfall amounts and critical reservoir water levels required to generate discharges for Blue Alert events were estimated for each roadway crossing downstream of a dam structure as described in Section 3.3.3. Emergency response to a Blue Alert includes additional roadway closures and evacuations of extensive developed areas.

Purple Alert

The most severe alert level within the FHFRP is the Purple flood alert (Purple Alert). This level is triggered by the imminent or occurring overtopping of a dam's crest or imminent failure of the structure. Once overtopping occurs, the potential for dam breach is significantly increased. The Purple Alert level operates under the assumption of a worst case scenario; that is, complete dam failure. The primary means for triggering a Purple Alert is piping or overtopping of a dam reported by an on-site observer. A secondary criterion is a rate of fall of the water level that exceeds the pre-determined maximum drawdown rate possible under the combined operation of the principle outlet and emergency spillway (Section 3.3.4). A rapid rate of fall in excess of the maximum criteria will trigger a water level gage alarm. Emergency response to a Purple Alert includes roadway closures and large-scale evacuation efforts.

Following the issuance of any of the flood alerts described above, and contingent upon the recovery of the emergency flood situation, an All Clear message is disseminated to indicate a return to normal status.

2.2 Flood Vulnerability Assessment

2.2.1 General

The types of flood hazards considered for this study include roadway passability, structure inundation, emergency spillway operation, and dam failure. Data sources for the flood vulnerability assessment are listed in detail in Appendix A and are referenced in this section by their resource number.

2.2.2 Roadway Crossing Evaluation

Purpose – Geometric data for each road crossing were collected for the purpose of quantifying the threshold discharge associated with 6 inches of flow depth, and for hydraulic analyses for evaluation of the Green, Red, and Blue Alert levels.

Data Sources – Multiple data sources were utilized for the flood vulnerability task. Information from existing reports and studies were used and are summarized in Table 2-1: In addition, field investigations were conducted to identify new and/or modified roadway crossings and to collect relevant data for those crossings.

Table 2-1 Data Sources for Flood Vulnerability Assessment

Resource No. (Appendix A)	Description/ Utility
1 thru 6	HEC-1 Models/ Discharge values at road crossing locations HEC-2/HEC-RAS Models/ Flow depth at road crossing locations
7 thru 12	HEC-1 Models/ Discharge values at road crossing locations HEC-2/HEC-RAS Models/ Flow depth at road crossing locations
17	Identify roadway crossings recommended for improvements Establish the 0.5 ft flow depth impassable roadway criteria
18	HEC-1 Models/ Discharge values for ½ PMF storm Determine peak stage of dam reservoir areas Determine peak discharge and flow depth through emergency spillway
22	HEC-1 Models/ Discharge values for ½ PMF storm Determine peak stage of dam reservoir areas Determine peak discharge and flow depth through emergency spillway
29	HEC-1 Model/ New discharge/flow depth through emergency spillway accounting for dam modifications

Application/Analysis – As described in Section 2.1, a threshold flow depth of 0.5 feet at any road crossing was assumed to constitute a potential hazard for vehicle passage. The methodology for determining the discharge associated with this threshold depth utilized data from hydrologic and hydraulic models previously prepared as part of the Floodplain Delineation Study (FDS) North (GVSCE, 1994), FDS South (AGK, 1996), and land development drainage studies completed by others. Both FDS studies relied on the existing condition HEC-1 models for discharge estimates. Given the significant amount of land development since the FDS studies were completed, it was decided that future condition HEC-1 models would be used in the FHFRP to construct the approximate 100-year floodplains and to determine threshold discharge values at roadway crossings.

HEC-1 Models – The time of occurrence between the peak rainfall intensity and the peak discharge at each roadway crossing was analyzed to estimate the hydrologic lead time (Section 2.3.1). If a concentration point (CP) from the model was located at the crossing location, the associated discharge and peak time was taken directly from the FDS model. If no CP existed at a particular crossing, then the discharge and peak time from the nearest upstream CP was used. The travel time to the crossing was then added to the peak time from the upstream CP.

HEC-RAS Models – The original HEC-2 models from the FDS North and FDS South studies were converted to HEC-RAS for the Emergency Access Plan study (GVSCE, 1997). These HEC-RAS files were used in the FHFRP to determine the minimum discharge required to achieve a 0.5 ft flow depth at each road crossing. Additional modifications by JEF were made to the 1997 GVSCE HEC-RAS models to reflect crossing upgrades and/or differences in estimated discharge values. For this purpose, new HEC-RAS models were constructed and/or appended to the 1997 GVSCE models. Rating curves were developed for the newly analyzed crossings and these are provided in Appendix B.

JEF was tasked to extend the 100-year floodplain delineations to the headwaters for the washes listed in the project scope (Section 1.4.2), including those not previously modeled by others. JEF conducted site visits to identify new crossings or crossings that were modified in the intervening period since the previous studies were completed. The Emergency Access Plan study (GVSCE, 1997) evaluated 86 crossings and determined the passable discharge, 100-year flow depth, and impassable duration for each. That study also identified 11 crossings for recommended improvements. Two of those recommendations had been completed at the time of FHFRP development (i.e., extended culvert at Saguaro Boulevard at Laser Drain and street drainage improvements along Grande Boulevard east of Saguaro Boulevard). In addition, drainage improvements at three other locations previously analyzed as part of the Emergency Access Plan had been implemented prior to or were in process during the development of the FHFRP. The FHFRP hydraulic analyses for determining roadway passability incorporated changes at the following locations:

- Arrow Drive at Arrow Wash – The new culvert installation upgraded passability status from Green Alert to the Red Alert level.

- Saguaro Boulevard between Palisades and El Lago Boulevards – Drainage improvements under construction at the time of FRP development were evaluated and found to not to change the passability status according to the criteria of the FRP due to other site conditions. That is, the new condition status remained within the same alert bin as the pre-improvement condition.

- Grande Boulevard east of Saguaro Boulevard – Street drainage improvements upgraded passability status from Green Alert to Caution level (described below).

In areas newly developed since the completion of the previous studies, JEF adopted the results of the more recent hydrologic and hydraulic analyses by others where those data were available. Where no previous models existed, JEF collected field data for the purpose of generating new models. The following locations were known to be slated for site development in the near future; however, drainage improvements appurtenant to these site developments were not incorporated in the FRP:

- Cereus Wash upstream of Saguaro Boulevard – Target Center
- Fountain Channel between El Lago Boulevard and Kiwanis Drive – Parcel 12

Interpretation – Each flood-impacted crossing was assigned a priority response level based on the amount of precipitation required to produce an impassable discharge. The precipitation estimates were segregated into four "bins" and given an alert priority as summarized in Table 2-2 and defined below. See Section 3.3 for discussion of the criteria development and prioritization methodology.

An additional "Caution" category was created for roadway crossings not meeting the 6 inches overtopping criteria. A "Caution" designation was assigned to roadway crossing locations where passability is impacted by local drainage conditions in the immediate vicinity, where overtopping occurs during wash flooding to a depth of less than 6 inches, and/or where subject to silt and debris deposition during floods. "Caution" designations were also assigned to roadways with longitudinal flow at the gutter line in excess of 6 inches, but with flow depths of less than 6 inches at the crown (e.g., El Lago Boulevard west of Fountain Hills Boulevard). Emergency responders should use caution at all times in flooded roadway crossings, but extra care is warranted at the designated "Caution" locations.

Storm data suggest that there is insufficient emergency response time if flood alerts are initiated when rainfall intensities peak (see Table 2-7). To resolve this, each alert priority level is triggered before the end of the rainfall at 62% of the total storm rainfall actually required to create impassable flow depths. See Section 3.3.1 for a discussion of the rationale for this rainfall threshold criterion.

Table 2-2 Flood Alert Priority Levels

Rainfall Detection Criteria (inches in 30 minutes)	Alert Priority Level
0.5	G1
1.0	G2
1.5	G3
2.0	R1

Results – Results of the roadway crossing evaluations are illustrated on the Reference Wall Map and are tabulated by gage sensor in the Dispatcher Atlas.

2.2.3 Flood Vulnerable Structures

Purpose – In addition to overtopping of roadway crossings, inundation of structures during flood events creates life-threatening hazards. The FHFRP addresses both identification and evacuation procedures for flood vulnerable structures. Structures are segregated into three categories as defined by the alert level at which they initially become impacted: Red, Blue, or Purple. Residents from flood impacted structures evacuate to shelter sites strategically located throughout the Town.

Data Sources – Data used to identify flood vulnerable structures are the same as those used for the corresponding Red Alert roadway crossing analyses.

Application/Analysis – Relatively few structures are impacted by a Red Alert, thus flood warnings may be communicated to individual residences. Table 2-3 lists the impacted structures and Figure 2-1 illustrates their spatial location. Street addresses and contact names are provided in the Dispatcher Atlas for the purpose of individual notification; telephone numbers should be added as part of the FHFRP implementation. Each structure affected by a Red Alert is assigned to an evacuation shelter as shown on the Emergency Access Map (EAM), Reference Wall Map, and as described in Section 6.2.

Table 2-3 Summary of Structures Impacted by Red Alert

ID	Street Name	System	Wash	Lot Number
1	Oxford Drive	Ashbrook	Oxford	16
2	Oxford Drive	Ashbrook	Oxford	17
3	Oxford Drive	Ashbrook	Oxford	18
4	Fountain Hills Boulevard	Ashbrook	Balboa	-
5	Golden Eagle Boulevard	Ashbrook	Ashbrook	-
6	Fairlynn Drive	Ashbrook	Tulip/ Legend	3
7	Ibsen Drive	Ashbrook	Ashbrook	14
8	Ibsen Drive	Ashbrook	Ashbrook	15
9	Ibsen Drive	Ashbrook	Ashbrook	16
10	Aloe Drive	Ashbrook	Ashbrook	25
11	Aloe Drive	Ashbrook	Ashbrook	26
12	La Casa Drive	Ashbrook	Ashbrook	27
13	La Casa Drive	Ashbrook	Ashbrook	28
14	La Casa Drive	Ashbrook	Ashbrook	29
15	La Casa Drive	Ashbrook	Ashbrook	30
16	Arrow Drive	Ashbrook	Ashbrook	15
17	Arrow Drive	Ashbrook	Ashbrook	14
18	Arrow Drive	Ashbrook	Ashbrook	13
19	Arrow Drive	Ashbrook	Ashbrook	12
20	Bayfield Drive	Ashbrook	Ashbrook	MC #37
21	Bayfield Drive	Ashbrook	Ashbrook	MC #36
22	Hamilton Drive	Ashbrook	Ashbrook	MC #14
23	Hamilton Drive	Ashbrook	Ashbrook	MC #15
24	Hamilton Drive	Ashbrook	Ashbrook	17
25	Chama Drive	Colony	Colony	1
26	Chama Drive	Colony	North Colony	6
27	Chama Drive	Colony	North Colony	5
28	Chama Drive	Colony	North Colony	4
29	Chama Drive	Colony	North Colony	3
30	Chama Drive	Colony	North Colony	2
31	Chama Drive	Colony	North Colony	1
32	Malta Drive	Malta	Malta	1
33	Kingstree Boulevard	Malta	Jacklin	26
34	Saguaro Boulevard	Malta	-	-
35	Saguaro Boulevard	Malta	-	-
36	Saguaro Boulevard	Malta	-	-
37	Firebrick Drive	Cereus	Cereus	1
38	Saguaro Boulevard	Cereus	Cereus	10

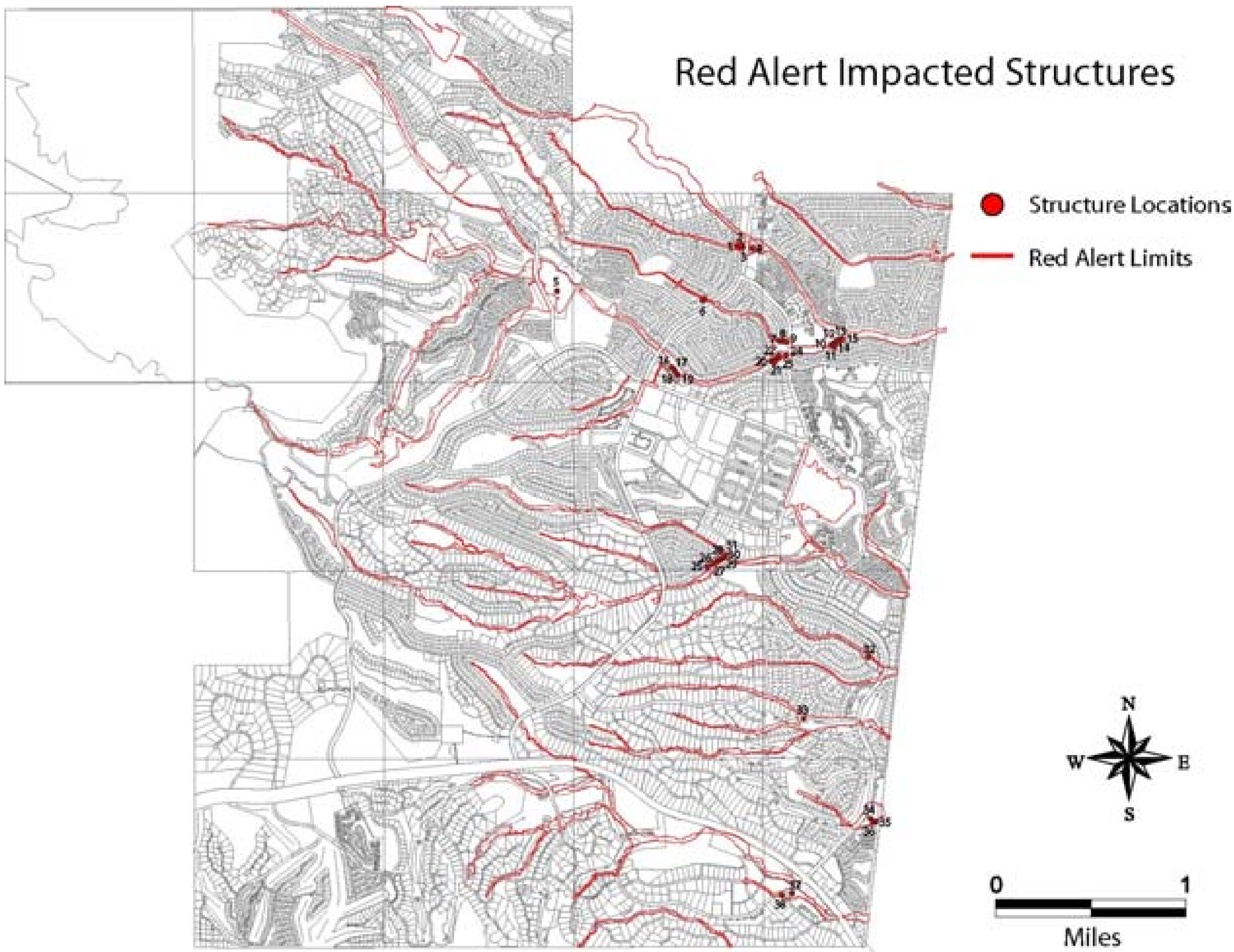


Figure 2-1 Locations of Red Alert Impacted Structures

Identification of impacted structures by Red, Blue, and Purple Alert levels were based on their planimetric relation to the floodplain inundation limits. If a structure was located within a floodplain limit it was considered affected by that alert level. It should be noted that although a structure may be located within the floodplain, the finished floor elevation may be high enough to prevent floodwater from entering the building. Field survey of the finished floor elevation for each impacted structure was outside the scope of this project; therefore, the most conservative approach was to advise warning for all structures inside the planimetric floodplain limits for each alert level.

2.2.4 Spillway Inundation Evaluation

Purpose – The Blue Alert level is described by the peak emergency spillway discharge for each individual dam within the town boundary. Hydrologic and hydraulic models were analyzed to determine the discharges from each dam and the downstream inundation limits.

Data Sources – Table 2-4 summarizes the data sources for the spillway inundation evaluation.

Table 2-4 Data Sources for the Spillway Inundation Evaluation

Resource No.	Description
93	½ PMF HEC-1 analyses for Aspen, Sunridge Canyon, North Heights, Golden Eagle Park, and Hesperus dams.
94	½ PMF HEC-1 analyses for Stoneridge dam.
126, 128	GVSCE Ashbrook Wash and Colony Wash HEC-RAS used as base models. Multiple cross-sections were extended to model ½ PMF discharges.
140	JEF HEC-RAS models created to extend the 100-yr floodplains to the town boundary and analyze roadway crossings.

Results - The Blue Alert is associated with maximum (½ PMF) dam spillway flows. Significant numbers of structures are impacted by a Blue Alert level warning, thus individual evacuation notifications cannot be implemented in a timely manner. As shown on the Emergency Access Map (EAM), structures affected by a Blue Alert generally form large groupings. This will facilitate group warning by emergency responders using mobile sirens and/or public address systems. The number of affected structures negates the timeliness of individual evacuation location assignments, thus emergency personnel must direct evacuated residents to the nearest site via group warning.

Consideration should be given to the installation of fixed sirens of sufficient design to signal warnings to the two residential areas of highest density of residences in the Blue zone inundations limits. These areas include the Lakeside Patio Homes and Morningside development between the confluence of Colony Wash and Panorama Wash, and the Courtside Villas and residences along Yerba Buena Way adjacent to Balboa Wash.

2.2.5 Dam Break Evaluation

Purpose – In the event that an extremely low-probability, high-magnitude storm event (or series of storm events) occurs, a dam break scenario is possible. The FHFRP addresses this potential flood scenario as previously described in Section 2.1 with the Purple Alert level. To evaluate this hazard, dam break models and floodplain limits were assessed to identify impacted structures and roadway crossings.

Data Sources – Dam break data sources included previous models by others. A previous dam break model for the old Golden Eagle Park dam was modified by JEF to incorporate new dam modifications and to determine changes to downstream inundation limits, if any. Table 2-5 summarizes data sources utilized for the dam break evaluation.

Table 2-5 Data Sources for the Dam Break Evaluation

Resource No.	Description
18	GVSCE Report (1996) - DAMBRK model used to determine discharge, hydrologic lead time, and floodplain limits.
19	GVSCE Plates (1996) - DAMBRK model used to determine discharge, hydrologic lead time, and floodplain limits.
20	GVSCE Appendices Vol. 1 (1996) - DAMBRK model used to determine discharge, hydrologic lead time, and floodplain limits.
21	GVSCE Appendices Vol. 2 (1996) - DAMBRK model used to determine discharge, hydrologic lead time, and floodplain limits.
22	AGK Report (1996) - DAMBRK model used to determine discharge, hydrologic lead time, and floodplain limits for Stoneridge and Fountain Lake Dams only.
28	FHSD Lake 27-1 EAP – AGK (1996) Failure of Firerock Dam Inundation Map
Appendix C	JEF BREACH model with Golden Eagle Park Dam modifications

Application/Analysis – Hydrologic models for the ½ PMF event were used for the dam break studies. Multiple assumptions were made in the modeling:

- Hesperus, Aspen, North Heights, Sunridge Canyon Dams
  - Inflow design flood = ½ PMF
  - Principle spillway = 100% clogged
  - Initial water surface elevation is the higher value of either the emergency spillway crest or water surface elevation for the 100-year flood
- Stoneridge and Fountain Lake Dams
  - Stoneridge Dam: Initial water surface = 0 ft
  - Fountain Lake Dam: Initial water surface = maximum operating level
  - No overtopping of dam crest
  - Roadway embankments withstand flows without collapsing
- Golden Eagle Park Dam
  - Inflow design flood = ½ PMF plus the breach of one of the upstream dams
  - Principle spillway = Destroyed
  - Initial water surface elevation is the higher value of either the emergency spillway crest or water surface elevation for the 100-year flood

JEF generated a modified BREACH model to assess the potential change, if any, in the downstream inundation limits that would result from a piping failure of the modified Golden Eagle Park Dam. The model incorporated recent modifications to the dam geometry, principle and auxiliary outlets, and emergency spillway. Model input, output, and a summary of findings for the post-modification BREACH model are provided in Appendix C. JEF found no significant changes in the dam failure outflow hydrograph that would warrant re-delineation of the downstream inundation limits from those previously documented for Golden Eagle Park Dam prior to its modification. The existing dam break limits were considered to be conservative and suitable for use in the FHFRP. Therefore, the Purple Alert dam break inundation limits for all dams, including Golden Eagle Park Dam, were digitized from hardcopy maps from the studies listed in Table 2-5.

Interpretation – Structures impacted by Purple inundation limits are too numerous to provide listings of individual names, addresses, and contact information. Major scale evacuation efforts would be required. Notification of residents in the Purple zone would be communicated by emergency responders via mobile sirens and/or public address systems.

Consideration should be given to the installation of fixed sirens of sufficient design to signal warnings to the two residential areas of highest density of residences in the Purple zone inundations limits. These areas include the Lakeside Patio Homes and Morningside development between the confluence of Colony Wash and Panorama Wash, and the Courtside Villas and residences along Yerba Buena Way adjacent to Balboa Wash.

Results - Structures affected by a Purple Alert include those impacted by both Red and Blue Alerts, plus structures impacted by a potential dam failure (see the EAM for Purple zone limits). Similar to the Blue Alert, individual warnings cannot be completed in a timely manner and therefore require group notifications.

2.3 Lead Time Estimation

The methodology for estimation of lead time for the Fountain Hills Flood Response Plan was adopted from the Wickenburg Flood Response Plan (Stantec, 1999). Equation (1) was used to determine effective lead times for each roadway crossing:

Effective Lead Time = Hydrologic Lead Time – Emergency Response Time (1)

The following definitions and descriptions of procedures for the determination of hydrologic, decision, action, and effective lead times as shown in italics are taken directly from the Wickenburg FRP Technical Addendum.

> *The design of an effective flood response plan is driven by the amount of lead time available for response agencies to mobilize and implement emergency response efforts. The hydrologic lead time is set by the basin response to rainfall. The travel time of the runoff to flood vulnerable areas is set by hydraulic characteristics of the conveyance channels to those areas. The sum of basin response time and hydraulic travel time constitutes the hydrologic lead time. The emergency response time is determined by the decision time needed to assess the flood event and issue warnings, and by the readiness of the local emergency response agencies to implement the appropriate action protocols.*
>
> *The balance of hydrologic lead time relative to emergency response time comprises the effective lead time. The magnitude of the resulting effective lead time determines whether the flood response plan for a particular watershed is proactive – triggered by the prediction of the runoff-producing rainfall – or reactive – relying on the detection of the event by watershed instrumentation – or a combination of both.*

The FRP for the Fountain Hills area involves both roadway crossings and impacted structures. For each location, the travel time increases with increasing downstream distance, thereby increasing hydrologic lead time and effective lead time. Decision makers in a flood emergency must exercise caution in the use of, and reliance upon, the lead times provided in Table 2-7. These lead times are estimates only based upon the best available technical information and should not be strictly interpreted. They should only be used as an indicator of the urgency of the necessary response actions and as a decision-making tool for prioritization of the response activities.

2.3.1 Hydrologic Lead Time

> *Hydrologic lead time refers to the response time of a watershed to runoff-producing rainfall. This basin response time is defined as the lag time from the occurrence of the highest rainfall intensity to the time of peak discharge. Basin response times are estimated for each roadway crossing impacted by flooding conditions. Hydraulic travel time is the estimated time the flood takes to travel from an upstream location to the identified flood vulnerable areas downstream. The sum of the basin response and travel lead times constitutes the hydrologic lead time for those watercourses.*

The optimal use of the hydrologic lead time period is to place the emergency response agencies on a heightened level of awareness to the potential flooding problem. Depending on the severity of the potential flooding problem, varying degrees of awareness and action may be evoked. If sufficient hydrologic lead time is available, then response agencies can best utilize it to prioritize response in an orderly fashion to avoid flooding surprises. Weather prediction, radar observation of the storm, or the alarm response of a flood detection network's rain or water level gages to observed rainfall or reservoir levels can provide response agencies with a basis for deciding when and how to trigger response activities.

Hydrologic lead times for each alert level were calculated from the HEC-1 and DAMBRK models peak time estimates. The hydrologic lead times for Green and Red Alert levels were computed from models developed for the Fountain Hills North (GVSCE, 1994) and Fountain Hills South (AGK, 1994) FDS studies and the Emergency Access Plan study (GVSCE, 1997). Lead times for the Blue Alert level were calculated from the ½ PMF HEC-1 models. The Purple Alert lead times were calculated from the dam break models. Specific models and reports are identified in Table 2-6.

Table 2-6 Data Sources for Hydrologic Lead Time Estimates

Resource No.	Alert Level	Description
56	Green, Red	HEC-1, 100-year, 6-hour, future condition FDS North
62	Green, Red	HEC-1, 100-year, 6-hour, future condition Powder Wash
66	Green, Red	HEC-1, 100-year, 6-hour, future condition Cereus Wash
70	Green, Red	HEC-1, 100-year, 6-hour, future condition Cyprus Pt. Wash
74	Green, Red	HEC-1, 100-year, 6-hour, future condition Jacklin Wash
78	Green, Red	HEC-1, 100-year, 6-hour, future condition Emerald Wash
82	Green, Red	HEC-1, 100-year, 6-hour, future condition Malta Wash
86	Green, Red	HEC-1, 100-year, 6-hour, future condition Colony Wash
90	Green, Red	HEC-1, 100-year, 6-hour, future condition Panorama Channel
93	Blue	½ PMF HEC-1 analyses for Aspen, Sunridge Canyon, North Heights, Golden Eagle Park, and Hesperus Dams.
94	Blue	½ PMF HEC-1 analyses for Stoneridge Dam.
20	Purple	Dam break analysis – North Heights Dam
20	Purple	Dam break analysis – Hesperus Dam
20	Purple	Dam break analysis – Sunridge Dam
20	Purple	Dam break analysis – Aspen Dam
20	Purple	Dam break analysis – Golden Eagle Park Dam
22	Purple	Dam break analysis – Stoneridge Dam

The methodologies for determining hydrologic lead times are described below:

Green Alert – Impassable discharge estimates for each roadway crossing were determined as described in Section 2.2.2. Figure 2-2 shows a plot of the temporal distribution of the 6-hour storm used in the HEC-1 rainfall-runoff model. The most intense portion of the storm occurs by the end of the fourth hour of the storm. The high rainfall intensities are the portion of the storm that generate the bulk of the runoff and correspond with the part of the storm that generates the maximum discharge. Therefore, the time between the most intense rainfall and the impassable discharge was used to estimate the hydrologic lead time to each crossing location for Green Alert. Hydrologic lead time was estimated by analysis of the HEC-1 future condition 100-year, 6-hour hydrograph at each crossing location. Four hours (240 minutes) was subtracted from the time corresponding to the impassable discharge estimate on the 100-year, 6-hour future conditions hydrograph. The resulting time was considered the hydrologic lead time. If a crossing did not correspond to a HEC-1 concentration points (CP), the hydrologic lead time computed from the nearest upstream CP hydrograph was added to the HEC-RAS travel time to the crossing location to yield the final hydrologic lead time for that location.

Red Alert – Future condition 100-year, 6-hour HEC-1 models were used to determine peak discharge estimates at each roadway crossing. The 6-hour and 24-hour models were compared to determine which resulted in higher peak discharge estimates and thus most conservative. The 6-hour storm model showed higher discharge values for both the FDS North and South studies. For roadway crossings that coincided with a HEC-1 CP, the peak time was extracted directly from the model. For crossings that did not directly coincide with a CP, the peak time from the closest upstream CP was added to the HEC-RAS travel time to the crossing location to result in the final effective lead time.

Blue Alert – Hydrologic lead times for Blue Alert levels were estimated using the methodology described above for Red Alert with the ½ PMF HEC-1 models.

Purple Alert – Purple Alert hydrologic lead times were derived from the existing DAMBRK models. The time between detection of the breach and the maximum breach flow is variable with each breach scenario. This breach lag time could vary from almost instantaneous on a rapidly rising limb of the hydrograph to a lagged breach on the falling limb of the hydrograph. Because this temporal variable is unique to each breach scenario, the flood wave travel time to each roadway crossing was used as the hydrologic lead time. The use of the travel time component only is conservative for flood warning purposes and serves to isolate Purple Alert from the preceding condition (i.e., reservoir status can change from Green or Red Alert to Purple Alert, not necessarily only from Blue to Purple).

2.3.2 Decision/Action Time

The emergency response time is determined by the decision time needed to assess the flood event and issue warnings, and by the readiness of the local emergency response agencies to implement the appropriate action protocols.

The decision time refers to the amount of time required by the dispatch/emergency personnel to:

1. *verify that a flash flood or flooding problem is imminent based on prediction tools or that flooding is occurring based on detection data;*

2. *identify the relative magnitude of the flooding event based on pre-determined criteria; and*

3. *issue the appropriate alert warning to local response agencies so that the applicable FRP action plans may be triggered.*

In effect, the decision time is a measure of the amount of time required by emergency response personnel to verify that a problem exists and to issue a warning. The action time component is the sum of the time required by the response agencies to acknowledge and respond to the flood alert messages, commit resources to the various components of the action plans, and to implement the appropriate response action.

Both decision and action times are estimated for local flood emergency response capabilities in Fountain Hills based on information provided to JEF during interviews with personnel of the FCDMC Flood Warning Branch, Fountain Hills Marshals Department, Maricopa County Sheriff's Office, Fountain Hills Public Works/ Engineering Department, Rural Metro Fire Department, Fountain Hills Unified School District, and Fountain Hills Sanitary District. The resulting decision times are estimated to range from 15 to 20 minutes. Action times range from a minimum of 8 minutes to a maximum of 30 minutes depending on response location. These values are used in the computation of the effective lead time as summarized in Table 2-7.

2.3.3 Effective Lead Time

The magnitude of the effective lead time for a particular watershed indicates the relative balance of the rate of response to flood-generating rainfall– or "flashiness" – of the physical system to the time required for emergency responders to implement flood response activities. The methodology for determining the effective lead time is based on the future condition 100-year, 6-hour HEC-1 models for Fountain Hills (AGK, 1994; GVSCE, 1994). The initial start time from which the hydrologic lead time and the decision/action lead time is subtracted is taken as the time at which the greatest amount of rainfall occurs in the shortest time period. The greatest increase in precipitation occurs at the end of 4.0 hours and the start of 4.25 hours from the beginning of the storm, as highlighted in Figure 2-2.

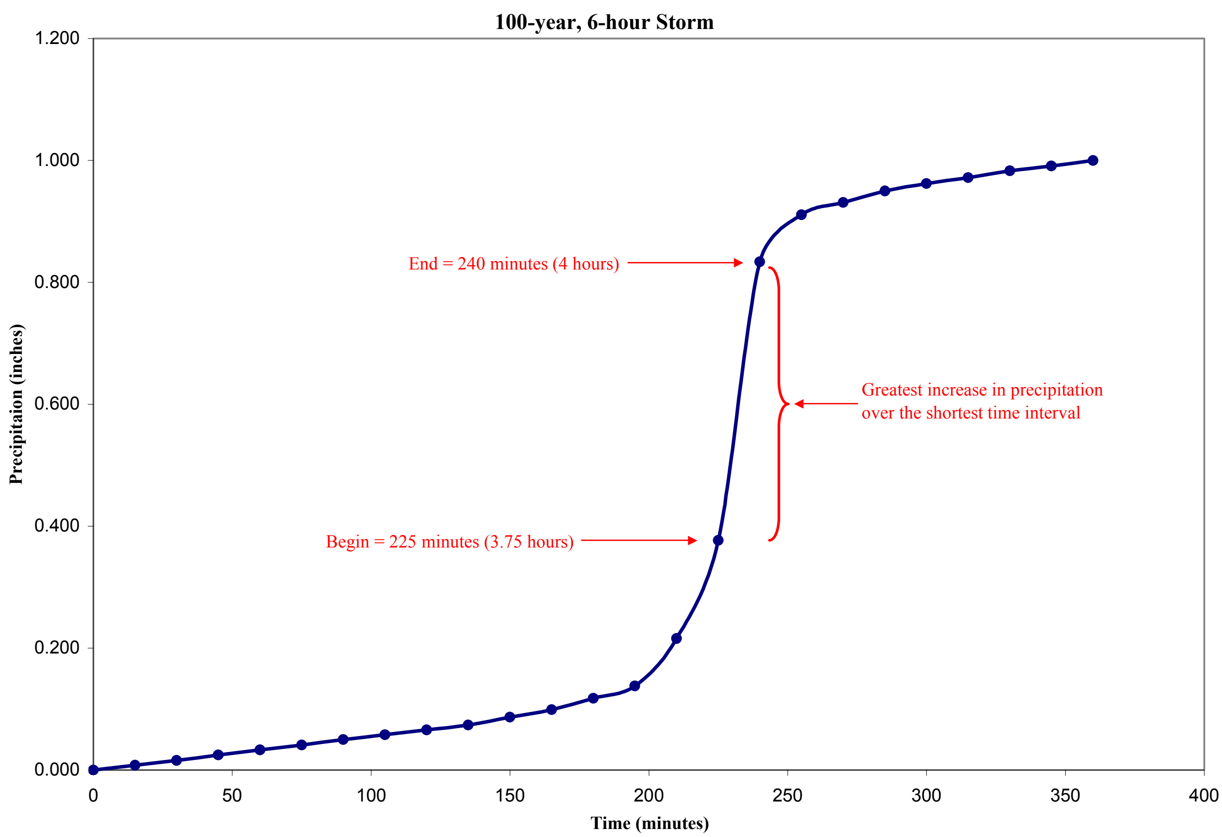


Figure 2-2 Plot of PC Record Showing the Time of Most Intense Precipitation

Based on the pattern shown in Figure 2-2, the peak storm intensity occurs at 4 hours; therefore, the initial time from which the effective lead time is estimated is 4 hours (240 minutes). The results of the effective lead time evaluation for Fountain Hills are summarized by wash system in Table 2-7. Those lead times range from largely negative values to relatively small positive values signifying the following:

- For those flood vulnerable areas with positive values, these lead times are indicative of the approximate time period afforded to emergency response personnel to barricade roadway crossings and evacuate inundation zones before they become inaccessible.

- The negative effective lead times for the Fountain Hills wash systems indicate that the time required for emergency responders to trigger and implement flood-related action plans exceeds the time required for floodwaters to reach critical threshold alert levels in flood vulnerable areas. Negative lead times occur when an alert level discharge at a roadway crossing occurs prior to 4 hours from the beginning of the storm event.

The prevalence of negative values in Fountain Hills implies the need for a predictive-based flood response plan and/or for minimizing the emergency response times with the most efficient information dissemination tools possible. Predictive-based flood response plans are prone to false positive results. Thus, the approach selected for the FHFRP to address the lack of effective lead time was to set a lower threshold for the rainfall criteria used in triggering the issuance of a flood alert. The 30-minute cumulative rainfall (corresponding to 62% of the total storm rainfall) was selected as the basis for the rainfall criteria for determination of the flood detection criteria for the FHFRP as described in Section 3.3.1.

Table 2-7 System Average Effective Lead Time

WASH SYSTEM	HYDROLOGIC LEAD TIME (min)				EFFECTIVE LEAD TIME (min)							
	Green Alert	Red Alert	Blue Alert	Purple Alert	Green Alert		Red Alert		Blue Alert		Purple Alert	
					min	max	min	max	min	max	min	max
Ashbrook Average	-32	9	1	14	-82	-55	-41	-14	-49	-22	-36	-9
Colony Average	-14	16	16	8	-64	-37	-34	-7	-34	-7	-42	-15
Malta/ Jacklin Average	-14	7	N/A	N/A	-64	-37	-43	-16	N/A	N/A	N/A	N/A
Cereus Average	-22	6	N/A	N/A	-72	-45	-44	-17	N/A	N/A	N/A	N/A

EMERGENCY RESPONSE TIME			
Decision Time		Action Time	
Minimum	Maximum	Minimum	Maximum
15	20	8	30

The results of the effective lead time analysis lead to the following conclusions about flood detection criteria and emergency preparedness in the development of the FHFRP:

1. While a prediction-based FRP is not recommended due to the likelihood for false positive flood warnings, existing predictive tools such as the NWS and MSP forecast products should be utilized to raise TOFH agency awareness that the issuance of flood alerts and the implementation of emergency action plans may become necessary.

2. A detection-based FRP is recommended. Reports of heavy rainfall or critical water levels behind the dams from observers in the field should take precedence over measured data. Given the rapid response times for the watersheds affecting Fountain Hills, rainfall detection thresholds need to be set so as to trigger flood alerts before the end of the total storm rainfall. Similarly, flood alerts based upon water levels behind the dams need to be triggered before critical thresholds are reached in order to provide emergency response time.

3. Emergency response times must be minimized by:

    a) an efficient and reliable means of dissemination of flood warnings and updates to response agencies and the public;

    b) emergency action plans that are streamlined with responsibilities that are clearly understood; and

    c) proper training for key personnel for all FHFRP agencies and regular flood exercises.

4. Recommended improvements and updates to the Flood Response Plan can serve to optimize effective lead times to the extent possible given the constraints of the physical hydrologic system.

SECTION 3: FLOOD DETECTION

Section 3 presents the methods and results of determination of the flood detection criteria for the Fountain Hills Flood Response Plan. For each of the four flood alert levels (Green, Red, Blue, and Purple), the detection criteria are identified and the methods of their derivation described. Section 3 ends with a listing of suggested enhancements to the FCDMC ALERT detection network.

Ideally, a flood threat could be identified by prediction based on a meteorological forecast and some modeling or historical results to compare against the forecast. A prediction-based flood response plan would allow the maximum amount of time possible for reaction and response by emergency personnel. Unfortunately, predictions are frequently quite divergent from reality. Therefore, flood response activity often waits for confirmation of a forecast through direct observation either by people or instruments of heavy rainfall or runoff. Reaction and response based on measured rainfall allows the second greatest amount of time to perform response activity. However, the same rainfall observed or the nature of the observation (i.e. rain gage) also includes a certain degree of uncertainty in the precise amount of runoff that will result. Therefore, the type of detection that lends the highest degree of certainty is observation or measurement of runoff. However, waiting to observe or measure the runoff leaves response personnel the least time to react.

Given the trade-offs of response time and uncertainty, it is recommended that the primary detection method for flood response for the FHFRP is measurement of runoff. The secondary detection method recommended is measurement of rainfall. Forecasts of heavy rainfall are recommended for use as a "heads up" providing valuable information for emergency response personnel to be prepared for possible action or reaction to a flood.

3.1 Flood Prediction Capability

3.1.1 District Meteorological Services Program

The Flood Control District of Maricopa County operates a program known as the Meteorological Services Program (or MSP) to provide "timely and accurate weather information regarding the potential for flood producing rain and/or damaging winds." (FCDMC, MSP SOP, 6/18/01; See Appendix D). The Town of Fountain Hills is a member user of the MSP. Weather Outlooks are issued daily describing the outlook for flood producing precipitation for 13 zones within the County. The Town is located within the Scottsdale MSP Zone. In addition to the daily Weather Outlook, a suite of flash flood advisory messages are generated when the potential for flood producing rainfall is forecast. Times and depths of forecasted rainfall are provided. These messages can serve as a basis for advance preparations by the Town prior to any rain hitting the ground.

The following description of the message suite as shown in italics is taken directly from the MSP Standard Operation Procedure:

> Weather Outlook: *The daily outlook will be disseminated to all clients daily, normally between 1:00 PM and 1:30 PM – weather permitting. The Outlook will include a synopsis of expected weather conditions for the remainder of the afternoon, the coming night and the following morning; the expected hours the bulk of the rain will fall (prime time); the probability of rain during "prime time"; and the amount of rain expected during this period. Expected wind conditions will be included in the synopsis portion of the Outlook.*
>
> Message 1 – Alert: *When it is believed developing weather conditions may lead to flooding and/or destructive winds an Alert will be issued. Lead time will generally be 1 to 3 hours in advance of the expected event. The Alert will include the zones to be affected, the time frame of the expected event, and the type of areas that will be impacted – such as roads, washes, or streams.*
>
> Message 2 – *Flash Flood Watch: When it appears the developing weather event may lead to flash flooding, a Watch will be issued for the expected affected areas. Lead time will generally be 1 to 2 hours in advance of the expected event. The Watch will include the time frame it will be in effect (valid time).*
>
> Message 3 – *Flash Flood Warning: When it appears flash flooding is imminent a Warning will be issued for the expected affected areas. Lead time will generally be less than an hour. The Warning will include the time frame it will be in effect (valid time).*

Message 2 & 3 Updates: *This message will update the existing Watch or Warning.*

Message 4 – Cancel: *When an event no longer poses a threat to the areas mentioned in a Watch or Warning, a Cancel message will be issued.*

Track Forecast: *At times the depiction of expected thunderstorm movement may best be shown by a graphic, including location of the primary thunderstorms of concern and a forecast track of these storms. The time frame will generally be for the next 1 to 2 hours.*

Quantitative Precipitation Forecast (QPF): *This graphical product may be issued when the forecaster believes he has a good grasp as to how much rain will fall, where, and when (valid time).*

The complete FCDMC MSP Standard Operation Procedure which includes examples of each message product is included in Appendix D. The MSP is operated independently of the National Weather Service which issues its own advisory statements regarding severe weather and flood producing rainfall and as described below in Section 3.1.2.

3.1.2 National Weather Service Products

In addition to the MSP products, the National Weather Service (NWS) also issues messages of flash flood and severe weather watches and warnings. The NWS also issues an urban small stream advisory to warn the public and public officials of the likelihood of runoff in small urban area streams.

The following is a brief synopsis of the NWS message suite:

Severe Thunderstorm Warning: A Severe Thunderstorm Warning is issued when the NWS determines that a severe weather occurrence is imminent or already occurring. Severe weather includes tornadoes, high wind, dust storms, hail, or locally heavy rainfall.

Flash Flood Watch: A Flash Flood Watch is issued when the NWS determines that a threat exists for flash flooding due to meteorological and soil conditions. The NWS

Watches are typically issued for an entire County or a large portion of a County. The time period for Flash Flood Watches is typically from 3 to 12 hours or longer.

Urban Small Stream Advisory: An Urban Small Stream Advisory is issued by the NWS when locally heavy rainfall is expected to occur but the total rainfall is expected to be less than the criteria for a Flash Flood Warning. Usually the type of flooding that is expected to result is of a nuisance variety and expected to pose a minimal threat to life and property.

Flash Flood Warning: A Flash Flood Warning is issued by the NWS when flash flooding is imminent or already occurring. A flash flood warning is often issued for specific basins over a period of 1 to 6 hours. Flash Flood Warnings are often issued based on observed flooding either by ground observers or telemetered stream gages. Additionally, Flash Flood Warnings may be issued on the basis of rain gages or radar.

The means for dissemination of the NWS and MSP flood warning messages are described in Section 4.1. The response of the Town to each type of message from either the MSP or the NWS is described in Section 6.1.

3.2 Flood Detection Network

The FCDMC currently operates a number of ALERT stations in the Fountain Hills area. The stations include nine precipitation gages, six water level sensors, and two temperature-humidity probes. Figure 3- shows the locations of the stations. Table 3-1 lists all of these sensors.

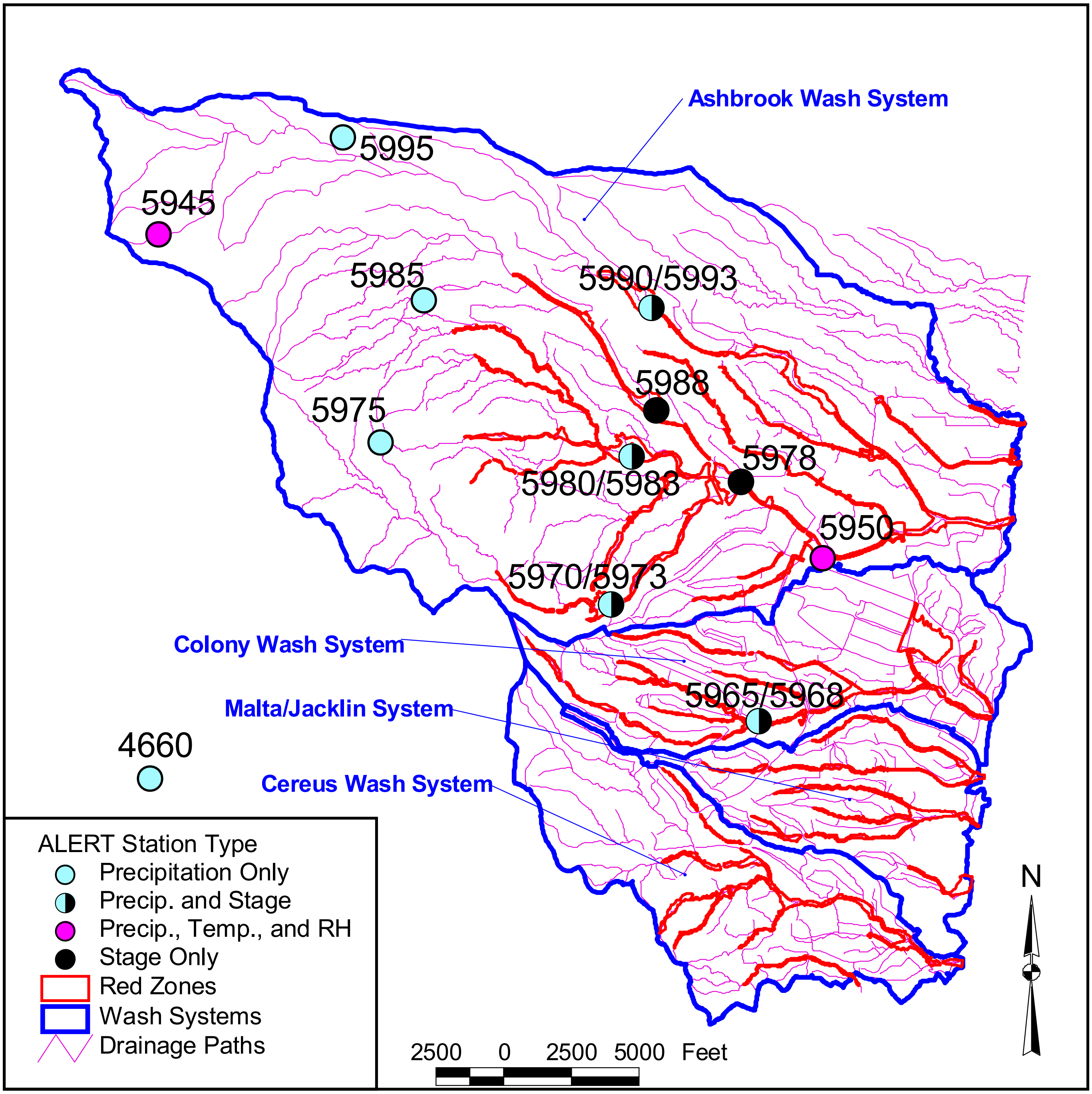


Figure 3-1 ALERT Station Location Map

Table 3-1 ALERT Stations in the Fountain Hills Area

SENSOR NAME	SENSOR ID	DEVICE TYPE	DATE INSTALLED	T_R_S	LATITUDE	LONGITUDE	ELEVATION (FEET)
Thompson Peak	5945	1 mm Tipping Bucket Rain Gage	07/27/89	4N-5E-35	33 38 40	111 49 11	3995
Fountain Hills Fire	5950	1 mm Tipping Bucket Rain Gage	12/09/93	3N-6E-15	33 36 40	111 43 29	2285
Stoneridge Dam	5965	1 mm Tipping Bucket Rain Gage	12/11/96	3N-6E-22	33 35 41	111 44 01	1710
Sunridge Canyon Dam	5970	1 mm Tipping Bucket Rain Gage	02/04/97	3N-6E-16	33 36 24	111 45 06	1930
Cloudburst Wash	5975	1 mm Tipping Bucket Rain Gage	03/13/97	3N-6E-07	33 37 13	111 46 37	2440
North Heights Dam	5980	1 mm Tipping Bucket Rain Gage	10/11/96	3N-6E-09	33 37 21	111 44 54	1820
Golden Eagle Blvd.	5985	1 mm Tipping Bucket Rain Gage	02/12/97	3N-6E-05	33 38 40	111 45 59	1905
Hesperus Dam	5990	1 mm Tipping Bucket Rain Gage	12/18/96	3N-6E-04	33 38 14	111 44 47	1895
Hesperus Wash	5995	1 mm Tipping Bucket Rain Gage	03/10/97	4N-6E-31	33 32 59	111 46 53	2280
Stoneridge Dam	5968	Pressure Transducer	12/11/96	3N-6E-22	33 35 41	111 44 01	1710
Sunridge Canyon Dam	5973	Pressure Transducer	02/04/97	3N-6E-16	33 36 24	111 45 06	1932
Golden Eagle Park Dam	5978	Pressure Transducer	12/12/96	3N-6E-10	33 37 07	111 44 07	1722
North Heights Dam	5983	Pressure Transducer	10/11/96	3N-6E-09	33 37 21	111 44 54	1819
Aspen Dam	5988	Pressure Transducer	01/02/97	3N-6E-4	33 37 34	111 44 48	1840
Hesperus Dam	5993	Pressure Transducer	12/18/96	3N-6E-04	33 38 14	111 44 47	1894
Thompson Peak	5946	Humidity	12/19/95	4N-5E-35	33 38 40	111 49 11	3993
Thompson Peak	5947	Temperature	12/19/95	4N-5E-35	33 38 40	111 49 11	3993
Fountain Hills Fire	5951	Humidity	07/23/97	3N-6E-15	33 36 40	111 43 29	2280
Fountain Hills Fire	5952	Temperature	07/23/97	3N-6E-15	33 36 40	111 43 29	2280

3.3 Flood Detection Criteria

3.3.1 Green Alert

3.3.1.1 Green Alert Rainfall Detection Criteria

For the flood vulnerable locations identified in Section 2.2, rainfall depths for use in flood detection were calculated. Three temporal distributions were examined: 1) a thunderstorm-type distribution; 2) the FCDMC 6-hour Pattern Number 1; and 3) the SCS Type II 24-hour distribution (see Figure 3-). The thunderstorm distribution was determined by examination of several severe observed rainfall distributions recorded by the FCDMC's ALERT system. Figure 3- shows the selected thunderstorm distribution and the observed rainfall. Note the similarity of the observed rainfall patterns with the selected thunderstorm distribution.

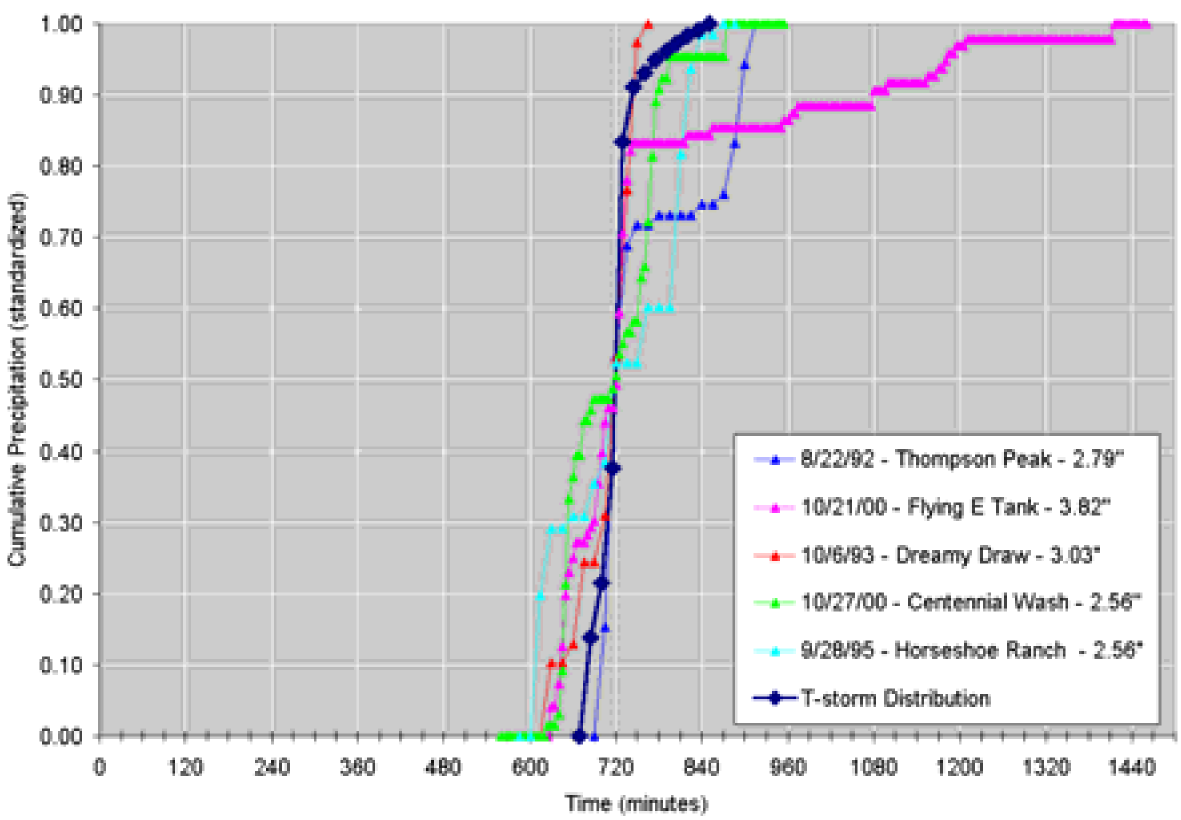


Figure 3-2 Thunderstorm Distribution and Observed Severe Rainfall Events

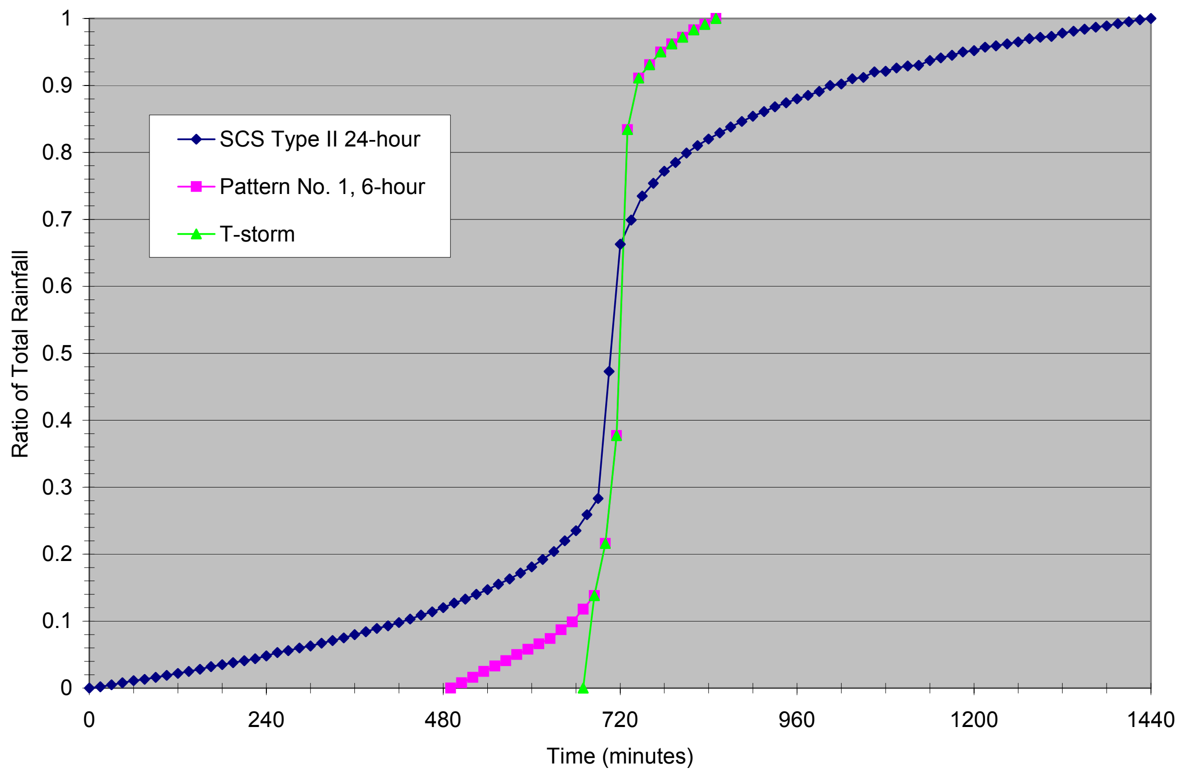


Figure 3-3 Temporal Rainfall Distributions Examined for Determination of Flood Detection Criteria

The detection criteria are based upon the rainfall intensities required to produce the critical threshold stages or discharges that inundate at-grade crossings at impassable levels.

Impassable discharges were determined as described in Section 2.2.2. For each impassable location, multiple ratio HEC-1 models were run from the Fountain Hills North (GVSCE, 1994) and South (AGK, 1994) Flood Delineation Studies future conditions HEC-1 models. Plots of the JR model results for the three temporal distributions were constructed. The impassable discharges were then plotted on the ratio results and the rainfall depth required to generate the impassable discharge at each location was determined. Figure 3- shows an example for Oxford Wash at Tanglewood Court. Note that the 6-hour Pattern No. 1 and thunderstorm distribution results are very similar. This was true for almost all locations. The plots for all impassable locations are provided in Appendix E.

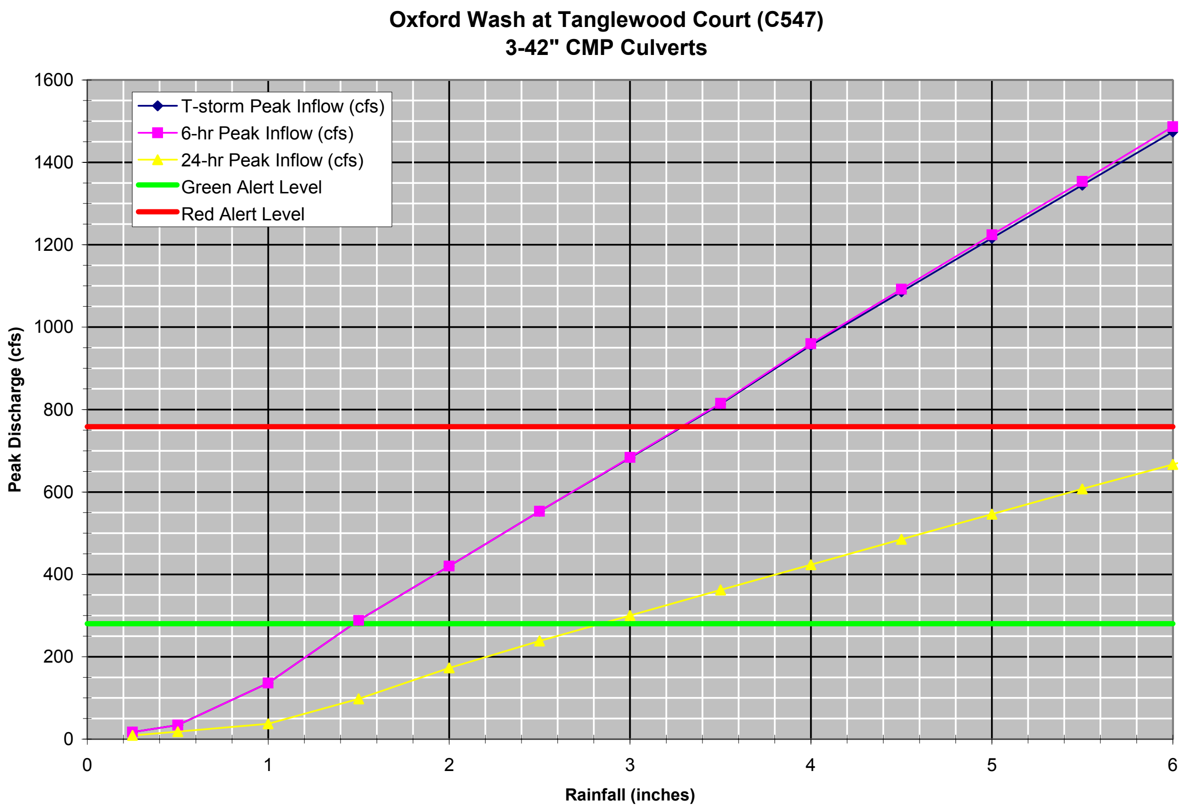


Figure 3-4 Example of Impassable Rainfall Depth Determination from Multiple Ratio Results

Because the thunderstorm distribution generally produces the most severe runoff for a given rainfall and is similar in shape to observed rainfall events in Maricopa County and Fountain Hills (Figure 3-), it will be used as the source for determination of the primary flood detection criteria for the Fountain Hills Flood Response Plan.

The rainfall depths determined from the multiple ratio modeling represent total storm rainfall. Because of the very short hydrologic lead times and largely negative effective lead times (Section 2.3.3), it was decided that the rainfall detection needed to be triggered before the end of the storm rainfall. To determine a point within a storm when alarms should be triggered, the temporal distributions were examined. Rainfall excess, and hence runoff, is generated when the rainfall intensity exceeds the infiltration rate. Therefore, the periods of highest rainfall intensity will produce the most runoff. Furthermore, in Fountain Hills, hydrologic response times are short. So the time to peak discharge will occur shortly after the period of maximum rainfall intensity. It was therefore decided to consider the proportion of total storm rainfall that falls within the “most intense” portion of each of the three temporal distributions. Table 3-2 shows the three temporal distributions and highlights the most intense 30-, 45-, and 60-minute portions of each distribution. Table 3-3 shows the maximum rainfall intensities for the three distributions for 30, 45, and 60 minutes, as well as the total storm duration for each distribution.

Table 3-2 Temporal Distributions and Most Intense Portions

Time	T-Storm	FCD Pattern 1	SCS Type II
0	0.000	0.000	0.000
15	0.138	0.008	0.002
30	0.216	0.016	0.005
45	0.377	0.025	0.008
60	0.834	0.033	0.011
75	0.911	0.041	0.013
90	0.931	0.050	0.016
105	0.950	0.058	0.019
120	0.962	0.066	0.022
135	0.972	0.074	0.025
150	0.983	0.087	0.028
165	0.991	0.099	0.032
180	1.000	0.118	0.035
195		0.138	0.038
210		0.216	0.041
225		0.377	0.044
240		0.834	0.048
255		0.911	0.053
270		0.931	0.056
285		0.950	0.060
300		0.962	0.063
315		0.972	0.067
330		0.983	0.071
345		0.991	0.075
360		1.000	0.080
375			0.084
390			0.089
405			0.093
420			0.098
435			0.103
450			0.109
465			0.114
480			0.120
495			0.127
510			0.133
525			0.140
540			0.147
555			0.155
570			0.163
585			0.172
600			0.181
615			0.192
630			0.204
645			0.220
660			0.235
675			0.259
690			0.283
705			0.473
720			0.663
735			0.699

Time	T-Storm	FCD Pattern 1	SCS Type II
750			0.735
765			0.754
780			0.772
795			0.785
810			0.799
825			0.810
840			0.820
855			0.829
870			0.838
885			0.846
900			0.854
915			0.861
930			0.868
945			0.874
960			0.880
975			0.885
990			0.891
1005			0.900
1020			0.902
1035			0.910
1050			0.912
1065			0.920
1080			0.921
1095			0.926
1110			0.929
1125			0.930
1140			0.937
1155			0.941
1170			0.945
1185			0.950
1200			0.952
1215			0.957
1230			0.959
1245			0.962
1260			0.965
1275			0.970
1290			0.972
1305			0.973
1320			0.978
1335			0.981
1350			0.984
1365			0.987
1380			0.989
1395			0.992
1410			0.995
1425			0.998
1440			1.000

Table 3-3 Percentage of Total Storm Rainfall During Maximum Rainfall Intensity for Various Durations

T-Storm			6-hr / Pattern No. 1			24-hr / SCS Type II	
(%)	(min)		(%)	(min)		(%)	(min)
100%	180		100%	360		100%	1440
91.1%	75		83.4%	240		69.9%	735
83.4%	60		77.3%	60		44.0%	60
69.5%	45		69.6%	45		41.6%	45
61.8%	30		61.8%	30		38.0%	30

From examination of Table 3-3 and consideration of the very short to negative effective lead times, the 30-minute cumulative rainfall was selected as the basis for the rainfall criteria for determination of the flood detection criteria for the Fountain Hills Flood Response Plan.

Once rainfall depths were determined from the plots in Appendix E, total depths were multiplied by the 30-minute percentages to establish the rainfall amount that would trigger closure of each impassable location. The resulting values were sorted and the distribution of rainfall trigger amounts examined. It was decided from this examination to establish three Green Alert "bins" or levels of detection criteria. Table 3-4 shows the impassable locations sorted by rainfall trigger amount and indicates the group "bins" or levels for the Green Alert, plus it contains those data for the Red and Blue Alert levels. The derivation of the rainfall criteria for Red Alert and Blue Alert is explained in Sections 3.3.2 and 3.3.3, respectively. The same data are presented spatially in Figure 3-5.

Table 3-4 Roadway Crossings and Rainfall Depths That Create Impassable Conditions

Street Location	System Name	Wash Name	Structure	T-storm				6-hr Pattern 1 Storm				24-hr SCS Type II Storm				PMP Rainfall	
				Green	**62%**	**Red**	**62%**	**Green**	**62%**	**Red**	**62%**	**Green**	**44%**	**Red**	**44%**	**Blue**	**71.8%**
				Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 60 min	Rainfall	in 60 min	Rainfall	in 30 min
				(in.)		(in.)		(in.)		(in.)		(in.)		(in.)		(in.)	
Richwood Ave	Ashbrook	Hesperus	Dip	<0.25	<0.1	2.6	1.6	<0.25	<0.1	2.5	1.5	0.3	<0.1	4.2	2.6	7.3	5.2
Del Cambre Blvd	Ashbrook	Ashbrook	Dip	<0.25	<0.1	2.1	1.3	<0.25	<0.1	2.1	1.3	<0.25	<0.1	3.6	2.2	7.3	5.2
El Pueblo Blvd	Ashbrook	Ashbrook	Dip	<0.25	<0.1	2.1	1.3	<0.25	<0.1	2.1	1.3	<0.25	<0.1	3.6	2.2	7.3	5.2
Escalante Drive	Ashbrook	Escalante	Dip	<0.25	<0.1	2.8	1.7	<0.25	<0.1	2.8	1.7	<0.25	<0.1	4.6	2.9	N/A	
Greenhurst Ave	Ashbrook	Tulip/ Legend	Dip	<0.25	<0.1	3.3	2.0	<0.25	<0.1	3.3	2.0	0.3	<0.1	6.2	3.8	N/A	
Fairlynn Drive	Ashbrook	Tulip/ Legend	Dip	<0.25	<0.1	3.3	2.0	<0.25	<0.1	3.3	2.0	0.3	<0.1	6.2	3.8	N/A	
Fountain Hills Blvd	Ashbrook	Tulip/ Legend	Dip	<0.25	<0.1	3.3	2.0	<0.25	<0.1	3.3	2.0	0.3	<0.1	6.2	3.8	N/A	
Galatea Drive	Ashbrook	Tulip/ Legend	Dip	<0.25	<0.1	3.1	1.9	<0.25	<0.1	3.1	1.9	<0.25	<0.1	5.9	3.7	N/A	
Bahia Drive	Ashbrook	Escalante	Dip	0.2	0.1	2.8	1.7	0.2	0.1	2.8	1.7	0.3	0.2	4.6	2.9	N/A	
Firebrick Drive	Cereus	Laser Drain	Dip	0.2	0.1	3.2	2.0	0.2	0.1	3.2	2.0	0.3	0.2	6.0	3.7	N/A	
Rand Drive	Malta /Jacklin	Malta Drain	Dip	0.2	0.1	3.2	2.0	0.2	0.1	3.2	2.0	0.3	0.2	5.8	3.6	N/A	
Kings Way	Ashbrook	Oxford	Dip	0.2	0.1	3.3	2.0	0.2	0.1	3.3	2.0	0.4	0.2	6.5	4.0	N/A	
Hampstead Drive	Ashbrook	Tulip/ Legend	Dip	0.2	0.1	3.3	2.0	0.2	0.1	3.3	2.0	0.5	0.3	6.5	4.0	N/A	
Kiwanis Drive	Colony	Fountain Channel	Dip	0.3	0.2	2.5	1.6	0.3	0.2	2.5	1.6	0.6	0.4	4.5	2.8	N/A	
Glenbrook Blvd	Ashbrook	Balboa	Dip	0.3	0.2	2.7	1.7	0.3	0.2	2.6	1.6	0.5	0.3	4.3	2.6	7.3	5.2
Cholula Drive	Ashbrook	Cholula	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.5	0.3	>6.5	>4.0	N/A	
Mayflower Drive	Ashbrook	Oxford	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.4	0.2	>6.5	>4.0	N/A	
El Pueblo Blvd	Ashbrook	Caliente	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.5	0.3	6.4	4.0	N/A	
Laser Drive & Saguaro	Cereus	Laser Drain	Street/Dip	0.3	0.2	3.2	2.0	0.3	0.2	3.2	2.0	0.6	0.4	6.0	3.7	N/A	
Tamarack Lane	Ashbrook	Oxford	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.6	0.4	>6.5	>4.0	N/A	
Greenhurst Avenue	Ashbrook	Oxford	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.6	0.4	>6.5	>4.0	N/A	
Fairlynn Drive	Ashbrook	Oxford	Dip	0.3	0.2	3.3	2.0	0.3	0.2	3.3	2.0	0.5	0.3	6.5	4.0	N/A	
Sobrante Avenue	Ashbrook	Caliente	Dip	0.4	0.2	3.3	2.0	0.4	0.2	3.3	2.0	0.8	0.5	6.1	3.8	N/A	
Kingstree Blvd	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Kingstree Blvd	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Kingstree Blvd	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Kingstree Blvd	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Kingstree Blvd	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	

Street Location	System Name	Wash Name	Structure	T-storm				6-hr Pattern 1 Storm				24-hr SCS Type II Storm				PMP Rainfall	
				Green	62%	Red	62%	Green	62%	Red	62%	Green	44%	Red	44%	Blue	71.8%
				Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 60 min	Rainfall	in 60 min	Rainfall	in 30 min
				(in.)		(in.)		(in.)		(in.)		(in.)		(in.)		(in.)	
Kingstree Wash	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Kingstree Wash	Malta /Jacklin	Kingstree	N/A	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.8	0.5	5.7	3.5	N/A	
Glenbrook Blvd	Ashbrook	Oxford	Dip	0.4	0.2	3.3	2.0	0.4	0.2	3.3	2.0	0.8	0.5	>6.5	>4.0	N/A	
Palmetto Lane	Ashbrook	Oxford	Dip	0.4	0.2	3.3	2.0	0.4	0.2	3.3	2.0	0.7	0.4	>6.5	>4.0	N/A	
Leo Drive	Cereus	Powder	Dip	0.4	0.2	3.2	2.0	0.4	0.2	3.2	2.0	0.7	0.4	5.5	3.4	N/A	
Del Cambre Blvd	Ashbrook	Caliente	Dip	0.5	0.3	3.3	2.0	0.5	0.3	3.3	2.0	1.0	0.6	6.1	3.8	N/A	
Jacklin Drive	Malta /Jacklin	Jacklin	Dip	0.5	0.3	3.2	2.0	0.5	0.3	3.2	2.0	0.8	0.5	5.4	3.3	N/A	
Shagbark Court	Ashbrook	Oxford	Dip	0.5	0.3	3.3	2.0	0.5	0.3	3.3	2.0	0.8	0.5	>6.5	>4.0	N/A	
El Pueblo Blvd	Ashbrook	Caliente	Dip	0.6	0.4	3.3	2.0	0.6	0.4	3.3	2.0	1.1	0.7	5.7	3.5	N/A	
Rosita Drive	Ashbrook	N/A	N/A	0.6	0.4	3.3	2.0	0.6	0.4	3.3	2.0	1.3	0.8	>6.5	>4.0	N/A	
Maple Drive	Ashbrook	Oxford	Dip	0.6	0.4	3.3	2.0	0.6	0.4	3.3	2.0	1.1	0.7	>6.5	>4.0	N/A	
Fountain Hills Blvd	Ashbrook	Oxford	Dip	0.6	0.4	3.3	2.0	0.6	0.4	3.3	2.0	1.1	0.7	6.5	4.0	N/A	
Cavern Drive	Ashbrook	Arrow	Culvert	0.7	0.4	3.3	2.0	0.7	0.4	3.3	2.0	1.3	0.8	>6.5	>4.0	N/A	
Saguaro Blvd	Colony	Fountain Channel	Culvert	0.7	0.4	3.2	2.0	0.7	0.4	3.3	2.0	1.2	0.7	6.0	3.7	N/A	
Bayfield Drive	Ashbrook	Ashbrook	Culvert	0.7	0.4	1.9	1.2	0.7	0.4	1.9	1.2	1.2	0.7	3.3	2.0	7.3	5.2
Saguaro Blvd	Ashbrook	Ashbrook	Culvert	0.7	0.4	2.0	1.2	0.7	0.4	2.0	1.2	1.2	0.7	3.4	2.1	7.3	5.2
Nicklaus Drive	Malta /Jacklin	Cyprus Point	Dip	0.7	0.4	3.2	2.0	0.7	0.4	3.2	2.0	1.3	0.8	5.9	3.7	N/A	
Nightingale Circle	Malta /Jacklin	Malta Drain	Culvert	0.7	0.4	3.2	2.0	0.7	0.4	3.2	2.0	1.3	0.8	5.7	3.5	N/A	
Oasis Drive	Malta /Jacklin	Malta Drain	Culvert	0.7	0.4	3.2	2.0	0.7	0.4	3.2	2.0	1.3	0.8	5.7	3.5	N/A	
Quinto Drive	Malta /Jacklin	Malta Drain	Culvert	0.7	0.4	3.2	2.0	0.7	0.4	3.2	2.0	1.3	0.8	5.7	3.5	N/A	
Powerderhorn Drive	Cereus	Powder	Dip	0.7	0.4	3.2	2.0	0.7	0.4	3.2	2.0	1.2	0.7	6.2	3.8	N/A	
Golden Eagle Park Blvd	Ashbrook	Ashbrook	Culvert	0.8	0.5	2.8	1.7	0.8	0.5	2.8	1.7	1.5	0.9	4.7	2.9	7.3	5.2
Laser Drive	Cereus	Laser Drain	Street	0.8	0.5	3.2	2.0	0.8	0.5	3.2	2.0	1.5	0.9	6.0	3.7	N/A	
Mountainside Drive	Ashbrook	Sunflower	Dip	0.8	0.5	3.3	2.0	0.8	0.5	3.3	2.0	1.7	1.1	>6.5	>4.0	N/A	
Zapata Drive	Ashbrook	Zapata	Culvert	0.8	0.5	3.3	2.0	0.8	0.5	3.3	2.0	1.6	1.0	>6.5	>4.0	7.3	5.2
Marathon Drive	Ashbrook	N/A	N/A	0.9	0.6	3.3	2.0	0.9	0.6	3.3	2.0	1.8	1.1	>6.5	>4.0	N/A	
Burro Drive	Malta /Jacklin	Emerald	Dip	0.9	0.6	3.2	2.0	0.9	0.6	3.2	2.0	1.6	1.0	5.7	3.5	N/A	
Demaret Drive	Malta /Jacklin	Cyprus Point	Dip	1.0	0.6	3.2	2.0	1.0	0.6	3.2	2.0	1.7	1.1	6.0	3.7	N/A	
Laser Drive	Cereus	Laser Drain	Street	1.0	0.6	3.2	2.0	1.0	0.6	3.2	2.0	1.8	1.1	6.2	3.8	N/A	
Richwood Avenue	Ashbrook	N/A	N/A	1.0	0.6	3.3	2.0	1.0	0.6	3.3	2.0	2.0	1.2	>6.5	>4.0	N/A	
Mimosa Drive	Ashbrook	Arrow	Culvert	1.1	0.7	3.3	2.0	1.1	0.7	3.3	2.0	1.7	1.1	>6.5	>4.0	N/A	

Street Location	System Name	Wash Name	Structure	T-storm				6-hr Pattern 1 Storm				24-hr SCS Type II Storm				PMP Rainfall	
				Green	**62%**	**Red**	**62%**	**Green**	**62%**	**Red**	**62%**	**Green**	**44%**	**Red**	**44%**	**Blue**	**71.8%**
				Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 60 min	Rainfall	in 60 min	Rainfall	in 30 min
				(in.)		(in.)		(in.)		(in.)		(in.)		(in.)		(in.)	
Firebrick Drive	Cereus	Trib of Laser Drain	Dip	1.1	0.7	3.2	2.0	1.1	0.7	3.2	2.0	1.8	1.1	5.7	3.5	N/A	
Mimosa Drive	Colony	Trib of N. Colony	Dip	1.1	0.7	3.2	2.0	1.1	0.7	3.2	2.0	2.3	1.4	6.4	4.0	N/A	
Mountainside Drive	Ashbrook	Arrow	Culvert	1.3	0.8	3.3	2.0	1.4	0.9	3.3	2.0	2.2	1.4	>6.5	>4.0	N/A	
Aspen Drive	Ashbrook	N/A	N/A	1.3	0.8	3.3	2.0	1.3	0.8	3.3	2.0	2.8	1.7	>6.5	>4.0	N/A	
Fountain Hills Blvd	Ashbrook	Balboa	Culvert	1.4	0.8	2.6	1.6	1.4	0.8	2.6	1.6	2.1	1.3	4.2	2.6	7.3	5.2
Baron Drive	Malta /Jacklin	Emerald	Culvert	1.4	0.8	3.1	1.9	1.4	0.8	3.2	2.0	2.2	1.3	5.0	3.1	N/A	
Glenbrook Blvd	Ashbrook	N/A	Dip	1.4	0.8	3.3	2.0	1.4	0.8	3.3	2.0	2.7	1.7	>6.5	>4.0	N/A	
Mountainside Drive	Colony	Trib of N. Colony	Culvert	1.4	0.9	3.2	2.0	1.4	0.9	3.2	2.0	2.8	1.7	6.4	4.0	N/A	
Saguaro Blvd & El Lago	Colony	Trib of Fountain Channel	2 Curb Inlets to Culvert	1.5	0.9	2.6	1.6	1.5	0.9	2.6	1.6	2.7	1.7	4.9	3.0	N/A	
Cromwell Drive	Malta /Jacklin	Malta Drain	Dip	1.5	0.9	3.2	2.0	1.5	0.9	3.2	2.0	3.0	1.9	6.5	4.0	N/A	
Tanglewood Court	Ashbrook	Oxford	Culvert	1.5	0.9	3.3	2.0	1.5	0.9	3.3	2.0	2.8	1.7	>6.5	>4.0	N/A	
Indian Wells Drive	Malta /Jacklin	Jacklin	Culvert	1.6	1.0	3.1	1.9	1.6	1.0	3.1	1.9	2.6	1.6	5.2	3.2	N/A	
Mission Bell Court	Malta /Jacklin	Malta Drain	Culvert	1.6	1.0	3.2	2.0	1.6	1.0	3.2	2.0	2.7	1.7	5.7	3.5	N/A	
Saguaro Blvd	Colony	Colony	Culvert	1.7	1.1	2.9	1.8	1.7	1.1	2.9	1.8	2.7	1.7	4.7	2.9	7.3	5.2
Dawn Ridge Court	Malta /Jacklin	Malta Drain	Culvert	1.7	1.1	3.2	2.0	1.7	1.1	3.2	2.0	2.8	1.7	5.7	3.5	N/A	
Eagle Feather	Ashbrook	Tulip	Culvert	1.9	1.2	3.3	2.0	1.9	1.2	3.3	2.0	3.2	2.0	5.5	3.4	N/A	
Saguaro Blvd	Colony	Fountain Channel	Culvert	2.0	1.2	3.2	2.0	2.0	1.2	3.3	2.0	3.7	2.3	6.0	3.7	N/A	
Saguaro Blvd and Malta Drive	Malta /Jacklin	Malta/ Emerald	Culvert	2.0	1.2	3.2	2.0	2.0	1.2	3.2	2.0	3.4	2.1	5.7	3.5	N/A	
Chama Drive	Colony	N. Colony	Culvert	2.0	1.2	3.1	1.9	2.0	1.2	3.1	1.9	3.4	2.1	5.2	3.2	N/A	
Saguaro Blvd	Colony	Fountain Channel	Culvert	2.1	1.3	3.2	2.0	2.1	1.3	3.2	2.0	4.2	2.6	6.2	3.8	N/A	
Boulder Avenue	Ashbrook	Hesperus	Culvert	2.1	1.3	2.7	1.7	2.1	1.3	2.6	1.6	3.2	2.0	4.2	2.6	7.3	5.2
Boulder Avenue	Ashbrook	Mountain	Culvert	2.2	1.4	3.3	2.0	2.2	1.4	3.3	2.0	3.4	2.1	5.6	3.5	N/A	
Hawk Drive	Malta /Jacklin	Malta Drain	N/A	2.3	1.4	3.2	2.0	2.3	1.4	3.2	2.0	4.4	2.7	6.2	3.8	N/A	
Glenbrook Blvd	Ashbrook	Tulip	Culvert	2.3	1.4	3.3	2.0	2.3	1.4	3.3	2.0	3.9	2.4	5.5	3.4	N/A	
Nicklaus Drive	Malta /Jacklin	Cyprus Point	Dip	2.5	1.6	3.2	2.0	2.5	1.6	3.2	2.0	4.9	3.0	6.2	3.8	N/A	
Saguaro Blvd	Colony	Fountain Channel	Culvert	2.6	1.6	3.2	2.0	2.6	1.6	3.2	2.0	5.1	3.2	6.2	3.8	N/A	
Saguaro Blvd	Malta	Hagan		2.6	1.6	3.2	2.0	2.6	1.6	3.2	2.0	2.6	1.6	3.2	2.0	N/A	

Street Location	System Name	Wash Name	Structure	T-storm				6-hr Pattern 1 Storm				24-hr SCS Type II Storm				PMP Rainfall	
				Green	**62%**	**Red**	**62%**	**Green**	**62%**	**Red**	**62%**	**Green**	**44%**	**Red**	**44%**	**Blue**	**71.8%**
				Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 30 min	Rainfall	in 60 min	Rainfall	in 60 min	Rainfall	in 30 min
				(in.)		(in.)		(in.)		(in.)		(in.)		(in.)		(in.)	
	/Jacklin	/Palmer															
Fountain Hills Blvd	Ashbrook	Arrow	Culvert	2.6	1.6	3.3	2.0	2.6	1.6	3.3	2.0	4.2	2.6	5.9	3.7	N/A	
Frisco Drive	Malta /Jacklin	Kingstree	Culvert	2.7	1.6	3.2	2.0	2.7	1.6	3.2	2.0	5.2	3.2	6.2	3.8	N/A	
Fountain Hills Blvd	Colony	N. Colony	Culvert	2.7	1.7	3.1	1.9	2.7	1.7	3.2	2.0	4.5	2.8	5.2	3.2	N/A	
Arrow Drive	Ashbrook	Arrow	Culvert	2.9	1.8	3.3	2.0	2.9	1.8	3.3	2.0	4.9	3.0	5.7	3.5	N/A	
	= multiple locations along Kingstree closed at lowest discharge near Walsh Drive (EAPFL 72)																

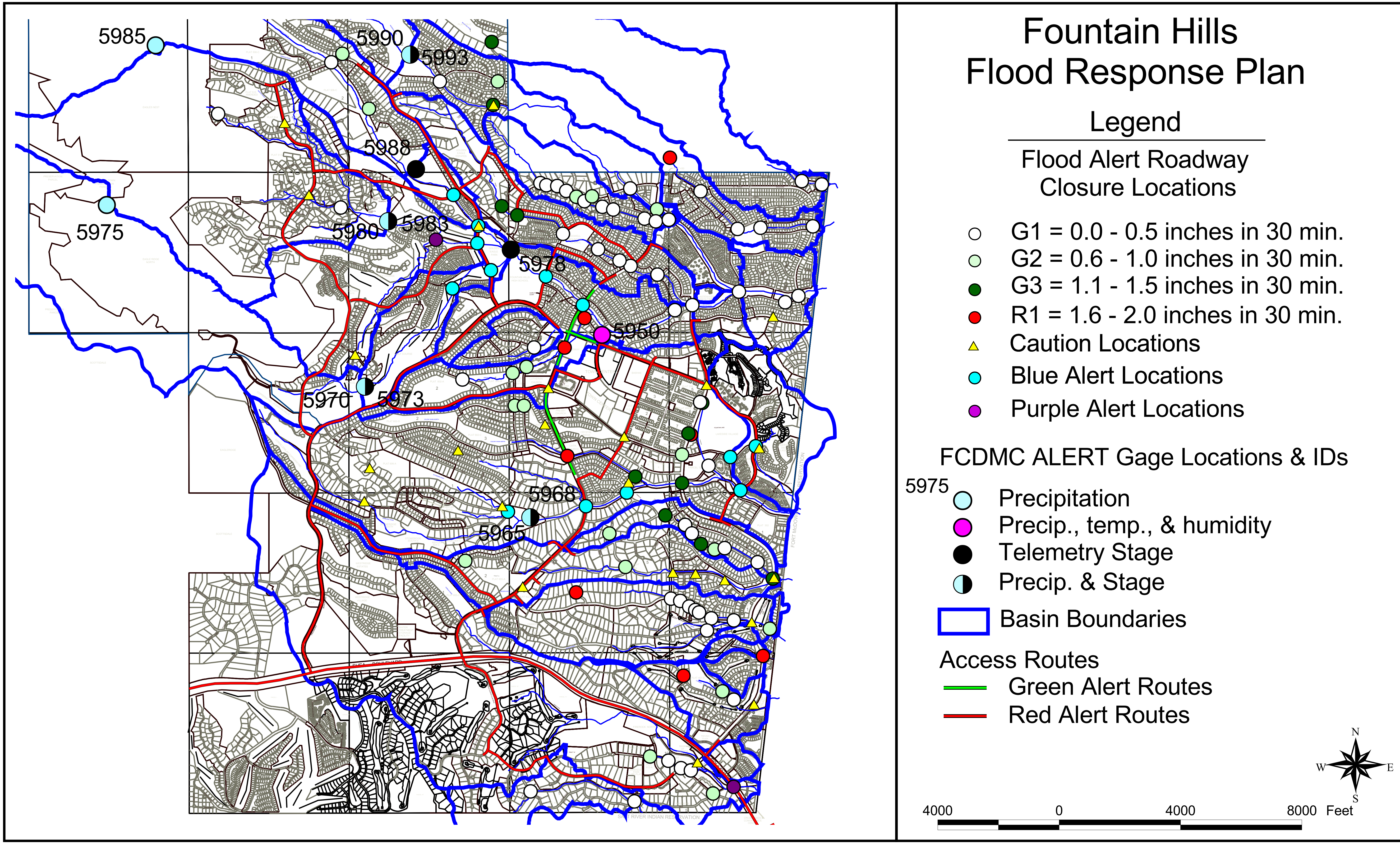


Figure 3-5 Impassable Crossing Locations

Following determination of the rainfall criteria, these values needed to be assigned to specific rainfall sensors in the ALERT detection network. This was done by examination of the nearest rain gage or gages that are within the drainage basin contributing to the impassable locations. Table 3-5 shows the impassable road crossings and the gage(s) which should be used to set alarms for the Green and Red Alert levels for each crossing. Figure 3-5 presents the spatial relationship of these data.

