APPENDIX 14

Environmental Baseline Report:
Hydrology

EAGLE GOLD PROJECT

Environmental Baseline Report: Hydrology

FINAL REPORT

Prepared for:

Victoria Gold Corp
680 – 1066 West Hastings Street
Vancouver, BC
V6E 3X2

Prepared by:

Stantec
4370 Dominion Street, Suite 500
Burnaby, BC
V5G 4L7
Tel: (604) 436-3014 Fax: (604) 436-3752

Project No.:

1490-10002

February 2010

Victoria
GOLD CORP

Stantec

AUTHORSHIP

Tobi Gardner, Ph.D.	Author
Steve Wilbur, Ph.D., P.Geol.	Senior Review
Ken Nordin, A.Sc.T., CCEP	Technical Support
Jennifer Todd, B.Sc., GIT	Field Assistance
Stu Withers, B.Sc.	Field Assistance

EXECUTIVE SUMMARY

Stantec was retained by Victoria Gold Corporation to prepare a baseline report for hydrology at the Eagle Gold project site. This report summarizes a field program that began in August 2007, and includes data collected through October 2009. The field program was developed based on: 1) an analysis of gaps in historic (existing) data obtained primarily during the period from 1993 through 1996, and 2) current regulatory requirements for environmental assessments in the Yukon. This report summarizes background information, methods, and results for the baseline hydrology assessment. Review and analysis of previous baseline hydrology information assessments at the site are also included in this report; and attempts to update that information have been made where possible.

Six continuous recording stream gauging stations were established in August 2007 and were continued until freeze-up conditions in October or November of that year depending on the stream. Gauging equipment was re-installed during the open water seasons in 2008 and 2009. An additional two continuous recording stations were established in 2009. Further, stream flow data were collected at nine other manually gauged stations during the three year period. Stage and stream flow data were summarized and analyzed, and annual hydrographs for the period of record were derived. Regional hydrology data were also obtained from six stations in the central Yukon. Due to the limited number of years of hydrometric data in the local study area, regional hydrologic data were used to derive flood frequency and magnitude estimates. Data from the field program were compared to these regional estimates as a check on estimated flood magnitudes. Maximum and minimum recorded flows were also evaluated to help describe the responses of streams to storm events and the timing of the storm hydrograph recession curves.

ABBREVIATIONS AND ACRONYMS

ECP	Eagle Creek Pond
HKP	Hallam Knight Piésold
LSA	local study area
MAR	mean annual runoff
m asl	meters above sea level
WSC	Water Survey of Canada

TABLE OF CONTENTS

List of Figures

List of Appendices

THIS PAGE INTENTIONALLY LEFT BLANK.

1 INTRODUCTION

This report presents results of the baseline hydrology studies completed by Stantec between 2007 and 2009 for the Eagle Gold Project proposed by Victoria Gold Corporation. The Eagle Gold Project is a proposed open pit gold mine within the Dublin Gulch watershed located 85 km northeast of the Village of Mayo, Yukon Territory.

Stantec was contracted by the Stratagold Corporation to begin environmental baseline studies in 2007. In 2009, Stratagold Corporation was acquired by Victoria Gold Corporation. During this time, the project was renamed from Dublin Gulch to Eagle Gold and the local study area was updated to reflect any changes to the geographic extent of the proposed Eagle Gold Project.

This report presents background information, methods, results, and analyses for the baseline hydrological studies that began in 2007; this report summarizes data and information through to October 2009.

Regionally, data were acquired from several hydrometric stations in the central Yukon (Figure 2-1). The local study area (LSA) lies in the upper regions of the Haggart Creek drainage basin with emphasis on the Dublin Gulch and Eagle Creek drainage basins and the adjacent riparian section along Haggart Creek down to the confluence with Lynx Creek (Figure 2-2). This area was delineated to characterize water resources, stream flows, and other hydrologic conditions in the potentially affected area associated with the Project and to address current regulatory requirements for environmental assessments of mining projects in the Yukon.

At the outset of Victoria's acquisition of the Eagle Gold Project in 2009, Stantec provided recommendations for: 1) re-establishing the network of hydrometric stations in the study area; 2) extending the monitoring program beyond one year of data; and 3) measuring discharge in major streams in the study area. These activities were recommended to support engineering and design elements for project facilities, and to provide important data inputs for deriving the mine site water balance, and developing the site water-management plan.

Hydrologic data were analyzed and results are presented to provide information on the hydrological characteristics of the LSA. Regional data were analyzed to characterize the expected flood flows and recurrence intervals for the region. This information was used to provide estimates for flood flows in the LSA.

2 BACKGROUND

2.1 Regional Setting

There is a lack of available hydrologic data within close proximity to the LSA. For this reason, hydrologic data from stations dispersed throughout the central Yukon were used to assess the regional hydrologic characteristics (Figure 2-2). Regionally, the LSA is within the Mayo Lake-Ross

River Eco-region in central Yukon. This area encompasses the Stewart, McMillan, and Pelly plateaus and is a division of the Yukon plateau physiographic region (Yukon Environment 2008). Most of the terrain in the regional area lies between 500 and 1,700 m asl.

The hydrology of the region is generally characterized by large snowmelt runoffs during the freshet, which quickly taper off to low summer stream flows interspersed with periodic increases in stream flow associated with intense rainfall events. This pattern of low stream flows punctuated by high stream flows associated with rain fall events continues throughout the summer to autumn when freeze up begins. In larger streams, baseflows are maintained below river/creek ice by groundwater contributions throughout the winter. Smaller streams tend to dry up during the late summer or fall as flow generally goes subsurface when the groundwater table drops to seasonally low levels. Aufeis ice may build in certain places of these streams if groundwater emerges from the channel during winter.

Placer mining has been conducted in both Haggart Creek and the Dublin Gulch basins over the past century. The outcome of these operations has resulted in large placer deposits which have altered the natural drainage character of Dublin Gulch, including channel diversions and some changes to sub-basin divides. The most notable changes have affected Eagle Pup and Stuttle Gulch. These water courses formerly entered into Dublin Gulch in the lower part of the valley. However, as a result of the placer mining activities, these drainages now join at the mouth of Stuttle Gulch and flow to Haggart Creek near Gil Gulch (Figure 2-2). Their combined stream flow downstream of Stuttle Gulch is referred to in this report as Eagle Creek. Several ponds were also created during past mining activities within the Dublin Gulch and Haggart Creek basin. These ponds are located adjacent to Haggart Creek and between Dublin Gulch and lower Eagle Creek in the Dublin Gulch valley (Figure 2-2).

The Haggart Creek basin area above Lynx Creek is approximately 98 km^2 with a mean channel slope of 4.4% and total relief of 792 m. The Dublin Gulch drainage basin has an area of approximately 10.4 km^2, a mean slope of 12% with a total relief of 747 m.

2.2 Review of Existing Information

2.2.1 Regional and Historical Data Sources

Regional hydrologic data available from several stream flow gauging stations in the Yukon provided long-term data sets to help describe long-term trends in the annual, seasonal, and monthly character of streams in central Yukon, and put the short-term data sets from the LSA in perspective. The station locations are shown in Figure 2-1 and listed in Table A-1 (Appendix A). These stations were operated and reported on by the Water Survey of Canada (WSC) of Environment Canada. Datasets are available at: http://www.wsc.ec.gc.ca/hydat/H2O/index_e.cfm.

The stations chosen for providing a regional context were selected based on their proximity to the LSA, the data available, the drainage basin size, and the period and length of the data record. The selected stations cover a large range in drainage basin size and all the selected stations have relatively lengthy records (with the exception of the Little Klondike River). However, as also noted in the Hallam Knight Piésold (HKP) report (1996), the scarcity of hydrometric stations in the Yukon limits the effectiveness of regional hydrologic analysis to the study area.

Hydrologic information has been collected within the LSA periodically since 1993. The available historical dataset includes summary information completed by First Dynasty Mines Ltd. on stream gauging in the LSA from 1993 to 1996. The New Millennium project data summary was completed by Hallam Knight Piésold in March 1996 and an addendum was completed by Clearwater Consultants in December 1996. For the most part, comparisons and analysis of historical data have focused on the Clearwater report assuming the intent of the addendum was to update and improve on the earlier HKP report. Jacques Whitford AXYS completed a climate and hydrology report for the LSA in 2008 which provided data summaries for the 2007 and 2008 data. Relevant information is also updated and included in this report

3 FIELD METHODS

3.1 Field Program

A field monitoring program took place during open-water conditions starting in August 2007 and continuing into October 2009 to characterize the seasonal and annual variations in surface water hydrology. Stream flow measurement sites were located within the Haggart Creek and Dublin Gulch drainage basins, upstream and downstream of Dublin Gulch, and at the mouth of Lynx Creek.

Six automated hydrometric stations (W1: Dublin Gulch upstream of Stewart Gulch, W4: Haggart Creek downstream of Dublin Gulch, W5: Haggart Creek upstream of Lynx Creek, W6: Lynx Creek upstream of Haggart Creek, W22: Haggart Creek upstream of Dublin Gulch, and W27: Eagle Creek near the camp) were established in 2007 in the LSA; and two additional automated stations (W20: Bawn-Boy Creek, and W31: Olive Gulch) were installed in 2009 (Figure 2-2)[1]. Stations W1, W4, W5, and W6 were located at or near the same locations as the historical hydrometric stations monitored from 1993 to 1996. During the 2007 and 2008 open-water seasons, four stream sections (W20: Bawn-Boy Creek, W21: Dublin Gulch upstream of Haggart Creek, W23: Haggart Creek downstream of Lynx Creek, and W26: Stewart Gulch), in addition to the six automated stations, were manually gauged to supplement the stream flow dataset. In 2009, an additional five stream sections (W36: Stewart Gulch, W51: Dublin Gulch downstream of Cascallen Creek, W52: Dublin Gulch upstream of Olive Gulch, W54: Dublin Gulch downstream of Ann Gulch, W61: Eagle Pup upstream of Stuttle), were manually gauged in addition to the stream sections sampled during 2007 – 2008. The stream flow monitoring stations and their period of records for the 2007 – 2009 field program are listed in Table A-2 (Appendix A).

---

[1] Station W13 was installed in August 2007 on Lynx Creek upstream of Ray Gulch (See Figure 2-2). The station was abandoned in September 2007.

Stream measurements included continuous water-level gauging, manual stream flow and channel geometry measurements. Water levels were recorded at 15-minute intervals as instantaneous data points using a HOBO pressure transducer at each of the automated gauging sites. The water level data record was supplemented by a field-measured staff gauge at those sites in conjunction with periodic stream flow measurements to develop a stage-discharge relationship for the stream section. All staff gauges were surveyed into benchmarks on the stream banks. Most sites were visited at least ten times during the field program (see Appendix B for sample dates). Discharge measurements were derived using one of the following techniques:

- Velocity-area method using either a Price AA current meter or Swoffer flow meter
- Salt dilution
- Calibrated V-notch weir
- Bucket/bag and stopwatch
- The float-area technique.

Annual stage-discharge plots were log-linear and a regression equation was derived for each station. These relationships were used to establish hydrographs for each of the stations for each year the station operated. Individual plots for all stations rather than cumulative plots were developed for each year because of annual changes in channel morphology from sedimentation and/or ice/hydraulic scour (e.g., due to high magnitude stream flows).

3.2 Historical Field Data

The HKP 1996 report summarizes measurements at various locations from 1993 to 1995. These stations were located at:

- Haggart Creek upstream of confluence with Ironrust Creek (H2)
- Ironrust Creek upstream of confluence with Haggart Creek (H3)
- Dublin Gulch downstream of Stewart Gulch (H1)
- Haggart Creek downstream of confluence with Dublin Gulch (H4)
- Haggart Creek upstream of confluence with Lynx Creek (H5)
- Lynx Creek upstream of confluence with Haggart Creek (H7).

These station locations are provided in Appendix C which shows the historical map of the study area from the HKP report. Stations H5 and H7 were instrumented with automated water-level recorders for the summer and fall months of 1993 through 1995. All stations were instrumented with automated water level recorders in 1996.

4 FIELD RESULTS

4.1 Basin Characteristics

Drainage basin boundaries were delineated for each of the sub-basins within the LSA from topographic maps. As noted earlier, the Eagle Pup drainage has been diverted from its natural course due to historical placer mining activities in the Dublin Gulch valley. As a result, the Eagle Creek drainage now captures the Eagle Pup drainage, the Stuttle Gulch drainage, and also receives stream flow from a pond located in the lower sections of the Dublin Gulch valley before entering the Haggart Creek valley.

The Eagle Creek Pond (ECP), located downstream from Stuttle Gulch is supplied by a spring upslope from the pond. The spring emerges from placer deposits adjacent to Dublin Gulch. To determine the contribution of the pond to the Eagle Creek drainage, stream flow from the pond outlet and Eagle Creek were gauged in August 2009 using the salt dilution technique. Based on measurements at that time, the pond outlet contributed approximately 38% of the Eagle Creek stream flow downstream.

Drainage from Eagle Creek flows west and then south from the Dublin Gulch valley into the Haggart Creek valley. It then flows south and parallel to Haggart Creek along the east side of the valley for several kilometers through placer deposits (Figure 2-2) including several ponds that also capture groundwater seeps from the Platinum Gulch basin. Eagle Creek eventually drains into Haggart Creek just downstream of the mouth of Gil Gulch.

Morphometric data for all sub-basins of interest in the LSA are included in Table A-3 (Appendix A). The slope values give representative mean slopes for the fluvial networks within the tributary basins. In general, the tributaries of Dublin Gulch are relatively steep, with a mean slope of 18% indicative of the mountainous terrain. Total elevation range in the LSA is from 701 to 1,539 m. Relief ranges from 255 m to 792 m in the study area sub-basins.

Several of the tributaries in the LSA are intermittent streams (i.e., the stream becomes dry at losing reaches, flow goes subsurface, along the water course) or ephemeral streams (i.e., the stream channel has little to no groundwater storage and flow is in response to snowmelt or heavy rains). The upper sections of Platinum Gulch are channelized with sections of perennial stream flow. However the lower sections of Platinum Gulch are dry during the summer months. Sections of Stewart Gulch become intermittent (surface water drains to the subsurface) during the open-water season. Stuttle Gulch appears to be a dry channel for most of the year, although some sections have overland flow from permafrost melting from the adjacent slopes. Ann Gulch is a dry channel in the summer, but in-channel sediment sorting patterns noted during field reconnaissance suggest it may have wet sections in the early summer as a result of rapid snowmelt runoff.

4.2 Hydrometric Station Discharge

Monthly summaries of the mean and recorded maximum and minimum stream flows for the automated hydrometric stations are provided in Tables A-4 and A-5 (Appendix A). Manual spot stream flow measurements for all stream sections sampled during the field program are provided in Appendix B.

Stage-discharge plots and regression equations for each gauge station are provided in Appendix D. The accuracy of the regression equations in estimating flow based on the continuous stage data is expressed by the coefficient of correlation (or r^2). Variance is low (predictability is high) when r^2 approaches 1.0. In this case, for the three years of data, r^2 ranged from 0.58 to 0.99, indicating fair to excellent correlations, respectively. There were no gauged data on spring flows because of the inherent difficulties and safety concerns in measuring freshet flows in melting ice and snow. Further, stream flow measurements collected in partially melted channels have dynamic and complicated stage-discharge relationships that do not match the ice-free condition. Hydrographs (including manual discharge measurements) for the automatic gauge sites are provided in Appendix E. In 2007, some of the stations were instrumented until November 20. However, ice in the streams caused water levels to increase and biased the stage record. For this reason, monthly summaries are only included to October 2007.

The open-water season pattern is characterized by freshet-generated peak flow in May to early June, followed by a relatively rapid recession to low base flow throughout July and August. Heavy rain events can cause short-term increases in stream flow and the storm-event recessions are generally rapid in the late summer and fall, reflective of low groundwater storage capacity of the basins. Winter flows, though not gauged, have been observed by field personnel in Haggart Creek and lower Dublin Gulch and are the lowest flows of the year reflective of base flow contributions.

4.3 Historical Station Discharge

As a result of instrumentation problems, HKP (1996) concluded that there were significant uncertainties in the study area stream flow data from 1993 to 1995. Based on the lack of study area stream flow data, stream flow estimates were derived based on regional stream flow analysis of McQuesten River data and Clear Creek data (HKP 1996).

In 1996, the stream flow gauges were re-installed in early June (Clearwater 1996). Although there were instrumentation problems again, hydrographs were produced for most of the stream gauge sites (scanned copies are provided in Appendix C). The hydrographs depict stream flow rates from early June to mid-September 1996. In general, the hydrographs are characterized by low flows punctuated by brief high flows during the summer and increasing stream flow in the fall. The sharp variations in the hydrograph reflect stream flow increases associated with rainfall events in the middle of June and middle of July. The July rainfall event, in particular, caused significant increases in stream flow. Data summaries for the stations at Dublin Gulch downstream of Stewart Gulch (H1, same location as W1), Haggart Creek downstream of Dublin Gulch (H4, same location as W4), Haggart Creek upstream of confluence with Lynx Creek (H5, same location as W5), and

Lynx Creek upstream of confluence with Haggart Creek (H7, same location as W6) from 1996 are provided in Table A-6 (Appendix A). These values are the minimum and maximum recorded stream flows at each gauging station.

Clearwater Consultants (1996) simulated long-term mean flows for streams in the LSA based on a regional analysis of long-term climate information and comparisons with long-term datasets of streams in the region. The analysis suggested that the flows measured during the 1993 – 1996 period were 73% to 83% of the long-term estimates reflecting lower than average precipitation during this period. Nevertheless, based on the uncertainties of the field data collection program in the 1990s and the reliance on regional analysis to derive local area stream flow, reliance on the historical data was limited to regional flood estimates only.

4.4 Recorded Maximum, Minimum, and Mean Stream Flows

Recorded maximum and minimum monthly stream flows are provided in Table A-5 for the period 2007 – 2009. These values do not necessarily reflect the peak or minimum values attained for each year. This is due to two factors. First the peak and minimum stream flows may not have been recorded if they occurred during freshet or during winter when transducers were not installed. Secondary to that, intrinsic natural variance and operational variability (reflected by the coefficient of correlation, r^2) are inherent to any stage-discharge relationship derived for natural streams, indicating some variation may be expected from the derived stream flows. However, in most cases, the stage-discharge relationships demonstrate high predictability and therefore, high confidence in the stream flows tabulated for this report.

In general, larger drainages tend to have greater stream flows. This is demonstrated in Figure 4-1 which shows the linear trend between maximum recorded stream flow and basin area for all years. Inter-annual variation amongst the years indicates small changes in the maximum discharge to area ratio. The lower 2007 trend is likely an artifact of the shorter sampling period in 2007. Further analysis of peak flows amongst the sub-basins is provided in Section 5.

Seven-day low flows for each month are compiled in Table B-2 (Appendix B). The data indicate that of the six continuous-recording stations monitored in 2007, 2008 and 2009, all but one of the stations had their minimum 7-day low flows occur in 2009, while 2008 and 2007 were similar. In 2009 the lowest flows occurred primarily in August, while in 2008 the lowest flows occurred primarily in June. Of the three months (August, September and October) monitored in 2007, lowest flows generally occurred in August as well.

5 DATA ANALYSIS

5.1 Flood Frequency Analysis

5.1.1 Recurrence Intervals

Flow frequency analyses were completed on the six regional stations listed in Table A-1. For each station, the annual maximum series was derived in HEC-SSP v1.1 using a log Pearson III distribution. Flood flow rates at specified return intervals are provided for the regional stations in Table A-7 (Appendix A) and estimated flood return intervals are plotted versus peak discharge in Figure 5-1.

Each of the regional return interval series was then plotted against drainage basin area to derive a power function (log-log trend lines) for each return interval (Figure 5-2). The return interval power functions were then extrapolated to smaller basin areas, which are reflective of the sub-basins in the LSA. The data are summarized in Table A-8 (Appendix A).

The maximum discharge data collected to date from the LSA were compared to the regionally generated flood recurrence power functions (Figure 5-3). The figure demonstrates that maximum stream flow data from the LSA are lower than the regionally estimated trend lines. One exception to this trend was the recorded peak flow in Lynx Creek in 2007, which approximated the estimated 10-year flood event. Also apparent from the figure is that the trend of the LSA data is steeper than the regionally generated lines. This may be due, in part, to the lack of peak spring freshet flow data for most of the streams in the study area. It is also reasonable to conclude that the regional flow data from the substantially larger streams likely do not represent flood flow processes in smaller basins. Therefore, the recurrence interval curves may actually steepen as basin area decreases and reflect less flow contributions from basins that are periodically dry. In estimating flood flows, a conservative approach would be to use the regional flood frequency analysis. However, this could lead to over-design for facilities in small basins.

5.1.2 Flood Estimates

5.1.2.1 Recent Flood Estimates

Preliminary flood flow estimates were derived for the sub-basins in the LSA based on the apparent conservative regression estimates developed from the regional data described above. The power function of the regional dataset was applied to the LSA drainage basins to estimate flood flows. Estimated flood flows and drainage areas for the continuously gauged sub-basins in the LSA are listed in Table A-8. Preliminary estimates for the 100-year event for Dublin Gulch (at W21), Haggart Creek (at W5), Haggart Creek above Dublin Gulch (at W22), and Eagle Creek (at W27) are 4.7 m^3/s, 29 m^3/s, 21.5 m^3/s, and 2.4 m^3/s respectively. As noted above, these are conservative estimates of the flood flows for the project site and should be used with caution for design considerations.

Historical estimates of flood flows derived by Clearwater Consultants (1996) were based on an extreme value distribution function applied to the McQuesten River dataset (n = 15 years). This distribution was applied to flows from Haggart Creek and Dublin Gulch to develop a runoff ratio between the estimated mean annual flow at Haggart Creek and Dublin Gulch and the mean annual flow at McQuesten River (HKP 1996). Flood events were derived as runoff values and are listed in Table A-9 (Appendix A). The historical estimated 100-year events for Dublin Gulch[2] and Haggart Creek (W5) were 5.3 m^3/s and 37 m^3/s, respectively.

5.1.3 Peak to Base Flow Ratio

Peak (Qmax – maximum recorded) versus base (Qmin – minimum recorded) flows during the 2007 to 2009 period of record for the LSA sub-basins with continuous data records are plotted in Figure 5.4. Constant peak to base flow ratios are also depicted on the diagram – the ratio increases from the bottom right to the top left. Over the long term, low ratios are generally indicative of streams dominated by groundwater flow, while high ratios are generally characteristic of streams dominated by peak flow events and low groundwater storage capacity. Nevertheless over the short term, high variability can be expected. The figure illustrates a large variability in the ratios (just over one to over 600) among the stations and from year to year. Dublin Gulch (W1) exemplifies this characteristic with peak to base flow ratios of about 3 in 2007 to 632 in 2009.

Comparing years, 2009 had the largest ratios, followed by 2008, and 2007. Further, all the 2007 ratios (except for W27) were less than 10, while all the 2008 and 2009 ratios (except W20) were greater than 10. Further, without exception the Qmin for each station was recorded in 2007, while the minimum flows recorded in 2009 were all greater than the minimum flows previously recorded. These trends likely reflect varying climatic conditions in 2009 compared to 2008 and the shorter monitoring period in 2007. In 2009, with drier and warmer conditions, groundwater levels may have been low, but base flows may have been augmented by increased depth of thaw and/or melting of permafrost. The wetter and cooler conditions prevalent in 2008 produced relatively high flows, but with less overall shallow groundwater contribution during low flow periods. The lower 2007 low ratios likely reflect the shorter sampling period (late summer and fall) that lacked a significant rainfall-induced flow event, and lower overall groundwater contributions to flow.

These data indicate that streamflow conditions can be highly variable from year to year for the streams in the LSA. The variability reflects large variations in annual climate conditions, coupled with site-specific sub-basin characteristics that may be associated with, for example, permafrost distribution, depth of thaw, the timing of freshet, rainstorm events, and/or antecedent moisture conditions. This variability should be considered when developing water management scenarios.

The Lynx Creek ratio from 2007 represents an extreme value in the dataset due to a significantly larger storm event response compared to the other streams.

---

[2] The historical estimate for Dublin Gulch cannot be compared to the recent estimate because the calculations for the historical estimates used a larger drainage area that included Eagle Pup and Stuttle Gulch basins.

5.1.4 Storm Responses

Annual hydrographs and rainfall data are plotted in Figures 5-5 to 5-7. The hydrographs demonstrate the synchronism of the larger streams in responding to rain events. Storm event response is fast and recession curves are relatively quick. Small sub-basins tend to have quicker responses to storm events compared to higher-order streams which have larger peaks and longer recession curves (Figures 5-5 to 5-7). These different responses reflect the drainage areas of the respective streams. Smaller basins experience quicker and faster peaks as a result of less surface area for overland flow to cover before contributing to stream flow. Larger basins have a greater contributing area, including larger interfluvial areas, and therefore peaks are slightly delayed, higher, and recession curves are of longer duration.

The relationship between time from peak flow to base flow was compared to drainage basin area as a means to evaluate variability in temporal aspects of the recession curves among the streams in the LSA. To make these comparisons, the period of time for the stream to return to approximately 30% of the peak flow (i.e., time from peak to 3/10s of peak flow) after a rain event was computed. The 30% criteria was used because not all streams returned to base flow conditions (which in most cases would be substantially less than approximately 30% of peak flow). Sample data for this comparison were taken from a rain event in late August 2009, indicative of a period past the influence of freshet when only rain events and groundwater discharge would affect stream flow rates.

Smaller basins in the LSA tended to have shorter recession times compared to larger basins (Figure 5-8). For example, the Dublin Gulch basin, Bawn-Boy basin, and Eagle Creek basin had a mean recession period of 155 hours compared to 218 hours for the Haggart Creek basins. This reflects the peak to base flow ratios noted above and demonstrates that smaller streams in the LSA (and in this case higher basins) will return to base flow conditions faster than larger streams in the LSA.

6 CLOSURE

Stantec has prepared this report for the sole benefit of Victoria Gold for the purpose of documenting baseline conditions in anticipation of an environmental assessment under the Yukon Territory *Environmental and Socio-Economic Assessment Act*. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Stantec and Victoria Gold. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties.

The information provided in this report was compiled from existing documents and data provided by Victoria Gold, field data compiled by Stantec (formerly Jacques Whitford AXYS Ltd.) This report represents the best professional judgment of our personnel available at the time of its preparation. Stantec reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

7 REFERENCES

Clearwater Consultants, Ltd. 1996. *Dublin Gulch Project, Initial Environmental Evaluation, Addendum*. Report prepared for New Millennium Mining Ltd., Denver, CO by Clearwater Consultants

Gordon, ND, McMahon TA, Finlayson, BL, Gippel, CJ, and Nathan, RJ 2004. *Stream Hydrology. 2nd Edition*. England, John Wiley and Sons.

Hallam Knight Piésold Ltd. (HPK) 1996. *Dublin Gulch Project, Initial Environmental Evaluation.* Report prepared for First Dynasty Mines, Ltd., Denver CO by Hallam Knight Piésold Ltd., Vancouver BC.

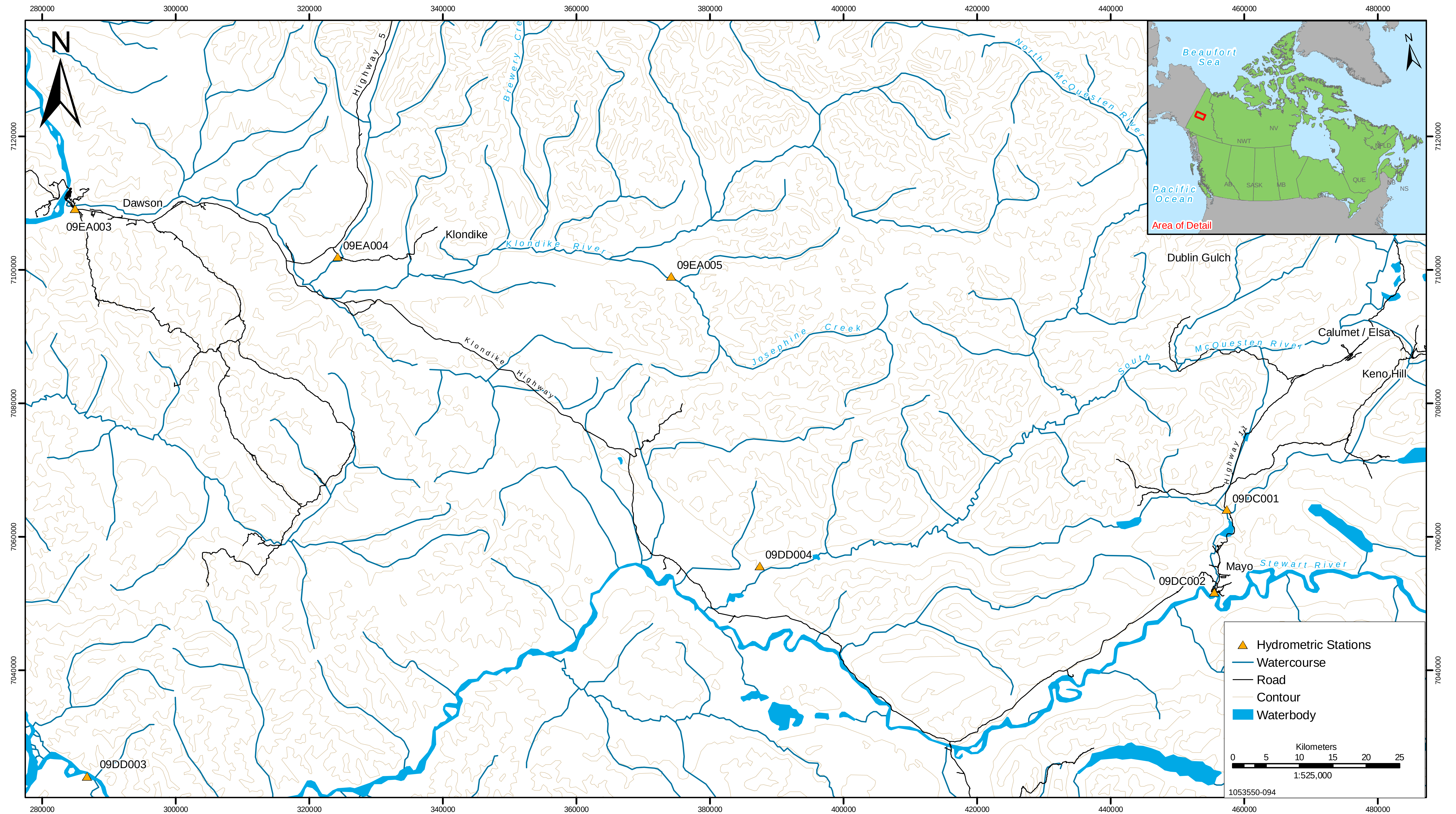
Haan, CT. 1977. *Statistical Methods in Hydrology*. Iowa, USA, Iowa State Press.

Jacques Whitford AXYS. 2007. *Data Gap Analysis for Dublin Gulch*. Report prepared for StrataGold Corp., Vancouver, BC by Jacques Whitford AXYS, Burnaby, BC.

Jacques Whitford AXYS. 2008. Dublin Gulch Project, *Climate and Hydrology Environmental Baseline Report.* Report prepared for StrataGold Corp., Vancouver, BC by Jacques Whitford AXYS, Burnaby, BC.

8 FIGURES

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

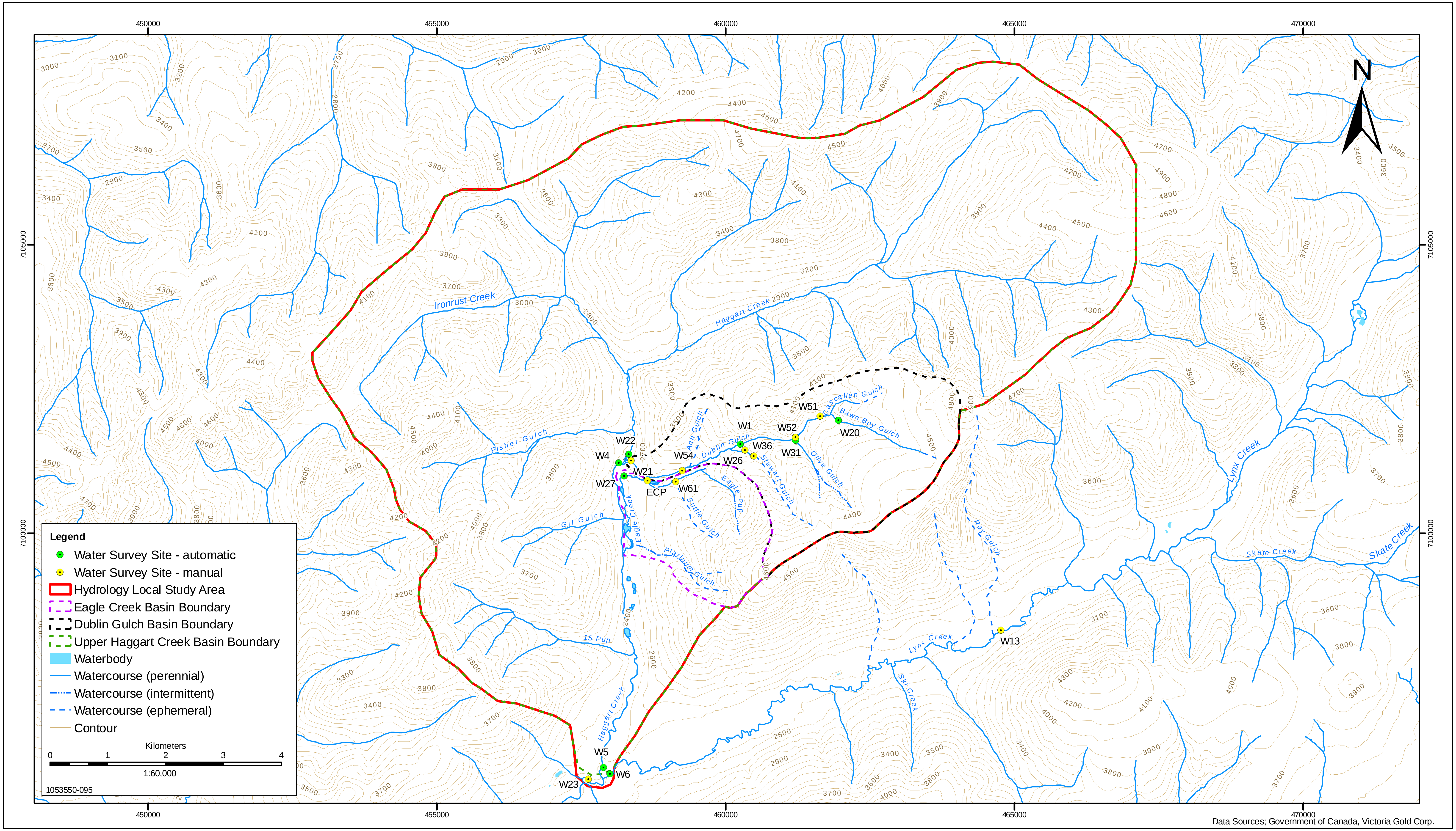
Stantec
4370 Dominion Street
Burnaby, British Columbia
V5G 4L7
Tel. (604) 436 3014
Fax. (604) 436 3752

Victoria GOLD CORP

REGIONAL SETTING AND REGIONAL HYDROMETRIC STATIONS

DUBLIN GULCH PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY RS
DATUM NAD 83	CHECKED BY
DATE 04-Jan-2009	FIGURE NO. 2-1



Data Sources; Government of Canada, Victoria Gold Corp.