Table 3-5 Green and Red Alert Road Crossings, Impassable Rainfall Detection Depth, and ALERT Rain Gage IDs

Street Location	System Name	Wash Name	Green Rainfall (in.)	62% in 30 min	Rain Gage(s) ID
Cavern Drive	Ashbrook	Arrow	0.7	0.4	5950, 5970
Mimosa Drive	Ashbrook	Arrow	1.1	0.7	5950, 5970
Mountainside Drive	Ashbrook	Arrow	1.3	0.8	5950, 5970
Fountain Hills Boulevard	Ashbrook	Arrow	2.6	1.6	5950, 5970
Arrow Drive	Ashbrook	Arrow	2.9	1.8	5950, 5970
Bayfield Drive	Ashbrook	Ashbrook	0.7	0.4	5950
Saguaro Boulevard	Ashbrook	Ashbrook	0.7	0.4	5950
Golden Eagle Park Blvd	Ashbrook	Ashbrook	0.8	0.5	5985
Del Cambre Boulevard	Ashbrook	Ashbrook	<0.25	<0.1	5950
El Pueblo Boulevard	Ashbrook	Ashbrook	<0.25	<0.1	5950
Glenbrook Boulevard	Ashbrook	Balboa	0.3	0.2	5950, 5980, 5990
Fountain Hills Boulevard	Ashbrook	Balboa	1.4	0.8	5950, 5980, 5990
El Pueblo Boulevard	Ashbrook	Caliente	0.3	0.2	5950, 5990
Sobrante Avenue	Ashbrook	Caliente	0.4	0.2	5950, 5990
Del Cambre Boulevard	Ashbrook	Caliente	0.5	0.3	5950, 5990
El Pueblo Boulevard	Ashbrook	Caliente	0.6	0.4	5950, 5990
Cholula Drive	Ashbrook	Cholula	0.3	0.2	5975, 5985
Bahia Drive	Ashbrook	Escalante	0.2	0.1	5990
Escalante Drive	Ashbrook	Escalante	<0.25	<0.1	5990
Boulder Avenue	Ashbrook	Hesperus	2.1	1.3	5990
Richwood Avenue	Ashbrook	Hesperus	<0.25	<0.1	5990
Greenhurst Avenue	Ashbrook	Tulip/ Legend	<0.25	<0.1	5950, 5980, 5990
Fairlynn Drive	Ashbrook	Tulip/ Legend	<0.25	<0.1	5950, 5980, 5990
Fountain Hills Boulevard	Ashbrook	Tulip/ Legend	<0.25	<0.1	5950, 5980, 5990
Galatea Drive	Ashbrook	Tulip/ Legend	<0.25	<0.1	5950, 5980, 5990
Boulder Avenue	Ashbrook	Mountain	2.2	1.4	5990
Rosita Drive	Ashbrook	N/A	0.6	0.4	5950
Marathon Drive	Ashbrook	N/A	0.9	0.6	5990
Richwood Avenue	Ashbrook	N/A	1.0	0.6	5990
Aspen Drive	Ashbrook	N/A	1.3	0.8	5990
Glenbrook Boulevard	Ashbrook	N/A	1.4	0.8	5950, 5980, 5990
Kings Way	Ashbrook	Oxford	0.2	0.1	5950, 5980, 5990
Mayflower Drive	Ashbrook	Oxford	0.3	0.2	5950, 5980, 5990
Tamarack Lane	Ashbrook	Oxford	0.3	0.2	5950, 5980, 5990
Greenhurst Avenue	Ashbrook	Oxford	0.3	0.2	5950, 5980, 5990
Fairlynn Drive	Ashbrook	Oxford	0.3	0.2	5950, 5980, 5990

Street Location	System Name	Wash Name	Green Rainfall (in.)	62% in 30 min	Rain Gage(s) ID
Glenbrook Boulevard	Ashbrook	Oxford	0.4	0.2	5950, 5980, 5990
Palmetto Lane	Ashbrook	Oxford	0.4	0.2	5950, 5980, 5990
Shagbark Court	Ashbrook	Oxford	0.5	0.3	5950, 5980, 5990
Maple Drive	Ashbrook	Oxford	0.6	0.4	5950, 5980, 5990
Fountain Hills Boulevard	Ashbrook	Oxford	0.6	0.4	5950, 5980, 5990
Tanglewood Court	Ashbrook	Oxford	1.5	0.9	5950, 5980, 5990
Mountainside Drive	Ashbrook	Sunflower	0.8	0.5	5950
Hampstead Drive	Ashbrook	Tulip/ Legend	0.2	0.1	5950, 5980, 5990
Eagle Feather	Ashbrook	Tulip/ Legend	1.9	1.2	5980, 5990
Glenbrook Boulevard	Ashbrook	Tulip/ Legend	2.3	1.4	5980, 5990
Zapata Drive	Ashbrook	Zapata	0.8	0.5	5975, 5980
Firebrick Drive	Cereus	Laser Drain	0.2	0.1	5965
Laser Drive & Saguaro	Cereus	Laser Drain	0.3	0.2	5965
Laser Drive	Cereus	Laser Drain	0.8	0.5	5965
Laser Drive	Cereus	Laser Drain	1.0	0.6	5965
Leo Drive	Cereus	Powder	0.4	0.2	5965
Powerderhorn Drive	Cereus	Powder	0.7	0.4	5965
Firebrick Drive	Cereus	Trib/Laser Drain	1.1	0.7	5965
Saguaro Boulevard	Colony	Colony	1.7	1.1	5950, 5965, 5970
Saguaro Boulevard	Colony	Fountain Channel	0.7	0.4	5950, 5965, 5970
Kiwanis Drive	Colony	Fountain Channel	0.3	0.2	5950, 5965, 5970
Saguaro Boulevard	Colony	Fountain Channel	2.0	1.2	5950, 5965, 5970
Saguaro Boulevard	Colony	Fountain Channel	2.1	1.3	5950, 5965, 5970
Saguaro Boulevard	Colony	Fountain Channel	2.6	1.6	5950, 5965, 5970
Saguaro Blvd & El Lago	Colony	Trib/Fountain Channel	1.5	0.9	5950, 5965, 5970
Mimosa Drive	Colony	Trib/N. Colony Wash	1.1	0.7	5950, 5965, 5970
Mountainside Drive	Colony	Trib/N. Colony Wash	1.4	0.9	5950, 5965, 5970
Chama Drive	Colony	N. Colony	2.0	1.2	5950, 5965, 5970
Fountain Hills Boulevard	Colony	N. Colony	2.7	1.7	5950, 5965, 5970
Nicklaus Drive	Malta/Jacklin	Cyprus Point	0.7	0.4	5965
Demaret Drive	Malta/Jacklin	Cyprus Point	1.0	0.6	5965
Nicklaus Drive	Malta/Jacklin	Cyprus Point	2.5	1.6	5965
Burro Drive	Malta/Jacklin	Emerald	0.9	0.6	5965
Baron Drive	Malta/Jacklin	Emerald	1.4	0.8	5965
Jacklin Drive	Malta/Jacklin	Jacklin	0.5	0.3	5965
Indian Wells Drive	Malta/Jacklin	Jacklin	1.6	1.0	5965
Kingstree Boulevard	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Boulevard	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Boulevard	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Boulevard	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Boulevard	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Wash	Malta/Jacklin	Kingstree	0.4	0.2	5965
Kingstree Wash	Malta/Jacklin	Kingstree	0.4	0.2	5965

Street Location	System Name	Wash Name	Green Rainfall (in.)	62% in 30 min	Rain Gage(s) ID
Saguaro Boulevard	Malta/Jacklin	Kingstree	0.6	0.4	5965
Frisco Drive	Malta/Jacklin	Kingstree	2.7	1.6	5965
Rand Drive	Malta/Jacklin	Malta Drain	0.2	0.1	5965
Nightingale Circle	Malta/Jacklin	Malta Drain	0.7	0.4	5965
Oasis Drive	Malta/Jacklin	Malta Drain	0.7	0.4	5965
Quinto Drive	Malta/Jacklin	Malta Drain	0.7	0.4	5965
Cromwell Drive	Malta/Jacklin	Malta Drain	1.5	0.9	5965
Mission Bell Court	Malta/Jacklin	Malta Drain	1.6	1.0	5965
Dawn Ridge Court	Malta/Jacklin	Malta Drain	1.7	1.1	5965
Hawk Drive	Malta/Jacklin	Malta Drain	2.3	1.4	5965
Saguaro Boulevard and Malta Drive	Malta/Jacklin	Malta Drain/	2.0	1.2	5965
Saguaro Blvd	Malta/Jacklin	Hagan/ Palmer	2.6	1.6	5965

The rainfall criteria for the Green Alert levels are summarized in Table 3-6.

Table 3-6 Summary of Rainfall Criteria for Alert Levels

Flood Alert Level	Rainfall Detection Criteria	Comments
G1	0.0 – 0.5” / 30 min.	Initiate G1 road closures
G2	0.6 – 1.0” / 30 min.	Initiate G2 road closures
G3	1.1 – 1.5” / 30 min.	Initiate G3 road closures
R1	1.6 – 2.0” / 30 min.	Initiate R1 road closures and Red Structure Evacuations

3.3.1.2 Green Alert Water Level Detection Criteria

Green Alert level discharges for locations downstream of the six dams in Fountain Hills can alternately be detected by water level estimates of discharge from the dam upstream of the Green Alert level location. Table 3-7 shows the dams and water levels at each dam for the impassable locations on washes downstream of dams. Note that Del Cambre and El Pueblo Boulevards on Ashbrook Wash have Green Alert level discharges below the detection limit of the water level sensors at Golden Eagle Park and Hesperus Dams.

Table 3-7 Green Alert Level Water Level Detection Criteria for Impassable Crossings Downstream of Dams

Street Location	Wash Name	Structure	Culvert Size	Green Q (cfs)	Dam Name	Dam Stage for Green Q (ft)
Bayfield Drive	Ashbrook	Culvert	3-60"x84'	595	GEP	7.2
Saguaro Boulevard	Ashbrook	Culvert	3-60"x121'	660	GEP	8.01
Del Cambre Boulevard	Ashbrook	Dip	N/A	10	GEP / Hesp	<2.3 / <1.0*
El Pueblo Boulevard	Ashbrook	Dip	N/A	8	GEP / Hesp	<2.3 / <1.0*
Richwood Avenue	Hesperus	Dip	N/A	27	Hesperus	2.0
Glenbrook Boulevard	Balboa	Dip	N/A	41	Hesperus	2.86
Fountain Hills Boulevard	Balboa	Culvert	2-54"x122'	280	Hesperus	22.66
Boulder Avenue	Hesperus	Culvert	1-60"x164'	308	Hesperus	27.42
Saguaro Boulevard	Colony	Culvert	1-72"x166'	395	Stoneridge	24.89
*Green level discharge below detection limit of pressure transducers at either dam.						

3.3.2 Red Alert

Rainfall detection criteria for the Red Alert level were estimated in a similar manner to the Green Alert level. The Red Alert level discharges are shown on the same plots with the Green Alert level results. Plots of the multiple ratio results are supplied in Appendix E. Table 3-4 shows the impassable locations sorted by rainfall trigger amount. **The Red Alert level criterion is 2.0 inches in 30 minutes for all locations**.

In addition to the impassable roadway crossings, the Red Alert level triggers notification and evacuation of 44 structures subject to potential inundation or being surrounded by floodwater making ingress and egress from the buildings hazardous. Section 6.1 further addresses structure evacuations.

3.3.3 Blue Alert

3.3.3.1 Blue Alert Rainfall Detection Criteria

The Blue Alert level represents flood hazards associated with emergency spillway flows from the six flood control dams in excess of the 100-year flood event. The outer limits of the Blue Alert zone correspond approximately with ½ of the runoff generated by the Probable Maximum Precipitation (PMP) event. The rainfall associated with the PMP event for the Fountain Hills area is about 14.7 inches in 6 hours for the Ashbrook Wash system (GVSCE, 1995) and 14.3 inches is 6 hours for the Colony System (AGK, 1995). While the

½ PMP was not used to compute the ½ PMF directly, it provides a reasonable estimate for rainfall criteria for a ½ PMF runoff event. Therefore, a reasonable rainfall total for the Blue Alert level is 7.3 inches in 6 hours.

Using an approach similar to the Green and Red Alert levels, a rainfall detection criterion for the Blue Alert level was estimated by examination of the most intense portion of the PMP rainfall distribution. Figure 3-6 and Table 3-8 show the standardized PMP temporal distribution used by AGK (1995). The most intense portions of the distribution are shown in Table 3-9. The most intense 30-minute portion of the rainfall is 71.8 percent of the total PMP rainfall. Therefore, **the rainfall detection criterion for the Blue Alert level is 5.2 inches in 30 minutes.**

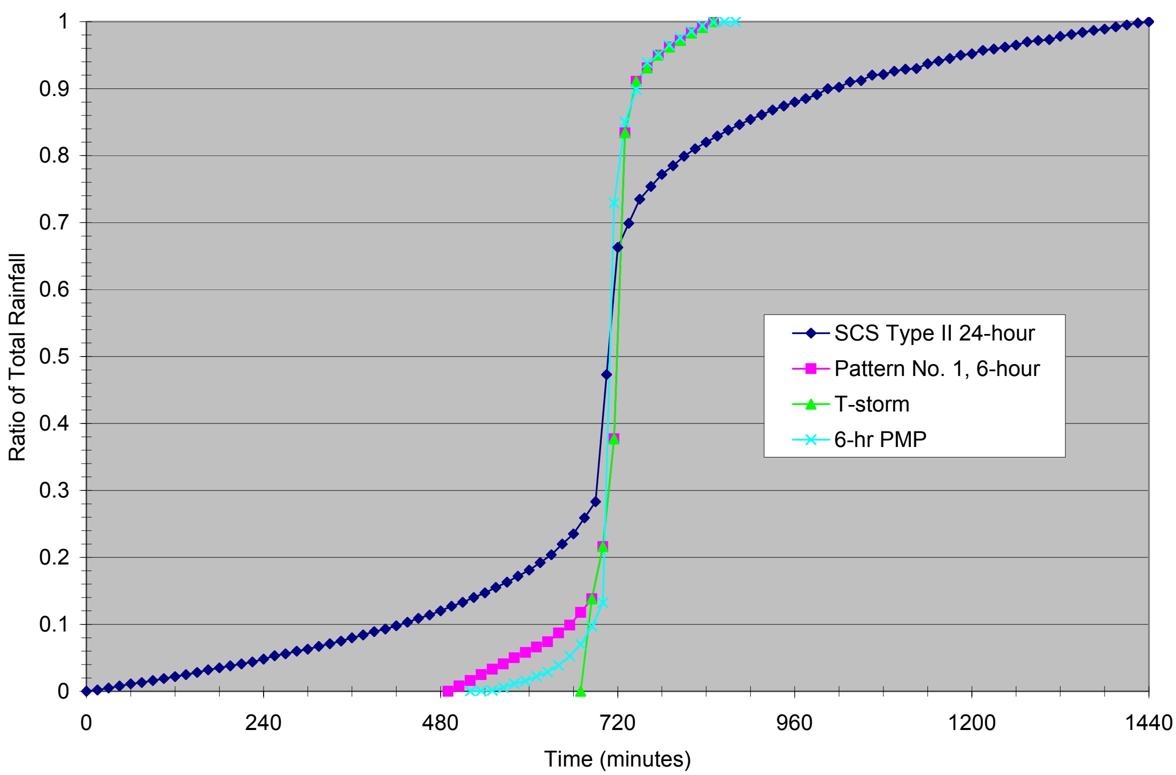


Figure 3-6 Rainfall Temporal Distributions Including 6-hour Probable Maximum Precipitation (PMP)

Table 3-8 PMP Temporal Distribution

Time	6-hr PMP
0	0
15	0.0007
30	0.0014
45	0.0056
60	0.0113
75	0.0154
90	0.0224
105	0.0288
120	0.0387
135	0.0526
150	0.0701
165	0.0968
180	0.1323
195	0.729
210	0.85
225	0.8984
240	0.9387
255	0.9509
270	0.9649
285	0.9762
300	0.9855
315	0.9937
330	0.9993
345	1
360	1

Table 3-9 PMP Most Intense Periods

6-hr / PMP	
(%)	(min)
100%	360
80.6%	60
76.6%	45
71.8%	30

3.3.3.2 Blue Alert Water Level Detection Criteria

Since the Blue Alert represents flood hazards associated with spillway flows and the six dams of interest have water level sensors, the Blue Alert level can also be detected by water level sensors. Table 3-10 shows water level detection criteria for crossings downstream of dams that are not otherwise closed for Red or Green Alerts.

Table 3-10 Water Level Detection Criteria For Blue Alert at Road Crossings

Street Location	Wash Name	Structure	Culvert Size	Blue Alert Level			Dam Name	Upstream Dam Stage for Start of Blue Closure	Blue Closure
				(cfs)	(elev.)	(stage)			
Ashbrook Wash System									
Hampstead Drive	Ashbrook	Culvert	3-10'x7' RCB	27,400			GEP	20.7'	Max culvert flow approx. = 1900 cfs
Fountain Hills Blvd.	Ashbrook	Culvert	2-12'x8' RCB	27,400			GEP	20.5'	Max culvert flow approx. = 1630 cfs
Sierra Madre Drive	Ashbrook	Culvert	5-10'x3' RCB	7,000			Aspen	28.8'	Max culvert flow approx. = 1750 cfs
Golden Eagle Blvd.	Ashbrook	Culvert	2-8'x4' RCB	7,000	1720'**	25.4'**	Aspen	28.7'	Max culvert flow approx. = 1600 cfs
Golden Eagle Blvd.	Bristol	Culvert	3-12'x8' RCB	15,000	1720'**	25.4'**	N. Heights	34.7'	Max culvert flow approx. = 2900 cfs
Golden Eagle Blvd.	Cloudburst	Culvert	2-10'x5' RCB	9,300	1720'**	25.4'**	Sunridge	42.0'*	Above approx. 500 cfs flow into golf course lake north of wash; then volume dependent control of overflow of Golden Eagle Blvd.
Brittlebush Lane	Cloudburst	Culvert	3-10.5'x4' RCB	9,300			Sunridge	42.8'	Max culvert flow approx. = 1100 cfs
Colony Wash System									
Sycamore Drive	Colony	flood pool	N/A		1705'	26.1'	Stoneridge	26.1'	Backflooding from pool area
Fountain Hills Blvd.	Colony	Culvert	2-4.81' equiv. pipes (60" CMP)	3,400			Stoneridge	25.2'	Max culvert flow approx. = 500 cfs
Arroyo Vista Drive	Colony	Culvert	2-60" CMP	3,000			Stoneridge	25.2'	Max culvert flow approx. = 500 cfs
Panorama Drive	Colony	Culvert	4-8'x6' RCB	5,100			Stoneridge	28.7'	Max culvert flow approx. = 2700 cfs
El Lago Blvd.	Fountain Lake Outfall	Spillway into road					Fountain Lake Dam	No Gage	Any emergency spillway flow

* = approximate stage of 500 cfs flow under Golden Eagle Blvd on Cloudburst Wash
** = elevation and stage of Golden Eagle Park Dam that floods Golden Eagle Boulevard

It is recommended that in the event that the rainfall criteria for the Blue Alert level have not been observed (measured) that a water level of 90 percent of the spillway capacity for each dam be used as a detection criteria for initiation of a Blue Alert for a particular dam. Table 3-11 shows the stage, elevation, and storage for 0, 10, 25, 50 and the 90 percent fill for each of the six dams. Note that the 90 percent fill levels are near to 1 foot below the spillway crest at each of the dams.

Table 3-11 Water Levels for Fountain Hills Dams at
Various Percentages of Spillway Capacity Storage

Dam (Gage ID#)	Elevation (feet, FDS datum) Stage (feet, gage height) Storage (ac-ft)					
	0%	**10%**	**25%**	**50%**	**90%**	**100%**
Stoneridge (5968)	1678.86 0.0 0.0	1688.18 9.32 6.6	1693.05 14.19 16.6	1696.65 17.79 33.1	1701.49 22.63 59.6	1702.70 23.84 66.2
Sunridge Canyon (5973)	1884.66 0.0 0.0	1904.61 19.95 9.4	1911.90 27.24 23.5	1918.12 33.46 47.0	1923.86 39.20 84.6	1924.80 40.14 94
Golden Eagle Park (5978)	1694.60 0.00 0.0	1705.61 11.01 9.7	1708.06 13.46 24.2	1711.00 16.40 48.3	1714.26 19.66 86.9	1714.86* 20.26 96.6
North Heights (5983)	1778.97 0.0 0.0	1793.05 14.08 13.8	1798.59 19.62 34.5	1804.11 25.14 69.1	1809.80 30.83 124.3	1810.80 31.83 138.1
Aspen (5988)	1808.61 0.0 0.0	1816.75 8.14 18.3	1821.85 13.24 45.8	1827.77 19.16 91.5	1834.21 25.60 164.7	1835.40 26.79 183
Hesperus (5993)	1851.88 0.0 0.0	1868.61 16.73 27.6	1874.14 22.26 69.0	1880.45 28.57 138.0	1887.58 35.77 248.4	1888.98 37.10 276
* Top of fuse plug.						

It is further recommended that if 50 percent of capacity is reached, the dams should be monitored closely remotely (by water level sensor) and by observers in the field to the extent possible. Furthermore, the evaluation of the potential for Blue Alert level flows should be made.

Matrices in Appendix F show HEC-1 rainfall-runoff results from multiple ratio rainfall depths from 6.5 inches to 0.25 inches for five different starting conditions at each of the six dams. An example for Hesperus Dam for the Thunderstorm Distribution is shown on the following page. The matrices show for each dam its response to the range of depths and starting conditions in terms of maximum stage in elevation and outflow discharge. Additionally, for each dam there is a matrix for the thunderstorm distribution, Pattern Number 1 6-hour distribution, and SCS Type II 24-hour distributions shown in Figure 3- and described in the Green Alert section. All of the analyses shown in the matrices assume no clogging of the principle outlets at each dam.

These matrices could be used by the technical specialists to make an educated judgment about the likelihood of spillway flows for "back-to-back" storms or re-intensifying storms.

One of the key results is shown in the matrices for Golden Eagle Park Dam (provided in Appendix F). It shows that the starting condition (i.e. starting storage volume) does not appreciably increase the likelihood of spillway overtopping. The reason is that the new large principle and auxiliary pipes under the dam drain the pool very quickly compared to the response time of the upstream watershed to subsequent rainfall.

HESPERUS DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: F100TDC#.DAT*

KK C536O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.91	1	FLOW	**5449.**	**4466.**	**3462.**	**2505.**	**1544.**	**660.**	343.	330.	311.	289.	256.	198.
		TIME	**1.90**	**1.95**	**2.03**	**2.17**	**2.32**	**2.73**	3.07	3.00	2.92	2.83	2.72	2.48
	2	FLOW	**5657.**	**4670.**	**3662.**	**2679.**	**1741.**	**805.**	344.	332.	314.	293.	260.	232.
		TIME	**1.87**	**1.93**	**2.02**	**2.12**	**2.27**	**2.60**	3.07	2.98	2.92	2.82	2.70	.00
	3	FLOW	**6161.**	**5176.**	**4194.**	**3186.**	**2268.**	**1294.**	**515.**	340.	326.	308.	285.	277.
		TIME	**1.83**	**1.88**	**1.93**	**2.03**	**2.15**	**2.35**	**2.80**	2.97	2.88	2.78	2.65	.00
	4	FLOW	**6937.**	**6016.**	**5062.**	**4116.**	**3140.**	**2267.**	**1318.**	**536.**	341.	329.	314.	312.
		TIME	**1.77**	**1.80**	**1.85**	**1.90**	**1.98**	**2.10**	**2.25**	**2.67**	2.85	2.73	2.57	.00
	5	FLOW	**7881.**	**6964.**	**6144.**	**5310.**	**4479.**	**3633.**	**2803.**	**2001.**	**1128.**	**502.**	343.	343.
		TIME	**1.68**	**1.72**	**1.73**	**1.77**	**1.78**	**1.83**	**1.90**	**1.98**	**2.13**	**2.45**	.00	.00

Starting Storage

** PEAK STAGES IN FEET **

Starting Storage	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
0%	1	STAGE	**1893.21**	**1892.71**	**1892.18**	**1891.57**	**1890.90**	**1889.95**	1887.63	1884.18	1880.20	1876.06	1871.39	1864.79
		TIME	**1.90**	**1.95**	**2.03**	**2.17**	**2.32**	**2.73**	3.08	3.00	2.92	2.83	2.72	2.48
10%	2	STAGE	**1893.31**	**1892.82**	**1892.29**	**1891.69**	**1891.03**	**1890.14**	1888.14	1884.77	1880.83	1876.68	1871.99	1868.45
		TIME	**1.87**	**1.93**	**2.02**	**2.12**	**2.27**	**2.60**	3.07	3.00	2.92	2.83	2.70	.00
25%	3	STAGE	**1893.55**	**1893.08**	**1892.57**	**1892.04**	**1891.40**	**1890.67**	**1889.59**	1886.82	1883.28	1879.55	1875.48	1874.13
		TIME	**1.83**	**1.88**	**1.93**	**2.03**	**2.15**	**2.35**	**2.80**	2.98	2.88	2.78	2.65	.00
50%	4	STAGE	**1893.93**	**1893.48**	**1893.03**	**1892.53**	**1892.01**	**1891.40**	**1890.70**	**1889.65**	1887.09	1884.06	1880.81	1880.38
		TIME	**1.77**	**1.80**	**1.85**	**1.90**	**1.98**	**2.08**	**2.25**	**2.67**	2.85	2.73	2.57	.00
90%	5	STAGE	**1894.25**	**1893.94**	**1893.55**	**1893.15**	**1892.72**	**1892.27**	**1891.78**	**1891.22**	**1890.49**	**1889.56**	1887.57	1887.57
		TIME	**1.68**	**1.72**	**1.73**	**1.77**	**1.78**	**1.83**	**1.90**	**1.98**	**2.13**	**2.45**	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1889.0 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1894.2 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,970 CFS**
PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **348 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1883.3 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.
* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F100TDC1.DAT TO F100TDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

3.3.4 Purple Alert

Purple Alert level represents the threat downstream of one of the six dams resulting from a catastrophic failure of the dam embankment. The inundation limits of the flood wave resulting from the dam failure were delineated by others (GVSCE, 1996; AGK, 1996). These limits represent the warning area requiring notification and/or evacuation in the event of such a failure. **The primary detection criteria for the failure of a dam will be an observer at the dam.**

A secondary detection criteria for dam failure is an excessive rate of fall in the water level behind the structure. The rate of fall criteria were determined by drawing lines tangent to the draw down curves for each dam (See Appendix G). An example for Stoneridge Dam is shown in Figure 3-7. The slope of each tangent line represents the threshold slope for identification of an excessive rate of fall in the dam. The results are summarized in Table 3-12. The "above" elevation/stage is the threshold elevation/stage for use in programming the ALERT system rate of fall alarms for the water level sensor at each dam.

Since Fountain Lake does not currently have an ALERT based remote water level sensor, no rate of fall criteria are provided in the current FRP for Fountain Lake. However, a process similar to that used in the current FRP could be followed to develop one in the future.

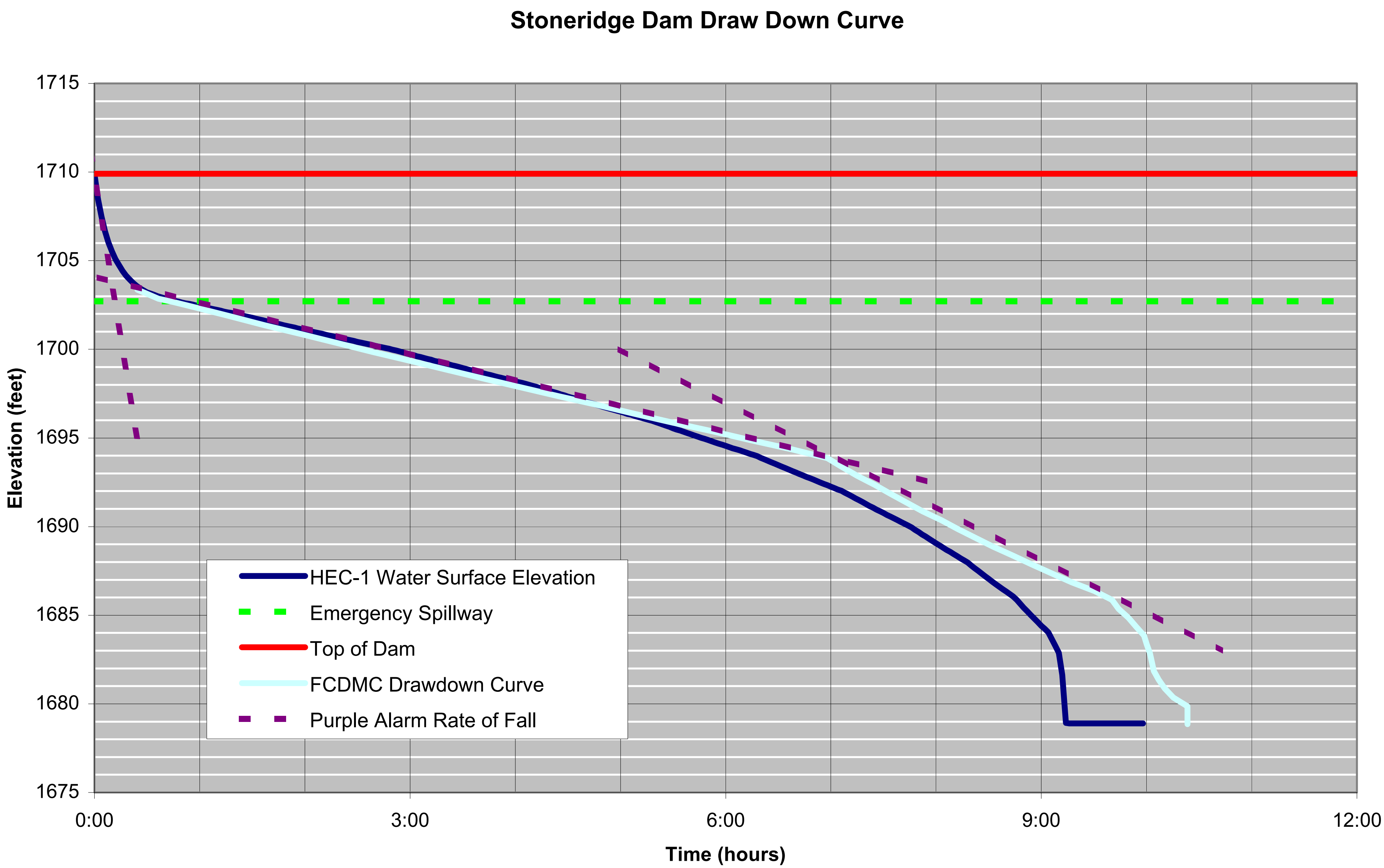


Figure 3-7 Example of Determination of Rate of Fall Criteria for Stoneridge Dam

Table 3-12 Rate of Fall Detection Criteria For Purple Alert

Stoneridge (5968)				
Feet	Minutes	Above Elev. (ft)	Above Stage (ft)	% Capacity
1	1.7	1704	25.1	
1	41	1694	15.1	
1	20	1686	7.1	3.0%
Hesperus (5993)				
1	3.3	1890	38.1	
1	35	1880	28.1	
1	24	1870	18.1	
1	11	1864	12.1	2.8%
Aspen (5988)				
1	1.9	1837	28.4	
1	31	1826	17.4	
1	22	1812	3.4	1.1%
North Heights (5983)				
1	1.3	1812	33.0	
1	24	1805	26.0	
1	17	1800	21.0	
1	12	1795	16.0	
1	9	1790	11.0	4.5%
Sunridge Canyon (5973)				
1	1.4	1926	41.3	
1	14	1918	33.3	
1	7	1910	25.3	
1	4	1903	18.3	
1	3	1896	11.3	1.6%
Golden Eagle Park (5978)				
1	0.5	1716	21.4	
1	8	1710	15.4	
1	4	1705	10.4	6.2%

3.4 Flood Detection Network Enhancements

The following is a list of suggestions for flood detection network enhancements for the Fountain Hills area:

1) Add a rain gage in the Cereus Wash System. A suggested possible location is near Dam 27-1 south of Shea Boulevard. Permitting of the gage should be easily obtained on land owned by the Fountain Hills Sanitary District (FHSD).

2) Staff gages
   a. At dams – Staff gages at the dams provide a way for observers in the field to verify readings from the electronic water level sensors. They also provide a 'manual' backup for monitoring of stage behind the dams.
   b. At road crossings – Some type of staff gage at road crossings could provide motorists with a physical demonstration of the depth of flow and associated hazard.

3) Roadway striping – In lieu of, or in addition to, staff gages at road crossings, a system of roadway paint striping could be used to identify hazardous depths.

4) Fountain Lake Pressure Transducer – While no overflow of Fountain Lake is predicted during the 100-year event, remote water level monitoring of Fountain Lake may be desirable for monitoring of possible Blue and/or Purple Alerts. The current plan identifies the Blue and Purple limits downstream of Fountain Lake, but other than the Blue rainfall criteria or observers, no other means of Blue or Purple Alert detection are provided for in the current FRP.

3.5 Summary

Table 3-13 shows a summary of the Flood Detection Criteria recommended for implementation for the FHFRP. The criteria were established by a combination of hydrologic and hydraulic modeling and application of engineering judgment.

Table 3-13 Summary of Flood Detection Criteria

Flood Alert	Rainfall Detection Criteria	Water Level Detection Criteria
Green 1	0.5" / 30 min.	See Table 3-7
Green 2	1.0" / 30 min.	
Green 3	1.5" / 30 min.	
Red	2.0" / 30 min.	
Blue	5.2" / 30 min.	1) Observer 2) See Table 3-10 and Table 3-11
Purple	N/A	1) Observer 2) Rate of Fall See Table 3-12

SECTION 4: INFORMATION DISSEMINATION

The message suite for Fountain Hills is comprised of flood warning messages issued by the National Weather Service (NWS), Flood Control District of Maricopa County (FCDMC) Meteorological Services Program (MSP), and the Town of Fountain Hills (TOFH) Marshals Department (FHMD). The message suite is summarized in Section 5. Each of these three groups of messages will be disseminated to emergency response agencies using multiple means of communication as described in this Section 4. Notification via multiple paths is provided for redundancy and robustness of the flood warning system. See Section 4.3 a discussion and flowchart of communication paths. The issuance of any of the warning messages will trigger emergency response per the action plans described in Section 6.

4.1 Dissemination of NWS and FCDMC Messages

The earliest recognition of a potential flood threat for the watersheds affecting Fountain Hills will be the forecast products available from the NWS and FCDMC.

National Weather Service (NWS) Products

Sections 3.1.2 describes the NWS flood warning products. The NWS issues Flash Flood Watch and Flash Flood Warning messages on a county-wide basis. The NWS will issue warning messages to emergency response agencies and the public via:

- *Emergency Alert System (EAS)* – The system consists of radio and television broadcast stations in the Phoenix operational area that are responsible for disseminating emergency information and warnings to the public. EAS broadcasts by commercial media are voluntary, but experience shows that the stations regularly transmit NWS messages.

- *NOAA Weather Radio (NWR)* – NWS issues Flash Flood Watch and Flash Flood Warning messages via NOAA Weather Radio according to standard protocol using tone alarms followed by voice messages.

- *Arizona Criminal Justice Information System (ACJIS)* – The ACJIS relays NWS warning messages issued for any portion of Arizona to law enforcement agencies via teletype. The ACJIS does not provide this service to the general public.

- *Internet* – Emergency response agencies and the public can proactively access NWS forecast products and warning messages directly on the Internet. Several weather related web sites are available. A recommended site is 24-hour hydrologic and weather information for the entire state available at http://www.phx.noaa.gov/.

FCDMC Meteorological Services Program (MSP) Messages

Section 3.1.1 describes the MSP flood warning products and examples are provided in Appendix D. The goal of the MSP is to reduce the response time of emergency managers by providing timely and accurate weather information regarding the potential for flood producing rain and/or damaging winds. FCDMC MSP messages are coordinated with the NWS Weather Forecast Office at Phoenix; however, MSP forecasts and messages are relatively more site-specific to the watersheds impacting Fountain Hills. Thus, the MSP products serve to supplement the NWS forecast and warning products.

FCDMC MSP products are disseminated via broadcast fax and/or e-mail to participant agencies. District management may also notify by telephone to aid in decision making. The District does not disseminate MSP messages directly to the public. Similar to the NWS warning messages, the response agencies and general public may proactively access weather and ALERT information via the Internet at http://www.fcd.maricopa.gov/alert/alert.htm or access the MSP Daily Outlook directly at http://156.42.96.39/alert/Sp/dailyf1.html .

Formerly MSP products were disseminated directly by fax to the Fountain Hills Public Works/ Engineering Department (FHPW) office personnel and Maricopa County Sheriff's Office (MCSO) Central Dispatch which relayed those messages by radio to the local MCSO District 4 office near Fountain Hills. The Fountain Hills Marshals Department (FHMD) Dispatch center and the FHPW field services managers were recently added to the MSP distribution list so that a local 24/7 facility and the on-site emergency responders directly receive MSP messages. The District Flood Warning Branch personnel will also provide an informal "heads up" telephone call when possible to the FHMD Dispatcher and the FHPW to report imminent severe weather approaching the Fountain Hills area.

The existing predictive tools, such as the NWS and MSP forecast products, should be utilized to raise TOFH agencies' awareness that the issuance of flood alerts and the implementation of emergency action plans may become necessary. The FHMD Dispatcher is responsible for monitoring the District ALERT system data for changing status. It is recommended that a dedicated line be installed at the FHMD dispatch center so that the Dispatcher can access the FCDMC ALERT system data network easily and reliably. Further, it is recommended that the District customize the ALERT graphic and text displays so that the TOFH color-coded flood alert criteria and message suite are incorporated therein. Such upgrades will provide the FHMD Dispatcher with the basic data to make informed decisions about the issuance of TOFH flood alert messages to the local response agencies.

4.2 Dissemination of TOFH Flood Alert Messages

The largely negative effective lead times directly influence the options available for dissemination of TOFH Flood Alert messages to both responding agencies and to the public. First, a highly reliable and efficient means of communicating flood warning messages to the emergency response agencies is necessary to minimize the time required to implement the agency action plans. Second, a mechanism is needed for warning Town residents of impending and/or occurring flood events and for disseminating evacuation notifications.

4.2.1 Agency Dissemination

Section 2.1 describes the TOFH Flood Alert levels. The FCDMC ALERT sensors will be programmed to alarm the FHMD first when critical rainfall and water level thresholds are reached. The Dispatcher will monitor those gage data by accessing the District ALERT data displays. Ideally, a dedicated line will be installed at the FHMD dispatch center for fast and reliable access to the FCDMC ALERT data network. The FHMD Dispatcher will issue

Flood Alert warnings to emergency responders based on the flood detection criteria described in Section 3.3 and utilizing the decision aids provided in the Dispatcher Atlas. Communications will be primarily by telephone using the agency contact list (Table 4-1) with 2-way radio back-up according to the communications flowchart (Figure 4-1).

The Dispatcher will have primary responsibility for issuing Green and Red Alerts and communicating those messages to the emergency response agencies as described above. In the case of the Red Alert, the Dispatcher is also responsible for contacting residents in the inundation zones directly by telephone using the resident contact information to be entered in the Dispatcher Atlas. The collection and maintenance of current resident contact information for this purpose will be the responsibility of the Town of Fountain Hills. When gage data and/or observers indicate impending emergency spillway flows at the dams, the FCDMC Flood Warning Branch and Fountain Hills Public Works/ Engineering Department will provide technical support to the Dispatcher for decisions involving the issuance of Blue or Purple Alerts.

Several options for the means to be used for efficient dissemination of the TOFH Flood Alert messages were investigated during the development of the FHFRP. JEF interviewed the primary contact person at each FRP stakeholder agency to determine what communication methods were currently employed by those agencies. Multiple agencies recently transitioned from pager systems to cellular phone communications. The implementation of a cellular call group whereby the Dispatcher could initiate one call that simultaneously contacted all cell phones in the call group was preliminarily explored. The stakeholder agencies utilize various wireless communications providers which requires that certain routing software be purchased so that one Dispatcher-initiated call reaches the cell phones of all the various wireless service providers. In addition, the cell phones in the call group require certain features in order for group text messaging to function successfully. It was decided that these issues required further investigation by TOFH Information Technology specialists before informed decisions could be made about the viability of this group call system for the FHFRP.

Table 4-1 Agency Contact Information

GROUP A – PRIMARY RESPONDERS

AGENCY	CONTACT	TELEPHONE NUMBER
EMERGENCY DIAL 911		
Nati (NW	*24/7 Forecaster *Meteorological Information for Emergency Responders only*	
Flood Control District of Maricopa County (FC	*Flood Warning Branch ALERT Room	602-272-0132
Mar Eme (MC	*Duty Officer	602-273-1411
Mar Offi (MCSO)	Communication Services	602-256-1011
Fou Dep (FH	*Dispatch	480-837-8800
Fou Dep (FH	*Tom Ward *Public Works Director* Tony Marchese *Street Maintenance/ Traffic Control/ Roadway Barricades* David Stepanek *Dam Monitoring*	602-721-7655 mobile 480-816-5114 office 602-721-1947 mobile 602-721-6379 mobile
Fou Dep	*Town Engineer* *Senior Civil Engineer*	480-816-5112 office 602-721-4800 mobile
Rur (RM	*911 Dispatch Center	480-945-6311 non-emergency

* Primary contact

Table 4-1 Agency Contact Information (Cont'd.)

GROUP B – SECONDARY RESPONDERS

AGENCY	CONTACT	TELEPHONE NUMBER
EMERGENCY DIAL 911		
Fountain Hills Sanitary District	* *Field Services Manager* Mike Thompson *Assistant District Engineer* Clark Moskop *WWTP Operations Manager* Ron Huber *General Manager*	480-797-1826 mobile ger 480-837-9444 office 480-797-9375 mobile 480-837-9444 office 480-797-4265 mobile 480-837-9444 office 480-797-9358 mobile
(CCWC)	*Cristi Graca *Customer Service Manager* *Water Supply Supervisor*	480-837-3411x215 office 602-768-0263 mobile 0 office 602-768-0380 mobile
	*Quinn Johnson *Land Development Manager* Jim Adair *Central Services Manager*	480-609-2229 office 602-686-3960 mobile 602-620-2734 mobile
Fountain Hills Unified School District (FHUSD) Four Peaks Elementary School *Shelter Site A* 480-837-9050 McDowell Mountain Elementary School *Shelter Site B* 480-837-1656	*Director, Buildings & Grounds* Tim Siemon, *Director, Transportation*	602-361-5325 mobile 480-837-0593 office 480-861-5034 mobile
Fountain Hills Community Center 480-816-5200	*James Willers *Department Director*	480-816-5200 office
Firerock Country Club *Shelter Site D* 480-837-1150	*Gatehouse Guard *24/7 Contact* Guy Guarino *General Manager*	480-837-1150 480-836-8100 Clubhouse 480-836-3438 direct
Ft. McDowell Indian Community	*911 Dispatch Center Tom Christmas *Chief, Ft. McDowell Fire Dept.*	480-837-1091 non-emergency 24/7 602-918-2785 cell backup 480-816-7520 direct 480-816-7521 office

* Primary contact

In lieu of the cell call groups, the Dispatcher will need to make sequential calls to the primary contacts at each stakeholder agency. The primary contact is then responsible for disseminating the information within their agency. FHMD currently staffs the dispatch center with two personnel for all shifts except graveyard, so it is possible for the flood warning message dissemination to proceed relatively quickly to make a total of 15 calls to agency primary contacts.

In order to improve the efficiency of the sequential dialing task, the stakeholder agencies were divided into two groups. Contact Group A comprise the primary or initial responders in the emergency action sequence; Contact Group B are the secondary responders. The Dispatcher is advised to prioritize the call sequence by communicating Flood Alert messages to Contact Group A first, then Group B. It is noted that the Ft. McDowell Indian Community Dispatcher will be responsible for message relay to tribal emergency responders according to the tribe's own emergency action plan.

Further, to save time in verbally relaying flood messages to agency contacts, the preparation of a pre-written, fill-in-the-blank message format is recommended. The message should include the color-coded alert level, wash system impacted, known problem areas, and effective times. A sample message follows:

> *This is (name and agency). A Green 2 Alert is issued for the (wash systems). Roadway closures are in effect for all Green 1 and Green 2 crossings. The Green 2 Alert effective times are (date) (begin/ end times). Initiate the Green 2 emergency action plan for your agency at this time. Monitor any changes to flood condition status. Report new information directly to the Fountain Hills Marshals Department at (phone number/ radio frequency) or call 911 in case of an emergency.*

4.2.2 Public Dissemination

At the Green Alert level, the primary on-site emergency task involves roadway closures. Barricades placed at overtopped crossings communicate to the Town residents that roadway passability is unsafe. Other means of communicating the passability status of roadway crossing are recommended in Section 3.4. These include some type of staff gage at road crossings that provide motorists with a physical demonstration of the depth of flow and associated hazard. In lieu of, or in addition to, staff gages at road crossings, a system of roadway paint striping could be used to identify hazardous depths.

At the Red Alert level, the FHMD Dispatcher will be responsible for calling the agency primary contacts similar to the Green Alert level. In addition, the Dispatcher will need to individually contact by telephone the residents in the evacuation zones along impacted wash systems to inform them of the need to evacuate, their destination shelter site, and passable evacuation routes using the contact information and routes maps provided in the Dispatcher Atlas and the Reference Wall Map. FHMD, MCSO, and RMFD field personnel will provide redundancy to the Dispatcher-initiated telephone contact by driving the evacuation zones and informing residents individually, by using mobile sirens, and/or public address systems of the need to evacuate, as conditions permit.

At the Blue and Purple Alert levels, more extensive inundation areas need evacuation and individual contact cannot be accomplished in a timely manner. For these extreme flood situations, evacuation notification will be accomplished by FHMD, MCSO, and RMFD field personnel driving the evacuation zones and informing residents using mobile sirens, and/or public address systems of the need to evacuate. To ensure uniformity, the preparation of a pre-written, fill-in-the-blank message format is recommended. The message should specify the color-coded flood alert level, plus it should include a brief statement of the type and sources of flood hazard in layman's terms. A sample message follows:

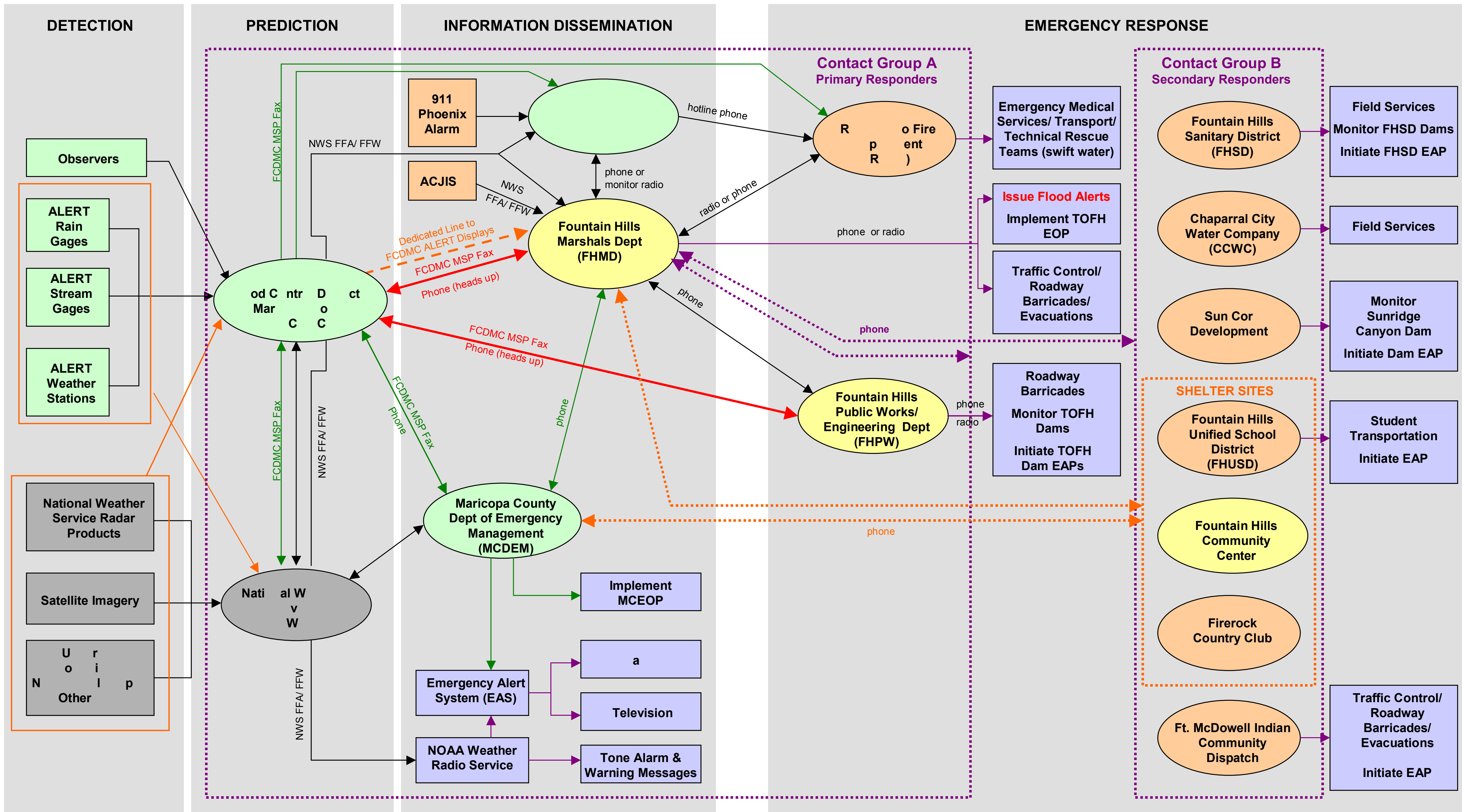
This is (name and agency). The (dam name) emergency spillway is flowing at high levels. A Blue Alert is issued for the (wash systems). The Blue Alert effective times are (date) (begin/ end times). Residents in the floodplain are urged to evacuate the area immediately. Persons evacuating the area should move away from the wash to higher ground. Roadway closures are in effect. Do not cross barricaded roadways. Displaced persons should go to (shelter site). More information will be available at the shelter sites.

A public information program is recommended to educate Town residents about the flood hazards in their community. Candidate elements of a public education program include public meetings, web pages, newspaper articles, brochures, mailers in utility bills, and/or an annual Flood Awareness Week just prior to the summer monsoon season. NWS and FCDMC have printed materials available that could be used directly or adapted to the specific needs of the FHFRP. It is strongly recommended that particularly residents living in Red, Blue, and/or Purple evacuation zones are contacted in advance of flood season and receive materials about the Flood Alerts, flooding hazards, and evacuation procedures. Further, consideration should be given to the installation of fixed sirens in areas of dense population within the Blue and Purple Alert zones for the purpose of expediting public notification in these areas. Candidate locations for fixed sirens include the neighborhoods in the Blue and Purple zones at the confluence of Panorama Wash and Colony Wash (i.e. Lakeside Patio Homes and Morningside) and at the confluence of Balboa Wash and Ashbrook Wash (i.e., Courtside Villas and the Yerba Buena neighborhood).

4.3 Communications Flowchart

The flow of information and communications in the FRP among personnel within the participating agencies will be as described above and by normal methods now in operation. The FHMD Dispatcher is the central contact for all communications concerning the FHFRP. According to the TOFH Emergency Operations Plan (Appendix H, Basic Plan, p. 5), Rural Metro Fire Department Dispatch will serve as the primary backup communication system to the Fountain Hills Marshals Department Dispatch. Figure 4-1 is a visual representation of the communication paths between the sources of flood information and the end users of that information.

Figure 4-1 Communications Flowchart



FOUNTAIN HILLS FLOOD RESPONSE PLAN

COMMUNICATIONS FLOWCHART

SECTION 5: FLOOD WARNING MESSAGE SUITE

Table 5-1 presents the message sequence, source agency, message content, and corresponding flood condition status for the NWS and FCDMC flood warning message suite. Table 5-2 presents the same set of information for the TOFH Flood Alert message suite. The flood detection criteria described in Section 3.3 trigger the progression of the TOFH Flood Alert message sequence to increasing **or** decreasing levels of alert as evolving flood conditions warrant. Similarly, note that flood alert messages may **not** always sequentially follow the levels presented in Tables 5-1 and 5-2. For example, it is possible for a flood emergency to progress from a Green 2 Alert to a Red Alert without a Green 3 Alert being issued due to rapidly developing adverse weather conditions.

The emergency action plans of the Fountain Hills FRP for stakeholder agencies are described in Section 6.1. The implementation of those action plans is linked directly to the dissemination of the various flood alert messages as triggered by the flood detection criteria.

Table 5-1 FHFRP Flood Warning Message Suite - NWS And FCDMC Warning Messages

MESSAGE SEQUENCE	MESSAGE CONTENT	FLOOD CONDITION STATUS
NATIONAL WEATHER SERVICE (NWS) Via NOAA Weather Radio Service, Emergency Alert System (Commercial Radio & TV), Arizona Criminal Justice Information System (ACJIS) and Internet at http://www.phx.noaa.gov		
SEVERE THUNDERSTORM WARNING	National Weather Service **Severe Thunderstorm Warning** (begin time/ end time)	• A severe weather occurrence is imminent or already occurring. • Severe weather includes tornadoes, high wind, dust storms, hail, or locally heavy rainfall.
FLASH FLOOD WATCH (FFA)	National Weather Service **Flash Flood Watch** (begin time/ end time)	• Threat exists for flash flooding due to meteorological and soil conditions. • Typically issued for entire Maricopa County or a large portion of the County. • Time period typically 3 to 12 hours or longer.
URBAN SMALL STREAM FLOOD ADVISORY	National Weather Service **Urban Small Stream Flood Advisory** (begin time/ end time)	• Locally heavy rainfall is expected to occur, but total rainfall is expected to be less than the criteria for a Flash Flood Warning. • Usually nuisance flooding is expected to result and poses minimal threat to life and property.
FLASH FLOOD WARNING (FFW)	National Weather Service **Flash Flood Warning** (begin time/ end time)	• Flash flooding is imminent or already occurring. • Often issued for specific basins over a period of 1 to 6 hours. • Often issued based on ground observers or telemetered stream gage data. • Flash Flood Warnings may be issued on basis of rain gage or radar data.
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC) **METEOROLOGICAL SERVICES PROGRAM (MSP)** Via Broadcast Fax and e-mail		
WEATHER OUTLOOK	Synopsis of expected weather conditions; Percent chance of rain; Prime time for rain; Maximum prime time rainfall amount.	• Disseminated daily between 1:00PM and 1:30PM
MESSAGE 1 ALERT	Affected zones; Time frame of expected event; Types of impacted areas (i.e., roads, washes/ streams).	• Developing weather conditions may lead to flooding and/or destructive winds. • Lead time generally 1 to 3 hours in advance of expected event.
TRACK FORECAST	Graphic showing location of primary thunderstorm; forecast storm track	• Depiction of expected thunderstorm movement. • Time frame generally for the next 1 or 2 hours.
MESSAGE 2 FLASH FLOOD WATCH	Affected zones; effective times; explanatory comments.	• Developing weather event may lead to flash flooding. • Lead time generally 1 to 2 hours in advance of expected event.
QUANTITATIVE PRECIPITATION FORECAST (QPF)	Graphic showing forecast rainfall amounts and locations	• Depiction of expected rainfall amounts and locations.
MESSAGE 3 FLASH FLOOD WARNING	Affected zones; effective times; explanatory comments.	• Flash flooding appears imminent for the expected affected areas. • Lead time generally less than 1 hour.
MESSAGE 2 & 3 UPDATE	Explanatory comments	• Updates existing Watch or Warning.
MESSAGE 4 CANCEL	Explanatory comments	• Event no longer poses a threat to areas mentioned in Watch or Warning.

Table 5-2 FHFRP Flood Warning Message Suite – TOFH Flood Alert Messages

MESSAGE SEQUENCE	MESSAGE CONTENT	FLOOD CONDITION STATUS
TOWN OF FOUNTAI		**TMENT DISPATCH** **Via Telephone or 2-way Radio**
GREEN 1 ALERT **GREEN 2 ALERT** **GREEN 3 ALERT**	**TOFH Green (*number*) Alert** **Wash System Name(s)** (begin time/ end time)	• Frequent storm, nuisance flood event. • Potential for loss of life exists at roadway crossings. • *Criteria*: Rainfall Rate as follows and/or Critical Water Levels behind dams - Green 1 0.5" / 30 minutes - Green 2 1.0" / 30 minutes - Green 3 1.5" / 30 minutes • Washes overtop Green (*number*) roadway crossings at depth of 6" or more. • Roadway closures required at impassable Green crossings. • No structures are threatened. • No evacuations required.
RED ALERT	**TOFH Red Alert** **Wash System Name(s)** (begin time/ end time)	• Approximate 100-year flood event. • Greater potential for loss of life exists. • *Criteria*: Rainfall Rate Red 2.0"/ 30 minutes. • Significant overtopping of Green roadway crossings possible. • Washes overtop Red roadway crossings at depth of 6" or more. • Roadway closures required at impassable Green and Red crossings. • Potential for property damage exists. • Evacuation of Red flood vulnerable structures required.
BLUE ALERT	**TOFH Blue Alert** **Dam Name(s)** **Wash System Name(s)** (begin time/ all clear)	• Dam emergency spillways operating at full capacity. • Approximate ½ Probable Maximum Flood (½ PMF). • Serious potential for loss of life exists. • *Criteria*: Rainfall Rate Blue 5.2"/ 30 minutes and/or Critical Water Levels behind dams. • Significant overtopping of Green and Red roadway crossings possible. • Washes overtop Blue roadway crossings at depth of 6" or more. • Roadway closures required at impassable Green, Red, and Blue crossings. • Serious potential exists for property damage downstream of the dam. • Evacuation of Red and Blue flood vulnerable structures required.
PURPLE ALERT	**TOFH Purple Alert** **Dam Name(s)** **Wash System Name(s)** (begin time/ all clear)	• Dam failure possible. • Overtopping of dam crest possible. • Serious potential for loss of life exists. • *Criteria*: Observer reports dam failure and/or gage alarm triggered when rate of fall of the water level exceeds a pre-determined maximum rate. • Significant overtopping of Green, Red, and Blue roadway crossings possible. • Washes overtop Purple roadway crossings. • Roadway closures required at impassable Green, Red, Blue, and Purple crossings. • Serious potential exists for property damage downstream of the dam. • Evacuation of Red, Blue, and Purple flood vulnerable structures required.
ALL CLEAR	**TOFH All Clear** (effective time)	• Floods on impacted washes have dropped below critical levels. • Potential for additional flooding is minimal.

SECTION 6: ACTION PLANS

Once a rainfall/ runoff event is occurring of sufficient magnitude so as to meet or exceed the established flood detection thresholds (Section 3.3), warning messages are issued (Section 5) using the information dissemination tools (Section 4.2) and communication flowpaths (Figure 4-1) previously established. Governmental and emergency response agencies participating in the Fountain Hills FRP must implement their respective emergency response action plans. Participating agencies will follow the action plans described herein within the context of their own jurisdiction's incident command system.

6.1 Agency Action Plans

Each FCDMC weather alert and/or flood warning and NWS Flash Flood Watch and/or Flash Flood Warning message is related to a different degree of flood threat. Consequently, each message requires a different associated response by the emergency response agencies. The message sequence is structured in a manner of increasing urgency triggered by imminent or occurring flooding in the Fountain Hills wash systems. This graduated flood warning message suite is associated with a similarly stepped action plan comprised of emergency response activities of increasing urgency. Generally, the NWS and MSP forecast products should be utilized to raise agency awareness that the issuance of TOFH Flood Alerts and the implementation of emergency action plans may become necessary. Table 6-1 presents the emergency action plans for each agency for the warning message generated by the NWS and FCDMC. Table 6-2 provides the emergency action plans for agencies responding the TOFH Flood Alert messages.

The agency action plans do not contain detailed operational procedures; rather, they provide an overview of technical support activities, communications, emergency operations and general responsibilities of each participating organization. Specific task assignments and responsibilities are described in these agencies' own emergency operations plans, dam owners' emergency action plans, and other supplemental documents. The FRP is intended to function independently as a stand-alone document, and to be added as an Appendix to the FCDMC Flood Emergency Response Manual, MCDEM Maricopa County Emergency Operations Plan (1999) , and TOFH Emergency Operations Plan (Appendix H).

Table 6-1 FHFRP Agency Action Plan For NWS and FCDMC Flood Warning Messages

CONTACT GROUP A – PRIMARY RESPONDERS							
WARNING MESSAGE	**NATIONAL WEATHER SERVICE (NWS)** **602-275-7003**	**FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC)** **602-506-8701/ 602-272-0132**	**MARICOPA COUNTY DEPT. OF EMERGENCY MANAGEMENT (MCDEM)** **602-273-1411**	**MARICOPA COUNTY SHERIFF'S OFFICE (MCSO)** **602-256-1011**	**FOUNTAIN HILLS MARSHALS DEPARTMENT (FHMD)** **480-837-8800**	**FOUNTAIN HILLS PUBLIC WORKS/ ENGINEERING DEPARTMENT (FHPW)** **602-721-7655/ 602-721-4800**	**RURAL METRO FIRE DEPARTMENT (RMFD)** **408-945-6311**
NATIONAL WEATHER SERVICE (NWS) WARNING MESSAGES **Via NOAA Weather Radio Service, Emergency Alert System (Commercial Radio & TV), Arizona Criminal Justice Information System (ACJIS), and Internet at http://www.phx.noaa.gov**							
Severe Thunderstorm Warning **Flash Flood Watch (FFA)** **Urban Small Stream Advisory** **Flash Flood Warning (FFW)**	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM, as needed. **Issue NWS Messages.**	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM, as needed. Implement FCDMC Flood Emergency Response Manual, as appropriate to warning message and flood status. "Heads up" call to FHMD and FHPW, as needed.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS, as needed. Implement Maricopa County Emergency Operations Plan, as appropriate to warning message and flood condition status.	Locate FHFRP materials. Monitor incoming weather, rainfall, streamflow data. Ready/ dispatch local area personnel, as appropriate to warning message and flood condition status.	Locate FHFRP materials. Monitor FCDMC ALERT data and sensor alarms. Monitor NWS warning message updates. Ready department personnel. **Issue TOFH Flood Alert Messages per Flood Detection Criteria, as needed.**	Locate FHFRP materials. Monitor FCDMC ALERT data. Monitor NWS warning message updates. Ready barricade crews and dam observers.	Locate FHFRP materials. Monitor current weather information. Ready/ dispatch local station crews as appropriate to emergency response needs.
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC) METEOROLOGICAL SERVICES PROGRAM (MSP) MESSAGES **Via Broadcast Fax and e-mail**							
Weather Outlook **Message 1 – Alert** **Track Forecast** **Message 2 – Flash Flood Watch** **Quantitative Precipitation Forecast** **Message 3 – Flash Flood Warning** **Message 2 & 3 – Update** **Message 4 – Cancel**	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM, as needed.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM, as needed. Implement FCDMC Flood Emergency Response Manual. "Heads up" call to FHMD and FHPW, as needed. **Issue MSP Messages to participating agencies.**	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS, as needed. Implement Maricopa County Emergency Operations Plan, as appropriate to warning message and flood condition status.	Locate FHFRP materials. Monitor incoming weather, rainfall, streamflow data. Ready/ dispatch local area personnel, as appropriate to warning message and flood condition status.	Locate FHFRP materials. Monitor FCDMC ALERT data and sensor alarms. Monitor MSP warning message updates. Ready department personnel. **Issue TOFH Flood Alert Messages per Flood Detection Criteria, as needed.**	Locate FHFRP materials. Monitor FCDMC ALERT data. Monitor MSP warning message updates. Ready barricade crews and dam observers.	Locate FHFRP materials. Monitor current weather information. Ready/ dispatch local station crews as appropriate to emergency response needs.

CONTACT GROUP B – SECONDARY RESPONDERS							
WARNING MESSAGE	**FOUNTAIN HILLS SANITARY DISTRICT (FHSD)** **480-797-1826**	**CHAPARRAL CITY WATER COMPANY (CCWC)** **602-768-0263**	**SUN COR DEVELOPMENT** **602-686-3960**	**FOUNTAIN HILLS UNIFIED SCHOOL DISTRICT (FHUSD)** **602-361-5325**	**FOUNTAIN HILLS COMMUNITY CENTER (FHCC)** **480-816-5200**	**FIREROCK COUNTRY CLUB** **480-837-1150**	**FT. McDOWELL INDIAN COMMUNITY DISPATCH** **480-837-1091**
NATIONAL WEATHER SERVICE (NWS) WARNING MESSAGES **Via NOAA Weather Radio Service, Emergency Alert System (Commercial Radio & TV), Arizona Criminal Justice Information System (ACJIS), and Internet at http://www.phx.noaa.gov**							
Severe Thunderstorm Warning **Flash Flood Watch (FFA)** **Urban Small Stream Advisory** **Flash Flood Warning (FFW)**	Locate FHFRP materials. Monitor weather information. Ready/ dispatch field services crews.	Locate FHFRP materials. Monitor weather information. Ready/ dispatch field services crews.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor current weather information. Alert transportation personnel.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor weather information. Ready/ dispatch local response agencies.
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC) METEOROLOGICAL SERVICES PROGRAM (MSP) MESSAGES **Via Broadcast Fax and e-mail**							
Weather Outlook **Message 1 – Alert** **Track Forecast** **Message 2 – Flash Flood Watch** **Quantitative Precipitation Forecast** **Message 3 – Flash Flood Warning** **Message 2 & 3 – Update** **Message 4 – Cancel**	Locate FHFRP materials. Monitor current weather information. Ready/ dispatch field services crews as appropriate to emergency response needs.	Locate FHFRP materials. Monitor current weather information. Ready/ dispatch field services crews as appropriate to emergency response needs.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor current weather information. Alert transportation personnel.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor current weather information.	Locate FHFRP materials. Monitor current weather information. Ready/ dispatch local response agencies as appropriate to emergency response needs.

See next page for TOFH Flood Alert messages →

Table 6-2 FHFRP Agency Action Plan for TOFH Flood Alert Messages

CONTACT GROUP A – PRIMARY RESPONDERS

WARNING MESSAGE	NATIONAL WEATHER SERVICE (NWS) 602-275-7003	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCDMC) 602-506-8701/ 602-272-0132	MARICOPA COUNTY DEPT. OF EMERGENCY MANAGEMENT (MCDEM) 602-273-1411	MARICOPA COUNTY SHERIFF'S OFFICE (MCSO) 602-256-1011	FOUNTAIN HILLS MARSHALS DEPARTMENT (FHMD) 480-837-8800	FOUNTAIN HILLS PUBLIC WORKS/ ENGINEERING DEPARTMENT (FHPW) 602-721-7655/ 602-721-4800	RURAL METRO FIRE DEPARTMENT (RMFD) 408-945-6311
TOWN OF FOUNTAIN HILLS (TOFH) FLOOD ALERT MESSAGES Via Telephone or 2-way Radio							
GREEN 1 ALERT **GREEN 2 ALERT**	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM, as needed.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM, as needed. Monitor TOFH Flood Alert messages. "Heads up" call to FHMD and FHPW, as needed.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS, as needed. Monitor TOFH Flood Alert messages.	Monitor incoming weather, rainfall, streamflow data. Establish communication with FHMD. Ready/ dispatch local area personnel, as appropriate to flood condition status. Provide traffic control at flooded roadway crossings, as needed.	Monitor FCDMC ALERT data/ sensor alarms. **Issue Green 1 Alert per Flood Detection Criteria to Contact Groups A only. OR** **Issue Green 2 Alert to both Contact Groups A&B.** Coordinate with FCDMC, as needed. Establish communications with MCSO and FHPW. Ready/ dispatch department personnel. Provide traffic control at flooded roadways.	Monitor current weather information. Monitor FCDMC ALERT data. Coordinate with FCDMC, as needed. Establish communication with FHMD. Place barricades at G1 or G2 roadway crossings corresponding to the Flood Alert Level issued by FHMD Dispatch and as shown on FRP Emergency Access Map.	Monitor current weather information. Ready/ dispatch local station crews, as appropriate to flood condition status and emergency response needs. Provide emergency medical services and transport, as required.
GREEN 3 ALERT	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM, as needed.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM, as needed. Monitor TOFH Flood Alert messages. Establish communication with FHMD Dispatch.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS, as needed. Monitor TOFH Flood Alert messages. Establish communication with FHMD. Contact Red Cross (602-336-6660) and shelter sites.	Maintain local area personnel on alert. Maintain communication with FHMD. Provide traffic control at flooded roadway crossings, as needed.	**Issue Green 3 Alert to Contact Groups A&B.** Maintain communications with MCSO and FHPW. Establish communications with FCDMC MCDEM, RMFD, FHSD, CCWC, Sun Cor, Ft. McDowell, and shelter sites. Provide traffic control at flooded crossings.	Monitor current weather information. Monitor FCDMC ALERT data. Maintain communications with FHMD. Coordinate with FHSD, CCWC, and Sun Cor. Place barricades at G3 roadway crossings as shown on FRP Emergency Access Map. Ready dam observers.	Monitor current weather information. Establish communication with FHMD. Dispatch local station crews, as appropriate to flood condition status and emergency response needs. Provide emergency medical services and transport, as required.
RED ALERT	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM. Maintain communication with FHMD Dispatch. **Implement FCDMC Flood Emergency Response Manual.** Provide flood data to emergency responders, as requested.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS. Maintain communication with FHMD and evacuation site(s). **Implement Maricopa County Emergency Operations Plan (EOP).** Initiate Emergency Alert System (EAS) message(s), as necessary.	Maintain local area personnel on alert. Maintain communication with FHMD. Establish communication with Arizona Department of Public Safety, as required. Assist in Red zone evacuations. Monitor evacuation routes for residents in need of assistance. Provide traffic control at flooded roadways. Secure affected areas.	**Issue Red Alert to Contact Groups A&B.** **Implement TOFH Emergency Operations Plan (EOP).** Contact residents in Red evacuation zone by telephone. Direct Red zone evacuations. Monitor evacuation routes. Provide traffic control at flooded roadways. Secure affected areas. Maintain all agency communications.	Monitor FCDMC ALERT data. Maintain communication with FHMD Dispatch,. Coordinate with FHSD, CCWC, and Sun Cor. Place barricades at Red roadway crossings as shown on FRP Emergency Access Map. Dispatch observers to TOFH dams.	Monitor current weather information. Maintain communication with FHMD. Assist in Red zone evacuations. Dispatch local station crews, as appropriate to flood condition status and emergency response needs. Provide emergency medical services and transport, as required. Conduct rescue operations, as required.
BLUE ALERT	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM. Coordinate with FHMD Dispatch. **Implement FCDMC Flood Emergency Response Manual.** Provide flood data, as requested.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS. **Implement Maricopa County EOP.** Initiate Emergency Alert System (EAS) message(s), as necessary.	Assist in Blue zone evacuations. Notify residents by driving Blue zone using mobile sirens/ public address system. Monitor evacuation routes for residents in need of assistance. Provide traffic control at flooded roadways. Secure affected areas.	**Issue Blue Alert to Contact Groups A&B.** **Implement TOFH EOP.** Direct Blue zone evacuations. Monitor evacuation routes. Provide traffic control. Secure affected areas. Maintain all agency communications. Coordinate with Ft. McDowell Dispatch.	Maintain communication with FHMD. Monitor TOFH dams. Coordinate with MCDEM observers. **Implement Emergency Action Plans (EAP) for impacted dam(s).** **Golden Eagle Park Dam Yellow Alert.** Place barricades at Blue roadway crossings.	Monitor current weather information. Maintain communication with FHMD. Assist in Blue zone evacuations. Notify residents by driving Blue zone using mobile sirens/ public address system. Provide emergency medical services. Conduct rescue operations, as required.
PURPLE ALERT	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and MCDEM.	Monitor incoming weather, rainfall, streamflow data. Coordinate with NWS and MCDEM. Coordinate with FHMD Dispatch. **Implement FCDMC Flood Emergency Response Manual.** Provide flood data, as requested.	Monitor incoming weather, rainfall, streamflow data. Coordinate with FCDMC and NWS. **Implement Maricopa County EOP.** Initiate Emergency Alert System (EAS) message(s), as necessary.	Assist in Purple zone evacuations. Notify residents by driving Purple zone using mobile sirens/ public address system. Monitor evacuation routes for residents in need of assistance. Provide traffic control at impacted roadways. Secure affected areas.	**Issue Purple Alert to Groups A&B.** **Implement TOFH EOP.** Direct Purple zone evacuations. Monitor evacuation routes. Provide traffic control. Secure affected areas. Maintain all agency communications. Coordinate with Ft. McDowell Dispatch.	Monitor TOFH dams. Maintain communication with FHMD Dispatch. **Implement Emergency Action Plans (EAP) for impacted dam(s).** **Golden Eagle Park (GEP) Dam Red Alert.**	Monitor current weather information. Maintain communication with FHMD. Assist in Purple zone evacuations. Notify residents by driving Purple zone using mobile sirens/ public address system. Provide emergency medical services. Conduct rescue operations, as required.
ALL CLEAR	Maintain communication with FCDMC on as-needed basis.	Maintain communication with FHMD Dispatch and FHPW on as-needed basis.	Maintain agency communications,as needed. Perform post-flood EOP activities.	Provide post-flood assistance.	**Issue All Clear to Contact Group A&B.** Perform post-flood recovery activities.	Remove barricades and roadway debris. Perform post-flood recovery activities.	Provide post-flood assistance.

CONTACT GROUP B – SECONDARY RESPONDERS

WARNING MESSAGE	FOUNTAIN HILLS SANITARY DISTRICT (FHSD) 480-797-1826	CHAPARRAL CITY WATER COMPANY (CCWC) 602-768-0263	SUN COR DEVELOPMENT 602-686-3960	SHELTER SITES FOUNTAIN HILLS UNIFIED SCHOOL DISTRICT (FHUSD) 602-361-5325	SHELTER SITES FOUNTAIN HILLS COMMUNITY CENTER 480-816-5200	SHELTER SITES FIREROCK COUNTRY CLUB 480-837-1150	FT. McDOWELL INDIAN COMMUNITY DISPATCH 480-837-1091
TOWN OF FOUNTAIN HILLS (TOFH) FLOOD ALERT MESSAGES Via Telephone or 2-way Radio							
GREEN 1 ALERT **GREEN 2 ALERT**	Monitor current weather information. Monitor FHSD infrastructure. Ready/ dispatch field services crews, as required.	Monitor current weather information. Monitor CCWC infrastructure. Ready/ dispatch field services crews, as required.	Monitor current weather information.	Monitor current weather information. Alert bus transportation personnel of flood potential.	Monitor current weather information.	Monitor current weather information.	Monitor current weather information. Ready/ dispatch tribal emergency response personnel as appropriate to flood condition status.
GREEN 3 ALERT	Coordinate with FHMD, FHPW, as needed. Ready/ dispatch field services crews. Ready dam observer(s).	Coordinate with FHMD, FHPW, as needed. Ready/ dispatch field services crews, as required.	Coordinate with FHMD, FHPW, as needed. Ready dam observer.	Establish communications with FHMD Dispatch, MCDEM, and Red Cross. Ready shelter sites.	Establish communications with FHMD Dispatch, MCDEM, and Red Cross. Ready shelter site.	Establish communications with FHMD Dispatch, MCDEM, and Red Cross. Ready shelter site.	Establish communication with FHMD. Ready/ dispatch tribal emergency response personnel.
RED ALERT	Coordinate with FHMD and FHPW. Dispatch dam observer(s) to FHSD dam(s). Implement FHSD Emergency Action Plan.	Coordinate with FHMD and FHPW. Dispatch field services crews, as required.	Coordinate with FHMD and FHPW. Dispatch dam observer to Sunridge Canyon Dam.	Receive residents evacuated from Red zone. Coordinate w/ on-site Red Cross personnel. Implement FHUSD Emergency Action Plan.	Receive residents evacuated from Red zone. Coordinate w/ on-site Red Cross personnel.	Receive residents evacuated from Red zone Coordinate w/ on-site Red Cross personnel.	Maintain communication with FHMD Dispatch. Implement Emergency Action Plan.
BLUE ALERT	Maintain observer(s) at dam(s). Implement FHSD Emergency Action Plan.	Coordinate with FHMD and FHPW. Dispatch field services crews, as required.	Maintain observer at dam. Implement Sunridge Canyon Dam EAP.	Receive Blue zone evacuees. Coordinate with MCDEM. **GEP Dam Yellow Alert**	Receive residents evacuated from Blue zone. Coordinate with MCDEM and Red Cross.	Receive residents evacuated from Blue zone. Coordinate with MCDEM and Red Cross.	Coordinate with FHMD Dispatch. Implement Emergency Action Plan.
PURPLE ALERT	Maintain observer(s) at dam(s). Implement FHSD Emergency Action Plan.	Coordinate with FHMD and FHPW. Dispatch field services crews, as required.	Maintain observer at dam. Implement Sunridge Canyon Dam EAP.	Receive Purple zone evacuees. Coordinate with MCDEM. **GEP Dam Red Alert**	Receive residents evacuated from Purple zone. MCDEM/ Red Cross coordination.	Receive residents evacuated from Purple zone. MCDEM/ Red Cross coordination.	Coordinate with FHMD Dispatch. Implement Emergency Action Plan.
ALL CLEAR	Perform post-flood recovery activities.	Perform post-flood recovery activities.	Perform post-flood recovery activities.	Perform post-flood recovery activities.	Perform post-flood recovery activities.	Perform post-flood recovery activities.	Perform post-flood recovery activities.

6.2 Evacuation Procedures

Evacuation procedures shall be implemented as described in TOFH Emergency Operations Plan (1999, Annex A, Appendix 5). Four shelter sites were identified by JEF for use as part of the FHFRP and these are listed in Table 6-3. Shelter sites are shown graphically on the Reference Wall Map, Emergency Access Map, and Dispatcher Atlas. Additionally, the resident contact information in the Dispatcher Atlas indicates to which site each individual resident should report. Ashbrook Wash system residents generally evacuate to Sites A, B, or C depending on which side of the wash they are located. Colony Wash system residents generally evacuate to Site C. Malta/ Jacklin and Cereus Wash system area residents evacuate to Site D.

Shelter site owners will be contacted by the FHMD Dispatcher and they will be responsible for opening the shelters. The Red Cross will fulfill the function of staffing the shelters. Red Cross Disaster Services (602-336-6660) shall be contacted for this purpose as per the agency action plans (Table 6-2).

Table 6-3 FHFRP Shelter Sites

Site A Four Peaks Elementary School 17300 Calaveras Avenue Fountain Hills, AZ 85268 480-837-9050	**Site C** Fountain Hills Community Center 13001 N. La Montana Drive Fountain Hills, AZ 85268 480-816-5200
Site B McDowell Mountain Elementary School 14825 N. Fayette Drive Fountain Hills, AZ 85268 480-837-1656	**Site D** Firerock Country Club Clubhouse 16000 Firerock Country Club Drive Fountain Hills, AZ 85268 480-837-1150

The NWS, FCDMC, and TOFH will provide timely weather information and flood warning messages to residents to the best of their ability using currently available technology. Residents are advised that prediction of flash floods is complex and conditions can change very rapidly. Residents have a responsibility to do what they can to remain alert for changing flood conditions impacting their residences by using NOAA Weather Radios, commercial radios, television, and/or the Internet. They should also closely monitor local conditions around their residences. When rainfall increases rapidly or flood conditions worsen significantly, residents should use common sense and evacuate even if they have not received flood warning messages.

6.3 Post-Flood Actions

The FHFRP is intended to function independently as a stand-alone document, and to be added as an Appendix to the FCDMC Flood Emergency Response Manual, MCDEM Maricopa County Emergency Operations Plan (1999) , and TOFH Emergency Operations Plan (see Appendix H). Post-flood action protocols, as addressed in the FCDMC, MCDEM, and TOFH documents, are incorporated by reference herein to the Fountain Hills Flood Response Plan. Post-flood actions include, but are not limited to, criteria for re-occupation of structures, an After-Action Report, relations with the news media, and government assistance for flood victims (both private and agencies). Refer to the cited documents for further information.

SECTION 7: IMPLEMENTATION

This section of the FRP describes the training, exercises, and update requirements of the FRP. These requirements, as recommended in this section, should be reviewed annually to take into account future development, changes in land use, changes in population, advances in communication and sensing technology, and the organization of the identified agencies and community. Any changes to the FRP should be communicated to all participating agencies and residents in the warning area.

7.1 Training

FHFRP training participants should include the agency stakeholders responsible for developing flood information, the emergency response agencies responsible for carrying out the action plans, the shelter site personnel, and the residents responsible for responding to evacuation notifications.

It is recommended that an orientation meeting is held for participating entities involved the FHFRP for the purpose of giving an overview of the FRP and to distribute FRP materials, as appropriate. For the water resource and emergency response agencies, training requirements will be met by participation in annual exercises described in Section 7.2. Specialized training may be required for FHMD, FHPW, MCSO, and/or RMFD personnel to familiarize themselves with the structure of the FRP and to maintain proficiency with any activities unique to carrying out their responsibilities as outlined in the action plan. Listing the training requirements of each agency is beyond the scope of this FRP; however, the identification of the need for this training is not. It is recommended that each agency establish a means of ensuring that any extra training in response to flooding events is provided on a periodic basis and is adequately documented.

The residents included in the FRP evacuation area should receive instructions on the structure of the FRP, interpretation of the warning messages, and evacuation procedures. A public information program is recommended as described in Section 4.2.2.

7.2 Flood Exercises

The scope, temporal and spatial extent of flood exercises should be varied to develop and maintain competency in using the decision-making tools and information dissemination equipment, and to maintain interest and communications among the agencies and residents. The agencies that should be represented are those listed in Table 4-1. In addition, representatives from the shelter sites should also be involved. The following elements should be considered in formulating a program of FHFRP exercises:

1. The spatial extent of the exercises should be varied. Flash flood exercises can be conducted on a wash system-specific basis or the spatial coverage may extended to include all Fountain Hills watersheds. Similarly, the FHFRP may be incorporated into regular County-wide flood exercises. The FRP should be exercised annually on a wash system-specific basis and/or for all Fountain Hills watersheds and every three years as part of a County-wide flood exercise.

2. The exercises should vary temporally. The exercise can be held in alternating years during November or December to test the robustness of the FRP for winter storm flooding and during May or June to test the FRP for monsoon thunderstorm flooding.

3. The scope of the exercises should vary so that those involved in the FRP implementation become familiar with their roles and responsibilities. Exercise formats may include the following:
   - *Orientation Seminar.* This seminar will bring together those with a role or interest in the FHFRP to discuss the plan and gain familiarity with the various products/ decision aids, roles and responsibilities, and implementation procedures.
   - *Drills*. A low level exercise involving a test of the procedures required for an actual emergency action. A pre-determined exercise could be prepared by the FCDMC and conducted without prior knowledge of the participating agencies.
   - *Tabletop Exercise.* A higher level exercise which involves a meeting of the stakeholder agencies to look at simulated emergency events and discuss the procedures to be taken.

- *Functional Exercise.* This exercise involves a simulated dam failure and/or severe flood event and requires the local and regional emergency management personnel to act out their roles without the commitment of equipment in the field.
- *Full Scale Exercise.* This is a field exercise which involves a complete simulation of an actual dam failure or severe flood event and evaluates all facets of the emergency management system.

4. Residents should receive mailers from the TOFH in advance of summer monsoon season and/or as part of NWS Flash Flood Awareness Week. Local newspapers could include press releases about the FHFRP in conjunction with the mailers.

7.3 FRP Updates

The FRP should be updated annually for changes in procedure and coverage due to communications upgrades, MSP/NWS forecast enhancements, changes in the flood detection network, changes in agency responsibilities, and/or population changes. The update should be conducted annually during April and May to insure necessary changes to the FRP are able to be made before the active summer monsoon season. All FRP updates should be mailed out to agencies and individuals that participate in the FWS.

The following verification and update activities should be conducted:

- The National Weather Service and District MSP should verify available products.

- Radio frequencies, telephone, and fax numbers should be tested to see if changes have been made since the last operational season. Agency and resident contact numbers should be verified.

- All observers should be called to verify their participation.

- The condition of the evacuation routes should be verified periodically. This includes verifying if any constructed upgrades have been made.

- Development within the upstream portions of the study area may change the flood warning needs as future development proceeds. While the current FRP is based upon future condition hydrology, flood warning needs should be re-evaluated as development occurs.

7.4 FRP Follow-Up

The following tasks are recommended to enhance the implementation of the FRP:

- A distribution list of agencies receiving the FHFRP materials at the orientation meeting is recommended. The list should be updated as revisions and/or amendments are issued.

- The enhancements to the flood detection network described in Section 3.4 should be prioritized and implemented.

- It is recommended that a dedicated line be installed at the FHMD dispatch center so that the Dispatcher can access the FCDMC ALERT system data network easily and reliably. Further, it is recommended that the District customize the ALERT graphic and text displays so that the TOFH color-coded flood alert criteria and message suite are incorporated therein. These upgrades will provide the FHMD Dispatcher with the basic data to make informed decisions about the issuance of TOFH flood alert messages to the local response agencies.

- The contact information for all residents of the Red evacuation zone as identified in the Dispatcher Atlas needs to be fully populated so that the FHMD dispatch center can initiate telephone contact with all impacted residents in the event of a Red Alert. The residents' names and addresses were partially collected by FHPW and provided to JEF in the development of the FHFRP. This effort should be completed so as to provide the Dispatcher with the most expedient means of informing residents by telephone of the need to evacuate the Red Alert zone.

- A local network of observers should be established to provide field verification of flood conditions during runoff events and to monitor dams. Dam observers require training as to dam hazard identification and dam operation.

- Consideration should be given to the installation of fixed sirens in areas of dense population within the Blue and Purple Alert zones for the purpose of expediting public notification in these areas. Candidate locations for fixed sirens include the neighborhoods in the Blue and Purple zones at the confluence of Panorama Wash and Colony Wash (i.e. Lakeside Patio Homes and Morningside) and at the confluence of Balboa Wash and Ashbrook Wash (i.e., Courtside Villas and the Yerba Buena neighborhood).

- Dissemination of warning messages can be expedited with a cell group call system. TOFH Information Technology specialists should explore viable options to implement a group call system for flood warning and other purposes. Future improvements in communicating warnings and evacuation notifications may occur in the long-term if the planned county-wide implementation of a reverse 911 call system is successfully implemented.

- Development of an Internet web page is recommended to post flood-related messages and to make FHFRP materials directly available to the public. The deliverables for the current project include digital files of all FHFRP materials in pdf format to facilitate the development of the recommended web page.

- The new Target center on Cereus Wash upstream of Saguaro Boulevard and south of Shea Boulevard is currently under construction. This area will require a re-assessment of the runoff computations and the inundation limits of the modified Cereus Wash. In addition, modification of the flood alert priority of the Saguaro Boulevard crossing may be warranted, especially if culvert upgrades are installed as part of the Target center site development.

- Maintenance of the principle outlet works at the dams by the Fountain Hills Public Works/ Engineering Department is of critical importance to ensure accurate sensor data interpretation.

- TOFH Emergency Operations Plan and the Emergency Action Plans for the dams should be revised to reflect communication changes and to reference the Fountain Hills Flood Response Plan.

- As described in Section 2.2.3, if a structure was located planimetrically within the floodplain limits for the Red, Blue, and Purple Alerts , then it was considered affected by the associated flow event. Field survey of finished floors of structures in these inundated areas may indicate that these are high enough to prevent water from entering the structures. If this is found to be the case, then changes will need to be made to the number of evacuation notifications.

SECTION 8: LIMITATIONS

The limitations of the technical foundation of the FHFRP are those common to all hydrologic and hydraulic analyses. There are inaccuracies inherent in watershed modeling to estimate discharge values and in step-backwater computer models to estimate water surface elevations. Engineering judgment is used in estimating various input parameters to these models, such as loss parameters, routing variables, and roughness coefficients. Where previous land development drainage reports sealed by a registered professional engineer indicated a 100-year level of design, these were adopted for the FHFRP without rigorous independent verification by JEF. Topographic mapping, though prepared to acceptable standards, also introduces error in measurements.

The operation of the FWS is predicated upon accurate measurement of rainfall and reservoir water levels by the gages comprising the flood detection network. Known inaccuracies are introduced in measurements of rain by the gages due to uncontrollable variables such as wind speed and direction. The variability of precipitation further complicates the estimation of accurate modeling results. Similarly, measurement of stage at the dams for the purpose of downstream discharge estimation can be inaccurate due to debris clogging or other changes to the inlet conditions that render the rating curves inaccurate.

The FHFRP flood detection criteria analyses, access maps, and roadway crossing prioritization assumes that the system functions as designed (e.g., no clogged culverts, regular inspection and maintenance of dam outlet works, clear trash racks, etc.). Further, the 0.5 foot passability criteria used to develop the flood alert priority for roadway crossings is not necessarily applicable to all vehicles. Larger vehicles used by emergency responders (e.g., fire engine trucks) may safely pass some crossings indicated as impassable. However, extreme caution is warranted as other factors affecting roadway passability, such as road surface conditions or erosion of roadway approaches, may not be discernable beneath the floodwaters. Data and information dissemination technology sometimes breaks down stopping the flow of gage data and impairing communications amongst emergency responders.

All of the above combine to produce results that are approximately correct, but exactly inaccurate. The users of this FHFRP should keep these known limitations in mind.

SECTION 9: CITED REFERENCES

AGK Engineers, Inc., 1996, Fountain Hills South Floodplain Delineation Study.

AGK Engineers, Inc.,1996, Dam Break Analysis for Stoneridge and Fountain Lake Dams

Flood Control District of Maricopa County, June 18, 2001, Standard Operation Procedure, Maricopa County Flood Forecasts/Warnings, 11 p.

George V. Sabol Consulting Engineers, Inc., 1994, Fountain Hills North Floodplain Delineation Study.

George V. Sabol Consulting Engineers, Inc., 1996, Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights Dam, and Sunridge Canyon Dam.

George V. Sabol Consulting Engineers, Inc., 1997, Fountain Hills Area Master Drainage Plan, Emergency Access Plan and Routes Evaluation Study.

Maricopa County Department of Emergency Management, 1999, Maricopa County Emergency Operations Plan, 500 p.

Pearthree, Philip et al., 1997, Surficial Geologic Map of Theodore Roosevelt Lake 30' x 60' Quadrangle, Arizona, Arizona Geological Survey Open-File Report 97-17.

Stantec Consulting, Inc., 1999, Wickenburg Flood Response Plan.

Town of Fountain Hills, Arizona, 1999, Emergency Operations Plan, 75 p.

Appendix A

FHFRP Phase I Data Collection Summary and Resource List

TABLE 2A
FOUNTAIN HILLS FLOOD RESPONSE PLAN – PHASE 1
Task 1 – Data Collection/ Hardcopy Documents

Source	Call Number	Title	Author	Date	Comments	Resource No.
Fountain Hills North Floodplain Delineation Study (FDS)						
FCDMC	A250.701 W006.102	FDS (N) Technical Data Notebook Hydrology, Existing Conditions	GVSCE	1994	Volume 1	1
FCDMC	A250.702 W006.103	FDS (N) Technical Data Notebook Hydrology, Existing Conditions	GVSCE	1994	Volume 2	2
FCDMC	A250.703 W006.104	FDS (N) Technical Data Notebook Hydrology, Existing Conditions	GVSCE	1994	Volume 3	3
FCDMC	A250.705 W006.101	FDS (N) Technical Data Notebook Hydrology, Future Conditions	GVSCE	1994		4
FCDMC	A250.704	FDS (N) Technical Data Notebook Hydraulics, Existing Conditions	GVSCE	1995		5
FCDMC	A250.902	FDS (N) Rating Curves	FCDMC	1994		6
FCDMC	W006.105	FDS (N) Field Reconnaissance	GVSCE	1994	Culverts, Dams, and Selected	
Fountain Hills South Floodplain Delineation Study (FDS)						
FCDMC	A251.704 W006.201	FDS (S) Technical Data Notebook Hydrology, Revised	AGK Eng.	1996	Volume 1	7
FCDMC	A251.705 W006.202	FDS (S) Technical Data Notebook Hydrology, Revised	AGK Eng.	1996	Volume 2	8
FCDMC	A251.706 W006.203	FDS (S) Technical Data Notebook Hydrology, Revised	AGK Eng.	1996	Volume 3	9
FCDMC	A251.707 W006.204	FDS (S) Technical Data Notebook Hydrology, Revised	AGK Eng.	1996	Volume 4	10
FCDMC	A251.708	FDS (S) Technical Data Notebook Hydraulics, Revised	AGK Eng.	1996	Volume 1	11
FCDMC	A251.709	FDS (S) Technical Data Notebook Hydraulics, Revised	AGK Eng.	1996	Volume 2	12

Area Master Drainage Plan (ADMP)						
FCDMC	A251.202	ADMP Final Report	GVSCE	1996	Reconnaissance Study and Alternative Evaluation for Golden Eagle Park Dam, Interim Report, Plates	13
FCDMC	A251.203	ADMP Final Report	GVSCE	1996	Reconnaissance Study and Alternative Evaluation for Golden Eagle Park Dam, Interim Report, Appendices	14
FCDMC	A251.201	ADMP Final Report	GVSCE	1997	ADMP Task 1 Part A: Project Summary Part B: Golden Eagle Park Dam, Feasibility Report	15
FCDMC	A250.201	ADMP Roadway Crossing Study	MKE and Entellus	1997	ADMP Task 2	16
FCDMC	A250.202	ADMP Emergency Access Plan and Routes Evaluation	MKE and Entellus	1997	ADMP Task 3	17
Dam Break Analyses						
FCDMC	A250.913	Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights Dam, Sun Ridge Canyon Dam	GVSCE; Anderson – Nelson, Inc.	1996	Report	18
FCDMC	A250.914	Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights	GVSCE; Anderson – Nelson, Inc.	1996	Plates	19
FCDMC	A250.915	Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights	GVSCE; Anderson – Nelson, Inc.	1996	Appendices Volume 1	20
FCDMC	A250.916	Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights Dam, Sun Ridge Canyon Dam	GVSCE; Anderson – Nelson, Inc.	1996	Appendices Volume 2	21
FCDMC	A251.908	Dam Break Analysis for Stoneridge and Fountain Lake Dams	AGK Eng. for Anderson – Nelson, Inc.	1996		22

Emergency Action Plans (EAP)						
FCDMC	A251.903	Fountain Hills Retardation Structure EAP	Anderson – Nelson, Inc.	1996		23
FCDMC	A251.904	Fountain Hills Retardation Structure EAP	Anderson – Nelson, Inc.	1996	North Heights Dam (No. 11), Sun Ridge Canyon Dam (No. 7)	24
FCDMC	A251.905	Fountain Hills Retardation Structure EAP	Anderson – Nelson, Inc.	1996	Aspen Dam (No. 6), Fountain Lake Dam, Hesperus Wash Dam (No. 36), Stoneridge Dam (No. 19)	25
FCDMC	A251.906	Fountain Hills Retardation Structure EAP	Anderson – Nelson, Inc.	1996	Golden Eagle Park Dam (No. 4)	26
MCDEM		Fountain Hills, Arizona Emergency Operations Plan	TFH	1998		27
FHSD		Fountain Hills Reclaimed Water Lake 27-1 Emergency Action Plan	FHSD	2000	Fountain Hills Sanitary District EAP	28
Golden Eagle Park Dam (GEP Dam)						
FCDMC	A251.601	GEP Dam Modification Pre-Design, Revised	Stantec	1999	Design Issues and Alternative Analysis Report	29
FCDMC	A251.602	GEP Dam Modification Pre-Design	Stantec	1999	Design Report	30
FCDMC	A251.603	GEP Dam Modification Final Design	Stantec	2000	Design Report	31
Hydrologic/ Hydraulic Studies						
FCDMC	A250.907	Fountain Hills Original Hydrologic Data	FCDMC	1975		32
FCDMC	A250.906	Fountain Hills Flood Control Structures Report	FCDMC	1975		33
FCDMC	A251.710	Hydrologic Study for Fountain Lake Dam	AGK Eng. for Anderson – Nelson, Incl	1995		34
FCDMC	A251.701	Hydrologic Study for Effluent Lakes Project	AGK Eng.	1994		35

FCDMC	A251.702	Hydrologic Study for Effluent Lakes Project	AGK Eng.	1995	Addendum No. 1	36
FCDMC	A251.703	Hydrologic Study for Effluent Lakes Project	AGK Eng.	1995	Addendum No. 2	37
FCDMC	A251.902	Recommended Embankment Protection for Effluent Lake 27-1	AGK Eng.	1994		38
FCDMC	A251.909	Hydrologic Study for Stoneridge Dam (Structure No. 19)	AGK Eng. for Anderson – Nelson, Inc.	1996		39
FCDMC	A250.301	Fountain Hills Boulevard at Ashbrook Wash, Final Drainage Report	Stanley Consulting	1995		40
FCDMC		Master Drainage Report for Sunridge Canyon	CVL	1995		41
FCDMC		Drainage Design Report for Sunridge Canyon Infrastructure	CVL	1995		42
TFH		Preliminary Drainage Report for Firerock	DEI	1997		43
TFH		Final Drainage Report for Infrastructure of Firerock CC	DEI	1999		44
TFH		Town Flood Problem Locations Field Notes	P. Harvey T. Marchese	2001		45
Dam General Data Files						
FCDMC	A250.912	Hesperus Wash Dam Structure No. 36	FCDMC	1975		46
FCDMC	A250.908	Golden Eagle Park Dam Structure No. 4	FCDMC	1975		47
FCDMC	A250.909	Aspen Dam Structure No. 6	FCDMC	1975		48
FCDMC	A250.910	Sunridge Canyon Dam Structure No. 7	FCDMC	1975		49
FCDMC	A250.911	North Heights Dam Structure No. 11	FCDMC	1975		50
FCDMC	A251.901	Sycamore Dam Structure No. 19	FCDMC	1984		51

TABLE 2B FOUNTAIN HILLS FLOOD RESPONSE PLAN – PHASE 1 Task 1 – Data Collection/ Digital Files						
Source	**File Name**	**Description**	**Author**	**Date**	**Comments**	**Resource No.**
HEC-1 Files						
FCDMC	ex100-6.ih1	FDS North Existing Conditions	GVSCE	1994	FCD 92-04; HEC-1; 100-yr, 6-hr storm	52
FCDMC	ex10-6.ih1	FDS North Existing Conditions	GVSCE	1994	FCD 92-04; HEC-1; 10-yr, 6-hr storm	53
FCDMC	ex100-24.ih1	FDS North Existing Conditions	GVSCE	1994	FCD 92-04; HEC-1; 100-yr, 24-hr storm	54
FCDMC	ex10-24.ih1	FDS North Existing Conditions	GVSCE	1994	FCD 92-04; HEC-1; 10-yr, 24-hr storm	55
FCDMC	Fu100-6.ih1	FDS North Future Development	GVSCE	1994	FCD 92-04; HEC-1; 100-yr, 6-hr storm	56
FCDMC	Fu100-24.ih1	FDS North Future Development	GVSCE	1994	FCD 92-04; HEC-1; 100-yr, 24-hr storm	57
FCDMC	Fu10-6.ih1	FDS North Future Development	GVSCE	1994	FCD 92-04; HEC-1; 10-yr, 6-hr storm	58
FCDMC	Fu10-24.ih1	FDS North Future Development	GVSCE	1994	FCD 92-04; HEC-1; 10-yr, 24-hr storm	59
FCDMC	110-6ce.dat	Powder Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	60
FCDMC	110-24ce.dat	Powder Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	61
FCDMC	110-6cf.dat	Powder Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	62
FCDMC	110-24cf.dat	Powder Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	63
FCDMC	120-6ce.dat	Cereus Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	64

FCDMC	120-24ce.dat	Cereus Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	65
FCDMC	120-6cf.dat	Cereus Wash, Future Developmnt	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	66
FCDMC	120-24cf.dat	Cereus Wash, Future Developmnt	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	67
FCDMC	130-6ce.dat	Cyprus Pt Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	68
FCDMC	130-24ce.dat	Cyprus Pt Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	69
FCDMC	130-6cf.dat	Cyprus Pt Wash, Future Developmnt	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	70
FCDMC	130-24cf.dat	Cyprus Pt Wash, Future Developmnt	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	71
FCDMC	150-6ce.dat	Jacklin Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	72
FCDMC	150-24ce.dat	Jacklin Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	73
FCDMC	150-6cf.dat	Jacklin Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	74
FCDMC	150-24cf.dat	Jacklin Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	75
FCDMC	160-6ce.dat	Emerald Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	76
FCDMC	160-24ce.dat	Emerald Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	77
FCDMC	160-6cf.dat	Emerald Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	78
FCDMC	160-24cf.dat	Emerald Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	79
FCDMC	170-6ce.dat	Malta Drain, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	80
FCDMC	170-24ce.dat	Malta Drain, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	81
FCDMC	170-6cf.dat	Malta Drain, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	82

FCDMC	170-24cf.dat	Malta Drain, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	83
FCDMC	180-6ce.dat	Colony Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	84
FCDMC	180-24ce.dat	Colony Wash, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	85
FCDMC	180-6cf.dat	Colony Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	86
FCDMC	180-24cf.dat	Colony Wash, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	87
FCDMC	190-6ce.dat	Panorama Chl, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	88
FCDMC	190-24ce.dat	Panorama Chl, Existing conditions	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	89
FCDMC	190-6cf.dat	Panorama Chl, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 6-hr storm	90
FCDMC	190-24cf.dat	Panorama Chl, Future Development	AGK Eng.	1994	FCD 92-05; HEC-1; 100-yr, 24-hr storm	91
FCDMC	colony.dat	Colony Wash, FWS Storm Reconstitution, Aug. 22,1992	FCDMC	1994	Data from Thompson Peak gage	92
JEF	north-bl.dat	FH North 1/2 PMF Storm Analysis	Combination of GVSCE: Fu100-6.ih1, and DAM36-PM.IH1	2001	Fu100-6.ih1 with 1/2 PMF rainfall data from DAM36-PM.IH1.	93
JEF	colony-bl.dat	Colony Wash 1/2 PMF Storm Analysis	Combination of AGK: D19-PMFF.DAT and 180-6CF.DAT	2001	180-6CF.DAT with rainfall from D19-PMFF.DAT	94
HEC-2 Files						
FCDMC	As.ih2	Ashbrook Wash, Existing conditions	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	95
FCDMC	Ar.ih2	Arrow Wash, Existing conditions	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	96

FCDMC	Ba&he.ih2	Balboa/Hesperus Wash, Existing	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	97
FCDMC	Ca.ih2	Caliente Wash, Existing Conditions	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	98
FCDMC	Es.ih2	Escalante Wash, Existing Conditions	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	99
FCDMC	Le&tu.ih2	Legend/Tulip Washes, Existing	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	100
FCDMC	Ox.ih2	Oxford Wash, Existing Conditions	GVSCE	1995	FCD 92-04;HEC-2; Floodplain/floodway model	101
FCDMC	Cereus.h2	Cereus Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	102
FCDMC	Chuckar.h2	Chuckar Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	103
FCDMC	Colony.h2	Colony Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	104
FCDMC	Cyprus.h2	Cyprus Point Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	105
FCDMC	Emerald.h2	Emerald Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	106
FCDMC	Fc-split.h2	Fountain Channel Split	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	107

FCDMC	Fountain.h2	Fountain Channel	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	108
FCDMC	Greyston.h2	Greystone Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	109
FCDMC	Jacklin.h2	Jacklin Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	110
FCDMC	Kingstr.h2	Kingstree Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	111
FCDMC	Laser-d.h2	Laser Drain	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	112
FCDMC	Logan.h2	Logan Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	113
FCDMC	Malta.h2	Malta Drain	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	114
FCDMC	Mangrum.h2	Mangrum Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	115
FCDMC	N-colony.h2	North Colony Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	116
FCDMC	Powder.h2	Powder Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	117
FCDMC	Sunburst.h2	Sunburst Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	118

FCDMC	Sycamore.h2	Sycamore Wash	AGK	1995	FCD 92-05;HEC-2; Floodplain/floodway model	119
FCDMC	Ex-dam.ih2	Ashbrook Wash downstream of Golden Eagle Park Dam multiple profiles	Stantec	1999	HEC-2; Ashbrook Wash hydraulic analyses downstream of GEP dam	120
FCDMC	Mod-1994.ih2	Ashbrook Wash GEP modifications alternatives analyses	Stantec	1999		121
FCDMC	Mod-chnl.ih2	Ashbrook Wash GEP modifications alternatives analyses	Stantec	1999		122
FCDMC	Mod-fu10.ih2	Ashbrook Wash GEP modifications alternatives analyses	Stantec	1999	HEC-2; 10-year future condition discharges	123
FCDMC	Modfu100.ih2	Ashbrook Wash GEP modifications alternatives analyses	Stantec	1999	HEC-2; 100-year future condition discharges	124

HEC RAS						
Stantec	Eap_arrow.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	125
Stantec	Eap_ashb.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	126
Stantec	Eap_cers.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	127
Stantec	Eap_col.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	128
Stantec	Eap_cyp.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	129
Stantec	Eap_emld.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	130
Stantec	Eap_foun.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	131
Stantec	Eap_jack.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	132
Stantec	Eap_ktre.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	133
Stantec	Eap_letu.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	134
Stantec	Eap_mael.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	135
Stantec	Eap_malt.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	136
Stantec	Eap_ncol.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	137
Stantec	Eap_ox.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	138
Stantec	Eap_powd.prj	FDS HEC-2 converted to RAS	GVSCE	1997	FCD 94-16; Emergency Access Plan	139
JEF	fh.prj	Extension of floodplains to Town Boundary	JEF	2001	Fountain Hills Flood Response Plan	140

Dambreak Analyses						
SunCor Dev.	ba210-pm.ih1	½ PMP HEC-1 for area between GEPD and upstream dams	GVSCE	1996	Uses PMP and JR records	141
SunCor Dev.	Dam11-pm.ih1	½ PMP HEC-1 for area contributing to North Heights Dam	GVSCE	1996	Uses PMP and JR records	142
SunCor Dev.	Dam36-pm.ih1	½ PMP HEC-1 for area contributing to Hesperus Dam	GVSCE	1996	Uses PMP and JR records	143
SunCor Dev.	Dam7-pm.ih1	½ PMP HEC-1 for area contributing to Sunridge Canyon Dam	GVSCE	1996	Uses PMP and JR records	144
SunCor Dev.	Dam6-pm.ih1	½ PMP HEC-1 for area contributing to Aspen Dam	GVSCE	1996	Uses PMP and JR records	145
SunCor Dev.	Dam4-pm.ih1	½ PMP HEC-1 for area contributing to GEP Dam	GVSCE	1996	Uses PMP and JR records	146
SunCor Dev.	Dam11-rt.ih1	½ PMP HEC-1 routing model for North Heights Dam	GVSCE	1996	Uses PMP and JR records	147
SunCor Dev.	Dam36-rt.ih1	½ PMP HEC-1 routing model for Hesperus Dam	GVSCE	1996	Uses PMP and JR records	148
SunCor Dev.	Dam7-rt.ih1	½ PMP HEC-1 routing model for Sunridge Canyon Dam	GVSCE	1996	Uses PMP and JR records	149
SunCor Dev.	Dam6-rt.ih1	½ PMP HEC-1 routing model for Aspen Dam	GVSCE	1996	Uses PMP and JR records	150
SunCor Dev.	Dam4-rt.ih1	½ PMP HEC-1 routing model for GEP Dam	GVSCE	1996	Uses PMP and JR records	151
SunCor Dev.	Dam11p.brc	Dam 11 breach by piping model	GVSCE	1996	Run in Boss Breach program	152
SunCor Dev.	Dam36p.brc	Dam 36 breach by piping model	GVSCE	1996	Run in Boss Breach program	153
SunCor Dev.	Dam7p.brc	Dam 7 breach by piping model	GVSCE	1996	Run in Boss Breach program	154

SunCor Dev.	Dam6p.brc	Dam 6 breach by piping model	GVSCE	1996	Run in Boss Breach program	155
SunCor Dev.	Dam4o.brc	Dam 4 breach by overtopping model	GVSCE	1996	Run in Boss Breach program	156
SunCor Dev.	Dam4p.brc	Dam 4 breach by piping model	GVSCE	1996	Run in Boss Breach program	157
SunCor Dev.	Dam11.dbk	Dam 11 dam break routing	GVSCE	1996	Run in Boss Dambrk program	158
SunCor Dev.	Dam36.dbk	Dam 36 dam break routing	GVSCE	1996	Run in Boss Dambrk program	159
SunCor Dev.	Dam7.dbk	Dam 7 dam break routing	GVSCE	1996	Run in Boss Dambrk program	160
SunCor Dev.	Dam6.dbk	Dam 6 dam break routing	GVSCE	1996	Run in Boss Dambrk program	161
SunCor Dev.	Dam4.dbk	Dam 4 dam break routing	GVSCE	1996	Run in Boss Dambrk program	162
SunCor Dev.	Ashbrk.dbk	Lower AshbrookWash dam break routing	GVSCE	1996	Run in Boss Dambrk program; assumes GEPD failure and Hesperus ½ PMP spillway flows	163

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Appendix B

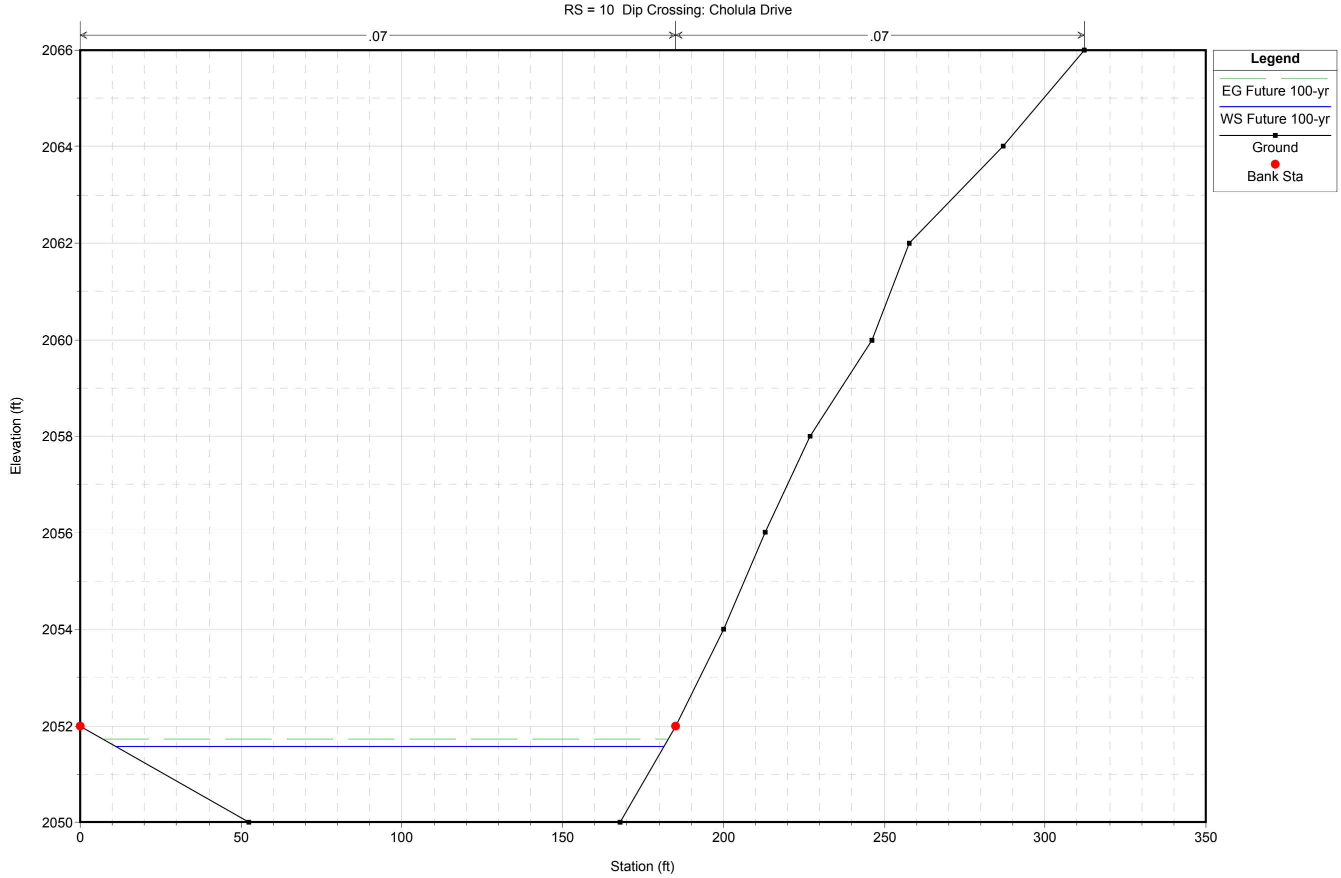
New Crossing Rating Curves

Cholula Wash at Cholula Drive

HECRAS Cross Section

Fountain Hills 100-yr Floodplains Plan: Cholula Wash

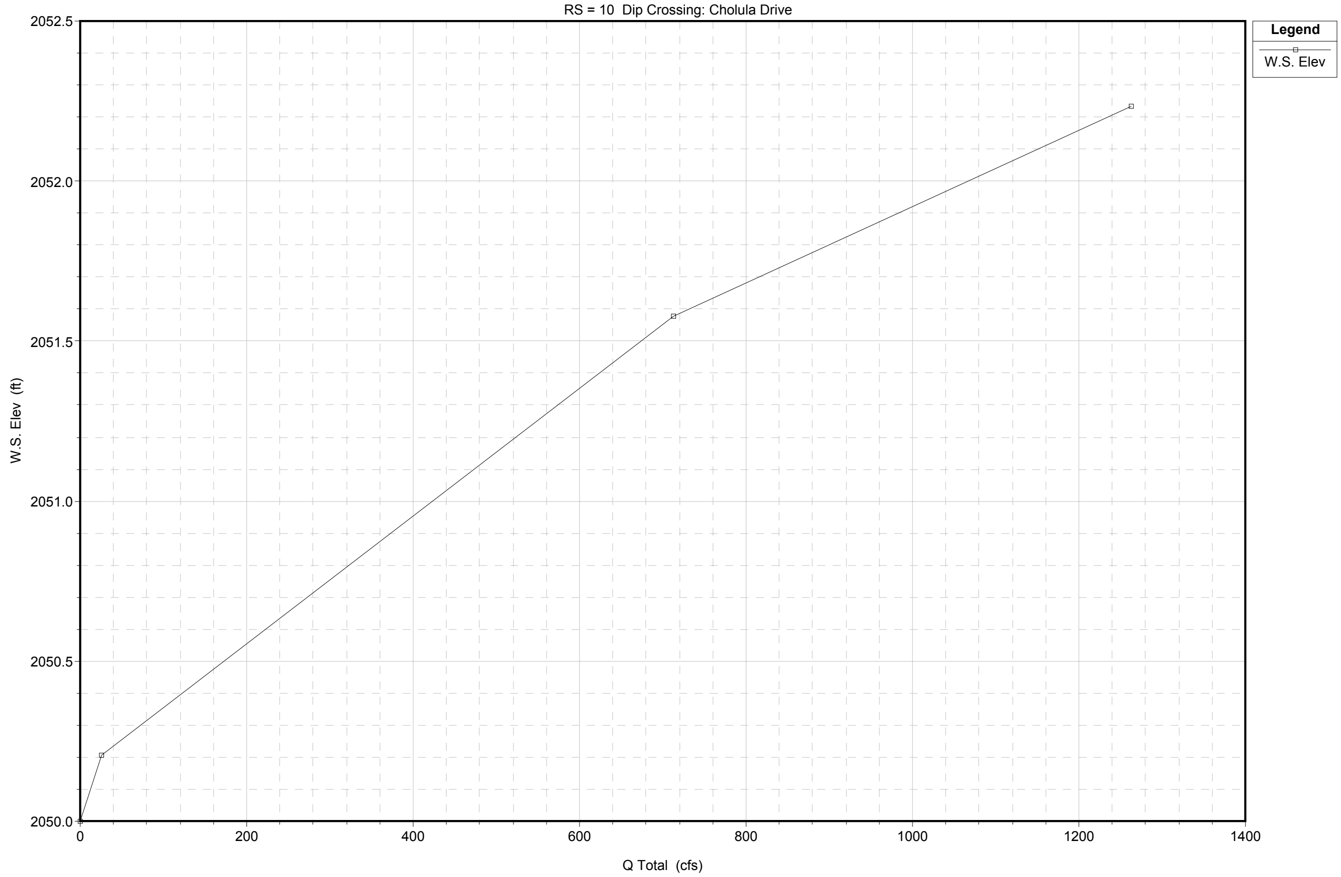
RS = 10 Dip Crossing: Cholula Drive



HECRAS Rating Curve

Fountain Hills 100-yr Floodplains Plan: Cholula Wash

RS = 10 Dip Crossing: Cholula Drive

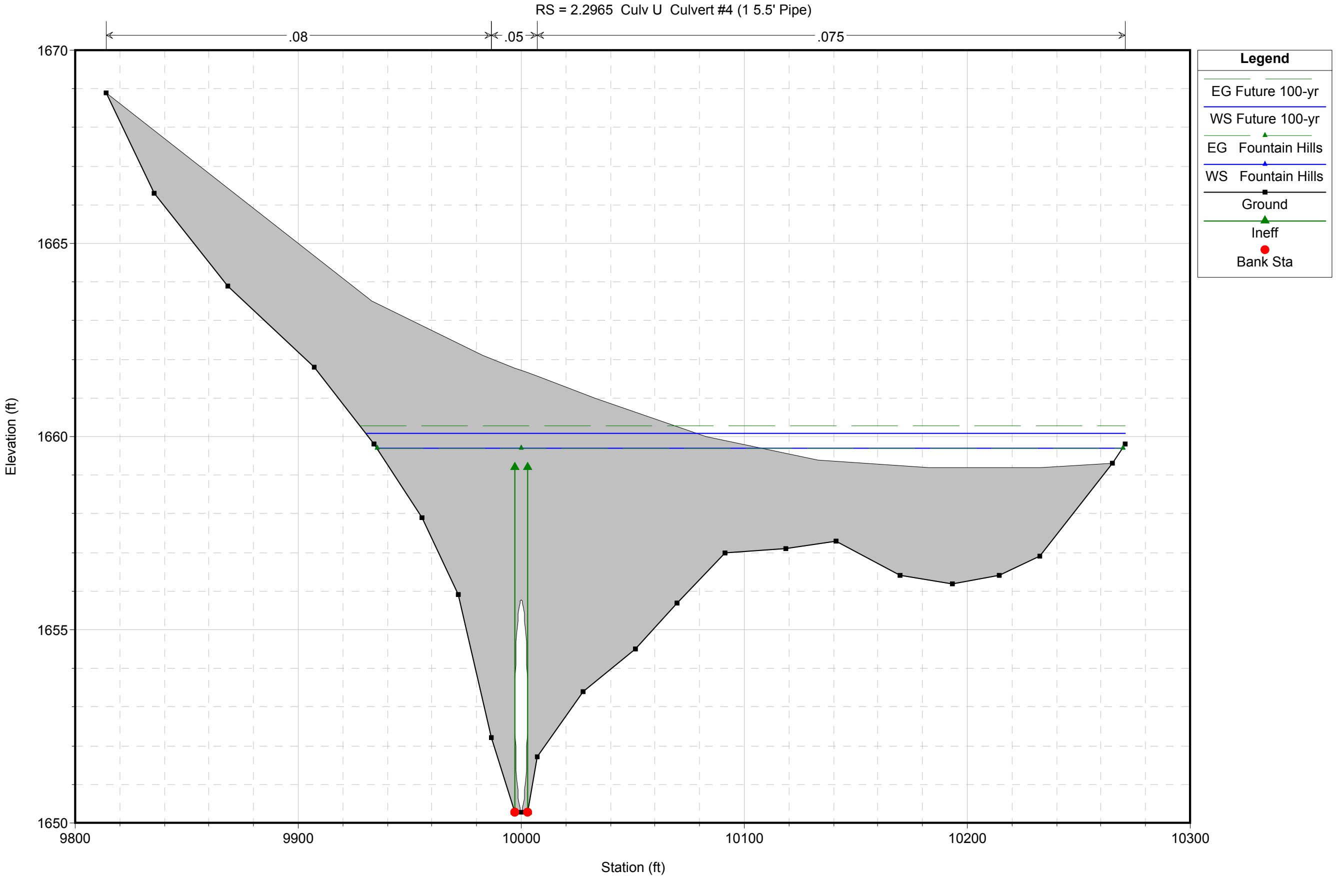


Caliente Wash at Fountain Hills Boulevard

HECRAS Cross Section

Flood Response Plan: Caliente Plan: FRP

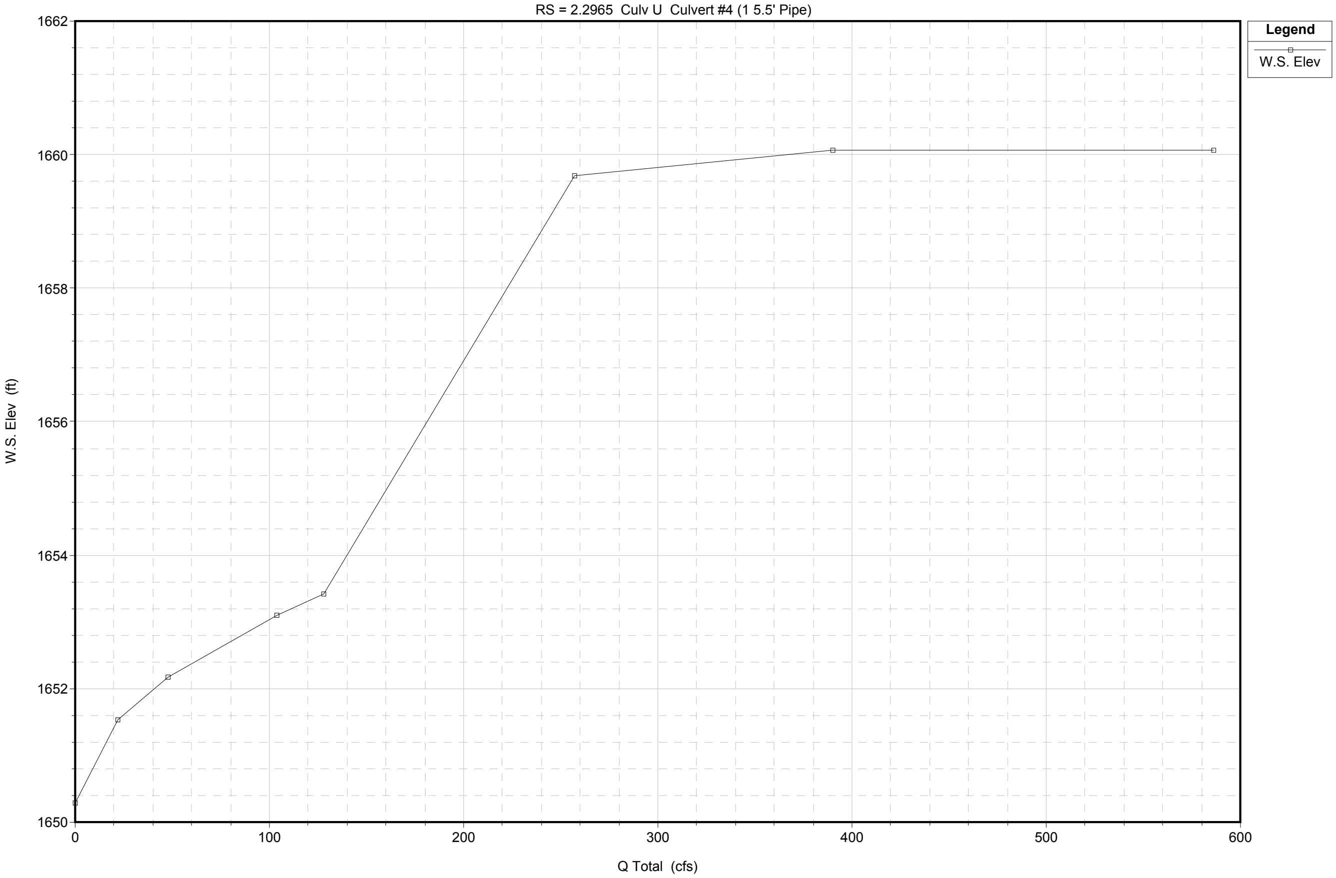
RS = 2.2965 Culv U Culvert #4 (1 5.5' Pipe)



HECRAS Rating Curve

Flood Response Plan: Caliente Plan: FRP

RS = 2.2965 Culv U Culvert #4 (1 5.5' Pipe)

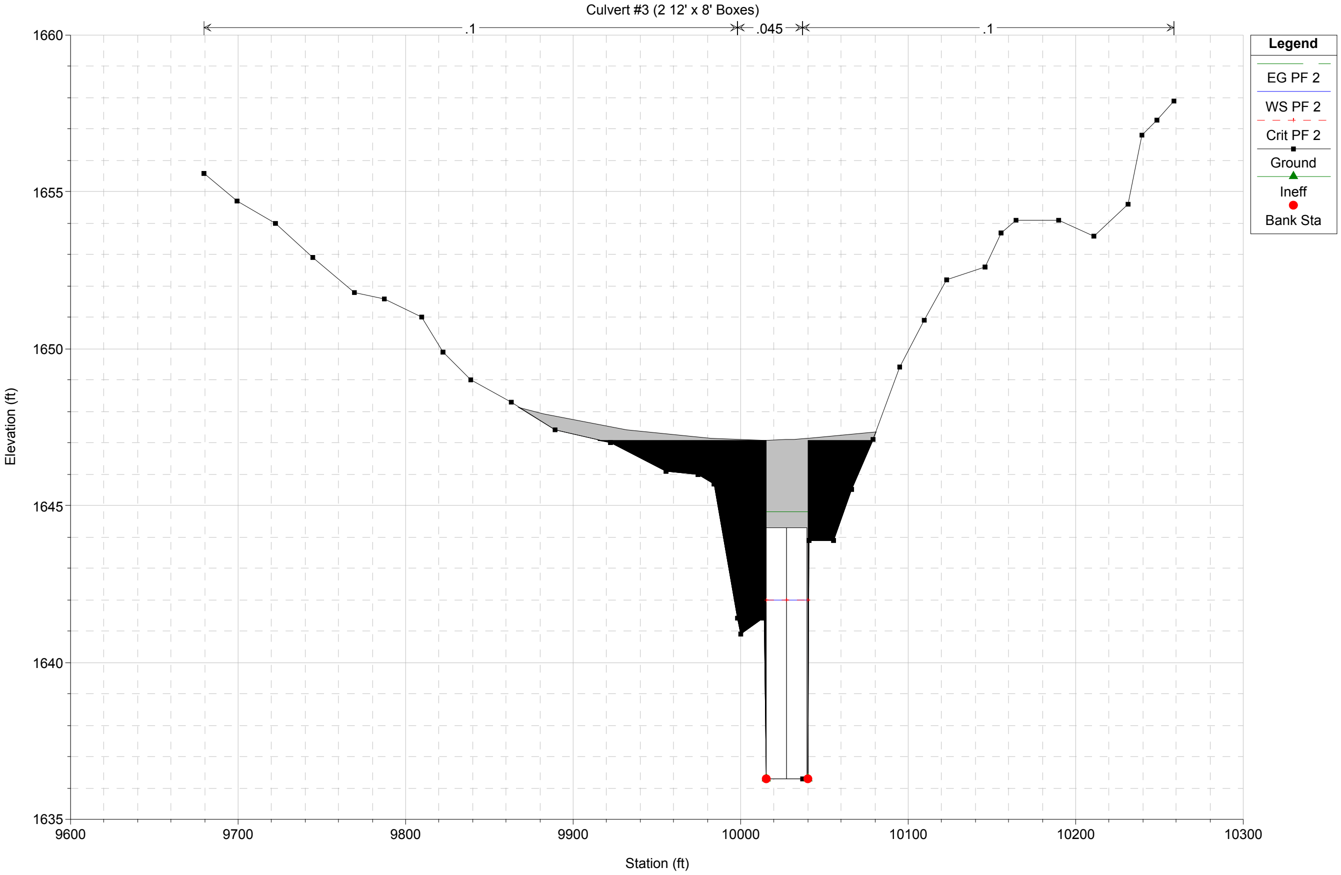


Ashbrook Wash at Fountain Hills Boulevard

HECRAS Cross Section

FRP: ashbrook - New Fnt Hills Blvd   Imported Plan 01   1/10/02

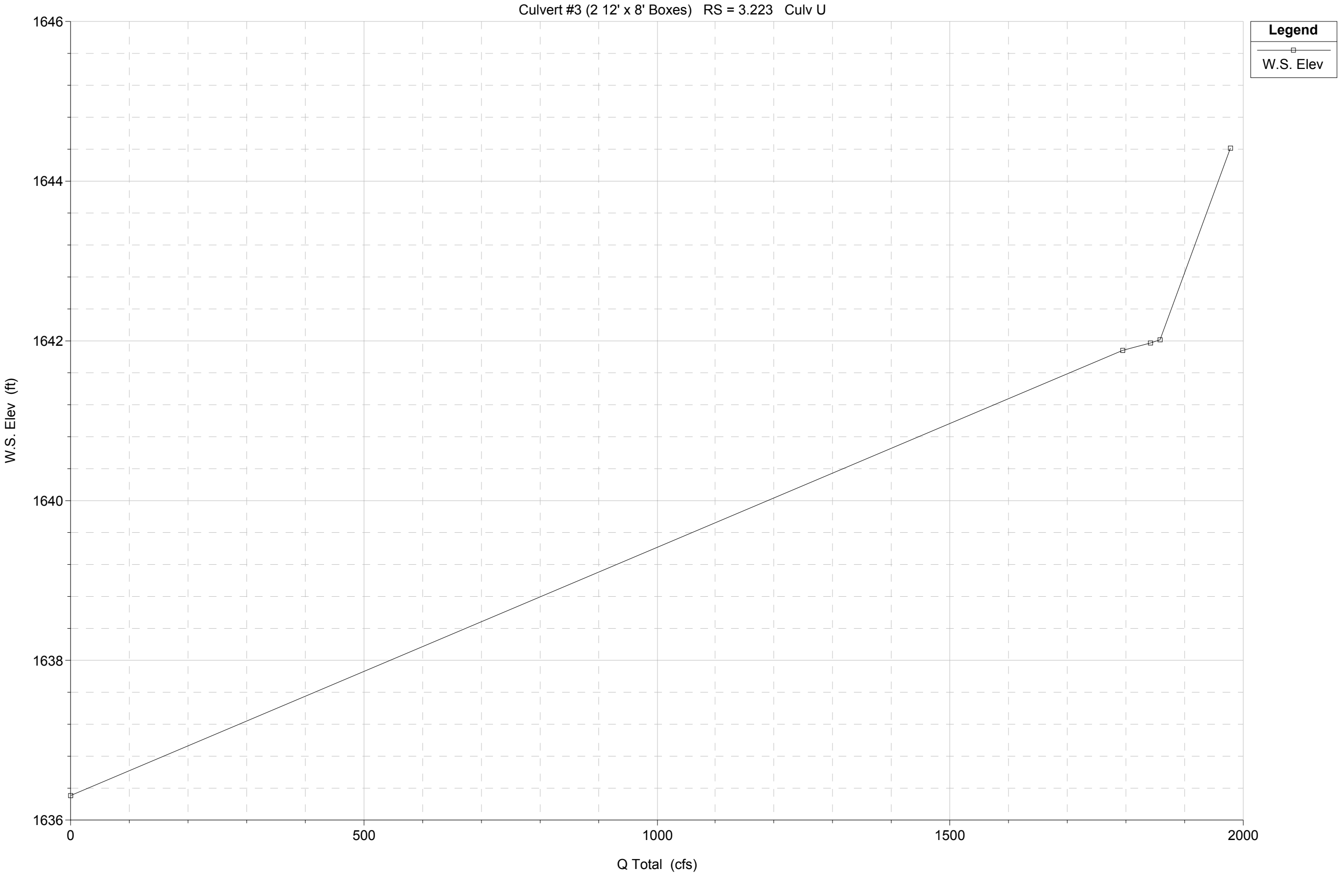
Culvert #3 (2 12' x 8' Boxes)



HECRAS Rating Curve

FRP: ashbrook - New Fnt Hills Blvd   Imported Plan 01   1/10/02

Culvert #3 (2 12' x 8' Boxes)   RS = 3.223   Culv U



Arrow Wash at Fountain Hills Boulevard

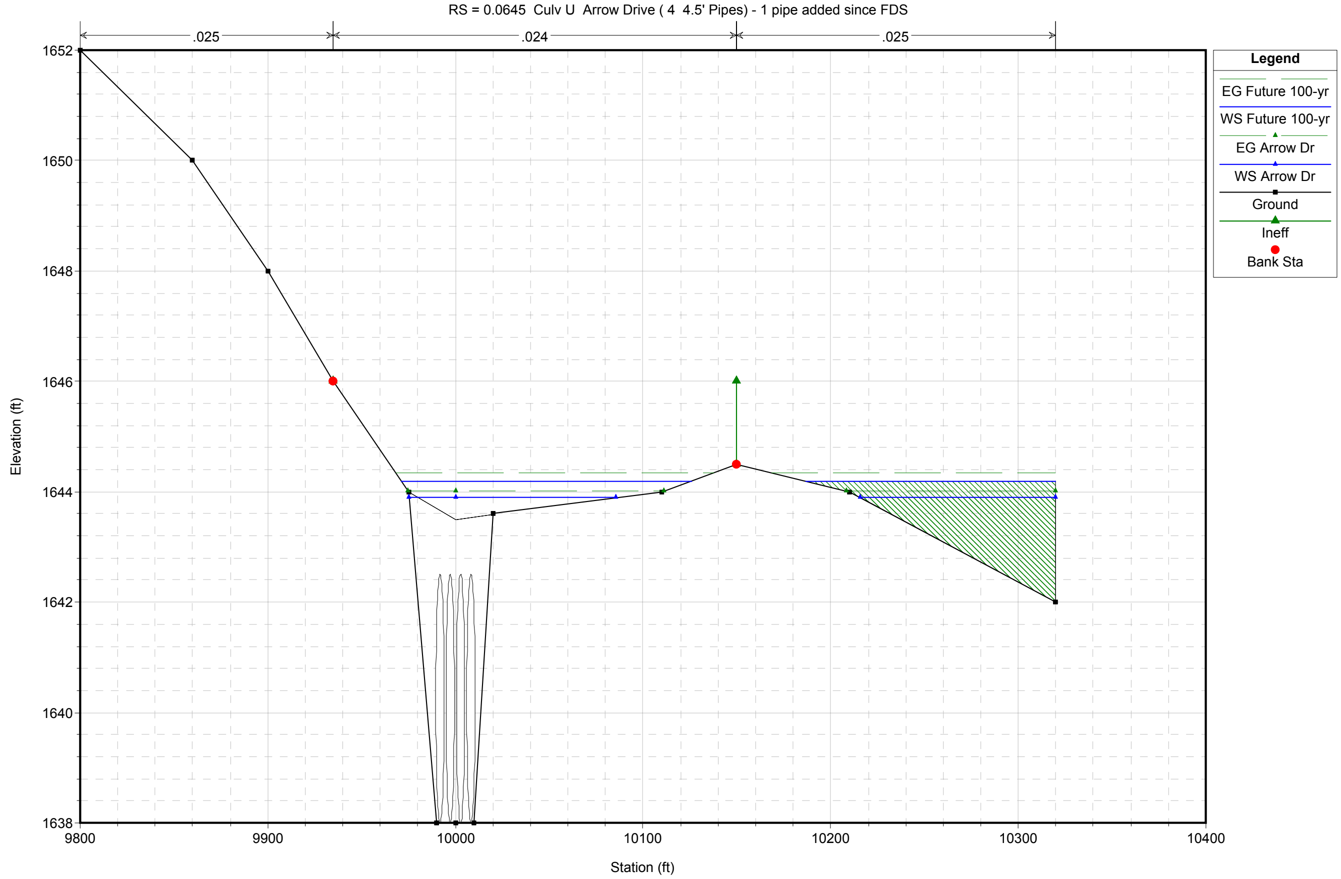
Refer to Fountain Hills FDS – North,
Appendix A, Hydraulic Calculations for C611
(GVSCE, 1994)

Arrow Wash at Arrow Drive

HECRAS Cross Section

Emergency Access Plan; Arrow Wash Plan: FRP

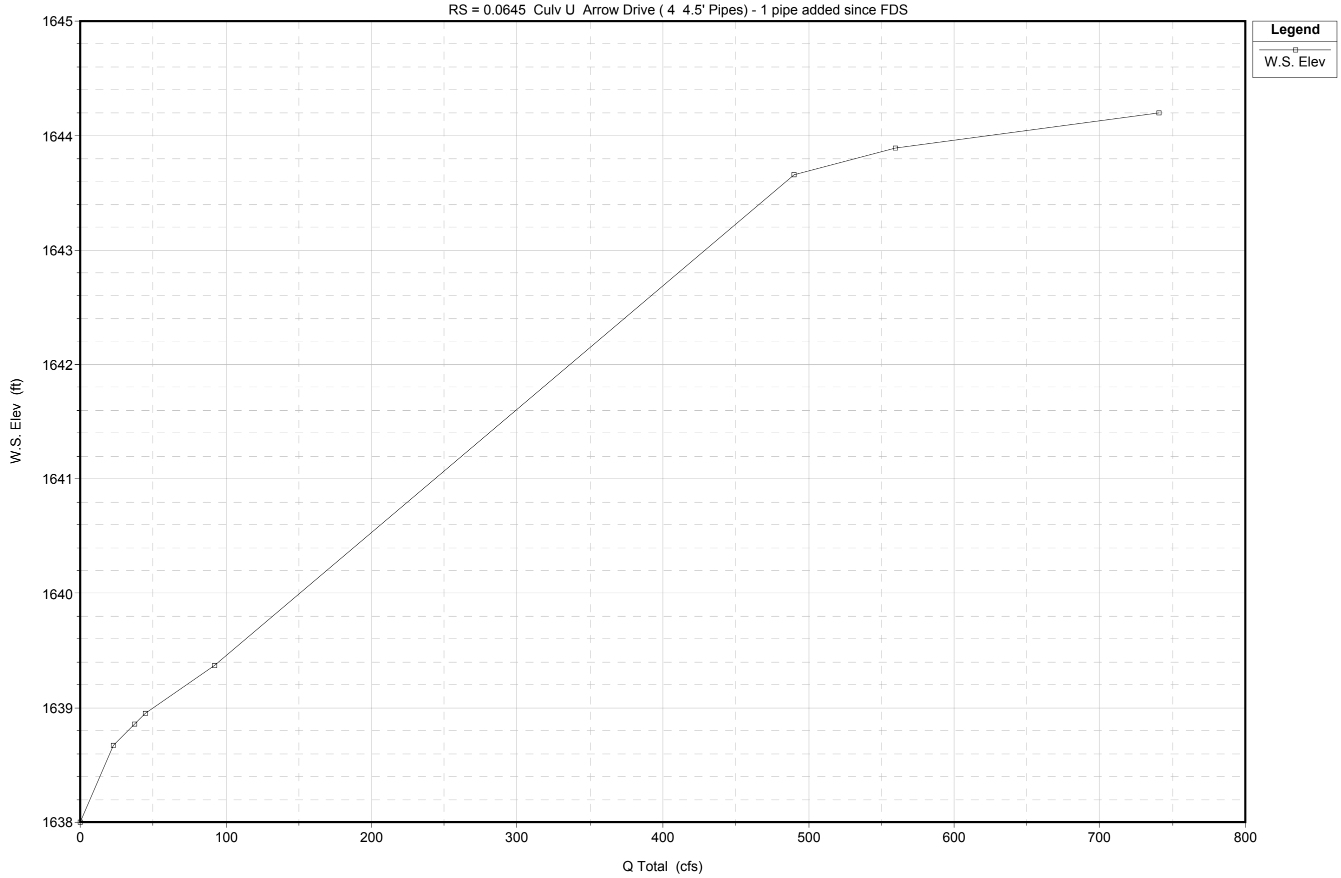
RS = 0.0645 Culv U Arrow Drive (4 4.5' Pipes) - 1 pipe added since FDS



HECRAS Rating Curve

Emergency Access Plan; Arrow Wash Plan: FRP

RS = 0.0645 Culv U Arrow Drive (4 4.5' Pipes) - 1 pipe added since FDS

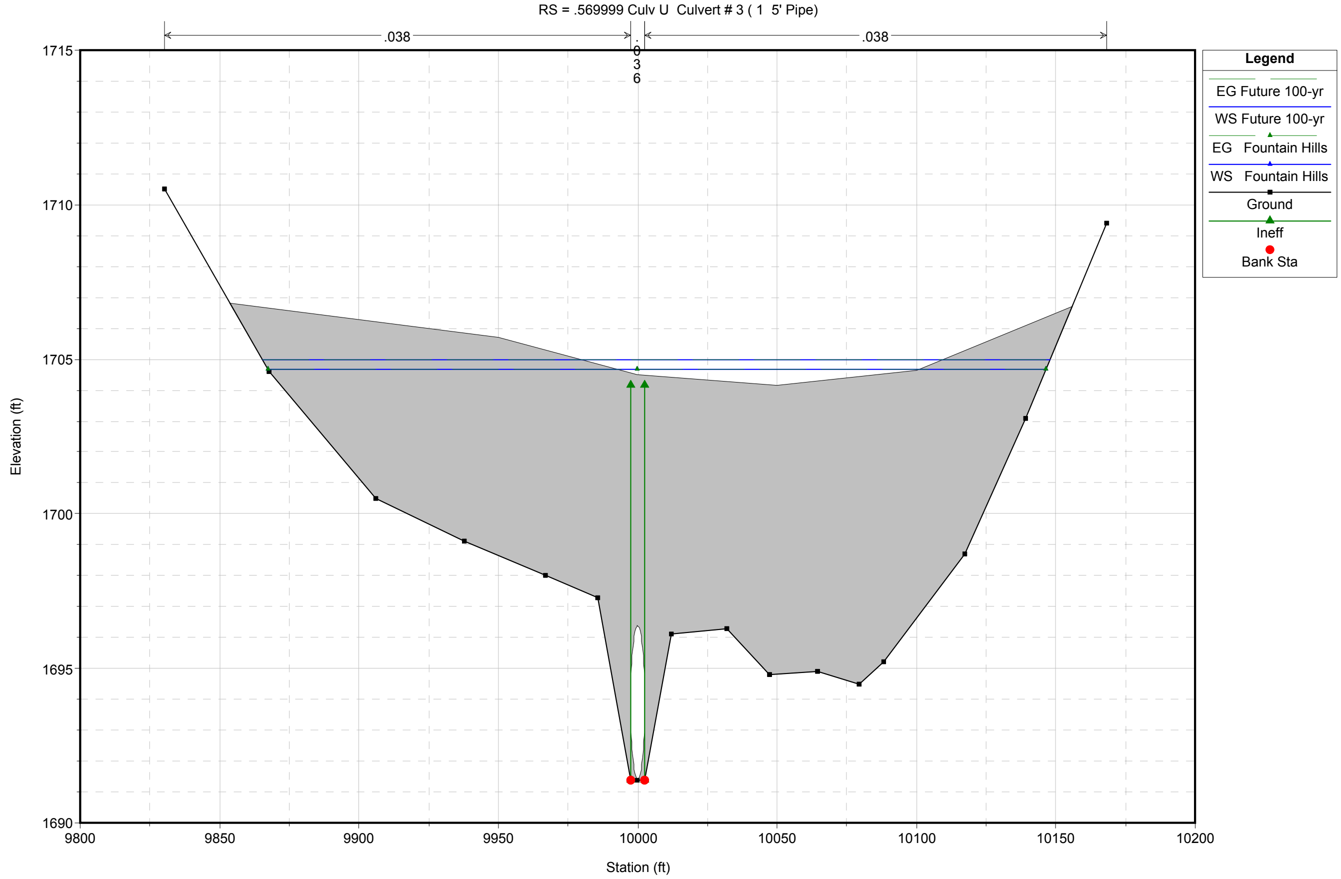


North Colony at Fountain Hills Boulevard

HECRAS Cross Section

Flood Response Plan; N Colony Wash Plan: N. Colony

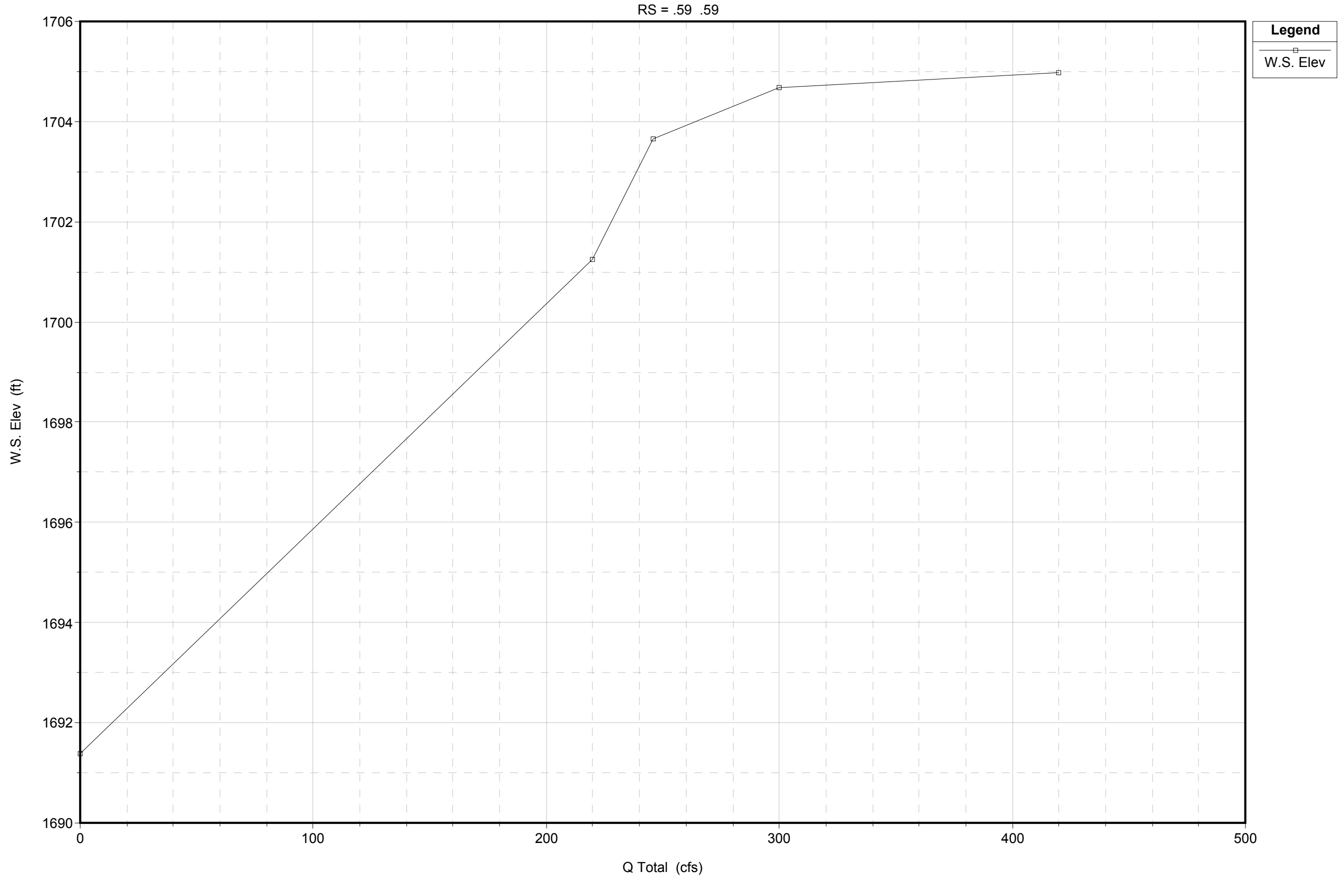
RS = .569999 Culv U Culvert # 3 (1 5' Pipe)



HECRAS Rating Curve

Flood Response Plan; N Colony Wash Plan: N. Colony

RS = .59 .59

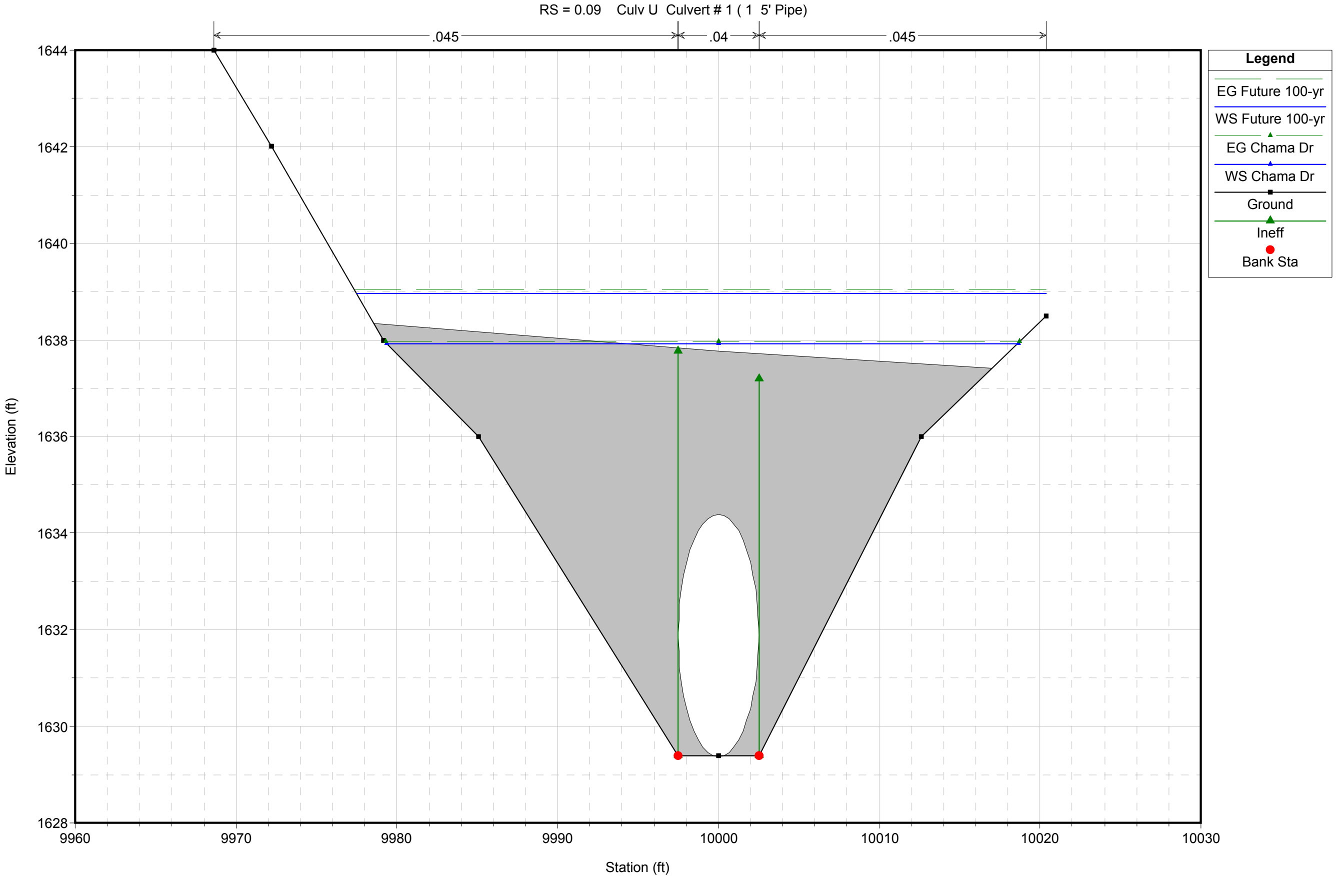


North Colony at Chama Drive

HECRAS Cross Section

Flood Response Plan; N Colony Wash Plan: N. Colony

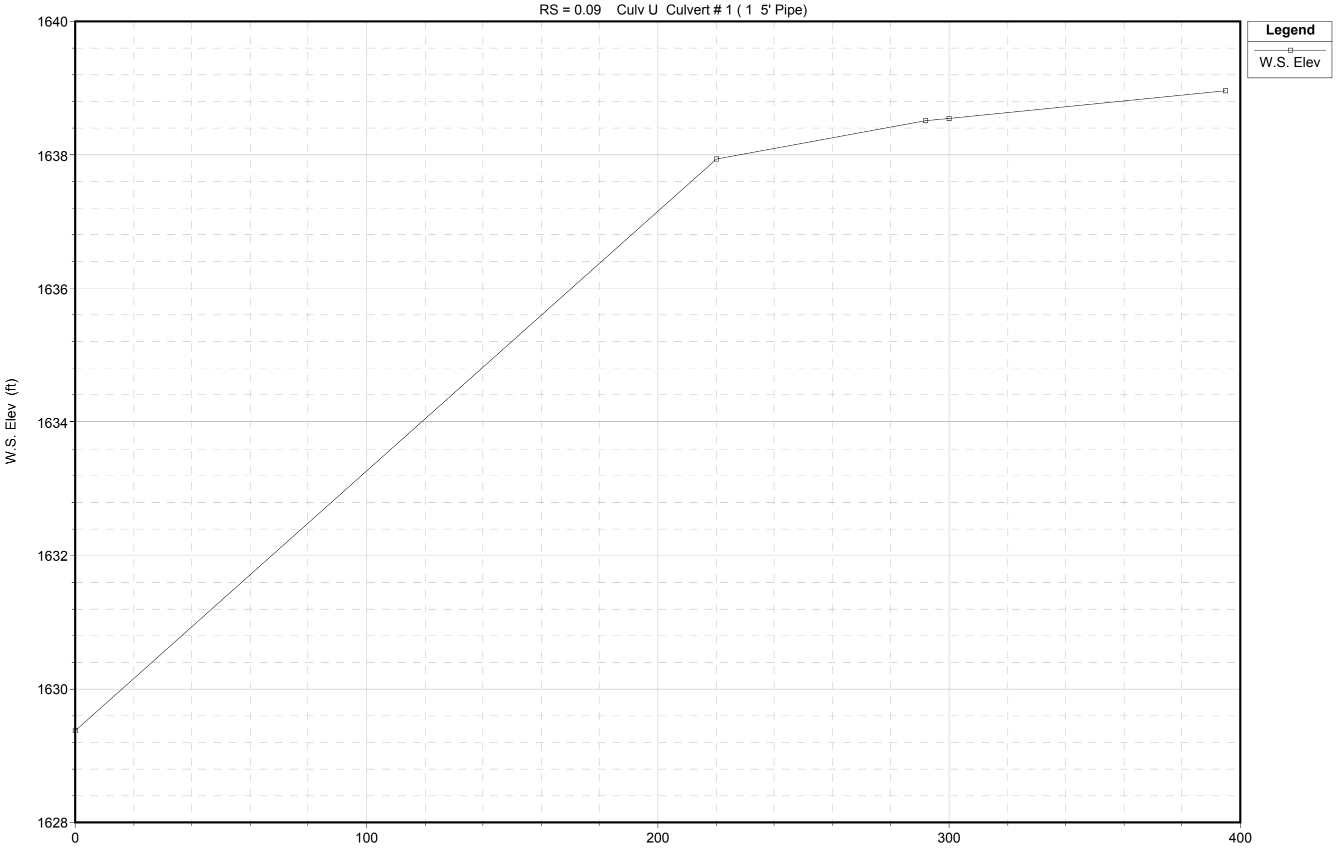
RS = 0.09 Culv U Culvert # 1 (1 5' Pipe)



HECRAS Rating Curve

Flood Response Plan; N Colony Wash Plan: N. Colony

RS = 0.09 Culv U Culvert # 1 (1 5' Pipe)



Appendix C

Golden Eagle Park Dam Post-Modification BREACH Model

Memorandum JE Fuller/ Hydrology & Geomorphology, Inc.

DATE: March 6, 2002

TO: Pat Deschamps, P.E., R.L.S.
Ted Lehman, P.E.

FROM: W. Scott Ogden, P.E.

RE: FCDMC On Call 2000C013 – Task 10
Fountain Hills Flood Response Plan
Revised Dam Breach Analysis for New GEPD

INTRODUCTION

The following technical memorandum summarizes a re-evaluation of the potential downstream flood hazard associated with a breach failure of the newly constructed Golden Eagle Park Dam (GEPD). The assumptions, analyses, and results of that re-evaluation are documented herein.

These analyses were performed to assess the need for re-mapping the downstream inundation limits for a potential breach of the new dam. The first step in that assessment was to re-develop the BREACH model based on the new GEPD configuration and storage conditions. If the BREACH model reported significantly larger breach flow rates, then the inundation mapping downstream would require revision as well.

It is noted that assumptions regarding the new GEPD's composition, internal failure mechanism parameters, and start of breach, are all conservative with respect to estimating a peak breach discharge from the new dam. It is also noted, that the analyses documented herein are not intended to represent a comprehensive analysis of the breach potential for the new GEPD, and should be limited in use to this flood response plan only.

DATA SOURCES

The following reports were obtained and reviewed:

- George V. Sabol Consulting Engineers, Inc, January 1996, *Town of Fountain Hills Dam Break Analysis for Golden Eagle Park Dam, Hesperus Wash Dam, Aspen Dam, North Heights Dam, and SunRidge Canyon Dam Report* (GVSCE, 1996)
- Stantec Consulting, Inc., February 2000, *Design Report for Golden Eagle Park Dam Modification Final Design*, FCD 1999C064 (Stantec, 2000).
- Stantec Consulting, Inc., March 2000, Construction Plans for Golden Eagle Park Dam Modifications, As-built February 2001, FCD 99-71 (Stantec, 2001).

BREACH MODEL ASSUMPTIONS

Table 1 is a summary of the modeling assumptions made in the development of the new BREACH model and associated comments.

Table 1
Summary of BREACH model development assumptions

Assumptions:	Comments:
IDF = ½ PMF as documented in the Stantec GEPD Design Report (Stantec, 2000).	It is noted that the IDF used in the GVSCE Dam Break Study has larger inflows than the IDF used to design the new GEPD facilities.
Stage-Storage Relation – per Table 2, Columns 1 & 2 in Stantec GEPD Design Report.	
Stage-Discharge Relation – per Table 3, Columns 1 and Column 4 plus Column 5, as reported in Stantec GEPD Design Report.	Principal outlet is assumed to be destroyed.
Dam Geometry – per Stantec GEPD Design Report and the as-built construction plans (Stantec, 2001).	
Composition material characteristics – taken from previous GVSCE Dam Break Study (GVSCE, 1996).	No attempt was made to re-parameterize the dam material composition as the primary structure of the dam embankment was not changed.
Tailwater Rating Curve – taken from previous GVSCE Dam Break Study.	Tailwater conditions are assumed to be the same as those modeled by GVSCE in 1996.
Piping Breach Parameters – same as those used in GVSCE Dam Break Study.	No overtopping analyses were performed since the new dam is designed to pass the IDF and not reasonably expected to overtop.
Time to Breach = 0.0 hours which is hour 2.42 in the IDF.	
Initial Pool Elevation (HI) is equal to the stage reported in the HEC-1 reservoir routing model for the initial discharge (reported in Stantec GEPD Design Report as file names IDF1-A.*).	At T=0.0 hours (IDF time of 2.42 hrs): Initial Discharge = 25,783 cfs Initial Pool Stage = 1,723.42 feet (8.56 feet over emergency spillway)
Assume that the fuse-plug is fully eroded.	

BREACH MODEL DEVELOPMENT

The parameters entered into the BREACH model are summarized in the output file, which is provided as an attachment hereto. The BREACH model data developed by GVSCE (GVSCE, 1996) is used as a basis, with modifications made as previously discussed. The peak breach outflow hydrograph was maximized by an iterative process of adjusting the timing of the IDF and its corresponding initial water surface elevation, with respect to the time to start of breach (which is assumed to be 0.0 hours for this simulation).

BREACH MODEL RESULTS

Results from the revised BREACH modeling are summarized as follows:

	OUTPUT SUMMARY	New Model	Old Model
QBP	MAX OUTFLOW(CFS) THRU BREACH	30166.	23260.
TP	TIME(HR) AT WHICH PEAK OUTFLOW OCCURS	0.29	0.217
QP	MAX TOTAL OUTFLOW(CFS) OCCURRING AT TIME TP	45566.	46387.
BRD	FINAL DEPTH(FT) OF BREACH	31.80	26.8
BRW	TOP WIDTH(FT) OF BREACH AT PEAK BREACH FLOW	31.79	26.8
HU	ELEV(FT) OF TOP OF DAM	1726.50	1721.50
HY	FINAL ELEV(FT) OF RESERVOIR WATER SURFACE	1709.26	1711.20
HC	FINAL ELEV(FT) OF BOTTOM OF BREACH	1694.70	1694.70
AGL	ACUTE ANGLE THAT BREACH SIDE MAKES WITH VERTICAL AT QBP	38.00	38.00

The “Old Model” column are the values presented in the 1996 GVSCE report. The “New Model” column values are those estimated by JEF. The predicted peak outflow for the new dam is only slightly smaller than the discharge predicted by GVSCE, however, there is much conservativeness in the new modeling assumptions.

At approximately 0.315 hours, the outflow hydrograph breaks and the peak discharge drops dramatically. Typically, this anomaly would be further analyzed and remedied if possible. However, the break occurs after the peak, and for the purposes of this simplified analysis, no further adjustments to correct the break were considered warranted.

CONCLUSIONS

The results of the new BREACH analyses indicate that a potential piping failure of the new GEPD would result in a peak discharge that is slightly less than the previously documented value. This reduction is primarily due to a reduction in the magnitude of the IDF that was adopted sometime between the GVSCE study and the Stantec design work. Given the level of conservancy built into the JEF BREACH analyses and the agency adoption and subsequent design authorization using the reduced IDF, it is concluded that the inundation mapping prepared and documented in the GVSCE study should be sufficient for the purposes of the FHFRP.