Stantec
4370 Dominion Street
Burnaby, British Columbia
V5G 4L7
Tel. (604) 436 3014
Fax. (604) 436 3752

Victoria GOLD CORP

LOCAL STUDY AREA AND HYDROLOGY SAMPLE LOCATIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY RS
DATUM NAD 83	CHECKED BY
DATE 23-Dec-2009	FIGURE NO. 2-2

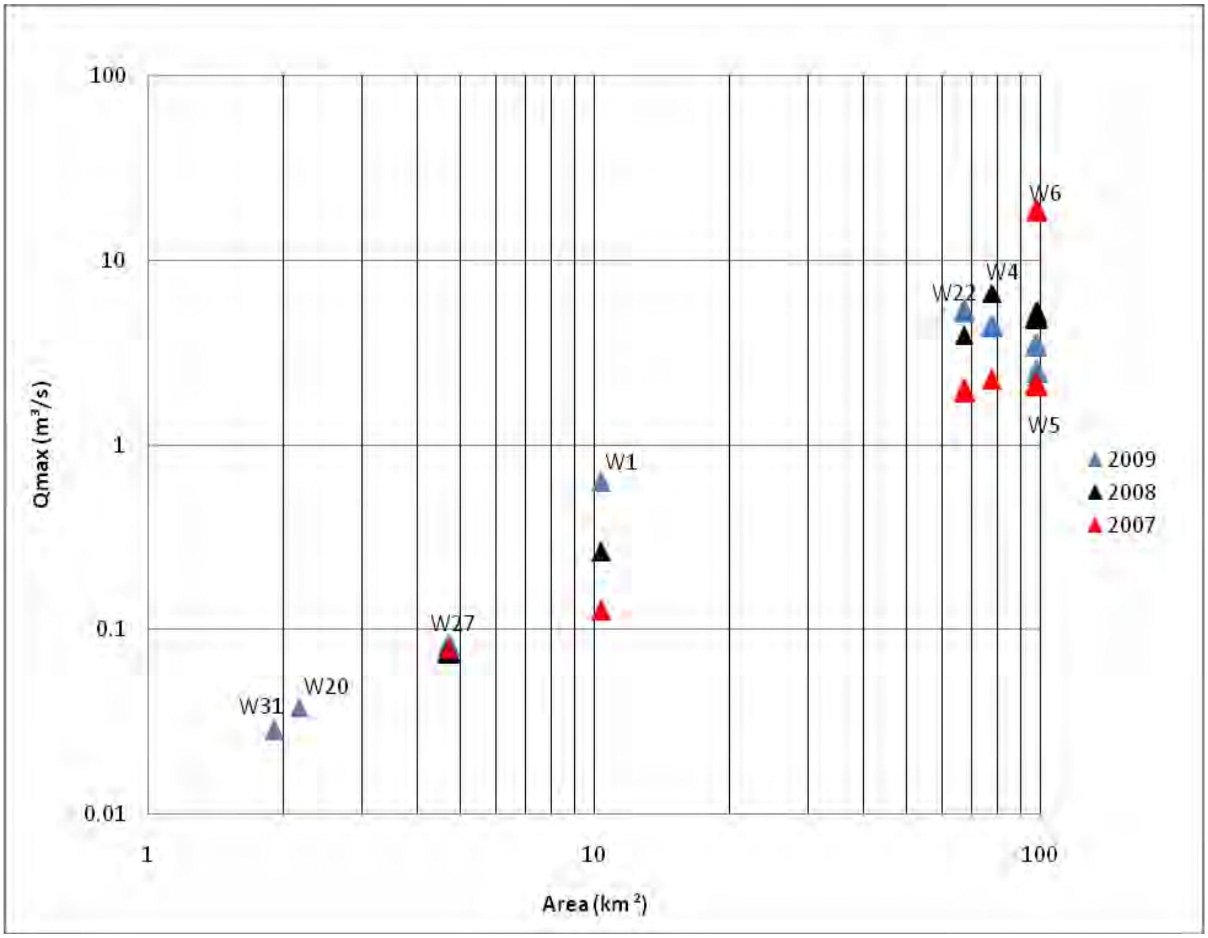


Figure 4-1: **2007 – 2009 Maximum Discharge versus Drainage Area in the Local Study Area**

Qmax (or peak flow) was the maximum discharge recorded at each automated station; station locations are illustrated in Figure 2-2. Station names associated with the alphanumeric symbols are provided in Section 3.1 and in Appendix B. The plot illustrates that peak flows increase with drainage basin area, and that Qmax was generally highest in 2009 and lowest in 2007.

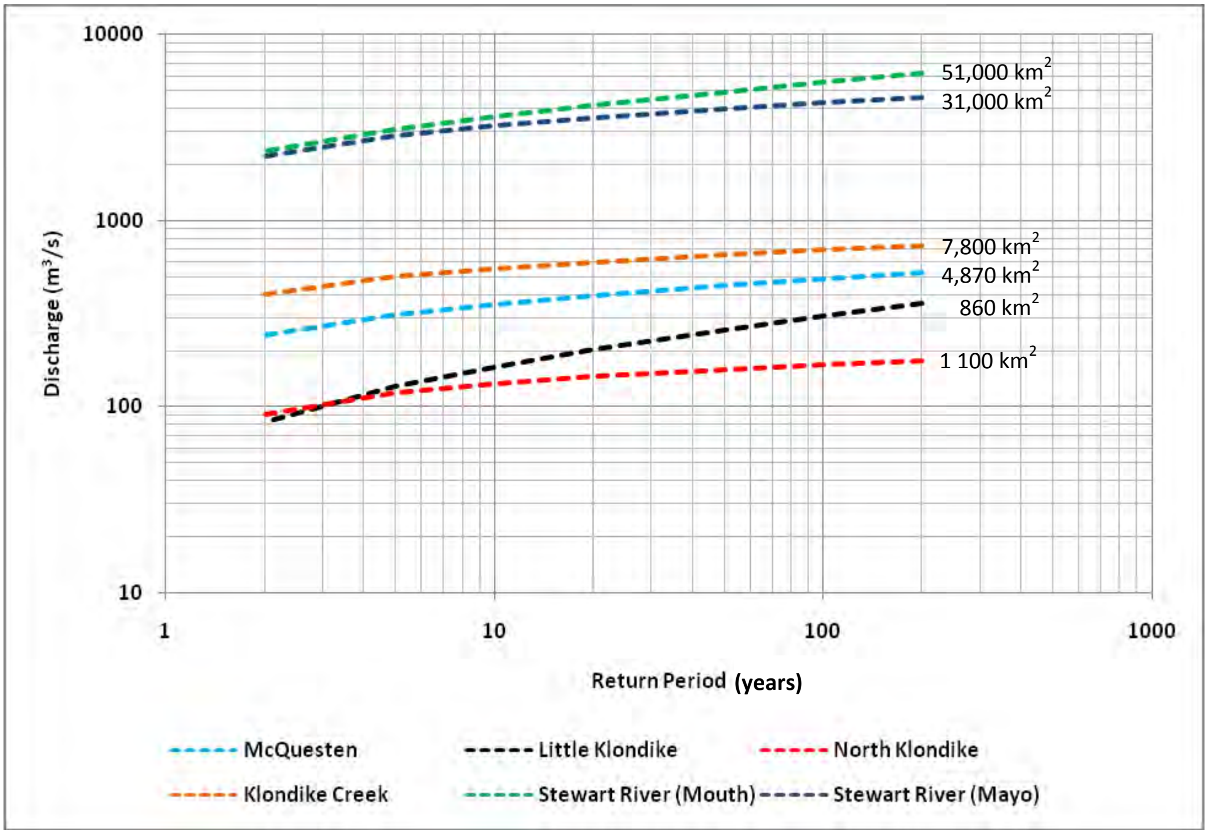


Figure 5-1: Return Period Flood Magnitudes for Gauging Stations in Central Yukon

Curves represent the estimated peak flows for a given return period for each station and were developed based on HEC-SSP v1.1 using a log Pearson III distribution. The drainage areas for each gaging station are listed to the right of each line. Station locations are listed in Table A-1 and there locations are shown on Figure 2-1. The plot illustrates the relationship between drainage basin area and peak flow, and that there appears to be more variability between stations (associated with basin area) than within each station (i.e., most of the curves are relatively flat).

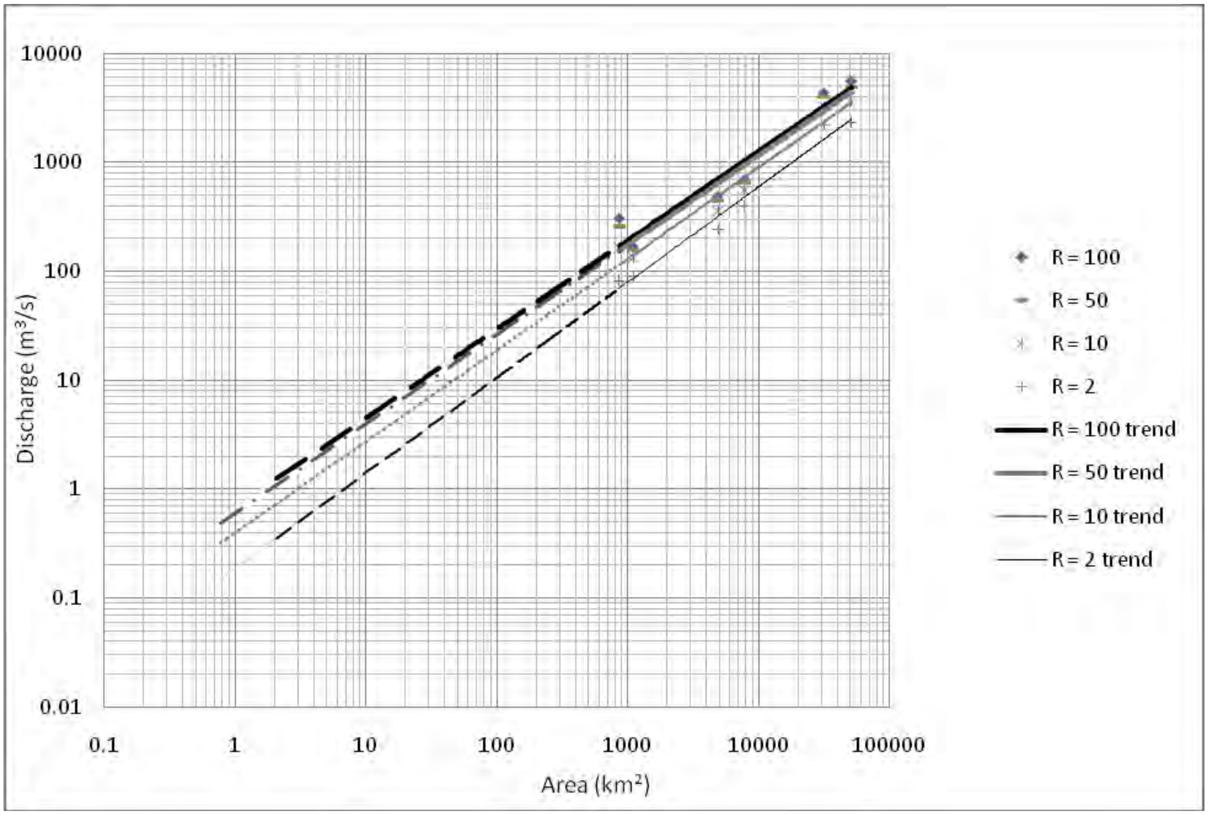


Figure 5.2: Peak Discharge versus Basin Area for Regional Stations

The four trend lines represent the 2, 10, 50 and 100-year return period peak flows, respectively. The lines are solid (from ~1,000 to ~100,000 km^2) where regional data are available (as shown by the symbols), and dashed (< ~1,000 km^2) where regional data are not available. All the LSA stations have basin areas less than 100 km. Thus, there is uncertainty in using the regional data to extropolate and predict peak flows for the LSA stations.

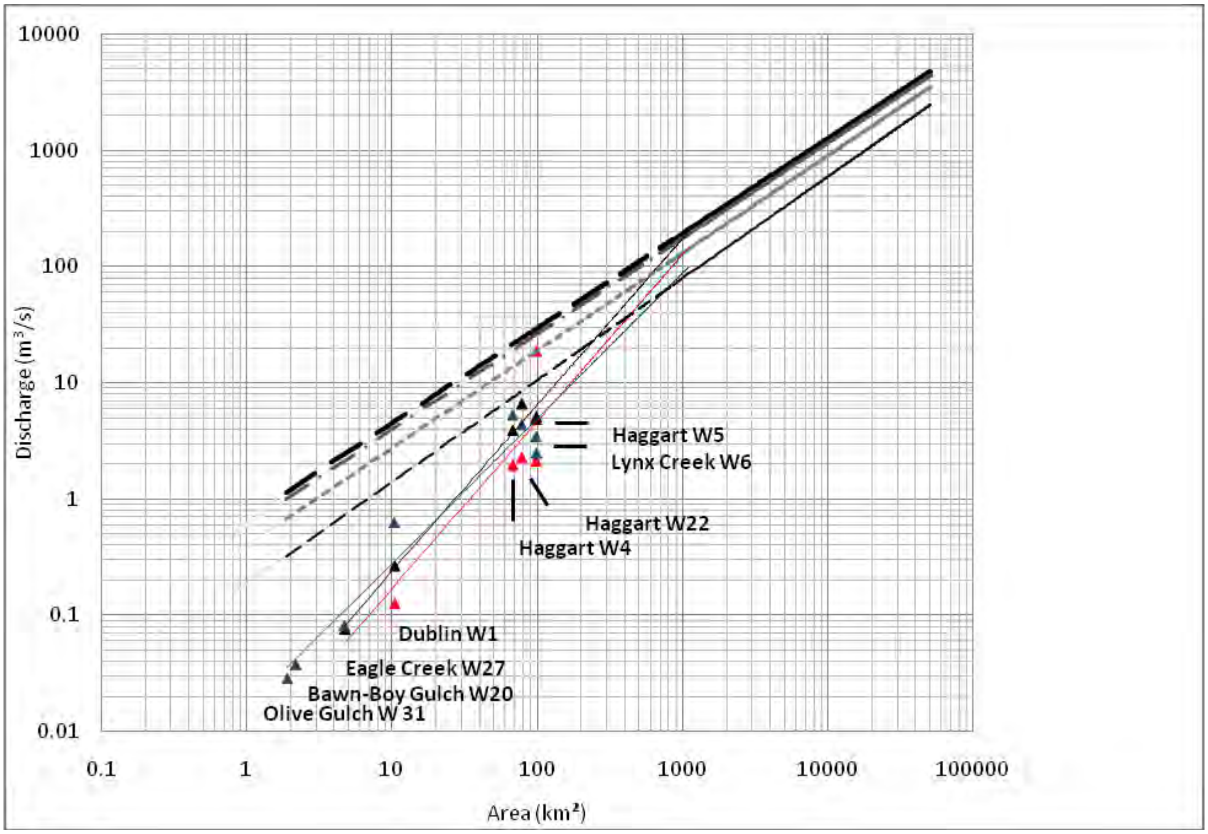


Figure 5-3: **Comparison of Regional Flood Estimates and Maximum Recorded Discharges for streams in the LSA**

Trend lines for the 2007 (red), 2008 (black) and 2009 (blue) LSA maximum recorded discharges are compared to the regional trend lines shown on Figure 5-2. See Figure 2-2 for station locations. The plot illustrates that the LSA trend lines developed from smaller basins fall below the regional trend lines developed from larger basins, and that the slope of the LSA trend lines are greater than the regional trend lines. This implies that peak flow predictions using the regional data will likely overestimate flood magnitudes for the LSA basins. Stream flow gauging at the LSA, however, did not include spring freshet flows in all streams, which may be relatively higher for the smaller basins. Nevertheless, conservative estimates of flood magnitude can be derived from the regional flood estimates, but some consideration for variations due to basin area should be expected.

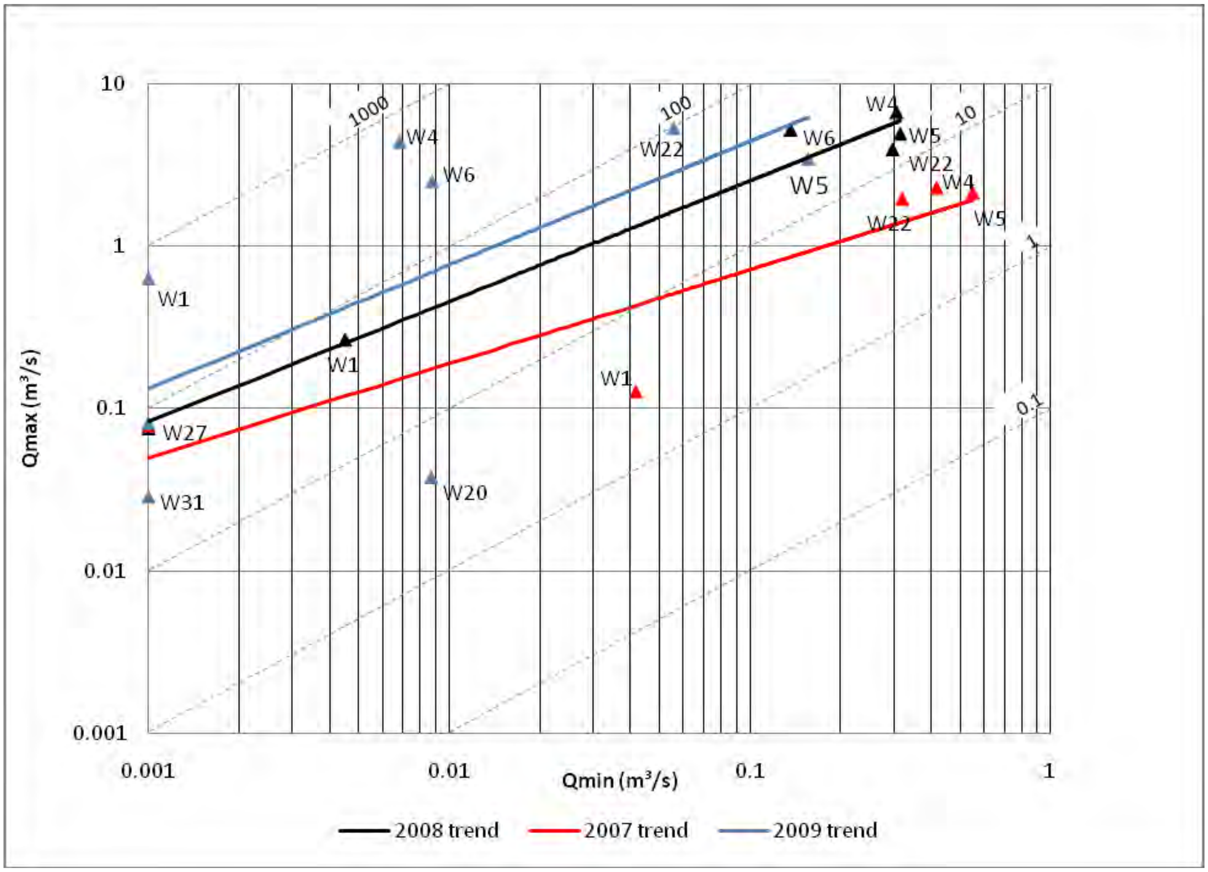


Figure 5-4: Maximum versus Minimum Recorded Discharges, 2007 – 2009

Qmax is the maximum recorded discharge and Qmin is minimum recorded discharge at automated stations during the period of record. See Figure 2-2 for station locations. 2009 blue trend line: $y = 25.6x^{0.762}$ $r^2 = 0.42$; 2008 black trend line: $y = 13.9x^{0.742}$ $r^2 = 0.98$; 2007 red trend line: $y = 2.7x^{0.58}$ $r^2 = 0.83$. Dashed lines represent the 0.1, 1, 10, 100, and 1000 Qmax/Qmin ratio trend lines. Colored symbols represent station data as in Figure 5.3.

Large variation in the Qmax/Qmin ratio is evident based on the inter-annual variation amongst the stations with a Qmax/Qmin ratio range from just over 1 to over 600. For example, at W1 (Dublin Gulch) the annual variations which may reflect operational conditions (e.g., 2007 was a short sample period from August to October), and the 2009 data indicate very large open-water season runoff values relative to base flow conditions. These may reflect differences in meteorological condtions between 2009 and 2008. This is also demonstrated by the higher 2009 trendline (blue) compared to the 2007 and 2008 trends.

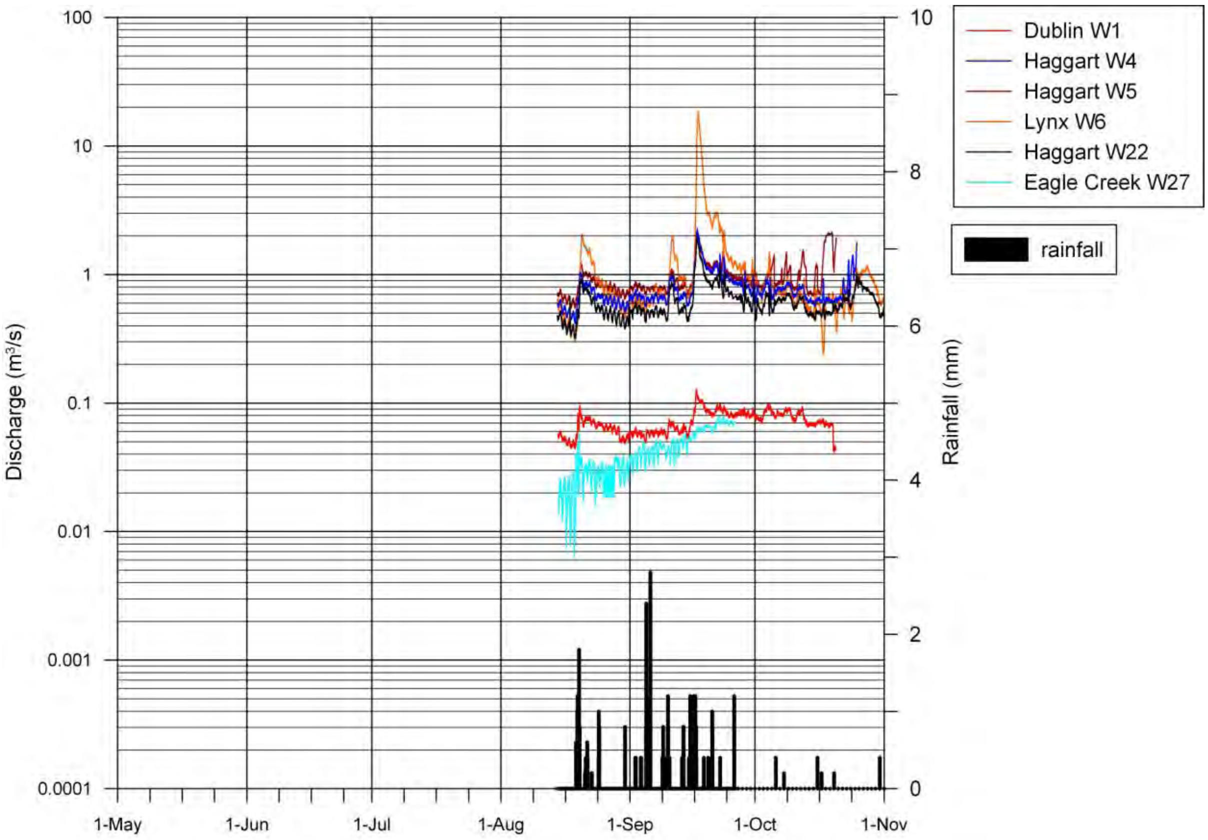


Figure 5-5: 2007 Study Area Hydrographs and Rainfall

Hydrographs for automated stations, 'Dublin W1' is Dublin Gulch W1; 'Haggart W4' is Haggart Creek downstream of Dublin Gulch; 'Haggart W5' is Haggart Creek upstream of Lynx Creek; 'Lynx W6' is Lynx Creek upstream of Haggart Creek; 'Haggart W22' is Haggart Creek upstream of Dublin Gulch; 'Eagle Creek W27' is Eagle Creek above Haggart Creek. See Figure 2-2 for station locations. Rainfall recorded at Potato Hills station.

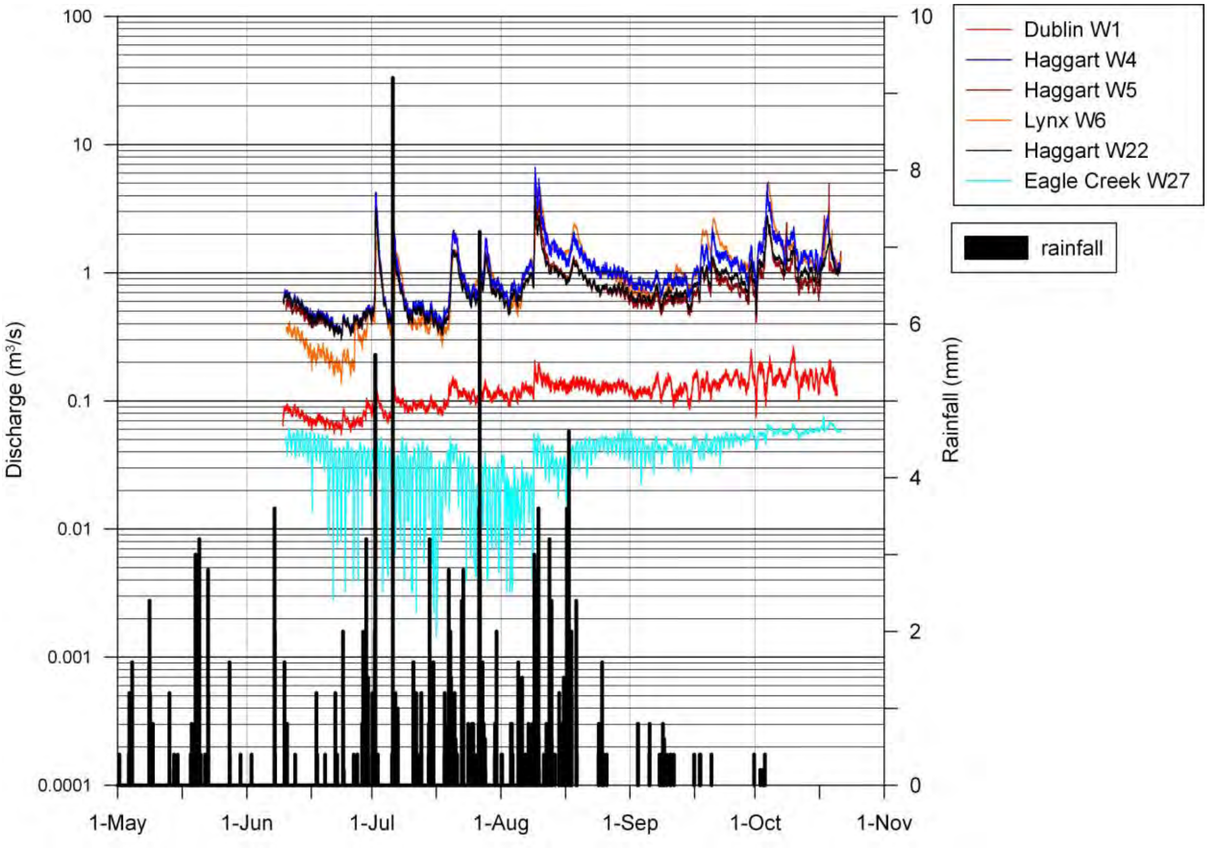


Figure 5-6: 2008 Local Study Area Hydrographs and Rainfall

Hydrographs for automated stations, ‘Dublin W1’ is Dublin Gulch W1; ‘Haggart W4’ is Haggart Creek downstream of Dublin Gulch; ‘Haggart W5’ is Haggart Creek upstream of Lynx Creek; ‘Lynx W6’ is Lynx Creek upstream of Haggart Creek; ‘Haggart W22’ is Haggart Creek upstream of Dublin Gulch; ‘Eagle Creek W27’ is Eagle Creek above Haggart Creek. See Figure 2-2 for station locations. Rainfall recorded at Potato Hills station.

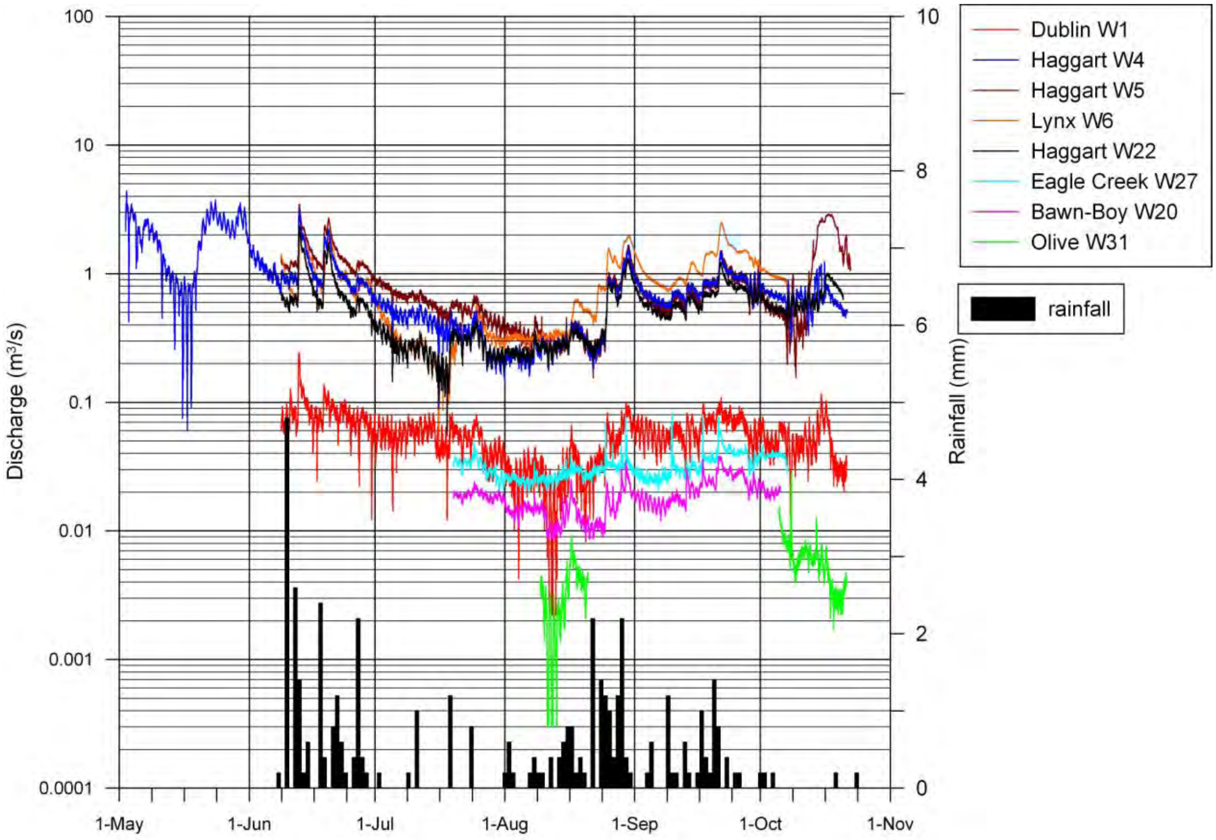


Figure 5-7: 2009 Local Study Area Hydrographs and Rainfall

Hydrographs for automated stations, ‘Dublin W1’ is Dublin Gulch W1; ‘Haggart W4’ is Haggart Creek downstream of Dublin Gulch; ‘Haggart W5’ is Haggart Creek upstream of Lynx Creek; ‘Lynx W6’ is Lynx Creek upstream of Haggart Creek; ‘Haggart W22’ is Haggart Creek upstream of Dublin Gulch; ‘Eagle Creek W27’ is Eagle Creek above Haggart Creek. See Figure 2-2 for station locations. Rainfall recorded at Potato Hills station.

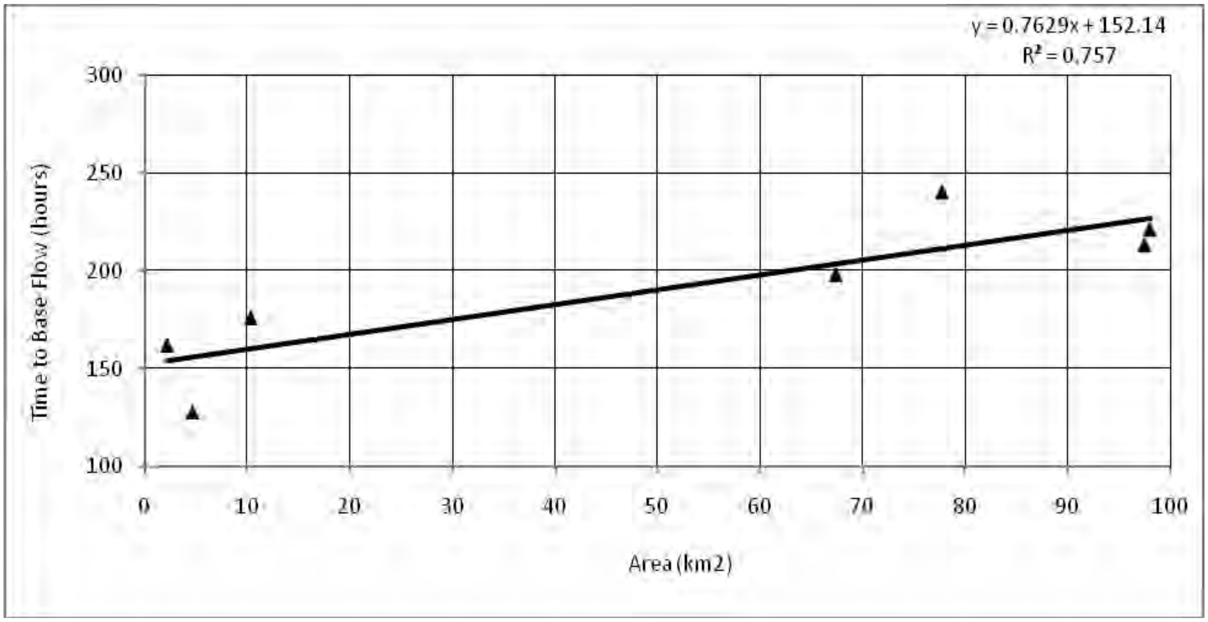


Figure 5-8: Peak to Base Flow Response versus Drainage Area, LSA

Time to 30% of peak flow is the period (in hours) from the maximum recorded stream flow to 30% of the maximum stream flow for a given storm event. The plot demonstrates that larger basins tend to require longer periods to return to low flow conditions (i.e., 30% of peak flow) compared to smaller basins. This indicates that the recession curves for the larger basins in the LSA will be longer lasting following rain events while smaller basins will tend to have quicker total storm responses assuming land cover and surface materials are similar.