Previous Report Excerpts

BREACH Model Output
for
JEF Analyses

```
FCDMC2000C013-TASK10  BREACH MODEL FOR MODIFIED GEPD.  TIME 0 = STRM 2.42 HRS

  HI=   1723.42  HU=   1726.50  HL=   1694.70  HPI=   1695.00  HSP=  1712.90  PI=   7.0  CA=0.000  CB=0.00

          (QIN(I),I=1,8)
  25783.00  40111.00  37985.00  27674.00  22673.00  19451.00   6892.00   2469.00

          (TIN(I),I=1,8)
      0.00      0.08      0.17      0.25      0.33      0.42      1.00      2.00

          (RSA(I),I=1,8)
     22.93     21.55     20.40     18.34     15.43     12.61      0.91      0.01

          (HSA(I),I=1,8)
   1726.00   1722.00   1718.00   1716.00   1714.00   1712.00   1704.00   1695.00

          (HSTW(I),I=1,8)
   1690.30   1693.00   1696.00   1699.00   1700.50   1702.00   1708.00   1711.00

          (BSTW(I),I=1,8)
      1.00     85.30    128.00    154.40    226.70    657.50    808.20    835.50

          (CMTW(I),I=1,8)
      0.05      0.05      0.05      0.05      0.05      0.05      0.05      0.05

  ZU=  2.30  ZD=  2.00  ZC=  0.50  GL=  4.00  GS=  0.25  VMP=  3.00  SEDCON=  0.00

  D50C=  0.70  PORC=  0.25  UWC=125.00  CNC=1.0000  AFRC= 38.00  COHC= 200.0  UNFCC=118.00

  D50S=  7.10  PORS=  0.30  UWS=120.00  CNS=1.0000  AFRS= 40.00  COHS=   0.0  UNFCS= 22.10

  BR=  1.00  WC=  12.0  CRL=  570.0  SM=110.00  D50DF= 16.10  UNFCDF= 10.90   BMX=  400.   BTMX=  570.

  DTH= 0.001  DBG= 0.000   H=  0.1000   TEH=    1.0  ERR=  0.01  FPT=  10.0  TPR=   0.0

          (SPQ(I),I=1,8)
      0.00   1665.00   6006.00  19648.00  27378.00  38215.00      0.00      0.00

          (SPH(I),I=1,8)
      0.00      2.14      4.64      9.14     11.14     13.64      0.00      0.00



          AFRA=   0.0   TH1= 65.00   H1=  0.07   TH2= 52.00   H2= 22.84   TH3= 45.00   H3=133.79   SEDCON=  0.50
```

```
1
    I       T   DTH   KG KC      QTOT       QTS              QB    SUB      BT      HY      HC     BO       PPP      HP       TWD    DH   DHH KIT AGL
  PIPE FLOW TO WEIR FLOW TRANSITION

          KSLUMP= 1     HCK=   22.67     DELT=    0.04     DEL= 25.00


          KSLUMP= 2     HCK=   22.88     DELT=    0.00     DEL= 13.00

          KTT= 0     I= 1856     T=   1.00
```

```
                              OUTPUT SUMMARY

     QBP  MAX OUTFLOW(CFS) THRU BREACH                                      30166.
     TP   TIME(HR) AT WHICH PEAK OUTFLOW OCCURS                               0.29
     QP   MAX TOTAL OUTFLOW(CFS) OCCURRING AT TIME TP                       45566.
     TRS  DURATION(HR) OF RISING LIMB OF HYDROGRAPH                           0.29
     TB   TIME(HR) AT WHICH SIGN. RISE IN OUTFLOW STARTS                      0.00
     BRD  FINAL DEPTH(FT) OF BREACH                                          31.80
     BRW  TOP WIDTH(FT) OF BREACH AT PEAK BREACH FLOW                        31.79
     HU   ELEV(FT) OF TOP OF DAM                                           1726.50
     HY   FINAL ELEV(FT) OF RESERVOIR WATER SURFACE                        1709.26
     HC   FINAL ELEV(FT) OF BOTTOM OF BREACH                              1694.700
     AGL  ACUTE ANGLE THAT BREACH SIDE MAKES WITH VERTICAL AT QBP           38.000
     QO   OUTFLOW (CFS) AT T=0.0                                            0.0319
     Z    SIDE SLOPE OF BREACH (FT/FT) AT PEAK BREACH FLOW                    0.00
     TFH  TIME OF FAILURE (HR) WHICH IS LINEAR EQUIVALENT OF TRS
          OBTAINED BY USING SIMPLIFIED DAM-BREAK DISCHARGE EQUATION          -0.62
     TFHI TIME OF FAILURE (HR) WHICH IS LINEAR EQUIVALENT OF TRS
          OBTAINED BY INTEGRATING QB VS TIME FROM T=0 TO T=TP                 0.13
     BO   BOTTOM WIDTH (FT) OF BREACH AT PEAK BREACH FLOW                    31.79
```

```
TIME   0.0    5000.0   10000.0   15000.0   20000.0   25000.0   30000.0   35000.0   40000.0   45000.0   50000.0  DISCHARGE
       0.000*         .         .         .         .         .         .         .         .         .         .          0.
       0.003.         .         .         .         .         *         .         .         .         .         .      25013.
       0.005.         .         .         .         .         *         .         .         .         .         .      25064.
       0.008.         .         .         .         .         *         .         .         .         .         .      25129.
       0.010.         .         .         .         .         *         .         .         .         .         .      25207.
       0.013.         .         .         .         .         .*        .         .         .         .         .      25298.
       0.015.         .         .         .         .         .*        .         .         .         .         .      25403.
       0.018.         .         .         .         .         .*        .         .         .         .         .      25519.
       0.020.         .         .         .         .         .*        .         .         .         .         .      25647.
       0.023.         .         .         .         .         . *       .         .         .         .         .      25786.
       0.025.         .         .         .         .         . *       .         .         .         .         .      25937.
       0.027.         .         .         .         .         . *       .         .         .         .         .      26097.
       0.030.         .         .         .         .         .  *      .         .         .         .         .      26268.
       0.032.         .         .         .         .         .  *      .         .         .         .         .      26449.
       0.035.         .         .         .         .         .  *      .         .         .         .         .      26638.
       0.038.         .         .         .         .         .   *     .         .         .         .         .      26838.
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       0.043.         .         .         .         .         .    *    .         .         .         .         .      27261.
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       0.097.         .         .         .         .         .         .      *  .         .         .         .      33716.
       0.100.         .         .         .         .         .         .       * .         .         .         .      33968.
       0.102.         .         .         .         .         .         .       * .         .         .         .      34216.
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       0.110.         .         .         .         .         .         .         *         .         .         .      34959.
```

```
0.112.         .         .         .         .         .         .         *         .         .         .      35216.
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0.117.         .         .         .         .         .         .         . *       .         .         .      35752.
0.120.         .         .         .         .         .         .         . *       .         .         .      36033.
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0.137.         .         .         .         .         .         .         .     *   .         .         .      38119.
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0.145.         .         .         .         .         .         .         .       * .         .         .      39004.
0.147.         .         .         .         .         .         .         .        *.         .         .      39292.
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0.155.         .         .         .         .         .         .         .         *         .         .      40125.
0.157.         .         .         .         .         .         .         .         .*        .         .      40390.
0.160.         .         .         .         .         .         .         .         .*        .         .      40648.
0.162.         .         .         .         .         .         .         .         . *       .         .      40898.
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      0.820.        .         .      *  .         .         .         .         .         .         .         .      13477.
      0.822.        .         .      *  .         .         .         .         .         .         .         .      13427.
      0.825.        .         .      *  .         .         .         .         .         .         .         .      13378.
      0.827.        .         .      *  .         .         .         .         .         .         .         .      13328.
      0.830.        .         .      *  .         .         .         .         .         .         .         .      13279.
      0.832.        .         .     *   .         .         .         .         .         .         .         .      13229.
      0.835.        .         .     *   .         .         .         .         .         .         .         .      13180.
      0.837.        .         .     *   .         .         .         .         .         .         .         .      13130.
      0.840.        .         .     *   .         .         .         .         .         .         .         .      13081.
      0.842.        .         .     *   .         .         .         .         .         .         .         .      13031.
      0.845.        .         .     *   .         .         .         .         .         .         .         .      12988.
Stop - Program terminated.
```

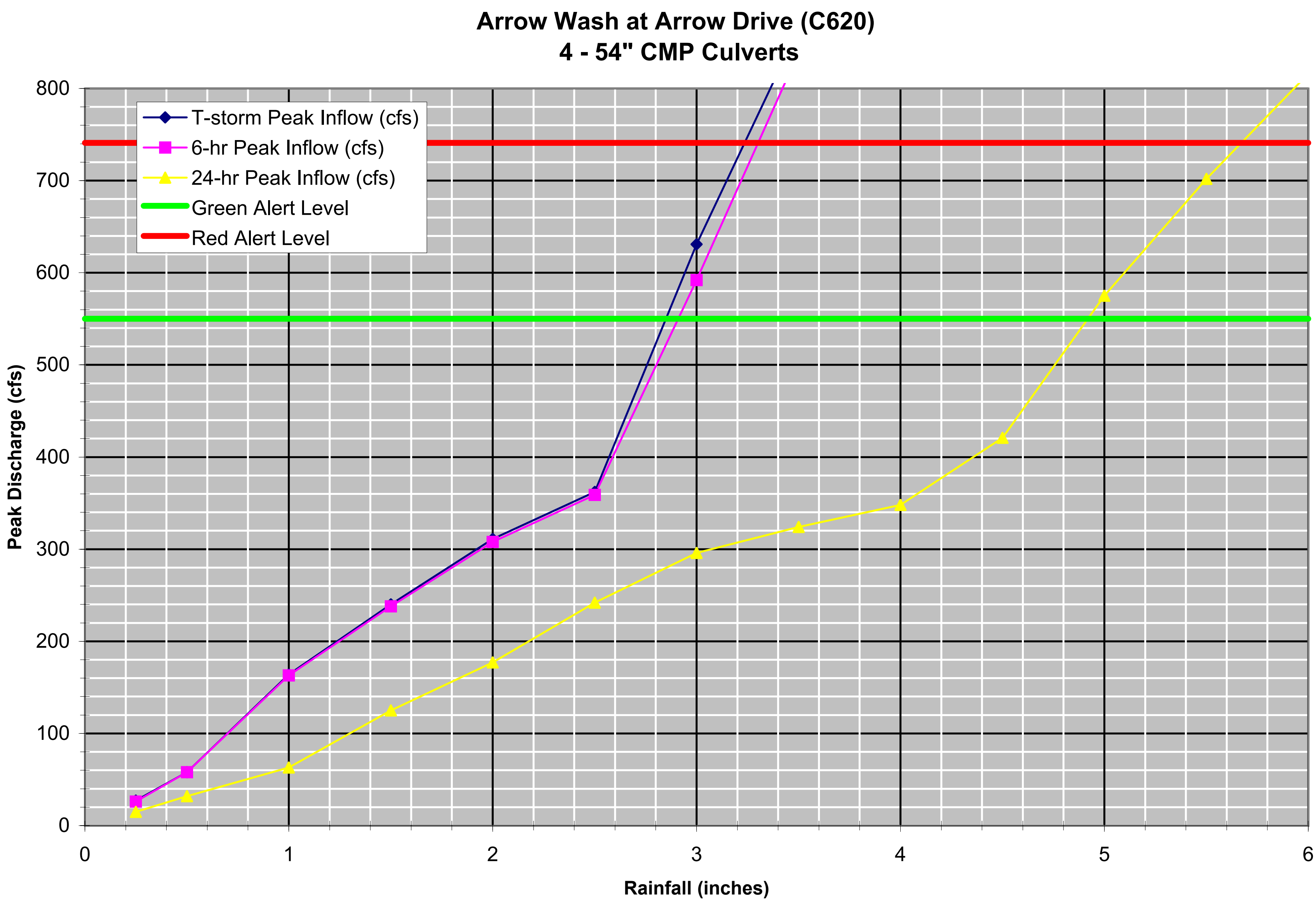
Appendix D

FCDMC Meteorological Services Program Standard Operation Procedure

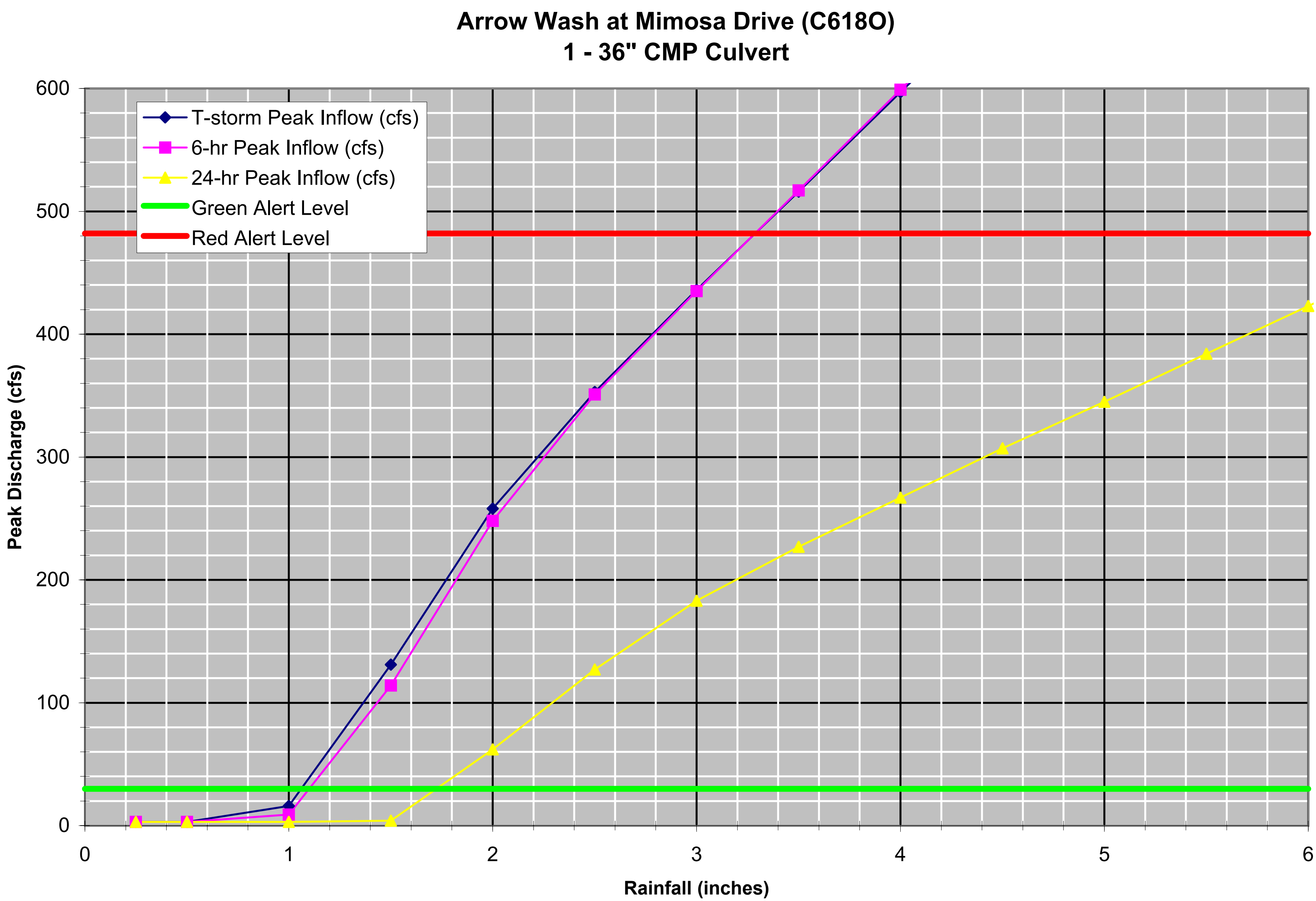
Appendix E

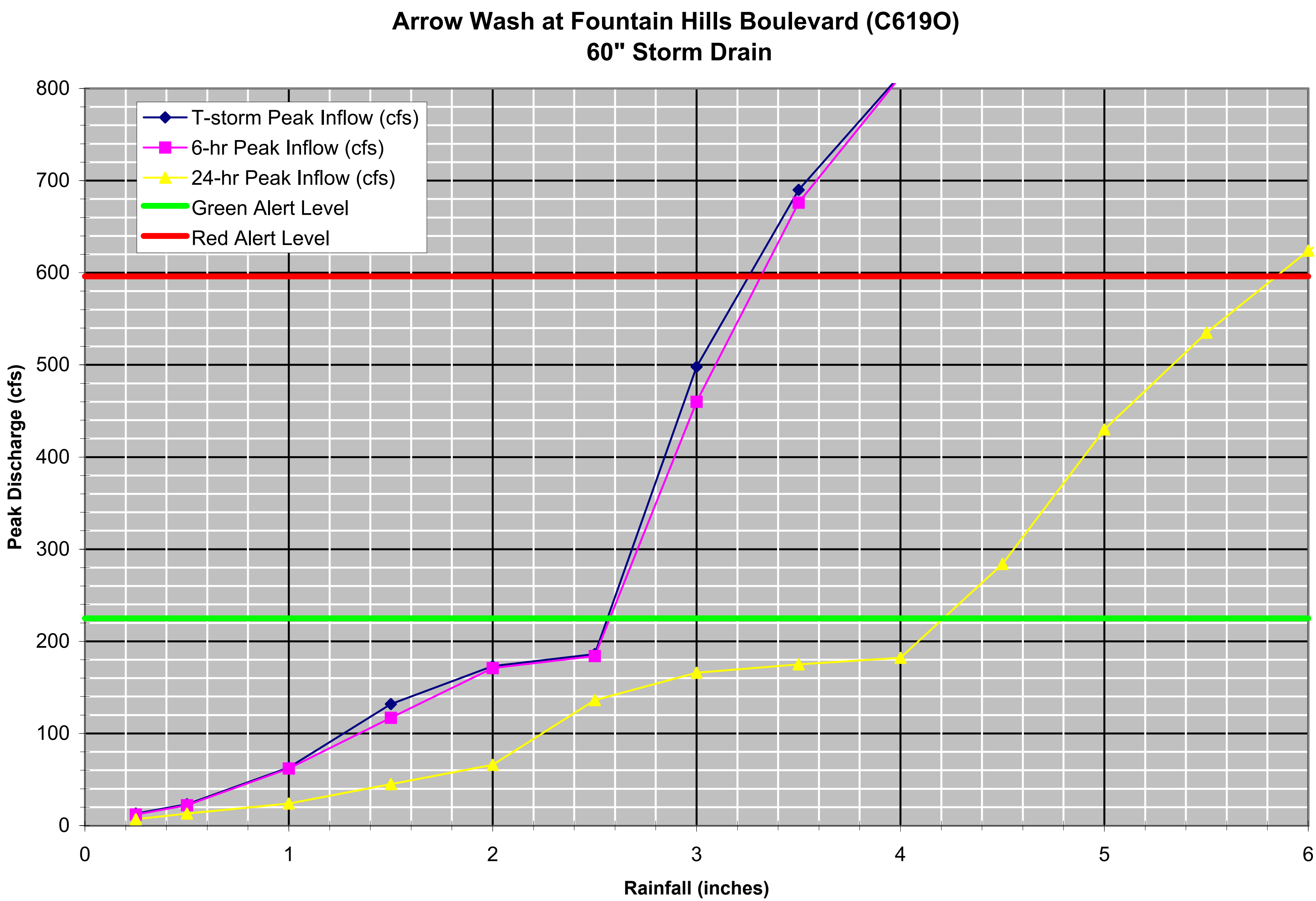
Impassable Rainfall Depth Determination from Multiple Ratio Results

Ashbrook Wash System

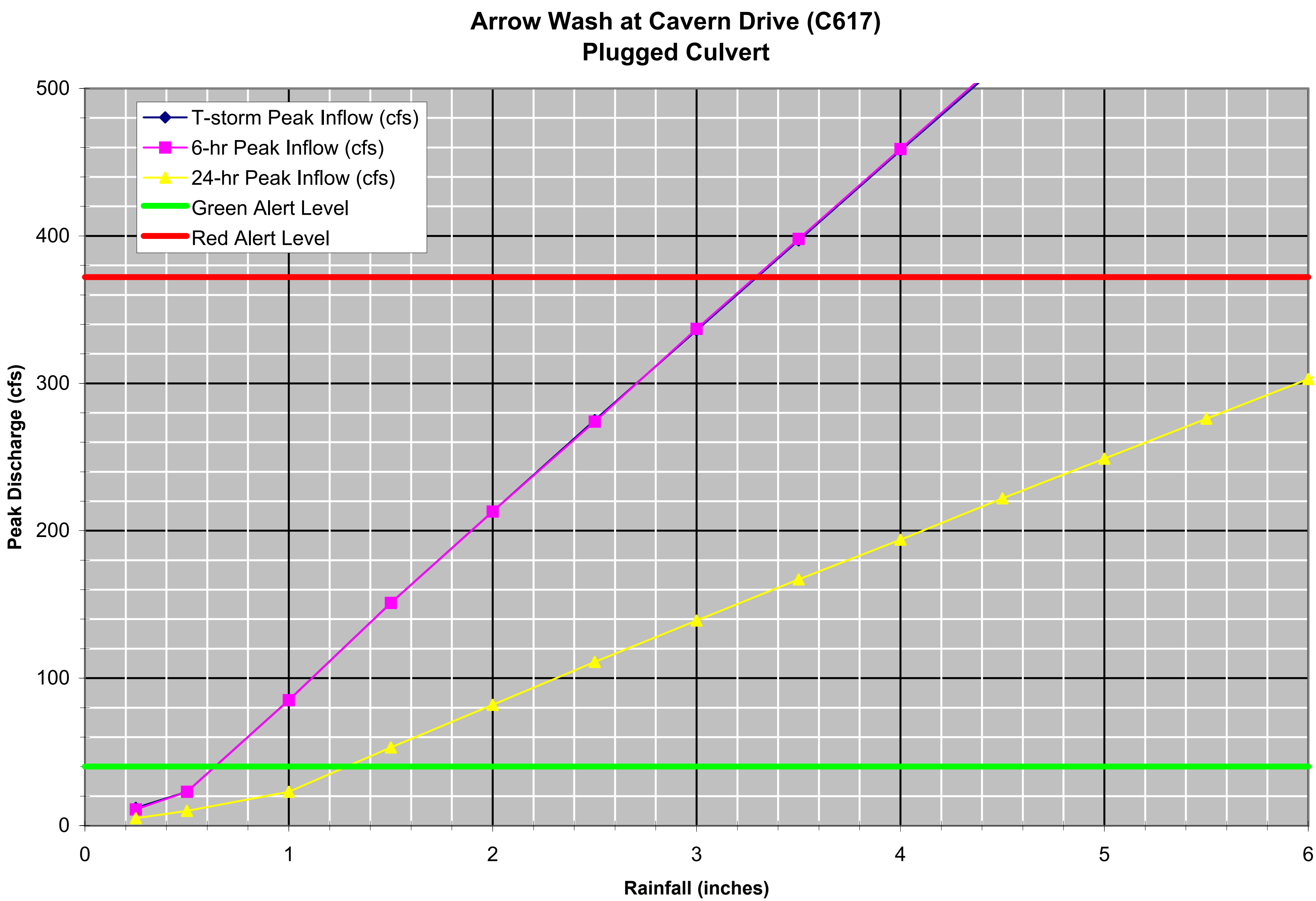


Arrow Wash at Arrow Drive (C620)
4 - 54" CMP Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
0
1
2
3
4
5
6

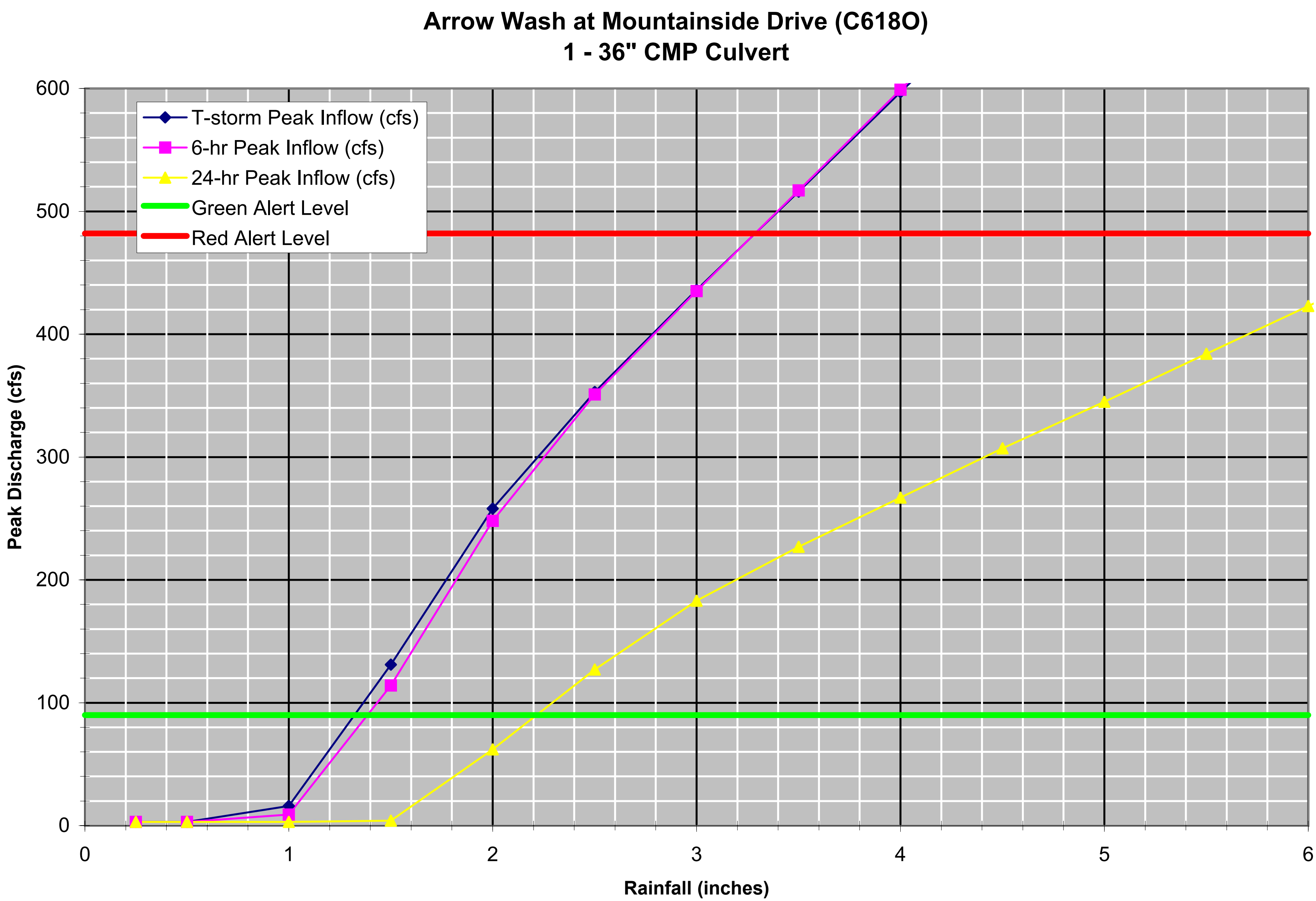

Arrow Wash at Mimosa Drive (C618O)
1 - 36" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
0
1
2
3
4
5
6



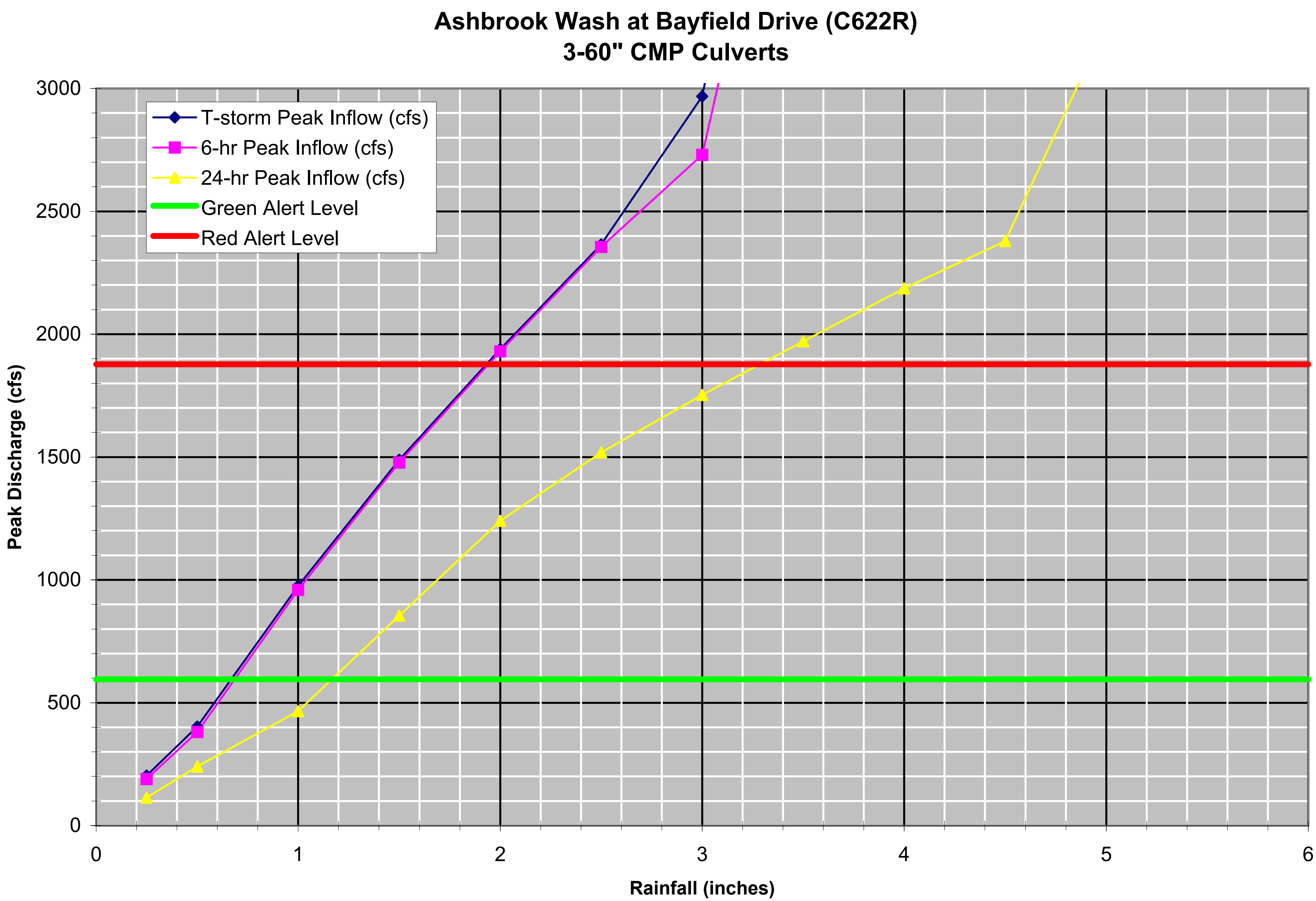
Arrow Wash at Fountain Hills Boulevard (C619O)
60" Storm Drain
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
1
2
3
4
5
6



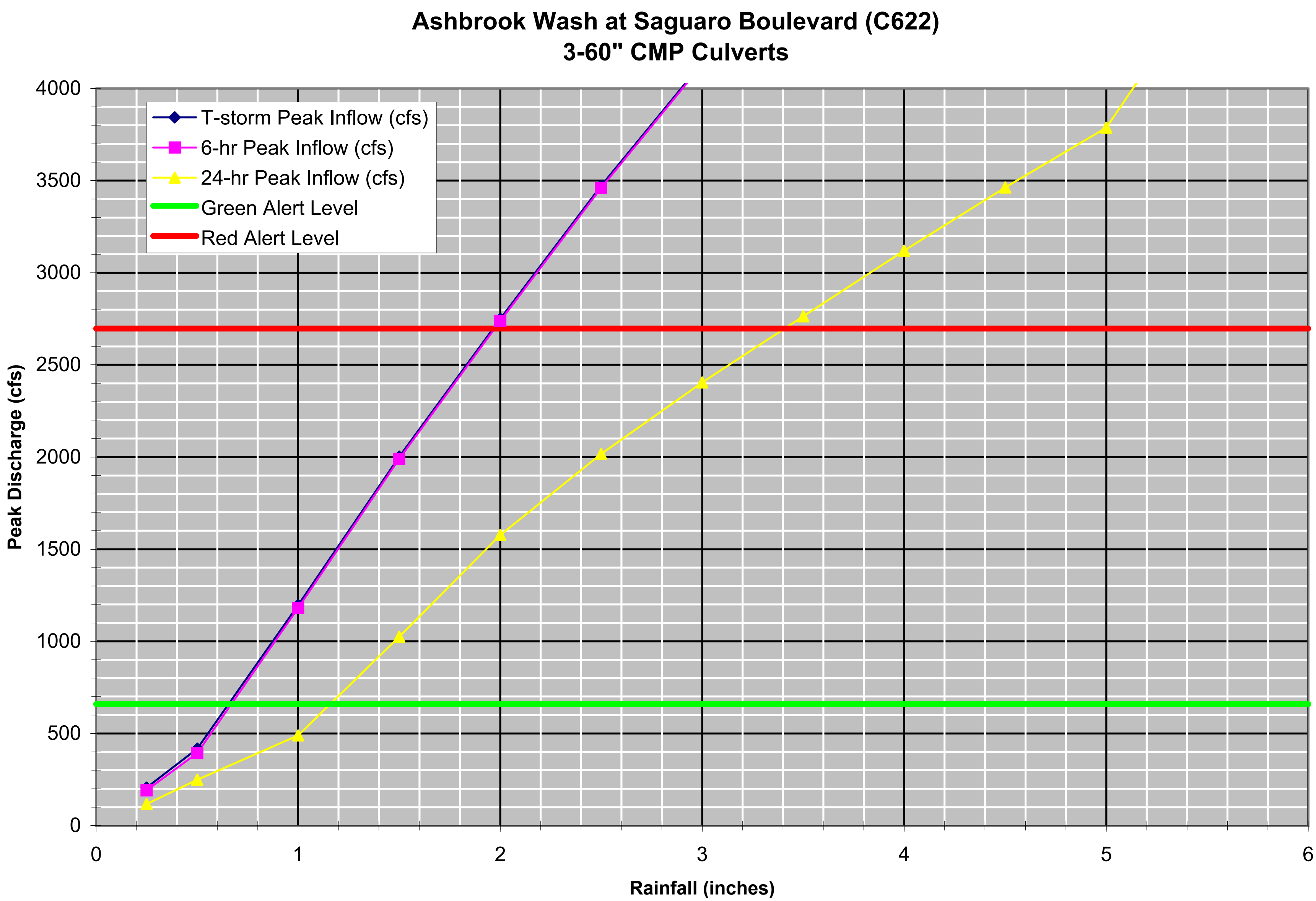
Arrow Wash at Cavern Drive (C617)
Plugged Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
0
1
2
3
4
5
6
Rainfall (inches)

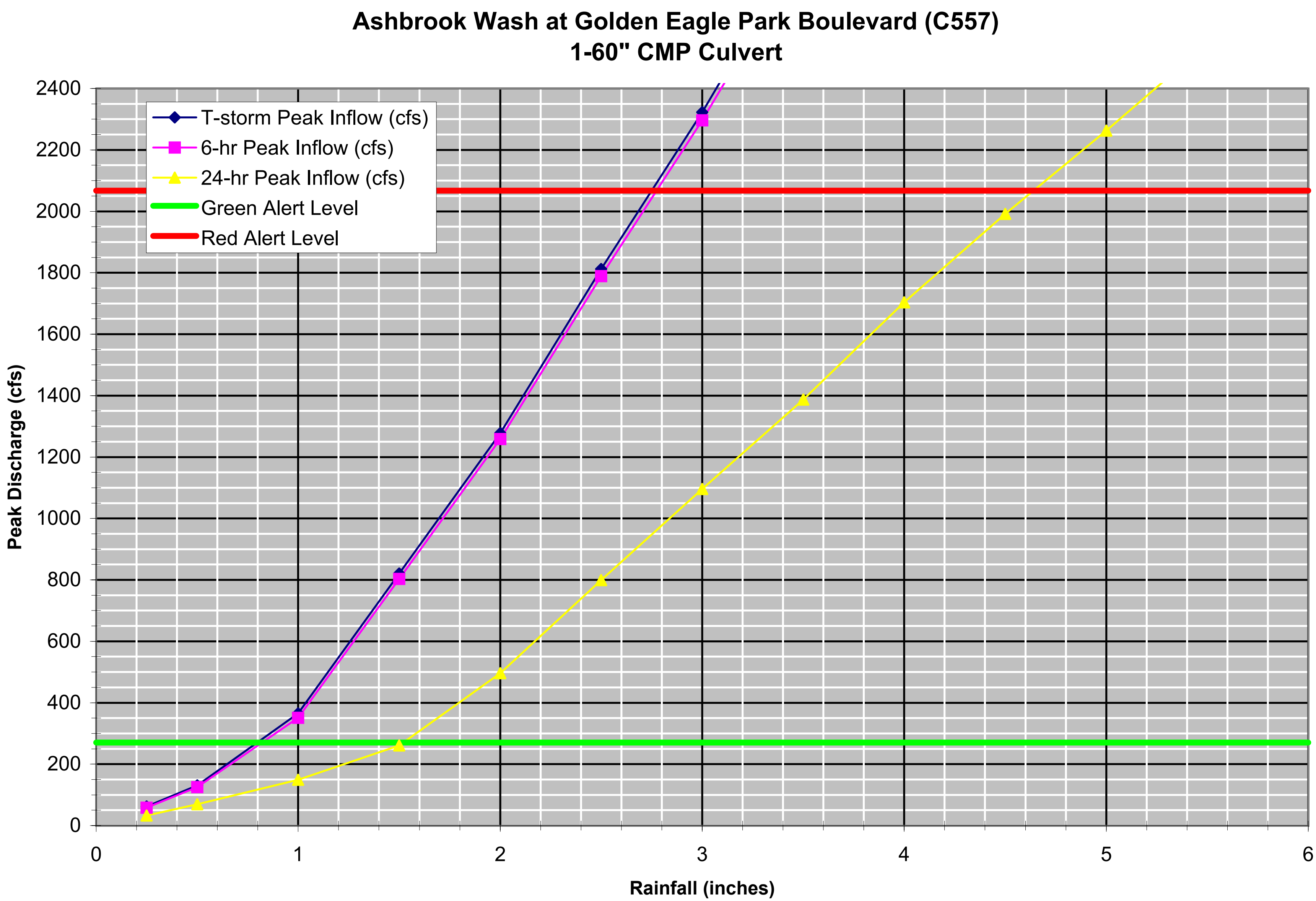


Arrow Wash at Mountainside Drive (C618O)
1 - 36" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
0
1
2
3
4
5
6

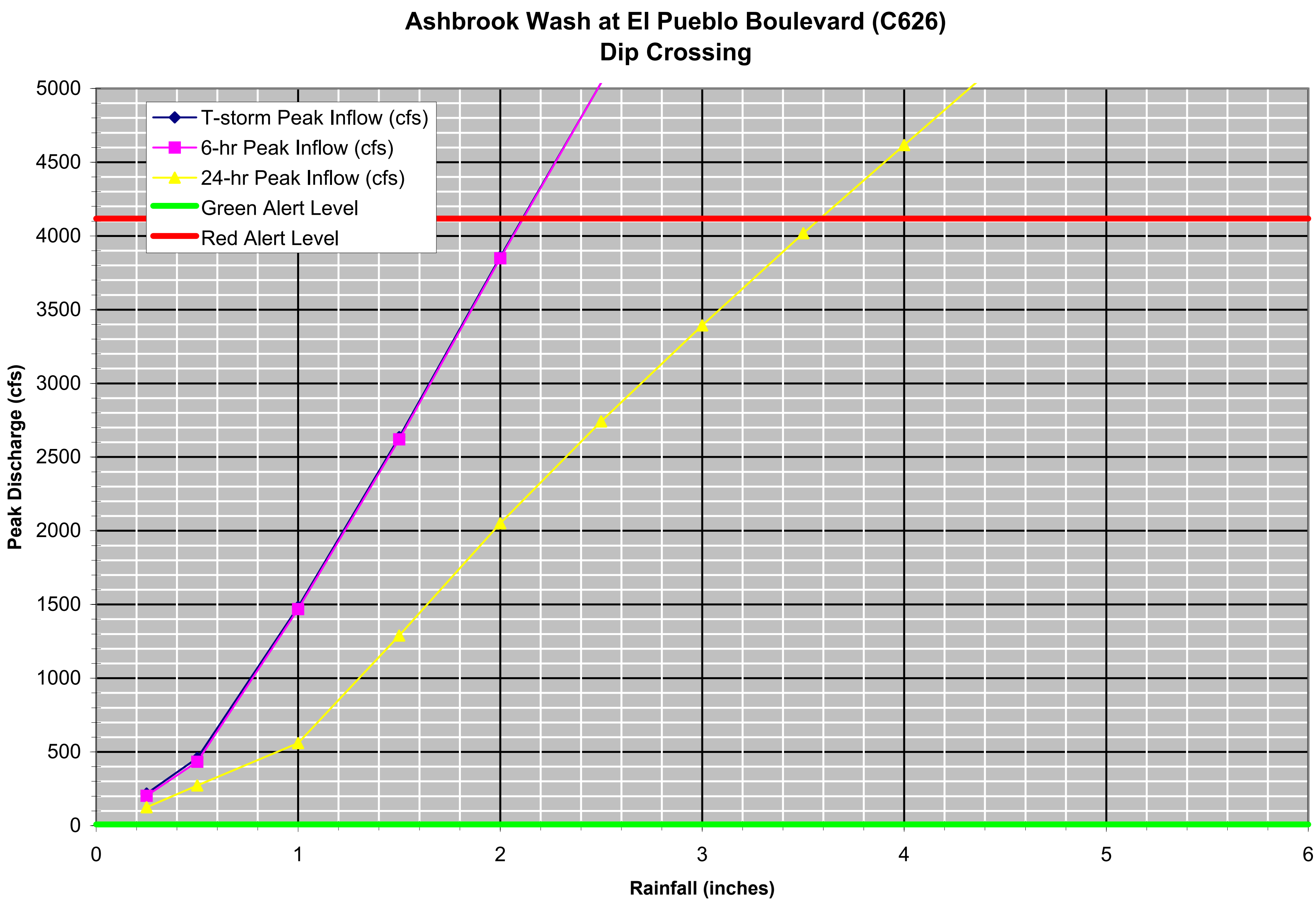


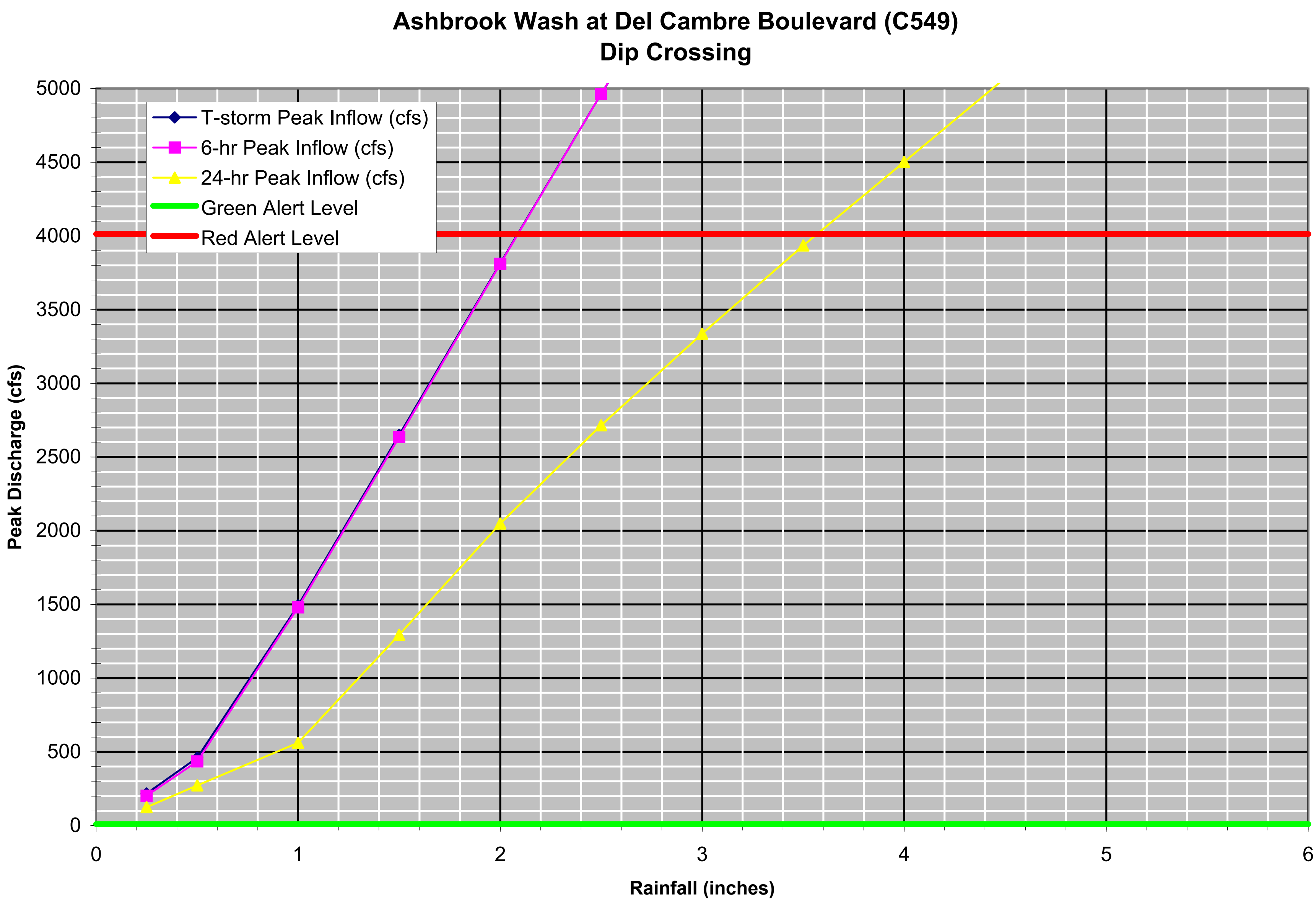
Ashbrook Wash at Bayfield Drive (C622R)
3-60" CMP Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
500
1000
1500
2000
2500
3000
0
1
2
3
4
5
6

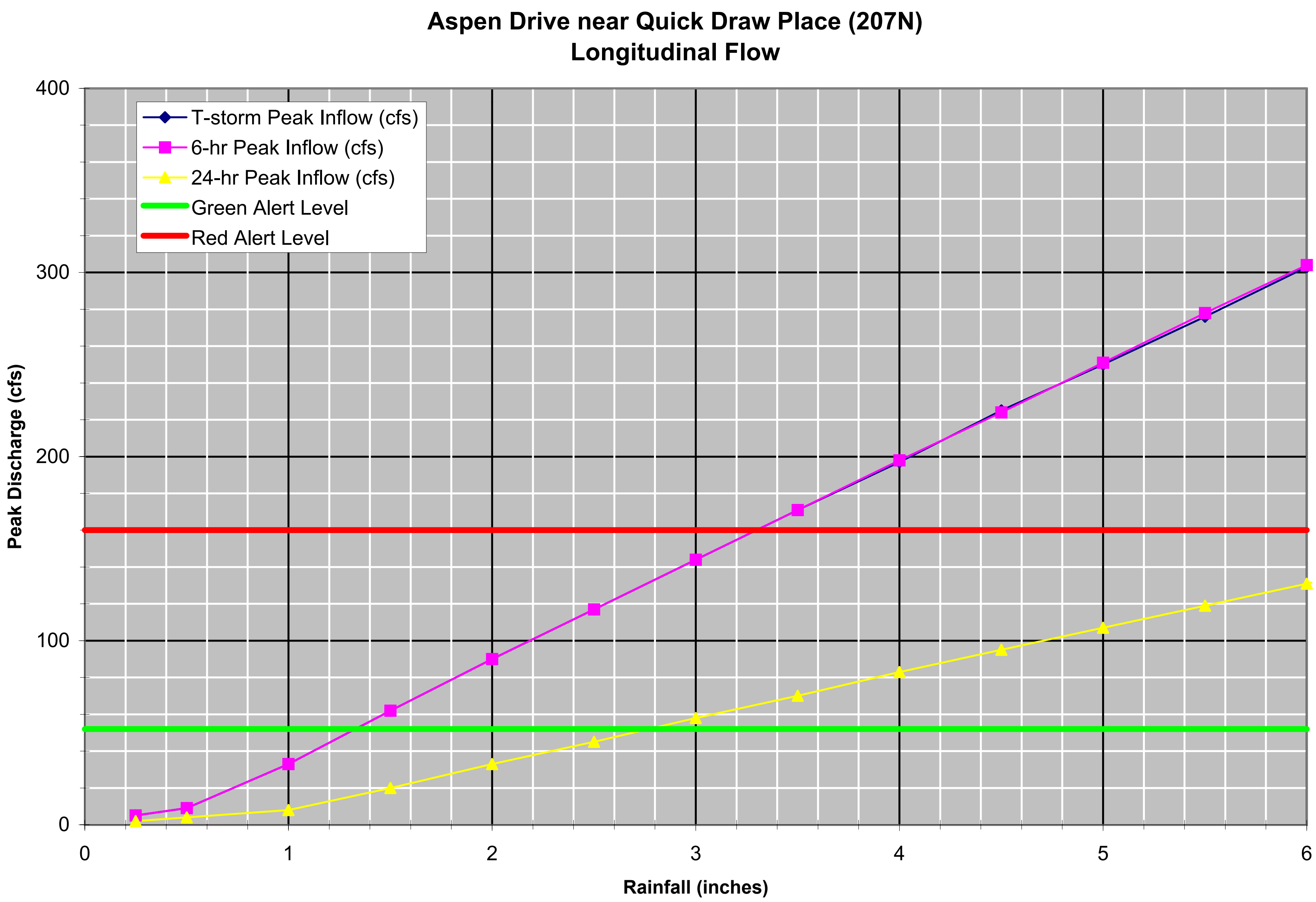

Ashbrook Wash at Saguaro Boulevard (C622)
3-60" CMP Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
500
1000
1500
2000
2500
3000
3500
4000
0
1
2
3
4
5
6

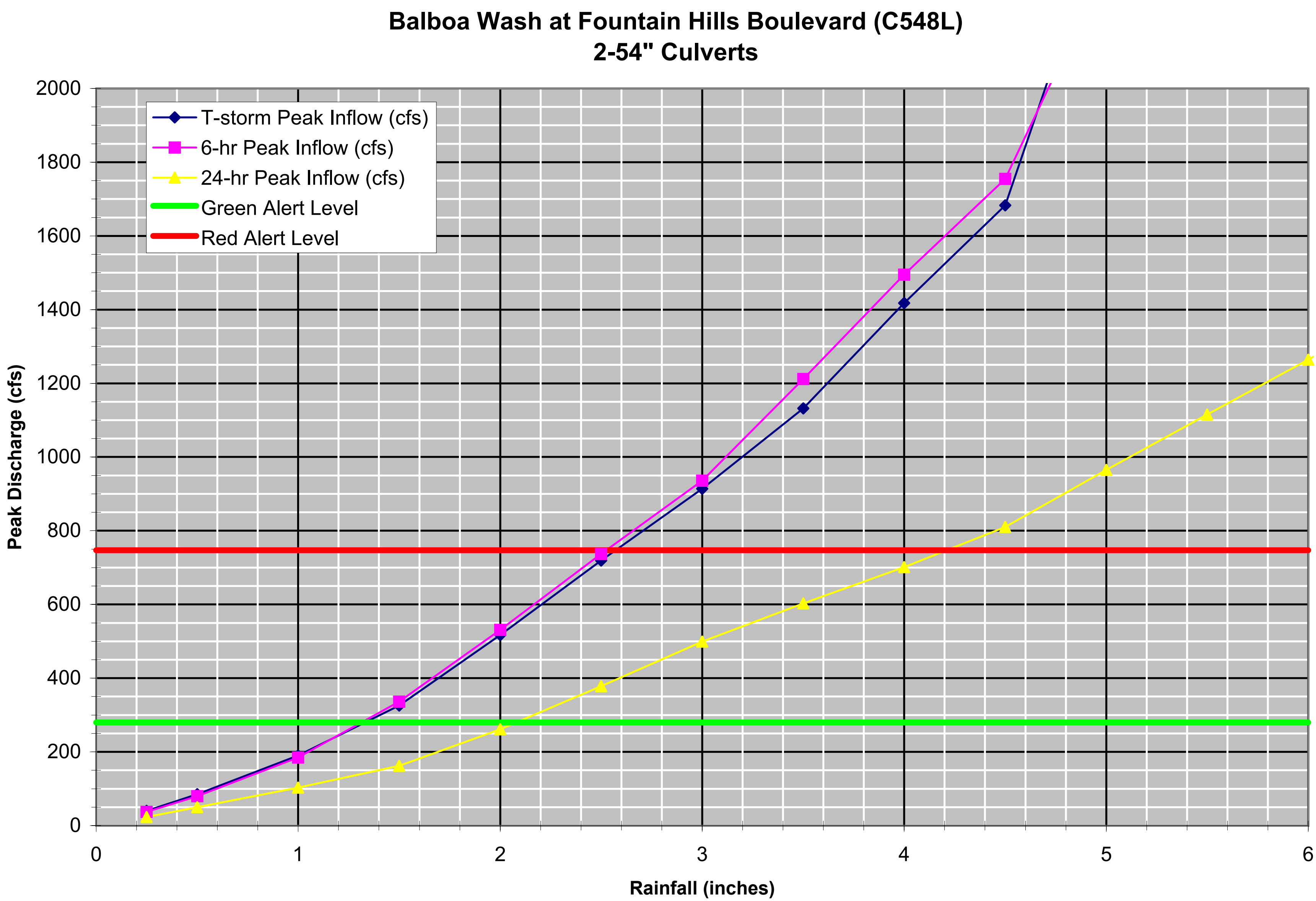


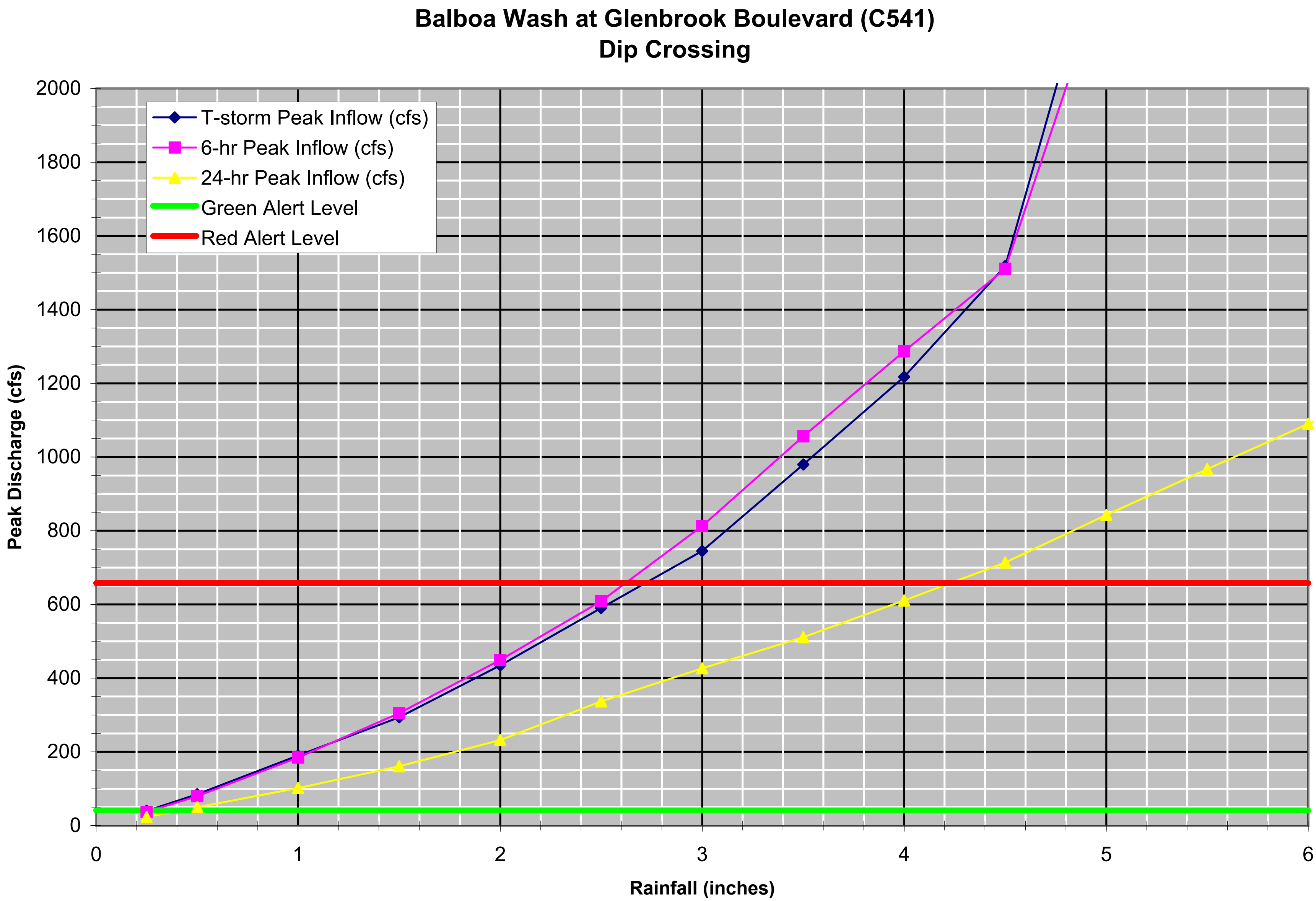
Ashbrook Wash at Golden Eagle Park Boulevard (C557)
1-60" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
0
1
2
3
4
5
6

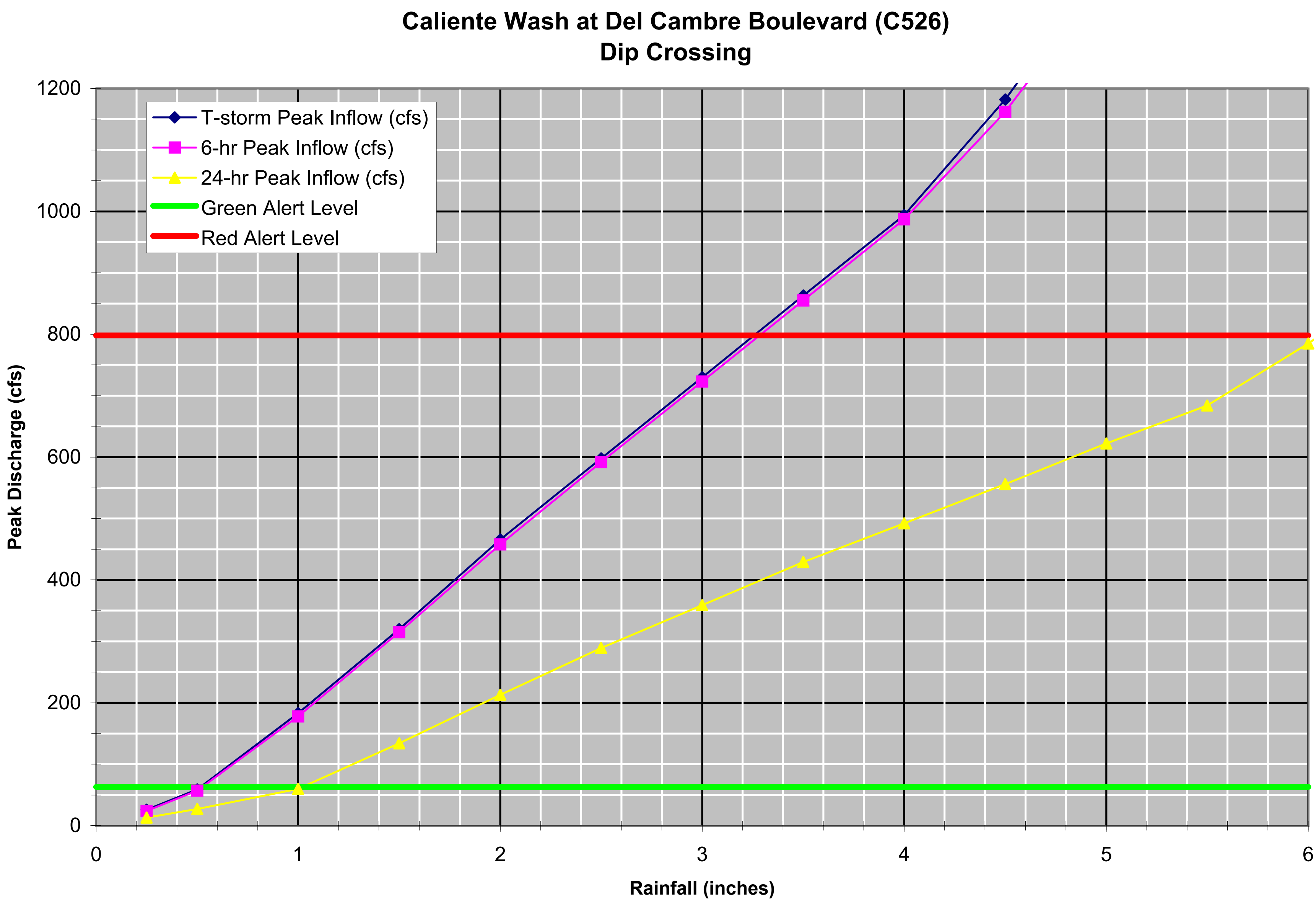

Ashbrook Wash at El Pueblo Boulevard (C626)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
0
1
2
3
4
5
6

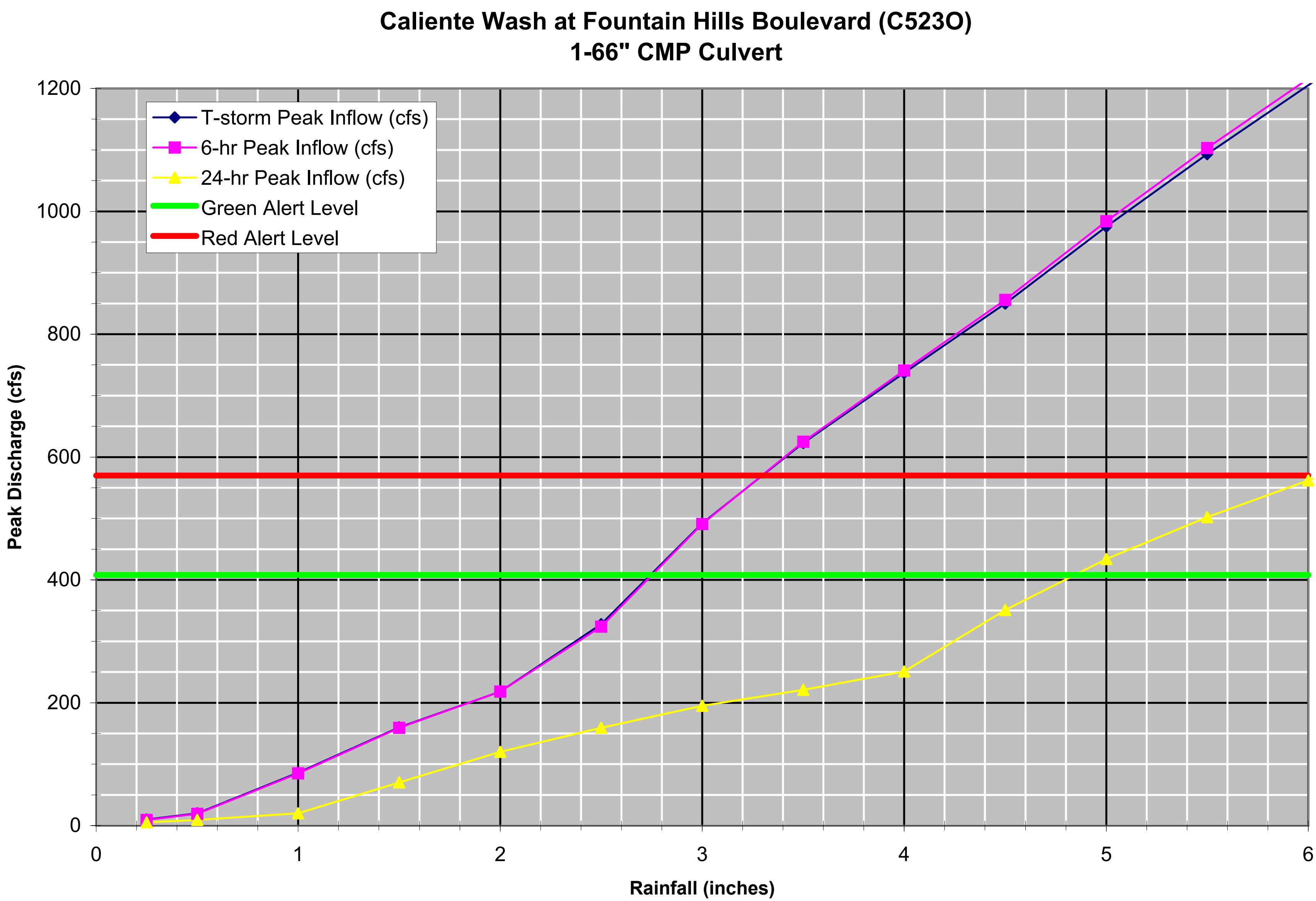

Ashbrook Wash at Del Cambre Boulevard (C549)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
0
1
2
3
4
5
6


Aspen Drive near Quick Draw Place (207N)
Longitudinal Flow
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
100
200
300
400
0
1
2
3
4
5
6

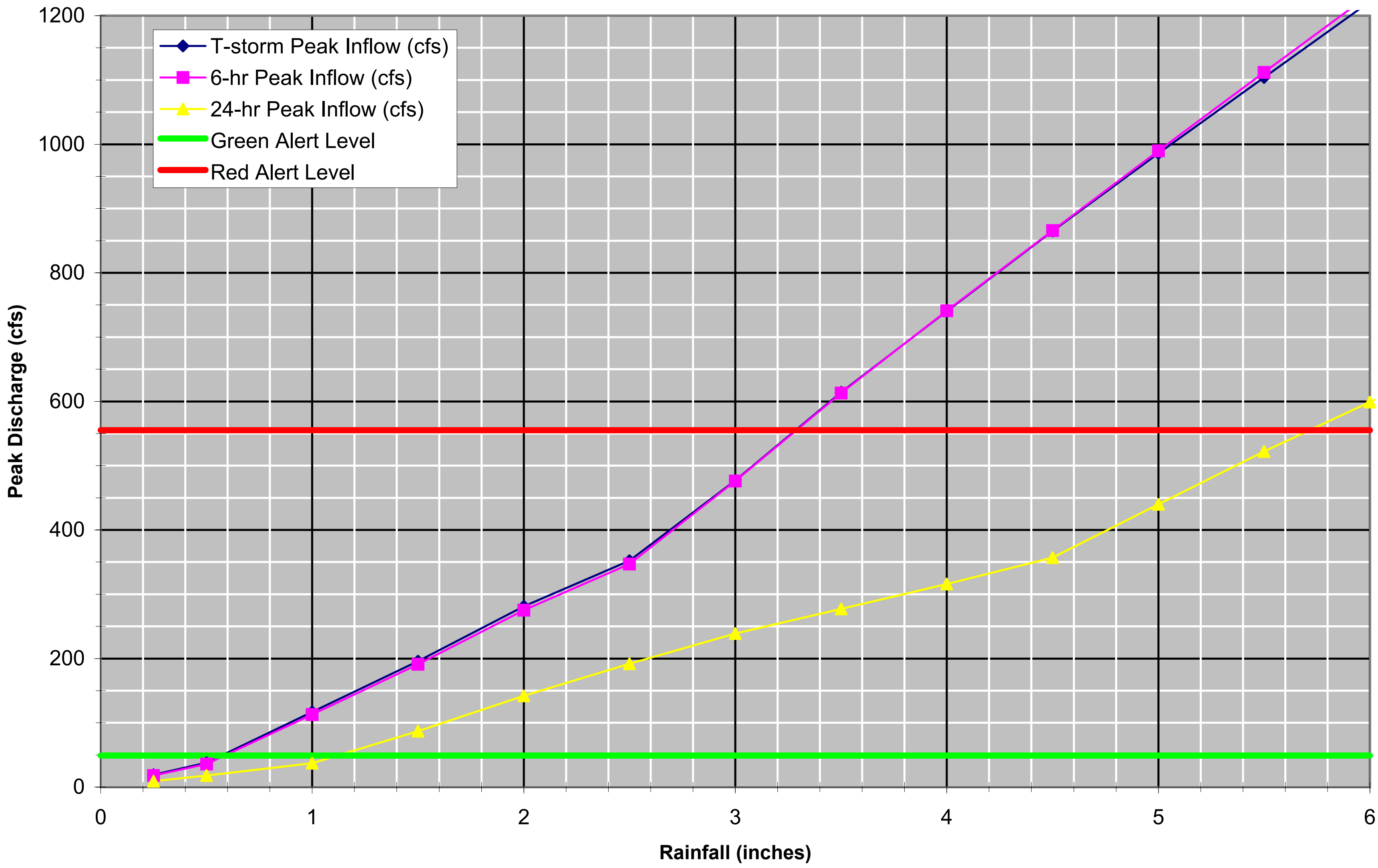

Balboa Wash at Fountain Hills Boulevard (C548L)
2-54" Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
1
2
3
4
5
6

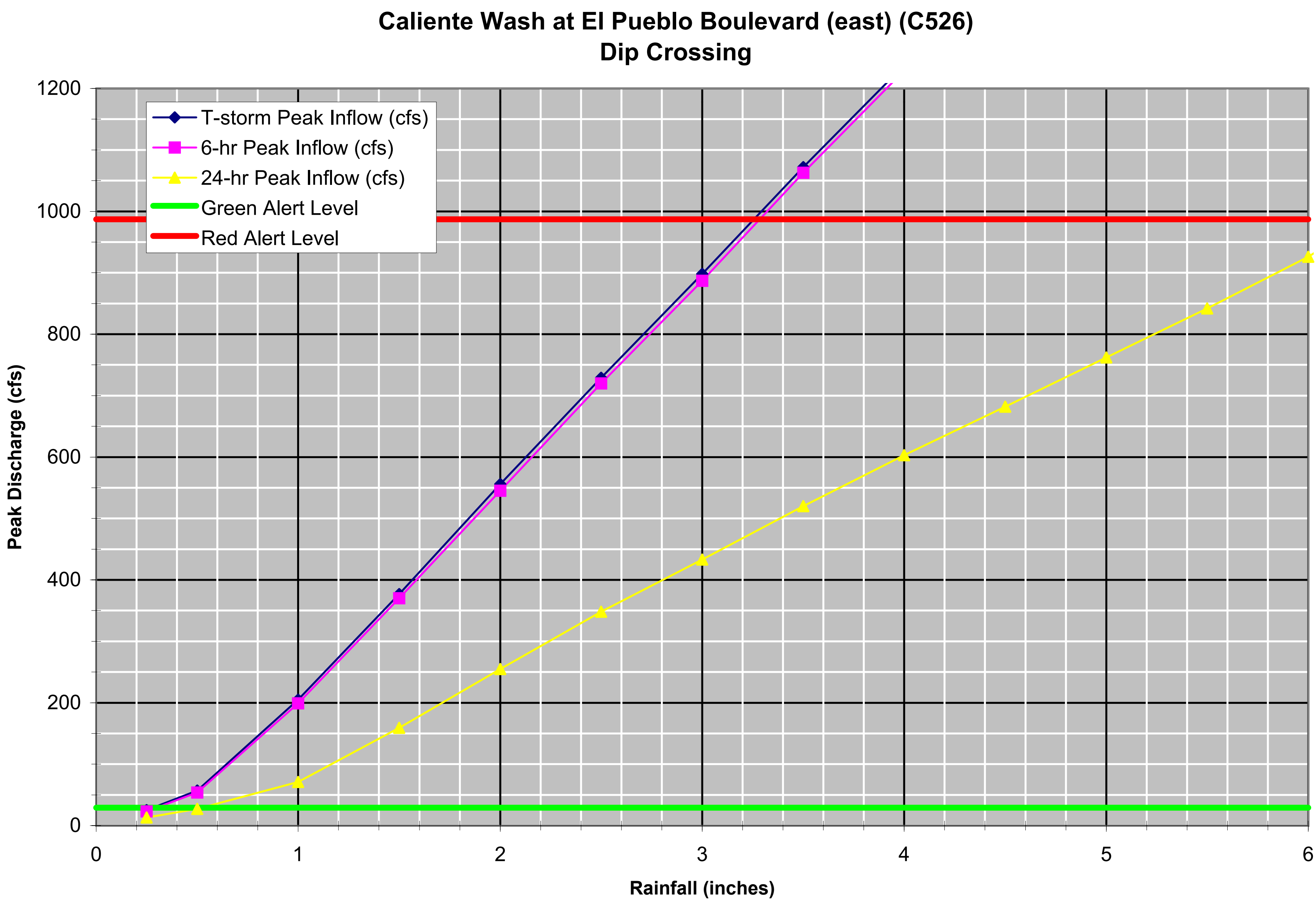

Balboa Wash at Glenbrook Boulevard (C541)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
1
2
3
4
5
6

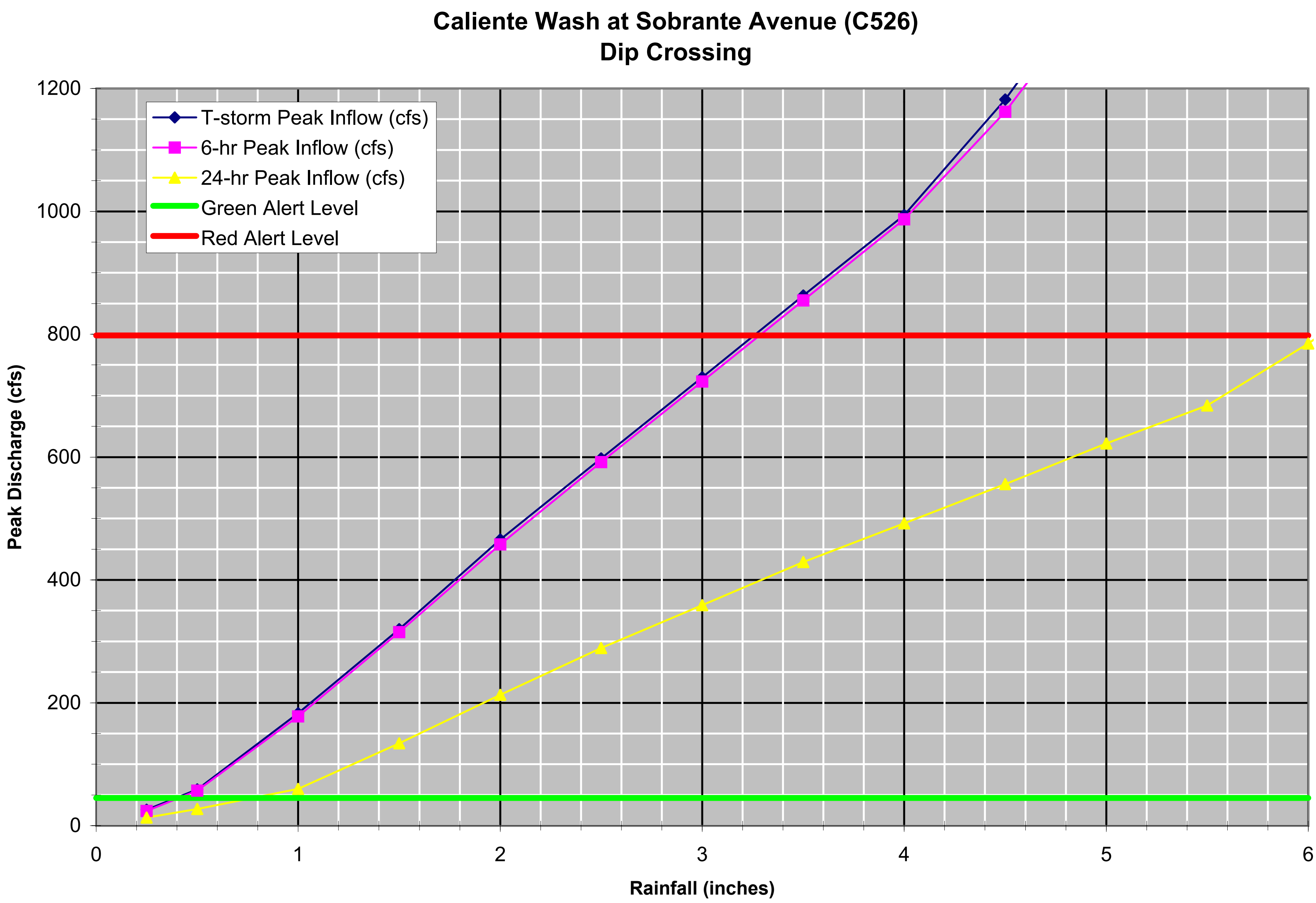

Caliente Wash at Del Cambre Boulevard (C526)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1
2
3
4
5
6

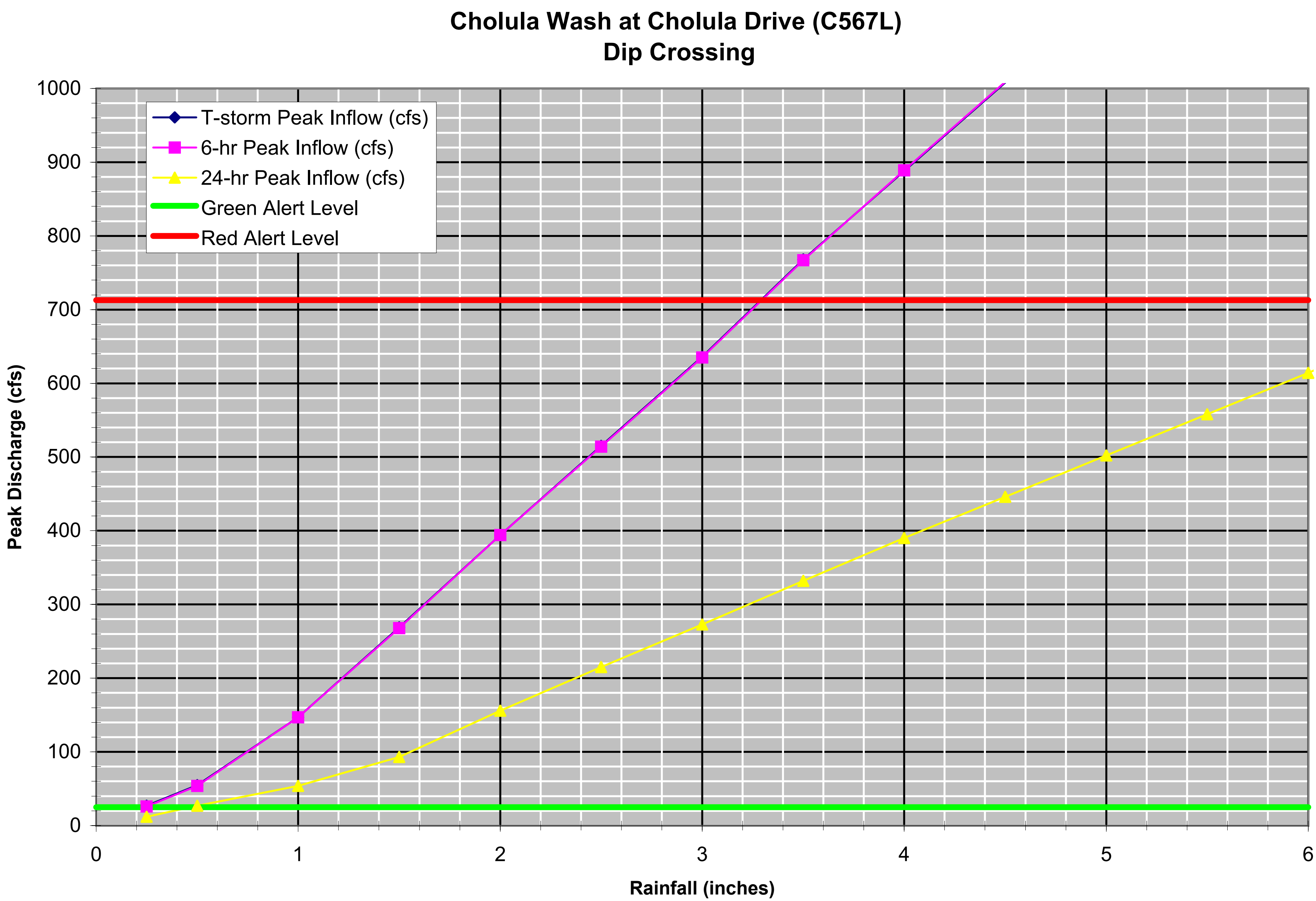

Caliente Wash at Fountain Hills Boulevard (C523O)
1-66" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
0
1
2
3
4
5
6

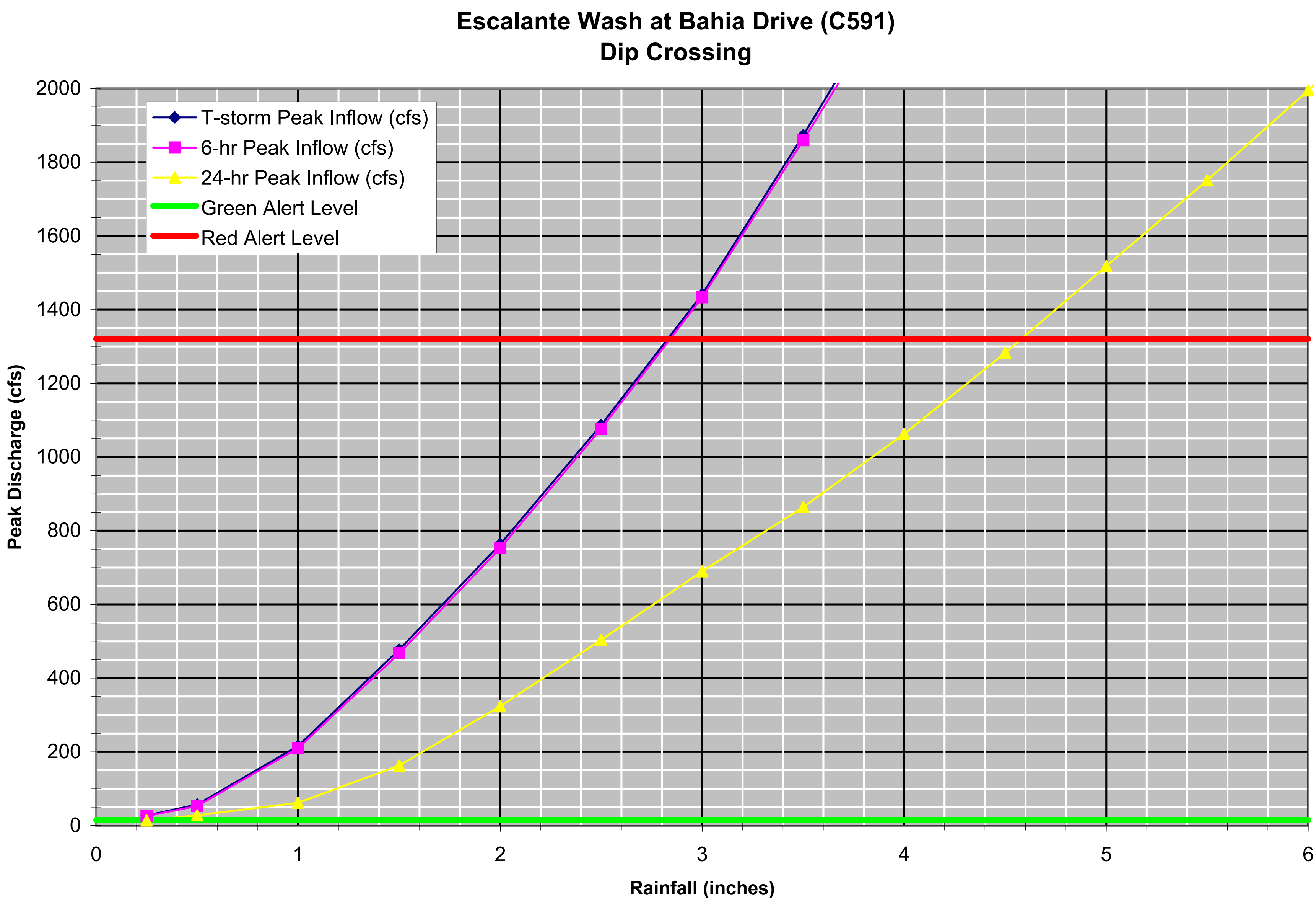
Caliente Wash at El Pueblo Boulevard (west) (C524)
Dip Crossing