APPENDIX A

Data Tables

Table A-1: Regional Hydrometric Stations

Hydrometric Station	Station ID	Latitude	Longitude	Data Record	Area	MAR	Mean Q	Median Q
McQuesten River	09DD004	63°36'40"	137°16'10"	1965-2009 (44)	4870	7.89	38.4	18.3
Little Klondike River	09EA005	63°59'45"	137°34'20"	1983-1994 (11)	860	8.25	7.1	2.62
North Klondike River	09EA004	63 69' 45"	137°34'20"	1974-2008 (34)	1100	11.7	12.8	6.49
Klondike Creek	09EA003	64°02'34"	139°24'28"	1965-2008 (47)	7800	8.32	64.9	27.8
Stewart River at Mouth	09DC002	63°59'45"	137°34'20"	1963-2008 (45)	51000	9.2	467	198
Stewart River at Mayo	09DD003	63°35'26"	135°53'48"	1949-1979 (30)	31600	12.12	383	142

NOTES:

Drainage Areas from WSC

MAR derived from drainage area and mean annual flow volume

Data Source: Environment Canada – Water Survey of Canada, 2009

Table A-2: LSA Stream Gauge Sites, 2007 – 2009

Drainage Basin	Sample Site	Type of Station	Sampling Periods
Haggart Creek	**W4**	A	8/13/07 – 11/20/07
	Haggart Creek	A	6/09/08 – 10/21/08
	DS Dublin Gulch	A	5/2/09 – 10/21/09
	W5	A	8/12/07 – 10/20/07
	Haggart Creek	A	6/10/08 – 10/21/08
	US Lynx Creek	A	6/08/09 – 10/22/09
	W22	A	8/13/07 – 11/21/07
	Haggart Creek	A	6/09/08 – 10/21/08
	US Dublin Gulch	A	5/03/09 – 10/20/09
	W23	M	8/12/07 – 11/21/07
	Haggart Creek	M	4/25/08 – 10/21/08
	DS Lynx Creek	M	4/22/09 – 9/02/09
	W27	A	8/14/07 – 9/26/07
	Eagle Creek	A	6/10/08 – 10/21/08
		A	7/20/09 – 10/07/09
	W61	M	7/21/09 – 7/25/09
	Eagle Pup US Stuttle		
	Eagle Pup Pond	M	8/25/2009
Lynx Creek	**W6**	A	8/13/07 – 11/20/07
	Lynx Creek	A	6/10/08 – 10/21/08
	US Haggart Creek	A	6/08/09 – 10/07/09
	W13	A	8/13/07 – 11/20/07
	Lynx Creek		
Dublin Gulch	**W21**	M	8/15/07 – 11/21/07
	Dublin Gulch	M	8/12/08 – 10/21/08
	US Haggart Creek	M	7/18/09 – 10/20/09
	W54	M	7/26/09 – 8/20/09
	Dublin DS Ann Gulch		
	W1	A	8/14/07 – 10/19/07
	Dublin Gulch	A	6/09/08 – 10/20/08
		A	6/08/09 – 10/21/09
	W26	M	8/14/07 – 11/20/07
	Stewart Gulch	M	4/25/08 – 8/12/08
		M	9/01/09 – 10/21/09

Drainage Basin	Sample Site	Type of Station	Sampling Periods
	W36	M	7/26/09 – 8/20/09
	Stewart Gulch		
	W31	A	7/26/09 – 10/21/09
	Olive Gulch		
	W52	M	7/26/09 – 8/20/09
	Dublin US Olive		
	W30	M	7/26/09 – 8/20/09
	Cascallen Gulch		
	W51	M	7/26/09 – 8/20/09
	Dublin DS Cascallen		
	W20	M	8/14/07 – 9/12/07
	Bawn-Boy Creek	M	6/09/08 – 8/12/08
	U.S. of Dublin Gulch	A	7/19/09 – 10/05/09

NOTES:
A is automated hydrometric station
M is manual hydrometric station
DS is Downstream
US is Upstream

Table A-3: LSA Sub-Basin Morphometric Data

Drainage	Area (km^2)	Elevation Range (m)	Relief (m)	Mean Slope (%)
Dublin Gulch	10.3	792 – 1,539	747	12.1
Eagle Creek#	4.7	762 – 1,402	640	12.3
Eagle Pup*	1.2	868 – 1,402	533	23.0
Ann Gulch	0.8	857 – 1,112	255	16.0
Stewart Gulch	1.5	944 – 1,402	458	20.0
Olive Gulch	1.9	1061 – 1,402	341	14.5
Bawn-Boy Gulch	2.2	1138 – 1,524	386	17.0
Cascallen Creek	0.8	1138 – 1,432	294	18.0
Stuttle Gulch	0.9	838 – 1,341	503	25.0
Lynx Creek	98.0	701 – 9,50	249	1.6
Haggart Creek above Lynx Ck	97.5	701 – 1,493	792	12.8

NOTES:
* Eagle Pup is the extent of the Eagle Pup drainage that formerly drained to Dublin Gulch
# Eagle Creek includes all of Eagle Pup, Stuttle Gulch and Platinum Gulch basins

Table A-4: Monthly Mean Flows for Gauged Streams at LSA, 2007 – 2009

Station	2007				2008						2009					
	Aug	Sep	Oct	Nov 07–May 08	Jun	Jul	Aug	Sep	Oct	Nov 08–Apr 09	May	Jun	Jul	Aug	Sep	Oct
Bawn-Boy (W20)	–	–	–	–	–	–	–	–	–	–	–	–	0.019*	0.015	0.022	0.02*
Olive Gulch (W31)	–	–	–	–	–	–	–	–	–	–	–	–	–	0.003*	nm	0.006*
Dublin Gulch Midway (W1)	0.062*	0.074	0.077^	nm	0.074*	0.102	0.130	0.133	0.152*	nm	nm	0.083*	0.053	0.035	0.063	0.049*
Eagle Creek (W27)	0.026*	0.053*	nm	nm	0.040*	0.030	0.037	0.045	0.059*	nm	nm	nm	0.031*	0.028	0.034	0.038*
Haggart Creek US Dublin (W22)	0.518*	0.701	0.633^	nm	0.462*	0.727	0.943	0.788	1.233*	nm	2.069*	0.959	0.273	0.404	0.658	0.637*
Haggart Creek DS Dublin (W4)	0.641*	0.875	0.768^	nm	0.479*	0.868	1.334	1.034	1.666*	nm	1.927*	1.108	0.406	0.426	0.795	0.654*
Haggart Creek US Lynx Creek (W5)	0.788*	0.970	1.083^	nm	0.431*	0.726	0.994	0.703	1.202*	nm	nm	1.425*	0.589	0.474	0.768	1.187*
Lynx Creek (W6)	0.777*	1.892	0.718^	nm	0.274*	0.741	1.340	1.121	1.665*	nm	nm	1.063*	0.318	0.647	1.223	0.964*

NOTES:
Values are in cubic meters per second
Values represent average stream flow of the month
- = no station established
nm = no measurements at station
* partial month
^ no values were derived for Nov 2007 due to ice effects in channels

Table A-5: Monthly Minimum and Maximum Flows for Gauged Streams at LSA, 2007 – 2009

Station	2007								2008									
	Aug		Sep		Oct		Nov 07–May 08		Jun		Jul		Aug		Sep		Oct	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bawn-Boy (W20)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Olive Gulch (W31)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Dublin Gulch Midway (W1)	0.04	0.10	0.05	0.13	0.04	0.10	nm	nm	0.05	0.11	0.07	0.18	0.09	0.21	0.09	0.25	0.00	0.26
Eagle Creek (W27)	0.00	0.06	0.00	0.08	nm	nm	nm	nm	0.00	0.06	0.00	0.05	0.00	0.06	0.02	0.06	0.02	0.08
Haggart Creek US Dublin (W22)	0.32	0.93	0.43	1.95	0.32	1.95	nm	nm	0.30	0.68	0.32	3.20	0.47	3.93	0.49	1.34	0.47	2.77
Haggart Creek DS Dublin (W4)	0.42	1.05	0.56	2.28	0.50	2.06	nm	nm	0.31	0.74	0.38	4.24	0.54	6.65	0.59	2.24	0.61	5.00
Haggart Creek US Lynx Creek (W5)	0.55	1.22	0.68	2.07	0.68	2.13	nm	nm	0.32	0.62	0.34	3.60	0.49	4.57	0.46	1.23	0.41	4.90
Lynx Creek (W6)	0.30	2.06	0.47	18.65	0.24	1.49	nm	nm	0.14	0.55	0.27	1.78	0.46	4.64	0.54	2.65	0.67	5.17

Table A-5: Monthly Minimum and Maximum Flows for Gauged Streams at LSA, 2007 – 2009, cont'd

Station			2009												2007 – 2009 Summary	
	Nov 08–April 09		May		Jun		Jul		Aug		Sep		Oct			
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bawn-Boy (W20)	–	–	–	–	–	–	0.02	0.02	0.01	0.03	0.01	0.04	0.02	0.02	0.01	0.04
Olive Gulch (W31)	–	–	–	–	–	–	0.00	0.01	nm	nm	0.00	0.03	nm	nm	0.00	0.03
Dublin Gulch Midway (W1)	nm	nm	nm	nm	0.01	0.24	0.00	0.08	0.00	0.63	0.03	0.11	0.01	0.12	0.00	0.63
Eagle Creek (W27)	nm	nm	nm	nm	nm	nm	0.02	0.05	0.02	0.08	0.02	0.08	0.03	0.05	0.00	0.08
Haggart Creek US Dublin (W22)	nm	nm	0.19	5.34	0.33	2.35	0.06	0.47	0.19	1.31	0.43	1.22	0.37	1.01	0.06	5.34
Haggart Creek DS Dublin (W4)	nm	nm	0.01	4.41	0.55	3.11	0.09	0.71	0.16	1.56	0.53	1.47	0.30	1.23	0.01	6.65
Haggart Creek US Lynx Creek (W5)	nm	nm	nm	nm	0.82	3.46	0.23	0.94	0.16	1.67	0.44	1.51	0.16	2.90	0.16	4.90
Lynx Creek (W6)	nm	nm	nm	nm	0.62	2.27	0.01	0.68	0.27	1.99	0.72	2.51	0.71	1.12	0.01	18.65

NOTES:

Monthly values represent the lowest and highest recorded stream flows

Values are in cubic meters per second

- = no station established

nm = no measurements at station

Table A-6: 1996 LSA Stream Flow Summaries

Station	Discharge (m^3/s)	
	Min	Max
Dublin Gulch Midway (H1)	0.04	0.4
Haggart Creek DS Dublin Gulch (H4)	0.01	8.2
Haggart Creek US Lynx Creek (H5)	0.4	4.5
Lynx Creek (H7)	0.2	16.8

NOTES:
Values represent the lowest and highest recorded stream flows during 1996 monitoring

Table A-7: Regional Recurrence Interval Flood Events

Percent Exceedence	Return Period	McQuesten	Little Klondike	North Klondike	Klondike Creek	Stewart River (Mouth)	Stewart River (Mayo)
0.5	200	527	358	177	730	6,222	4,606
1	100	488	305	168	694	5,553	4,310
2	50	448	257	159	655	4,927	4,005
5	20	396	201	145	599	4,158	3,579
10	10	355	163	132	551	3,609	3,231
20	5	311	127	117	496	3,076	2,846
50	2	243	82	90	400	2,345	2,212

NOTES:
Return period flood magnitudes derived from log Pearson III frequency distribution analysis of annual maxima series
Flood magnitudes in m^3/s

Table A-8: LSA Estimated Flood Magnitudes

Return Period	Dublin Gulch	Haggart Creek	Lynx Creek	Eagle Creek	Eagle Pup	Stuttle Gulch	Ann Gulch	Stewart Gulch	Olive Gulch	Bawn-Boy Gulch	Cascallen Gulch
200	5.2	32.2	32.3	2.7	0.90	0.72	0.68	1.1	1.3	1.5	0.64
100	4.7	29.0	29.1	2.4	0.80	0.63	0.60	0.94	1.2	1.3	0.56
50	4.1	25.9	26.0	2.1	0.70	0.55	0.52	0.82	1.0	1.1	0.49
20	3.4	21.7	21.8	1.7	0.56	0.44	0.42	0.66	0.83	0.93	0.39
10	2.8	18.6	18.6	1.5	0.46	0.36	0.34	0.55	0.69	0.77	0.32
5	2.3	15.3	15.3	1.2	0.36	0.28	0.27	0.43	0.54	0.60	0.25
2	1.5	10.4	10.4	0.7	0.22	0.17	0.16	0.26	0.33	0.37	0.15

NOTES:
Values derived from power function of regression analysis of regional flood events versus drainage basin area
2 year event = 0.188x^0.8754 R^2 = .98
5 year event = 0.3112x^0.8499 R^2 = .97
10 year event = 0.3981x^0.8387 R^2 = .96
20 year event = 0.485x^0.8302 R^2 = .95
50 year event = 0.6004x^0.8217 R^2 = .93
100 year event = 0.6887x^0.8167 R^2 = .91
200 year event = 0.7791x^0.8124 R^2 = .89
All stream flow estimates in m^3/s

Table A-9: Historical LSA Flood Runoff Estimates

Return Interval	Dublin Gulch	Haggart Creek
200	5.6	39.1
100	5.3	37.0
50	5.0	34.9
20	4.6	32.1
10	4.3	29.9

NOTES:
Flood estimates from HKP (1996) and converted to m^3/s
Estimates based on extreme value analysis of McQuesten River historical data

APPENDIX B

Study Area Hydrology Data, 2007 – 2009

Table B-1: Stream Flow Data, 2007 – 2009

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W1 – Dublin Gulch					
	14-Aug-07	17:47	0.059	0.298	
	29-Aug-07	10:50	0.062	0.297	
	12-Sep-07	09:05	0.063	0.296	
	26-Sep-07	12:45	0.092	0.301	
	19-Oct-07	18:20	0.047	0.283	
	20-Nov-07	17:00	0.040	0.260	
	25-Apr-08	15:40	0.015	nm	frozen
	9-Jun-08	14:45	0.072	0.290	
	12-Aug-08	17:35	0.176	0.372	
	12-Aug-08	17:05	0.177	0.372	
	20-Oct-08	18:00	0.097	0.350	
	8-Jun-09	14:00	nm	nm	
	19-Jul-09	12:00	0.045	0.191	
	26-Jul-09	13:30	0.032	0.180	
	9-Aug-09	15:05	0.025	0.178	
	20-Aug-09	19:40	0.044	0.182	
	1-Sep-09	18:30	0.074	0.202	
	5-Oct-09	10:15	0.055	0.198	
	21-Oct-09	13:50	0.0360	0.302	
W4 – Haggart Creek, downstream from Dublin Gulch					
	13-Aug-07	16:15	0.701	0.451	
	15-Aug-07	9:30	0.693	0.441	
	28-Aug-07	18:30	0.631	0.435	
	11-Sep-07	19:00	0.810	0.463	
	25-Sep-07	15:30	0.737	0.454	
	19-Oct-07	16:10	0.442	0.404	
	21-Nov-07	09:00	0.360	nm	frazil ice
	25-Apr-08	12:50	0.050	nm	frozen
	9-Jun-08	19:30	0.740	0.440	
	12-Aug-08	19:30	1.575	0.540	
	21-Oct-08	11:55	0.926	0.482	
	21-Apr-09	06:33	nm	nm	
	18-Jul-09	19:00	0.361	0.679	
	26-Jul-09	18:08	0.303	0.671	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	9-Aug-09	17:25	0.298	0.673	
	20-Aug-09	17:00	0.344	0.675	
	2-Sep-09	08:30	0.834	0.741	
	7-Oct-09	11:00	0.449	0.703	
	21-Oct-09	17:50	0.394	0.430	
W5 – Haggart Creek, upstream from Lynx Creek					
	12-Aug-07	19:30	0.744	0.414	
	28-Aug-07	16:50	0.698	0.412	
	11-Sep-07	17:05	0.896	0.450	
	25-Sep-07	18:30	0.873	0.440	
	20-Oct-07	12:45	0.323	nm	frazil ice
	21-Nov-07	12:40	0.280	nm	frazil ice
	25-Apr-08	22:10	0.282	nm	ice effects
	10-Jun-08	11:30	0.653	0.370	
	13-Aug-08	11:00	1.900	0.510	
	21-Oct-08	14:25	1.230	0.498	
	8-Jun-09	15:00	nm	0.657	
	20-Jul-09	10:15	0.452	0.545	
	26-Jul-09	20:00	0.419	0.548	
	9-Aug-09	19:10	0.385	0.540	
	20-Aug-09	12:30	0.458	0.536	
	2-Sep-09	14:30	0.895	0.607	
	7-Oct-09	14:00	0.605	0.587	
	22-Oct-09	11:45	0.466	nm	
W6 – Lynx Creek, upstream from Haggart Creek					
	13-Aug-07	10:00	0.846	0.402	
	28-Aug-07	16:15	0.872	0.405	
	11-Sep-07	16:00	1.399	0.470	
	25-Sep-07	19:00	1.059	0.430	
	20-Oct-07	12:00	0.231	0.321	
	21-Nov-07	15:00	0.274	nm	frazil ice
	25-Apr-08	19:20	0.335	nm	frazil ice
	10-Jun-08	12:30	0.433	0.160	
	13-Aug-08	11:45	1.810	0.392	
	21-Oct-08	15:10	1.179	0.291	
	20-Jul-09	11:00	0.408	0.440	
	26-Jul-09	20:30	0.533	0.430	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	9-Aug-09	19:55	0.343	0.420	
	20-Aug-09	13:20	0.499	0.462	
	2-Sep-09	14:00	1.161	0.585	
	7-Oct-09	15:00	0.771	0.520	
	22-Oct-09	12:20	0.521	0.154	
W13 – Lynx Creek upstream of Ray Gulch					
	12-Aug-07	11:13	0.574	nm	
	12-Sep-07	14:45	0.687	nm	
W20^ – Bawn-boy Creek, upstream from Dublin Gulch					
	14-Aug-07	14:40	0.025	nm	
	29-Aug-07	10:00	0.033	nm	
	12-Sep-07	08:10	0.028	nm	
	9-Jun-08	17:30	0.015	nm	
	12-Aug-08	16:30	0.045	nm	
	19-Jul-09	10:30	0.018	0.170	
	26-Jul-09	09:00	0.022	0.180	
	9-Aug-09	10:10	0.012	0.160	
	20-Aug-09	21:00	0.014	0.165	
	2-Sep-09	–	nm	nm	grizzly in area
	5-Oct-09	18:00	0.024	0.200	
	21-Oct-09	15:50	0.004	0.114	
W21* – Dublin Gulch Alluvial Fan, upstream from Haggart Creek					
	15-Aug-07	10:15	0.059	nm	
	28-Aug-07	20:30	0.050	nm	
	11-Sep-07	20:45	0.071	nm	
	25-Sep-07	17:00	0.099	nm	
	19-Oct-07	17:40	0.043	nm	
	21-Nov-07	11:30	0.020	nm	
	12-Aug-08	21:00	0.250	nm	
	21-Oct-08	11:20	0.098	nm	
	18-Jul-09	19:30	0.012	0.150	
	26-Jul-09	18:30	0.008	0.150	
	9-Aug-09	17:40	0.008	0.130	
	20-Aug-09	15:30	0.012	0.160	
	1-Sep-09	21:00	0.067	0.200	
	6-Oct-09	10:30	nm	nm	
	20-Oct-09	18:05	0.362	0.274	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W22 – Haggart Creek, upstream from Dublin Gulch					
	13-Aug-07	20:40	0.597	0.333	
	15-Aug-07	11:10	0.577	0.339	
	28-Aug-07	19:45	0.538	0.340	
	11-Sep-07	08:00	0.684	0.354	
	25-Sep-07	16:35	0.641	0.351	
	19-Oct-07	17:00	0.372	0.338	
	21-Nov-07	10:45	0.343	0.300	
	25-Apr-08	13:30	0.266	nm	frozen
	9-Jun-08	20:30	0.688	0.260	
	12-Aug-08	20:30	1.237	0.325	
	21-Oct-08	10:35	0.741	0.300	
	21-Apr-09	20:00	0.191	nm	
	18-Jul-09	20:30	0.349	0.510	
	26-Jul-09	17:30	0.294	0.506	
	9-Aug-09	16:45	0.278	0.506	
	20-Aug-09	16:10	0.276	0.508	
	1-Sep-09	20:30	0.749	0.589	
	7-Oct-09	10:00	0.361	0.545	
W23* – Haggart Creek, downstream from Lynx Creek					
	12-Aug-07	15:30	1.584	nm	
	28-Aug-07	15:15	1.695	nm	
	11-Sep-07	15:00	2.261	nm	
	25-Sep-07	17:50	2.025	nm	
	20-Oct-07	10:55	0.634	nm	
	21-Nov-07	16:00	nm	nm	frazil ice
	25-Apr-08	18:00	0.659	nm	
	10-Jun-08	14:30	1.139	nm	
	13-Aug-08	10:30	4.048	nm	
	21-Oct-08	16:05	2.125	nm	
	22-Apr-09	10:00	0.551	nm	Salt Dilution
	20-Jul-09	09:15	0.844	0.320	
	26-Jul-09	19:30	0.788	0.240	
	9-Aug-09	18:20	0.669	0.210	
	20-Aug-09	09:10	0.974	0.250	
	2-Sep-09	12:30	2.269	0.420	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W26 – Stewart Gulch, upstream from Dublin Gulch, Avulsion Channel					
	14-Aug-07	18:45	0.004	nm	
	29-Aug-07	11:30	0.012	nm	
	12-Sep-07	09:50	0.004	nm	
	26-Sep-07	13:00	0.006	nm	
	19-Oct-07	18:30	0.002	nm	
	20-Nov-07	16:00	nm	nm	frozen
	25-Apr-08	18:00	nm	nm	frozen
	9-Jun-08	16:00	0.005	nm	float/area
	12-Aug-08	17:00	0.036	nm	
	20-Oct-08	18:45	0.005	nm	
	1-Sep-09	18:00	0.014	0.124	avulsion channel; weir
	5-Oct-09	10:00	0.017	0.135	weir
	21-Oct-09	14:30	0.043	0.100	weir
W36* – Stewart Gulch, Main Channel					
	26-Jul-09	14:15	0.004	0.100	
	9-Aug-09	13:00	0.004	0.100	salt dilution
	20-Aug-09	18:46	0.004	0.100	salt dilution
W27 – Eagle Creek					
	14-Aug-07	21:20	0.015	0.008	
	28-Aug-07	09:15	0.039	0.037	
	12-Sep-07	10:55	0.017	0.028	
	26-Sep-07	08:30	0.017	nm	pulled data logger
	20-Oct-07	09:30	0.011	nm	
	21-Nov-07	12:40	0.004	nm	frazil ice
	26-Apr-08	08:00	0.011	nm	ice effects
	10-Jun-08	09:30	0.026	0.050	
	13-Aug-08	08:15	0.050	0.132	
	21-Oct-08	12:45	0.051	0.120	
	19-Jul-09	14:00	0.033	0.335	weir
	26-Jul-09	16:45	0.033	0.334	weir
	9-Aug-09	16:00	0.024	0.316	weir
	11-Aug-09	17:30	0.023	0.311	weir
	20-Aug-09	17:30	0.026	0.318	weir

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	26-Aug-09	19:12	0.038	0.345	weir
	1-Sep-09	21:00	0.029	0.326	weir
	22-Oct-09	09:00	0.013	0.318	
W30* – Cascallen Gulch					
	26-Jul-09	10:30	0.001	0.030	bucket
	9-Aug-09	10:30	0.000	0.000	
	20-Aug-09	21:30	0.000	0.000	
W31 – Olive Gulch					
	26-Jul-09	13:00	0.005	0.268	
	9-Aug-09	12:10	0.003	0.264	
	20-Aug-09	20:15	0.004	0.266	
	26-Aug-09	08:00	0.012	0.294	
	5-Oct-09	11:20	0.013	0.324	
	21-Oct-09		0.011	0.315	
W51* – Dublin Gulch, downstream from Cascallen Gulch					
	26-Jul-09	10:15	0.014	0.150	
	9-Aug-09	10:30	0.010	0.110	
	20-Aug-09	21:45	0.011	0.120	
W52* – Dublin Gulch, upstream from Olive Gulch					
	26-Jul-09	11:30	0.031	0.210	
	9-Aug-09	11:20	0.036	0.220	
	20-Aug-09	20:35	0.031	0.200	
W54* – Dublin Gulch, downstream from Ann Gulch					
	26-Jul-09	15:00	0.033	0.180	
	9-Aug-09	15:20	0.030	0.170	
	20-Aug-09	17:05	0.032	0.180	
W61* – Eagle Pup, upstream from Stuttle					
	21-Jul-09	10:00	0.007	0.080	
	25-Jul-09	17:10	0.008	0.080	

NOTES:
*Manual Gauge
^Automatic gauge in 2009 only
nm – no measurement taken

Table B-2: Monthly Seven-day Low Flows for Gauged Streams in LSA, 2007 – 2009

7-Day Low Flow	W20	W31	W1	W27	W22	W4	W5	W6
2007								
January								
February								
March								
April								
May								
June								
July								
August			0.051*	0.022*	0.452*	0.519*	0.644*	0.419*
September			***0.056***	***0.030***	***0.472***	***0.609***	***0.760***	***0.573***
October			0.044		0.501	0.631	***0.879***	0.547
November								
December								
2008								
January								
February								
March								
April								
May								
June			0.063	0.032	0.381	0.397	0.377	0.201
July			***0.075***	0.023	***0.428***	***0.439***	***0.417***	***0.306***
August			***0.110***	0.019	***0.635***	***0.739***	***0.643***	***0.636***
September			***0.118***	0.041	0.635	0.808	0.577	0.684
October			0.118	***0.051***	***0.865***	***1.119***	***0.733***	***1.170***
November								
December								
2009								
January								
February								
March								
April								
May					0.937*	0.723*		
June			0.069*		0.541	0.796	1.094*	0.800*
July	0.019*		0.044	0.029*	0.206	0.267	0.456	0.190
August	0.011	0.002*	0.021	0.025	***0.233***	***0.220***	***0.286***	***0.309***
September	0.016	***0.002***	0.054	***0.026***	0.509	0.625	0.573	0.826
October	***0.021****	0.003*	0.029*	***0.037****	0.541*	0.497*	0.430*	0.763*
November								
December								

NOTES:

* partial month

***Bold/Italic** values indicate seven-day period overlapped between months*

Table B-1: Stream Flow Data, 2007 – 2009

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W1 – Dublin Gulch					
	14-Aug-07	17:47	0.059	0.298	
	29-Aug-07	10:50	0.062	0.297	
	12-Sep-07	09:05	0.063	0.296	
	26-Sep-07	12:45	0.092	0.301	
	19-Oct-07	18:20	0.047	0.283	
	20-Nov-07	17:00	0.040	0.260	
	25-Apr-08	15:40	0.015	nm	frozen
	9-Jun-08	14:45	0.072	0.290	
	12-Aug-08	17:35	0.176	0.372	
	12-Aug-08	17:05	0.177	0.372	
	20-Oct-08	18:00	0.097	0.350	
	8-Jun-09	14:00	nm	nm	
	19-Jul-09	12:00	0.045	0.191	
	26-Jul-09	13:30	0.032	0.180	
	9-Aug-09	15:05	0.025	0.178	
	20-Aug-09	19:40	0.044	0.182	
	1-Sep-09	18:30	0.074	0.202	
	5-Oct-09	10:15	0.055	0.198	
	21-Oct-09	13:50	0.0360	0.302	
W4 – Haggart Creek, downstream from Dublin Gulch					
	13-Aug-07	16:15	0.701	0.451	
	15-Aug-07	9:30	0.693	0.441	
	28-Aug-07	18:30	0.631	0.435	
	11-Sep-07	19:00	0.810	0.463	
	25-Sep-07	15:30	0.737	0.454	
	19-Oct-07	16:10	0.442	0.404	
	21-Nov-07	09:00	0.360	nm	frazil ice
	25-Apr-08	12:50	0.050	nm	frozen
	9-Jun-08	19:30	0.740	0.440	
	12-Aug-08	19:30	1.575	0.540	
	21-Oct-08	11:55	0.926	0.482	
	21-Apr-09	06:33	nm	nm	
	18-Jul-09	19:00	0.361	0.679	
	26-Jul-09	18:08	0.303	0.671	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	9-Aug-09	17:25	0.298	0.673	
	20-Aug-09	17:00	0.344	0.675	
	2-Sep-09	08:30	0.834	0.741	
	7-Oct-09	11:00	0.449	0.703	
	21-Oct-09	17:50	0.394	0.430	
W5 – Haggart Creek, upstream from Lynx Creek					
	12-Aug-07	19:30	0.744	0.414	
	28-Aug-07	16:50	0.698	0.412	
	11-Sep-07	17:05	0.896	0.450	
	25-Sep-07	18:30	0.873	0.440	
	20-Oct-07	12:45	0.323	nm	frazil ice
	21-Nov-07	12:40	0.280	nm	frazil ice
	25-Apr-08	22:10	0.282	nm	ice effects
	10-Jun-08	11:30	0.653	0.370	
	13-Aug-08	11:00	1.900	0.510	
	21-Oct-08	14:25	1.230	0.498	
	8-Jun-09	15:00	nm	0.657	
	20-Jul-09	10:15	0.452	0.545	
	26-Jul-09	20:00	0.419	0.548	
	9-Aug-09	19:10	0.385	0.540	
	20-Aug-09	12:30	0.458	0.536	
	2-Sep-09	14:30	0.895	0.607	
	7-Oct-09	14:00	0.605	0.587	
	22-Oct-09	11:45	0.466	nm	
W6 – Lynx Creek, upstream from Haggart Creek					
	13-Aug-07	10:00	0.846	0.402	
	28-Aug-07	16:15	0.872	0.405	
	11-Sep-07	16:00	1.399	0.470	
	25-Sep-07	19:00	1.059	0.430	
	20-Oct-07	12:00	0.231	0.321	
	21-Nov-07	15:00	0.274	nm	frazil ice
	25-Apr-08	19:20	0.335	nm	frazil ice
	10-Jun-08	12:30	0.433	0.160	
	13-Aug-08	11:45	1.810	0.392	
	21-Oct-08	15:10	1.179	0.291	
	20-Jul-09	11:00	0.408	0.440	
	26-Jul-09	20:30	0.533	0.430	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	9-Aug-09	19:55	0.343	0.420	
	20-Aug-09	13:20	0.499	0.462	
	2-Sep-09	14:00	1.161	0.585	
	7-Oct-09	15:00	0.771	0.520	
	22-Oct-09	12:20	0.521	0.154	
W13 – Lynx Creek upstream of Ray Gulch					
	12-Aug-07	11:13	0.574	nm	
	12-Sep-07	14:45	0.687	nm	
W20^ – Bawn-boy Creek, upstream from Dublin Gulch					
	14-Aug-07	14:40	0.025	nm	
	29-Aug-07	10:00	0.033	nm	
	12-Sep-07	08:10	0.028	nm	
	9-Jun-08	17:30	0.015	nm	
	12-Aug-08	16:30	0.045	nm	
	19-Jul-09	10:30	0.018	0.170	
	26-Jul-09	09:00	0.022	0.180	
	9-Aug-09	10:10	0.012	0.160	
	20-Aug-09	21:00	0.014	0.165	
	2-Sep-09	–	nm	nm	grizzly in area
	5-Oct-09	18:00	0.024	0.200	
	21-Oct-09	15:50	0.004	0.114	
W21* – Dublin Gulch Alluvial Fan, upstream from Haggart Creek					
	15-Aug-07	10:15	0.059	nm	
	28-Aug-07	20:30	0.050	nm	
	11-Sep-07	20:45	0.071	nm	
	25-Sep-07	17:00	0.099	nm	
	19-Oct-07	17:40	0.043	nm	
	21-Nov-07	11:30	0.020	nm	
	12-Aug-08	21:00	0.250	nm	
	21-Oct-08	11:20	0.098	nm	
	18-Jul-09	19:30	0.012	0.150	
	26-Jul-09	18:30	0.008	0.150	
	9-Aug-09	17:40	0.008	0.130	
	20-Aug-09	15:30	0.012	0.160	
	1-Sep-09	21:00	0.067	0.200	
	6-Oct-09	10:30	nm	nm	
	20-Oct-09	18:05	0.362	0.274	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W22 – Haggart Creek, upstream from Dublin Gulch					
	13-Aug-07	20:40	0.597	0.333	
	15-Aug-07	11:10	0.577	0.339	
	28-Aug-07	19:45	0.538	0.340	
	11-Sep-07	08:00	0.684	0.354	
	25-Sep-07	16:35	0.641	0.351	
	19-Oct-07	17:00	0.372	0.338	
	21-Nov-07	10:45	0.343	0.300	
	25-Apr-08	13:30	0.266	nm	frozen
	9-Jun-08	20:30	0.688	0.260	
	12-Aug-08	20:30	1.237	0.325	
	21-Oct-08	10:35	0.741	0.300	
	21-Apr-09	20:00	0.191	nm	
	18-Jul-09	20:30	0.349	0.510	
	26-Jul-09	17:30	0.294	0.506	
	9-Aug-09	16:45	0.278	0.506	
	20-Aug-09	16:10	0.276	0.508	
	1-Sep-09	20:30	0.749	0.589	
	7-Oct-09	10:00	0.361	0.545	
W23* – Haggart Creek, downstream from Lynx Creek					
	12-Aug-07	15:30	1.584	nm	
	28-Aug-07	15:15	1.695	nm	
	11-Sep-07	15:00	2.261	nm	
	25-Sep-07	17:50	2.025	nm	
	20-Oct-07	10:55	0.634	nm	
	21-Nov-07	16:00	nm	nm	frazil ice
	25-Apr-08	18:00	0.659	nm	
	10-Jun-08	14:30	1.139	nm	
	13-Aug-08	10:30	4.048	nm	
	21-Oct-08	16:05	2.125	nm	
	22-Apr-09	10:00	0.551	nm	Salt Dilution
	20-Jul-09	09:15	0.844	0.320	
	26-Jul-09	19:30	0.788	0.240	
	9-Aug-09	18:20	0.669	0.210	
	20-Aug-09	09:10	0.974	0.250	
	2-Sep-09	12:30	2.269	0.420	