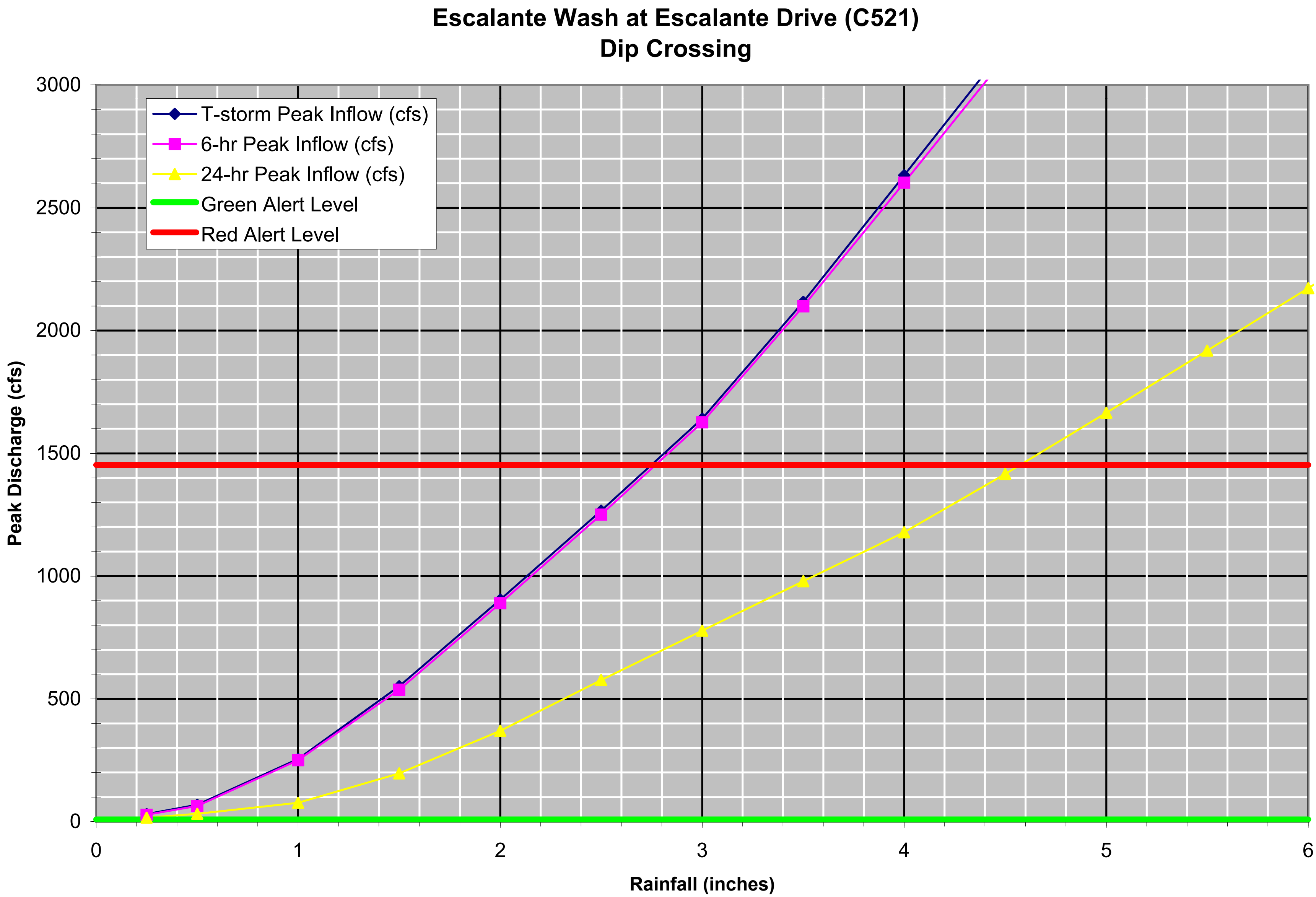

Caliente Wash at El Pueblo Boulevard (east) (C526)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
0
1
2
3
4
5
6


Caliente Wash at Sobrante Avenue (C526)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
200
400
600
800
1000
1200
0
1
2
3
4
5
6

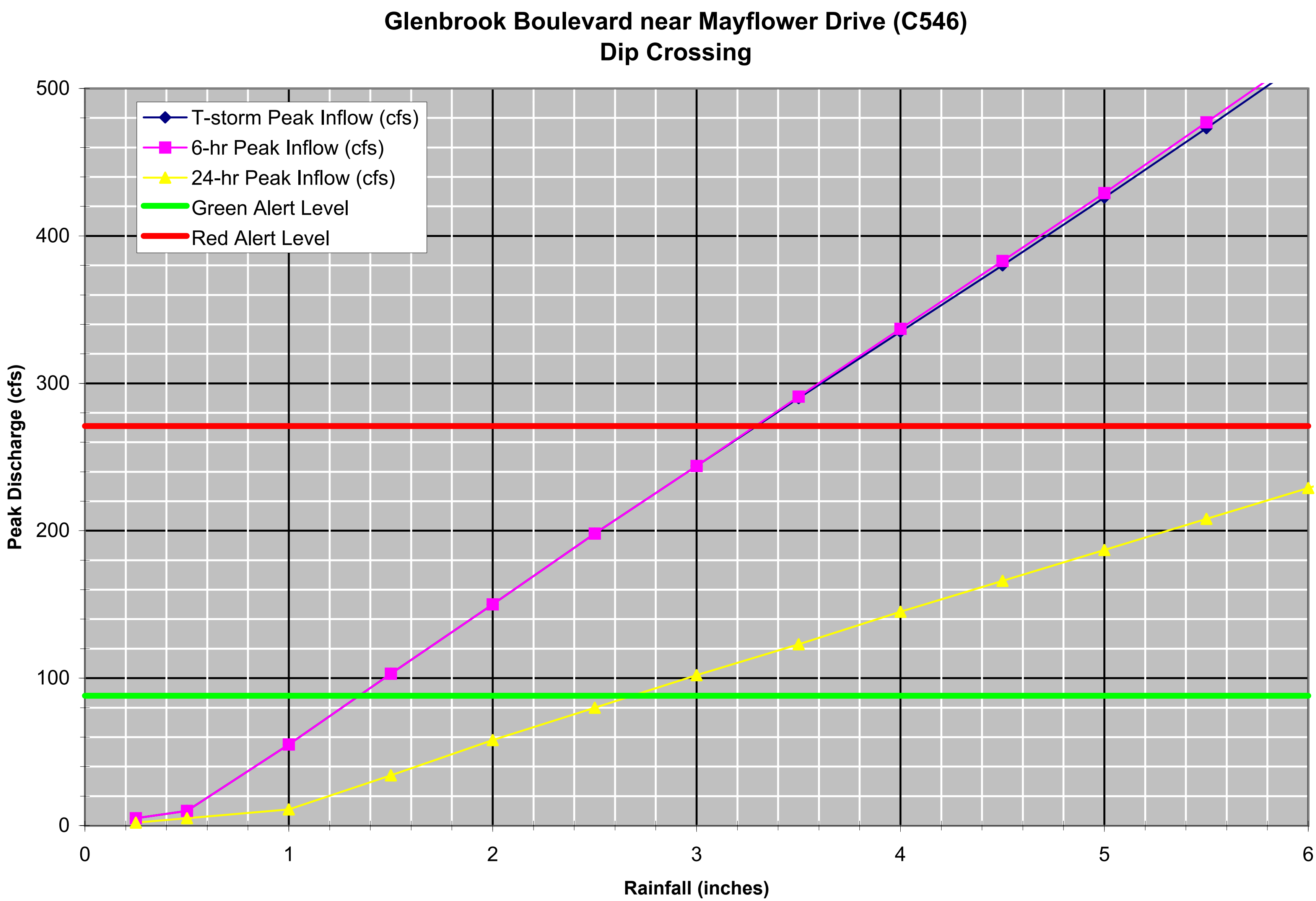

Cholula Wash at Cholula Drive (C567L)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
100
200
300
400
500
600
700
800
900
1000
0
1
2
3
4
5
6



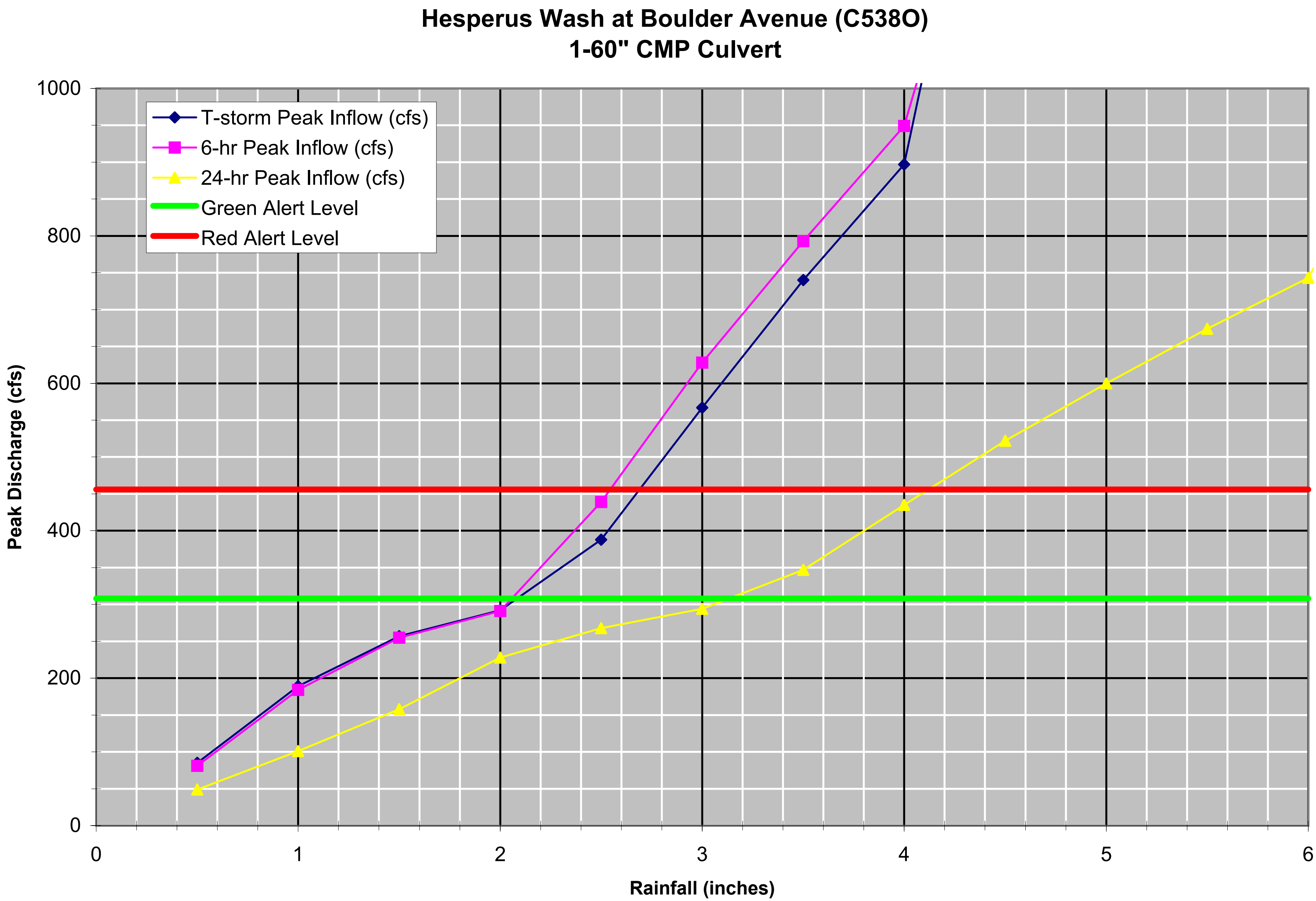
Escalante Wash at Bahia Drive (C591)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
1
2
3
4
5
6



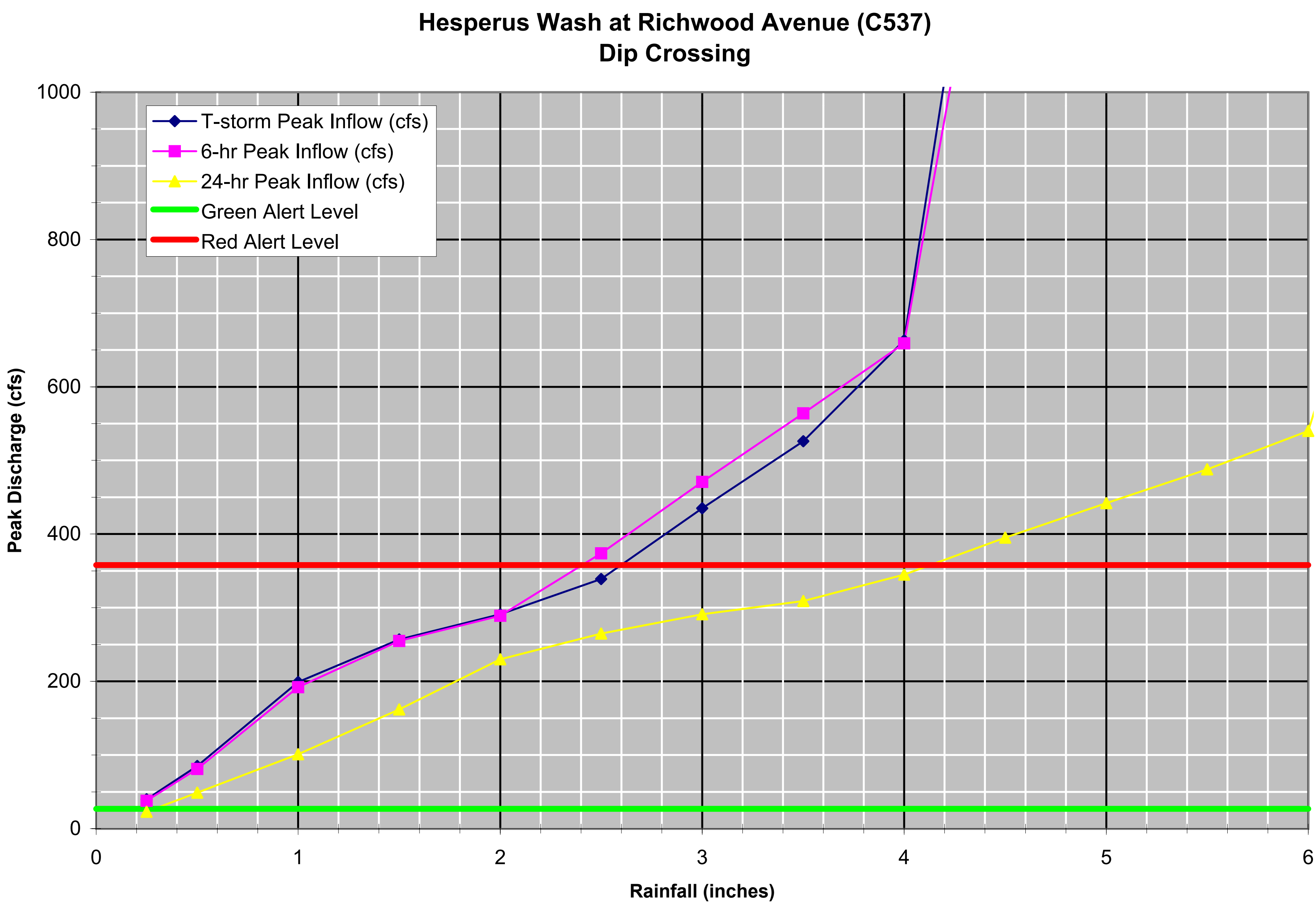
Escalante Wash at Escalante Drive (C521)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
3000
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6

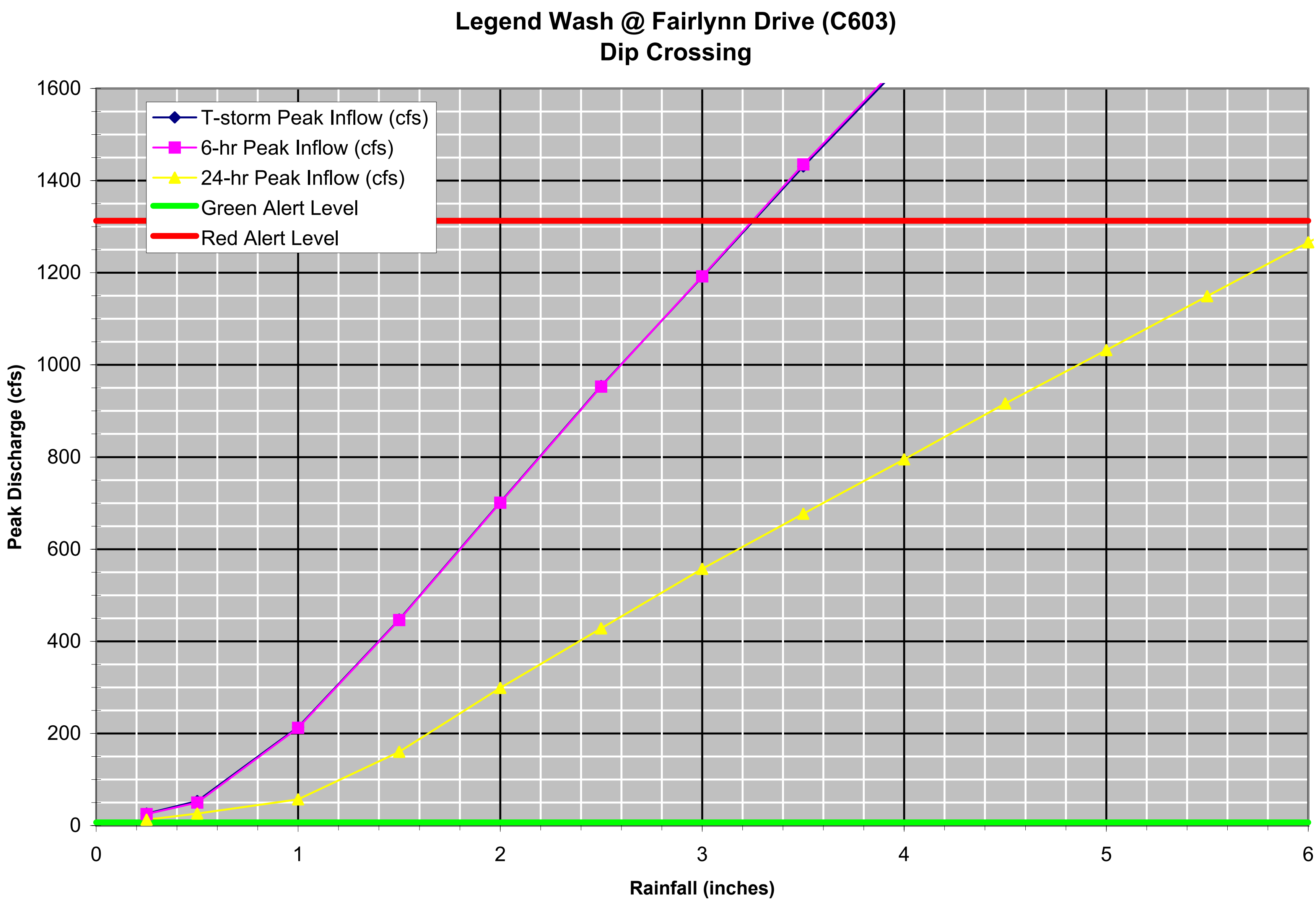


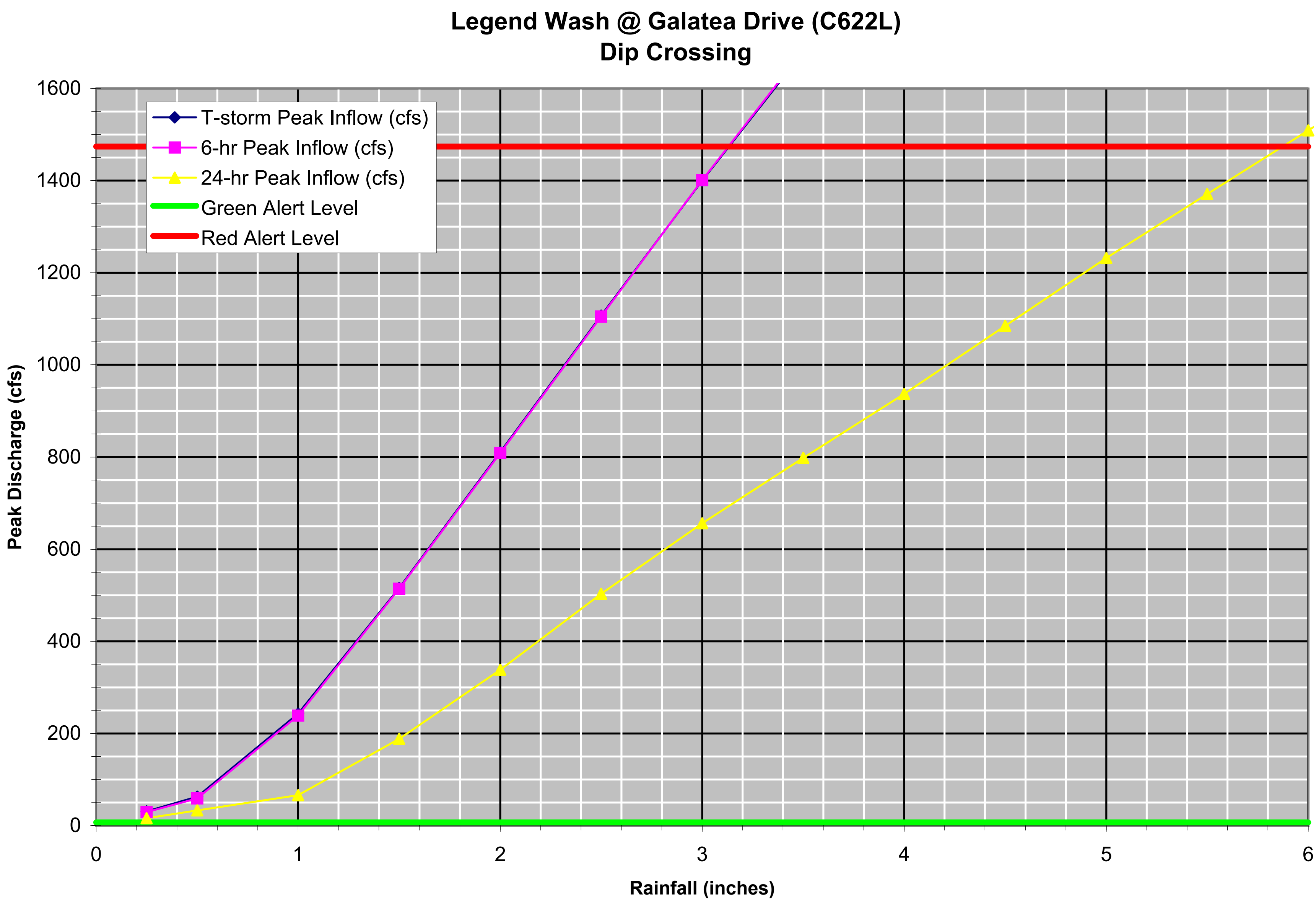
Glenbrook Boulevard near Mayflower Drive (C546)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
500
400
300
200
100
0
0
1
2
3
4
5
6
Rainfall (inches)

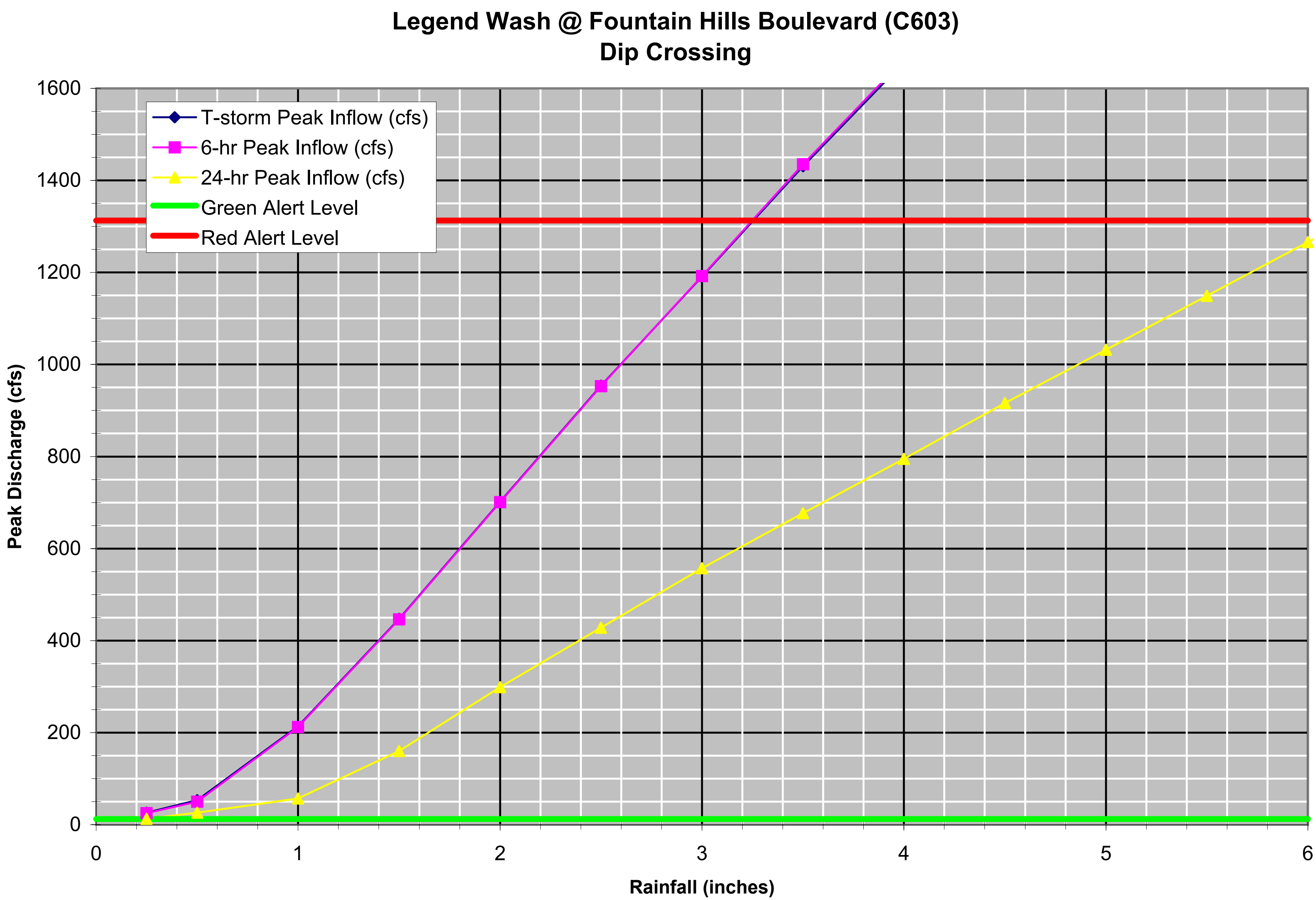


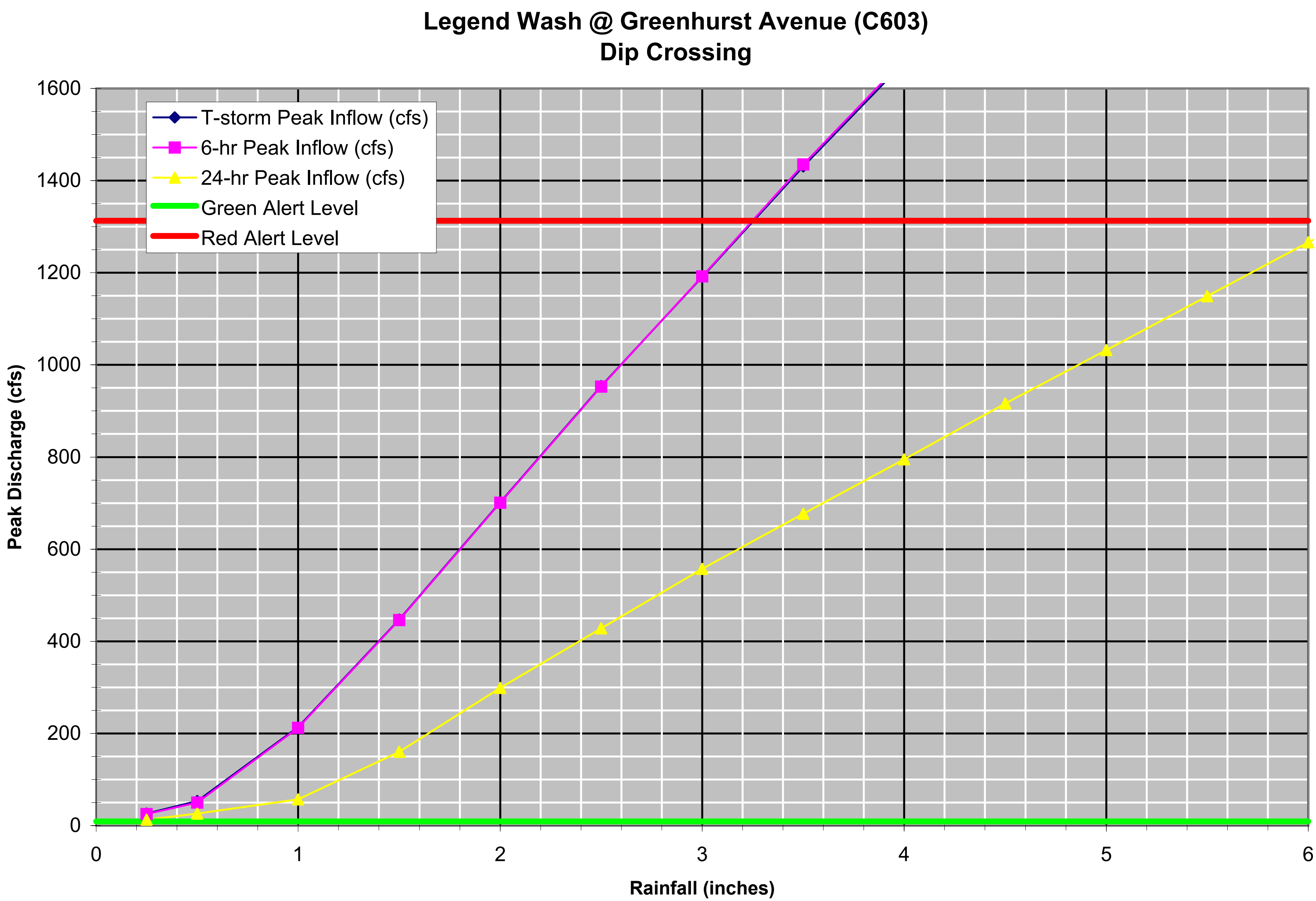
Hesperus Wash at Boulder Avenue (C538O)
1-60" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
0
1
2
3
4
5
6


Hesperus Wash at Richwood Avenue (C537)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
0
1
2
3
4
5
6

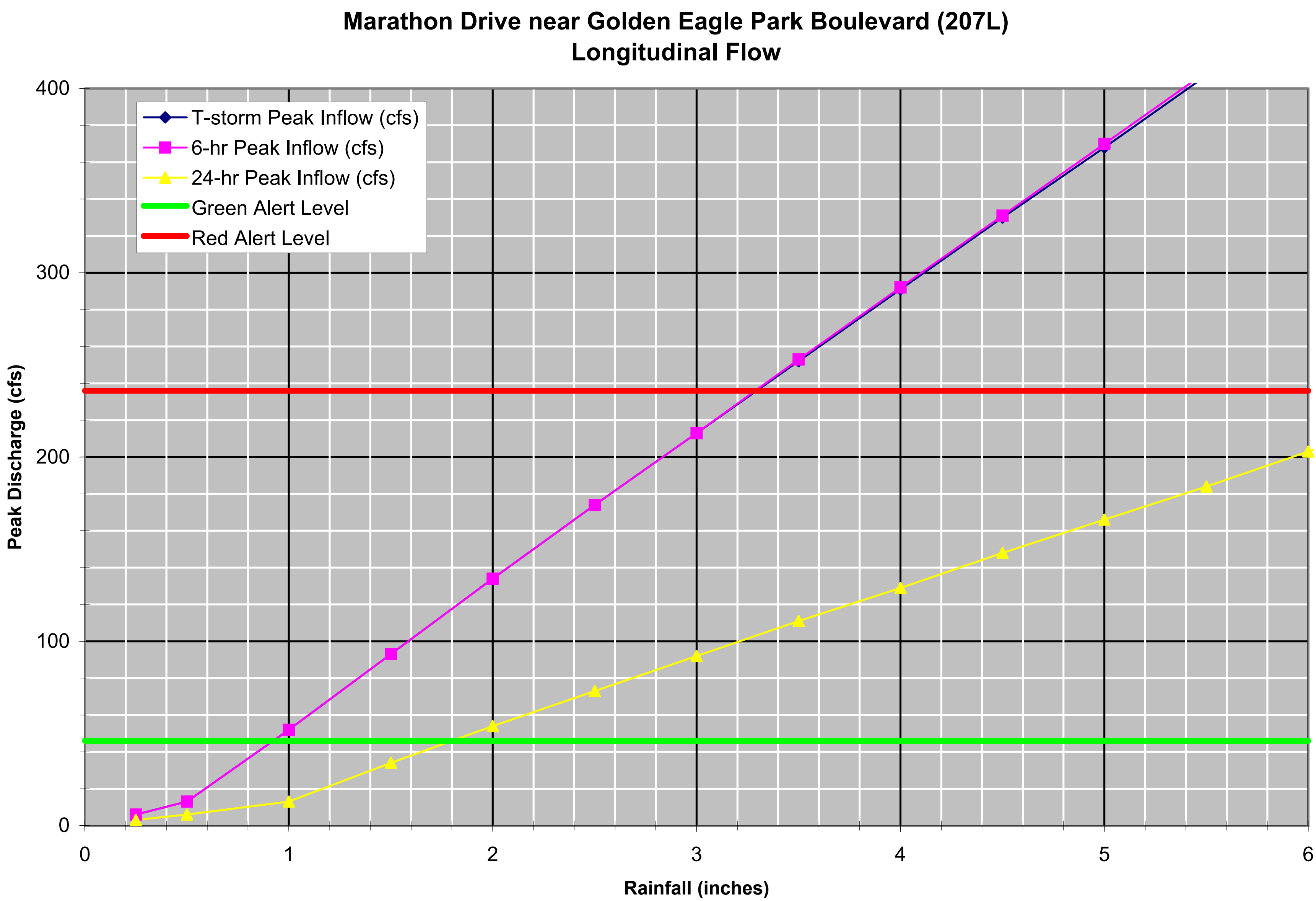

Legend Wash @ Fairlynn Drive (C603)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

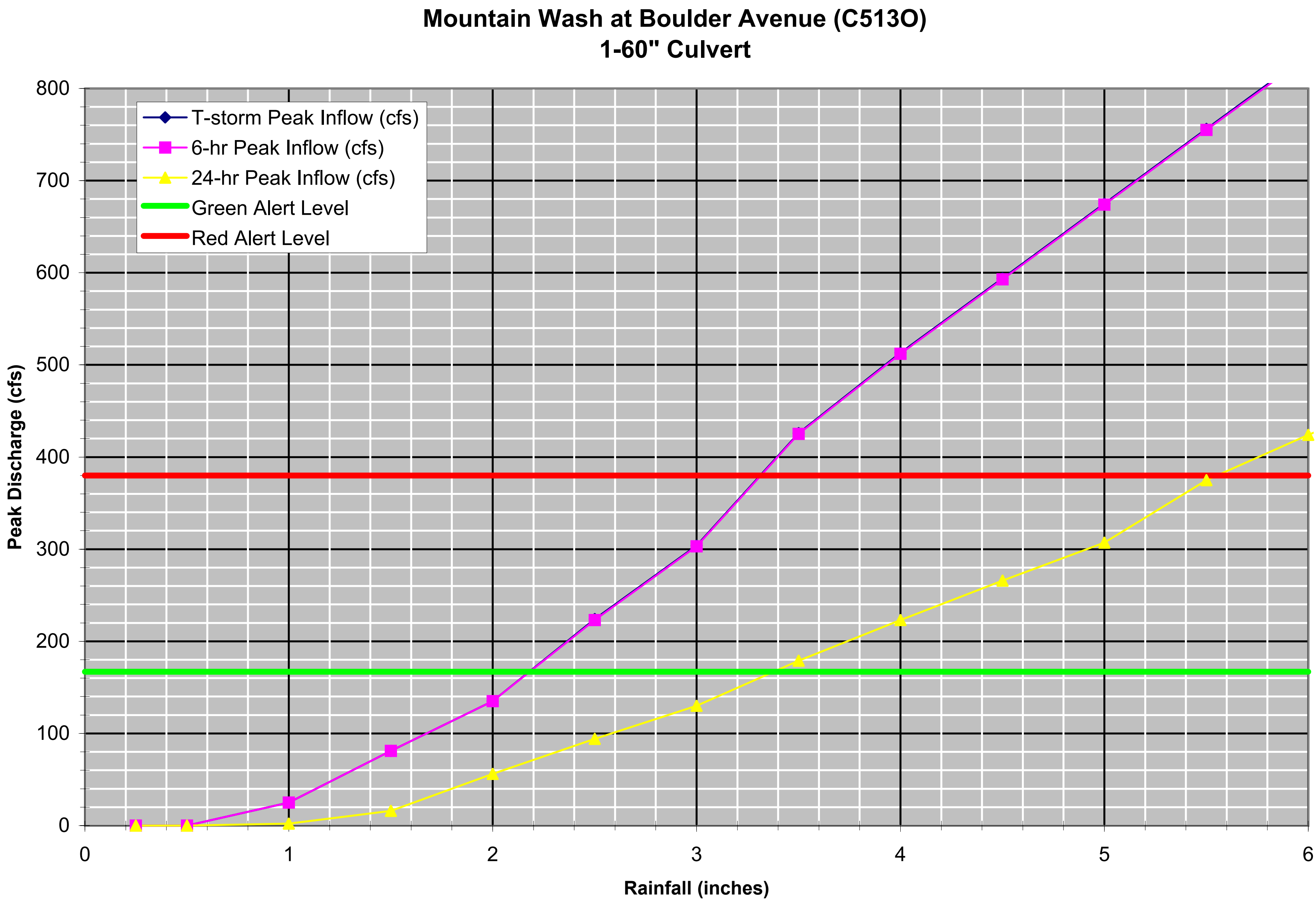

Legend Wash @ Galatea Drive (C622L)
Dip Crossing
Peak Discharge (cfs)
0
200
400
600
800
1000
1200
1400
1600
Rainfall (inches)
0
1
2
3
4
5
6
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level


Legend Wash @ Fountain Hills Boulevard (C603)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

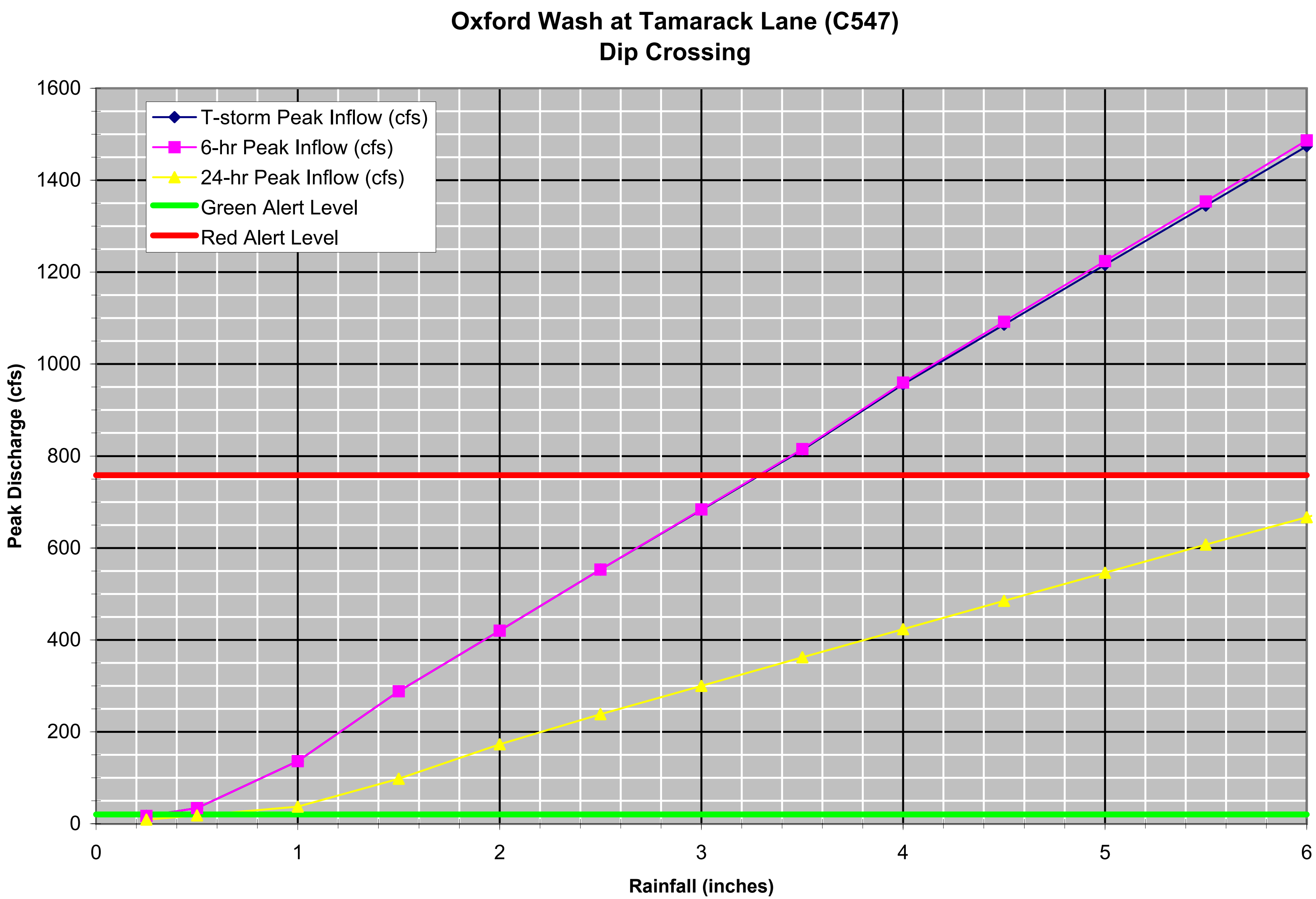


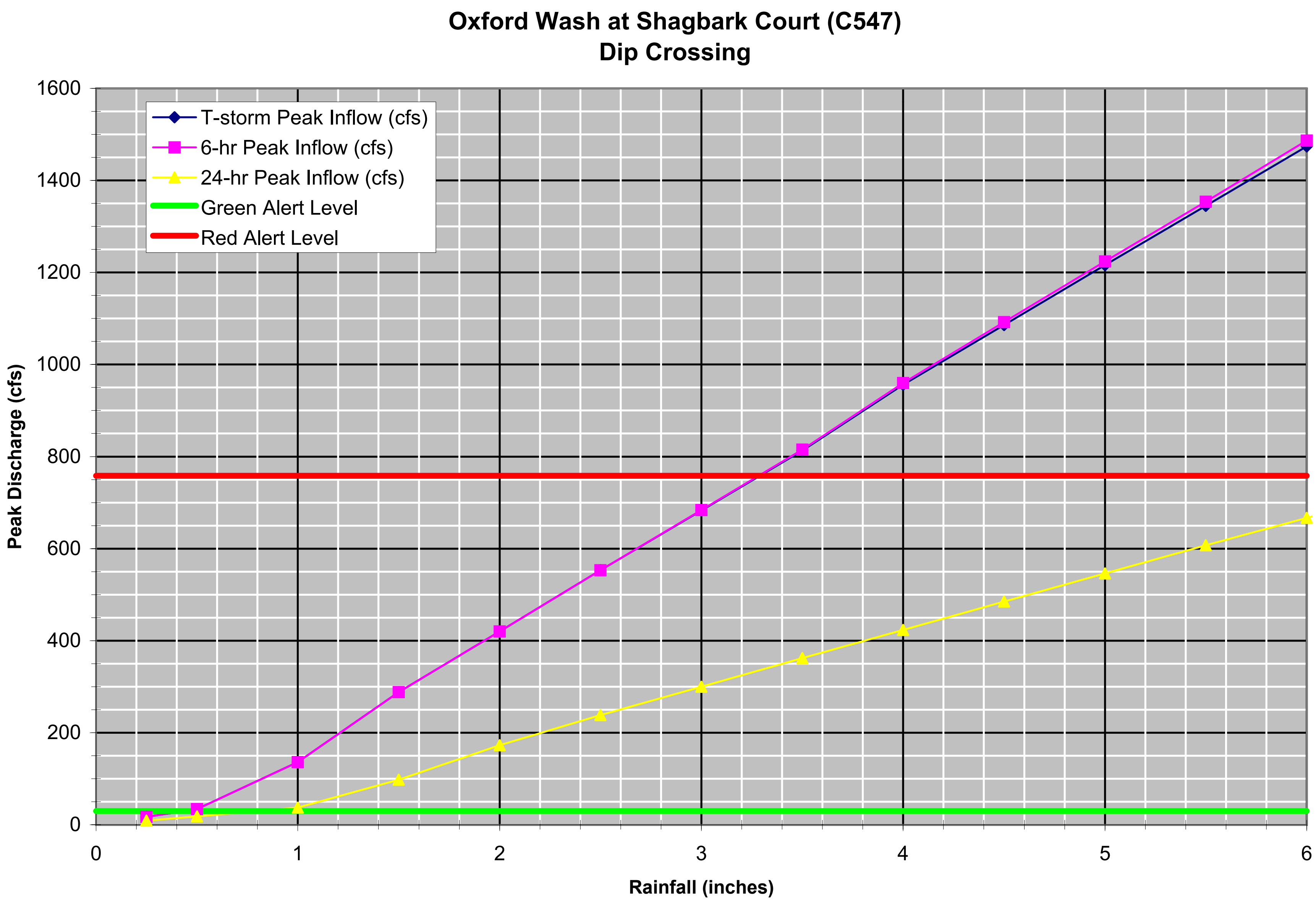
Legend Wash @ Greenhurst Avenue (C603)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
1600
1400
1200
1000
800
600
400
200
0
0
1
2
3
4
5
6


Marathon Drive near Golden Eagle Park Boulevard (207L)
Longitudinal Flow
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
0
1
2
3
4
5
6

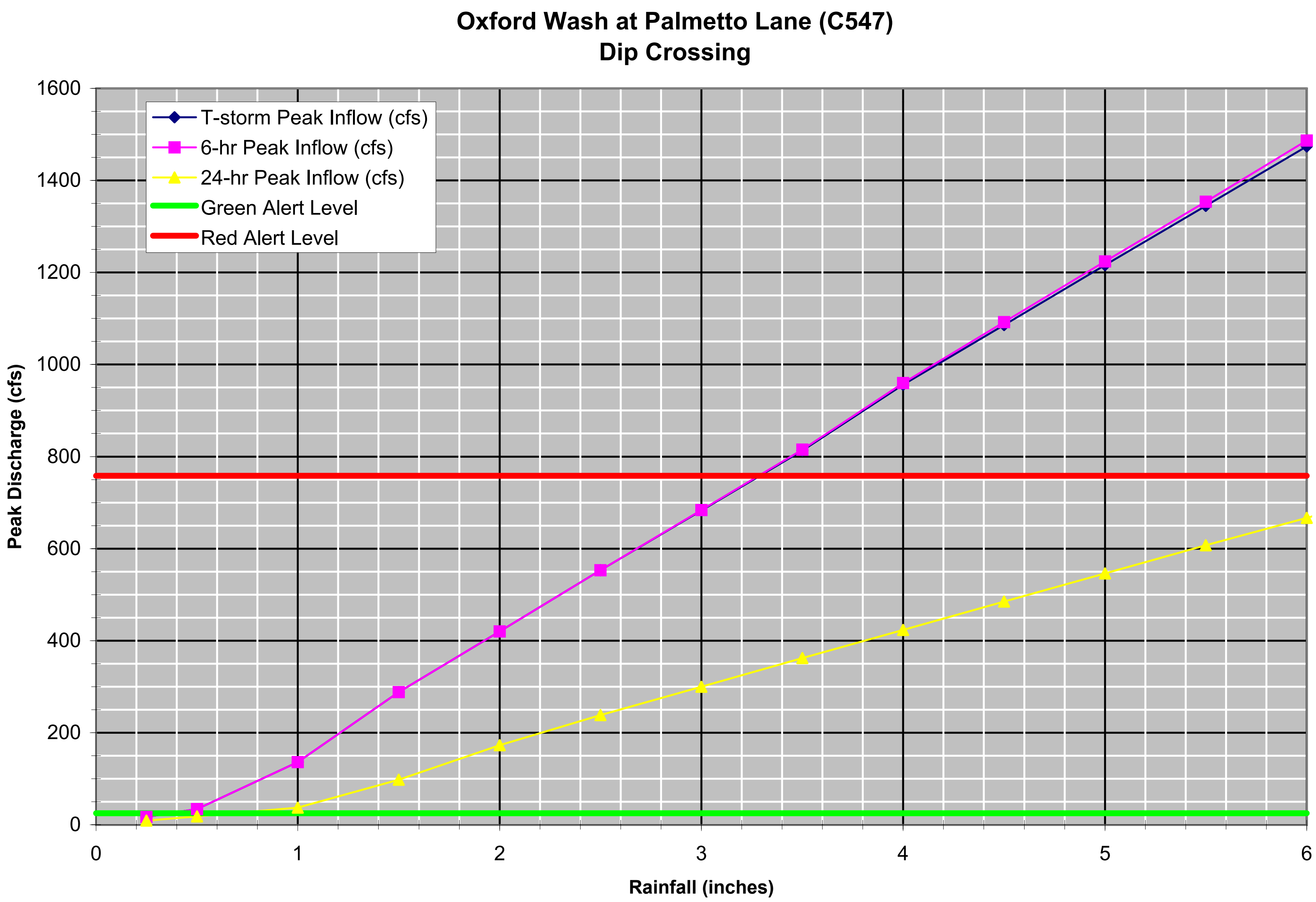


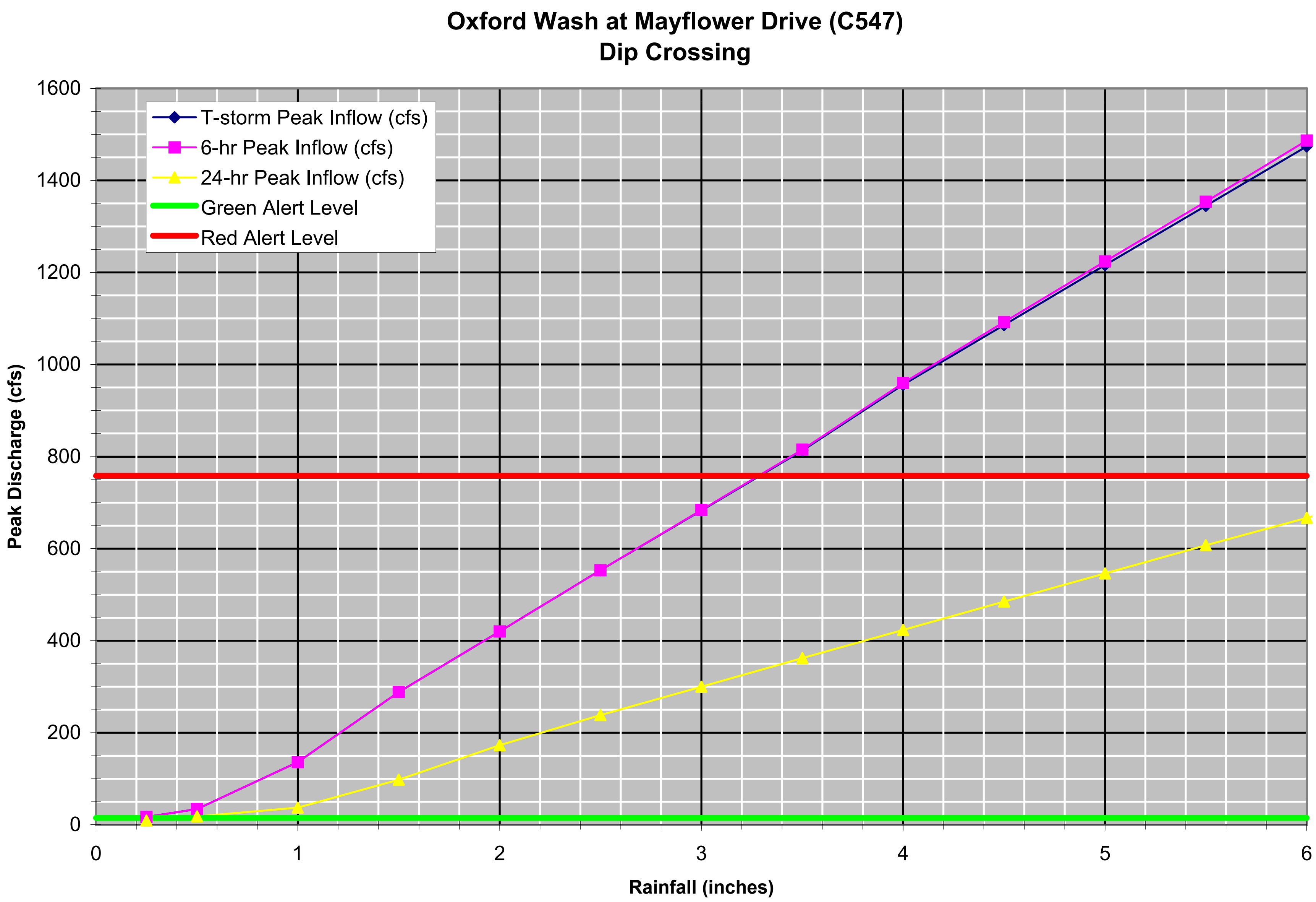
Mountain Wash at Boulder Avenue (C513O)
1-60" Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
800
700
600
500
400
300
200
100
0
0
1
2
3
4
5
6
Rainfall (inches)

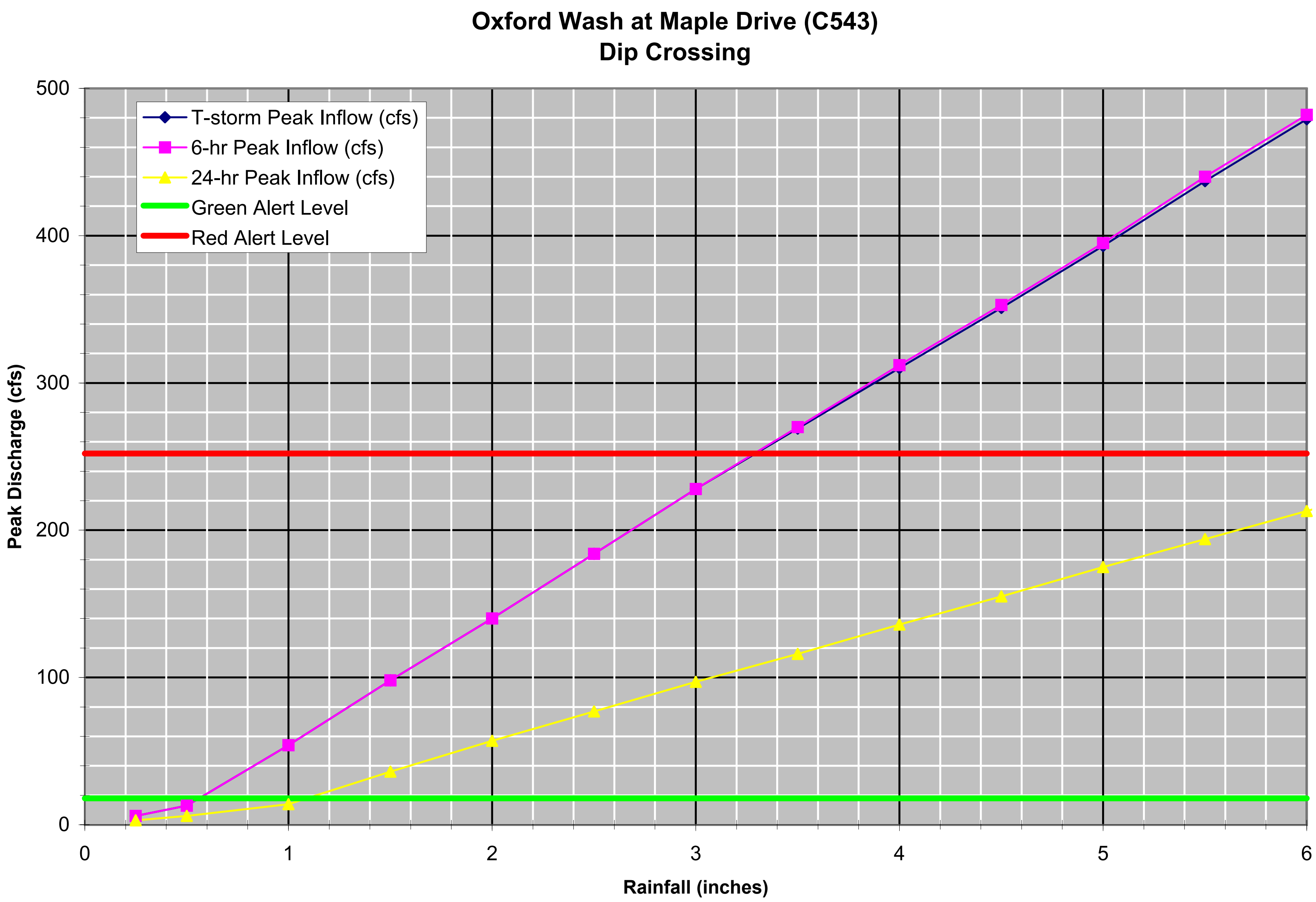

Oxford Wash at Tamarack Lane (C547)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6



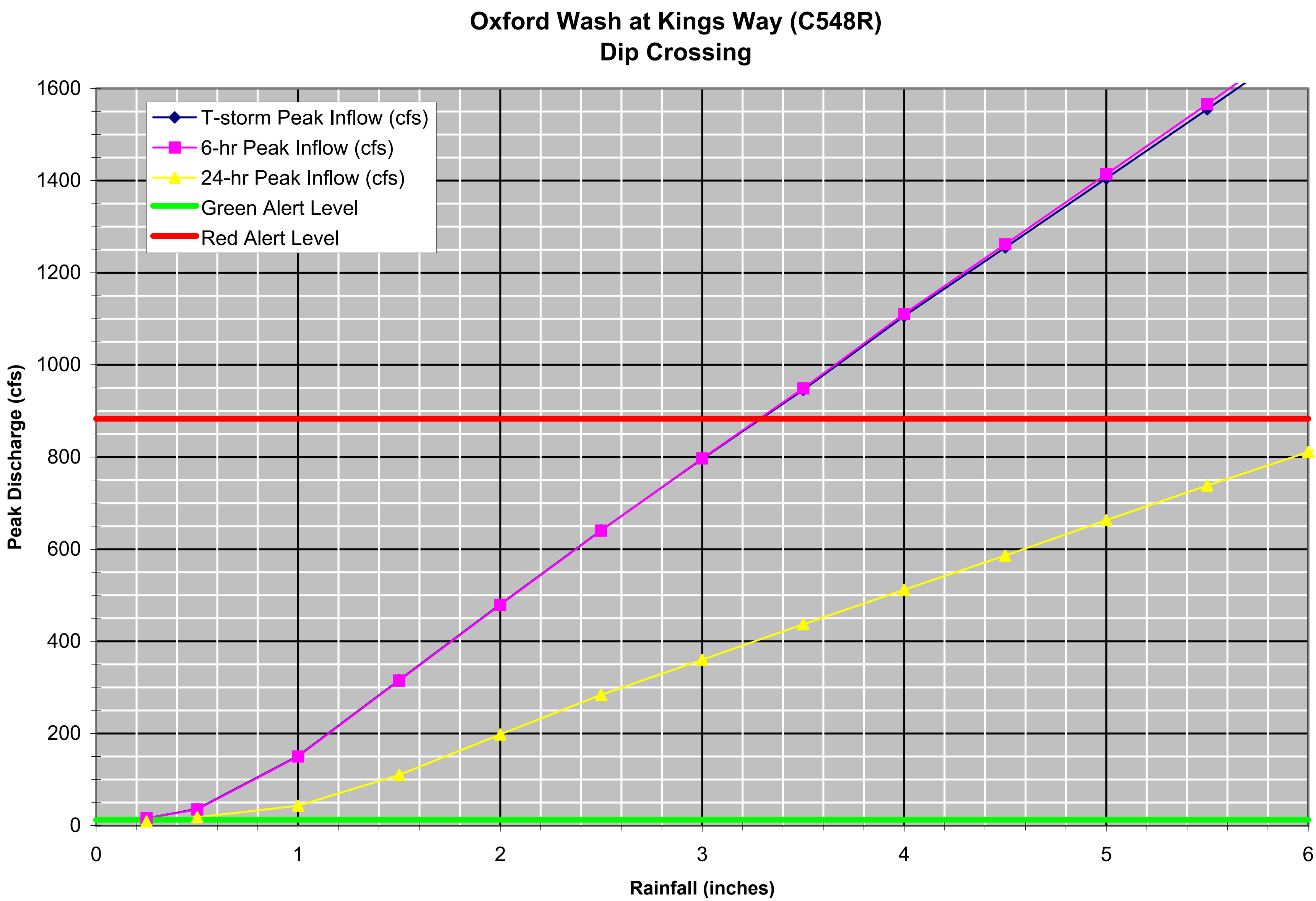
Oxford Wash at Shagbark Court (C547)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

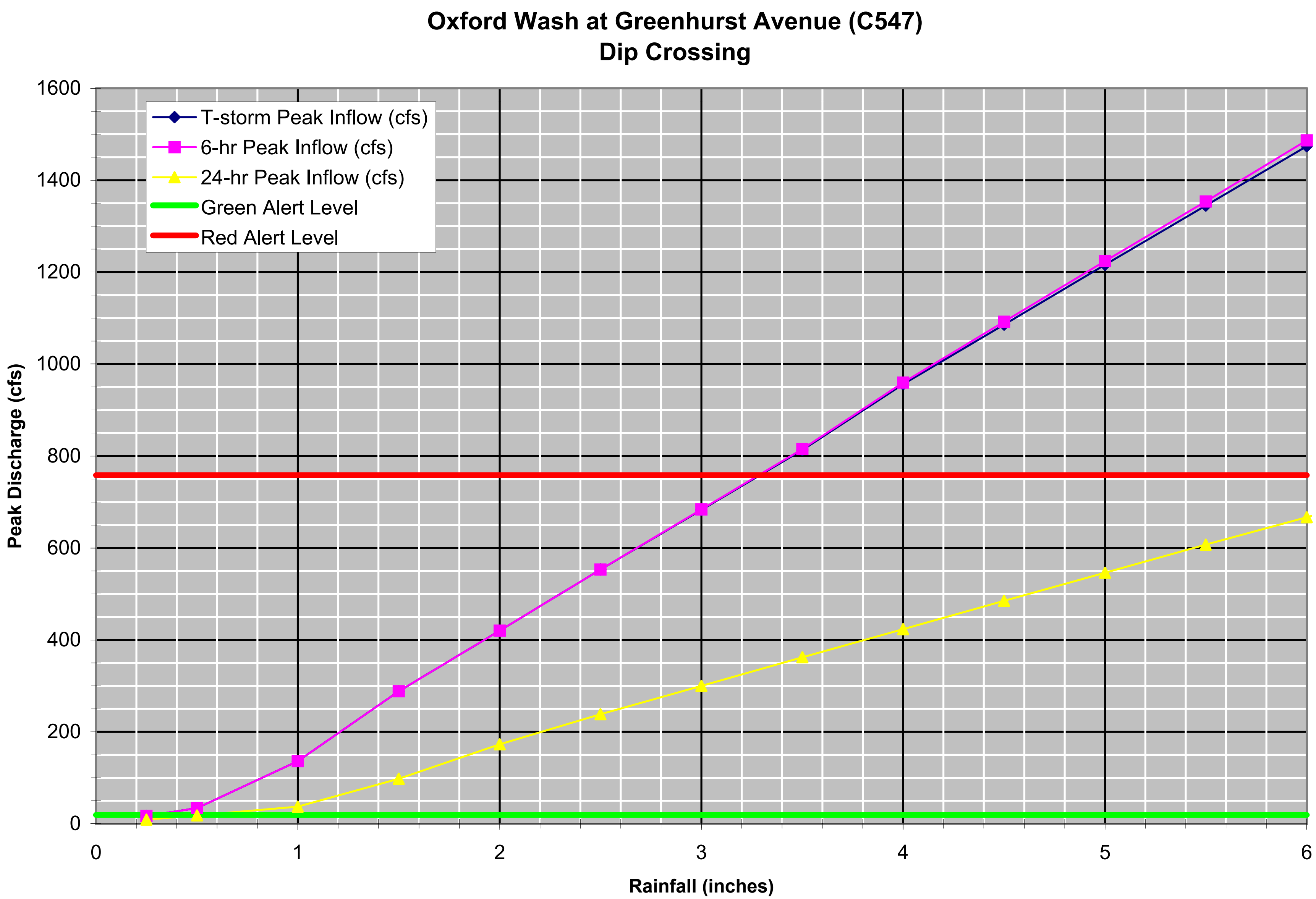

Oxford Wash at Palmetto Lane (C547)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

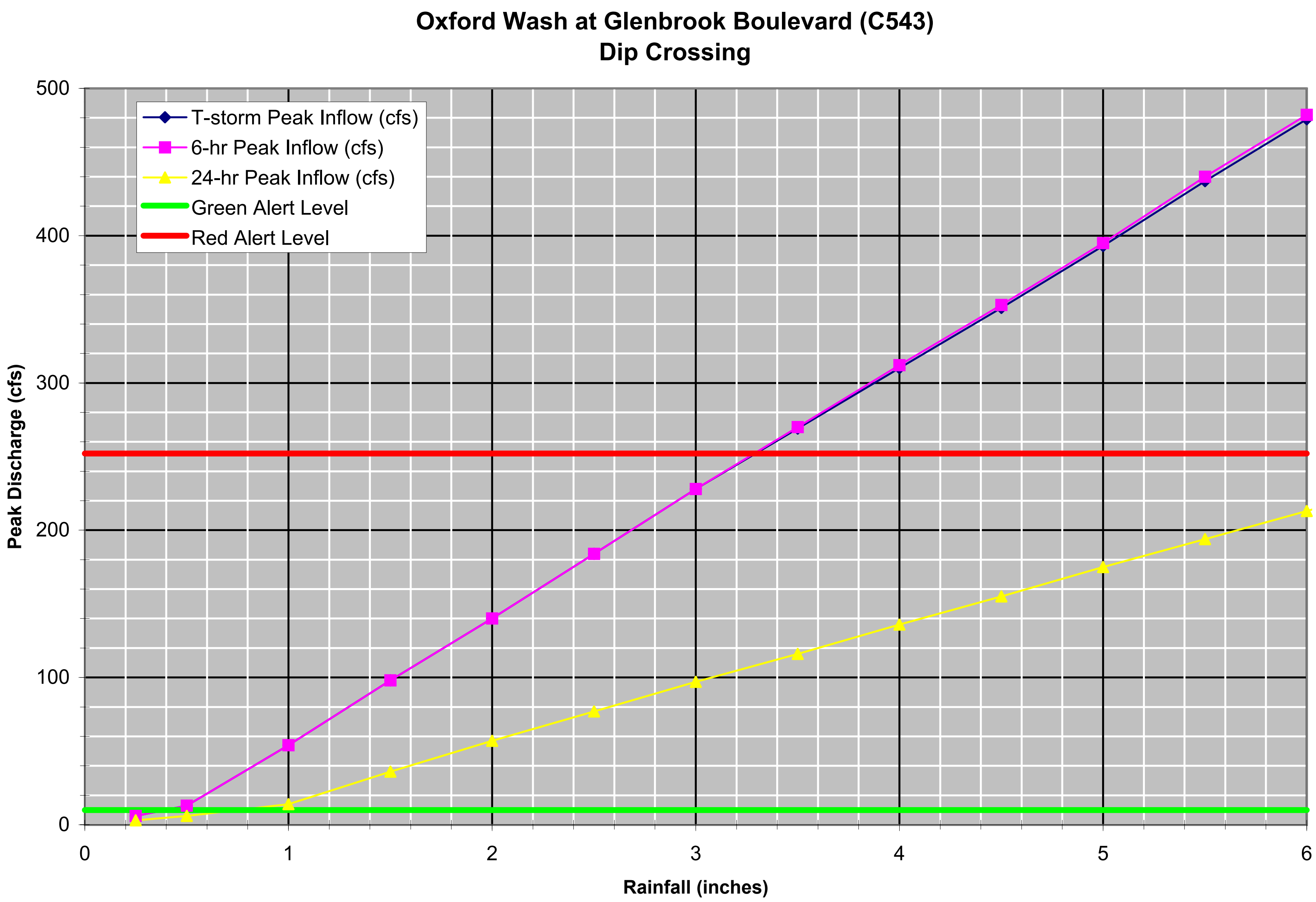

Oxford Wash at Mayflower Drive (C547)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6



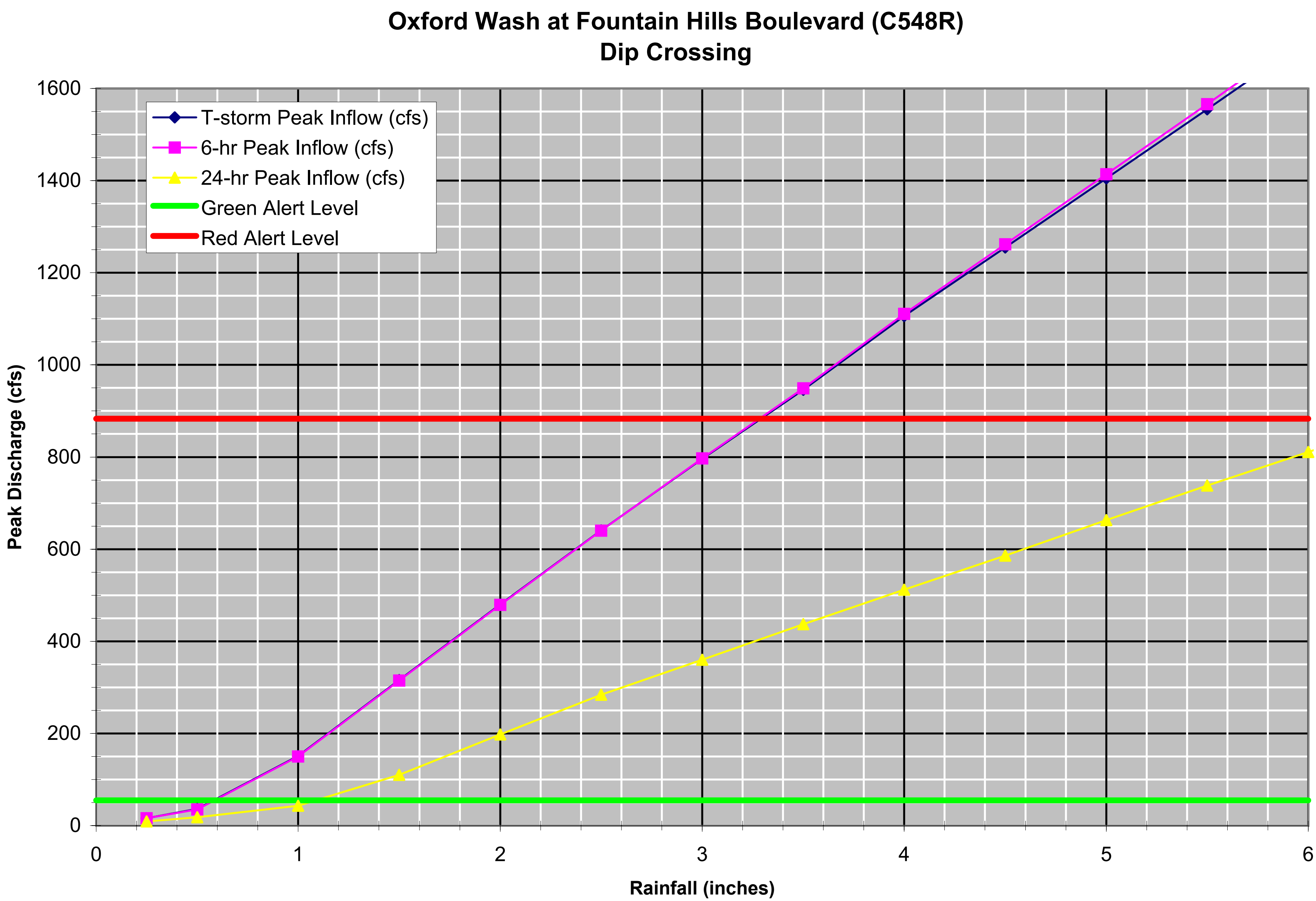
Oxford Wash at Maple Drive (C543)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
500
400
300
200
100
0
0
1
2
3
4
5
6
Rainfall (inches)


Oxford Wash at Kings Way (C548R)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

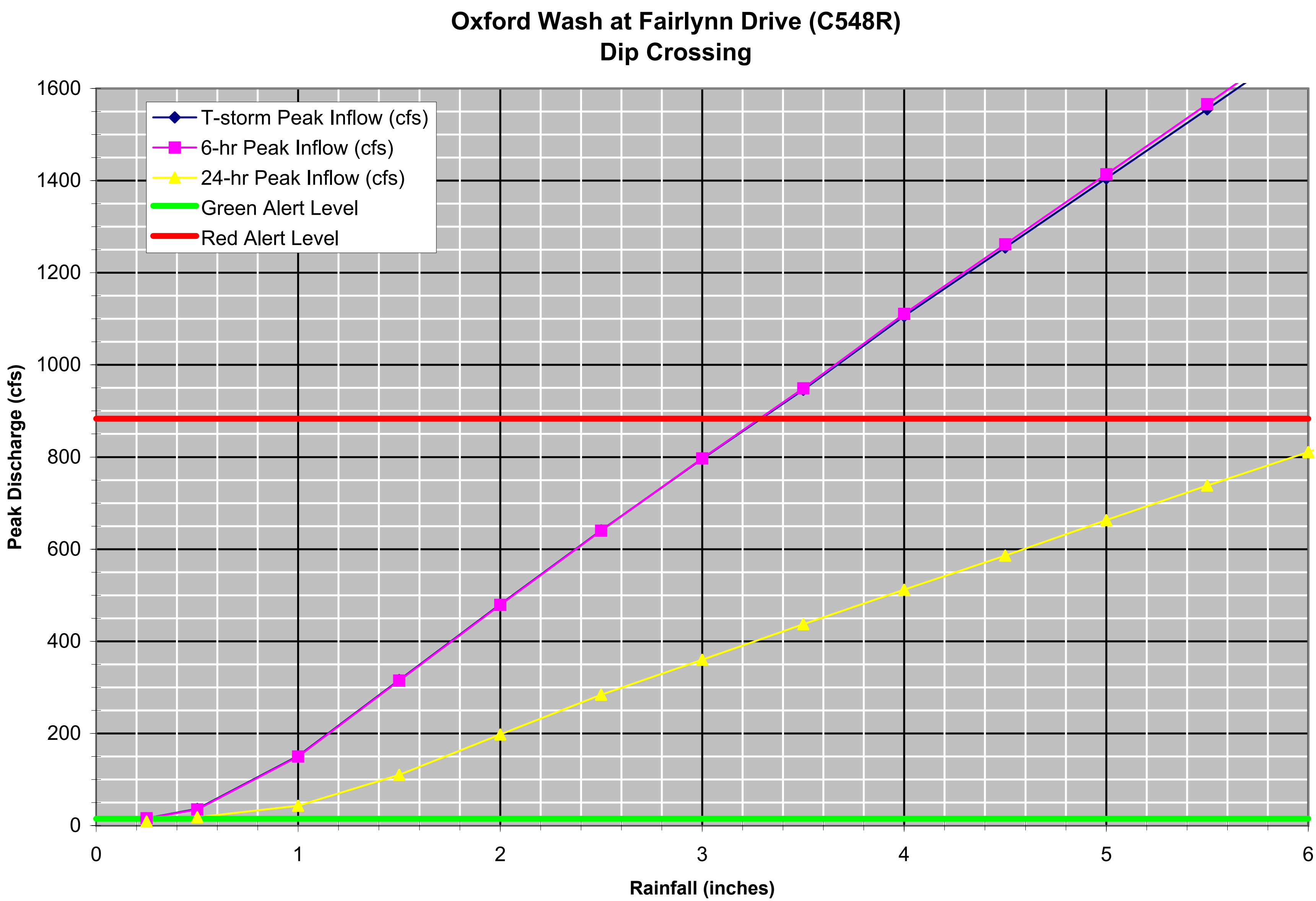

Oxford Wash at Greenhurst Avenue (C547)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6



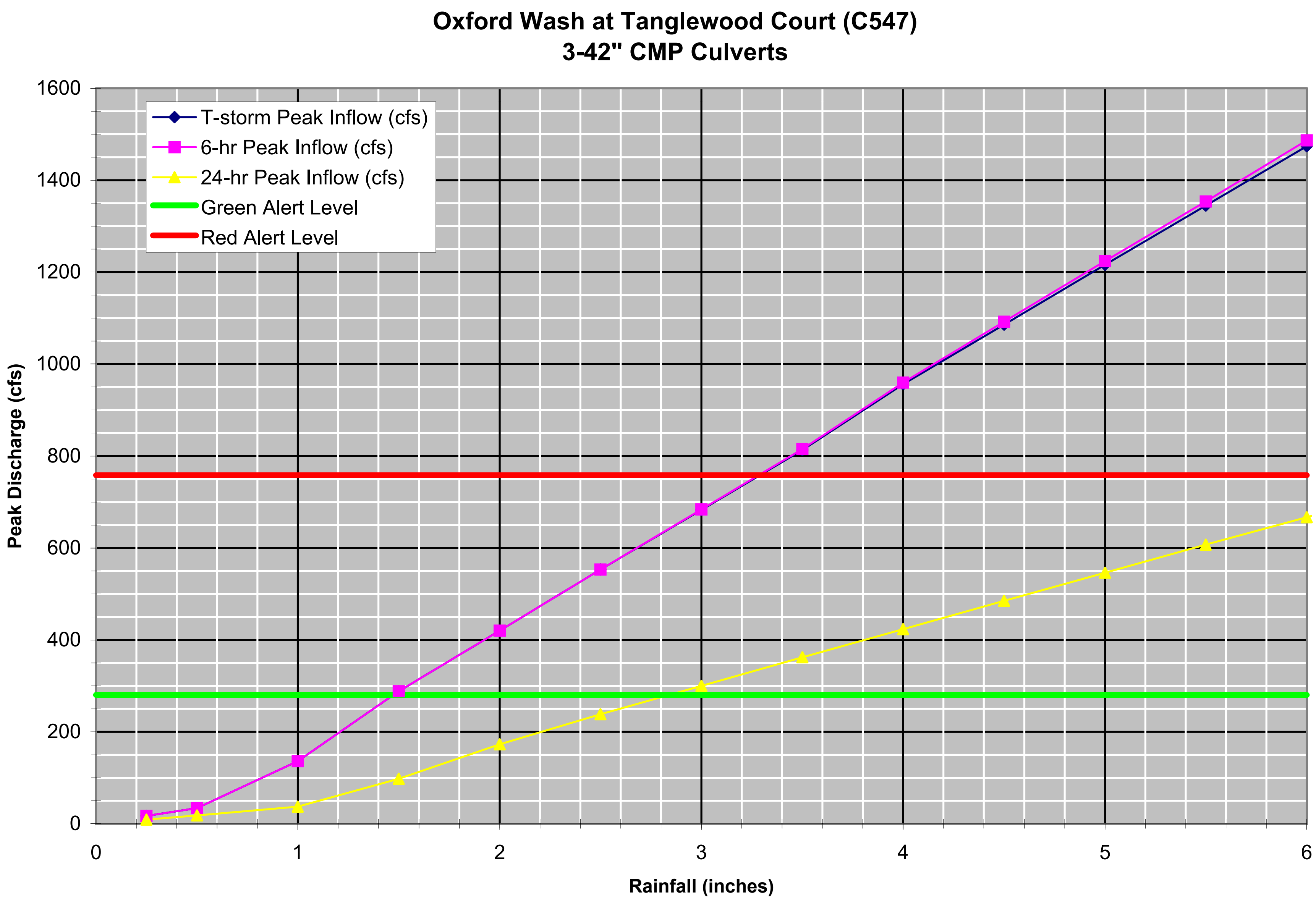
Oxford Wash at Glenbrook Boulevard (C543)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
100
200
300
400
500
0
1
2
3
4
5
6



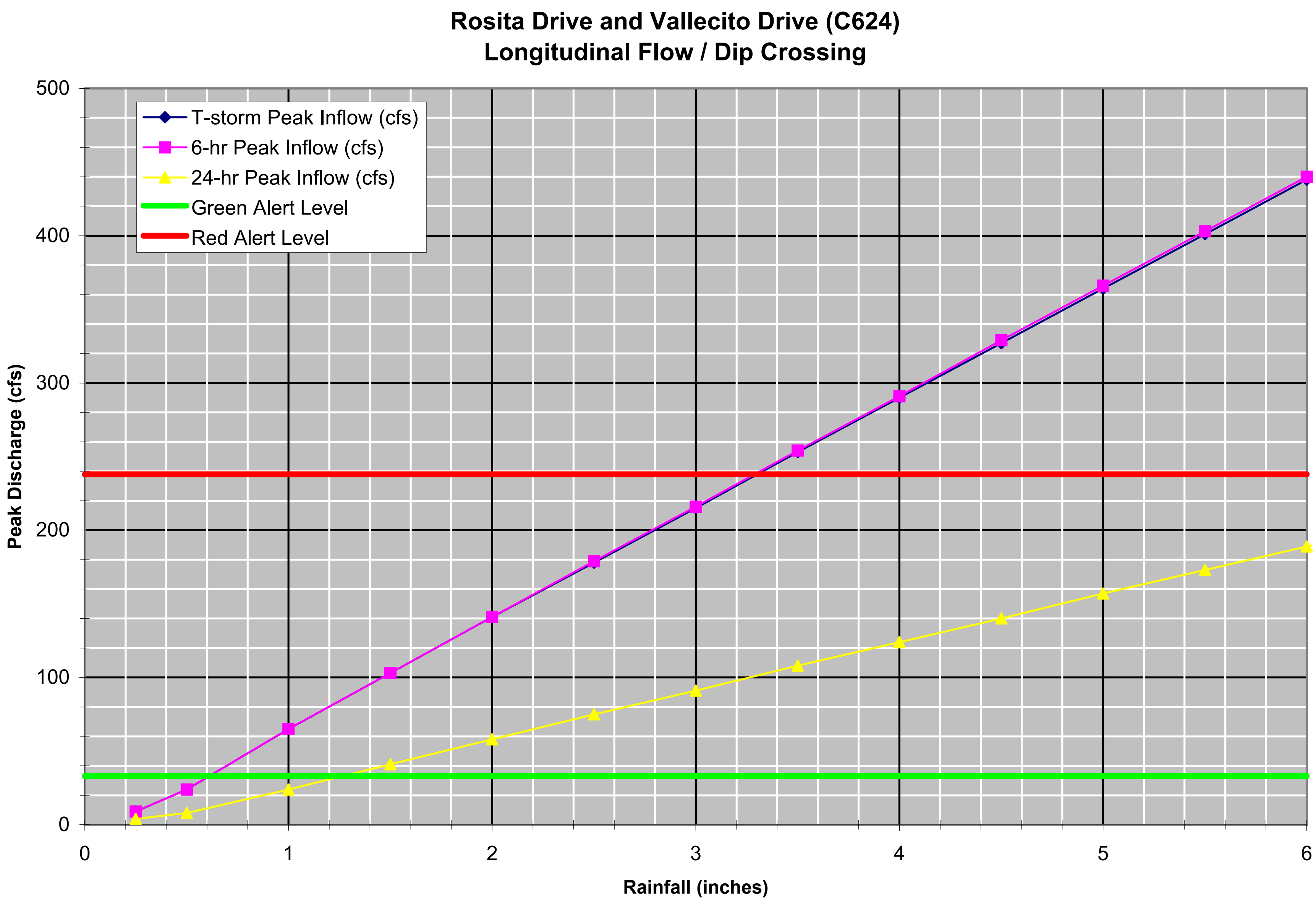
Oxford Wash at Fountain Hills Boulevard (C548R)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