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
W26 – Stewart Gulch, upstream from Dublin Gulch, Avulsion Channel					
	14-Aug-07	18:45	0.004	nm	
	29-Aug-07	11:30	0.012	nm	
	12-Sep-07	09:50	0.004	nm	
	26-Sep-07	13:00	0.006	nm	
	19-Oct-07	18:30	0.002	nm	
	20-Nov-07	16:00	nm	nm	frozen
	25-Apr-08	18:00	nm	nm	frozen
	9-Jun-08	16:00	0.005	nm	float/area
	12-Aug-08	17:00	0.036	nm	
	20-Oct-08	18:45	0.005	nm	
	1-Sep-09	18:00	0.014	0.124	avulsion channel; weir
	5-Oct-09	10:00	0.017	0.135	weir
	21-Oct-09	14:30	0.043	0.100	weir
W36* – Stewart Gulch, Main Channel					
	26-Jul-09	14:15	0.004	0.100	
	9-Aug-09	13:00	0.004	0.100	salt dilution
	20-Aug-09	18:46	0.004	0.100	salt dilution
W27 – Eagle Creek					
	14-Aug-07	21:20	0.015	0.008	
	28-Aug-07	09:15	0.039	0.037	
	12-Sep-07	10:55	0.017	0.028	
	26-Sep-07	08:30	0.017	nm	pulled data logger
	20-Oct-07	09:30	0.011	nm	
	21-Nov-07	12:40	0.004	nm	frazil ice
	26-Apr-08	08:00	0.011	nm	ice effects
	10-Jun-08	09:30	0.026	0.050	
	13-Aug-08	08:15	0.050	0.132	
	21-Oct-08	12:45	0.051	0.120	
	19-Jul-09	14:00	0.033	0.335	weir
	26-Jul-09	16:45	0.033	0.334	weir
	9-Aug-09	16:00	0.024	0.316	weir
	11-Aug-09	17:30	0.023	0.311	weir
	20-Aug-09	17:30	0.026	0.318	weir

Station	Date	Time	Discharge (m^3/s)	Stage (m)	Comments
	26-Aug-09	19:12	0.038	0.345	weir
	1-Sep-09	21:00	0.029	0.326	weir
	22-Oct-09	09:00	0.013	0.318	
W30* – Cascallen Gulch					
	26-Jul-09	10:30	0.001	0.030	bucket
	9-Aug-09	10:30	0.000	0.000	
	20-Aug-09	21:30	0.000	0.000	
W31 – Olive Gulch					
	26-Jul-09	13:00	0.005	0.268	
	9-Aug-09	12:10	0.003	0.264	
	20-Aug-09	20:15	0.004	0.266	
	26-Aug-09	08:00	0.012	0.294	
	5-Oct-09	11:20	0.013	0.324	
	21-Oct-09		0.011	0.315	
W51* – Dublin Gulch, downstream from Cascallen Gulch					
	26-Jul-09	10:15	0.014	0.150	
	9-Aug-09	10:30	0.010	0.110	
	20-Aug-09	21:45	0.011	0.120	
W52* – Dublin Gulch, upstream from Olive Gulch					
	26-Jul-09	11:30	0.031	0.210	
	9-Aug-09	11:20	0.036	0.220	
	20-Aug-09	20:35	0.031	0.200	
W54* – Dublin Gulch, downstream from Ann Gulch					
	26-Jul-09	15:00	0.033	0.180	
	9-Aug-09	15:20	0.030	0.170	
	20-Aug-09	17:05	0.032	0.180	
W61* – Eagle Pup, upstream from Stuttle					
	21-Jul-09	10:00	0.007	0.080	
	25-Jul-09	17:10	0.008	0.080	

NOTES:
*Manual Gauge
^Automatic gauge in 2009 only
nm – no measurement taken

Table B-2: Monthly Seven-day Low Flows for Gauged Streams in LSA, 2007 – 2009

7-Day Low Flow	W20	W31	W1	W27	W22	W4	W5	W6
2007								
January								
February								
March								
April								
May								
June								
July								
August			0.051*	0.022*	0.452*	0.519*	0.644*	0.419*
September			***0.056***	***0.030***	***0.472***	***0.609***	***0.760***	***0.573***
October			0.044		0.501	0.631	***0.879***	0.547
November								
December								
2008								
January								
February								
March								
April								
May								
June			0.063	0.032	0.381	0.397	0.377	0.201
July			***0.075***	0.023	***0.428***	***0.439***	***0.417***	***0.306***
August			***0.110***	0.019	***0.635***	***0.739***	***0.643***	***0.636***
September			***0.118***	0.041	0.635	0.808	0.577	0.684
October			0.118	***0.051***	***0.865***	***1.119***	***0.733***	***1.170***
November								
December								
2009								
January								
February								
March								
April								
May					0.937*	0.723*		
June			0.069*		0.541	0.796	1.094*	0.800*
July	0.019*		0.044	0.029*	0.206	0.267	0.456	0.190
August	0.011	0.002*	0.021	0.025	***0.233***	***0.220***	***0.286***	***0.309***
September	0.016	***0.002***	0.054	***0.026***	0.509	0.625	0.573	0.826
October	***0.021****	0.003*	0.029*	***0.037****	0.541*	0.497*	0.430*	0.763*
November								
December								

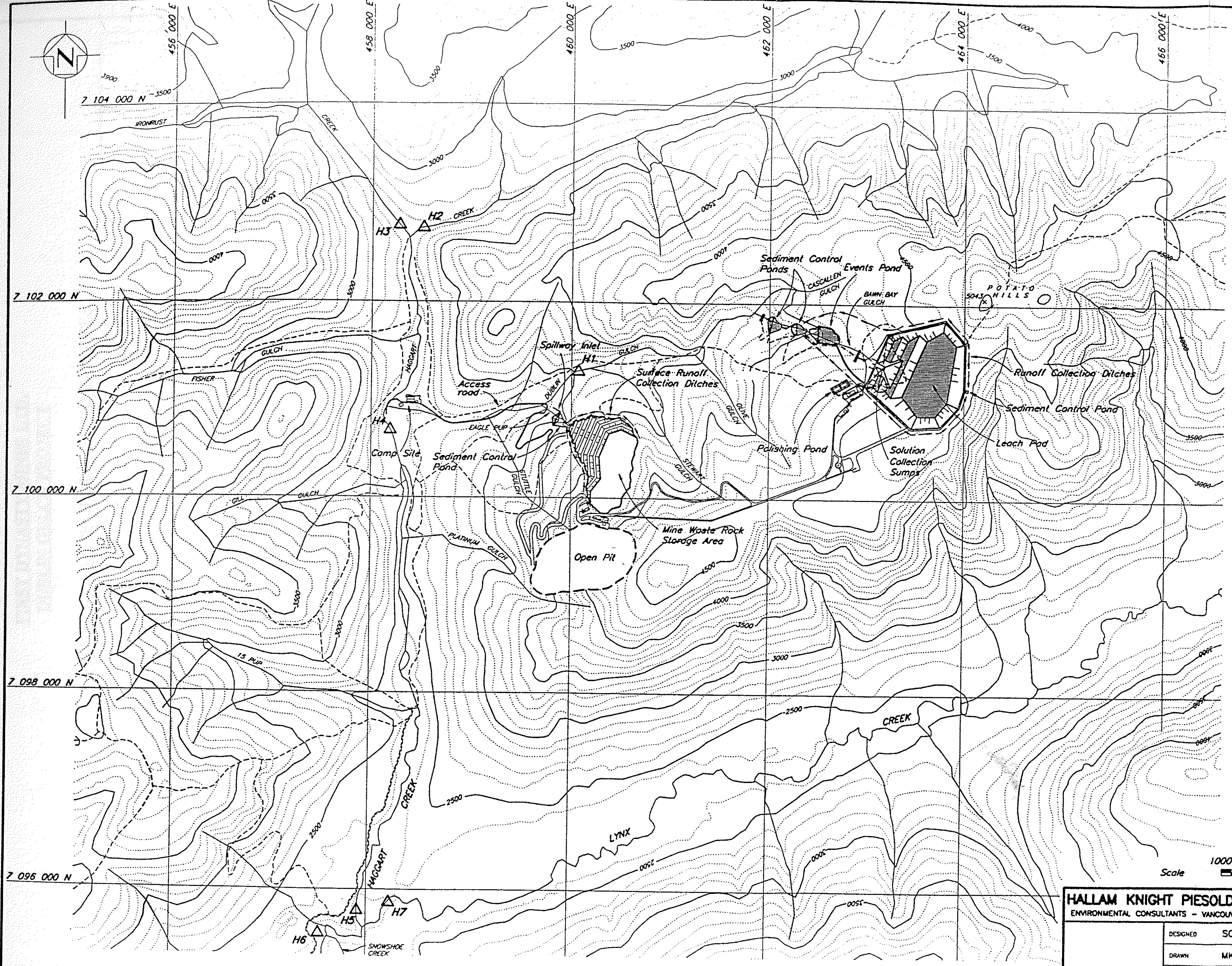
NOTES:

* partial month

Bold/Italic *values indicate seven-day period overlapped between months*

APPENDIX C

Study Area Hydrology Information, 1996



LEGEND

- - - - - - Existing access road

←— —← Diversion ditch

△ H5 Hydrology Monitoring Stations

NOTE

1. *Contour elevations are in feet.*
2. *Topography developed from NTS map sheets.*

Scale 1000 500 0 1000 2000 *Metres*

CAD FILE: \PROJECT\1000\H2811\EE\013 1:20000 Plot 1=20 NOV 20, 1995

DRG. NO.	DESCRIPTION
REFERENCE DRAWINGS	

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

REV.	DATE	DESCRIPTION	APPROVED
REVISIONS			

HALLAM KNIGHT PIESOLD LTD.
ENVIRONMENTAL CONSULTANTS – VANCOUVER, B.C.

DESIGNED SCB
DRAWN MKS
CHECKED
APPROVED

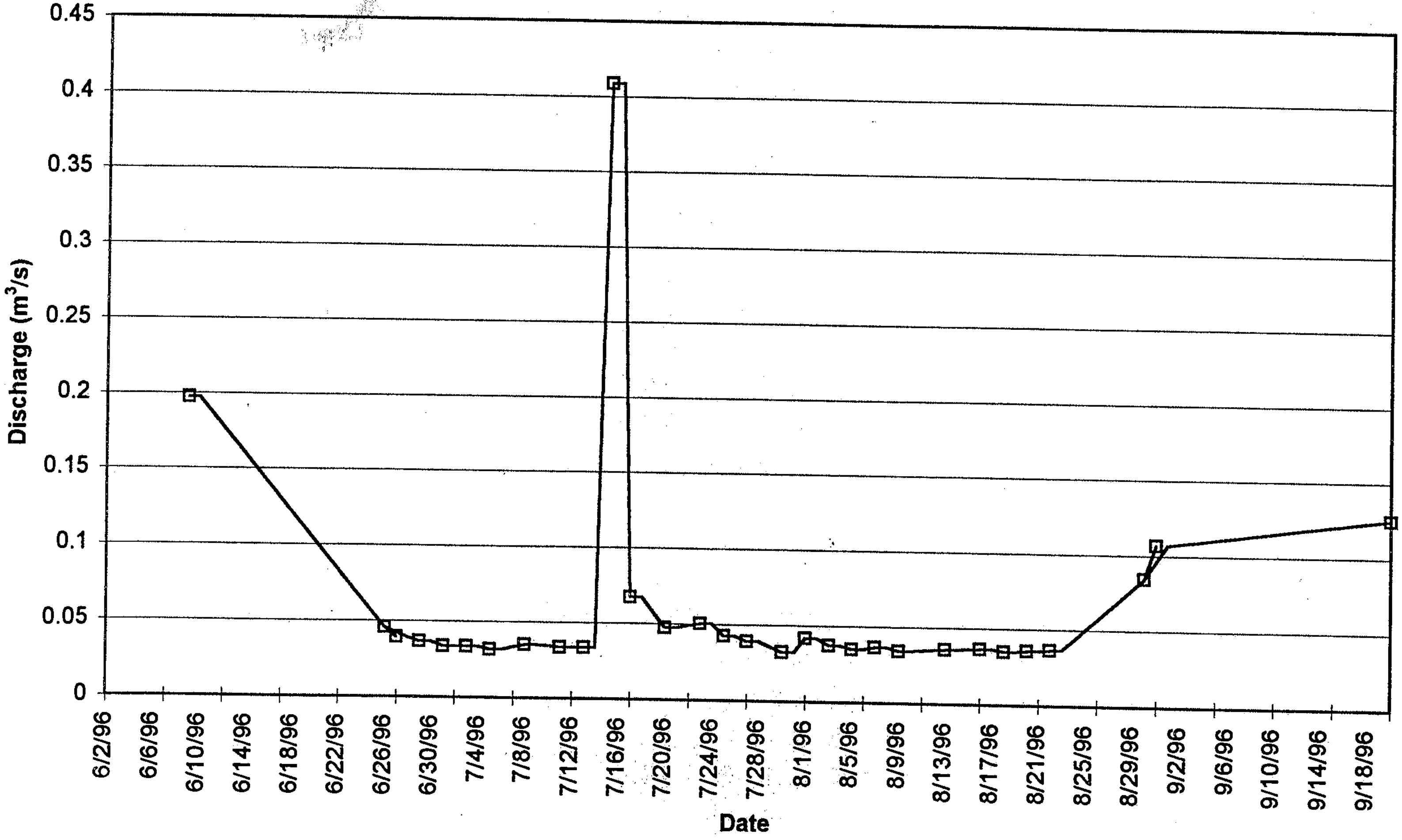
FIRST DYNASTY MINES LTD.

DUBLIN GULCH PROPERTY

HYDROLOGICAL MONITORING STATIONS
FIGURE 4.3

DATE NOV. 20, 1995 | SCALE AS SHOWN | DRG. NO. H2811 | REV. –

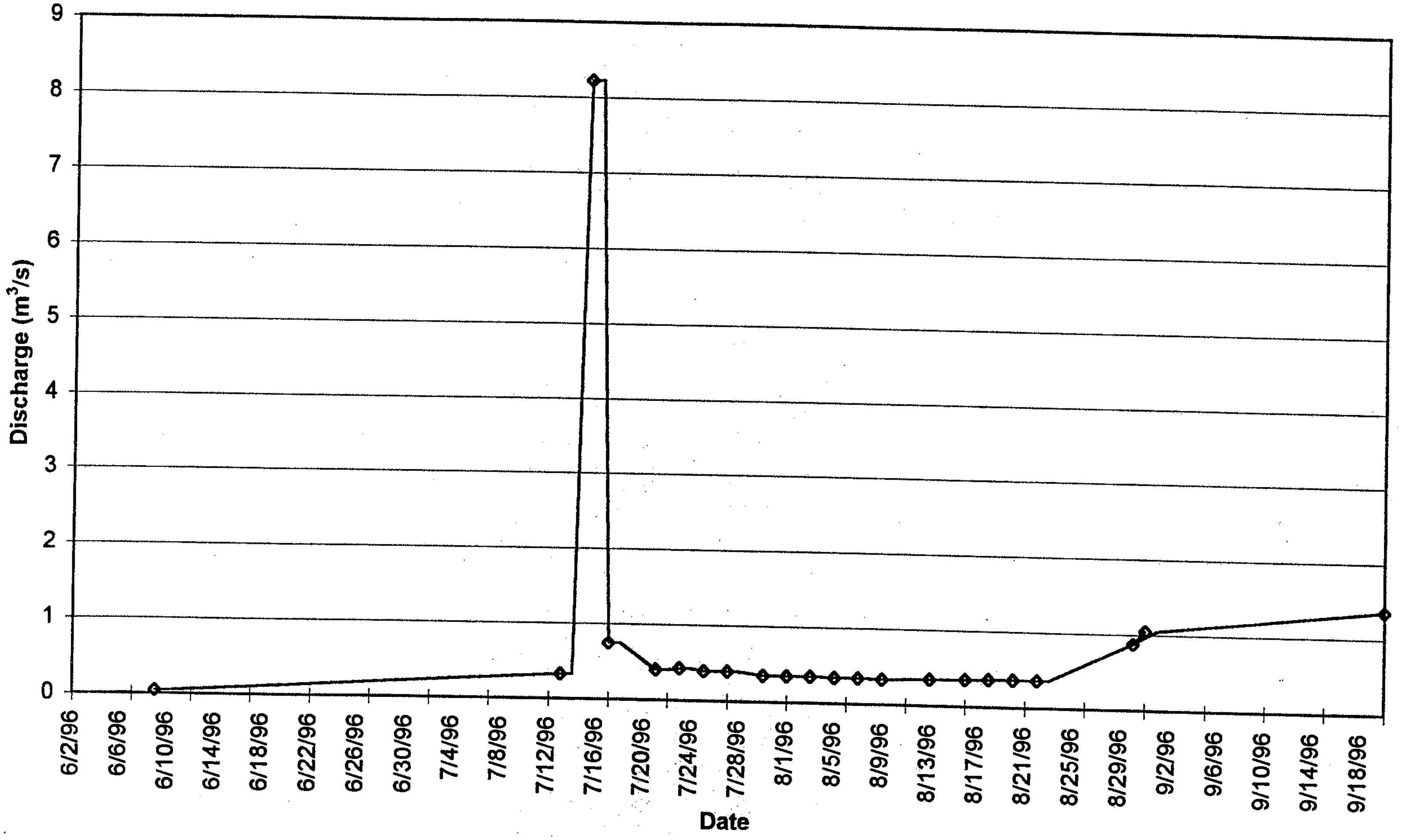
NEW MILLENNIUM MINING LTD.
DUBLIN GULCH PROJECT
Appendix XIV
Figure x
Stream Hydrograph For Station H1, 1996



I:\hallam\h2811\hydrolog\sgsum96.xls [Hydrograph - H1] 12/6/96

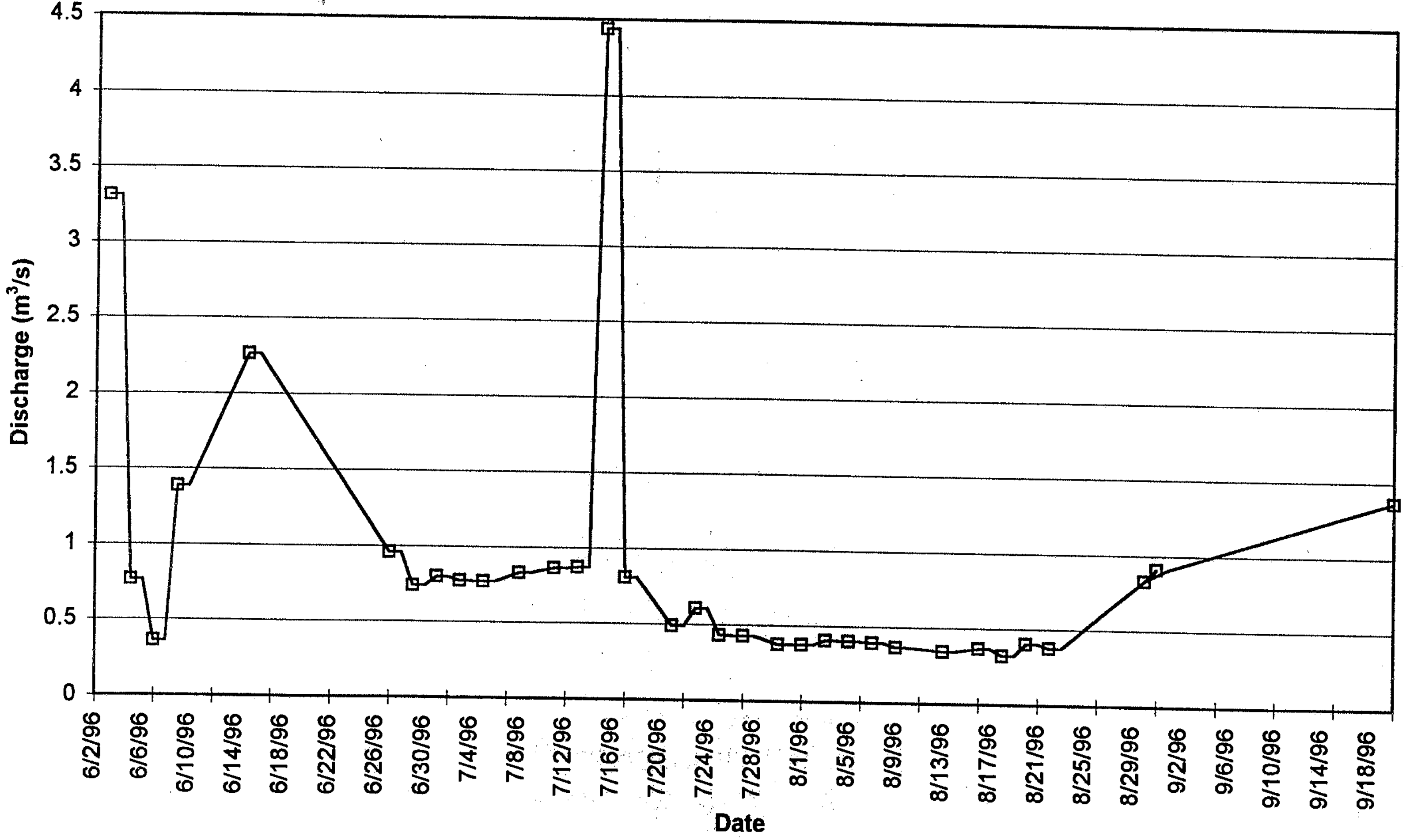
Hallam Knight Piésold Ltd.
ENVIRONMENTAL CONSULTANTS

NEW MILLENNIUM MINING LTD.
DUBLIN GULCH PROJECT
Appendix XIV
Figure xiii
Stream Hydrograph For Station H4, 1996



I:\hallam\h2811\hydrolog\sgsum96.xls [Hydrograph - H4] 12/6/96

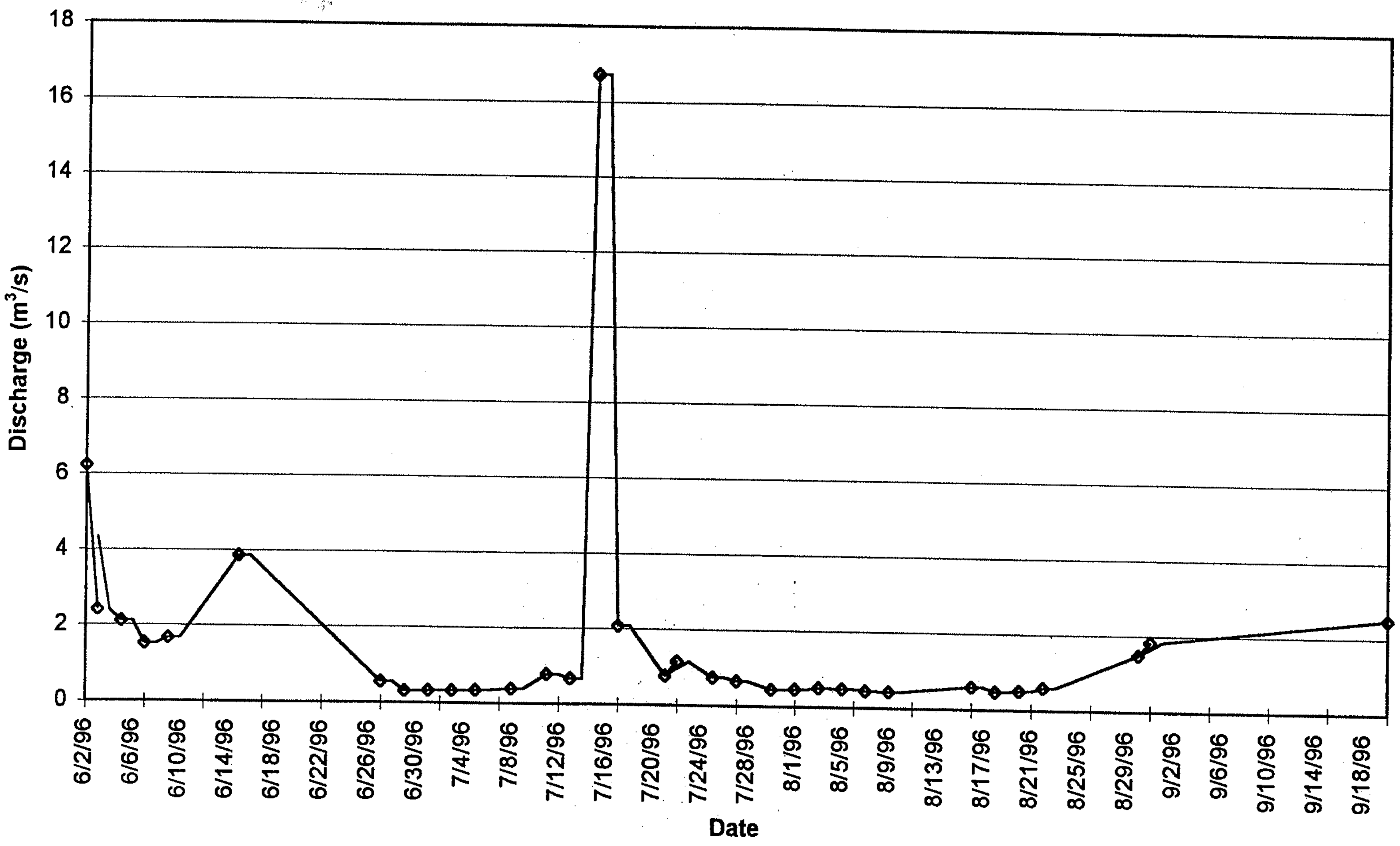
NEW MILLENNIUM MINING LTD.
DUBLIN GULCH PROJECT
Appendix XIV
Figure xiv
Stream Hydrograph For Station H5, 1996



I:\hallam\h2811\meteor\sgsum96.xls [Hydrograph - H5]

Hallam Knight Piésold Ltd.
ENVIRONMENTAL CONSULTANTS

NEW MILLENNIUM MINING LTD.
DUBLIN GULCH PROJECT
Appendix XIV
Figure xvi
Stream Hydrograph For Station H7, 1996

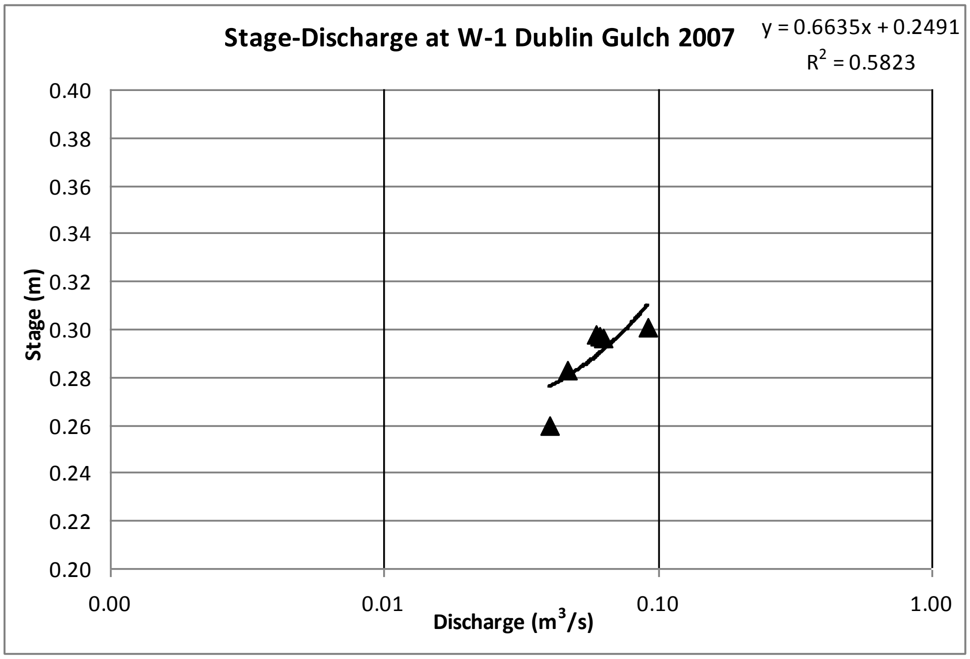


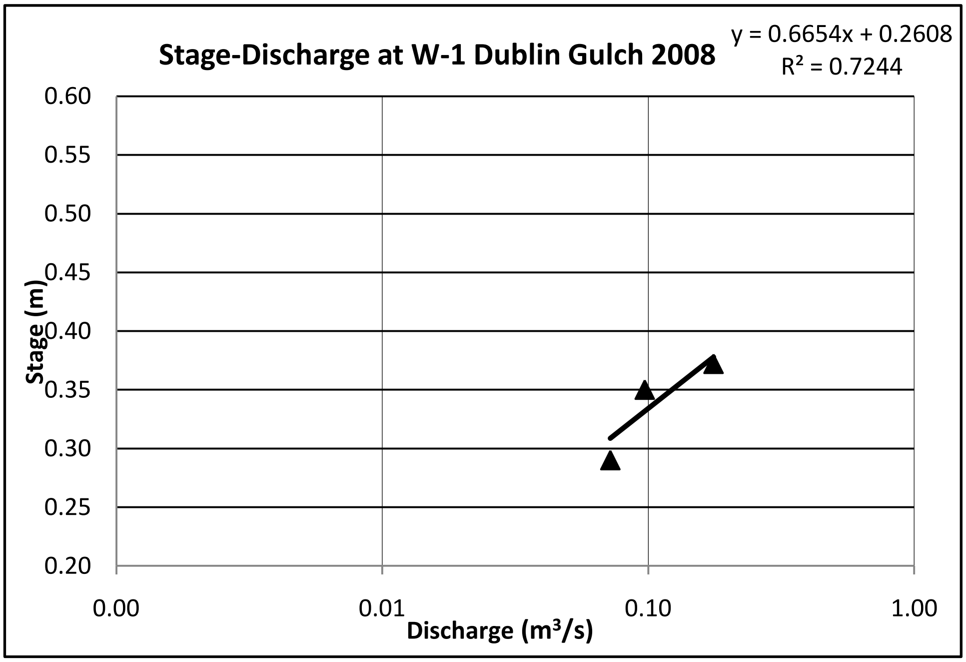
I:\hallam\h2811\hydrolog\sgsum96.xls [Hydrograph - H7] 12/6/96

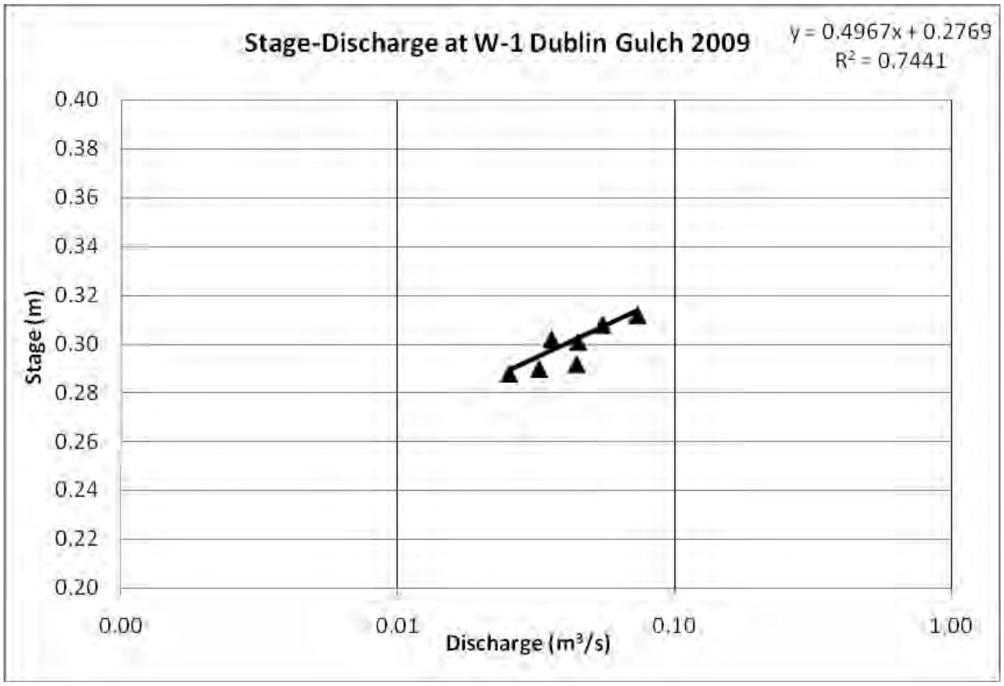
Hallam Knight Piésold Ltd.
ENVIRONMENTAL CONSULTANTS

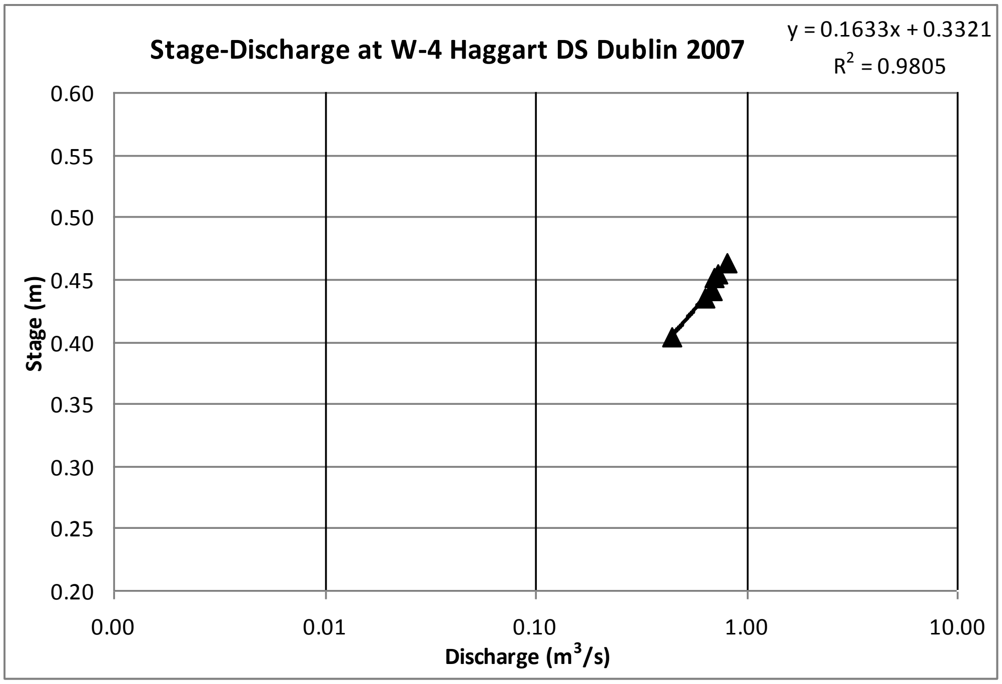
APPENDIX D

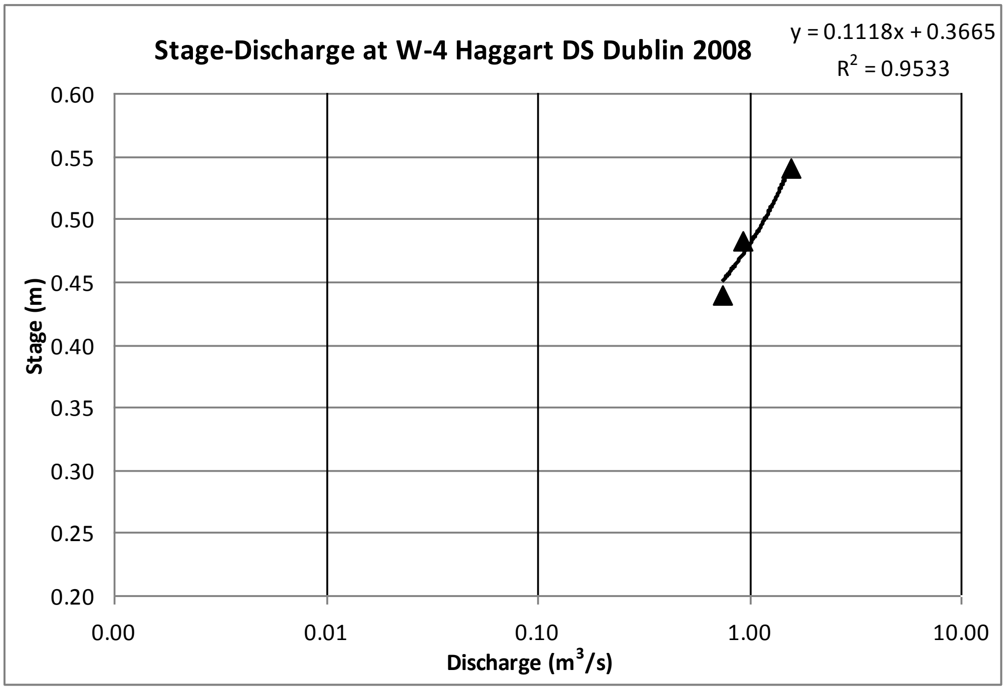
Study Area Stage-discharge Plots, 2007 – 2009

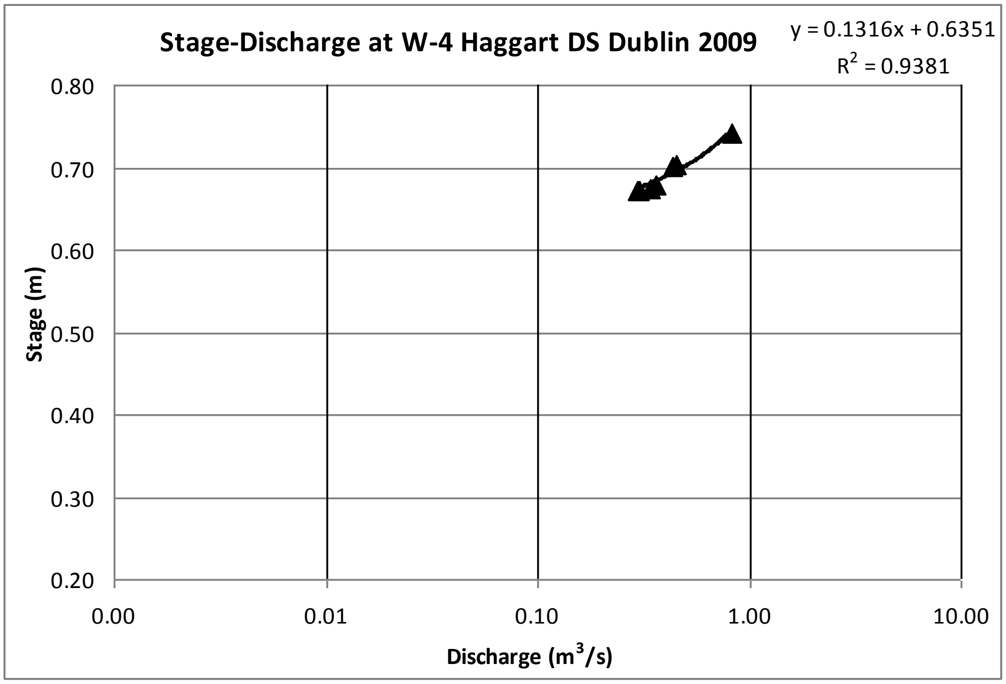

Stage-Discharge at W-1 Dublin Gulch 2007
y = 0.6635x + 0.2491
R² = 0.5823
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

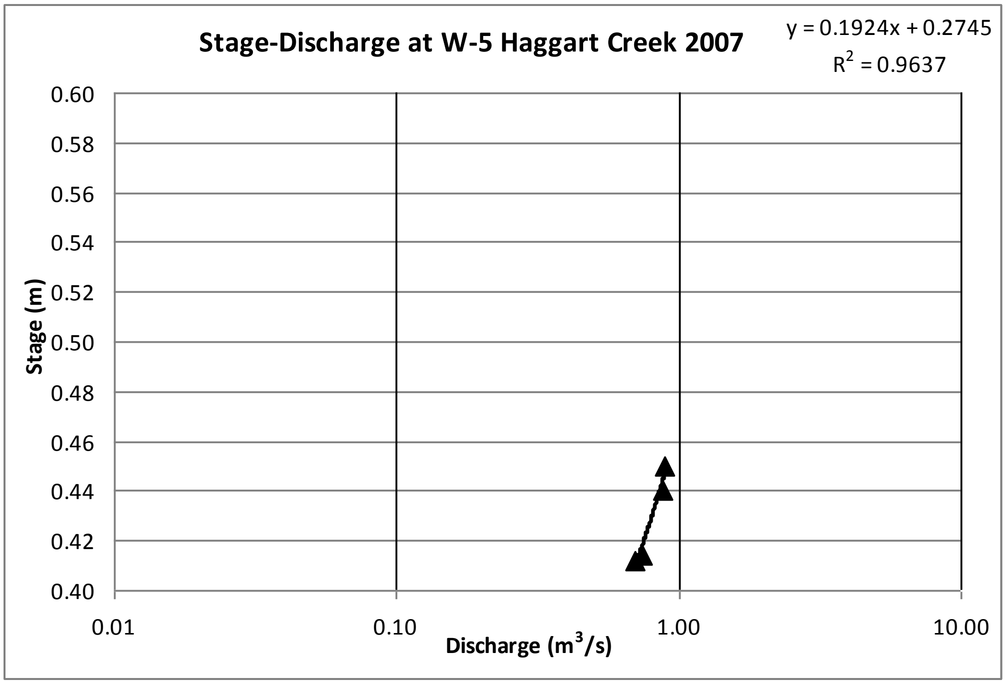

Stage-Discharge at W-1 Dublin Gulch 2008
y = 0.6654x + 0.2608
R² = 0.7244
Stage (m)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

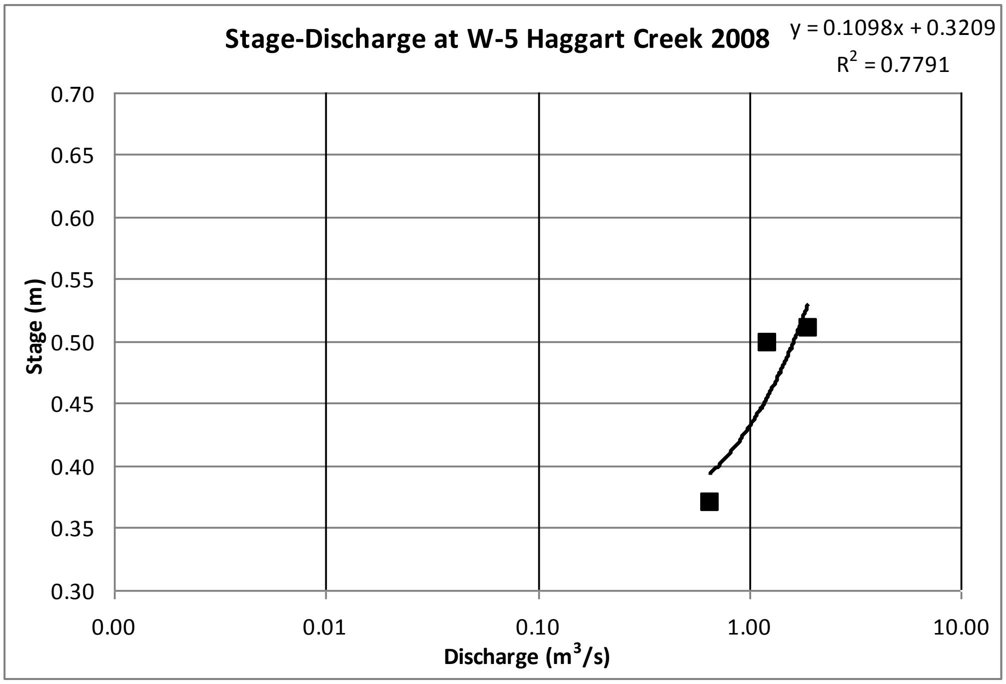

Stage-Discharge at W-1 Dublin Gulch 2009
y = 0.4967x + 0.2769
R² = 0.7441
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

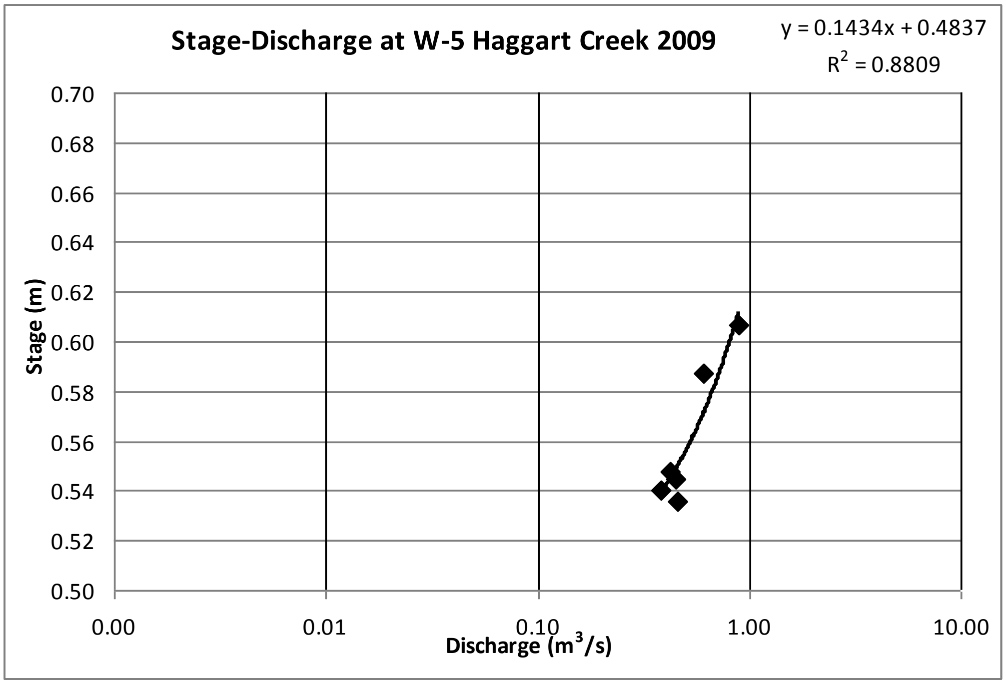

Stage-Discharge at W-4 Haggart DS Dublin 2007
y = 0.1633x + 0.3321
R² = 0.9805
Stage (m)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

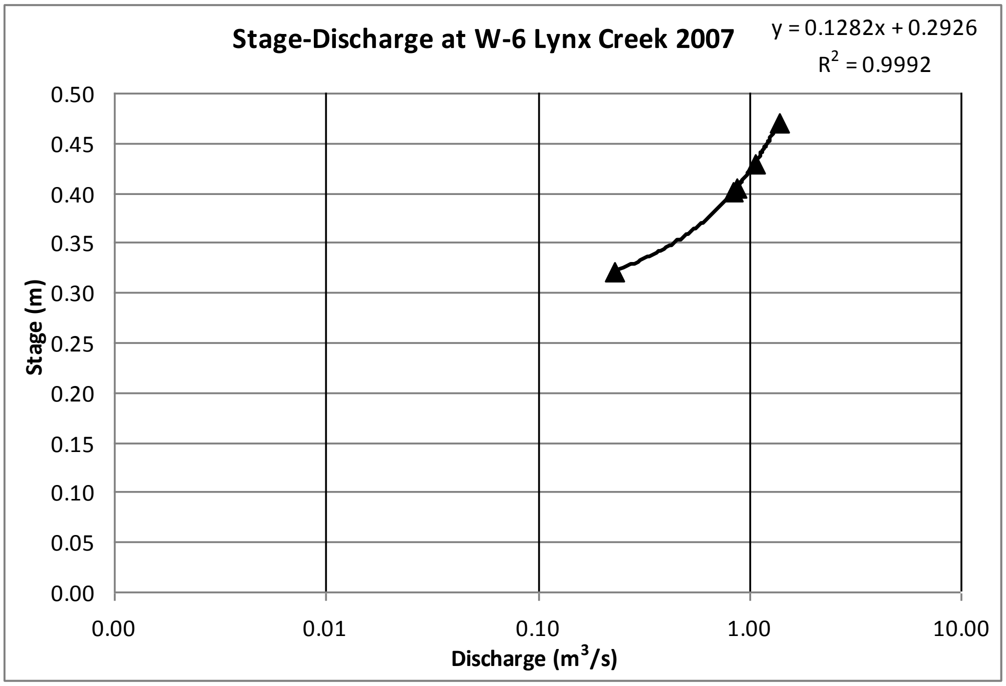

Stage-Discharge at W-4 Haggart DS Dublin 2008
y = 0.1118x + 0.3665
R^2 = 0.9533
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
Stage (m)
0.00
0.01
0.10
1.00
10.00
Discharge (m^3/s)

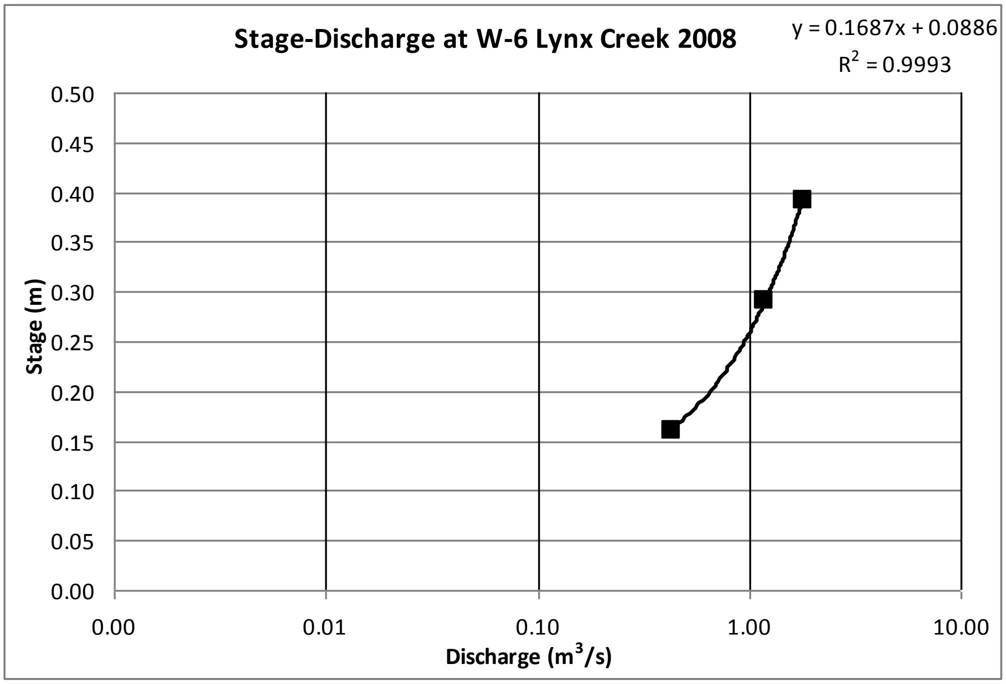

Stage-Discharge at W-4 Haggart DS Dublin 2009
y = 0.1316x + 0.6351
R^2 = 0.9381
0.80
0.70
0.60
0.50
0.40
0.30
0.20
Stage (m)
0.00
0.01
0.10
1.00
10.00
Discharge (m^3/s)

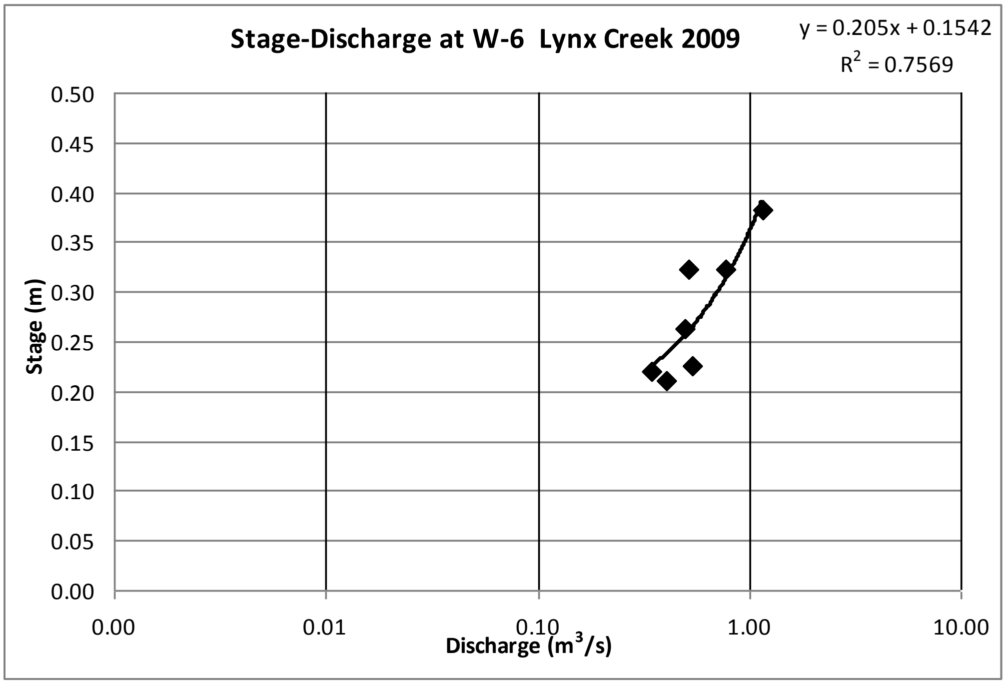

Stage-Discharge at W-5 Haggart Creek 2007
y = 0.1924x + 0.2745
R² = 0.9637
Stage (m)
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.01
0.10
1.00
10.00
Discharge (m³/s)

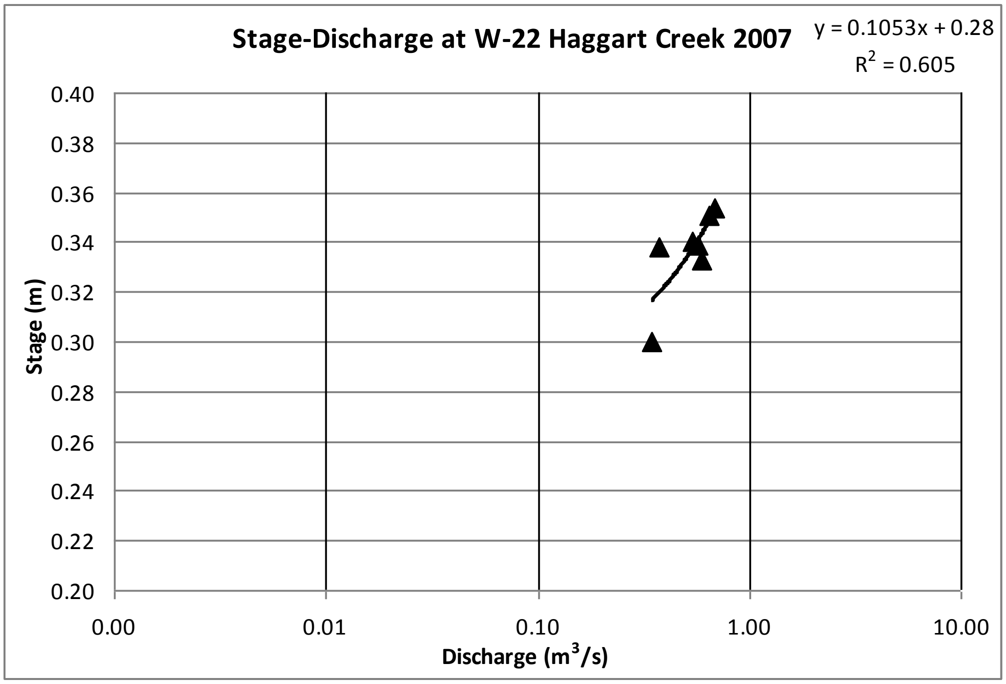

Stage-Discharge at W-5 Haggart Creek 2008
y = 0.1098x + 0.3209
R² = 0.7791
Stage (m)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

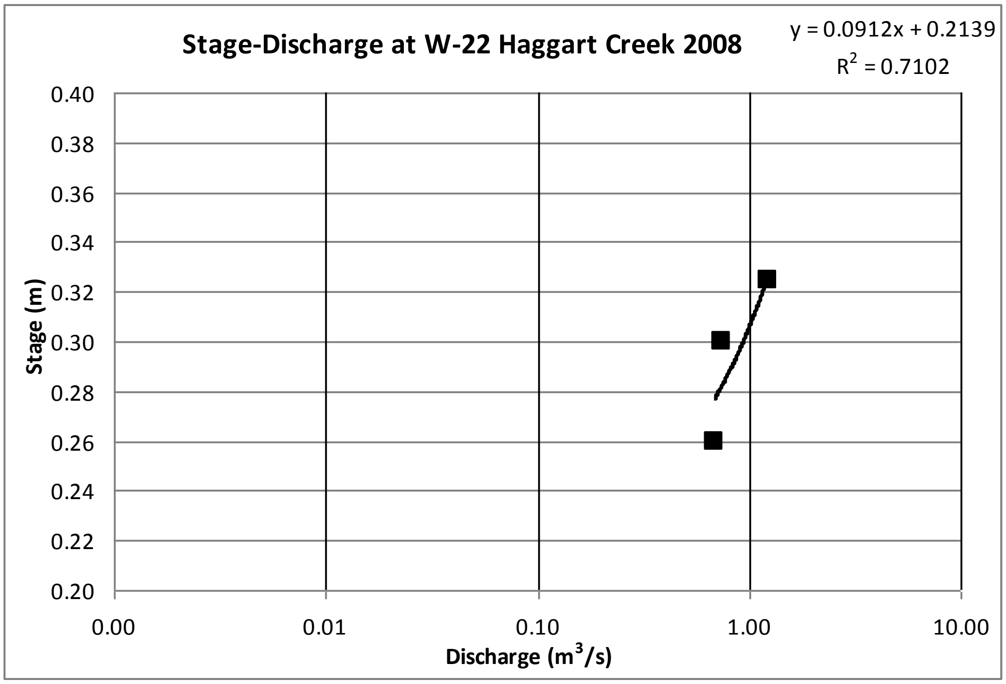

Stage-Discharge at W-5 Haggart Creek 2009
y = 0.1434x + 0.4837
R2 = 0.8809
Stage (m)
0.70
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

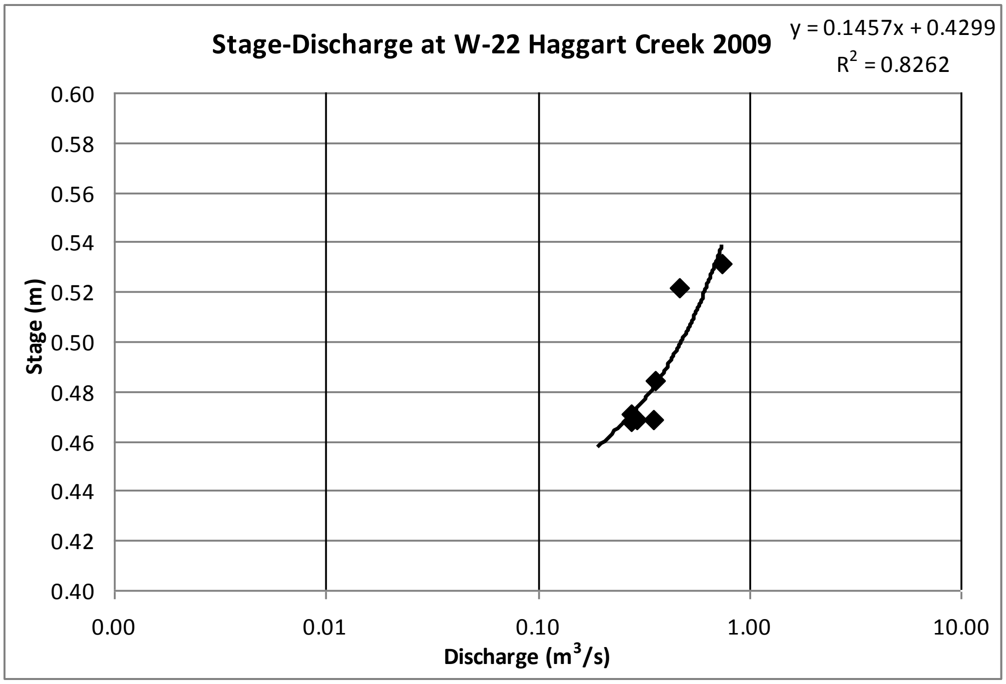

Stage-Discharge at W-6 Lynx Creek 2007
y = 0.1282x + 0.2926
R2 = 0.9992
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

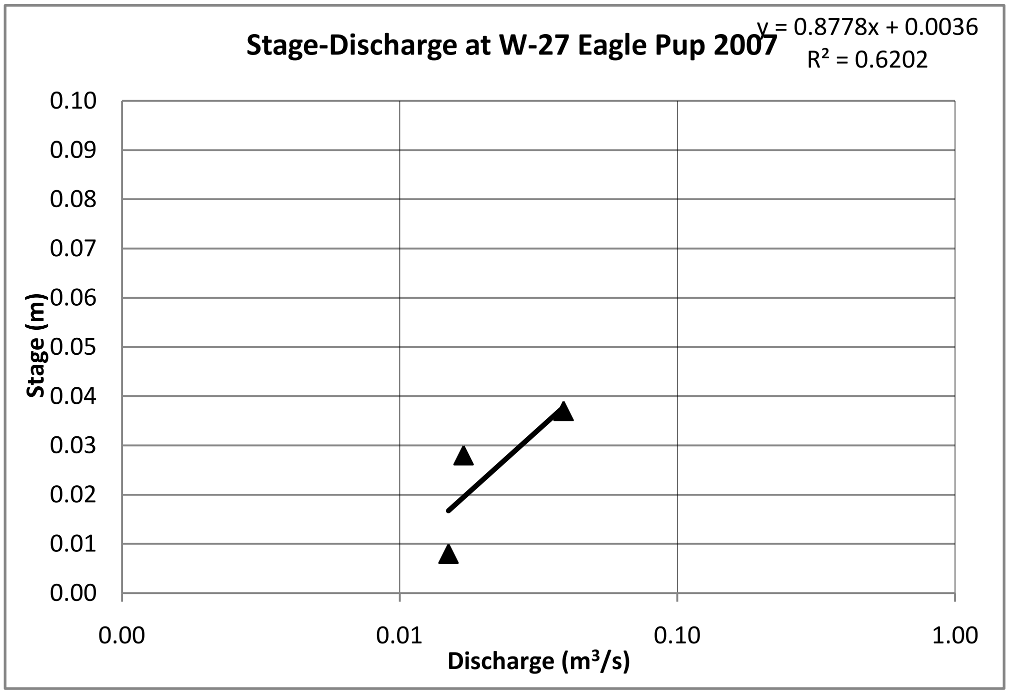

Stage-Discharge at W-6 Lynx Creek 2008
y = 0.1687x + 0.0886
R² = 0.9993
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

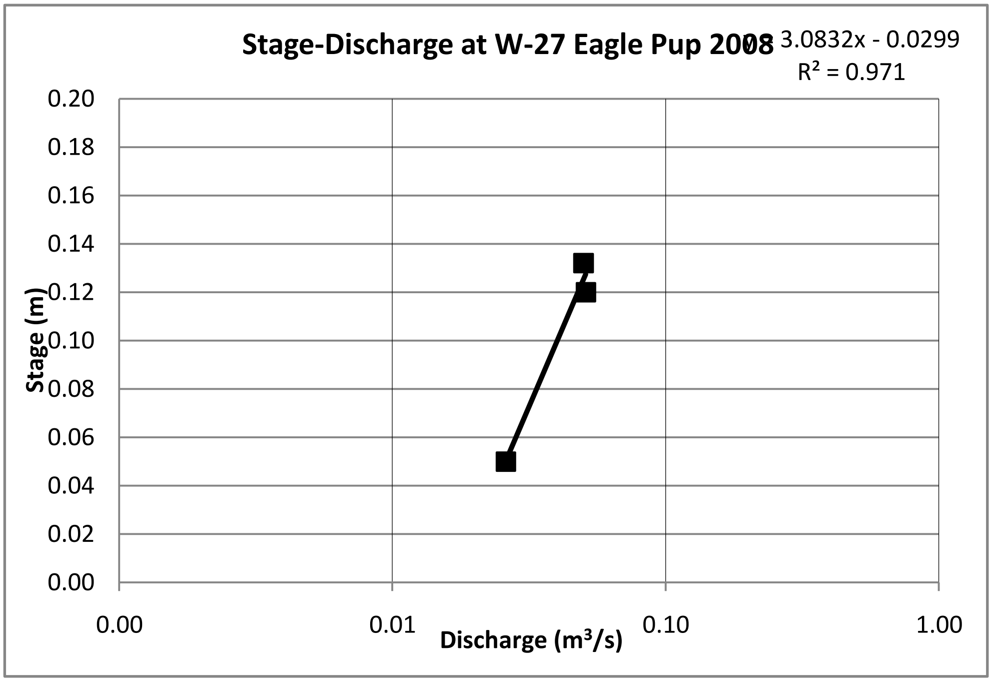

Stage-Discharge at W-6 Lynx Creek 2009
y = 0.205x + 0.1542
R² = 0.7569
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

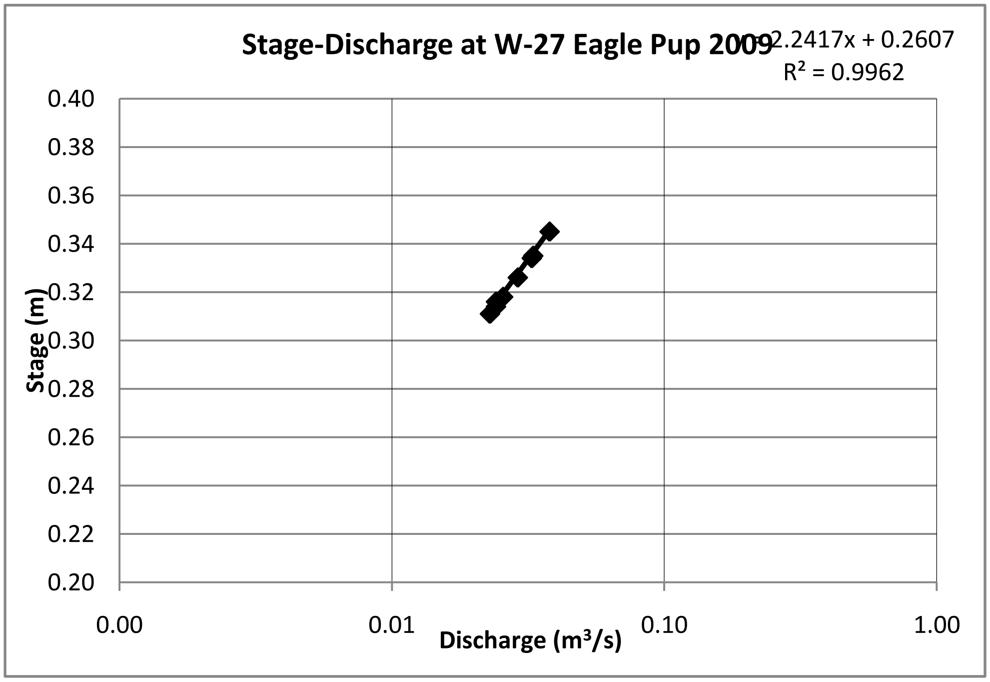

Stage-Discharge at W-22 Haggart Creek 2007
y = 0.1053x + 0.28
R² = 0.605
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

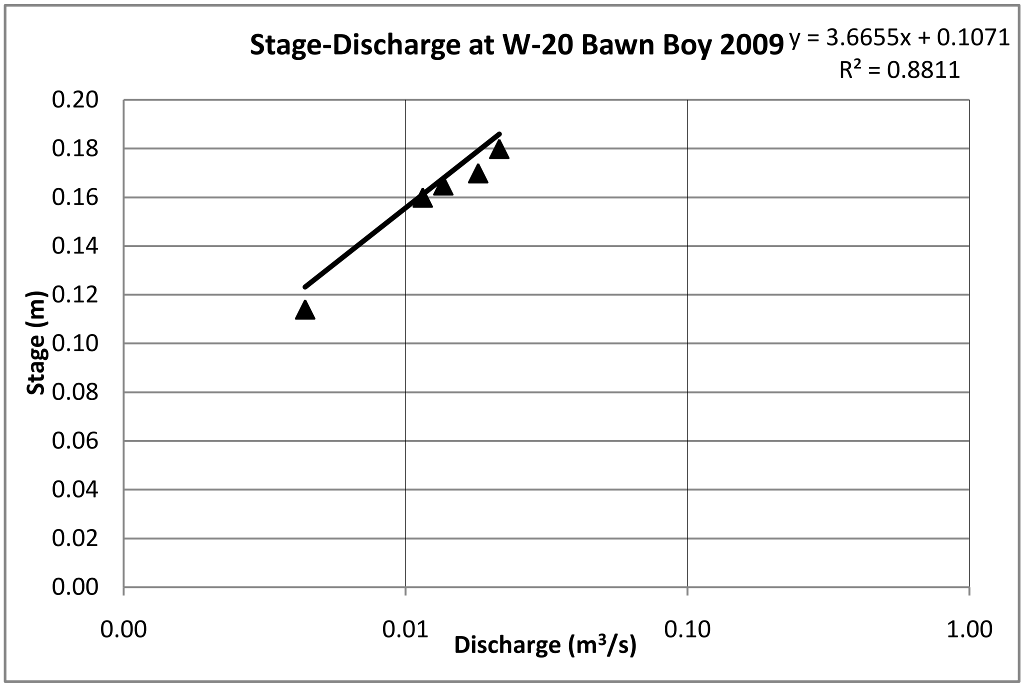

Stage-Discharge at W-22 Haggart Creek 2008
y = 0.0912x + 0.2139
R² = 0.7102
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