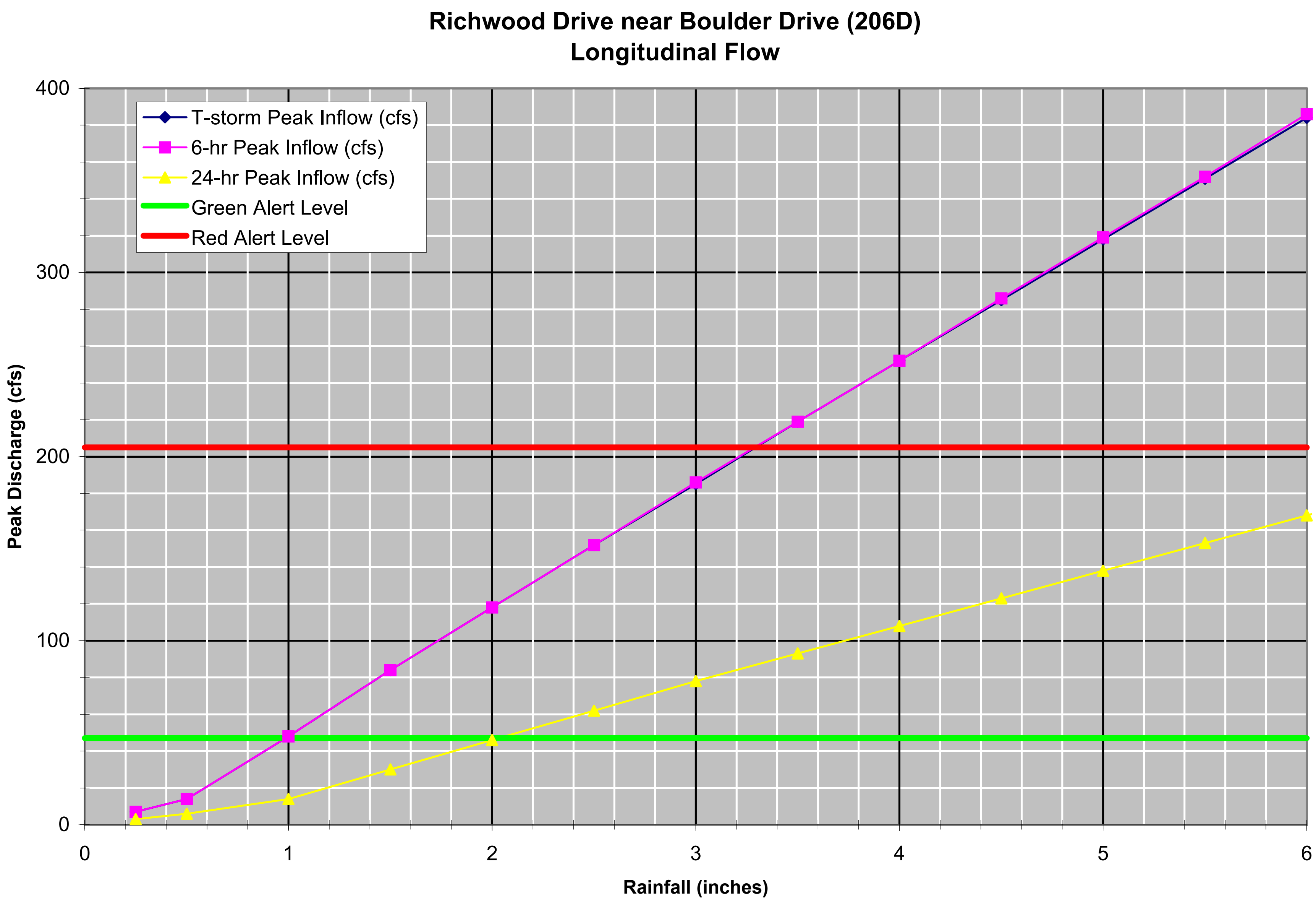


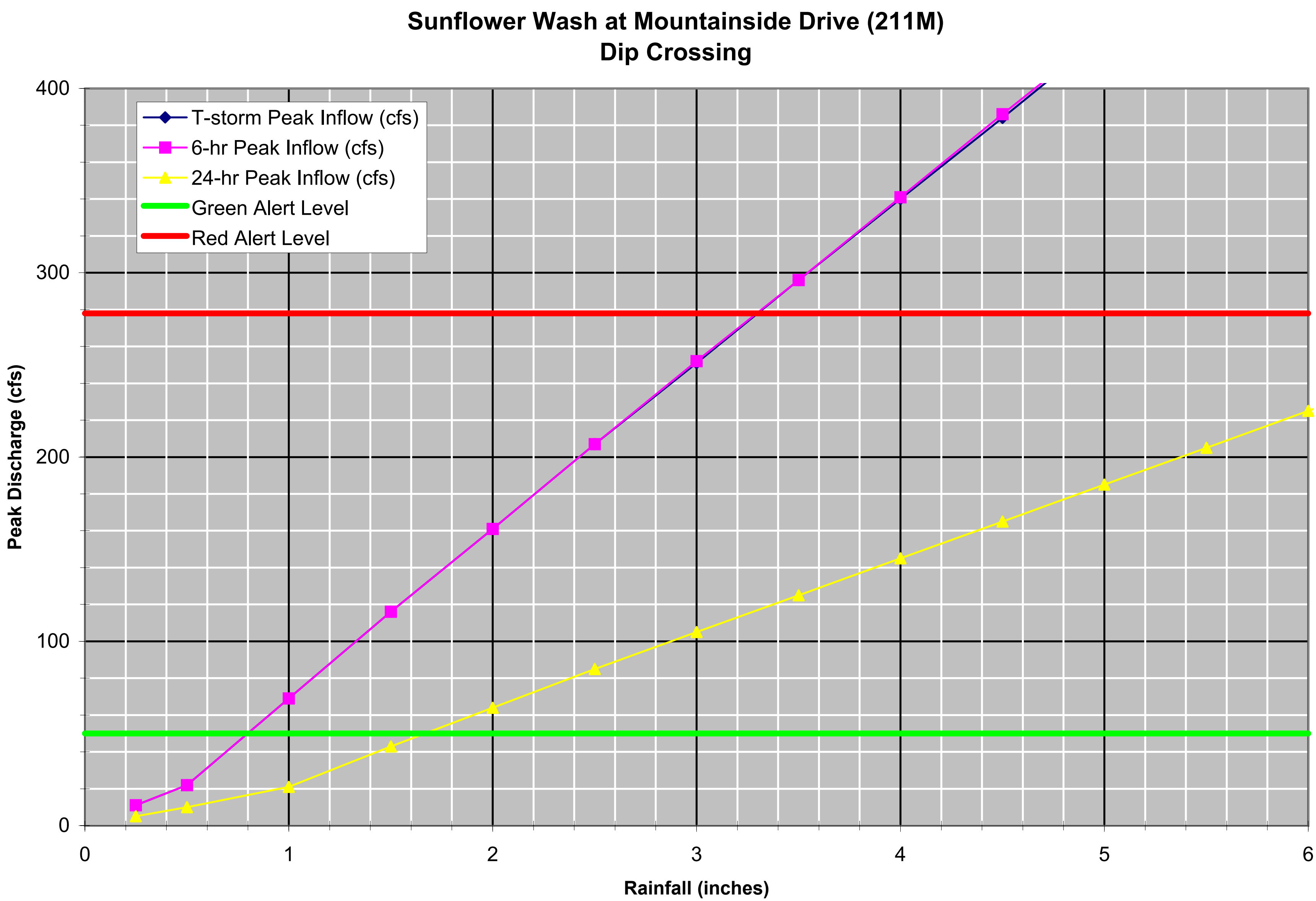
Oxford Wash at Fairlynn Drive (C548R)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

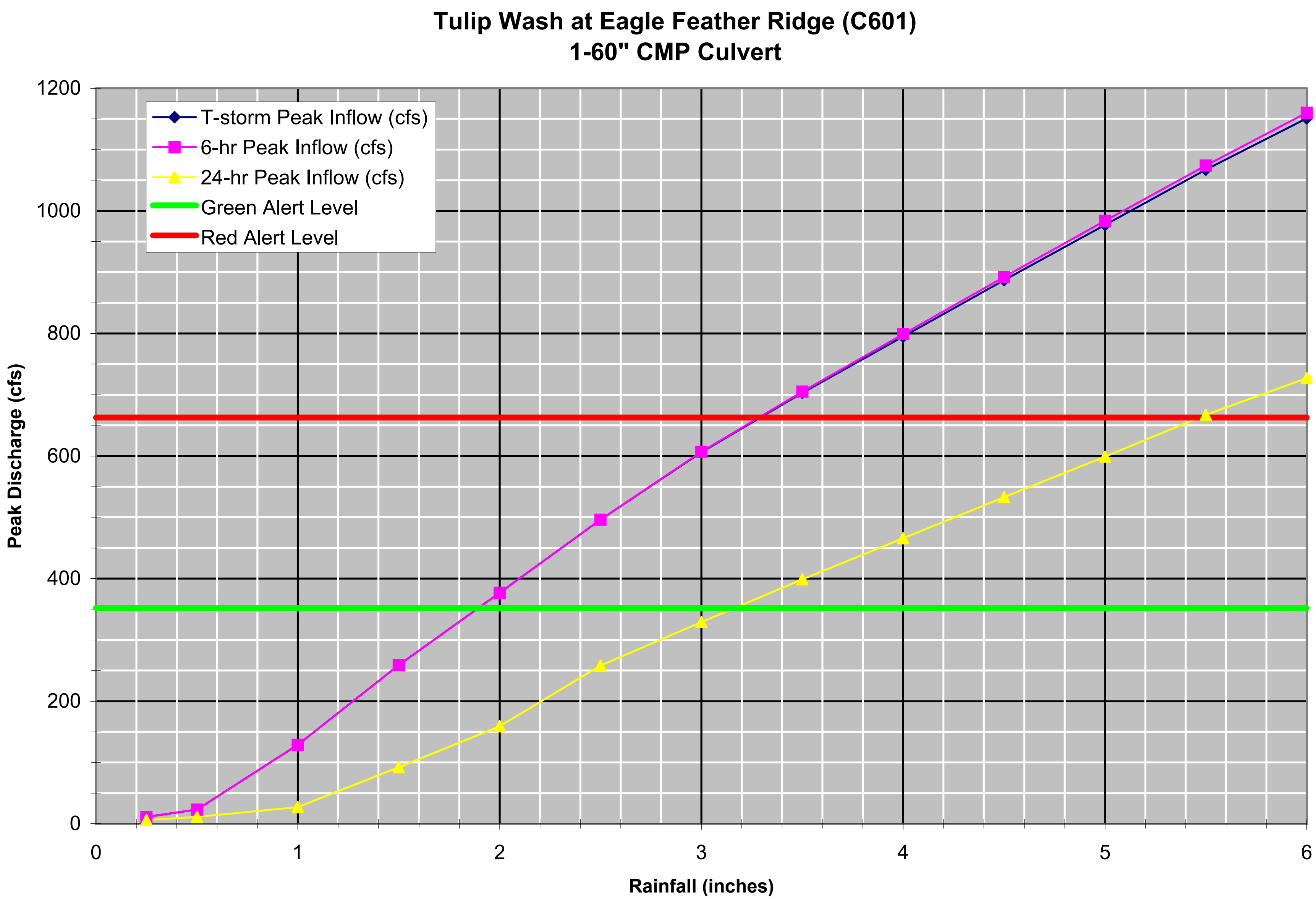


Oxford Wash at Tanglewood Court (C547)
3-42" CMP Culverts
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6

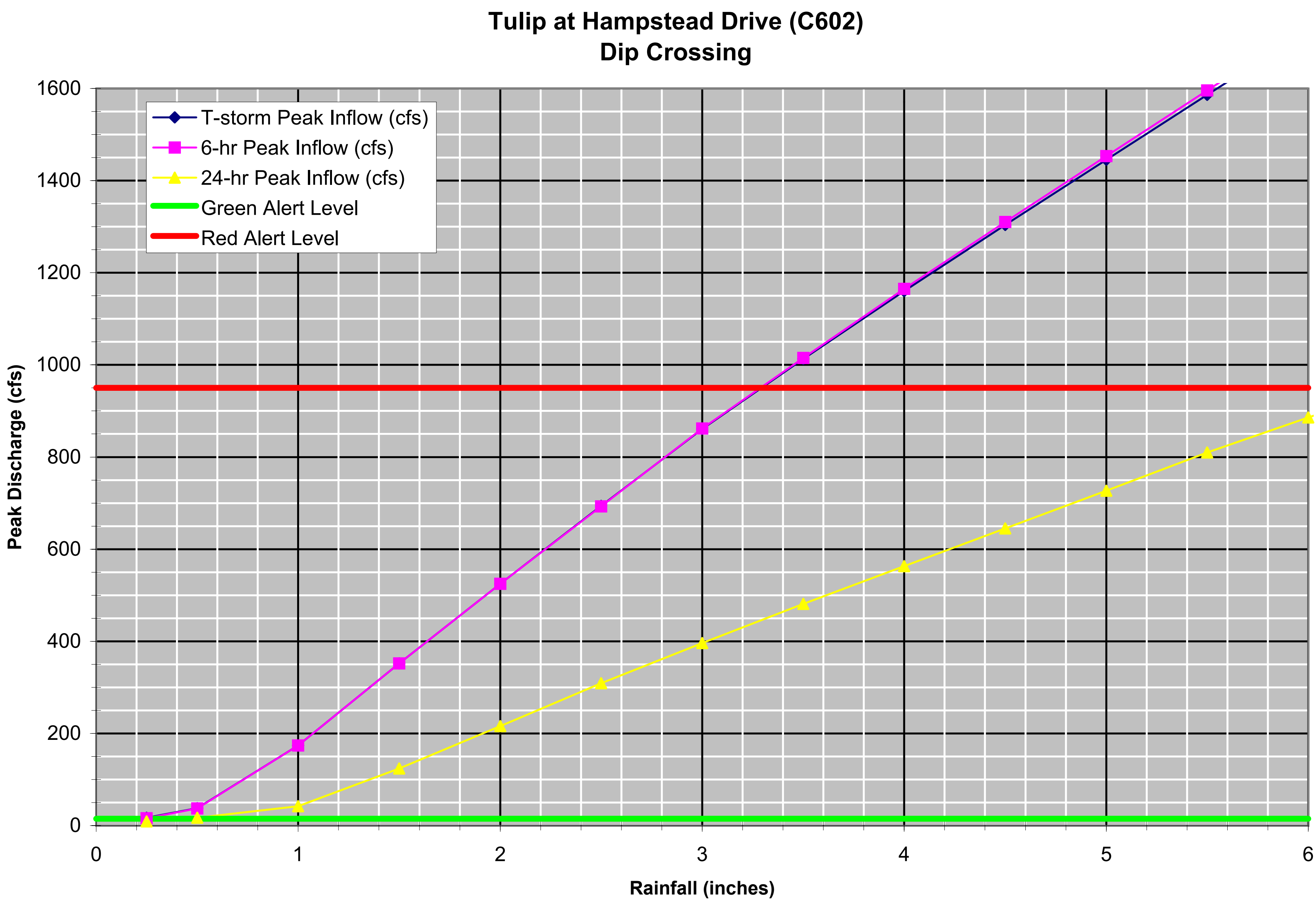

Rosita Drive and Vallecito Drive (C624)
Longitudinal Flow / Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
0
1
2
3
4
5
6


Richwood Drive near Boulder Drive (206D)
Longitudinal Flow
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
0
1
2
3
4
5
6

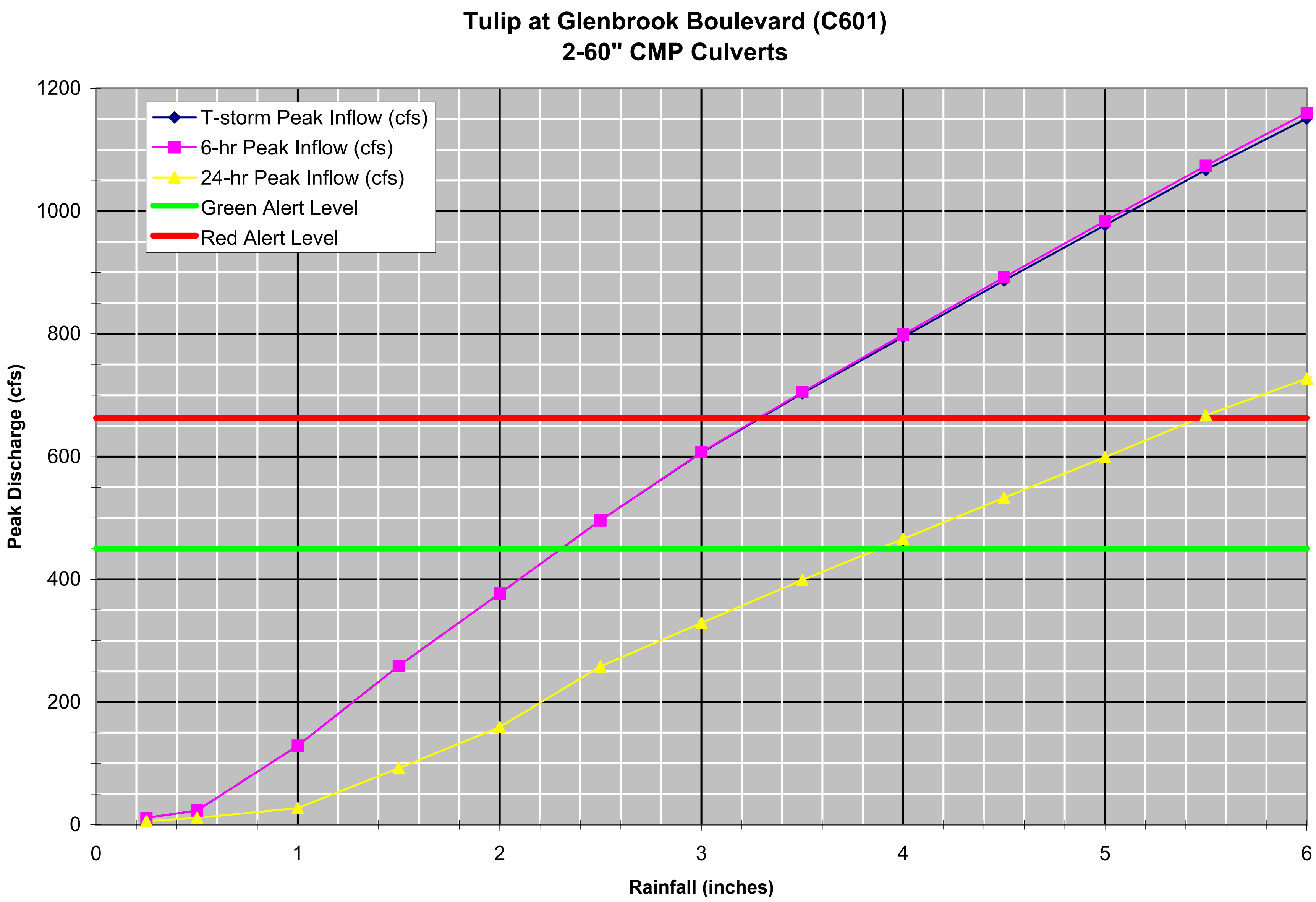

Sunflower Wash at Mountainside Drive (211M)
Dip Crossing
Peak Discharge (cfs)
Rainfall (inches)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
0
100
200
300
400
0
1
2
3
4
5
6

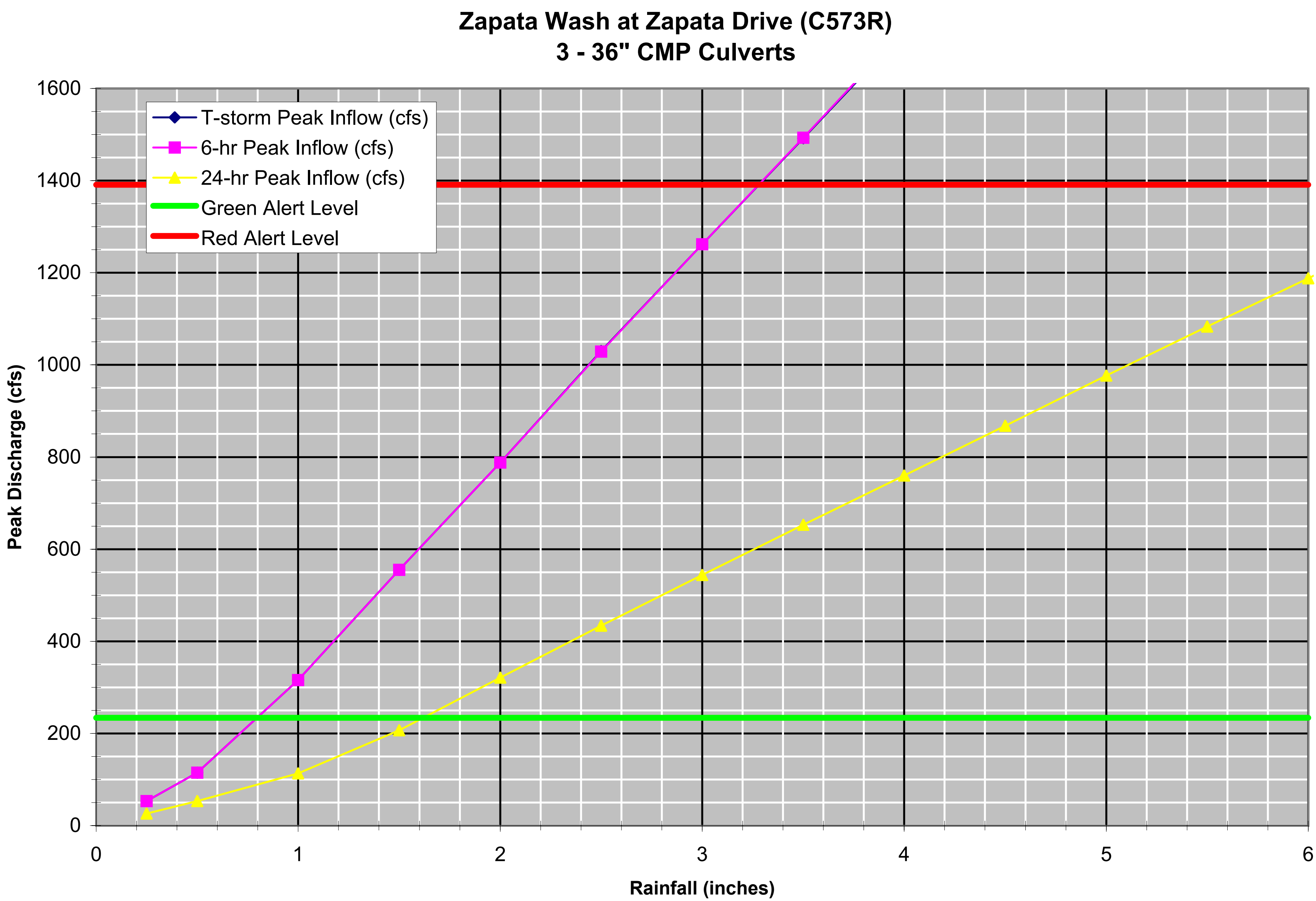


Tulip Wash at Eagle Feather Ridge (C601)
1-60" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
200
400
600
800
1000
1200
Rainfall (inches)
0
1
2
3
4
5
6



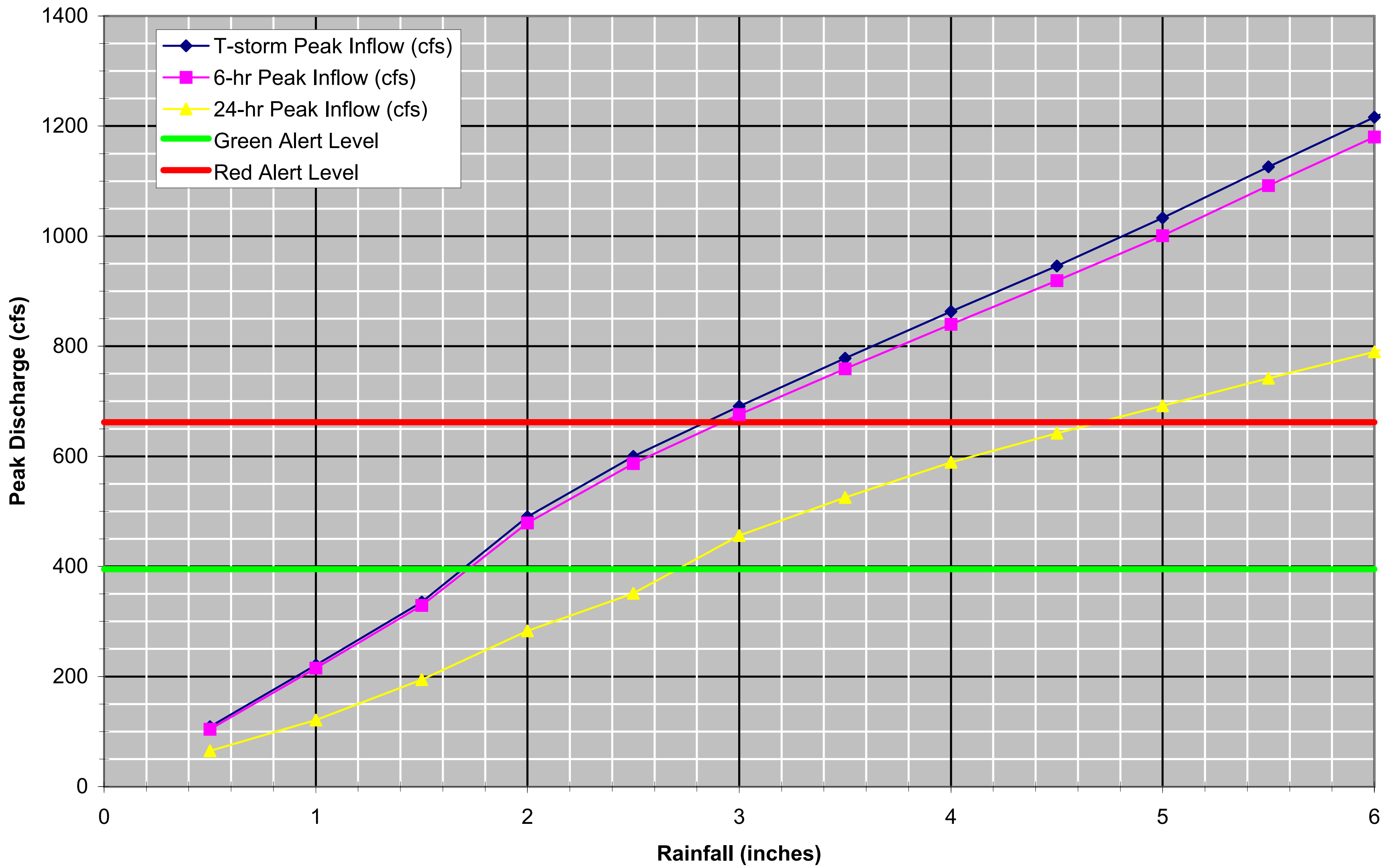
Tulip at Hampstead Drive (C602)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
200
400
600
800
1000
1200
1400
1600
0
1
2
3
4
5
6
Rainfall (inches)

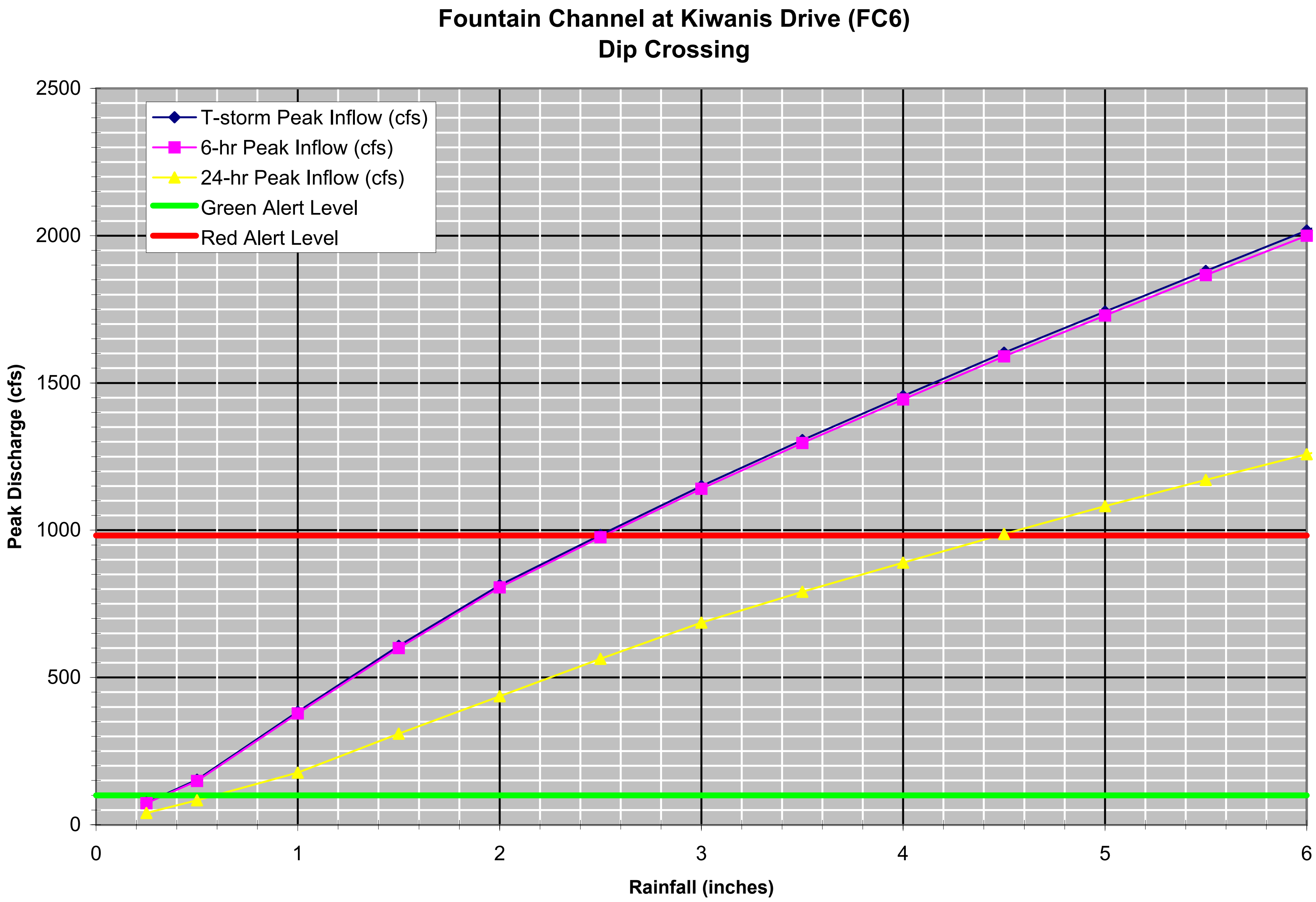

Tulip at Glenbrook Boulevard (C601)
2-60" CMP Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
1200
1000
800
600
400
200
0
0
1
2
3
4
5
6
Rainfall (inches)


Zapata Wash at Zapata Drive (C573R)
3 - 36" CMP Culverts
Peak Discharge (cfs)
0
200
400
600
800
1000
1200
1400
1600
Rainfall (inches)
0
1
2
3
4
5
6
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level

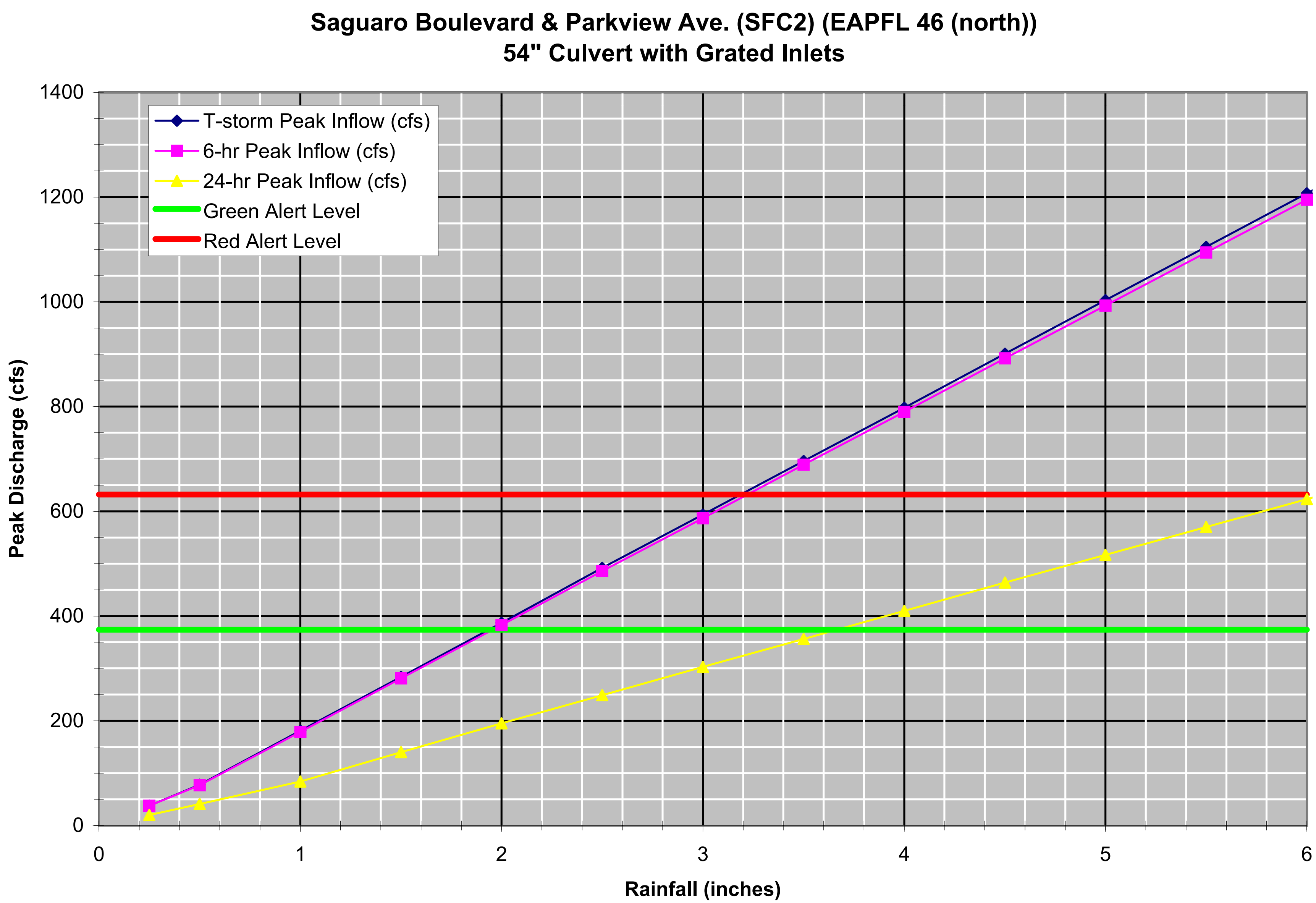
Colony Wash System

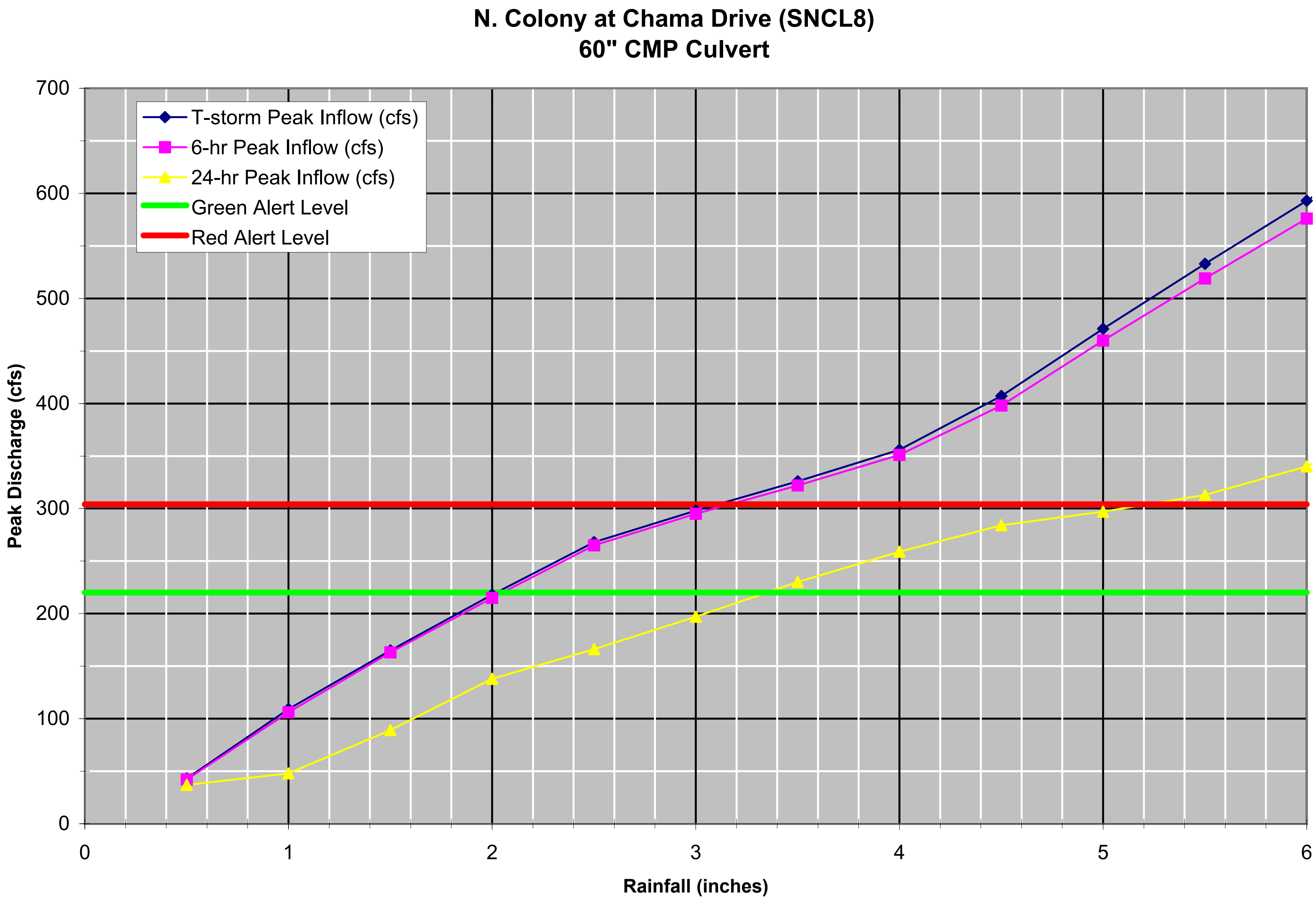
Colony Wash at Saguaro Boulevard (SCLN5)
1-72"x166' Culvert



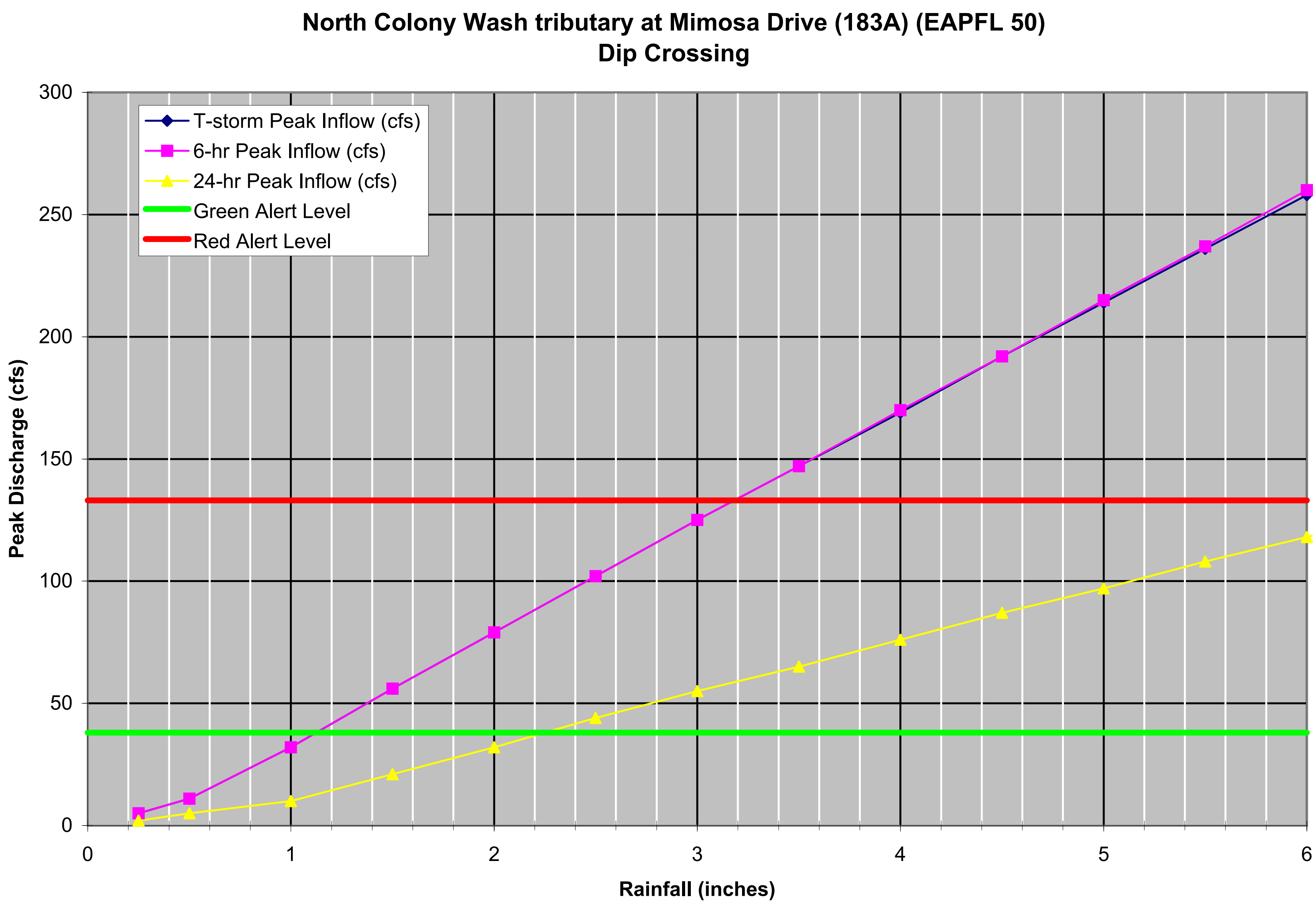


Fountain Channel at Kiwanis Drive (FC6)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
500
1000
1500
2000
2500
0
1
2
3
4
5
6

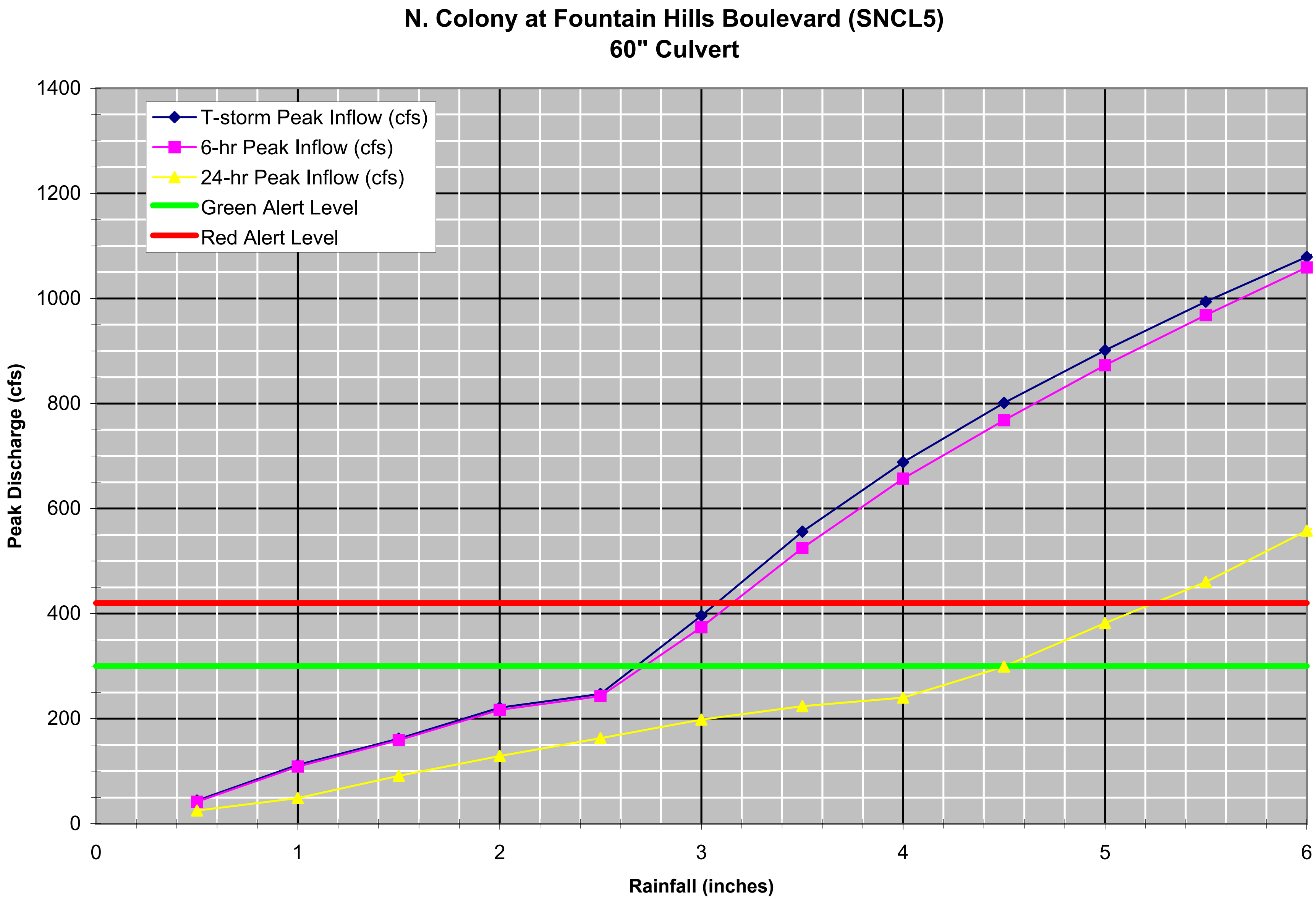

Saguaro Boulevard & Parkview Ave. (SFC2) (EAPFL 46 (north))
54" Culvert with Grated Inlets
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1200
1400
0
1
2
3
4
5
6

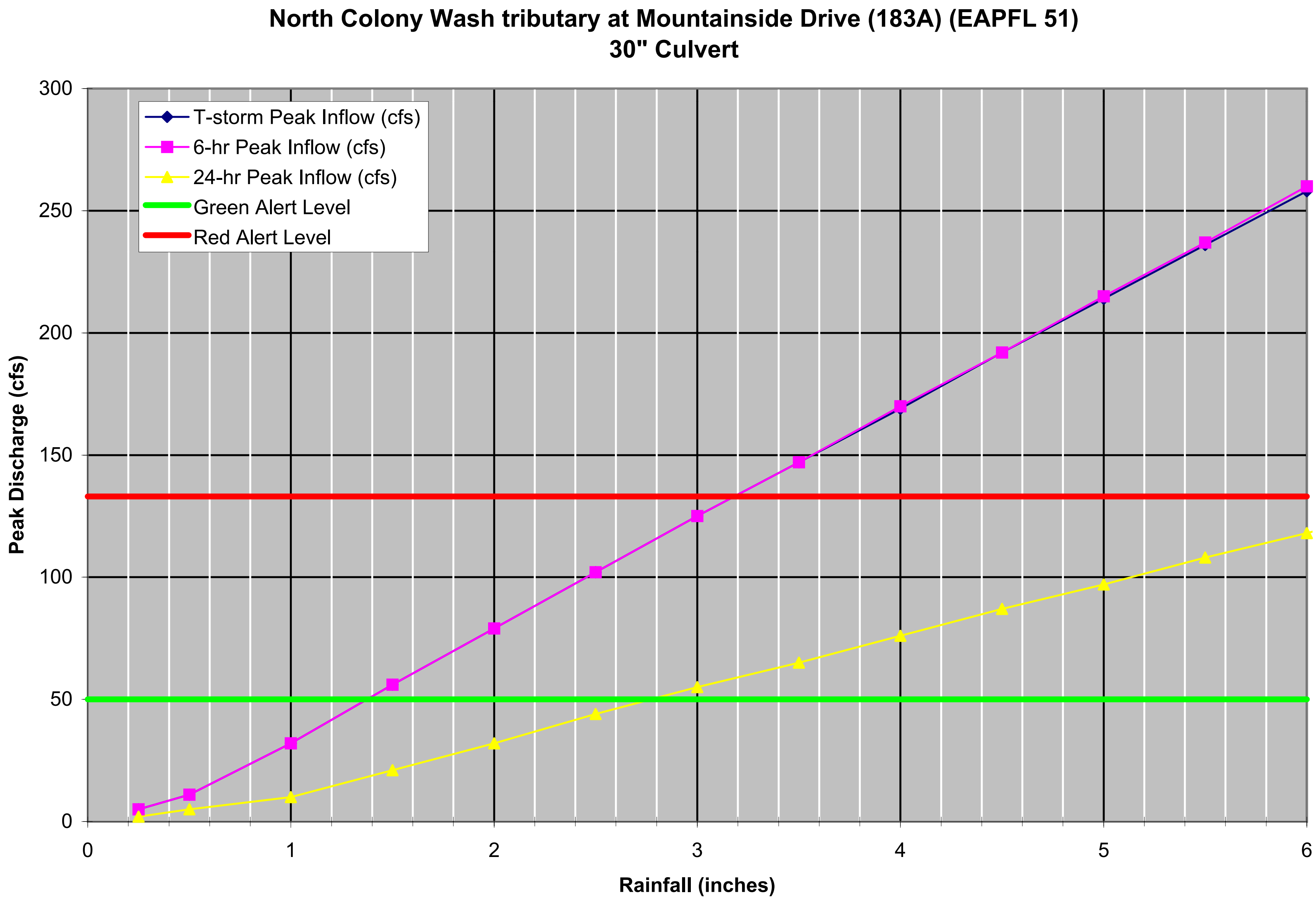


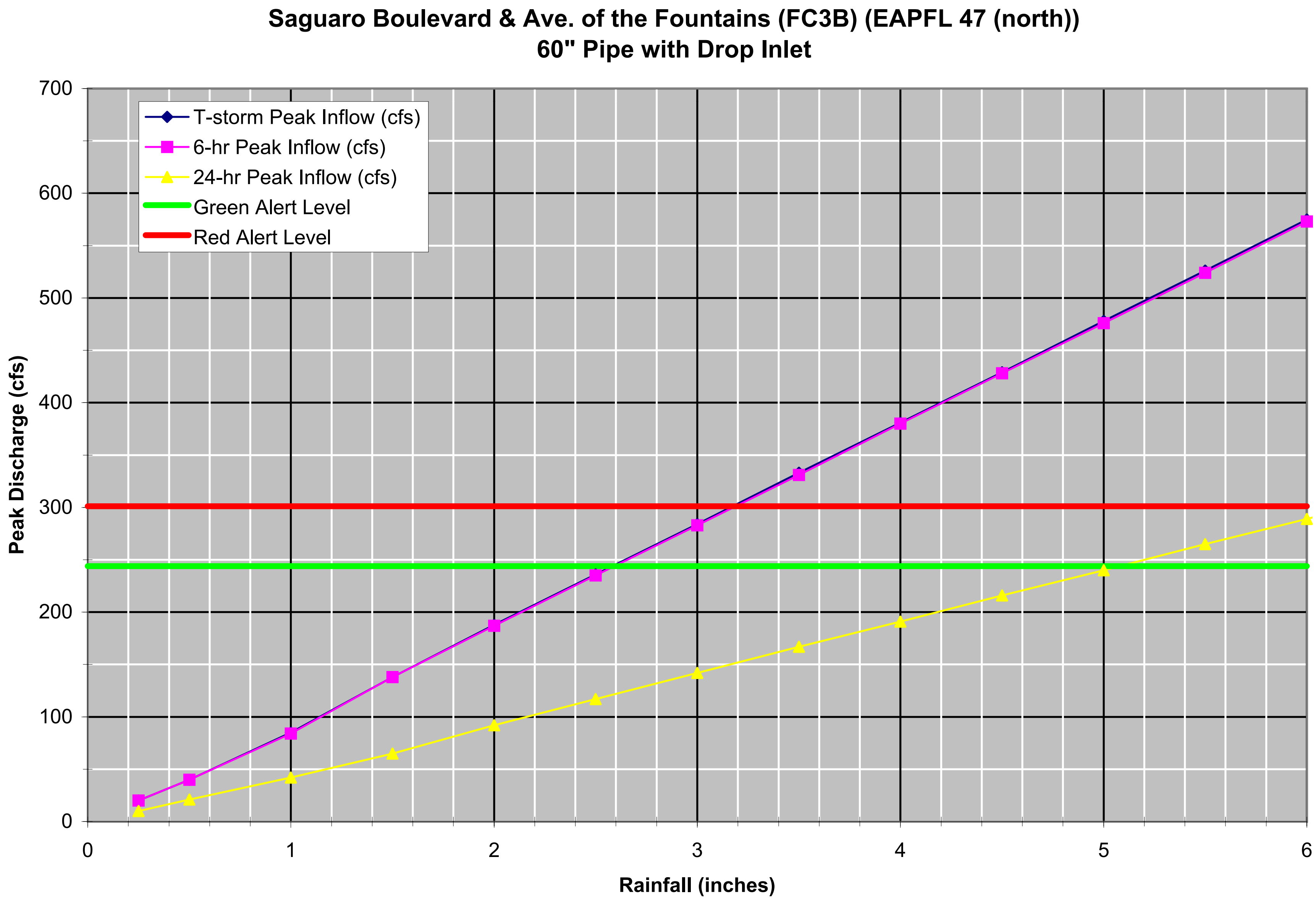
N. Colony at Chama Drive (SNCL8)
60" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
0
1
2
3
4
5
6



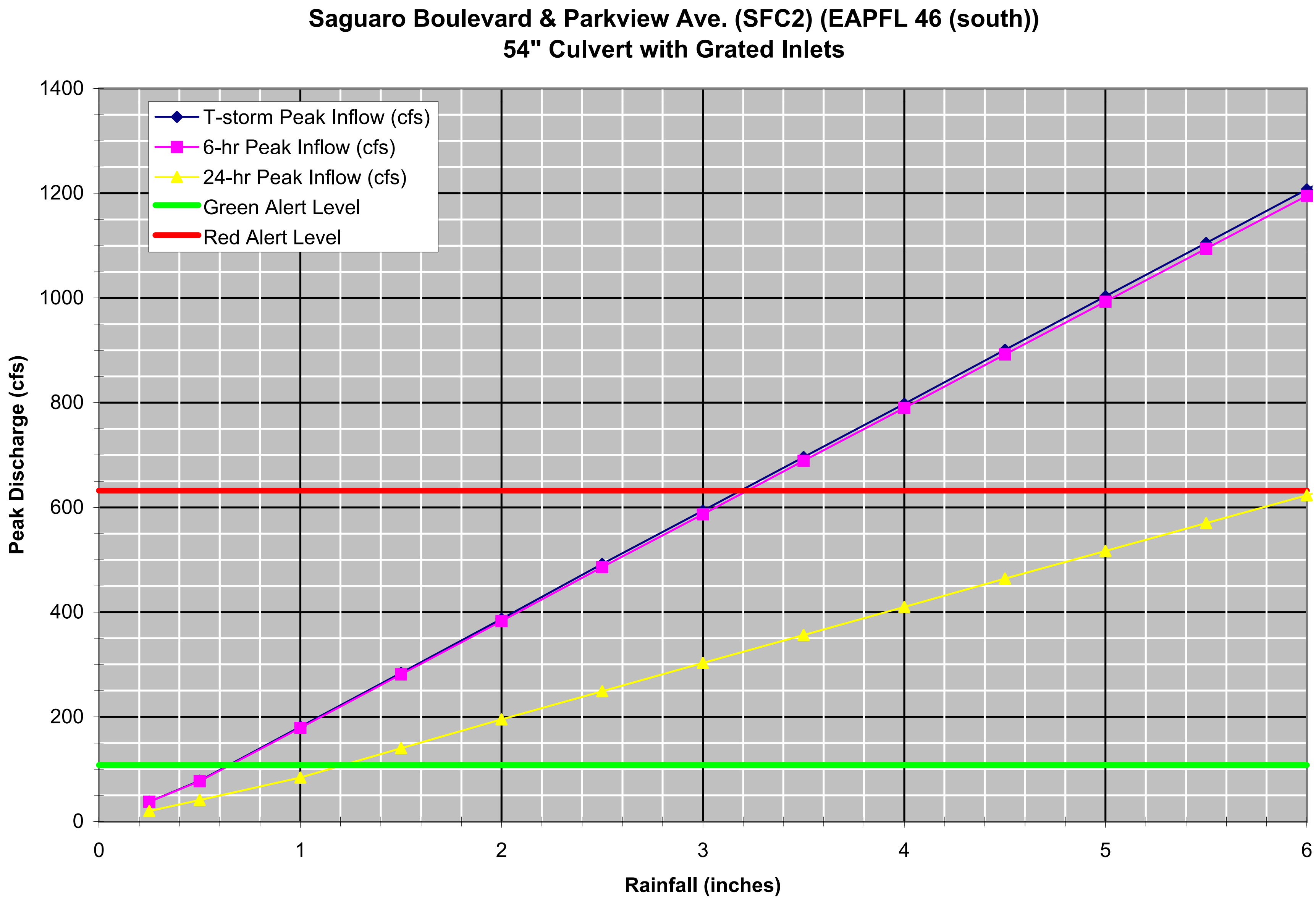
North Colony Wash tributary at Mimosa Drive (183A) (EAPFL 50)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
50
100
150
200
250
300
0
1
2
3
4
5
6

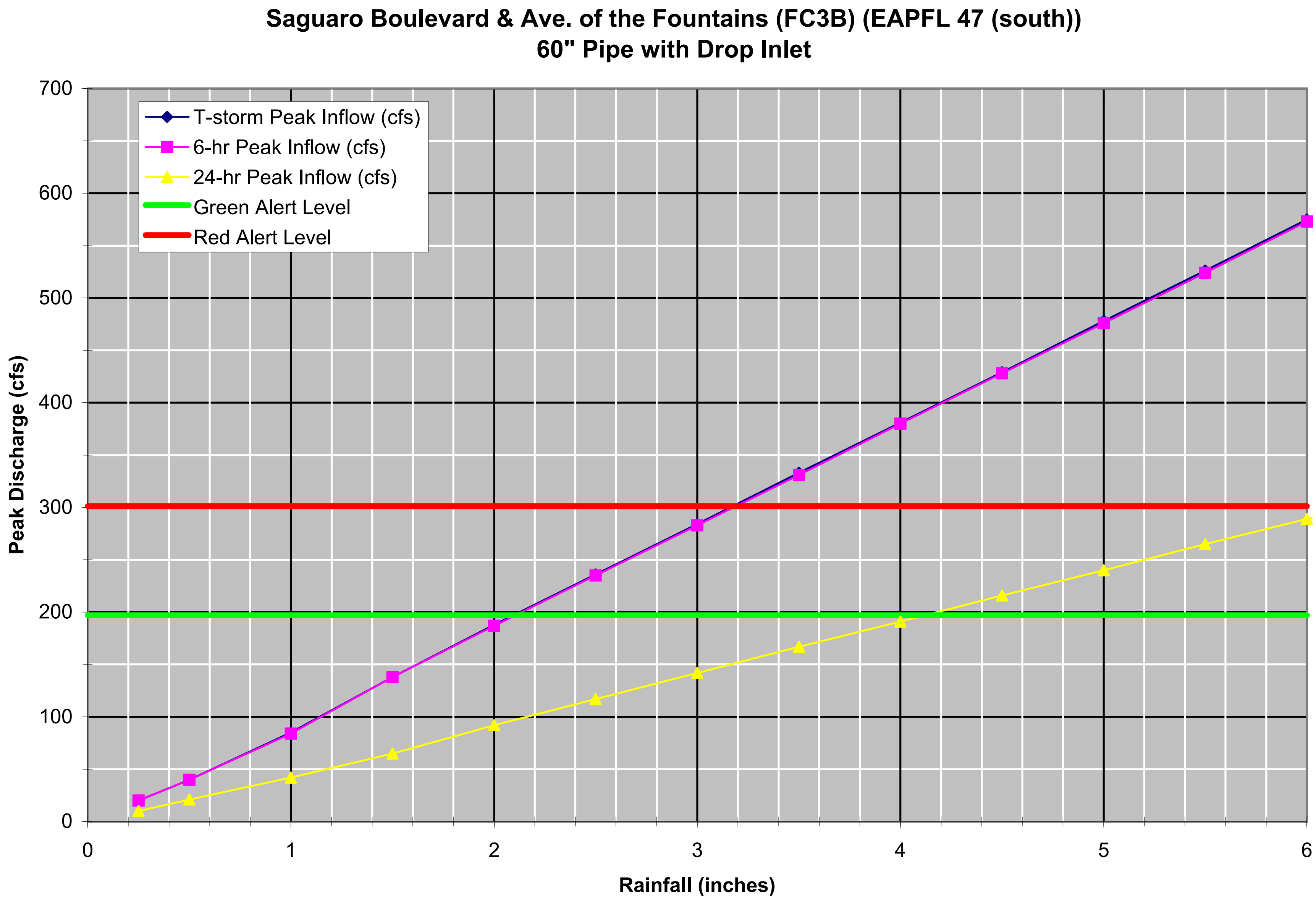

N. Colony at Fountain Hills Boulevard (SNCL5)
60" Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
200
400
600
800
1000
1200
1400
0
1
2
3
4
5
6
Rainfall (inches)


North Colony Wash tributary at Mountainside Drive (183A) (EAPFL 51)
30" Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
50
100
150
200
250
300
0
1
2
3
4
5
6

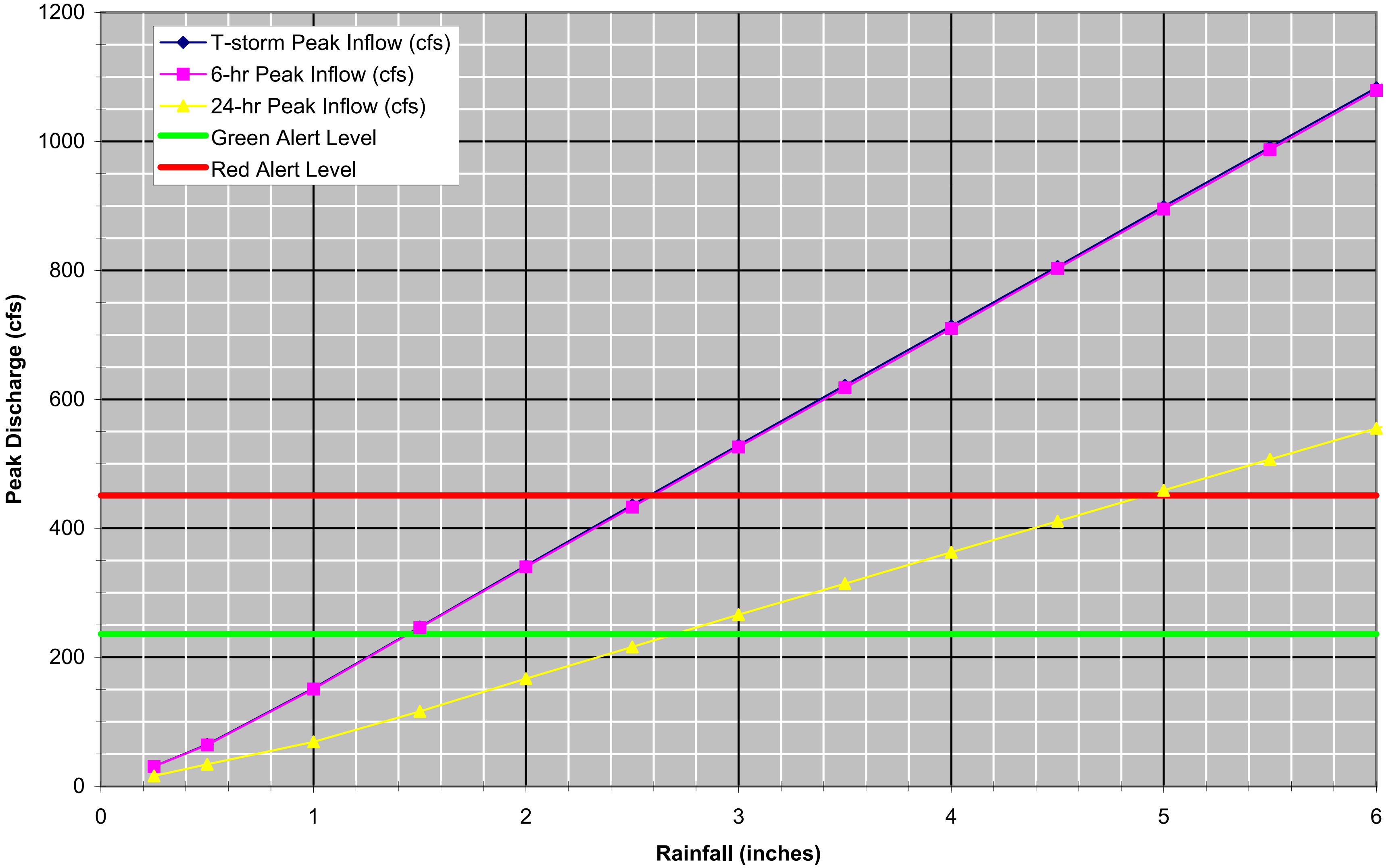


Saguaro Boulevard & Ave. of the Fountains (FC3B) (EAPFL 47 (north))
60" Pipe with Drop Inlet
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
700
0
1
2
3
4
5
6
Rainfall (inches)

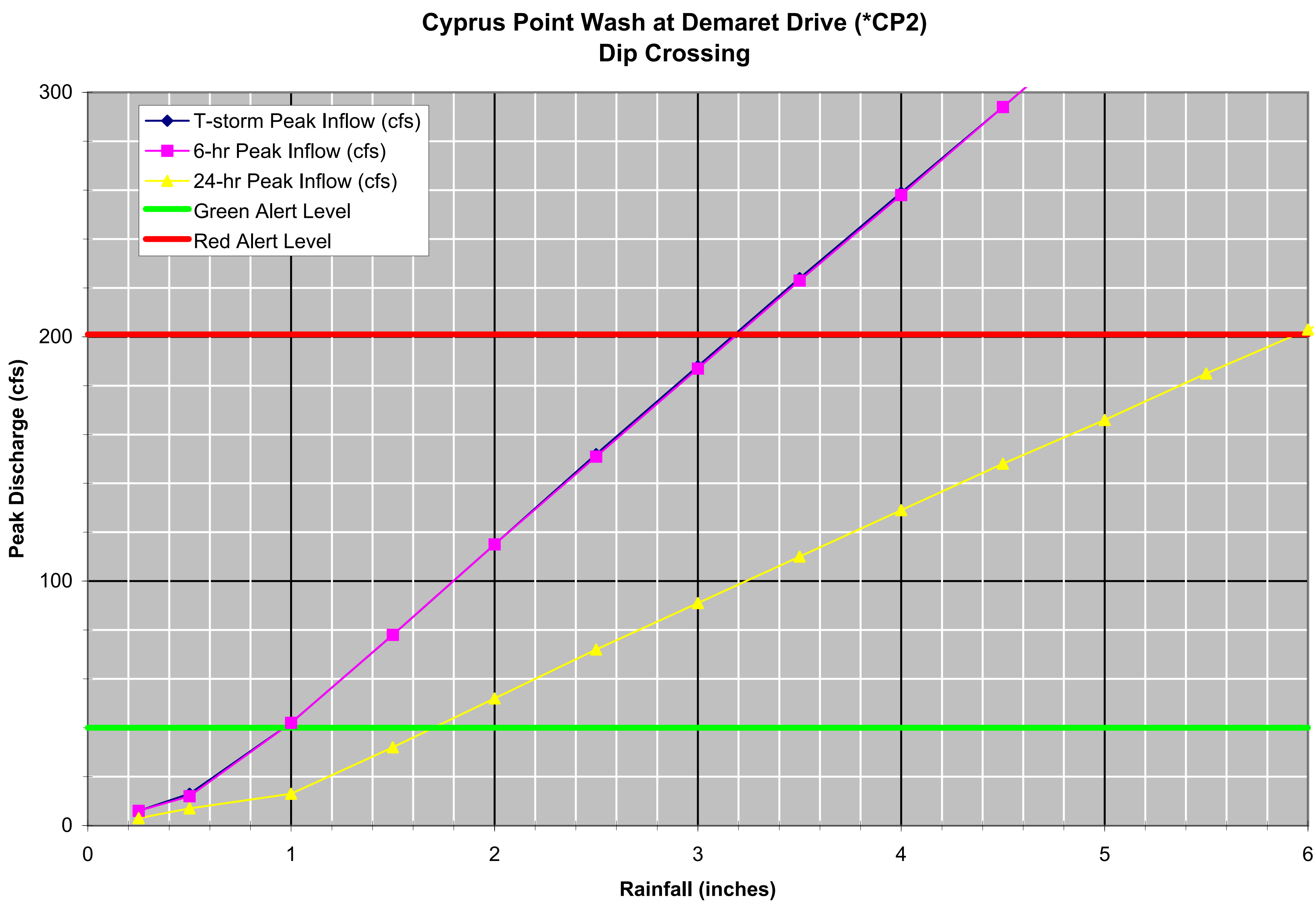

Saguaro Boulevard & Parkview Ave. (SFC2) (EAPFL 46 (south))
54" Culvert with Grated Inlets
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
1400
1200
1000
800
600
400
200
0
0
1
2
3
4
5
6
Rainfall (inches)

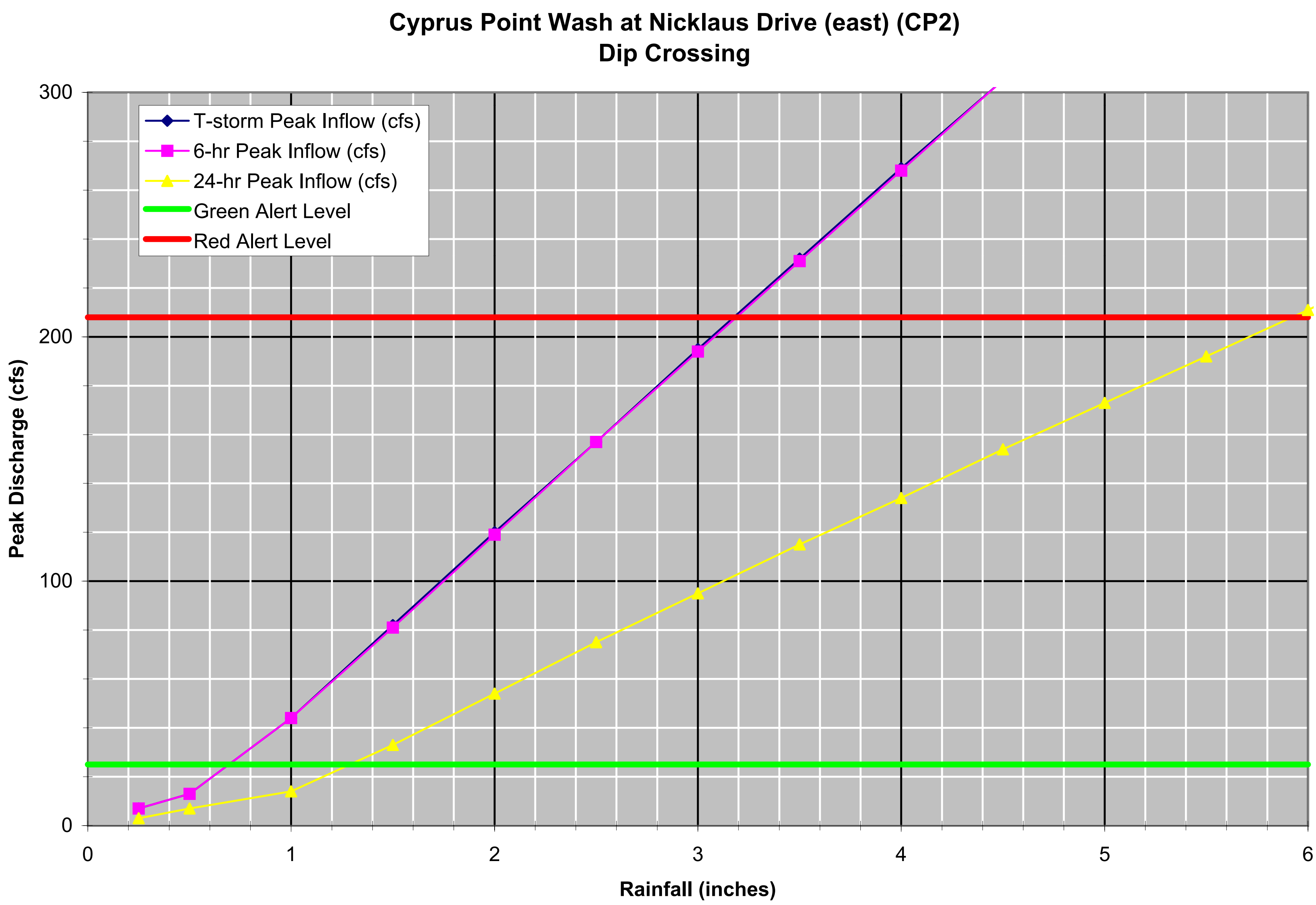

Saguaro Boulevard & Ave. of the Fountains (FC3B) (EAPFL 47 (south))
60" Pipe with Drop Inlet
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
700
Rainfall (inches)
0
1
2
3
4
5
6

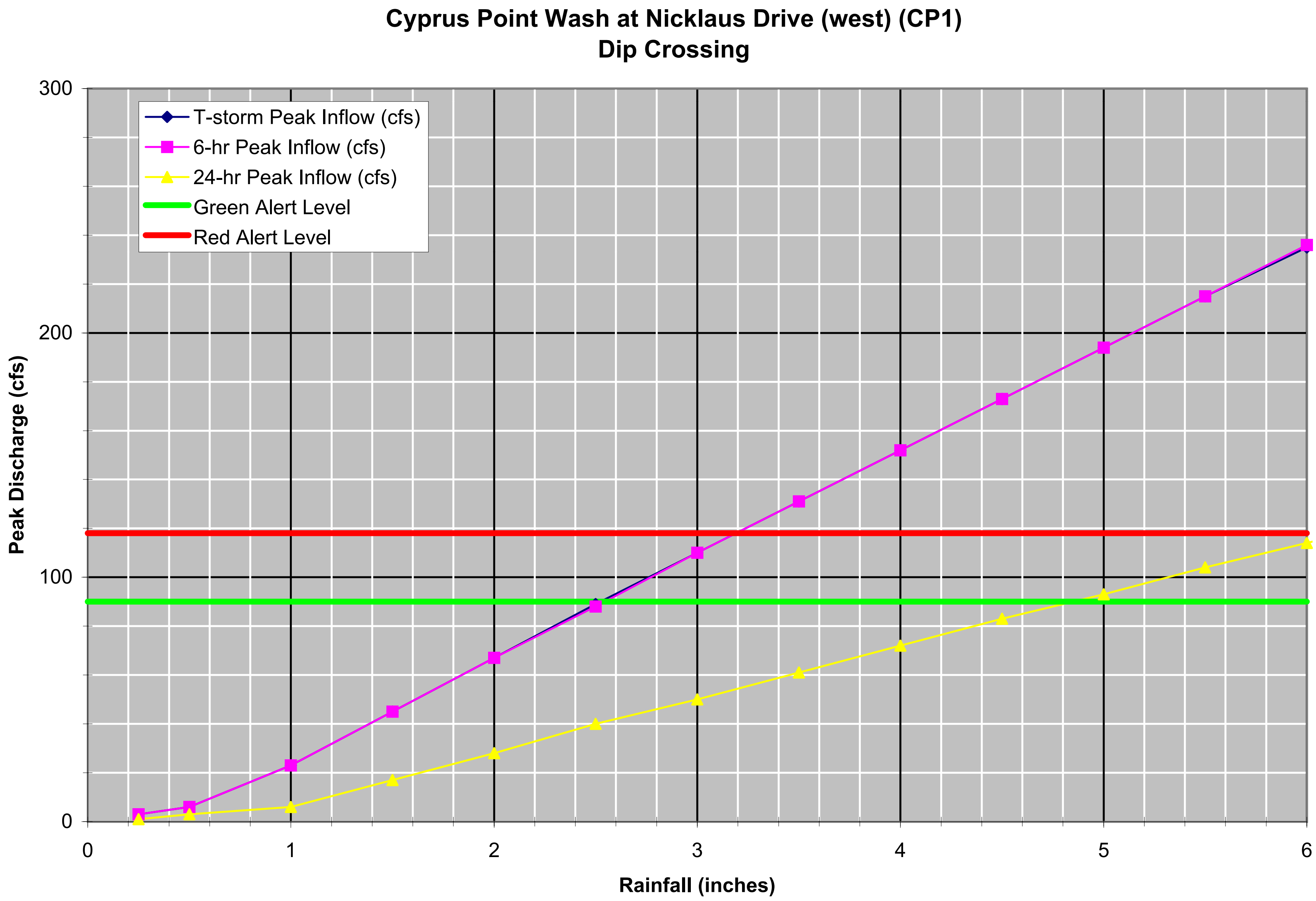
Saguaro Boulevard at El Lago Boulevard (LC2) (EAPFL 49)
Street Flow to 60" RCP with 2 Catch Basins