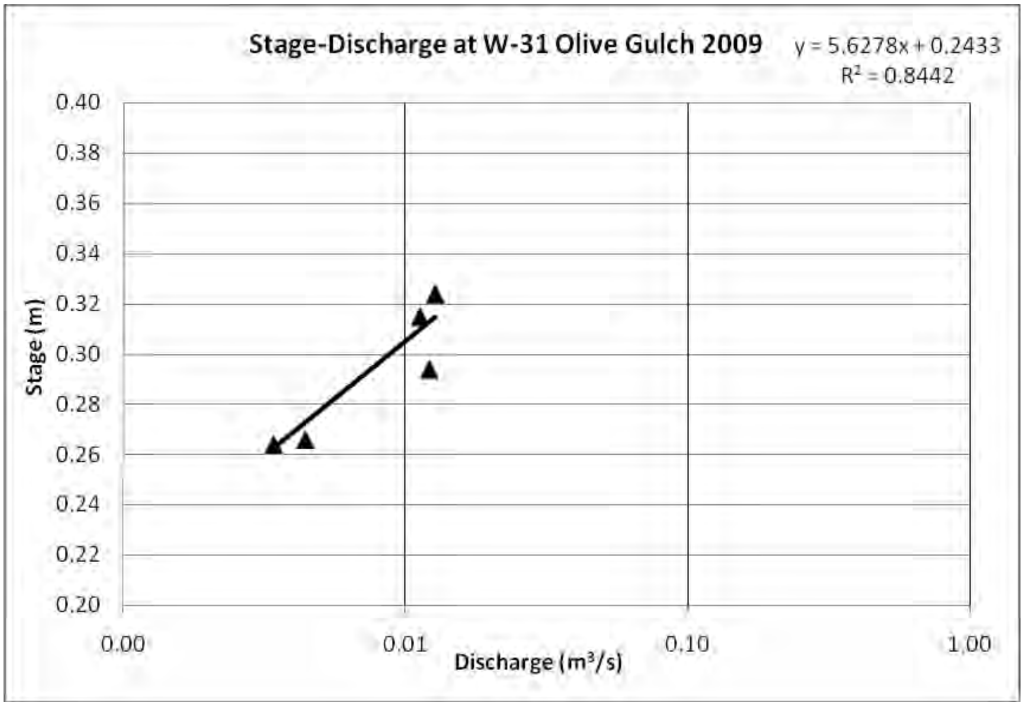

Stage-Discharge at W-22 Haggart Creek 2009
y = 0.1457x + 0.4299
R² = 0.8262
Stage (m)
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

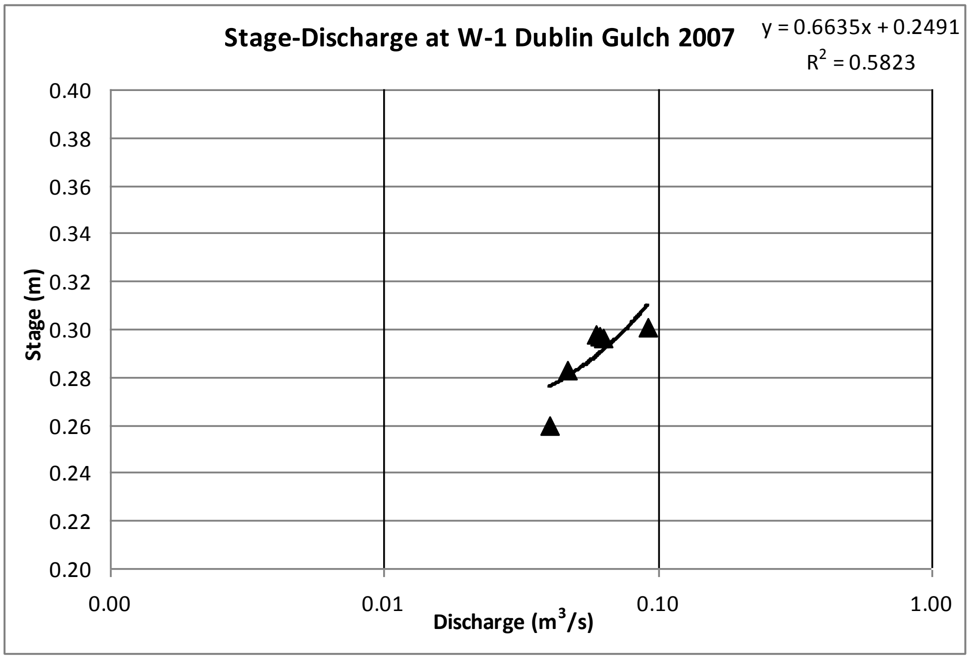

Stage-Discharge at W-27 Eagle Pup 2007
y = 0.8778x + 0.0036
R² = 0.6202
Stage (m)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.00
0.01
0.10
1.00
Discharge (m³/s)

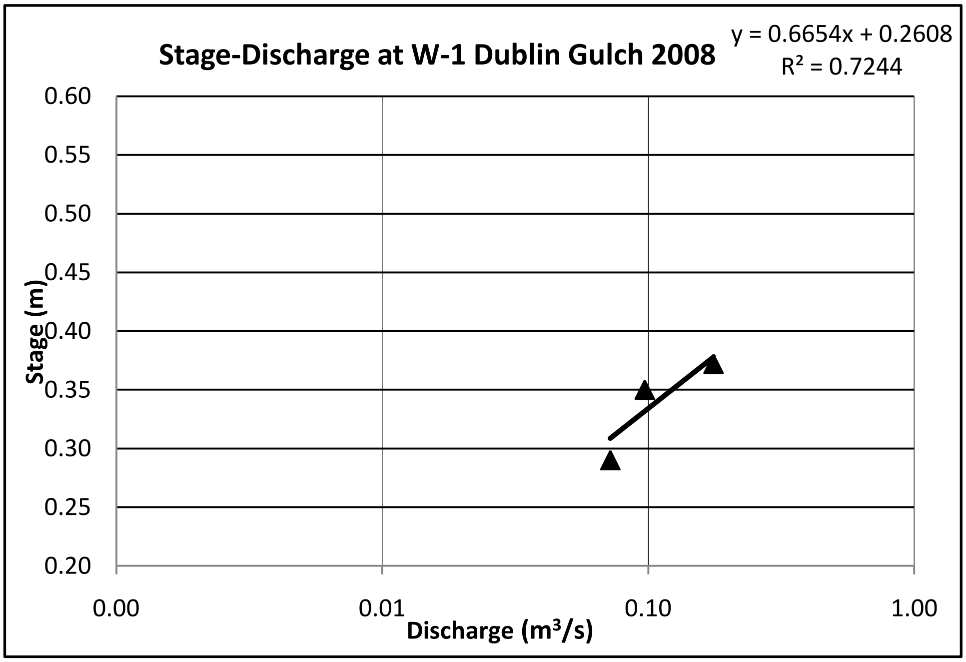

Stage-Discharge at W-27 Eagle Pup 2008
y = 3.0832x - 0.0299
R² = 0.971
Stage (m)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Discharge (m³/s)
0.00
0.01
0.10
1.00

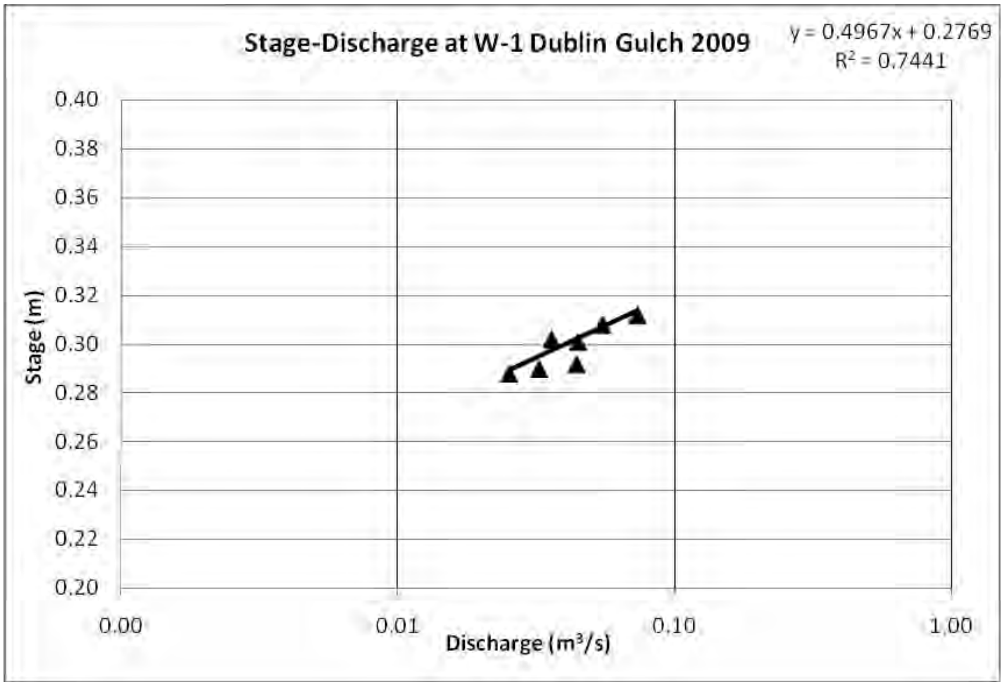

Stage-Discharge at W-27 Eagle Pup 2009
y = 2.2417x + 0.2607
R² = 0.9962
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
Discharge (m³/s)
0.00
0.01
0.10
1.00

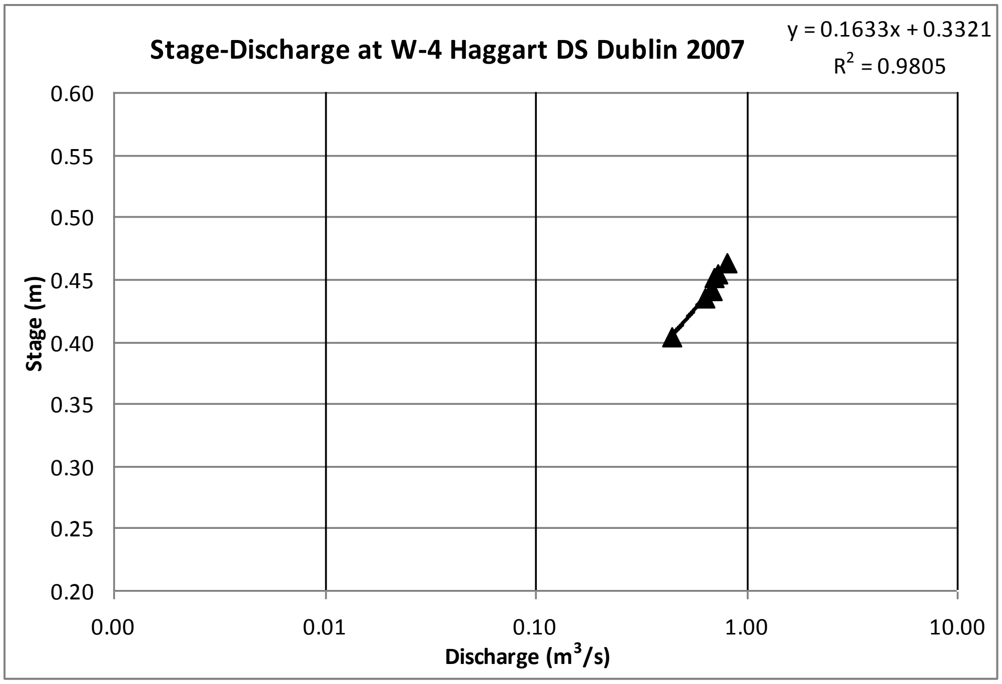

Stage-Discharge at W-20 Bawn Boy 2009
y = 3.6655x + 0.1071
R² = 0.8811
Stage (m)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
0.01
0.10
1.00
Discharge (m³/s)

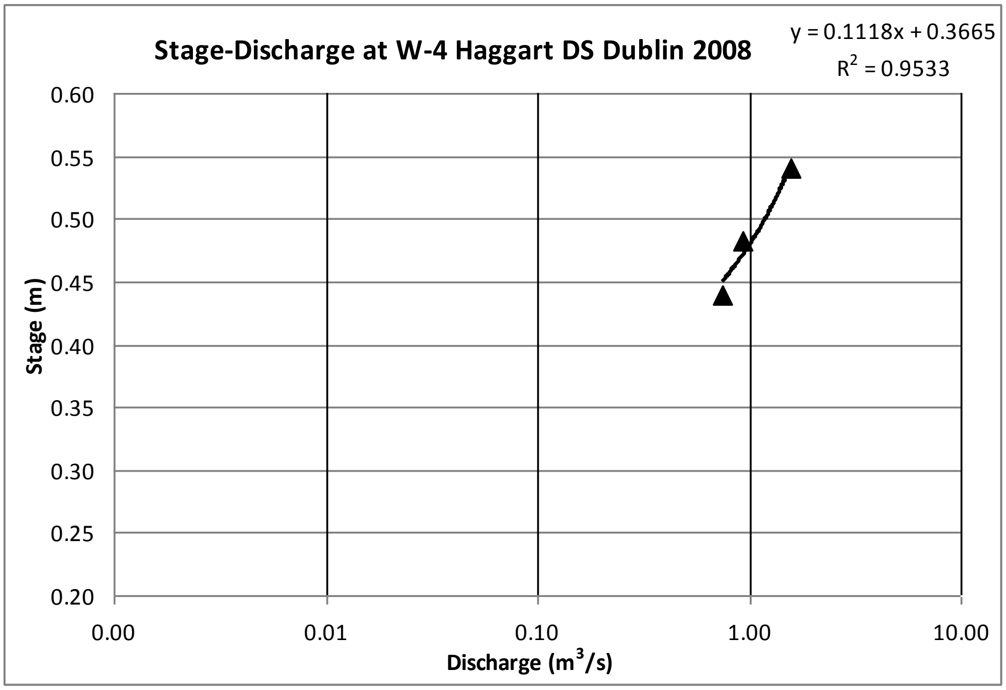

Stage-Discharge at W-31 Olive Gulch 2009
y = 5.6278x + 0.2433
R² = 0.8442
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

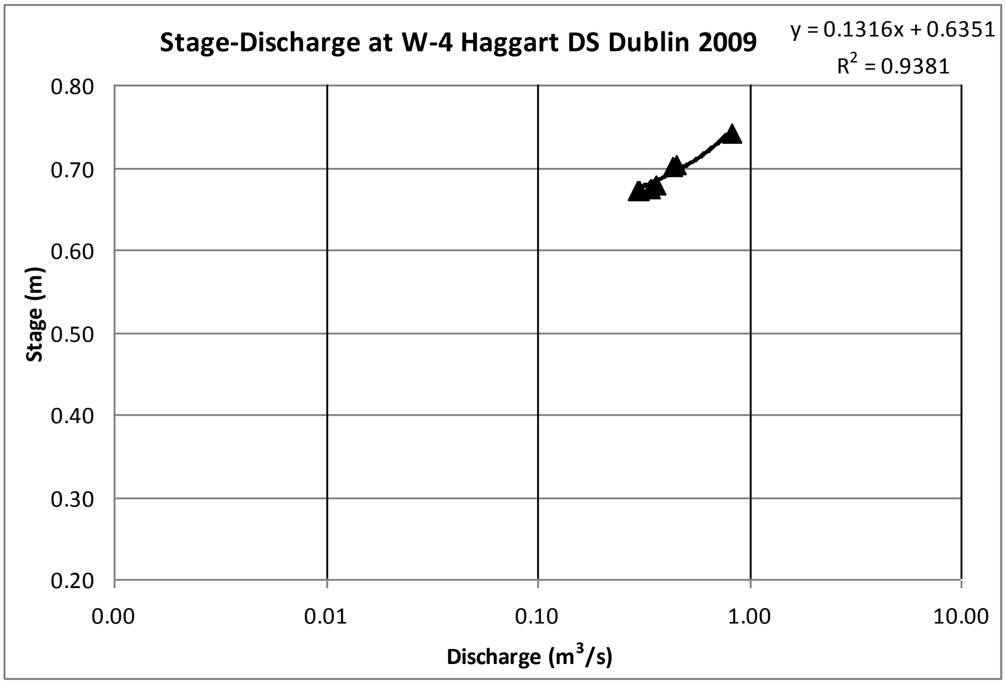

Stage-Discharge at W-1 Dublin Gulch 2007
y = 0.6635x + 0.2491
R² = 0.5823
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

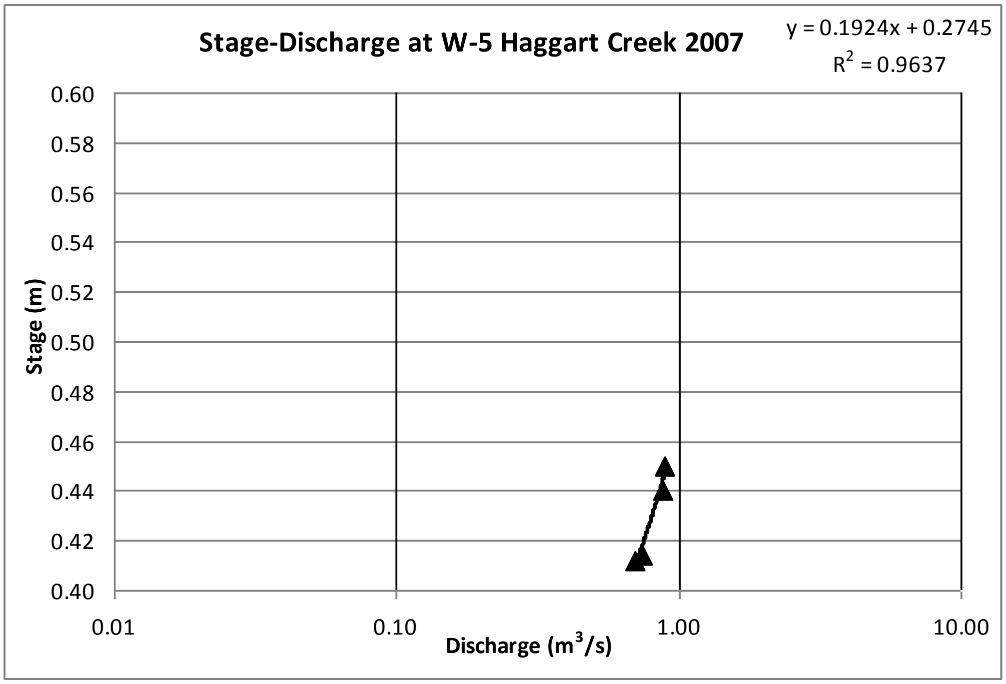

Stage-Discharge at W-1 Dublin Gulch 2008
y = 0.6654x + 0.2608
R² = 0.7244
Stage (m)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

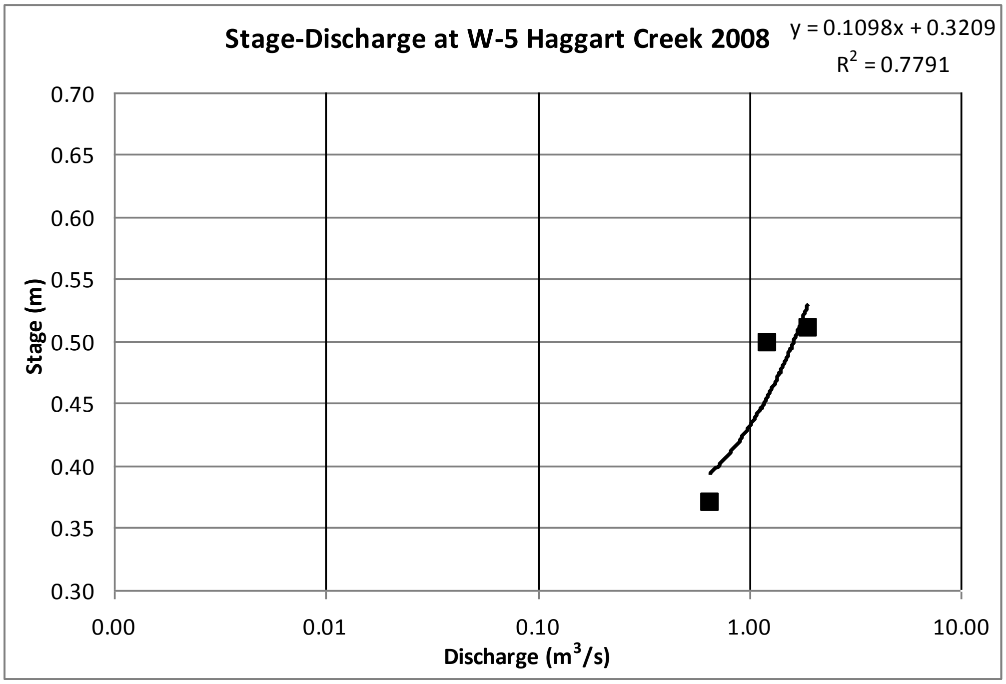

Stage-Discharge at W-1 Dublin Gulch 2009
y = 0.4967x + 0.2769
R² = 0.7441
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

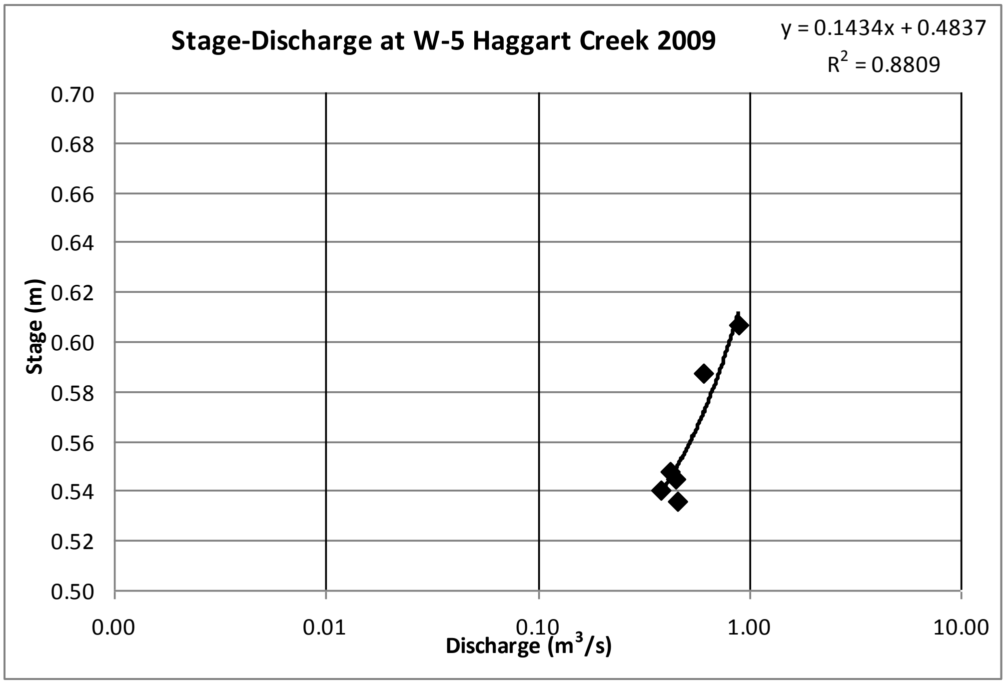

Stage-Discharge at W-4 Haggart DS Dublin 2007
y = 0.1633x + 0.3321
R² = 0.9805
Stage (m)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

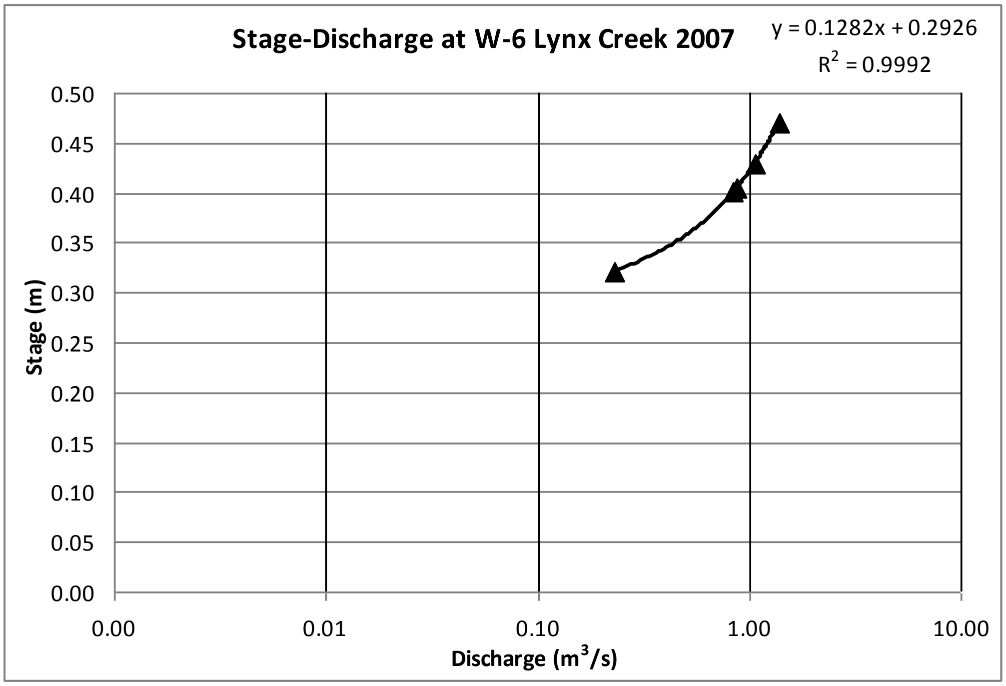

Stage-Discharge at W-4 Haggart DS Dublin 2008
y = 0.1118x + 0.3665
R² = 0.9533
Stage (m)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

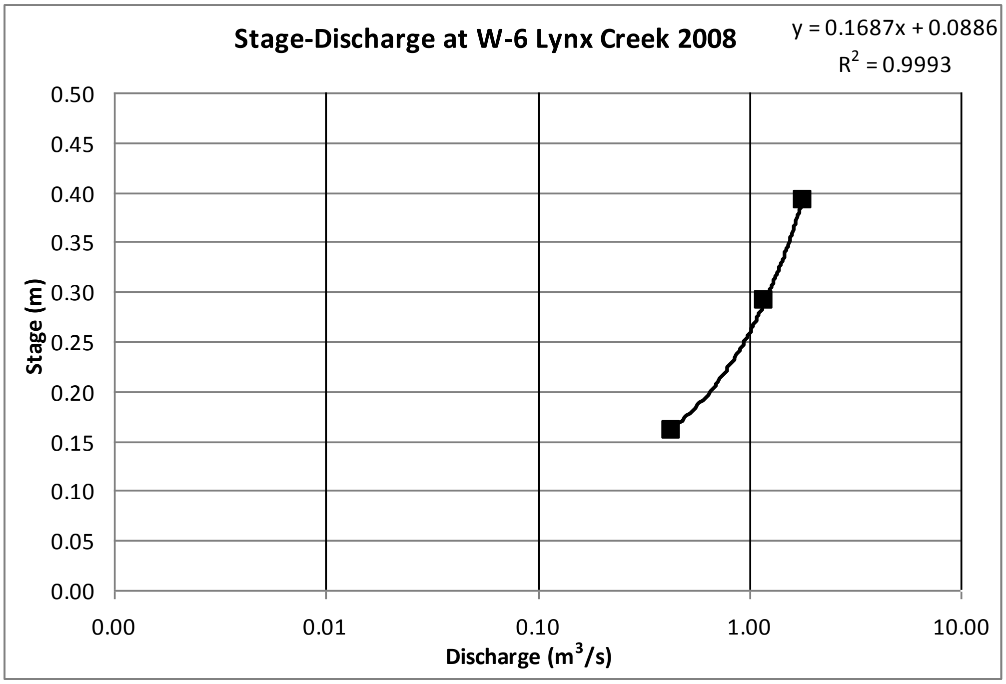

Stage-Discharge at W-4 Haggart DS Dublin 2009
y = 0.1316x + 0.6351
R² = 0.9381
Stage (m)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

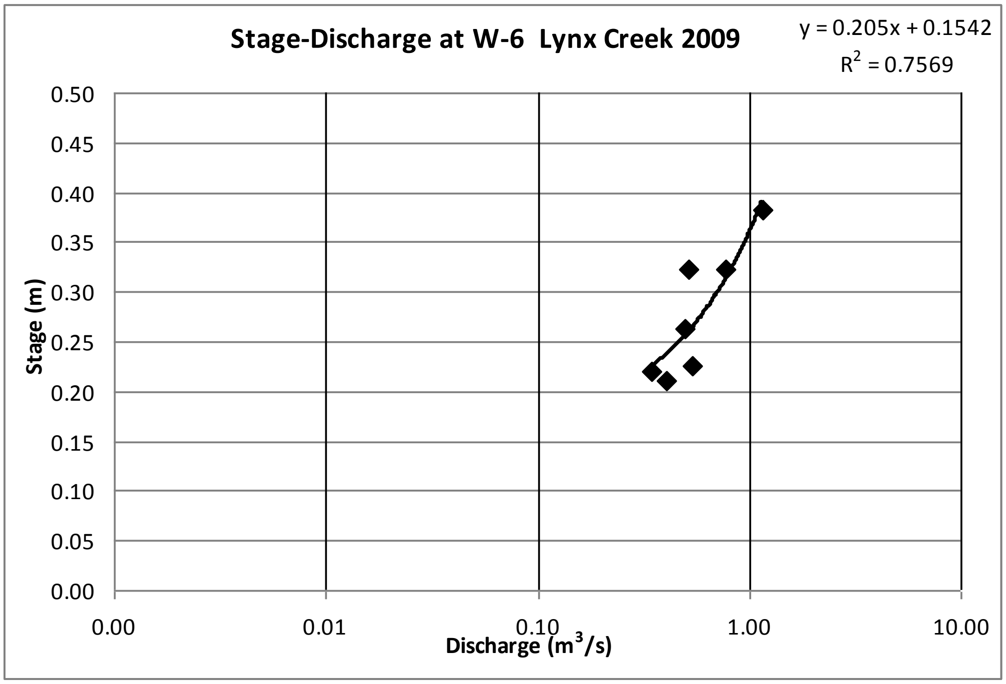

Stage-Discharge at W-5 Haggart Creek 2007
y = 0.1924x + 0.2745
R² = 0.9637
Stage (m)
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.01
0.10
1.00
10.00
Discharge (m³/s)

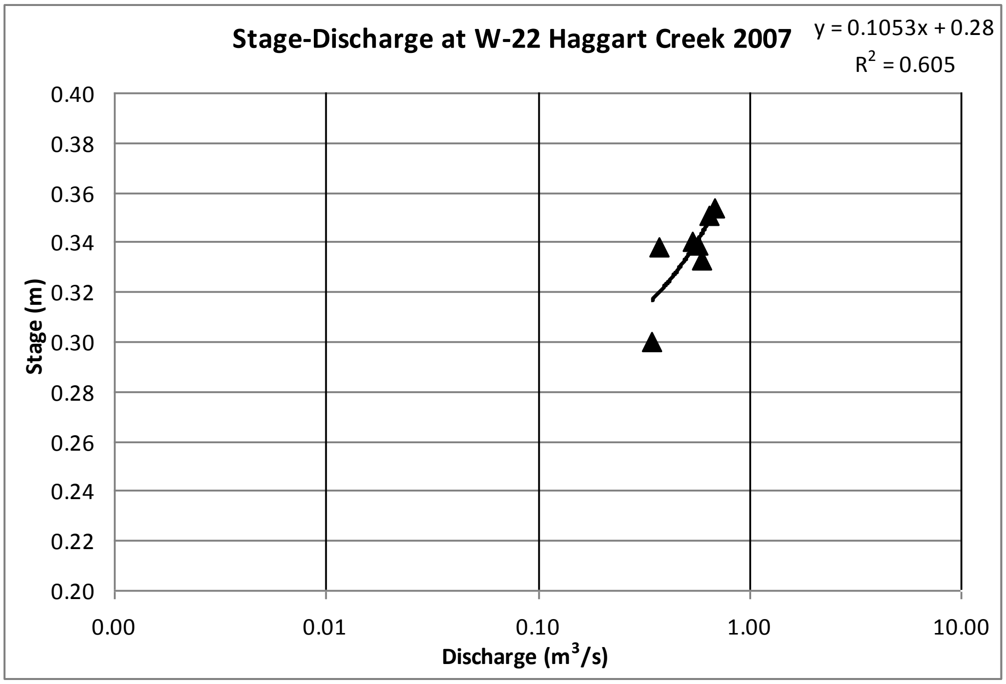

Stage-Discharge at W-5 Haggart Creek 2008
y = 0.1098x + 0.3209
R² = 0.7791
Stage (m)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

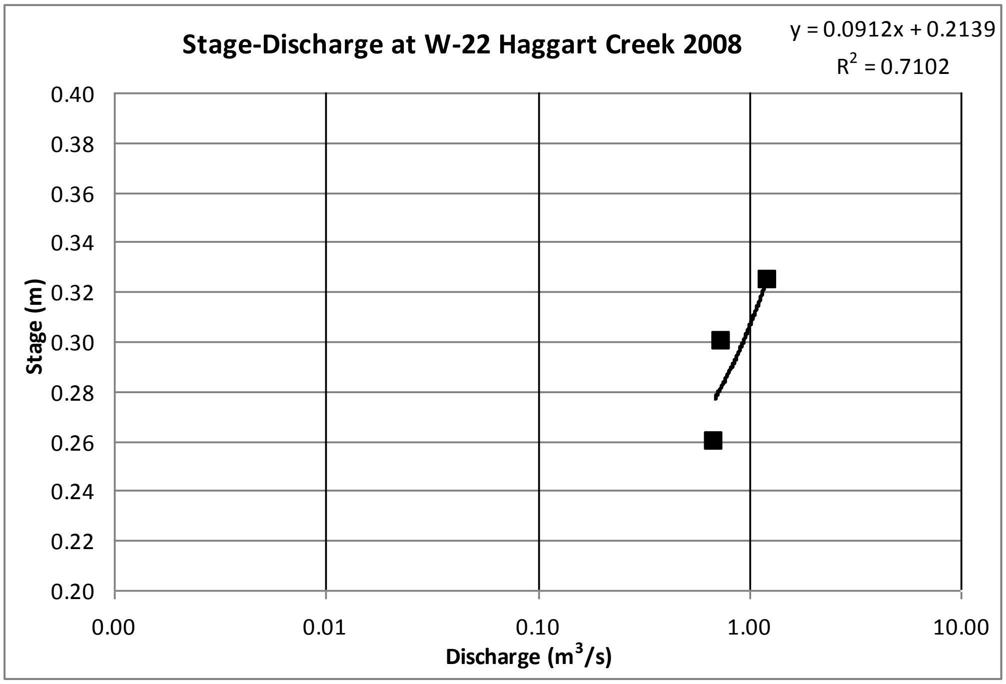

Stage-Discharge at W-5 Haggart Creek 2009
y = 0.1434x + 0.4837
R² = 0.8809
Stage (m)
0.70
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