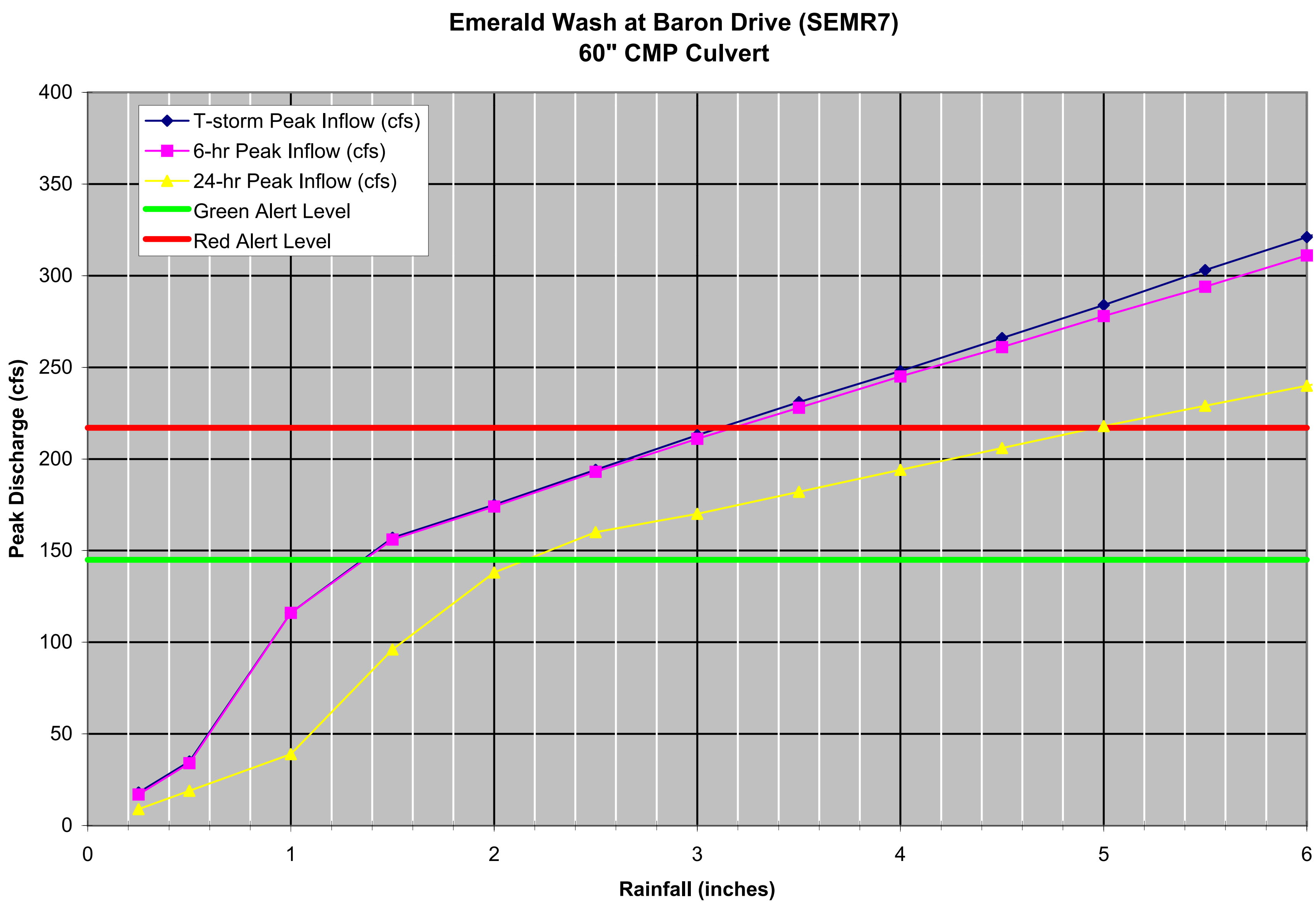


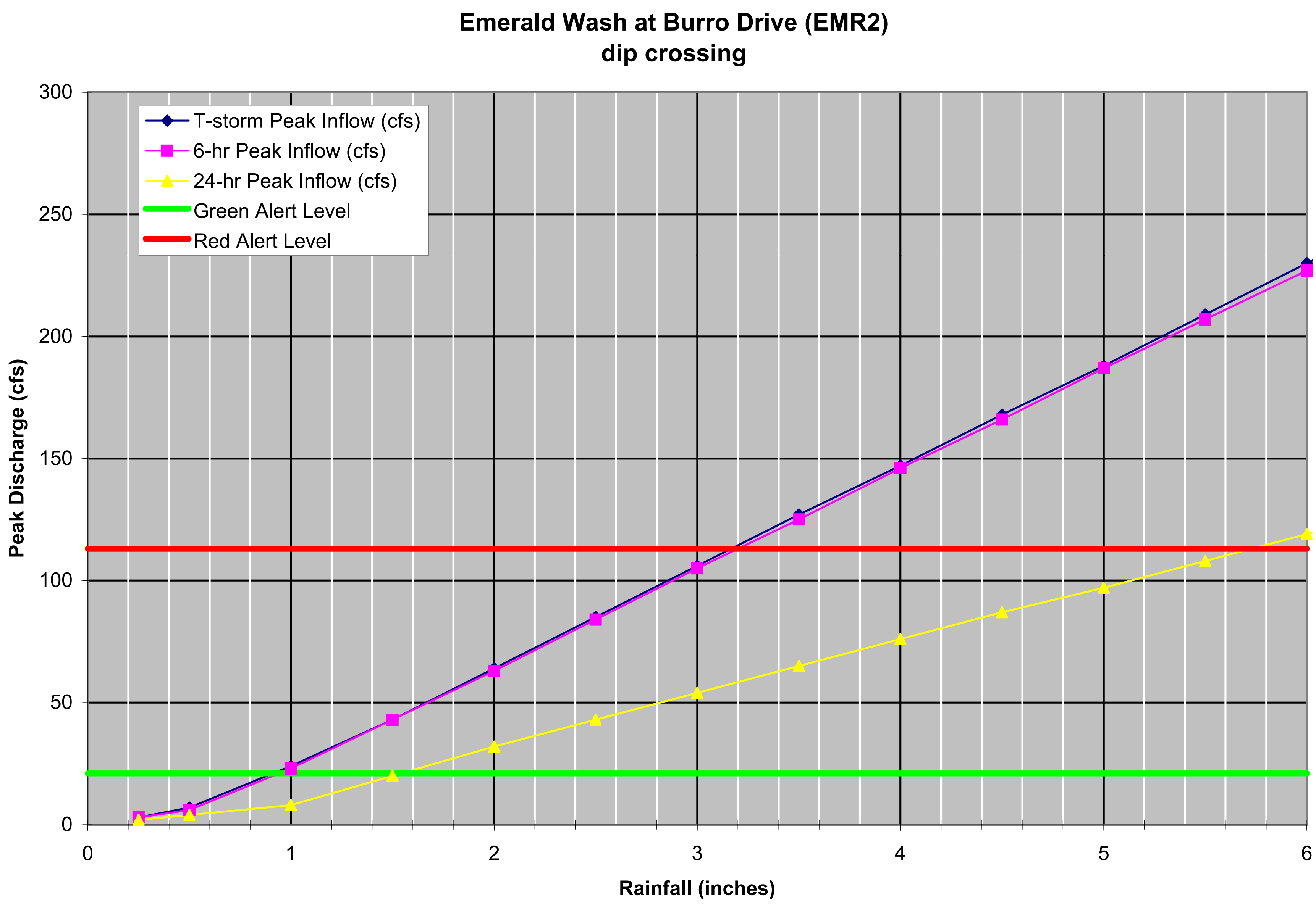
Malta Drain / Jacklin Wash System

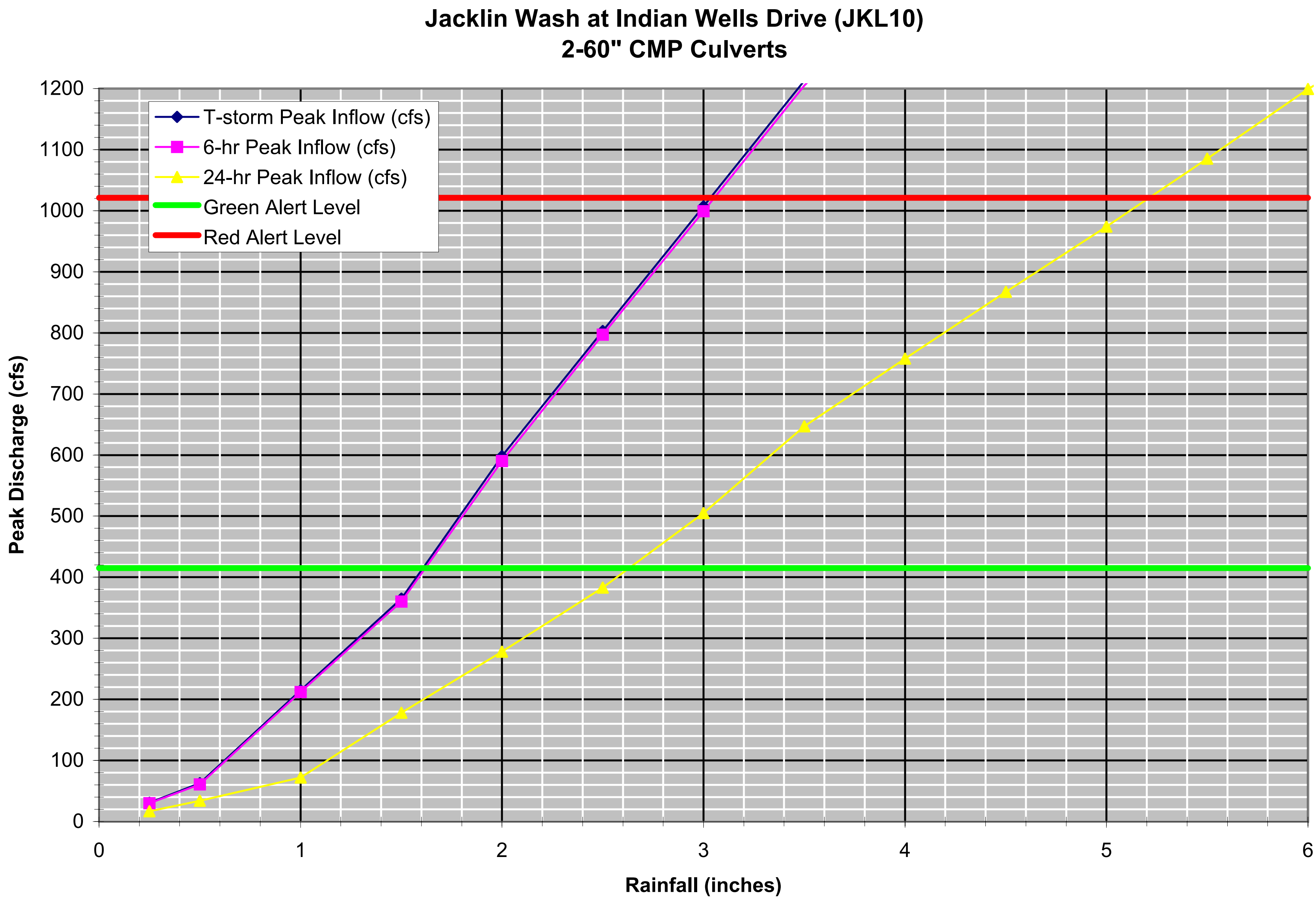

Cyprus Point Wash at Demaret Drive (*CP2)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
0
1
2
3
4
5
6

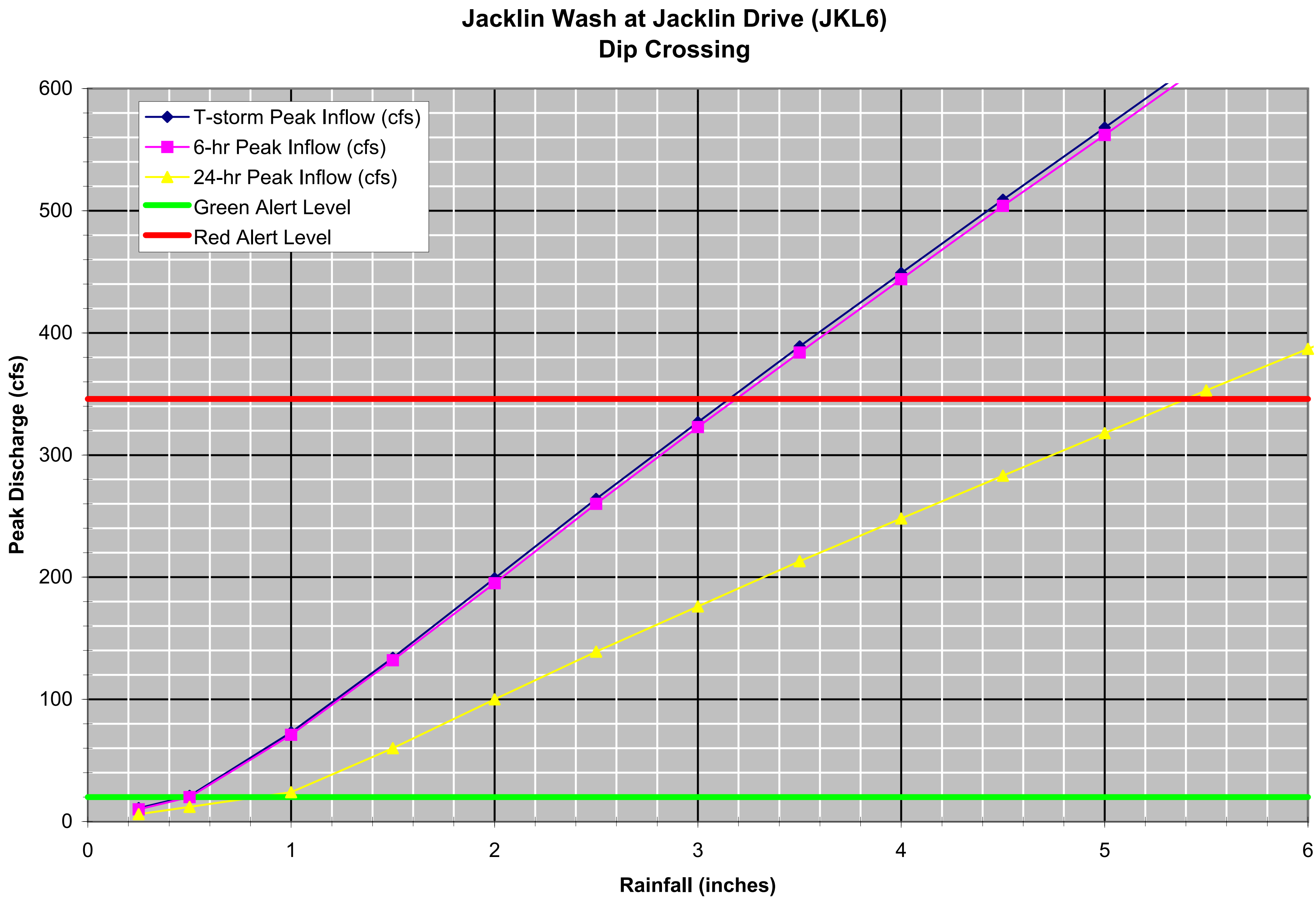

Cyprus Point Wash at Nicklaus Drive (east) (CP2)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
300
200
100
0
0
1
2
3
4
5
6
Rainfall (inches)

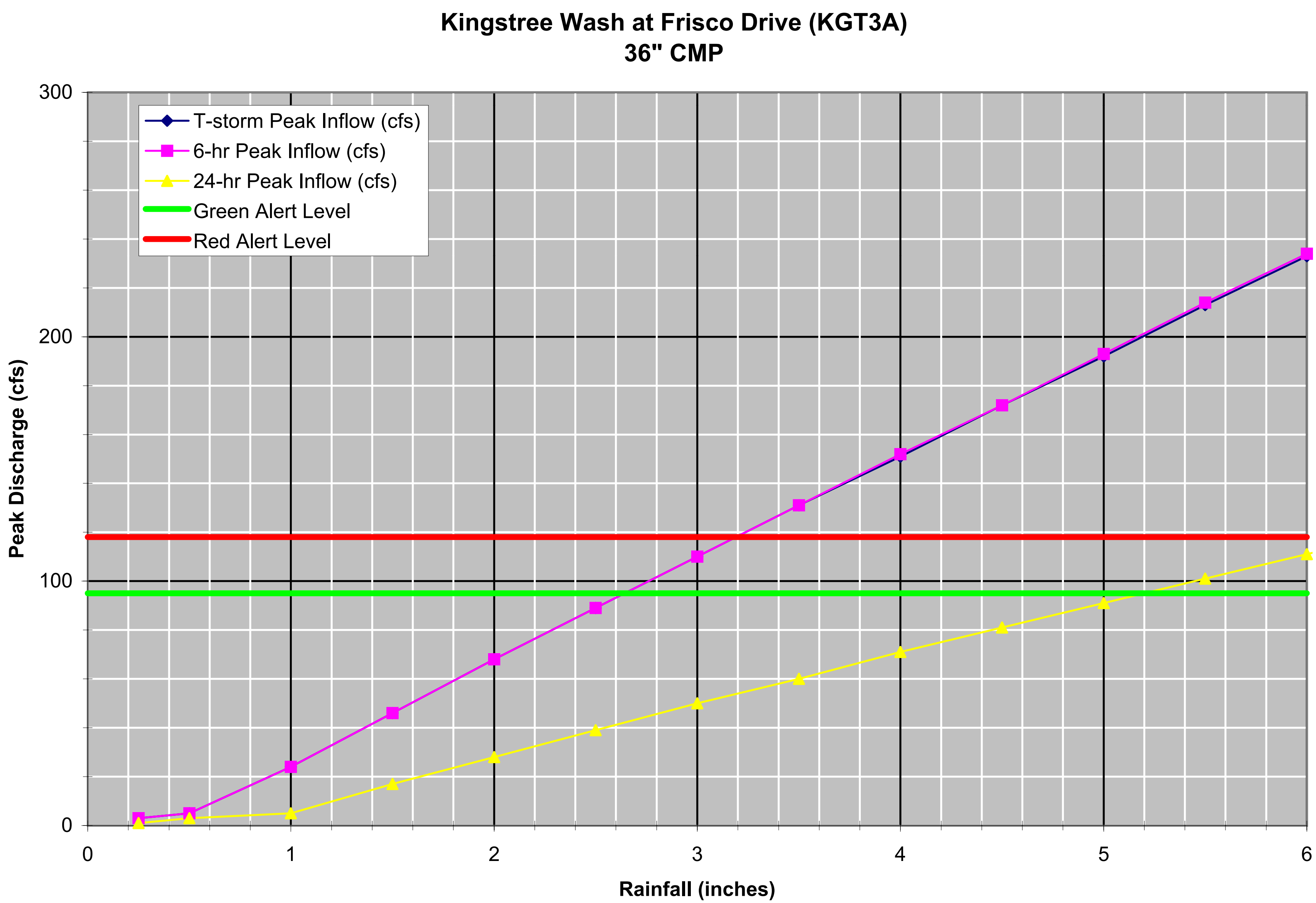

Cyprus Point Wash at Nicklaus Drive (west) (CP1)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
300
200
100
0
0
1
2
3
4
5
6
Peak Discharge (cfs)
Rainfall (inches)


Emerald Wash at Baron Drive (SEMR7)
60" CMP Culvert
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
Rainfall (inches)

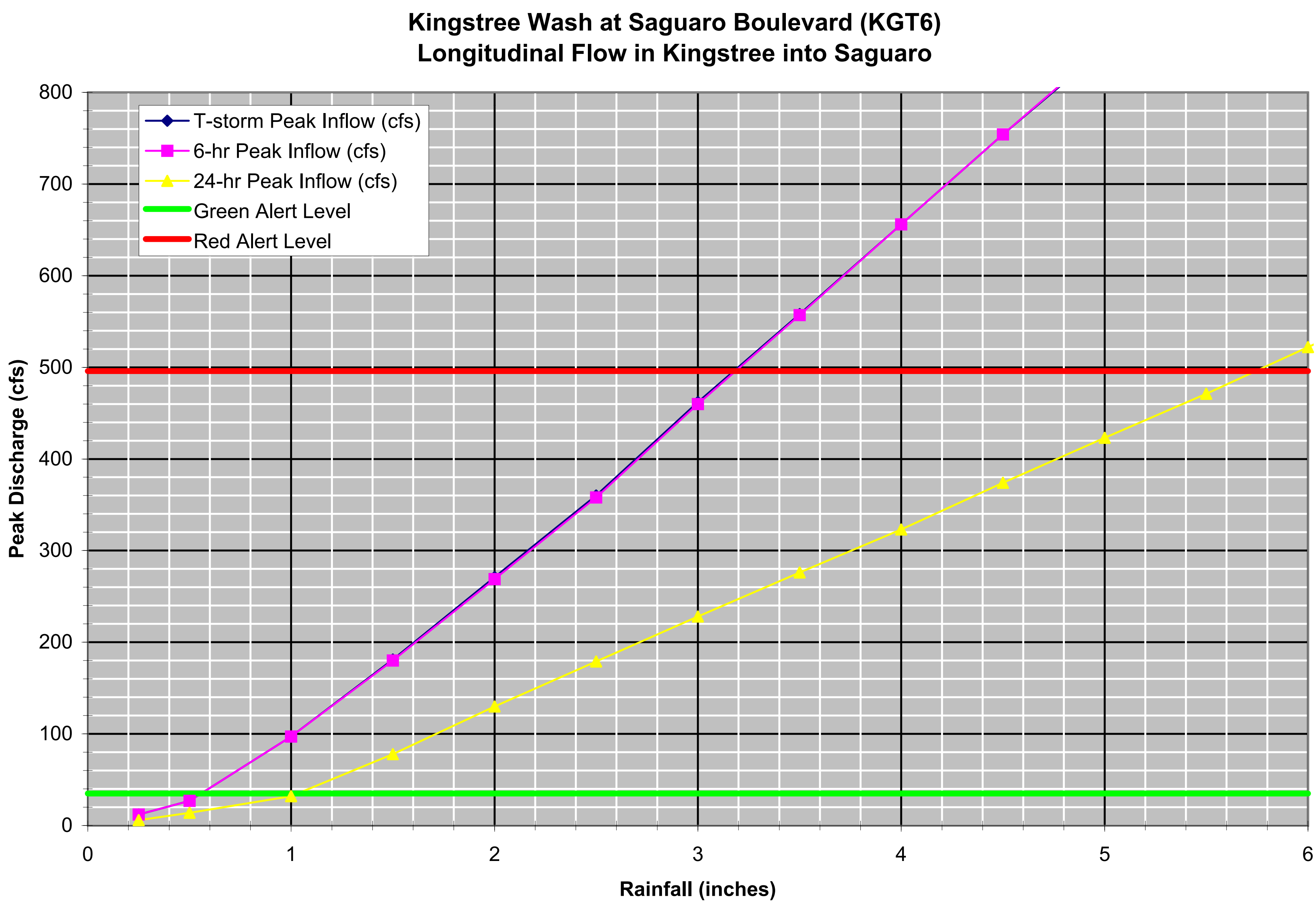

Emerald Wash at Burro Drive (EMR2)
dip crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
50
100
150
200
250
300
0
1
2
3
4
5
6

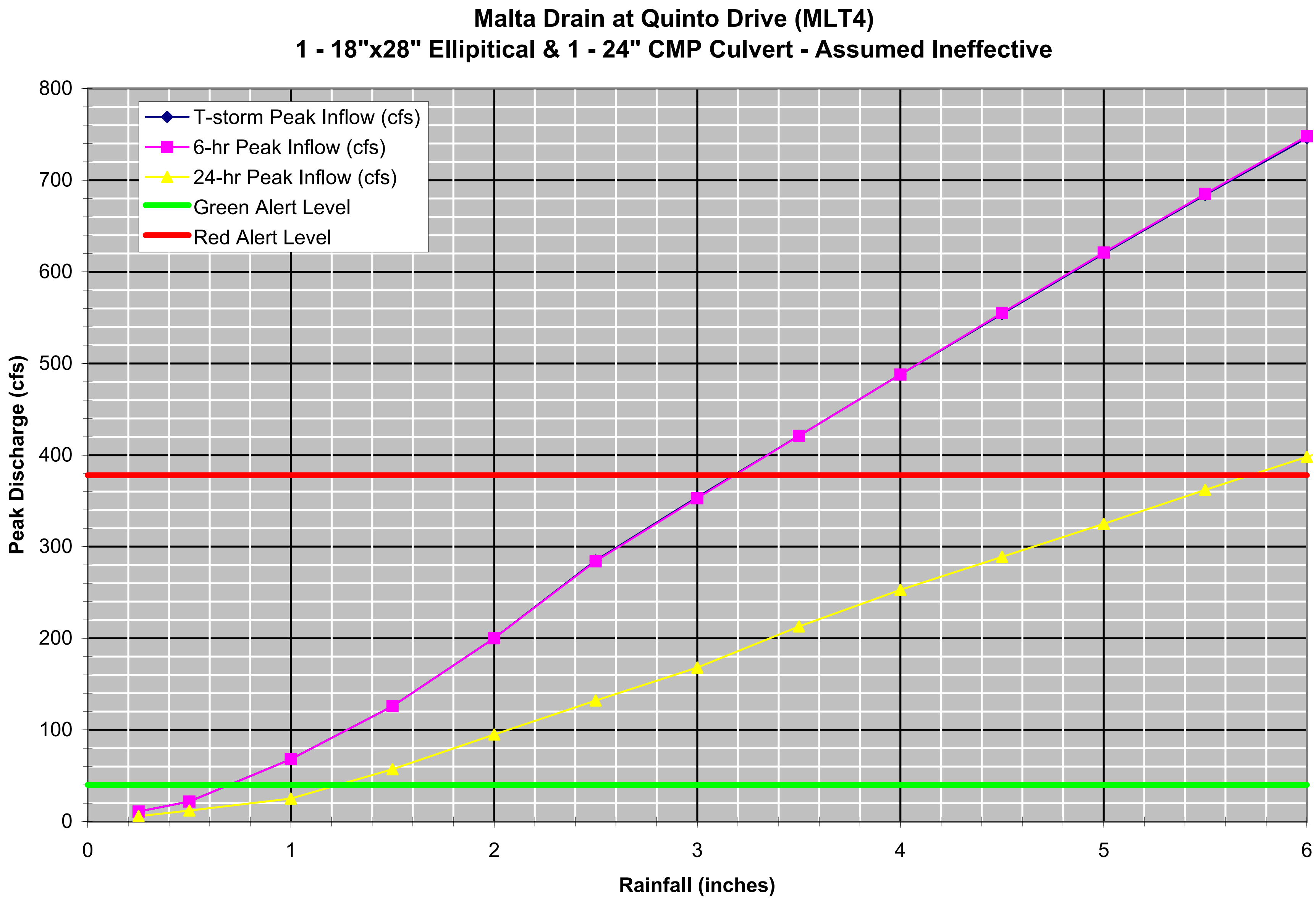

Jacklin Wash at Indian Wells Drive (JKL10)
2-60" CMP Culverts
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
0
1
2
3
4
5
6

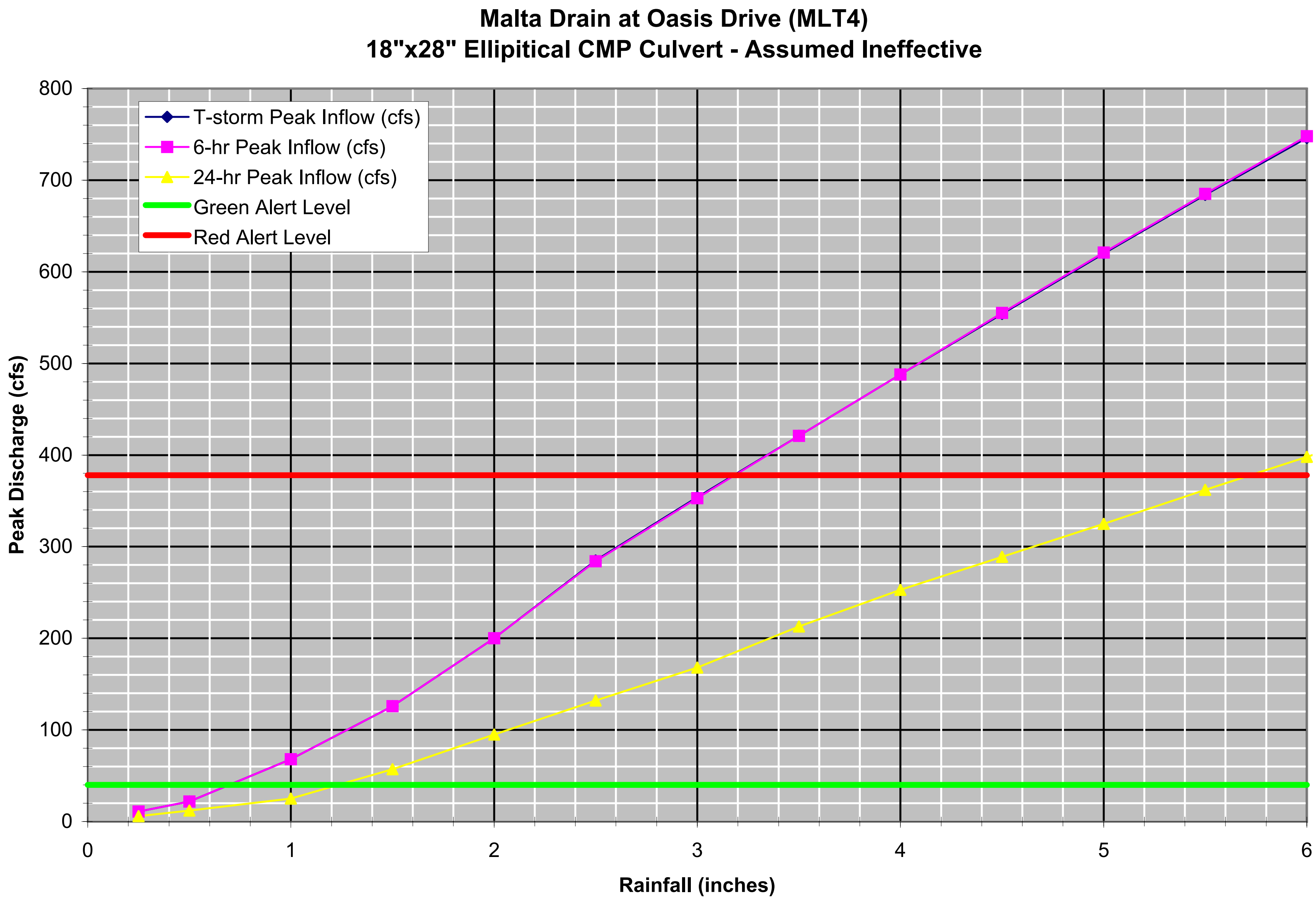

Jacklin Wash at Jacklin Drive (JKL6)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
0
1
2
3
4
5
6
Rainfall (inches)



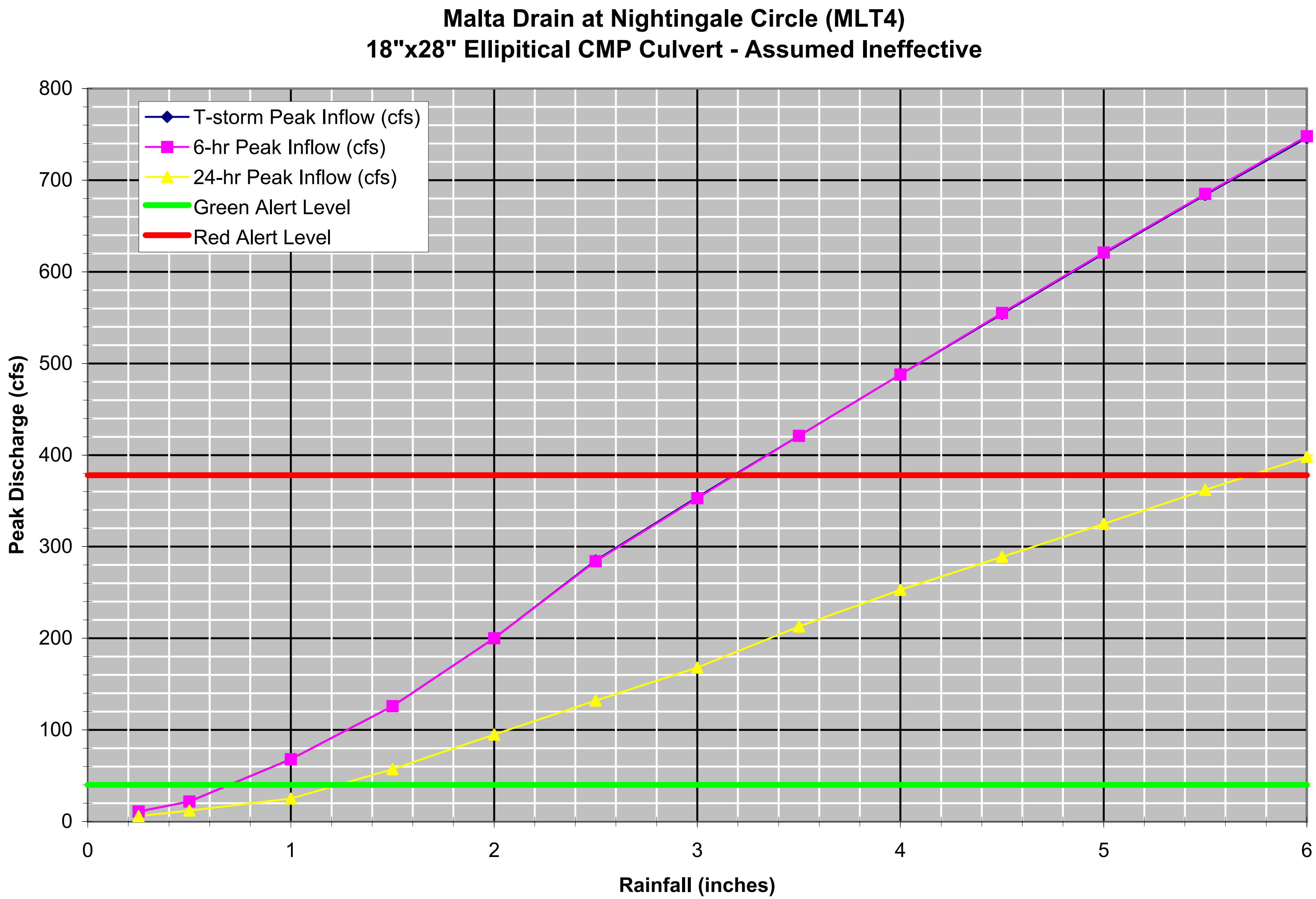
Kingstree Wash at Frisco Drive (KGT3A)
36" CMP
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
0
1
2
3
4
5
6


Kingstree Wash at Saguaro Boulevard (KGT6)
Longitudinal Flow in Kingstree into Saguaro
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
1
2
3
4
5
6

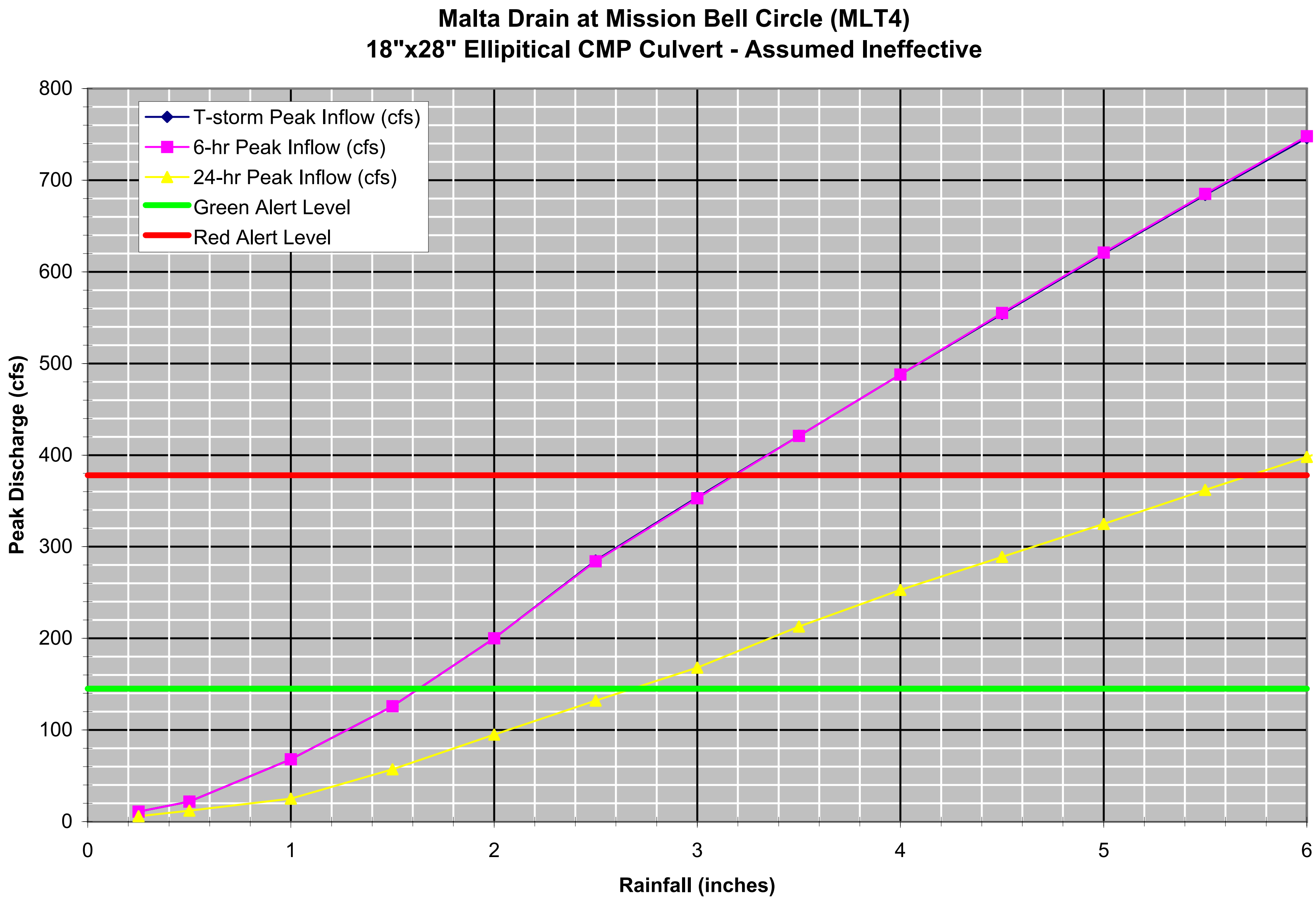

Malta Drain at Quinto Drive (MLT4)
1 - 18"x28" Ellipitical & 1 - 24" CMP Culvert - Assumed Ineffective
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
700
800
Rainfall (inches)
0
1
2
3
4
5
6

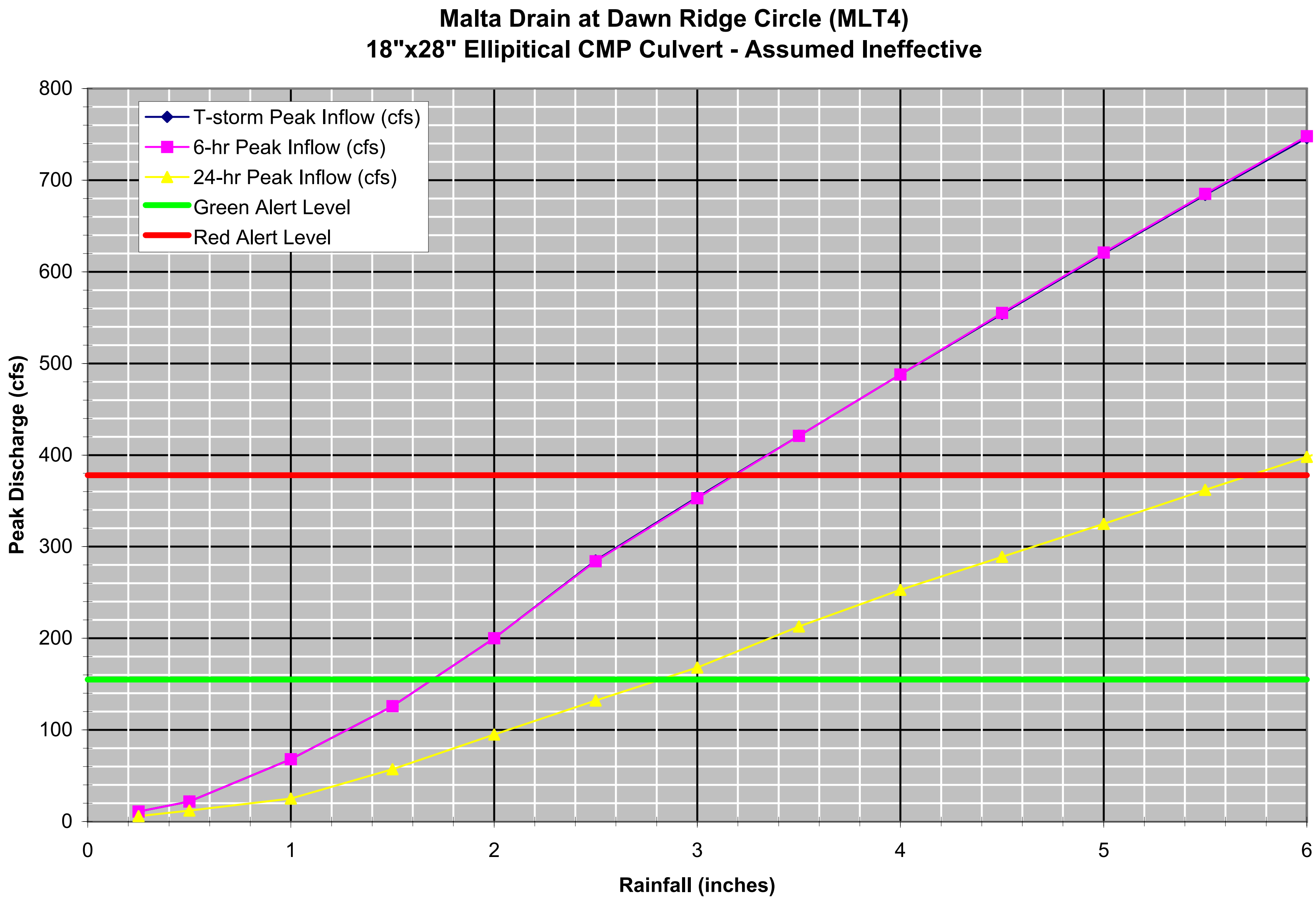


Malta Drain at Oasis Drive (MLT4)
18"x28" Ellipitical CMP Culvert - Assumed Ineffective
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
0
1
2
3
4
5
6

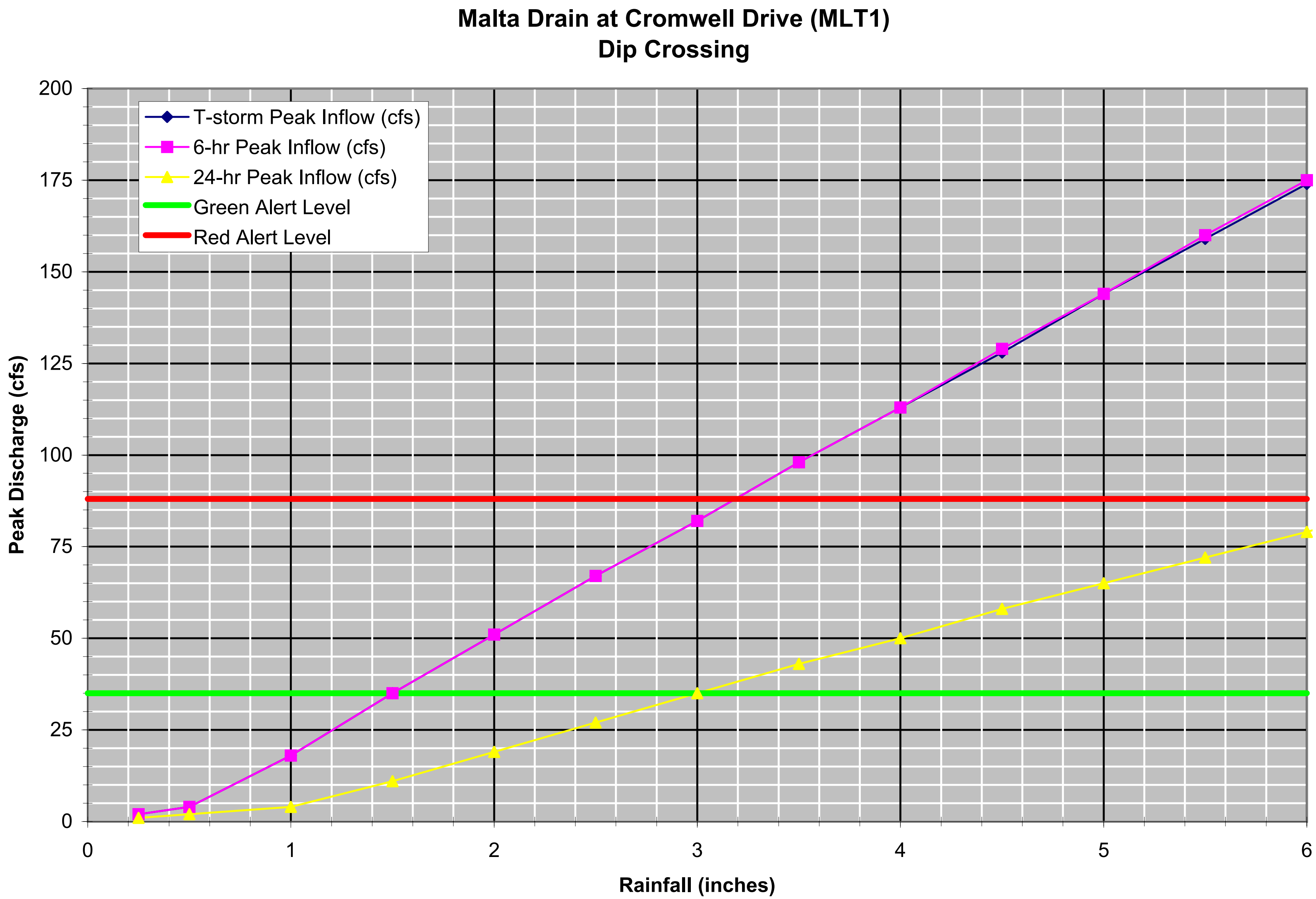


Malta Drain at Nightingale Circle (MLT4)
18"x28" Ellipitical CMP Culvert - Assumed Ineffective
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
1
2
3
4
5
6

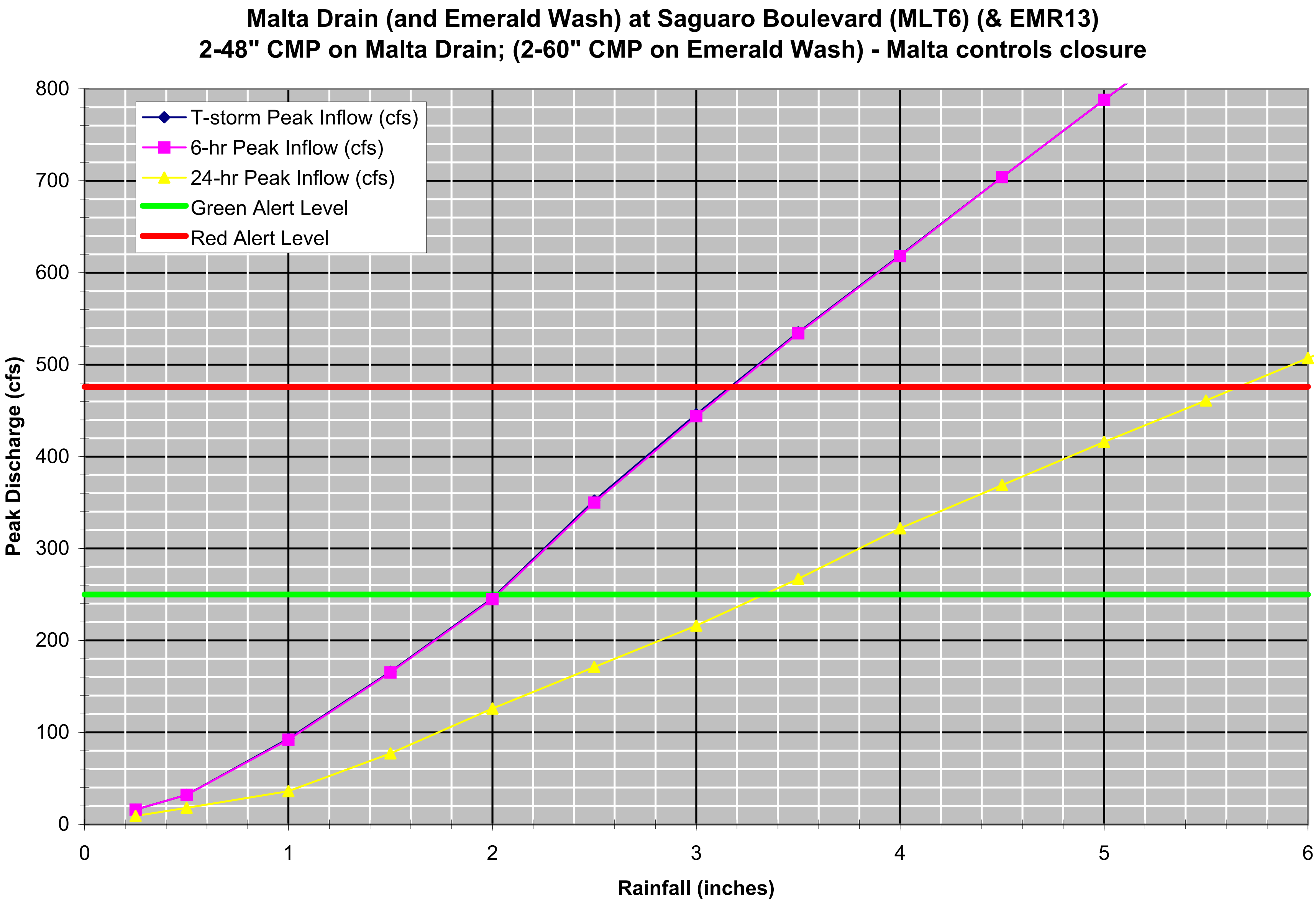

Malta Drain at Mission Bell Circle (MLT4)
18"x28" Ellipitical CMP Culvert - Assumed Ineffective
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
0
1
2
3
4
5
6



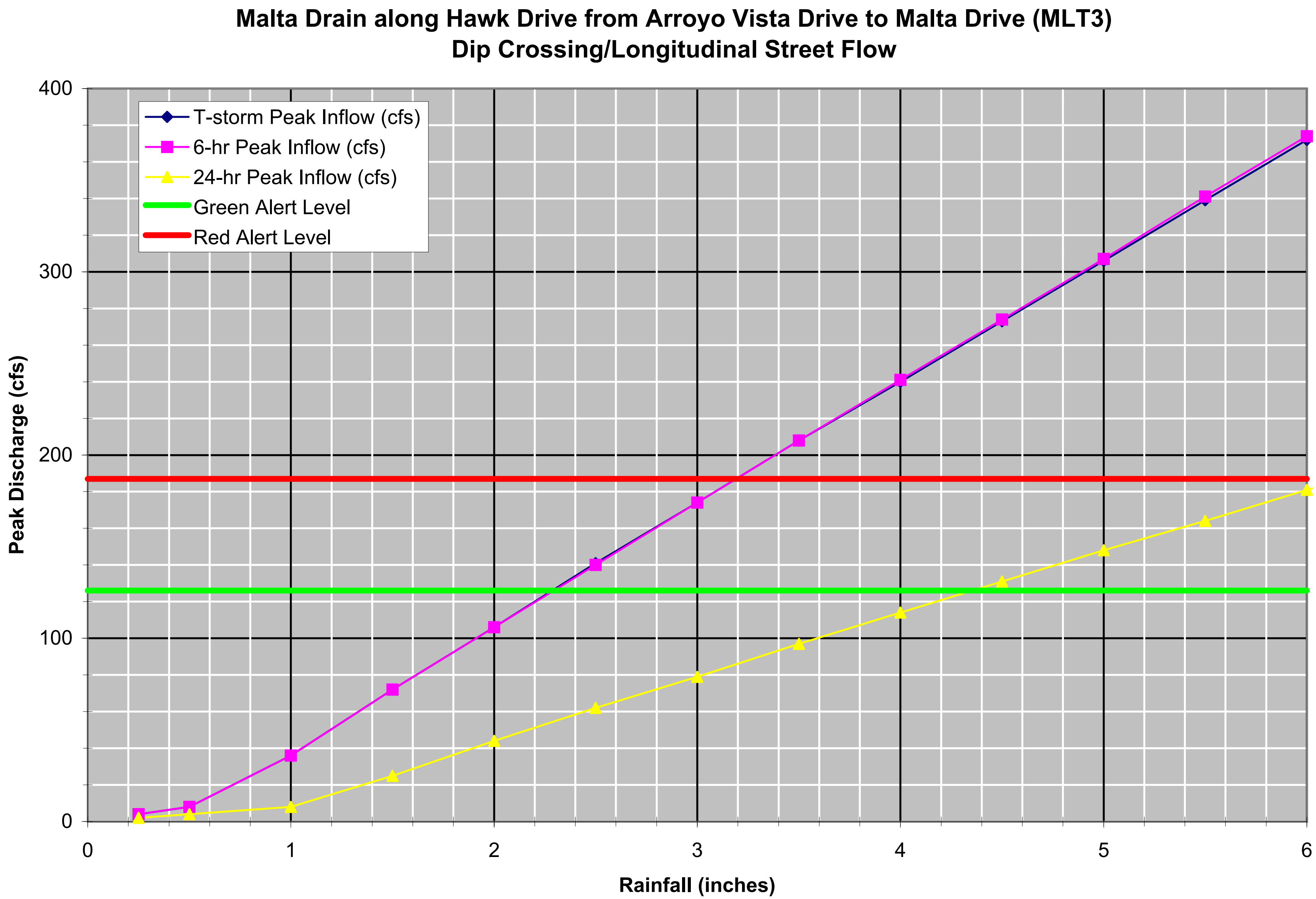
Malta Drain at Dawn Ridge Circle (MLT4)
18"x28" Ellipitical CMP Culvert - Assumed Ineffective
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
0
1
2
3
4
5
6



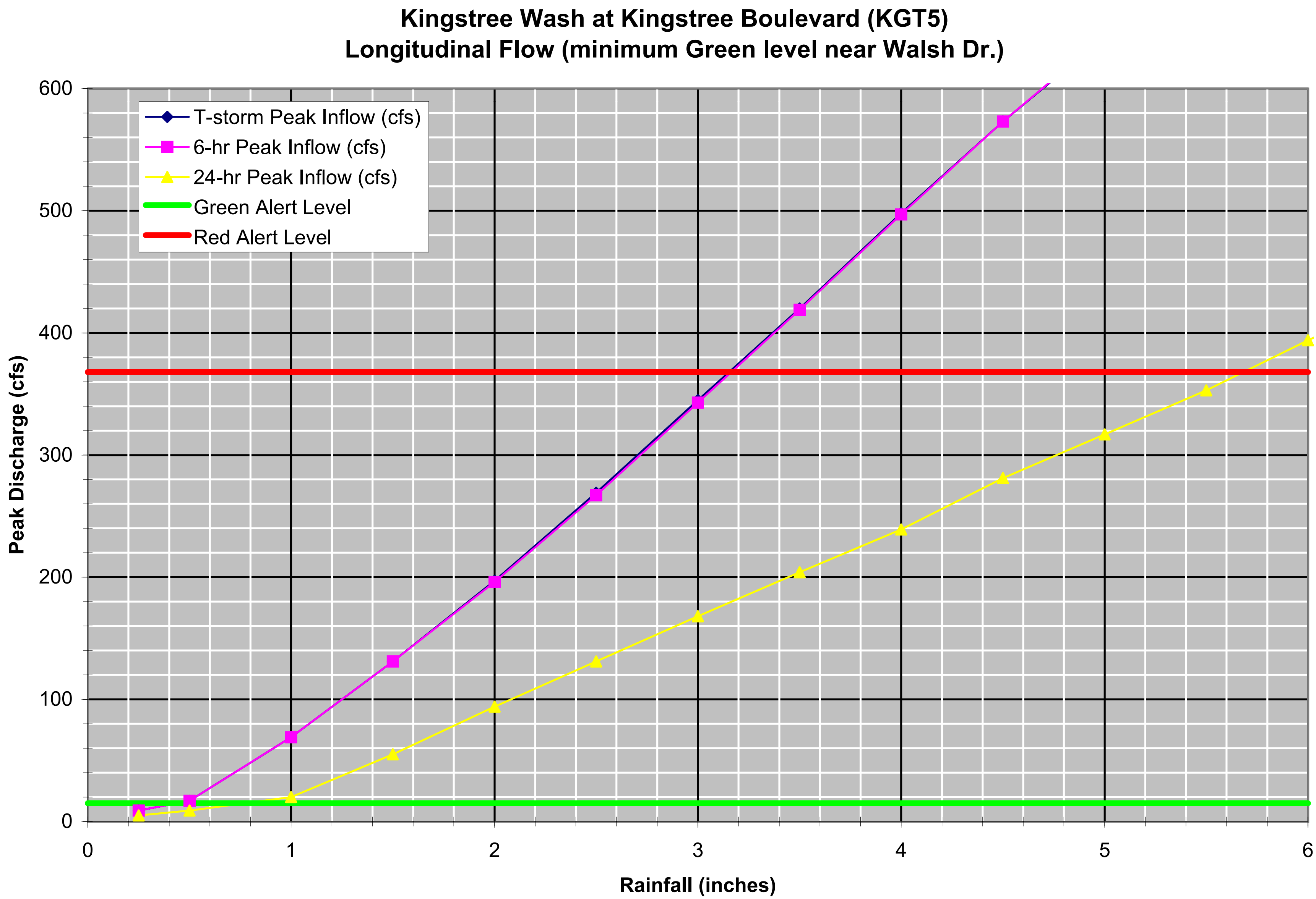
Malta Drain at Cromwell Drive (MLT1)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
25
50
75
100
125
150
175
200
Rainfall (inches)
0
1
2
3
4
5
6

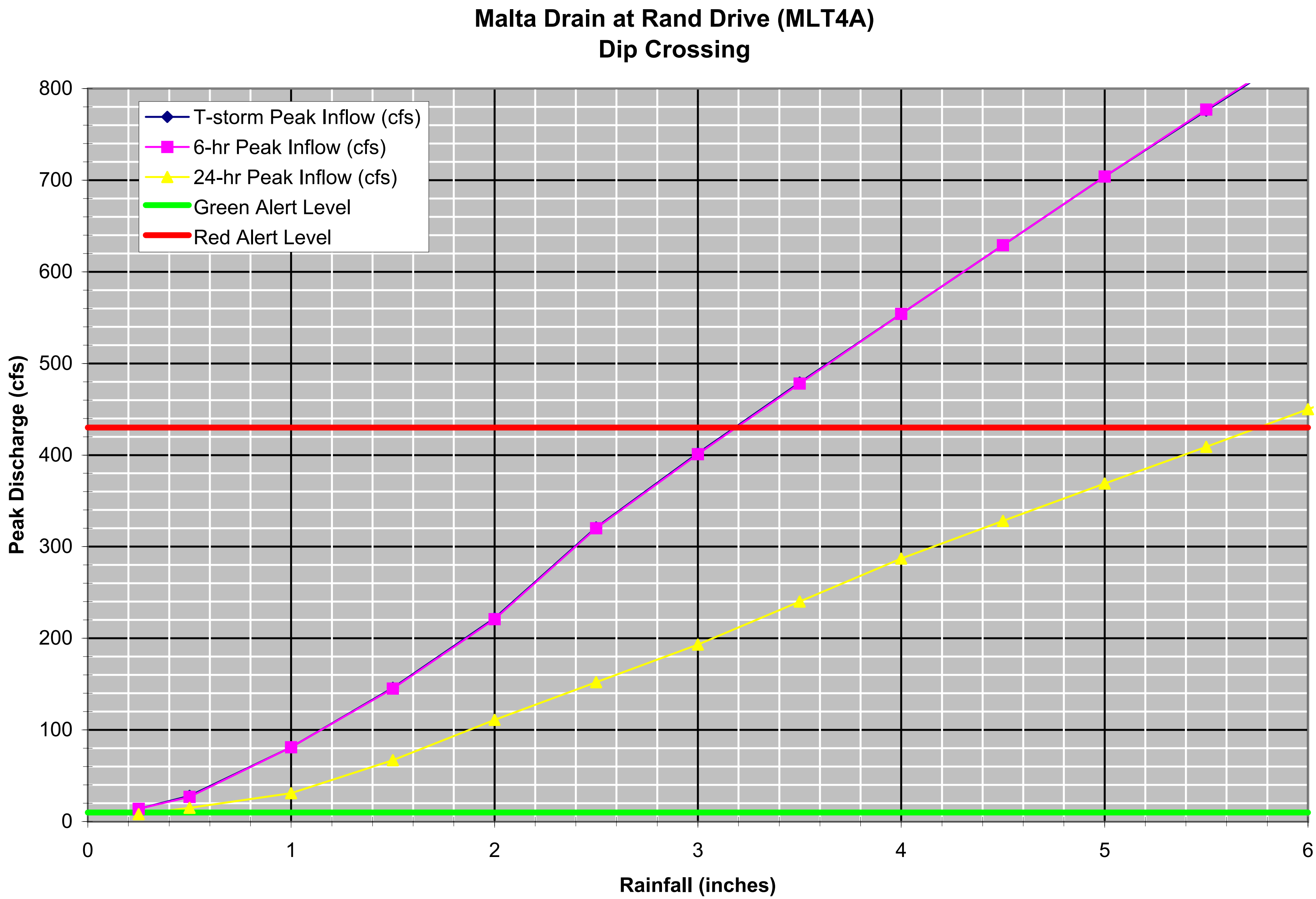


Malta Drain (and Emerald Wash) at Saguaro Boulevard (MLT6) (& EMR13)
2-48" CMP on Malta Drain; (2-60" CMP on Emerald Wash) - Malta controls closure
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
700
800
Rainfall (inches)
0
1
2
3
4
5
6



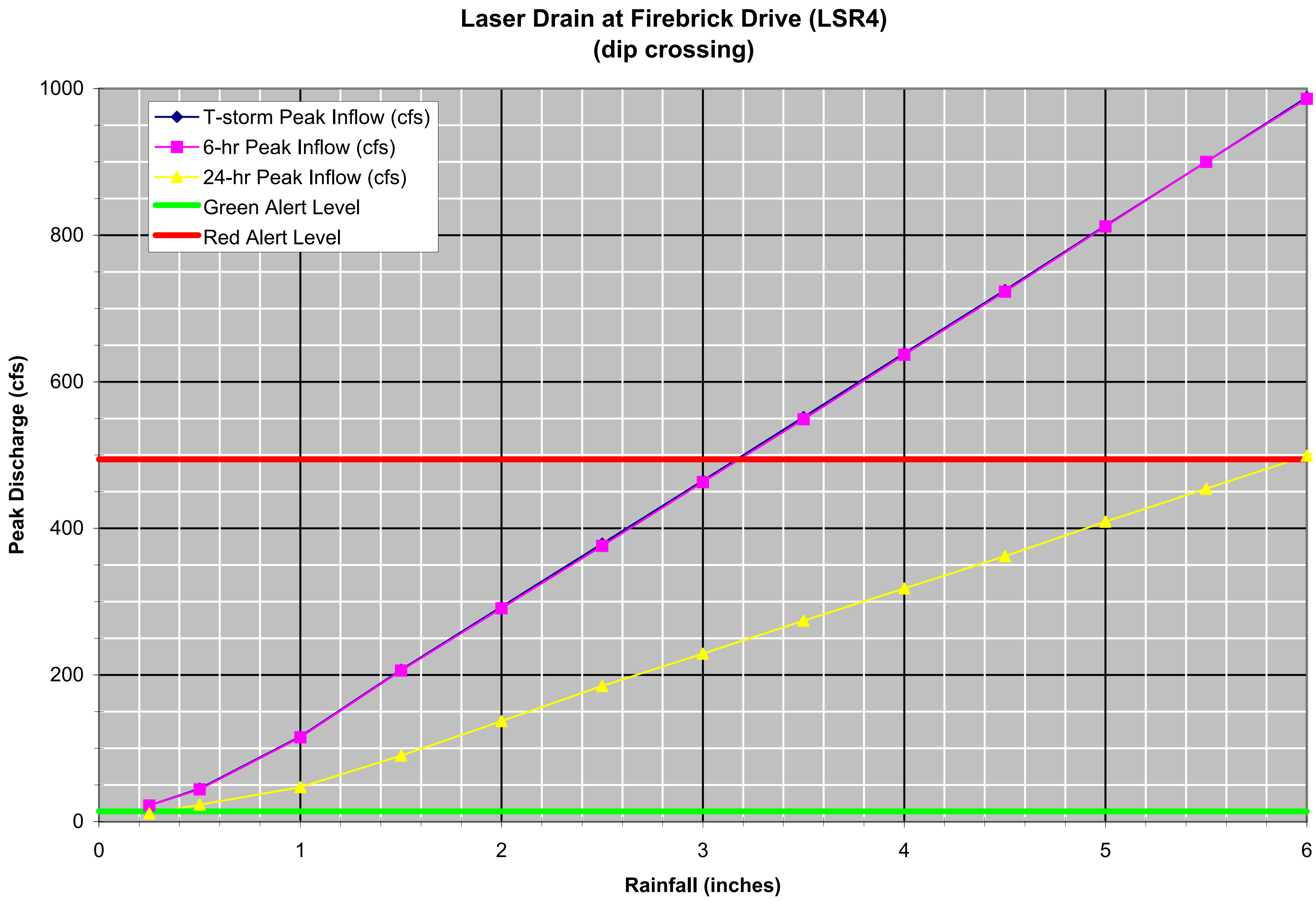
Malta Drain along Hawk Drive from Arroyo Vista Drive to Malta Drive (MLT3)
Dip Crossing/Longitudinal Street Flow
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
0
1
2
3
4
5
6
Rainfall (inches)

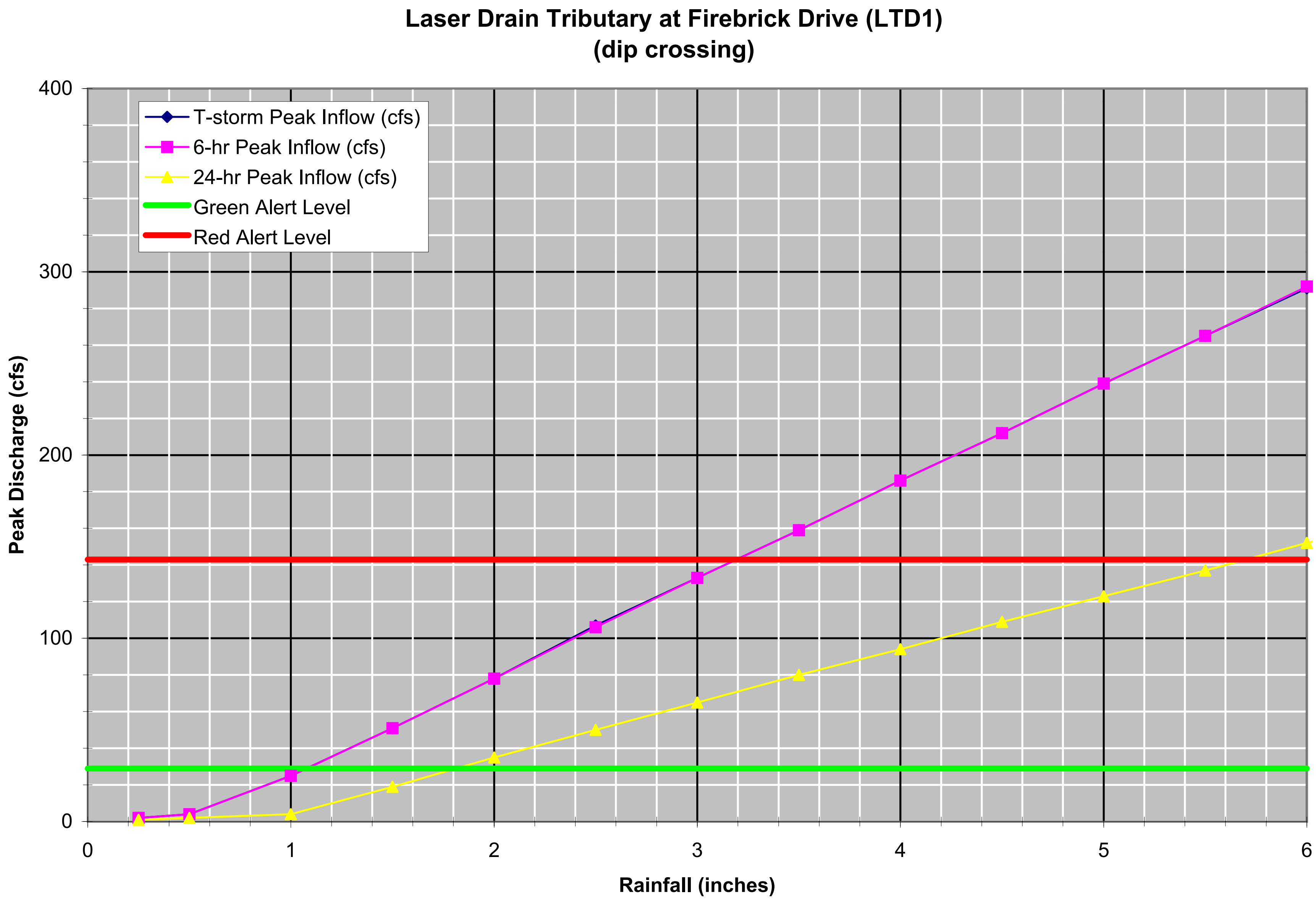

Kingstree Wash at Kingstree Boulevard (KGT5)
Longitudinal Flow (minimum Green level near Walsh Dr.)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
0
1
2
3
4
5
6



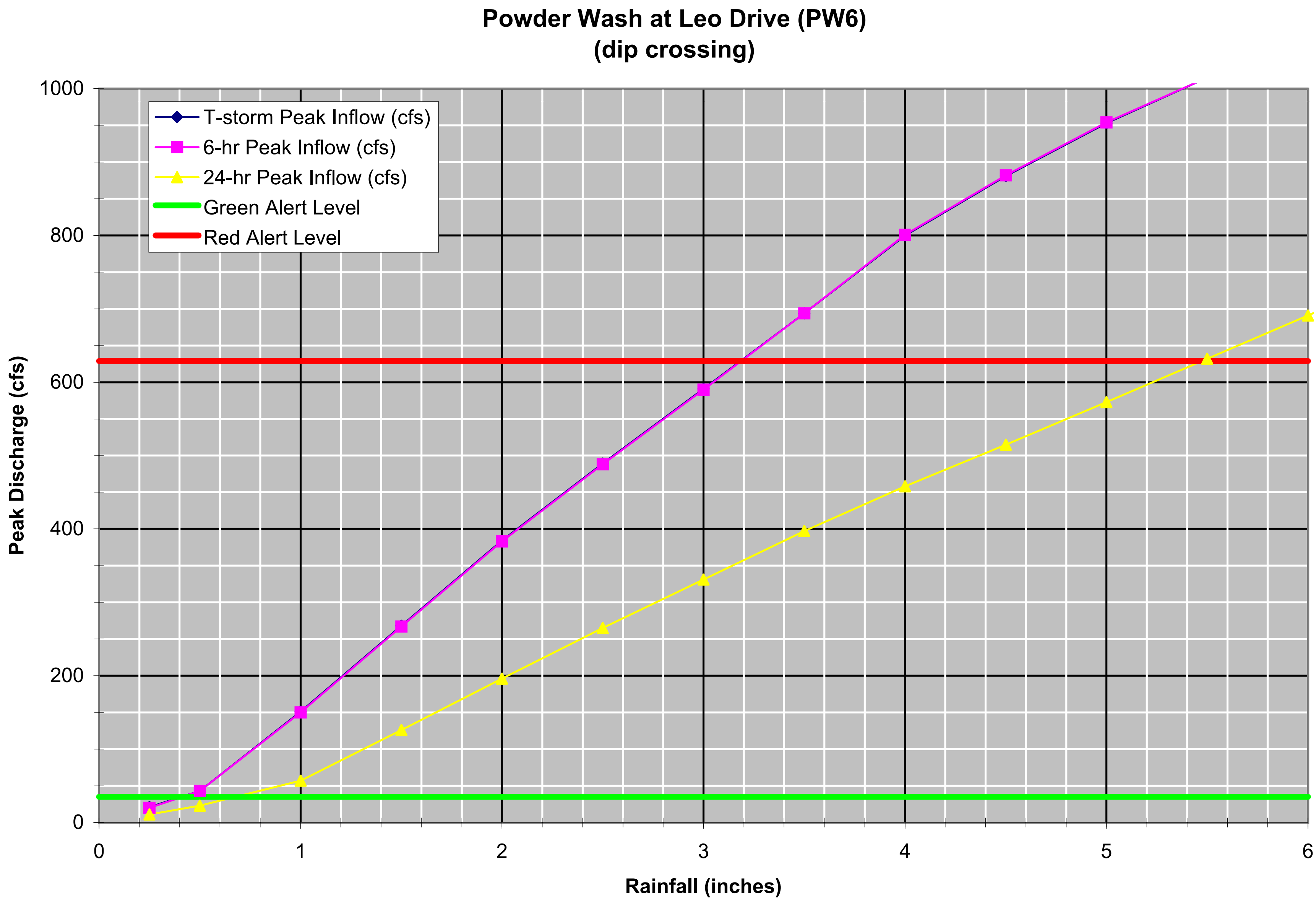
Malta Drain at Rand Drive (MLT4A)
Dip Crossing
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
500
600
700
800
0
1
2
3
4
5
6

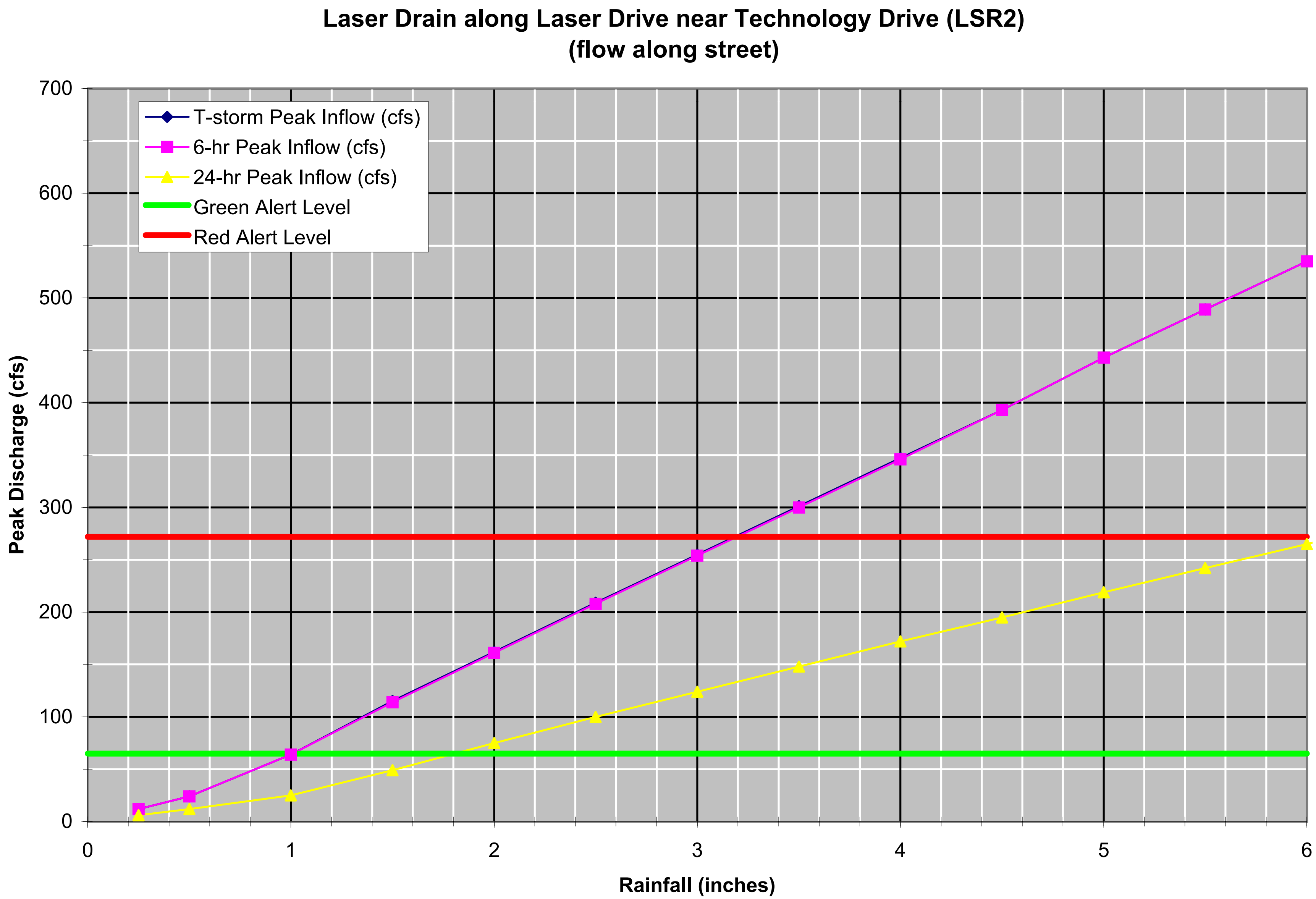
Cereus Wash System


Laser Drain at Firebrick Drive (LSR4)
(dip crossing)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
0
1
2
3
4
5
6

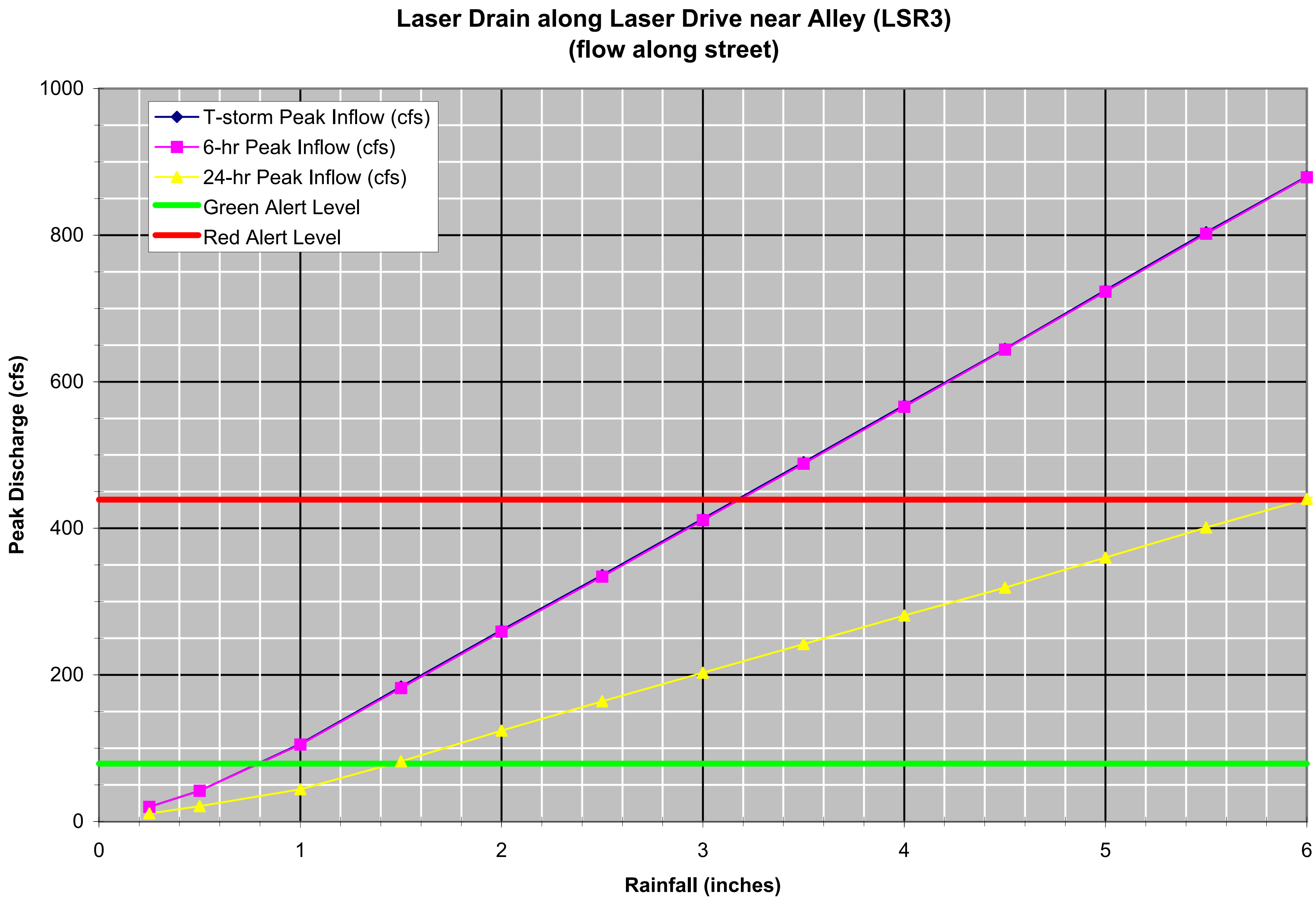


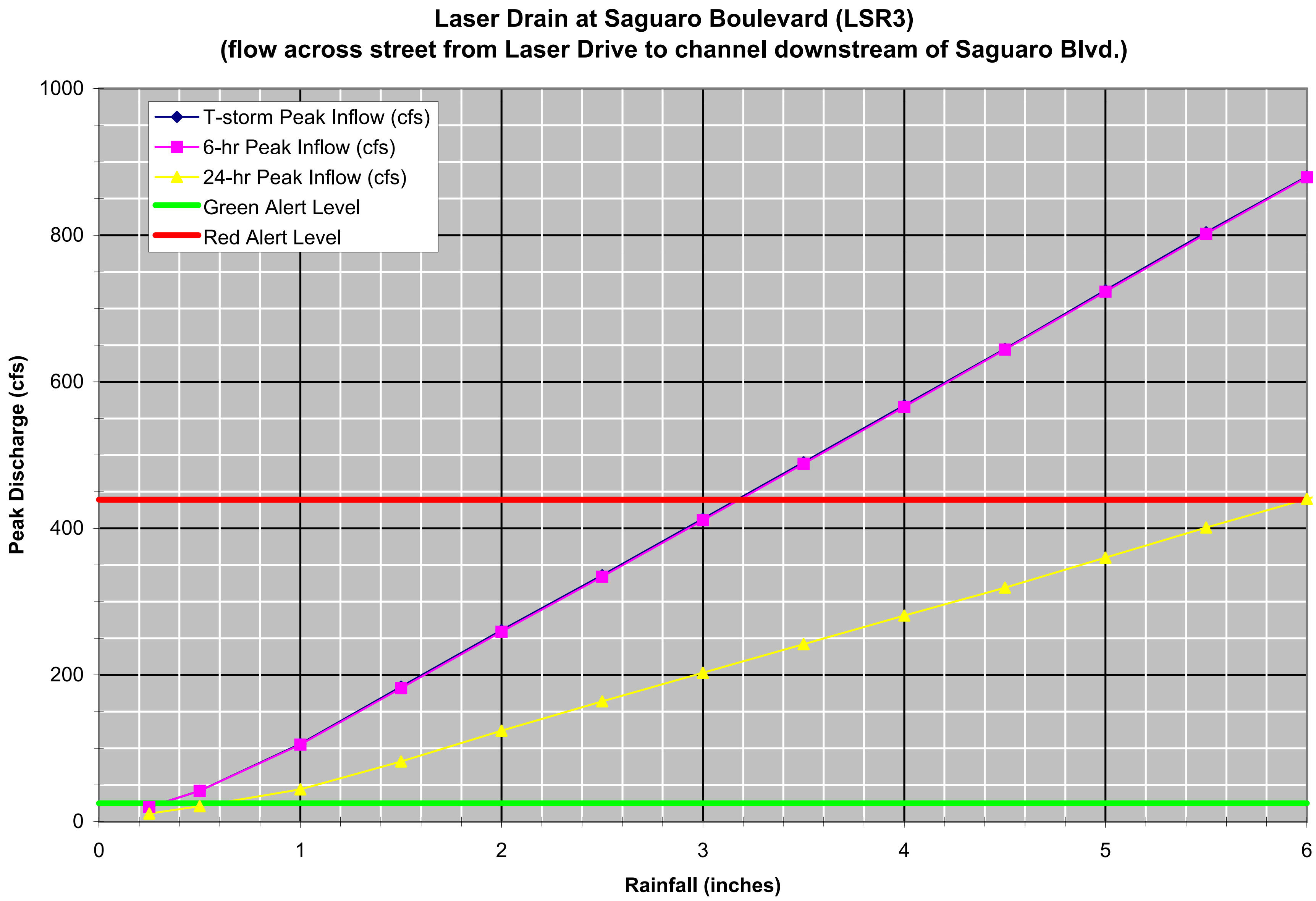
Laser Drain Tributary at Firebrick Drive (LTD1)
(dip crossing)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
100
200
300
400
0
1
2
3
4
5
6


Powder Wash at Leo Drive (PW6)
(dip crossing)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
200
400
600
800
1000
Rainfall (inches)
0
1
2
3
4
5
6



Laser Drain along Laser Drive near Technology Drive (LSR2)
(flow along street)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
100
200
300
400
500
600
700
0
1
2
3
4
5
6
Rainfall (inches)


Laser Drain along Laser Drive near Alley (LSR3)
(flow along street)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
Rainfall (inches)
0
200
400
600
800
1000
1
2
3
4
5
6


Laser Drain at Saguaro Boulevard (LSR3)
(flow across street from Laser Drive to channel downstream of Saguaro Blvd.)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
1000
800
600
400
200
0
0
1
2
3
4
5
6
Rainfall (inches)

Powder Wash at Powderhorn Drive (PW3)
(dip crossing)
T-storm Peak Inflow (cfs)
6-hr Peak Inflow (cfs)
24-hr Peak Inflow (cfs)
Green Alert Level
Red Alert Level
Peak Discharge (cfs)
0
200
400
600
800
1000
Rainfall (inches)
0
1
2
3
4
5
6

Appendix F

Matrices of Results
for
Water Level and Outflow
from
Fountain Hills Dams
for
Various Assumed Starting Conditions,
Various Rainfall Depths,
and
Temporal Storm Distributions

For
Evaluation of Blue Alert Potential

STONERIDGE DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: 180TFDC.DAT*
KK SSNB6

			RATIOS APPLIED TO PRECIPITATION											
AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
.85	1	FLOW	**786.**	**694.**	**604.**	**517.**	**432.**	**335.**	**136.**	112.	103.	93.	80.	63.
		TIME	**1.83**	**1.90**	**2.03**	**2.17**	**2.37**	**2.60**	**2.93**	2.83	2.63	2.40	2.17	1.90
	2	FLOW	**820.**	**725.**	**634.**	**545.**	**459.**	**370.**	**190.**	114.	106.	96.	84.	70.
		TIME	**1.77**	**1.83**	**1.93**	**2.07**	**2.27**	**2.50**	**2.73**	2.80	2.60	2.37	2.13	1.87
	3	FLOW	**887.**	**788.**	**694.**	**600.**	**510.**	**422.**	**305.**	118.	111.	102.	92.	84.
		TIME	**1.67**	**1.70**	**1.80**	**1.90**	**2.07**	**2.23**	**2.47**	2.77	2.57	2.33	2.10	.00
	4	FLOW	**1014.**	**913.**	**812.**	**713.**	**613.**	**517.**	**420.**	**305.**	119.	112.	104.	100.
		TIME	**1.50**	**1.53**	**1.57**	**1.63**	**1.73**	**1.87**	**2.03**	**2.23**	2.53	2.30	2.03	.00
	5	FLOW	**1177.**	**1082.**	**990.**	**896.**	**800.**	**703.**	**599.**	**495.**	**396.**	**272.**	121.	118.
		TIME	**1.33**	**1.37**	**1.37**	**1.37**	**1.40**	**1.40**	**1.47**	**1.53**	**1.63**	**1.80**	1.97	.00

Starting Storage

** PEAK STAGES IN FEET **

0%	1	STAGE	**1704.18**	**1704.01**	**1703.84**	**1703.68**	**1703.52**	**1703.34**	**1702.75**	1700.91	1698.89	1696.41	1693.37	1689.34
		TIME	**1.83**	**1.90**	**2.03**	**2.17**	**2.37**	**2.60**	**2.93**	2.83	2.63	2.40	2.17	1.90
10%	2	STAGE	**1704.24**	**1704.06**	**1703.89**	**1703.73**	**1703.57**	**1703.40**	**1703.02**	1701.45	1699.52	1697.15	1694.38	1690.90
		TIME	**1.77**	**1.83**	**1.93**	**2.07**	**2.27**	**2.50**	**2.73**	2.83	2.60	2.37	2.13	1.87
25%	3	STAGE	**1704.37**	**1704.18**	**1704.01**	**1703.83**	**1703.66**	**1703.50**	**1703.28**	1702.50	1700.71	1698.64	1696.34	1694.31
		TIME	**1.67**	**1.70**	**1.80**	**1.90**	**2.07**	**2.23**	**2.47**	2.77	2.57	2.33	2.10	.00
50%	4	STAGE	**1704.60**	**1704.41**	**1704.23**	**1704.04**	**1703.85**	**1703.68**	**1703.49**	**1703.28**	1702.66	1700.92	1699.14	1698.25
		TIME	**1.50**	**1.53**	**1.57**	**1.63**	**1.73**	**1.87**	**2.03**	**2.23**	2.53	2.30	2.03	.00
90%	5	STAGE	**1704.89**	**1704.73**	**1704.56**	**1704.38**	**1704.20**	**1704.02**	**1703.83**	**1703.63**	**1703.45**	**1703.22**	1702.68	1702.39
		TIME	**1.33**	**1.37**	**1.37**	**1.37**	**1.40**	**1.40**	**1.47**	**1.53**	**1.63**	**1.80**	1.97	.00

EMERGENCY SPILLWAY ELEVATION = **1702.7 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1709.9 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,700 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **119 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1700.6 FT (2.1 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: 180TFDC1.DAT AND 180TFDC2.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX.