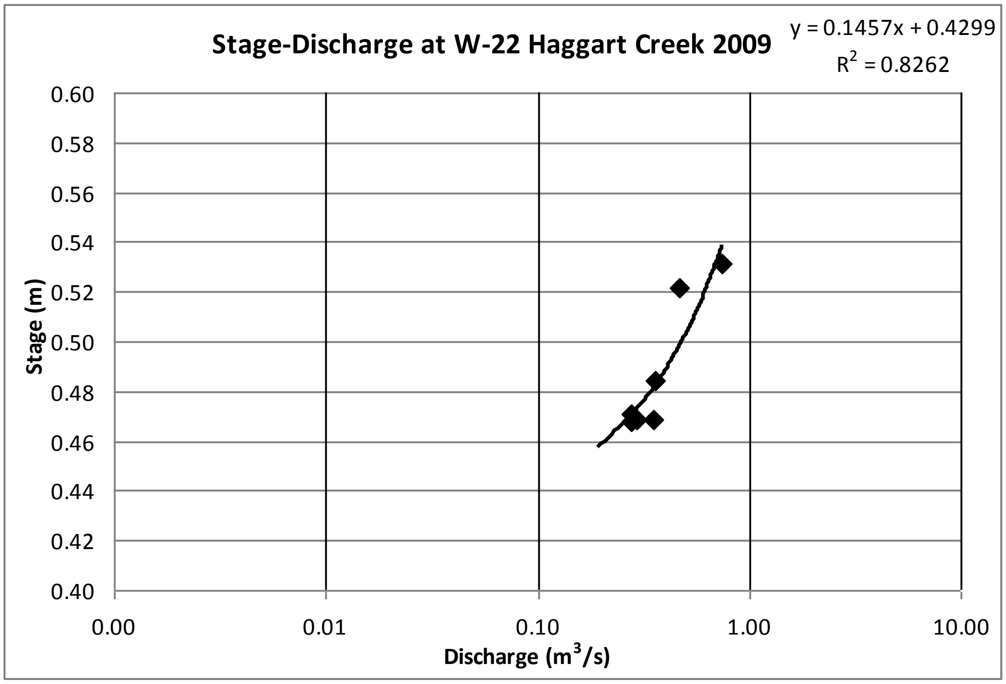

Stage-Discharge at W-6 Lynx Creek 2007
y = 0.1282x + 0.2926
R² = 0.9992
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)

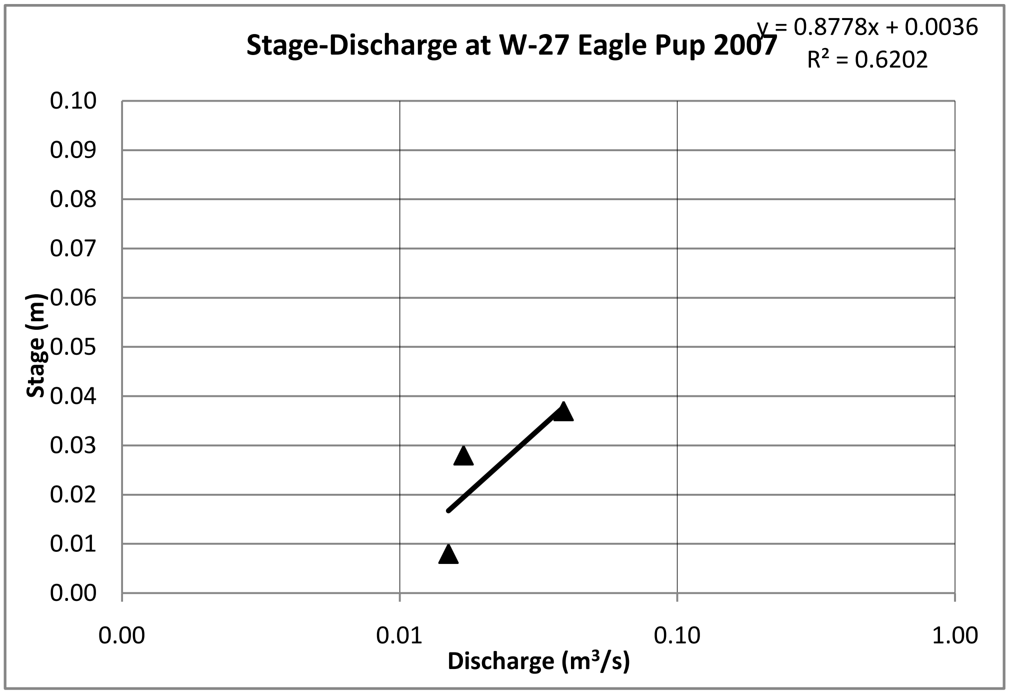

Stage-Discharge at W-6 Lynx Creek 2008
y = 0.1687x + 0.0886
R2 = 0.9993
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

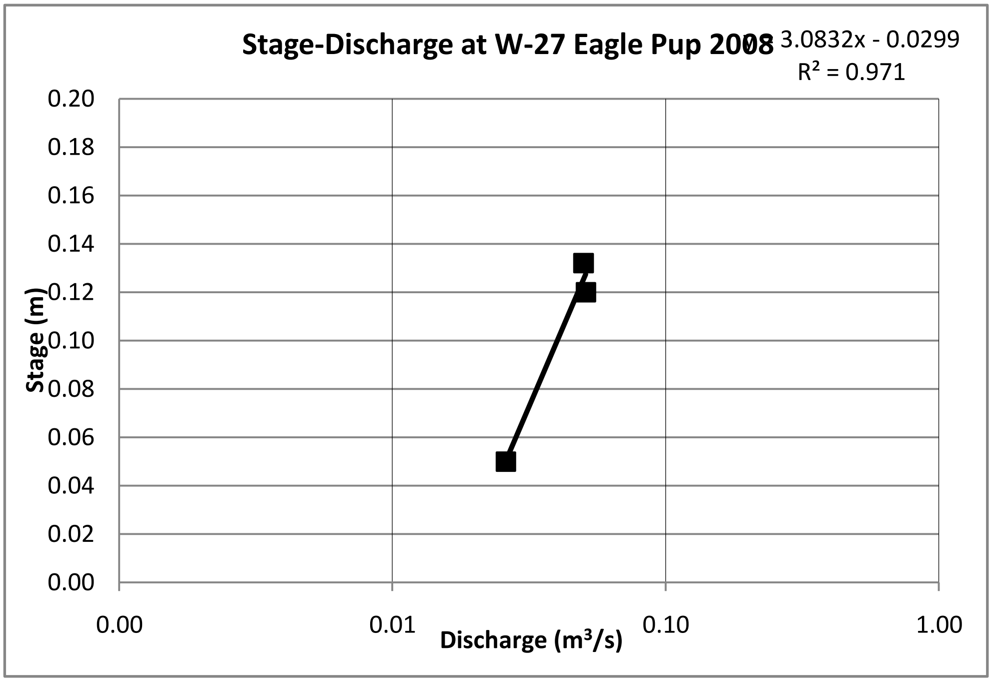

Stage-Discharge at W-6 Lynx Creek 2009
y = 0.205x + 0.1542
R2 = 0.7569
Stage (m)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

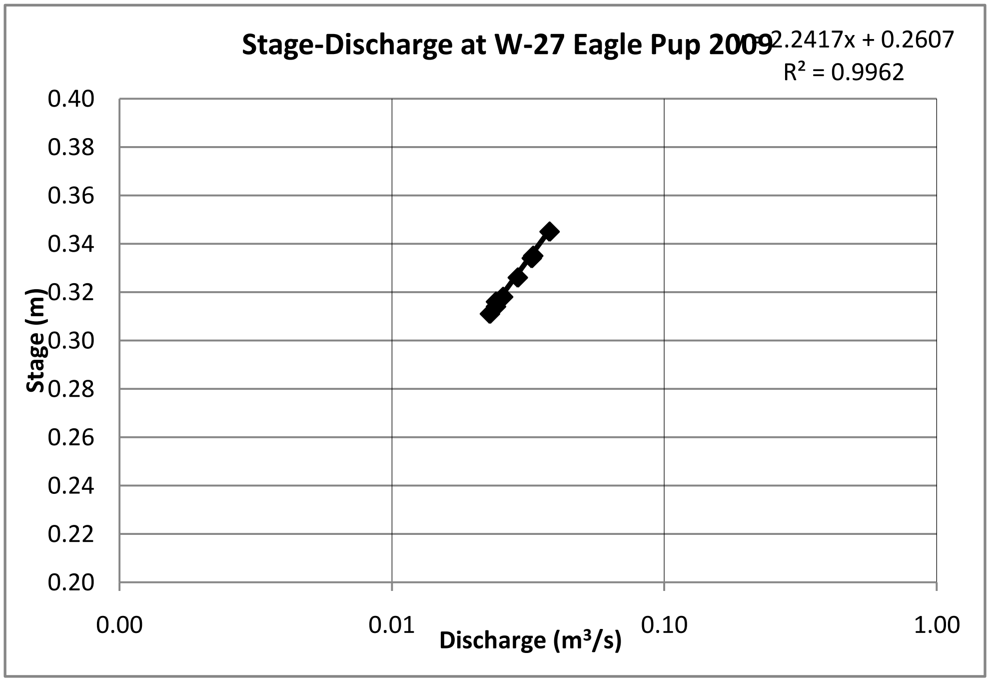

Stage-Discharge at W-22 Haggart Creek 2007
y = 0.1053x + 0.28
R2 = 0.605
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

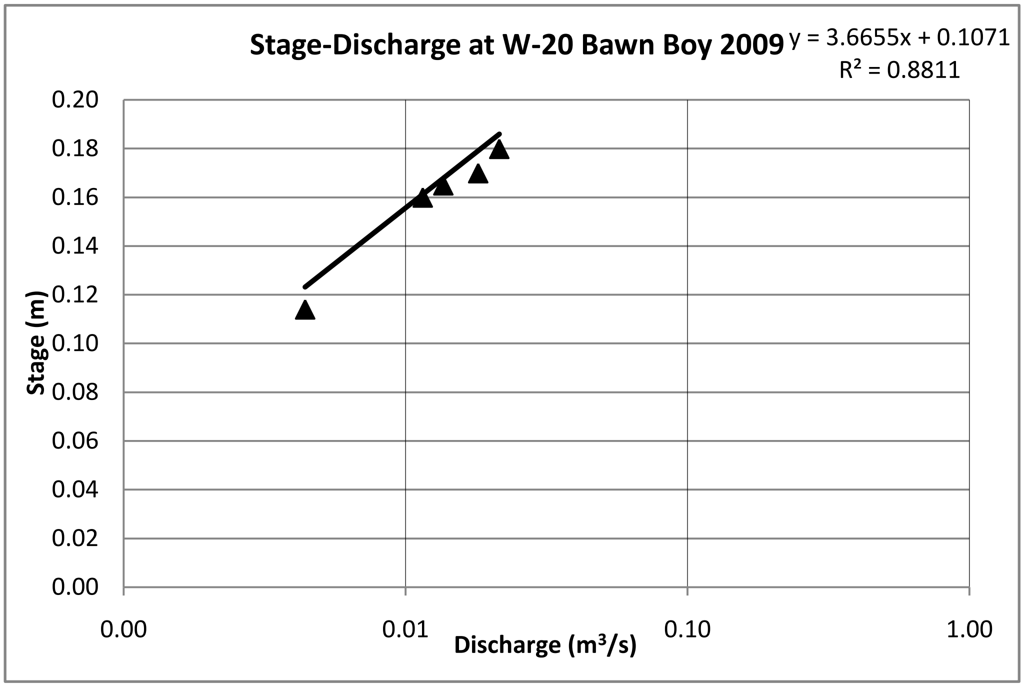

Stage-Discharge at W-22 Haggart Creek 2008
y = 0.0912x + 0.2139
R2 = 0.7102
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
10.00
Discharge (m3/s)

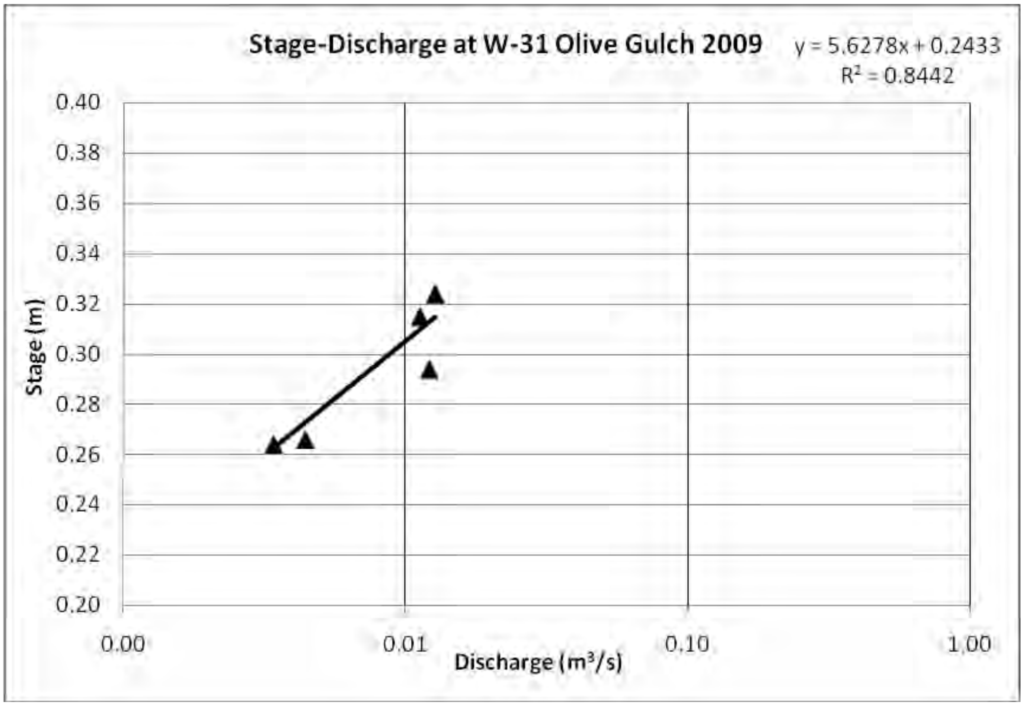

Stage-Discharge at W-22 Haggart Creek 2009
y = 0.1457x + 0.4299
R² = 0.8262
Stage (m)
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.00
0.01
0.10
1.00
10.00
Discharge (m³/s)


Stage-Discharge at W-27 Eagle Pup 2007
y = 0.8778x + 0.0036
R² = 0.6202
Stage (m)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.00
0.01
0.10
1.00
Discharge (m³/s)


Stage-Discharge at W-27 Eagle Pup 2008
y = 3.0832x - 0.0299
R² = 0.971
Stage (m)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
0.01
0.10
1.00
Discharge (m³/s)

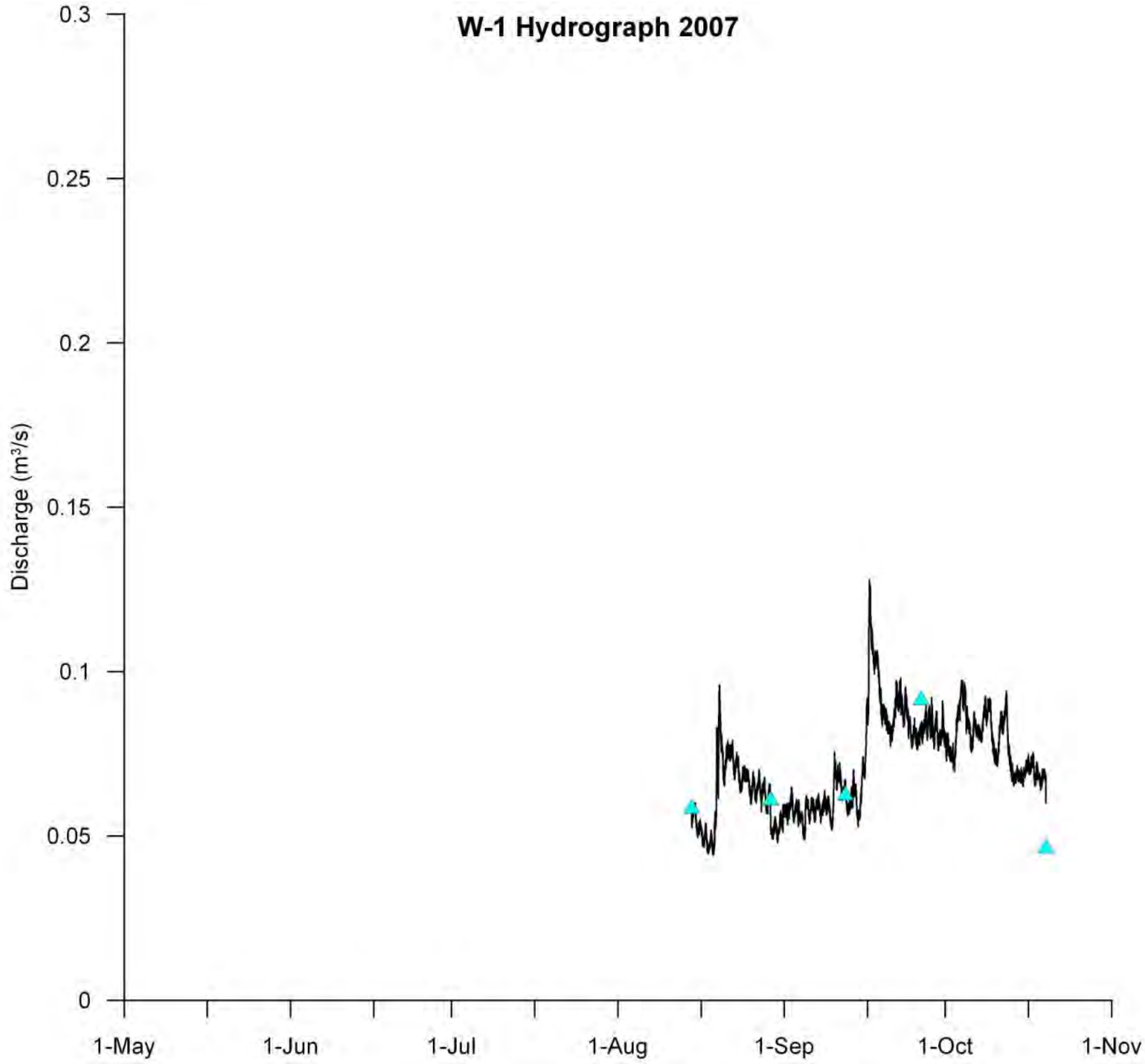

Stage-Discharge at W-27 Eagle Pup 2009
y = 2.2417x + 0.2607
R² = 0.9962
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

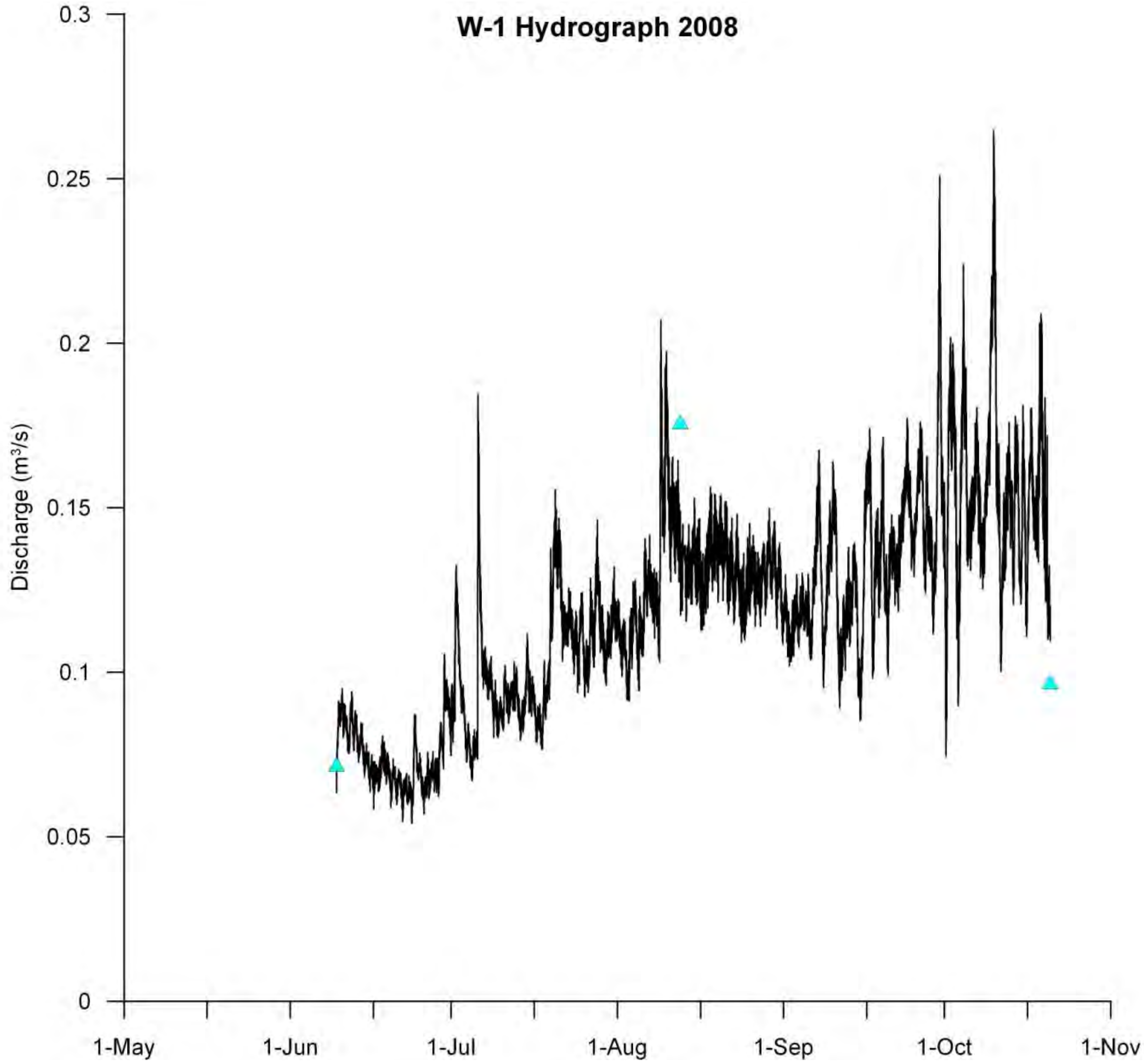

Stage-Discharge at W-20 Bawn Boy 2009
y = 3.6655x + 0.1071
R² = 0.8811
Stage (m)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0.00
0.01
0.10
1.00
Discharge (m³/s)

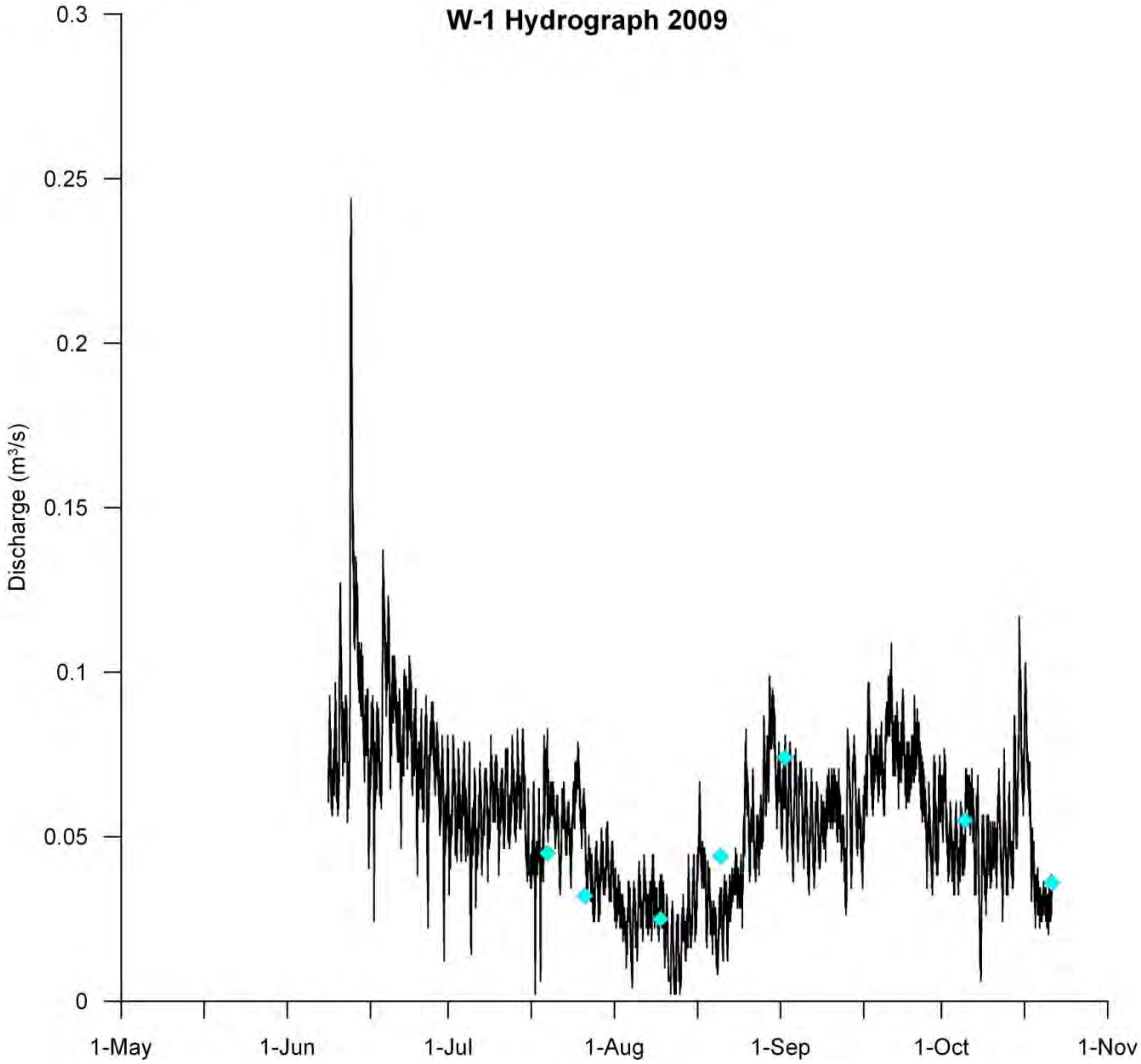

Stage-Discharge at W-31 Olive Gulch 2009
y = 5.6278x + 0.2433
R² = 0.8442
Stage (m)
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.00
0.01
0.10
1.00
Discharge (m³/s)