STONERIDGE DAM 6-HOUR PATTERN NO. 1 DISTRIBUTION HEC-1 FILE: 1806FDC.DAT*

KK SSNB6

RATIOS APPLIED TO PRECIPITATION

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
.85	1	FLOW	**724.**	**641.**	**559.**	**481.**	**403.**	**293.**	118.	110.	102.	92.	79.	63.
		TIME	**4.93**	**5.03**	**5.13**	**5.30**	**5.50**	**5.67**	6.03	5.83	5.63	5.40	5.17	4.90
	2	FLOW	**724.**	**641.**	**559.**	**481.**	**403.**	**293.**	118.	110.	102.	92.	79.	67.
		TIME	**4.93**	**5.03**	**5.13**	**5.30**	**5.50**	**5.67**	6.03	5.83	5.63	5.40	5.17	.00
	3	FLOW	**742.**	**657.**	**573.**	**492.**	**412.**	**307.**	118.	111.	102.	92.	84.	84.
		TIME	**4.90**	**4.97**	**5.10**	**5.27**	**5.47**	**5.63**	6.03	5.83	5.63	5.40	.00	.00
	4	FLOW	**810.**	**721.**	**633.**	**549.**	**468.**	**383.**	**233.**	116.	108.	100.	100.	100.
		TIME	**4.77**	**4.83**	**4.93**	**5.03**	**5.20**	**5.43**	**5.67**	5.80	5.57	.00	.00	.00
	5	FLOW	**970.**	**876.**	**782.**	**689.**	**595.**	**505.**	**412.**	**297.**	119.	118.	118.	118.
		TIME	**4.53**	**4.57**	**4.60**	**4.67**	**4.77**	**4.90**	**5.07**	**5.23**	5.50	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1704.06**	**1703.91**	**1703.75**	**1703.61**	**1703.46**	**1703.26**	1702.45	1700.64	1698.65	1696.20	1693.16	1689.17
		TIME	**4.93**	**5.03**	**5.13**	**5.30**	**5.50**	**5.67**	6.07	5.83	5.63	5.40	5.17	4.90
10%	2	STAGE	**1704.06**	**1703.91**	**1703.75**	**1703.61**	**1703.46**	**1703.26**	1702.45	1700.64	1698.65	1696.20	1693.16	1690.13
		TIME	**4.93**	**5.03**	**5.13**	**5.30**	**5.50**	**5.67**	6.07	5.83	5.63	5.40	5.17	.00
25%	3	STAGE	**1704.10**	**1703.94**	**1703.78**	**1703.63**	**1703.48**	**1703.28**	1702.56	1700.72	1698.70	1696.21	1694.31	1694.31
		TIME	**4.90**	**4.97**	**5.10**	**5.27**	**5.47**	**5.63**	6.03	5.83	5.63	5.40	.00	.00
50%	4	STAGE	**1704.22**	**1704.06**	**1703.89**	**1703.74**	**1703.58**	**1703.42**	**1703.14**	1701.87	1700.04	1698.25	1698.25	1698.25
		TIME	**4.77**	**4.83**	**4.93**	**5.03**	**5.20**	**5.43**	**5.67**	5.80	5.57	.00	.00	.00
90%	5	STAGE	**1704.52**	**1704.35**	**1704.17**	**1704.00**	**1703.82**	**1703.65**	**1703.48**	**1703.27**	1702.59	1702.39	1702.39	1702.39
		TIME	**4.53**	**4.57**	**4.60**	**4.67**	**4.77**	**4.90**	**5.07**	**5.23**	5.50	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1702.7 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1709.9 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,700 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **119 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1700.6 FT (2.1 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: 1806FDC1.DAT AND 1806FDC2.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX.

KK SSNB6

RATIOS APPLIED TO PRECIPITATION

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
.85	1	FLOW	**380.**	**288.**	**153.**	115.	110.	105.	99.	92.	84.	74.	60.	42.
		TIME	**13.57**	**13.70**	**13.97**	14.17	14.00	13.83	13.63	13.43	13.23	13.03	12.87	12.57
	2	FLOW	**380.**	**288.**	**153.**	115.	110.	105.	99.	92.	84.	74.	67.	67.
		TIME	**13.57**	**13.70**	**13.97**	14.17	14.00	13.83	13.63	13.43	13.23	13.03	.00	.00
	3	FLOW	**380.**	**288.**	**153.**	115.	110.	105.	99.	92.	84.	84.	84.	84.
		TIME	**13.57**	**13.70**	**13.97**	14.17	14.00	13.83	13.63	13.43	13.23	.00	.00	.00
	4	FLOW	**380.**	**288.**	**153.**	115.	110.	105.	100.	100.	100.	100.	100.	100.
		TIME	**13.57**	**13.70**	**13.97**	14.17	14.00	13.83	.00	.00	.00	.00	.00	.00
	5	FLOW	**380.**	**288.**	**153.**	118.	118.	118.	118.	118.	118.	118.	118.	118.
		TIME	**13.57**	**13.70**	**13.97**	.00	.00	.00	.00	.00	.00	.00	.00	.00

Starting Storage

** PEAK STAGES IN FEET **

Starting Storage	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
0%	1	STAGE	**1703.42**	**1703.25**	**1702.84**	1701.76	1700.54	1699.26	1697.85	1696.18	1694.32	1691.97	1688.49	1684.32
		TIME	**13.57**	**13.70**	**13.97**	14.20	14.00	13.83	13.67	13.43	13.23	13.03	12.87	12.57
10%	2	STAGE	**1703.42**	**1703.25**	**1702.84**	1701.76	1700.54	1699.26	1697.85	1696.18	1694.32	1691.97	1690.13	1690.13
		TIME	**13.57**	**13.70**	**13.97**	14.20	14.00	13.83	13.67	13.43	13.23	13.03	.00	.00
25%	3	STAGE	**1703.42**	**1703.25**	**1702.84**	1701.76	1700.54	1699.26	1697.85	1696.18	1694.32	1694.31	1694.31	1694.31
		TIME	**13.57**	**13.70**	**13.97**	14.20	14.00	13.83	13.67	13.43	13.23	.00	.00	.00
50%	4	STAGE	**1703.42**	**1703.25**	**1702.84**	1701.76	1700.54	1699.26	1698.25	1698.25	1698.25	1698.25	1698.25	1698.25
		TIME	**13.57**	**13.70**	**13.97**	14.20	14.00	13.83	.00	.00	.00	.00	.00	.00
90%	5	STAGE	**1703.42**	**1703.25**	**1702.84**	1702.39	1702.39	1702.39	1702.39	1702.39	1702.39	1702.39	1702.39	1702.39
		TIME	**13.57**	**13.70**	**13.97**	.00	.00	.00	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1702.7 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1709.9 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,700 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **119 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1700.6 FT (2.1 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS DUE TO ARRAY LIMITATIONS WHEN RUN WITH SUFFICIENT ORDINATES FOR NMIN = 2 AND NQ =2000 FOR JR-JP COMBINATIONS MODELLED.

HESPERUS DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: F100TDC#.DAT*

KK C536O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.91	1	FLOW	**5449.**	**4466.**	**3462.**	**2505.**	**1544.**	**660.**	343.	330.	311.	289.	256.	198.
		TIME	**1.90**	**1.95**	**2.03**	**2.17**	**2.32**	**2.73**	3.07	3.00	2.92	2.83	2.72	2.48
	2	FLOW	**5657.**	**4670.**	**3662.**	**2679.**	**1741.**	**805.**	344.	332.	314.	293.	260.	232.
		TIME	**1.87**	**1.93**	**2.02**	**2.12**	**2.27**	**2.60**	3.07	2.98	2.92	2.82	2.70	.00
	3	FLOW	**6161.**	**5176.**	**4194.**	**3186.**	**2268.**	**1294.**	**515.**	340.	326.	308.	285.	277.
		TIME	**1.83**	**1.88**	**1.93**	**2.03**	**2.15**	**2.35**	**2.80**	2.97	2.88	2.78	2.65	.00
	4	FLOW	**6937.**	**6016.**	**5062.**	**4116.**	**3140.**	**2267.**	**1318.**	**536.**	341.	329.	314.	312.
		TIME	**1.77**	**1.80**	**1.85**	**1.90**	**1.98**	**2.10**	**2.25**	**2.67**	2.85	2.73	2.57	.00
	5	FLOW	**7881.**	**6964.**	**6144.**	**5310.**	**4479.**	**3633.**	**2803.**	**2001.**	**1128.**	**502.**	343.	343.
		TIME	**1.68**	**1.72**	**1.73**	**1.77**	**1.78**	**1.83**	**1.90**	**1.98**	**2.13**	**2.45**	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1893.21**	**1892.71**	**1892.18**	**1891.57**	**1890.90**	**1889.95**	1887.63	1884.18	1880.20	1876.06	1871.39	1864.79
		TIME	**1.90**	**1.95**	**2.03**	**2.17**	**2.32**	**2.73**	3.08	3.00	2.92	2.83	2.72	2.48
10%	2	STAGE	**1893.31**	**1892.82**	**1892.29**	**1891.69**	**1891.03**	**1890.14**	1888.14	1884.77	1880.83	1876.68	1871.99	1868.45
		TIME	**1.87**	**1.93**	**2.02**	**2.12**	**2.27**	**2.60**	3.07	3.00	2.92	2.83	2.70	.00
25%	3	STAGE	**1893.55**	**1893.08**	**1892.57**	**1892.04**	**1891.40**	**1890.67**	**1889.59**	1886.82	1883.28	1879.55	1875.48	1874.13
		TIME	**1.83**	**1.88**	**1.93**	**2.03**	**2.15**	**2.35**	**2.80**	2.98	2.88	2.78	2.65	.00
50%	4	STAGE	**1893.93**	**1893.48**	**1893.03**	**1892.53**	**1892.01**	**1891.40**	**1890.70**	**1889.65**	1887.09	1884.06	1880.81	1880.38
		TIME	**1.77**	**1.80**	**1.85**	**1.90**	**1.98**	**2.08**	**2.25**	**2.67**	2.85	2.73	2.57	.00
90%	5	STAGE	**1894.25**	**1893.94**	**1893.55**	**1893.15**	**1892.72**	**1892.27**	**1891.78**	**1891.22**	**1890.49**	**1889.56**	1887.57	1887.57
		TIME	**1.68**	**1.72**	**1.73**	**1.77**	**1.78**	**1.83**	**1.90**	**1.98**	**2.13**	**2.45**	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1889.0 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1894.2 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,970 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **348 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1883.3 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F100TDC1.DAT TO F100TDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

KK C536O

			RATIOS APPLIED TO PRECIPITATION											
AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.91	1	FLOW	**5144.**	**4217.**	**3263.**	**2371.**	**1417.**	**609.**	342.	329.	310.	287.	254.	191.
		TIME	**4.92**	**4.98**	**5.07**	**5.18**	**5.37**	**5.77**	6.07	6.00	5.92	5.83	5.72	5.50
	2	FLOW	**5147.**	**4219.**	**3265.**	**2373.**	**1420.**	**611.**	342.	329.	310.	287.	254.	232.
		TIME	**4.92**	**4.98**	**5.07**	**5.18**	**5.37**	**5.77**	6.07	6.00	5.92	5.83	5.72	.00
	3	FLOW	**5216.**	**4281.**	**3322.**	**2417.**	**1471.**	**634.**	343.	329.	311.	288.	277.	277.
		TIME	**4.92**	**4.97**	**5.05**	**5.18**	**5.35**	**5.75**	6.07	6.00	5.92	5.83	.00	.00
	4	FLOW	**5900.**	**4964.**	**4026.**	**3060.**	**2180.**	**1226.**	**472.**	340.	325.	312.	312.	312.
		TIME	**4.85**	**4.90**	**4.95**	**5.05**	**5.17**	**5.37**	**5.83**	5.97	5.88	.00	.00	.00
	5	FLOW	**7039.**	**6185.**	**5293.**	**4405.**	**3489.**	**2608.**	**1737.**	**832.**	345.	343.	343.	343.
		TIME	**4.75**	**4.78**	**4.82**	**4.87**	**4.93**	**5.02**	**5.12**	**5.40**	5.83	.00	.00	.00
Starting Storage														
		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1893.07**	**1892.58**	**1892.08**	**1891.48**	**1890.81**	**1889.83**	1887.40	1883.93	1879.94	1875.81	1871.16	1864.12
		TIME	**4.92**	**4.98**	**5.07**	**5.18**	**5.37**	**5.77**	6.08	6.00	5.92	5.83	5.72	5.50
10%	2	STAGE	**1893.07**	**1892.58**	**1892.08**	**1891.48**	**1890.81**	**1889.83**	1887.40	1883.93	1879.95	1875.82	1871.17	1868.45
		TIME	**4.92**	**4.98**	**5.07**	**5.18**	**5.37**	**5.77**	6.07	6.00	5.92	5.83	5.72	.00
25%	3	STAGE	**1893.10**	**1892.61**	**1892.11**	**1891.51**	**1890.84**	**1889.89**	1887.52	1884.06	1880.08	1875.94	1874.13	1874.13
		TIME	**4.92**	**4.97**	**5.05**	**5.18**	**5.35**	**5.75**	6.07	6.00	5.92	5.83	.00	.00
50%	4	STAGE	**1893.43**	**1892.98**	**1892.48**	**1891.96**	**1891.34**	**1890.60**	**1889.49**	1886.61	1883.02	1880.38	1880.38	1880.38
		TIME	**4.85**	**4.90**	**4.95**	**5.05**	**5.17**	**5.37**	**5.83**	5.97	5.88	.00	.00	.00
90%	5	STAGE	**1893.98**	**1893.57**	**1893.14**	**1892.68**	**1892.20**	**1891.64**	**1891.03**	**1890.17**	1888.42	1887.57	1887.57	1887.57
		TIME	**4.75**	**4.78**	**4.82**	**4.87**	**4.93**	**5.02**	**5.12**	**5.40**	5.85	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1889.0 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1894.2 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,970 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **348 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1883.3 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F1006DC1.DAT TO F1006DC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

HESPERUS DAM SCS TYPE II 24-HR DISTRIBUTION HEC-1 FILE: F10024C#.DAT*

KK C536O

RATIOS APPLIED TO PRECIPITATION

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.91	1	FLOW	**973.**	**534.**	344.	338.	328.	317.	305.	287.	262.	227.	161.	100.
		TIME	**13.60**	**13.97**	14.23	14.17	14.12	14.05	13.97	13.90	13.80	13.67	13.57	13.80
	2	FLOW	**973.**	**534.**	344.	338.	328.	317.	305.	287.	262.	232.	232.	232.
		TIME	**13.60**	**13.97**	14.23	14.17	14.12	14.05	13.97	13.90	13.80	.00	.00	.00
	3	FLOW	**973.**	**534.**	344.	338.	328.	317.	305.	287.	277.	277.	277.	277.
		TIME	**13.60**	**13.97**	14.23	14.17	14.12	14.05	13.97	13.90	.00	.00	.00	.00
	4	FLOW	**973.**	**534.**	344.	338.	328.	317.	312.	312.	312.	312.	312.	312.
		TIME	**13.60**	**13.97**	14.23	14.17	14.12	14.05	.00	.00	.00	.00	.00	.00
	5	FLOW	**1015.**	**557.**	345.	343.	343.	343.	343.	343.	343.	343.	343.	343.
		TIME	**13.58**	**13.93**	14.23	.00	.00	.00	.00	.00	.00	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1890.32**	**1889.64**	1888.10	1886.16	1883.84	1881.46	1878.77	1875.76	1872.25	1867.94	1861.50	1857.54
		TIME	**13.60**	**13.97**	14.25	14.18	14.12	14.05	13.98	13.90	13.80	13.67	13.57	13.80
10%	2	STAGE	**1890.32**	**1889.64**	1888.10	1886.16	1883.84	1881.46	1878.77	1875.76	1872.25	1868.45	1868.45	1868.45
		TIME	**13.60**	**13.97**	14.25	14.18	14.12	14.05	13.98	13.90	13.80	.00	.00	.00
25%	3	STAGE	**1890.32**	**1889.64**	1888.10	1886.16	1883.84	1881.46	1878.77	1875.76	1874.13	1874.13	1874.13	1874.13
		TIME	**13.60**	**13.97**	14.25	14.18	14.12	14.05	13.98	13.90	.00	.00	.00	.00
50%	4	STAGE	**1890.32**	**1889.64**	1888.10	1886.16	1883.84	1881.46	1880.38	1880.38	1880.38	1880.38	1880.38	1880.38
		TIME	**13.60**	**13.97**	14.25	14.18	14.12	14.05	.00	.00	.00	.00	.00	.00
90%	5	STAGE	**1890.37**	**1889.70**	1888.20	1887.57	1887.57	1887.57	1887.57	1887.57	1887.57	1887.57	1887.57	1887.57
		TIME	**13.58**	**13.93**	14.25	.00	.00	.00	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1889.0 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1894.2 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **6,970 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **348 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1883.3 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F10024C1.DAT TO F10024C6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

ASPEN DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: F100TDC#.DAT*

KK C560O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.15	1	FLOW	**5257.**	**4496.**	**3689.**	**2892.**	**2079.**	**1344.**	**614.**	295.	275.	247.	208.	150.
		TIME	**1.53**	**1.57**	**1.62**	**1.68**	**1.80**	**1.95**	**2.28**	2.67	2.60	2.52	2.42	2.30
	2	FLOW	**5402.**	**4660.**	**3862.**	**3075.**	**2268.**	**1512.**	**786.**	299.	281.	255.	219.	165.
		TIME	**1.52**	**1.55**	**1.58**	**1.65**	**1.75**	**1.87**	**2.15**	2.67	2.58	2.50	2.40	2.23
	3	FLOW	**5643.**	**4939.**	**4181.**	**3409.**	**2622.**	**1855.**	**1140.**	**410.**	290.	269.	240.	201.
		TIME	**1.48**	**1.52**	**1.55**	**1.60**	**1.68**	**1.78**	**1.97**	**2.47**	2.57	2.47	2.35	.00
	4	FLOW	**5974.**	**5325.**	**4640.**	**3919.**	**3205.**	**2466.**	**1747.**	**1051.**	**365.**	290.	270.	255.
		TIME	**1.45**	**1.47**	**1.50**	**1.53**	**1.57**	**1.65**	**1.73**	**1.92**	**2.42**	2.43	2.28	.00
	5	FLOW	**6267.**	**5671.**	**5070.**	**4454.**	**3823.**	**3212.**	**2584.**	**1960.**	**1368.**	**765.**	301.	296.
		TIME	**1.40**	**1.42**	**1.43**	**1.45**	**1.47**	**1.48**	**1.53**	**1.60**	**1.67**	**1.85**	2.22	.00

** PEAK STAGES IN FEET **

Starting Storage	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
0%	1	STAGE	**1839.47**	**1839.09**	**1838.65**	**1838.17**	**1837.64**	**1836.99**	**1836.28**	1833.91	1830.57	1826.75	1822.41	1817.15
		TIME	**1.53**	**1.57**	**1.62**	**1.68**	**1.78**	**1.95**	**2.28**	2.68	2.60	2.52	2.42	2.30
10%	2	STAGE	**1839.54**	**1839.17**	**1838.75**	**1838.28**	**1837.77**	**1837.14**	**1836.49**	1834.60	1831.41	1827.74	1823.54	1818.38
		TIME	**1.52**	**1.55**	**1.58**	**1.65**	**1.75**	**1.87**	**2.15**	2.67	2.58	2.50	2.40	2.23
25%	3	STAGE	**1839.67**	**1839.31**	**1838.93**	**1838.48**	**1838.01**	**1837.45**	**1836.81**	**1835.87**	1833.02	1829.67	1825.92	1821.72
		TIME	**1.48**	**1.52**	**1.55**	**1.60**	**1.68**	**1.78**	**1.97**	**2.47**	2.57	2.47	2.35	.00
50%	4	STAGE	**1839.83**	**1839.51**	**1839.16**	**1838.78**	**1838.36**	**1837.91**	**1837.36**	**1836.73**	**1835.67**	1832.93	1829.87	1827.76
		TIME	**1.45**	**1.47**	**1.50**	**1.52**	**1.57**	**1.65**	**1.73**	**1.92**	**2.42**	2.43	2.28	.00
90%	5	STAGE	**1839.98**	**1839.68**	**1839.38**	**1839.07**	**1838.73**	**1838.36**	**1837.99**	**1837.55**	**1837.01**	**1836.47**	1835.10	1834.09
		TIME	**1.40**	**1.42**	**1.43**	**1.45**	**1.47**	**1.48**	**1.53**	**1.60**	**1.67**	**1.85**	2.23	.00

EMERGENCY SPILLWAY ELEVATION = **1835.4 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1843.2 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **14,600 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **305 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1832.4 FT (3.0 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F100TDC1.DAT TO F100TDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

ASPEN DAM 6-HOUR PATTERN NO. 1 DISTRIBUTION HEC-1 FILE: F1006DC#.DAT*
KK C560O

AREA	PLAN		RATIOS APPLIED TO PRECIPITATION											
			RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.15	1	FLOW	**4955.**	**4202.**	**3435.**	**2662.**	**1903.**	**1206.**	**492.**	293.	272.	243.	204.	146.
		TIME	**4.55**	**4.60**	**4.65**	**4.72**	**4.83**	**5.00**	**5.45**	5.68	5.60	5.52	5.43	5.30
	2	FLOW	**4981.**	**4227.**	**3460.**	**2688.**	**1922.**	**1222.**	**505.**	293.	272.	243.	204.	146.
		TIME	**4.55**	**4.58**	**4.63**	**4.72**	**4.83**	**5.00**	**5.43**	5.67	5.60	5.52	5.43	5.30
	3	FLOW	**5085.**	**4341.**	**3570.**	**2800.**	**2017.**	**1315.**	**599.**	295.	275.	247.	209.	201.
		TIME	**4.55**	**4.58**	**4.63**	**4.70**	**4.80**	**4.95**	**5.30**	5.67	5.60	5.52	5.42	.00
	4	FLOW	**5389.**	**4686.**	**3933.**	**3190.**	**2422.**	**1685.**	**983.**	**312.**	287.	263.	255.	255.
		TIME	**4.52**	**4.53**	**4.58**	**4.63**	**4.72**	**4.82**	**5.03**	**5.63**	5.57	5.48	.00	.00
	5	FLOW	**5877.**	**5244.**	**4582.**	**3885.**	**3196.**	**2479.**	**1779.**	**1093.**	**394.**	296.	296.	296.
		TIME	**4.45**	**4.47**	**4.50**	**4.53**	**4.57**	**4.63**	**4.73**	**4.90**	**5.37**	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1839.32**	**1838.94**	**1838.50**	**1838.04**	**1837.50**	**1836.87**	**1836.08**	1833.47	1830.11	1826.30	1822.00	1816.83
		TIME	**4.55**	**4.60**	**4.65**	**4.72**	**4.83**	**5.00**	**5.45**	5.68	5.60	5.53	5.43	5.30
10%	2	STAGE	**1839.33**	**1838.95**	**1838.51**	**1838.05**	**1837.51**	**1836.88**	**1836.10**	1833.50	1830.11	1826.30	1822.00	1816.83
		TIME	**4.55**	**4.58**	**4.63**	**4.72**	**4.82**	**5.00**	**5.43**	5.68	5.60	5.53	5.43	5.30
25%	3	STAGE	**1839.39**	**1839.01**	**1838.58**	**1838.12**	**1837.60**	**1836.96**	**1836.25**	1833.89	1830.58	1826.80	1822.49	1821.72
		TIME	**4.55**	**4.58**	**4.63**	**4.70**	**4.80**	**4.95**	**5.30**	5.67	5.60	5.52	5.42	.00
50%	4	STAGE	**1839.54**	**1839.19**	**1838.79**	**1838.35**	**1837.88**	**1837.30**	**1836.66**	**1835.44**	1832.40	1828.89	1827.76	1827.76
		TIME	**4.52**	**4.53**	**4.58**	**4.63**	**4.72**	**4.82**	**5.03**	**5.63**	5.57	5.48	.00	.00
90%	5	STAGE	**1839.78**	**1839.47**	**1839.13**	**1838.77**	**1838.35**	**1837.92**	**1837.38**	**1836.76**	**1835.80**	1834.09	1834.09	1834.09
		TIME	**4.45**	**4.47**	**4.50**	**4.53**	**4.57**	**4.63**	**4.73**	**4.90**	**5.37**	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1835.4 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1843.2 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **14,600 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **305 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1832.4 FT (3.0 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F1006DC1.DAT TO F1006DC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

KK C560O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5”	6.0”	5.5”	5.0”	4.5”	4.0”	3.5”	3.0”	2.5”	2.0”	1.5”	1.0”
2.15	1	FLOW	**1443.**	**1055.**	**617.**	302.	291.	279.	263.	242.	215.	179.	136.	88.
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	13.47	13.35	13.45
	2	FLOW	**1443.**	**1055.**	**617.**	302.	291.	279.	263.	242.	215.	179.	144.	144.
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	13.47	.00	.00
	3	FLOW	**1443.**	**1055.**	**617.**	302.	291.	279.	263.	242.	215.	201.	201.	201.
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	.00	.00	.00
	4	FLOW	**1448.**	**1058.**	**619.**	302.	291.	279.	263.	255.	255.	255.	255.	255.
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	.00	.00	.00	.00	.00
	5	FLOW	**1500.**	**1106.**	**665.**	303.	296.	296.	296.	296.	296.	296.	296.	296.
		TIME	**12.95**	**13.10**	**13.35**	13.90	.00	.00	.00	.00	.00	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1837.08**	**1836.73**	**1836.28**	1835.16	1833.21	1831.15	1828.81	1826.13	1823.14	1819.59	1816.02	1813.55
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	13.47	13.35	13.45
10%	2	STAGE	**1837.08**	**1836.73**	**1836.28**	1835.16	1833.21	1831.15	1828.81	1826.13	1823.14	1819.59	1816.70	1816.70
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	13.47	.00	.00
25%	3	STAGE	**1837.08**	**1836.73**	**1836.28**	1835.16	1833.21	1831.15	1828.81	1826.13	1823.14	1821.72	1821.72	1821.72
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	13.63	13.55	.00	.00	.00
50%	4	STAGE	**1837.08**	**1836.73**	**1836.28**	1835.16	1833.21	1831.15	1828.81	1827.76	1827.76	1827.76	1827.76	1827.76
		TIME	**12.98**	**13.13**	**13.40**	13.90	13.83	13.77	13.70	.00	.00	.00	.00	.00
90%	5	STAGE	**1837.13**	**1836.78**	**1836.36**	1835.37	1834.09	1834.09	1834.09	1834.09	1834.09	1834.09	1834.09	1834.09
		TIME	**12.95**	**13.10**	**13.35**	13.90	.00	.00	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1835.4 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1843.2 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **14,600 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **305 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1832.4 FT (3.0 FT BELOW SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F10024C1.DAT TO F10024C6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

NORTH HEIGHTS DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: F100TDC#.DAT*

KK C578O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
1.60	1	FLOW	**9222.**	**8143.**	**7005.**	**5892.**	**4713.**	**3586.**	**2425.**	**1346.**	**406.**	314.	293.	257.
		TIME	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.40**	**1.52**	**1.83**	1.85	1.80	1.72
	2	FLOW	**9343.**	**8283.**	**7157.**	**6053.**	**4880.**	**3757.**	**2586.**	**1497.**	**528.**	317.	296.	261.
		TIME	**1.18**	**1.20**	**1.22**	**1.23**	**1.27**	**1.32**	**1.38**	**1.48**	**1.73**	1.85	1.80	1.72
	3	FLOW	**9537.**	**8519.**	**7436.**	**6374.**	**5270.**	**4135.**	**2997.**	**1893.**	**840.**	324.	306.	278.
		TIME	**1.18**	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.42**	**1.60**	1.85	1.78	1.70
	4	FLOW	**9763.**	**8823.**	**7841.**	**6839.**	**5833.**	**4744.**	**3698.**	**2598.**	**1565.**	**612.**	320.	301.
		TIME	**1.17**	**1.18**	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.43**	**1.63**	1.77	1.67
	5	FLOW	**9888.**	**8999.**	**8094.**	**7177.**	**6300.**	**5406.**	**4472.**	**3568.**	**2600.**	**1679.**	**824.**	326.
		TIME	**1.17**	**1.17**	**1.18**	**1.18**	**1.18**	**1.20**	**1.22**	**1.23**	**1.27**	**1.33**	**1.47**	1.63

** PEAK STAGES IN FEET **

Starting Storage	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
0%	1	STAGE	**1816.71**	**1816.30**	**1815.82**	**1815.29**	**1814.72**	**1814.07**	**1813.36**	**1812.51**	**1811.30**	1807.90	1803.74	1798.39
		TIME	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.40**	**1.52**	**1.83**	1.85	1.80	1.72
10%	2	STAGE	**1816.76**	**1816.35**	**1815.90**	**1815.37**	**1814.81**	**1814.17**	**1813.47**	**1812.65**	**1811.61**	1808.39	1804.31	1799.00
		TIME	**1.18**	**1.20**	**1.22**	**1.23**	**1.27**	**1.32**	**1.38**	**1.48**	**1.73**	1.85	1.80	1.72
25%	3	STAGE	**1816.83**	**1816.44**	**1816.02**	**1815.52**	**1815.00**	**1814.39**	**1813.73**	**1812.97**	**1812.03**	1809.84	1806.11	1801.27
		TIME	**1.18**	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.42**	**1.60**	1.85	1.78	1.70
50%	4	STAGE	**1816.92**	**1816.56**	**1816.18**	**1815.74**	**1815.27**	**1814.74**	**1814.14**	**1813.48**	**1812.72**	**1811.72**	1809.00	1805.31
		TIME	**1.17**	**1.18**	**1.18**	**1.20**	**1.22**	**1.25**	**1.28**	**1.33**	**1.43**	**1.63**	1.77	1.67
90%	5	STAGE	**1816.97**	**1816.63**	**1816.28**	**1815.91**	**1815.49**	**1815.06**	**1814.58**	**1814.06**	**1813.48**	**1812.82**	**1812.01**	1810.27
		TIME	**1.17**	**1.17**	**1.18**	**1.18**	**1.18**	**1.20**	**1.22**	**1.23**	**1.27**	**1.33**	**1.47**	1.63

EMERGENCY SPILLWAY ELEVATION = **1810.8 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1818.4 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **13,400 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **328 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1812.3 FT (1.5 FT OVER SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F100TDC1.DAT TO F100TDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

NORTH HEIGHTS DAM 6-HOUR PATTERN NO. 1 DISTRIBUTION HEC-1 FILE: F1006DC#.DAT*
KK C578O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			RATIOS APPLIED TO PRECIPITATION											
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
1.60	1	FLOW	**8690.**	**7583.**	**6504.**	**5409.**	**4304.**	**3225.**	**2136.**	**1124.**	328.	312.	290.	253.
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	4.73
	2	FLOW	**8692.**	**7585.**	**6506.**	**5412.**	**4306.**	**3227.**	**2138.**	**1125.**	328.	312.	290.	254.
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	4.73
	3	FLOW	**8714.**	**7607.**	**6525.**	**5428.**	**4318.**	**3238.**	**2145.**	**1132.**	328.	312.	290.	258.
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	.00
	4	FLOW	**8989.**	**7899.**	**6790.**	**5684.**	**4544.**	**3450.**	**2310.**	**1261.**	**358.**	313.	294.	294.
		TIME	**4.20**	**4.22**	**4.23**	**4.27**	**4.30**	**4.33**	**4.40**	**4.53**	**4.87**	4.85	.00	.00
	5	FLOW	**9539.**	**8539.**	**7494.**	**6470.**	**5411.**	**4322.**	**3246.**	**2155.**	**1121.**	327.	324.	324.
		TIME	**4.18**	**4.18**	**4.20**	**4.22**	**4.23**	**4.27**	**4.32**	**4.38**	**4.52**	4.83	.00	.00

Starting Storage			** PEAK STAGES IN FEET **											
0%	1	STAGE	**1816.51**	**1816.08**	**1815.59**	**1815.06**	**1814.48**	**1813.86**	**1813.15**	**1812.30**	1810.78	1807.36	1803.23	1797.94
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	4.73
10%	2	STAGE	**1816.51**	**1816.08**	**1815.59**	**1815.07**	**1814.48**	**1813.87**	**1813.15**	**1812.30**	1810.79	1807.36	1803.23	1797.95
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	4.73
25%	3	STAGE	**1816.52**	**1816.09**	**1815.60**	**1815.07**	**1814.49**	**1813.87**	**1813.16**	**1812.30**	1810.80	1807.38	1803.26	1798.57
		TIME	**4.22**	**4.23**	**4.25**	**4.27**	**4.30**	**4.35**	**4.43**	**4.57**	4.90	4.85	4.80	.00
50%	4	STAGE	**1816.62**	**1816.20**	**1815.72**	**1815.19**	**1814.62**	**1813.99**	**1813.27**	**1812.43**	**1811.12**	1807.70	1804.00	1804.00
		TIME	**4.20**	**4.22**	**4.23**	**4.27**	**4.28**	**4.33**	**4.40**	**4.53**	**4.87**	4.85	.00	.00
90%	5	STAGE	**1816.83**	**1816.45**	**1816.05**	**1815.57**	**1815.06**	**1814.49**	**1813.88**	**1813.16**	**1812.30**	1810.67	1809.82	1809.82
		TIME	**4.18**	**4.18**	**4.20**	**4.22**	**4.23**	**4.27**	**4.32**	**4.38**	**4.52**	4.83	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1810.8 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1818.4 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **13,400 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **328 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1812.3 FT (1.5 FT OVER SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F1006DC1.DAT TO F1006DC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

NORTH HEIGHTS DAM SCS TYPE II 24-HR DISTRIBUTION HEC-1 FILE: F10024C#.DAT*
KK C578O

RATIOS APPLIED TO PRECIPITATION

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
1.60	1	FLOW	**2915.**	**2348.**	**1804.**	**1294.**	**785.**	**352.**	320.	309.	294.	273.	240.	179.
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.73**	**13.05**	13.03	12.97	12.92	12.85	12.77	12.72
	2	FLOW	**2915.**	**2348.**	**1804.**	**1294.**	**785.**	**352.**	320.	309.	294.	273.	240.	198.
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.73**	**13.05**	13.03	12.97	12.92	12.85	12.77	.00
	3	FLOW	**2915.**	**2348.**	**1804.**	**1294.**	**785.**	**352.**	320.	309.	294.	273.	258.	258.
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.73**	**13.05**	13.03	12.97	12.92	12.85	.00	.00
	4	FLOW	**2915.**	**2348.**	**1804.**	**1294.**	**785.**	**352.**	320.	309.	294.	294.	294.	294.
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.73**	**13.05**	13.03	12.97	.00	.00	.00	.00
	5	FLOW	**2915.**	**2348.**	**1805.**	**1294.**	**785.**	**352.**	324.	324.	324.	324.	324.	324.
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.73**	**13.05**	.00	.00	.00	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1813.69**	**1813.30**	**1812.91**	**1812.46**	**1811.96**	**1811.05**	1809.09	1806.78	1804.00	1800.67	1796.30	1789.85
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.72**	**13.05**	13.03	12.97	12.92	12.85	12.77	12.72
10%	2	STAGE	**1813.69**	**1813.30**	**1812.91**	**1812.46**	**1811.96**	**1811.05**	1809.09	1806.78	1804.00	1800.67	1796.30	1791.67
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.72**	**13.05**	13.03	12.97	12.92	12.85	12.77	.00
25%	3	STAGE	**1813.69**	**1813.30**	**1812.91**	**1812.46**	**1811.96**	**1811.05**	1809.09	1806.78	1804.00	1800.67	1798.57	1798.57
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.72**	**13.05**	13.03	12.97	12.92	12.85	.00	.00
50%	4	STAGE	**1813.69**	**1813.30**	**1812.91**	**1812.46**	**1811.96**	**1811.05**	1809.09	1806.78	1804.00	1804.00	1804.00	1804.00
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.72**	**13.05**	13.03	12.97	.00	.00	.00	.00
90%	5	STAGE	**1813.69**	**1813.30**	**1812.91**	**1812.46**	**1811.96**	**1811.05**	1809.82	1809.82	1809.82	1809.82	1809.82	1809.82
		TIME	**12.35**	**12.40**	**12.47**	**12.57**	**12.72**	**13.05**	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1810.8 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1818.4 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **13,400 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **328 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1812.3 FT (1.5 FT OVER SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F10024C1.DAT TO F10024C6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

SUNRIDGE CANYON DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: F100TDC#.DAT*

KK C584O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			RATIOS APPLIED TO PRECIPITATION											
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.15	1	FLOW	**7145.**	**6388.**	**5609.**	**4759.**	**3980.**	**3042.**	**2119.**	**1201.**	**372.**	345.	328.	289.
		TIME	**1.23**	**1.25**	**1.27**	**1.28**	**1.32**	**1.37**	**1.42**	**1.53**	**1.82**	1.77	1.70	1.60
	2	FLOW	**7173.**	**6422.**	**5651.**	**4819.**	**4022.**	**3107.**	**2177.**	**1253.**	**384.**	345.	328.	290.
		TIME	**1.23**	**1.25**	**1.27**	**1.28**	**1.32**	**1.35**	**1.42**	**1.52**	**1.80**	1.77	1.70	1.60
	3	FLOW	**7237.**	**6509.**	**5769.**	**4963.**	**4159.**	**3294.**	**2368.**	**1438.**	**490.**	348.	331.	301.
		TIME	**1.23**	**1.23**	**1.25**	**1.27**	**1.30**	**1.33**	**1.38**	**1.48**	**1.72**	1.77	1.70	.00
	4	FLOW	**7331.**	**6637.**	**5950.**	**5225.**	**4449.**	**3706.**	**2841.**	**1941.**	**1022.**	357.	343.	333.
		TIME	**1.22**	**1.23**	**1.23**	**1.25**	**1.27**	**1.30**	**1.33**	**1.40**	**1.52**	1.77	1.70	.00
	5	FLOW	**7378.**	**6709.**	**6065.**	**5412.**	**4722.**	**4093.**	**3408.**	**2672.**	**1877.**	**1088.**	**380.**	354.
		TIME	**1.22**	**1.22**	**1.23**	**1.23**	**1.25**	**1.25**	**1.27**	**1.30**	**1.35**	**1.43**	**1.67**	.00
Starting Storage														
		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1930.20**	**1929.87**	**1929.47**	**1929.04**	**1928.61**	**1928.05**	**1927.39**	**1926.58**	**1925.01**	1921.15	1916.48	1908.69
		TIME	**1.23**	**1.25**	**1.27**	**1.28**	**1.32**	**1.35**	**1.42**	**1.53**	**1.82**	1.77	1.70	1.60
10%	2	STAGE	**1930.21**	**1929.88**	**1929.49**	**1929.07**	**1928.64**	**1928.09**	**1927.44**	**1926.63**	**1925.19**	1921.32	1916.66	1908.89
		TIME	**1.23**	**1.25**	**1.27**	**1.28**	**1.32**	**1.35**	**1.42**	**1.52**	**1.80**	1.77	1.70	1.60
25%	3	STAGE	**1930.23**	**1929.93**	**1929.55**	**1929.14**	**1928.72**	**1928.20**	**1927.57**	**1926.81**	**1925.59**	1921.99	1917.43	1911.17
		TIME	**1.23**	**1.23**	**1.25**	**1.27**	**1.30**	**1.33**	**1.38**	**1.48**	**1.72**	1.77	1.70	.00
50%	4	STAGE	**1930.27**	**1929.99**	**1929.64**	**1929.27**	**1928.88**	**1928.45**	**1927.92**	**1927.26**	**1926.41**	1924.47	1920.66	1917.93
		TIME	**1.22**	**1.23**	**1.23**	**1.25**	**1.27**	**1.30**	**1.33**	**1.40**	**1.52**	1.77	1.70	.00
90%	5	STAGE	**1930.29**	**1930.02**	**1929.70**	**1929.37**	**1929.02**	**1928.68**	**1928.27**	**1927.79**	**1927.22**	**1926.48**	**1925.13**	1923.72
		TIME	**1.22**	**1.22**	**1.23**	**1.23**	**1.25**	**1.25**	**1.27**	**1.30**	**1.35**	**1.43**	**1.67**	.00

EMERGENCY SPILLWAY ELEVATION = **1924.8 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1932.4 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **12,500 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **359 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1926.3 FT (1.5 FT OVER SPILLWAY)

NOTE: ABOVE 1928.0 FT FLOW OVERTOPS IMPOUND AREA INTO LONGMONT WASH WATERSHED. PEAK DISCHARGES REPORTED HERE REFLECT DISCHARGE THAT CONTINUES DOWN CLOUDBURST WASH ONLY.

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F100TDC1.DAT TO F100TDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

SUNRIDGE CANYON DAM 6-HOUR PATTERN NO. 1 DISTRIBUTION HEC-1 FILE: F1006DC#.DAT*
KK C584O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.15	1	FLOW	**6891.**	**6128.**	**5331.**	**4493.**	**3710.**	**2813.**	**1906.**	**1012.**	357.	343.	326.	287.
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.70	4.60
	2	FLOW	**6891.**	**6128.**	**5331.**	**4493.**	**3710.**	**2813.**	**1906.**	**1012.**	357.	343.	326.	287.
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.70	4.60
	3	FLOW	**6891.**	**6129.**	**5331.**	**4493.**	**3710.**	**2813.**	**1906.**	**1012.**	357.	343.	326.	301.
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.70	.00
	4	FLOW	**6894.**	**6130.**	**5333.**	**4495.**	**3712.**	**2814.**	**1908.**	**1014.**	357.	343.	333.	333.
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	.00	.00
	5	FLOW	**6997.**	**6227.**	**5433.**	**4589.**	**3812.**	**2890.**	**1981.**	**1079.**	357.	354.	354.	354.
		TIME	**4.25**	**4.27**	**4.28**	**4.30**	**4.33**	**4.37**	**4.43**	**4.57**	4.82	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1930.10**	**1929.73**	**1929.33**	**1928.90**	**1928.45**	**1927.90**	**1927.24**	**1926.41**	1924.49	1920.70	1916.07	1908.33
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.72	4.60
10%	2	STAGE	**1930.10**	**1929.73**	**1929.33**	**1928.90**	**1928.45**	**1927.90**	**1927.24**	**1926.41**	1924.49	1920.70	1916.07	1908.33
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.72	4.60
25%	3	STAGE	**1930.10**	**1929.73**	**1929.33**	**1928.90**	**1928.45**	**1927.90**	**1927.24**	**1926.41**	1924.49	1920.70	1916.07	1911.17
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	4.72	.00
50%	4	STAGE	**1930.10**	**1929.74**	**1929.33**	**1928.90**	**1928.45**	**1927.90**	**1927.24**	**1926.41**	1924.50	1920.70	1917.93	1917.93
		TIME	**4.25**	**4.27**	**4.28**	**4.32**	**4.33**	**4.38**	**4.45**	**4.58**	4.82	4.77	.00	.00
90%	5	STAGE	**1930.14**	**1929.78**	**1929.38**	**1928.95**	**1928.51**	**1927.95**	**1927.29**	**1926.47**	1924.65	1923.72	1923.72	1923.72
		TIME	**4.25**	**4.27**	**4.28**	**4.30**	**4.33**	**4.37**	**4.43**	**4.57**	4.82	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1924.8 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1932.4 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **12,500 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **359 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1926.3 FT (1.5 FT OVER SPILLWAY)

NOTE: ABOVE 1928.0 FT FLOW OVERTOPS IMPOUND AREA INTO LONGMONT WASH WATERSHED. PEAK DISCHARGES REPORTED HERE REFLECT DISCHARGE THAT CONTINUES DOWN CLOUDBURST WASH ONLY.

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F1006DC1.DAT TO F1006DC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

SUNRIDGE CANYON DAM SCS TYPE II 24-HR DISTRIBUTION HEC-1 FILE: F10024C#.DAT*
KK C5840

			RATIOS APPLIED TO PRECIPITATION											
AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
			Rainfall Depth											
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
2.15	1	FLOW	**2508.**	**2051.**	**1609.**	**1156.**	**681.**	357.	349.	340.	328.	301.	245.	156.
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	12.68	12.58	12.60
	2	FLOW	**2508.**	**2051.**	**1609.**	**1156.**	**681.**	357.	349.	340.	328.	301.	245.	221.
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	12.68	12.58	.00
	3	FLOW	**2508.**	**2051.**	**1609.**	**1156.**	**681.**	357.	349.	340.	328.	301.	301.	301.
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	.00	.00	.00
	4	FLOW	**2508.**	**2051.**	**1609.**	**1156.**	**681.**	357.	349.	340.	333.	333.	333.	333.
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	.00	.00	.00	.00
	5	FLOW	**2508.**	**2051.**	**1609.**	**1156.**	**681.**	357.	354.	354.	354.	354.	354.	354.
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	.00	.00	.00	.00	.00	.00
Starting Storage														
		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1927.68**	**1927.34**	**1926.97**	**1926.54**	**1925.96**	1924.67	1922.34	1919.83	1916.46	1911.13	1902.87	1893.95
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	12.68	12.58	12.60
10%	2	STAGE	**1927.68**	**1927.34**	**1926.97**	**1926.54**	**1925.96**	1924.67	1922.34	1919.83	1916.46	1911.13	1902.87	1899.79
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	12.68	12.58	.00
25%	3	STAGE	**1927.68**	**1927.34**	**1926.97**	**1926.54**	**1925.96**	1924.67	1922.34	1919.83	1916.46	1911.17	1911.17	1911.17
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	12.77	.00	.00	.00
50%	4	STAGE	**1927.68**	**1927.34**	**1926.97**	**1926.54**	**1925.96**	1924.67	1922.34	1919.83	1917.93	1917.93	1917.93	1917.93
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	12.88	12.83	.00	.00	.00	.00
90%	5	STAGE	**1927.68**	**1927.34**	**1926.97**	**1926.54**	**1925.96**	1924.67	1923.72	1923.72	1923.72	1923.72	1923.72	1923.72
		TIME	**12.38**	**12.43**	**12.48**	**12.57**	**12.72**	12.93	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1924.8 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1932.4 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **12,500 CFS**

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **359 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1926.3 FT (1.5 FT OVER SPILLWAY)

NOTE: ABOVE 1928.0 FT FLOW OVERTOPS IMPOUND AREA INTO LONGMONT WASH WATERSHED. PEAK DISCHARGES REPORTED HERE REFLECT DISCHARGE THAT CONTINUES DOWN CLOUDBURST WASH ONLY.

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: F10024C1.DAT TO F10024C6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

GOLDEN EAGLE PARK DAM THUNDERSTORM DISTRIBUTION HEC-1 FILE: FGEPTDC#.DAT*

KK C599O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5"	6.0"	5.5"	5.0"	4.5"	4.0"	3.5"	3.0"	2.5"	2.0"	1.5"	1.0"
7.15**	1	FLOW	**19631.**	**16695.**	**13856.**	**11255.**	**9003.**	**6694.**	**4619.**	**2675.**	1203.	1117.	1004.	794.
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	1.53	1.43
	2	FLOW	**19631.**	**16695.**	**13856.**	**11255.**	**9003.**	**6694.**	**4619.**	**2675.**	1203.	1117.	1004.	915.
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	1.53	.00
	3	FLOW	**19635.**	**16699.**	**13859.**	**11259.**	**9004.**	**6694.**	**4619.**	**2675.**	1203.	1117.	1024.	1024.
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	.00	.00
	4	FLOW	**19646.**	**16713.**	**13877.**	**11297.**	**9037.**	**6729.**	**4638.**	**2698.**	1204.	1135.	1135.	1135.
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	.00	.00	.00
	5	FLOW	**19658.**	**16730.**	**13900.**	**11349.**	**9089.**	**6792.**	**4688.**	**2772.**	1256.	1254.	1254.	1254.
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.48**	**1.55**	**1.63**	**1.78**	1.60	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1721.83**	**1720.96**	**1720.07**	**1719.26**	**1718.46**	**1717.57**	**1716.55**	**1715.56**	1712.76	1710.66	1708.18	1704.45
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	1.53	1.43
10%	2	STAGE	**1721.83**	**1720.96**	**1720.07**	**1719.26**	**1718.46**	**1717.57**	**1716.55**	**1715.56**	1712.76	1710.66	1708.18	1706.42
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	1.53	.00
25%	3	STAGE	**1721.83**	**1720.96**	**1720.07**	**1719.26**	**1718.46**	**1717.57**	**1716.55**	**1715.56**	1712.76	1710.66	1708.61	1708.61
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	1.58	.00	.00
50%	4	STAGE	**1721.83**	**1720.96**	**1720.08**	**1719.27**	**1718.47**	**1717.59**	**1716.56**	**1715.58**	1712.77	1711.09	1711.09	1711.09
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.50**	**1.55**	**1.65**	**1.80**	1.63	.00	.00	.00
90%	5	STAGE	**1721.83**	**1720.97**	**1720.09**	**1719.29**	**1718.49**	**1717.61**	**1716.58**	**1715.61**	1714.08	1714.03	1714.03	1714.03
		TIME	**1.43**	**1.45**	**1.47**	**1.45**	**1.48**	**1.55**	**1.63**	**1.78**	1.60	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1714.9 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1726.5 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **25,200 CFS – 37,100 CFS*****

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **1,281 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1714.9 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: FGEPTDC1.DAT TO FGEPTDC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

** TOTAL DRAINAGE AREA. 5.76 SQUARE MILES CONTROLLED BY DAMS (NORTH HEIGHTS, ASPEN, AND SUNRIDGE CANYON).

*** RANGE IN EMERGENCY SPILLWAY DISCHARGE FROM 0-100 PERCENT OF FUSE PLUG ERODED AT TOP OF DAM ELEVATION.

GOLDEN EAGLE PARK DAM 6-HOUR PATTERN NO. 1 DISTRIBUTION HEC-1 FILE: FGEP6DC#.DAT*

KK C599O

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
		RATIOS APPLIED TO PRECIPITATION	1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth	6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
7.15**	1	FLOW	**18030.**	**15355.**	**12702.**	**10307.**	**8258.**	**6082.**	**4170.**	**2247.**	1197.	1108.	993.	771.
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	4.53	4.37
	2	FLOW	**18030.**	**15355.**	**12702.**	**10307.**	**8258.**	**6082.**	**4170.**	**2247.**	1197.	1108.	993.	915.
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	4.53	.00
	3	FLOW	**18030.**	**15355.**	**12702.**	**10307.**	**8258.**	**6082.**	**4170.**	**2247.**	1197.	1108.	1024.	1024.
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	.00	.00
	4	FLOW	**18030.**	**15355.**	**12702.**	**10307.**	**8258.**	**6082.**	**4170.**	**2247.**	1197.	1135.	1135.	1135.
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	.00	.00	.00
	5	FLOW	**18030.**	**15355.**	**12702.**	**10307.**	**8258.**	**6082.**	**4170.**	**2247.**	1254.	1254.	1254.	1254.
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	.00	.00	.00	.00
Starting Storage		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1721.37**	**1720.54**	**1719.71**	**1718.96**	**1718.17**	**1717.29**	**1716.32**	**1715.35**	1712.60	1710.46	1707.95	1704.08
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	4.53	4.37
10%	2	STAGE	**1721.37**	**1720.54**	**1719.71**	**1718.96**	**1718.17**	**1717.29**	**1716.32**	**1715.35**	1712.60	1710.46	1707.95	1706.42
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	4.53	.00
25%	3	STAGE	**1721.37**	**1720.54**	**1719.71**	**1718.96**	**1718.17**	**1717.29**	**1716.32**	**1715.35**	1712.60	1710.46	1708.61	1708.61
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	4.58	.00	.00
50%	4	STAGE	**1721.37**	**1720.54**	**1719.71**	**1718.96**	**1718.17**	**1717.29**	**1716.32**	**1715.35**	1712.60	1711.09	1711.09	1711.09
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	4.63	.00	.00	.00
90%	5	STAGE	**1721.37**	**1720.54**	**1719.71**	**1718.96**	**1718.17**	**1717.29**	**1716.32**	**1715.35**	1714.03	1714.03	1714.03	1714.03
		TIME	**4.47**	**4.48**	**4.50**	**4.48**	**4.52**	**4.58**	**4.68**	**4.85**	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1714.9 FT**

BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1726.5 FT**

EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **25,200 CFS – 37,100 CFS*****

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **1,281 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1714.9 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

* RESULTS HERE COMPILED FROM MULTIPLE MODELS: FGEP6DC1.DAT TO FGEP6DC6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.

** TOTAL DRAINAGE AREA. 5.76 SQUARE MILES CONTROLLED BY DAMS (NORTH HEIGHTS, ASPEN, AND SUNRIDGE CANYON).

*** RANGE IN EMERGENCY SPILLWAY DISCHARGE FROM 0-100 PERCENT OF FUSE PLUG ERODED AT TOP OF DAM ELEVATION.

RATIOS APPLIED TO PRECIPITATION

AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	RATIO10	RATIO11	RATIO12
			1.30	1.20	1.10	1.00	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20
		Rainfall Depth												
			6.5″	6.0″	5.5″	5.0″	4.5″	4.0″	3.5″	3.0″	2.5″	2.0″	1.5″	1.0″
7.15**	1	FLOW	**5972.**	**4921.**	**3921.**	**4921.**	**1671.**	1206.	1155.	1095.	1019.	915.	675.	440.
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	12.55	12.48	12.33	12.90
	2	FLOW	**5972.**	**4921.**	**3921.**	**4921.**	**1671.**	1206.	1155.	1095.	1019.	915.	915.	915.
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	12.55	12.48	.00	.00
	3	FLOW	**5972.**	**4921.**	**3921.**	**4921.**	**1671.**	1206.	1155.	1095.	1024.	1024.	1024.	1024.
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	.00	.00	.00	.00
	4	FLOW	**5972.**	**4921.**	**3921.**	**4921.**	**1671.**	1206.	1155.	1135.	1135.	1135.	1135.	1135.
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	.00	.00	.00	.00	.00
	5	FLOW	**5972.**	**4921.**	**3921.**	**4921.**	**1671.**	1254.	1254.	1254.	1254.	1254.	1254.	1254.
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	.00	.00	.00	.00	.00	.00	.00

Starting Storage														
		** PEAK STAGES IN FEET **												
0%	1	STAGE	**1717.23**	**1716.70**	**1716.19**	**1716.70**	**1715.06**	1712.84	1711.57	1710.15	1708.49	1706.43	1702.79	1700.14
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	12.55	12.48	12.33	12.90
10%	2	STAGE	**1717.23**	**1716.70**	**1716.19**	**1716.70**	**1715.06**	1712.84	1711.57	1710.15	1708.49	1706.43	1706.42	1706.42
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	12.55	12.48	.00	.00
25%	3	STAGE	**1717.23**	**1716.70**	**1716.19**	**1716.70**	**1715.06**	1712.84	1711.57	1710.15	1708.61	1708.61	1708.61	1708.61
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	12.62	.00	.00	.00	.00
50%	4	STAGE	**1717.23**	**1716.70**	**1716.19**	**1716.70**	**1715.06**	1712.84	1711.57	1711.09	1711.09	1711.09	1711.09	1711.09
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	12.75	12.68	.00	.00	.00	.00	.00
90%	5	STAGE	**1717.23**	**1716.70**	**1716.19**	**1716.70**	**1715.06**	1714.03	1714.03	1714.03	1714.03	1714.03	1714.03	1714.03
		TIME	**12.60**	**12.65**	**12.73**	**12.65**	**13.10**	.00	.00	.00	.00	.00	.00	.00

EMERGENCY SPILLWAY ELEVATION = **1714.9 FT**
BOLD AND UNDERLINE = ABOVE SPILLWAY

TOP OF DAM ELEVATION = **1726.5 FT**
EMERGENCY SPILLWAY DISCHARGE CAPACITY ≈ **25,200 CFS – 37,100 CFS*****

PRINCIPLE OUTLET DISCHARGE AT EMERGENCY SPILLWAY ELEVATION = **1,281 CFS**

WATER SURFACE ELEVATION FOR 100-YR (FUTURE CONDITIONS) EVENT = 1714.9 FT (AT SPILLWAY)

NOTE: MODELS ASSUME NO CLOGGING OF PRINCIPLE OUTLET. THEREFORE, IF CLOGGING CONDITIONS EXIST HIGHER PEAK STAGES SHOULD BE EXPECTED.

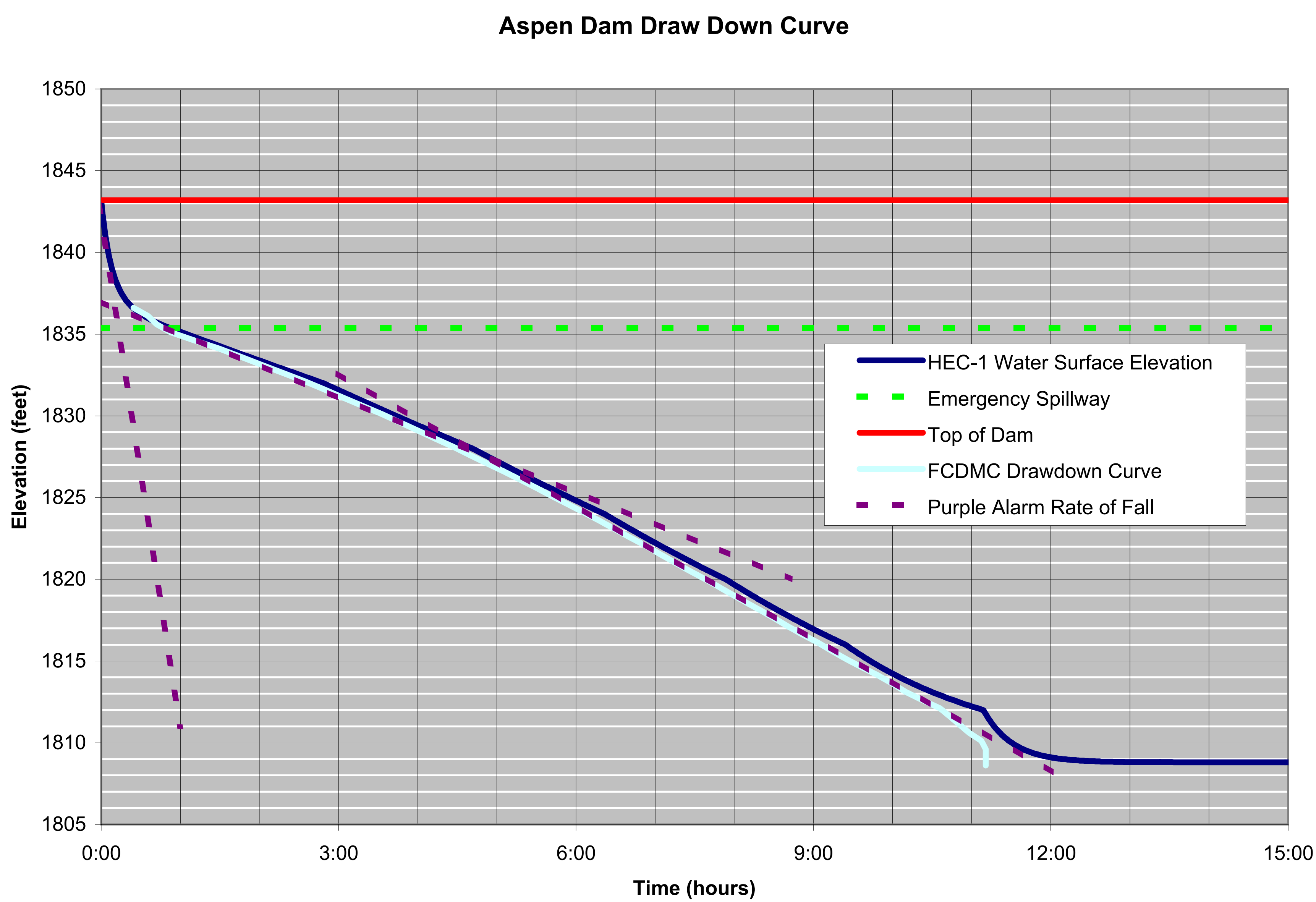
* RESULTS HERE COMPILED FROM MULTIPLE MODELS: FGEP24C1.DAT TO FGEP24C6.DAT DUE TO LIMITATIONS OF JP X JR = 45 MAX AND JP X JR X NQ = 32000.
** TOTAL DRAINAGE AREA. 5.76 SQUARE MILES CONTROLLED BY DAMS (NORTH HEIGHTS, ASPEN, AND SUNRIDGE CANYON).
*** RANGE IN EMERGENCY SPILLWAY DISCHARGE FROM 0-100 PERCENT OF FUSE PLUG ERODED AT TOP OF DAM ELEVATION.

Appendix G

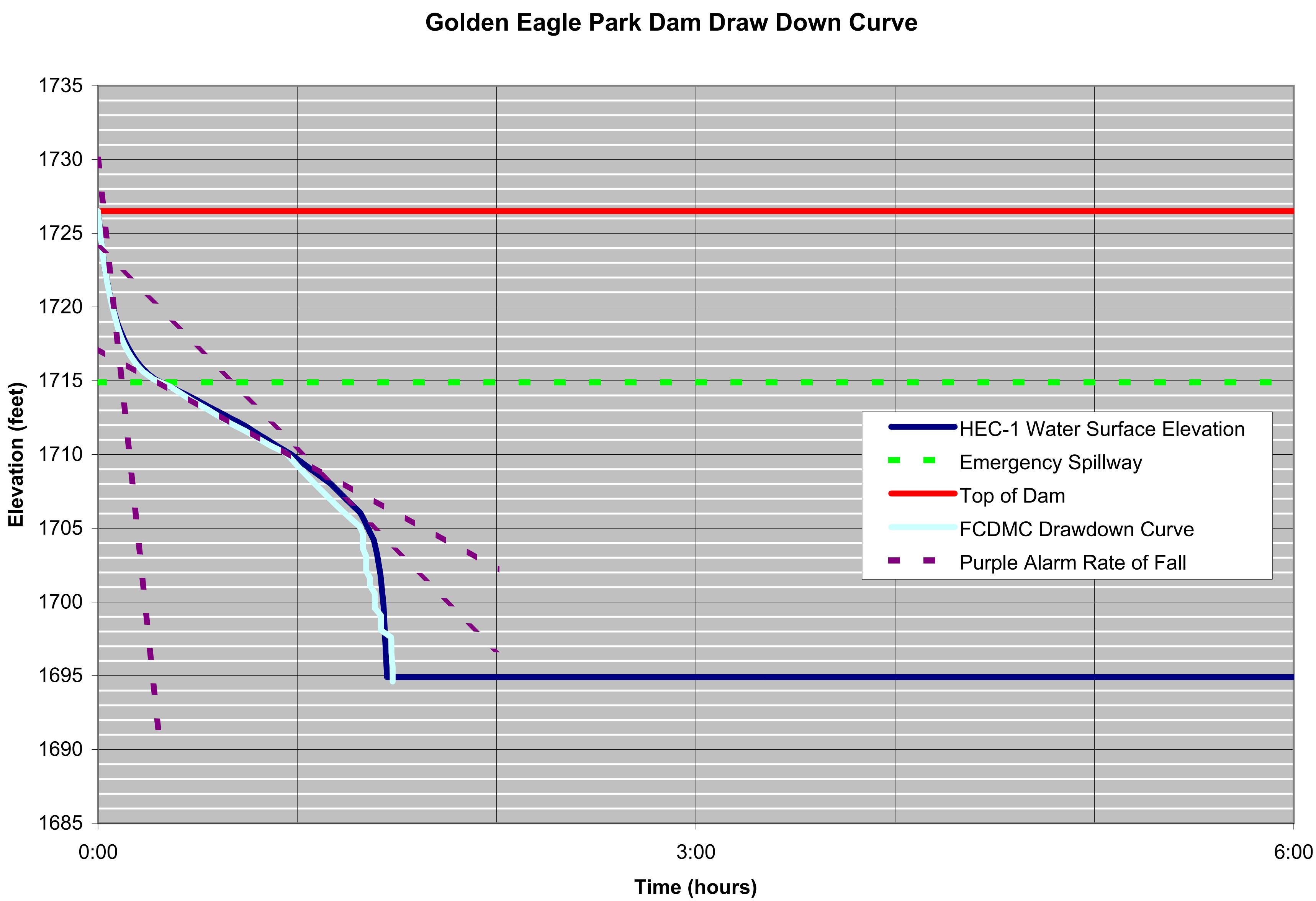
Dam Drawdown Curves

Rate of Fall Criteria for Purple Alert
(Dam Failure)

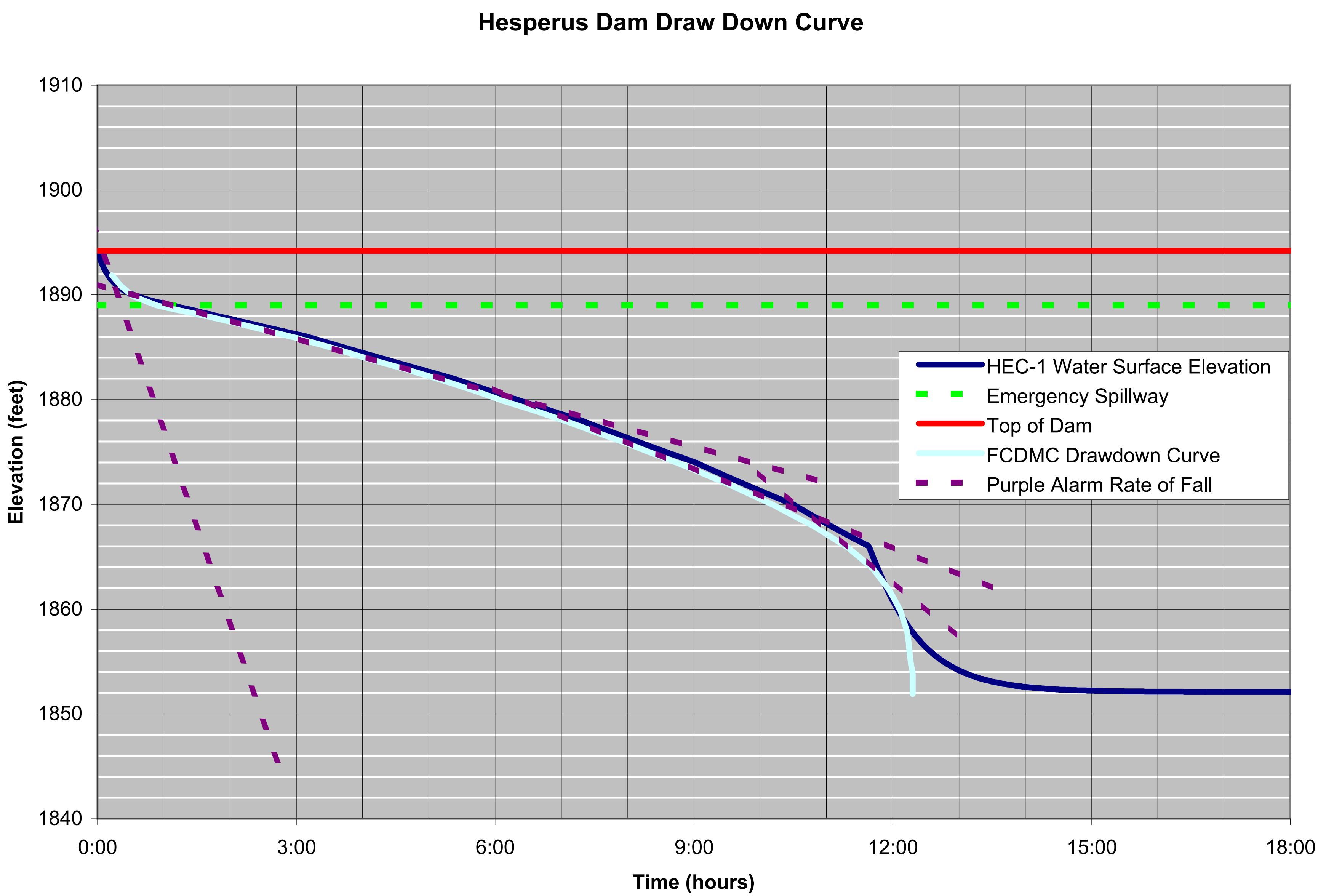
Stoneridge		Above	Above	
ft	min	Elev	Stage	% Cap.
1	1.7	1704	25.1	
1	41	1694	15.1	
1	20	1686	7.1	3.0%
Hesperus				
1	3	1890	38.1	
1	35	1880	28.1	
1	24	1870	18.1	
1	11	1864	12.1	2.8%
Aspen				
1	2	1837	28.4	
1	31	1826	17.4	
1	22	1812	3.4	1.1%
N. Heights				
1	1	1812	33.0	
1	24	1805	26.0	
1	17	1800	21.0	
1	12	1795	16.0	14.3%
1	9	1790	11.0	4.5%
Sunridge				
1	1	1926	41.3	
1	14	1918	33.3	
1	7	1910	25.3	
1	4	1903	18.3	7.8%
1	3	1896	11.3	1.6%
GEP				
1	0.5	1716	21.4	
1	8	1710	15.4	
1	4	1705	10.4	6.2%

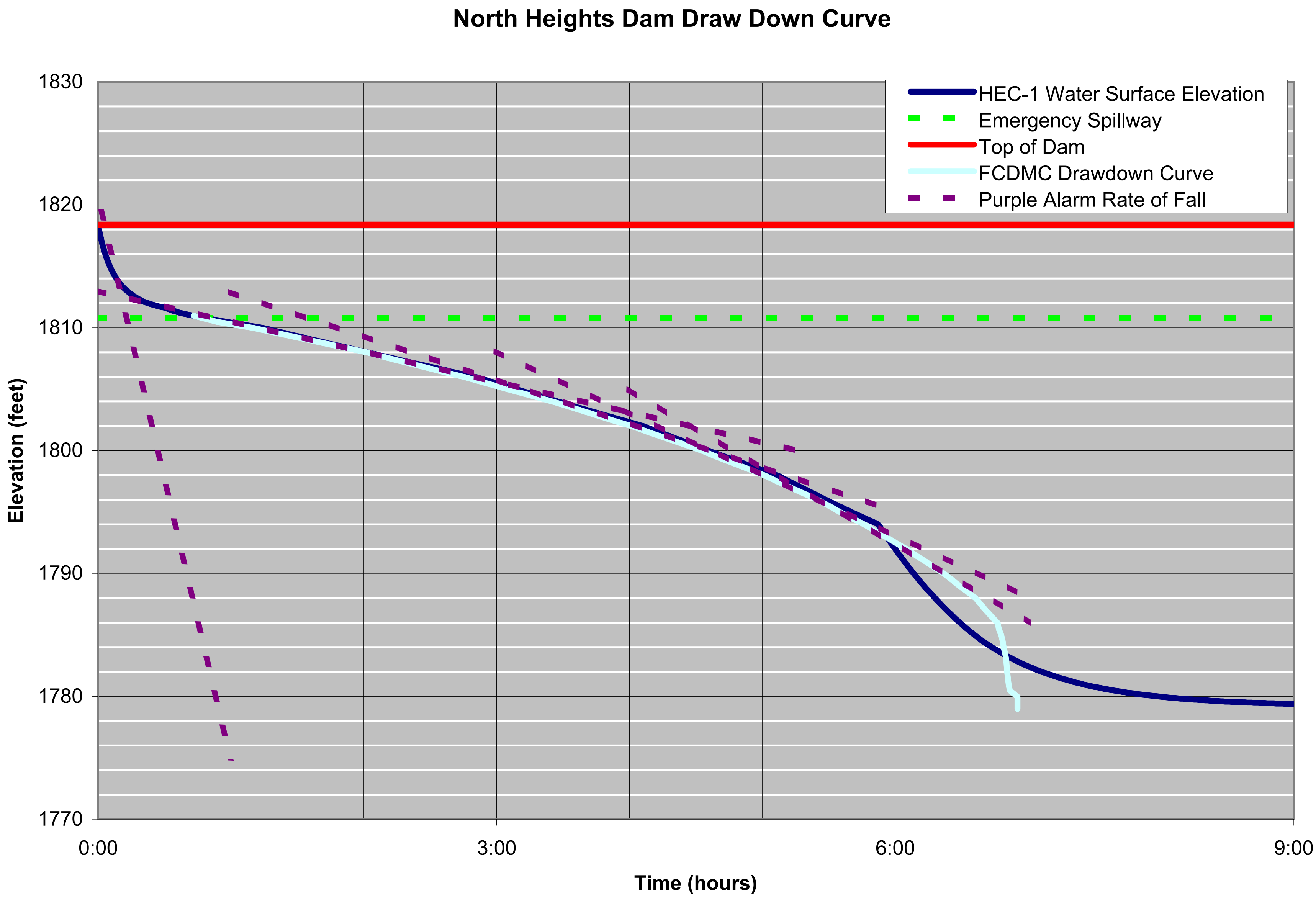


Aspen Dam Draw Down Curve
1850
1845
1840
1835
1830
1825
1820
1815
1810
1805
Elevation (feet)
0:00
3:00
6:00
9:00
12:00
15:00
Time (hours)
HEC-1 Water Surface Elevation
Emergency Spillway
Top of Dam
FCDMC Drawdown Curve
Purple Alarm Rate of Fall

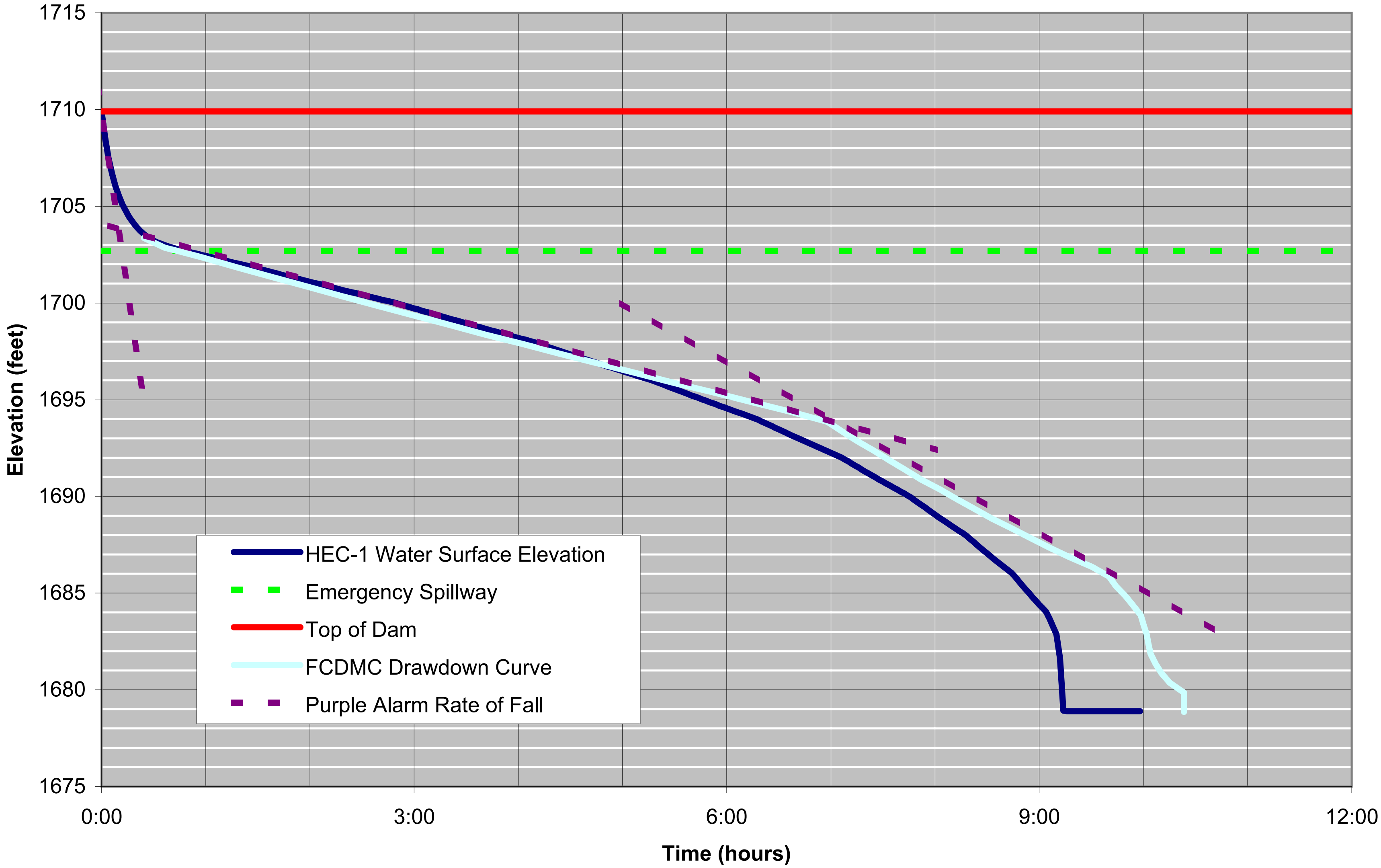


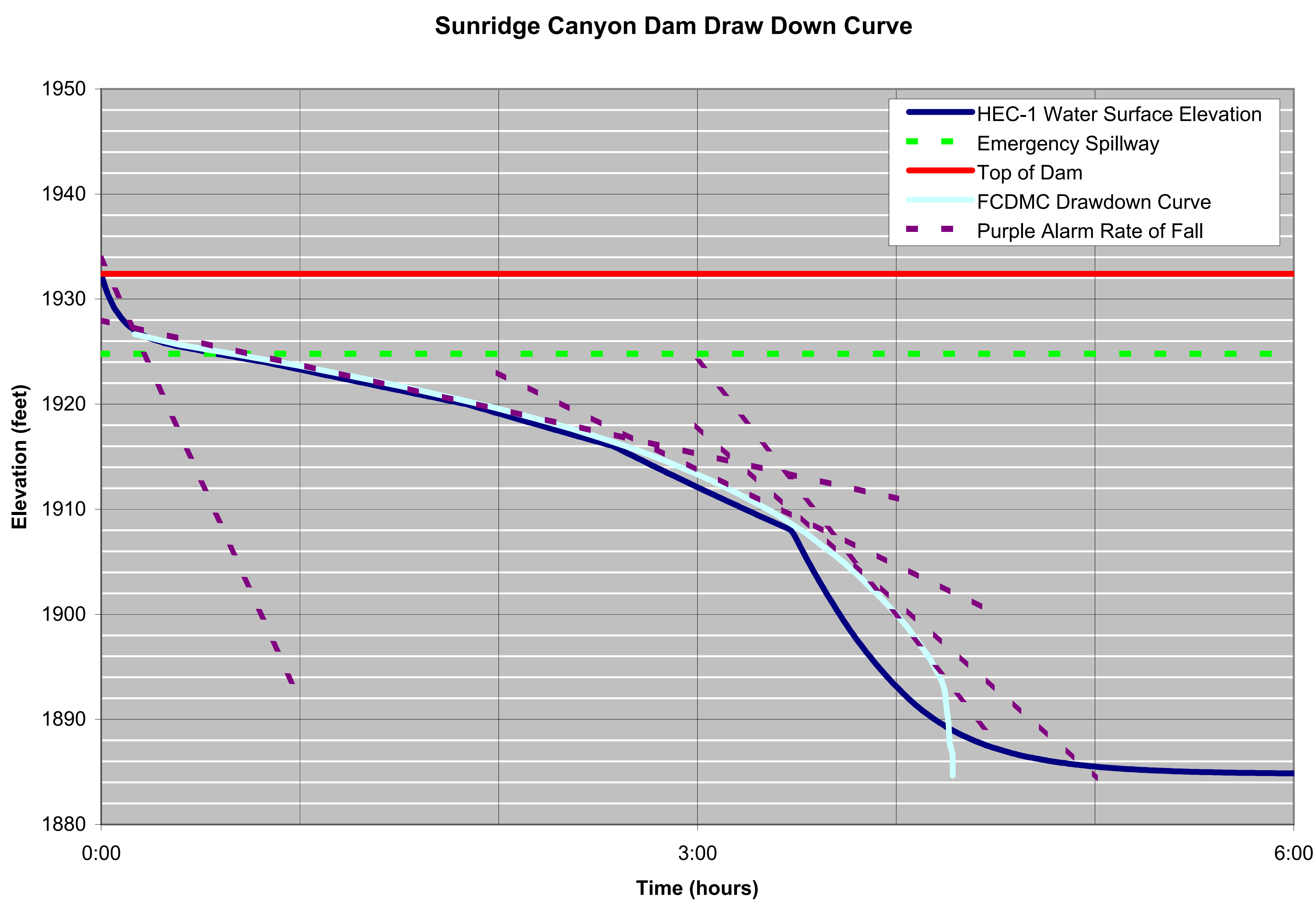
Golden Eagle Park Dam Draw Down Curve
1735
1730
1725
1720
1715
1710
1705
1700
1695
1690
1685
Elevation (feet)
0:00
3:00
6:00
Time (hours)
HEC-1 Water Surface Elevation
Emergency Spillway
Top of Dam
FCDMC Drawdown Curve
Purple Alarm Rate of Fall


Hesperus Dam Draw Down Curve
Elevation (feet)
Time (hours)
1910
1900
1890
1880
1870
1860
1850
1840
0:00
3:00
6:00
9:00
12:00
15:00
18:00
HEC-1 Water Surface Elevation
Emergency Spillway
Top of Dam
FCDMC Drawdown Curve
Purple Alarm Rate of Fall


North Heights Dam Draw Down Curve
1830
1820
1810
1800
1790
1780
1770
Elevation (feet)
0:00
3:00
6:00
9:00
Time (hours)
HEC-1 Water Surface Elevation
Emergency Spillway
Top of Dam
FCDMC Drawdown Curve
Purple Alarm Rate of Fall

Stoneridge Dam Draw Down Curve





Sunridge Canyon Dam Draw Down Curve
Elevation (feet)
1950
1940
1930
1920
1910
1900
1890
1880
0:00
3:00
6:00
Time (hours)
HEC-1 Water Surface Elevation
Emergency Spillway
Top of Dam
FCDMC Drawdown Curve
Purple Alarm Rate of Fall

Appendix H

Town of Fountain Hills Emergency Operations Plan