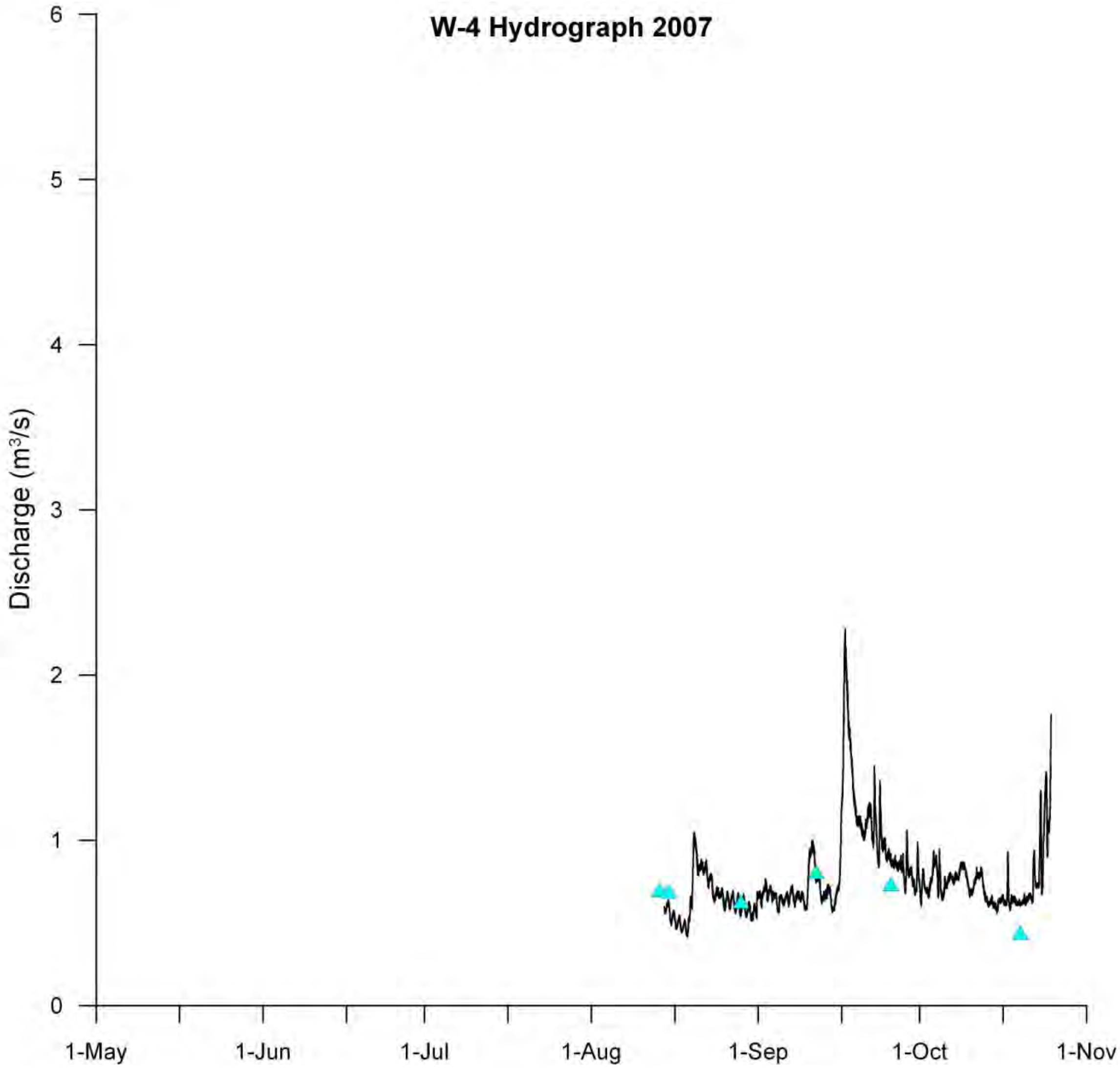
APPENDIX E

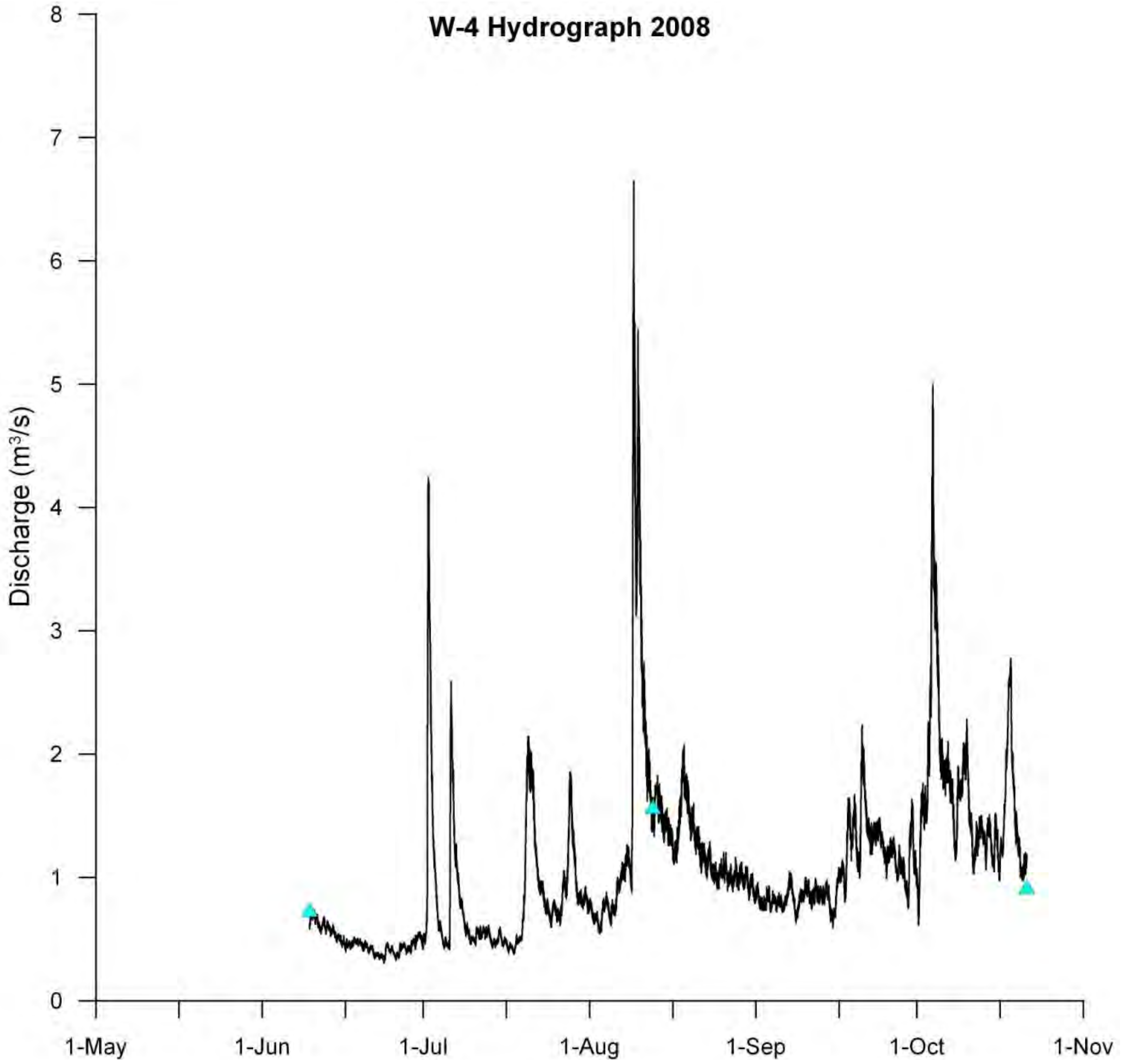
Study Area Hydrographs, 2007 – 2009

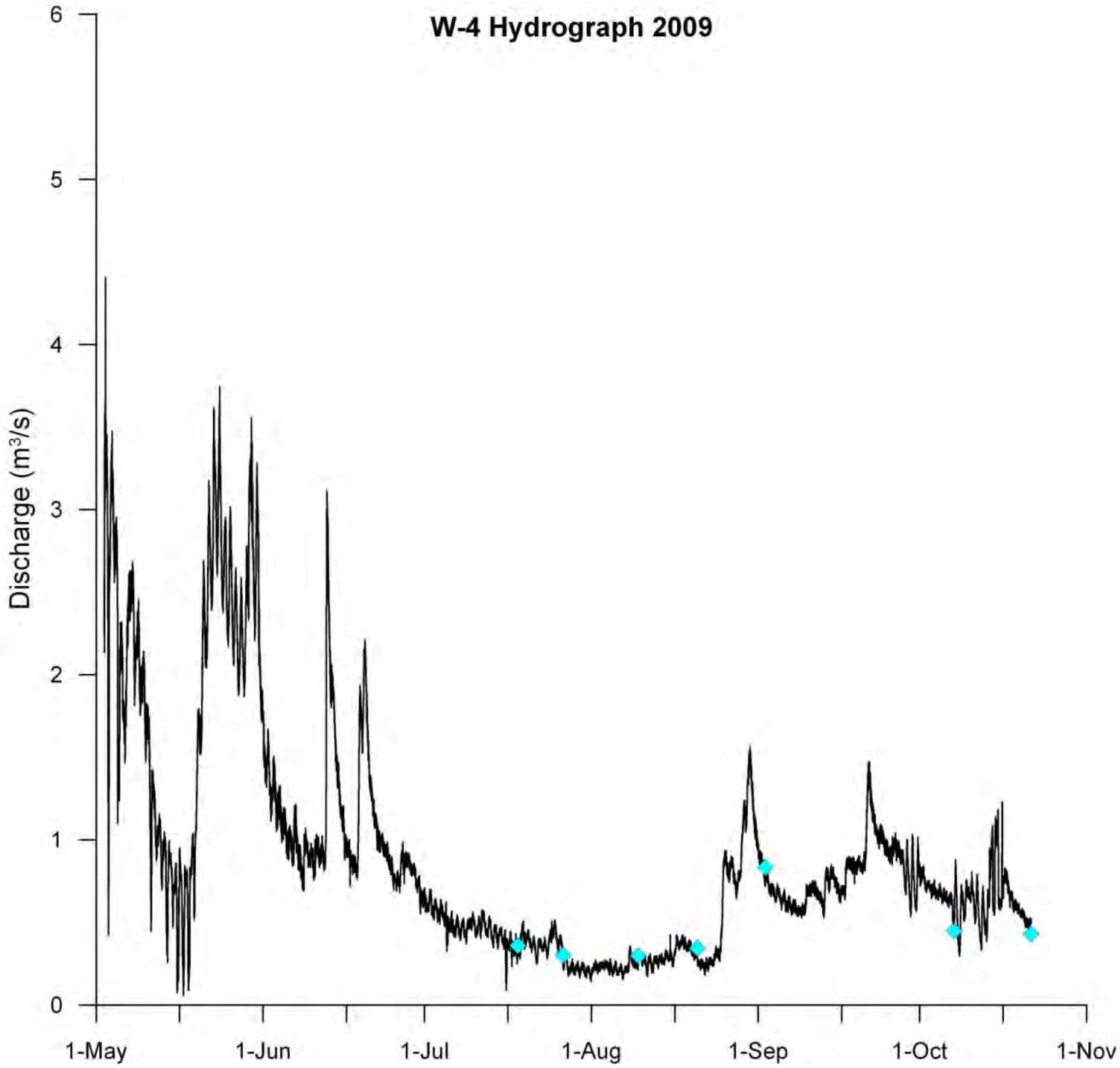

W-1 Hydrograph 2007
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

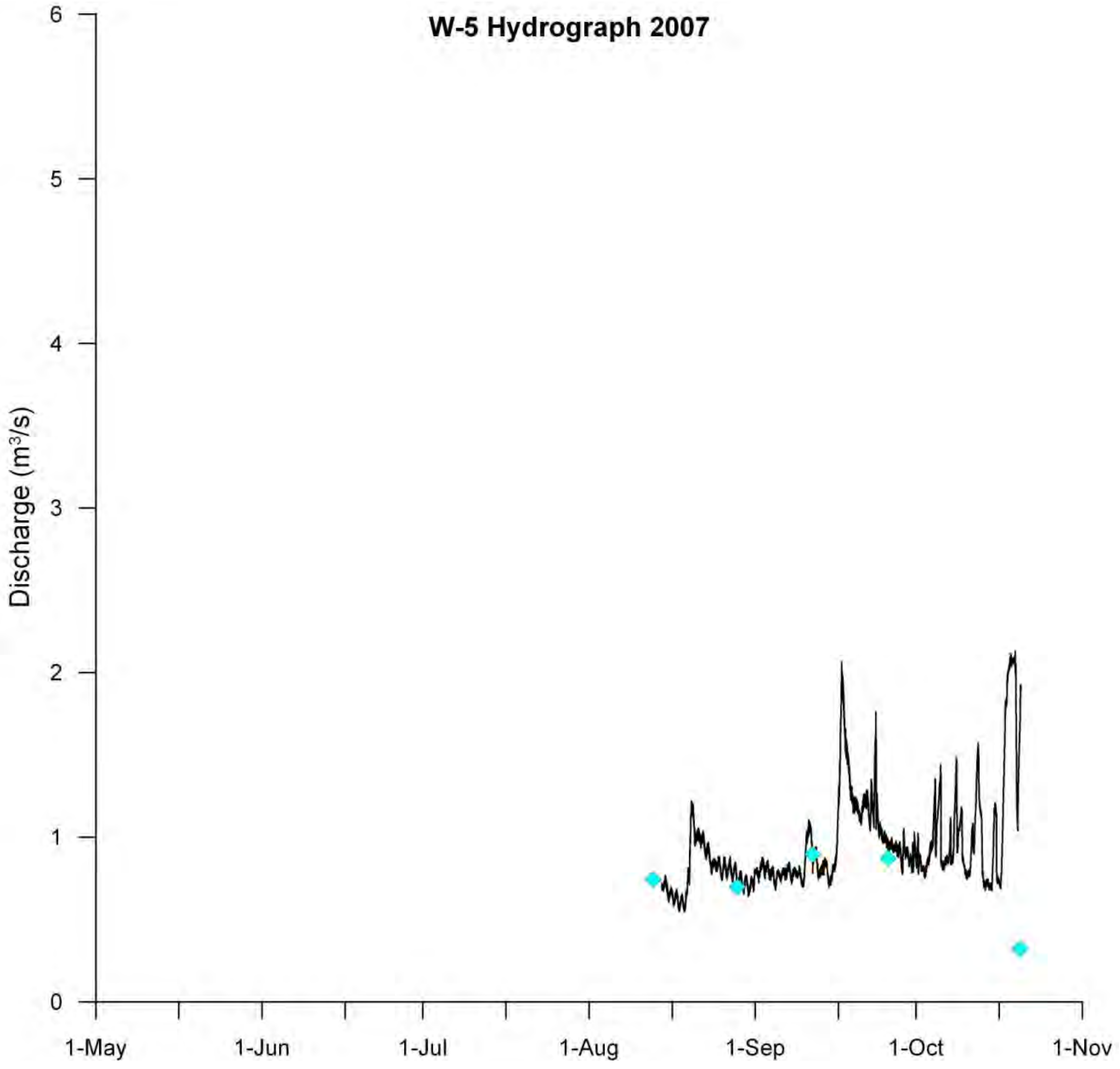

W-1 Hydrograph 2008
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

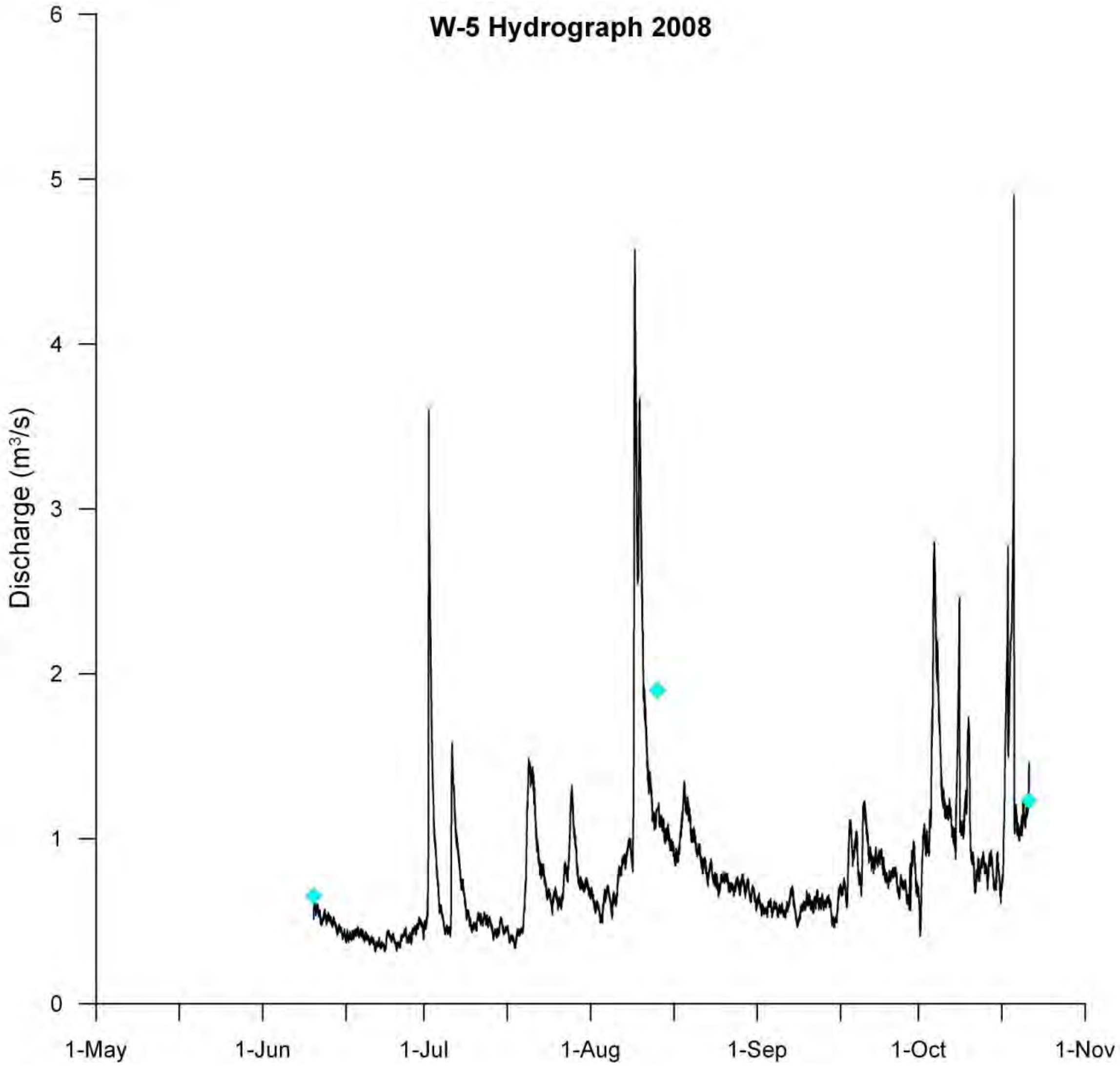

W-1 Hydrograph 2009
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

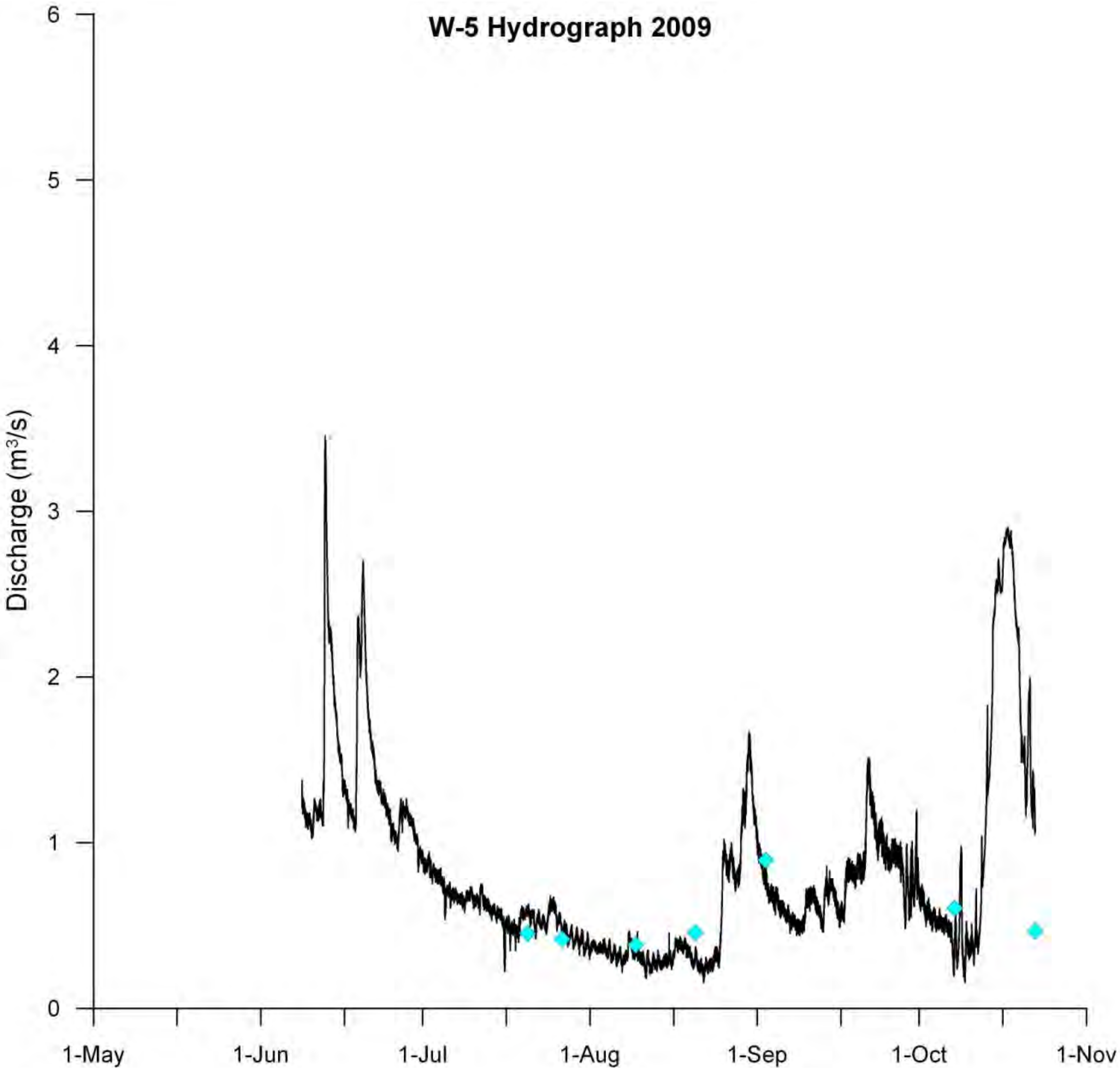

W-4 Hydrograph 2007
Discharge (m^3/s)
6
5
4
3
2
1
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

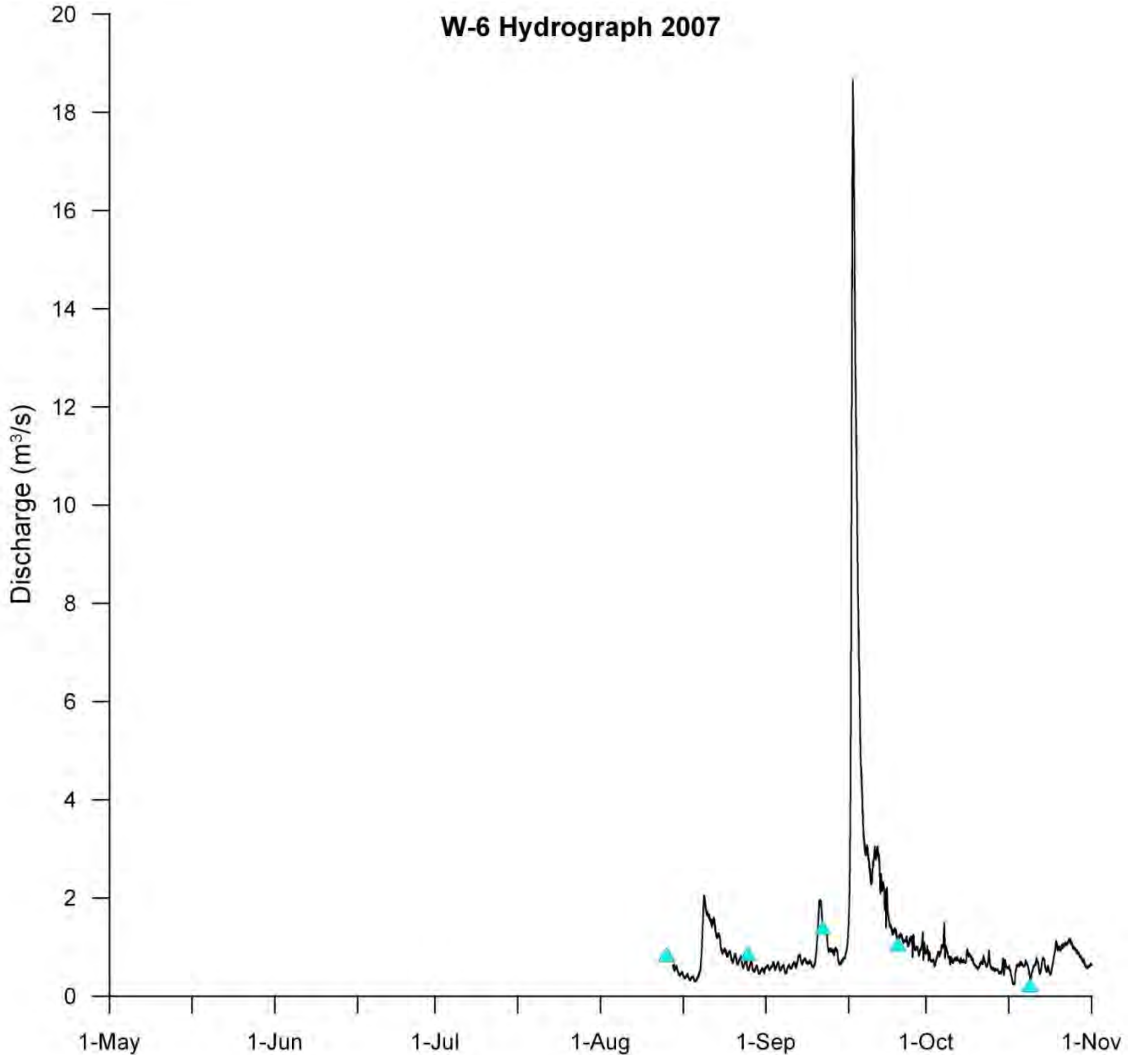

W-4 Hydrograph 2008
Discharge (m³/s)
0
1
2
3
4
5
6
7
8
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

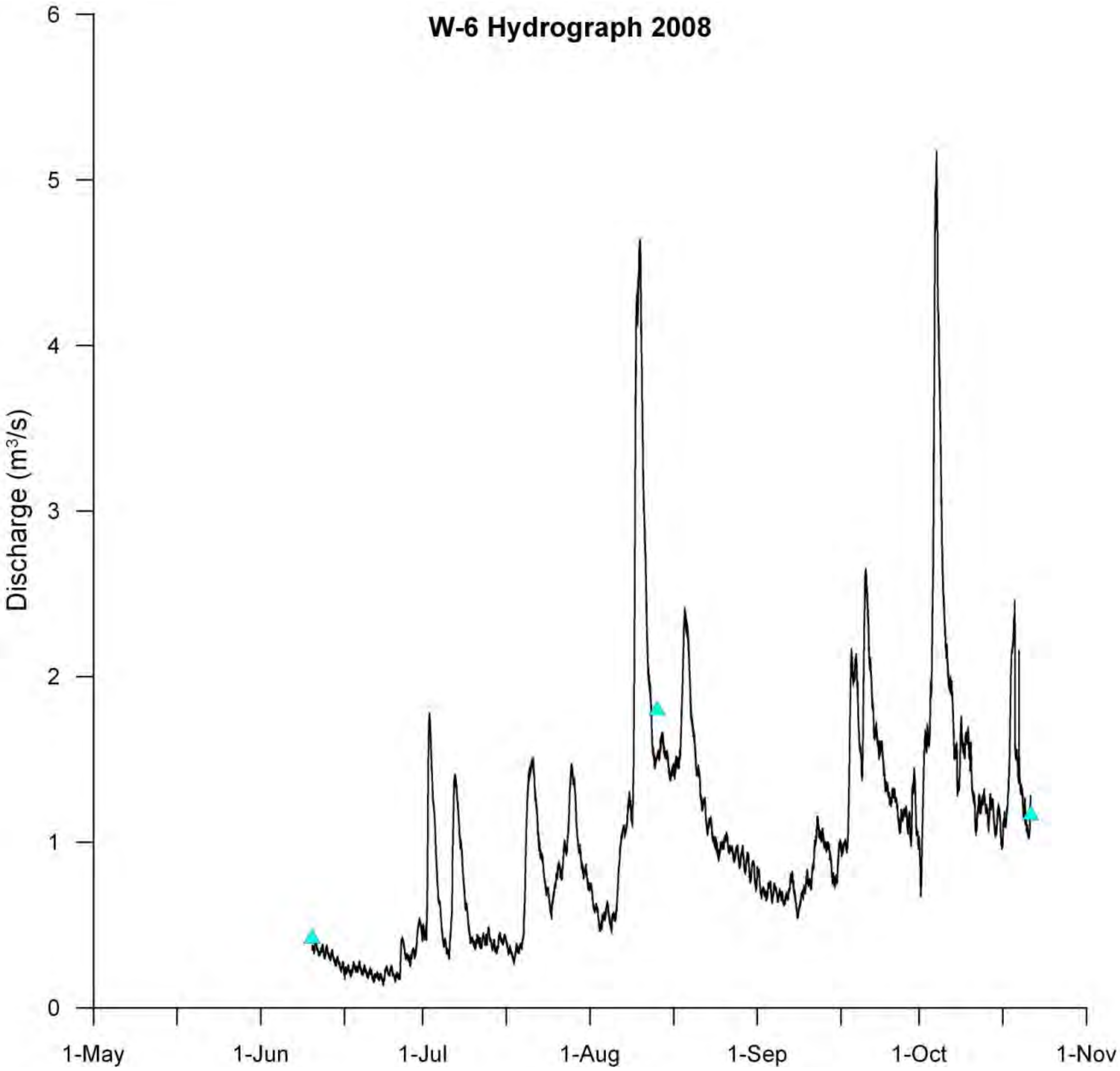

W-4 Hydrograph 2009
Discharge (m³/s)
6
5
4
3
2
1
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

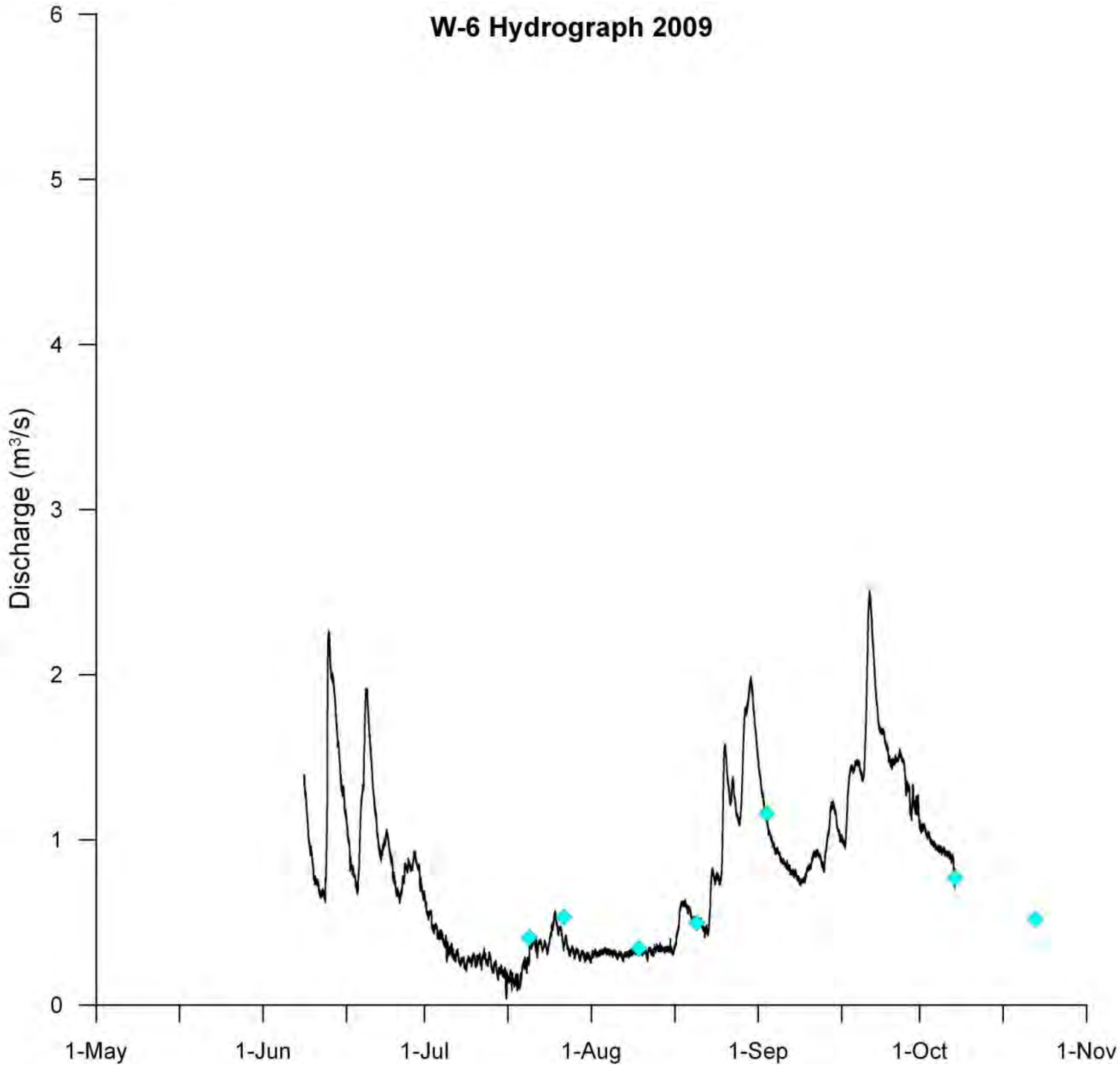

W-5 Hydrograph 2007
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

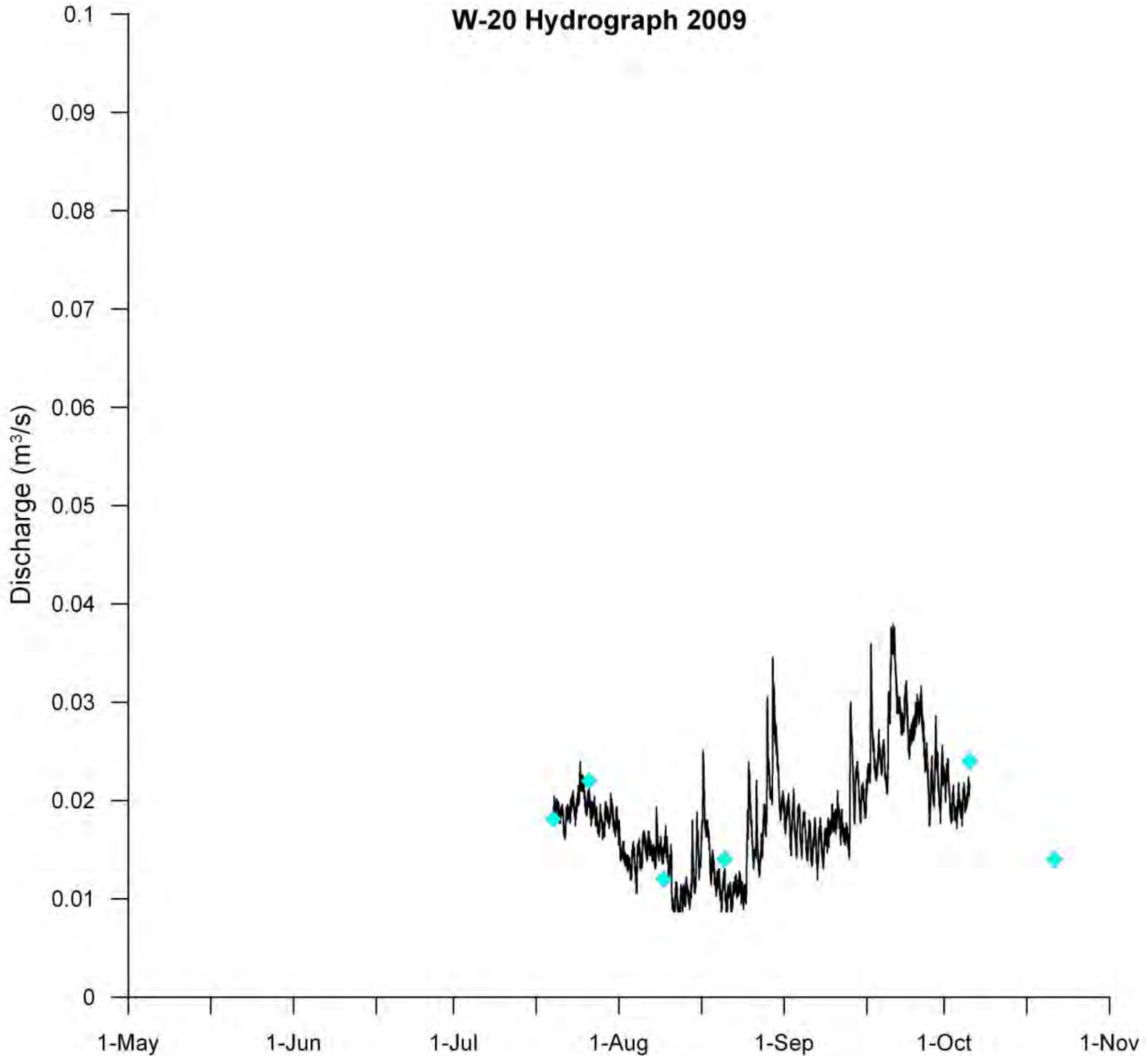

W-5 Hydrograph 2008
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

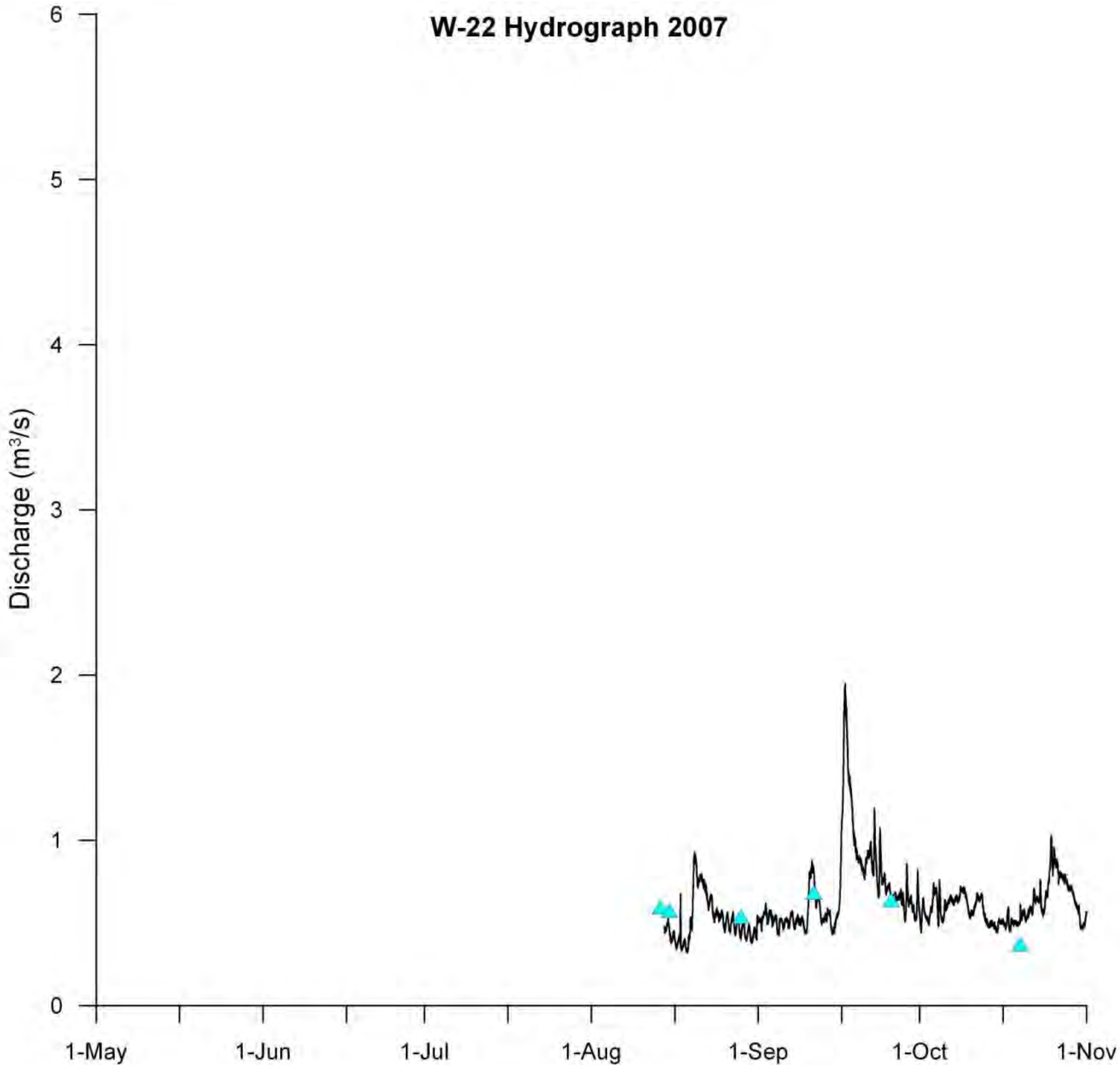

W-5 Hydrograph 2009
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

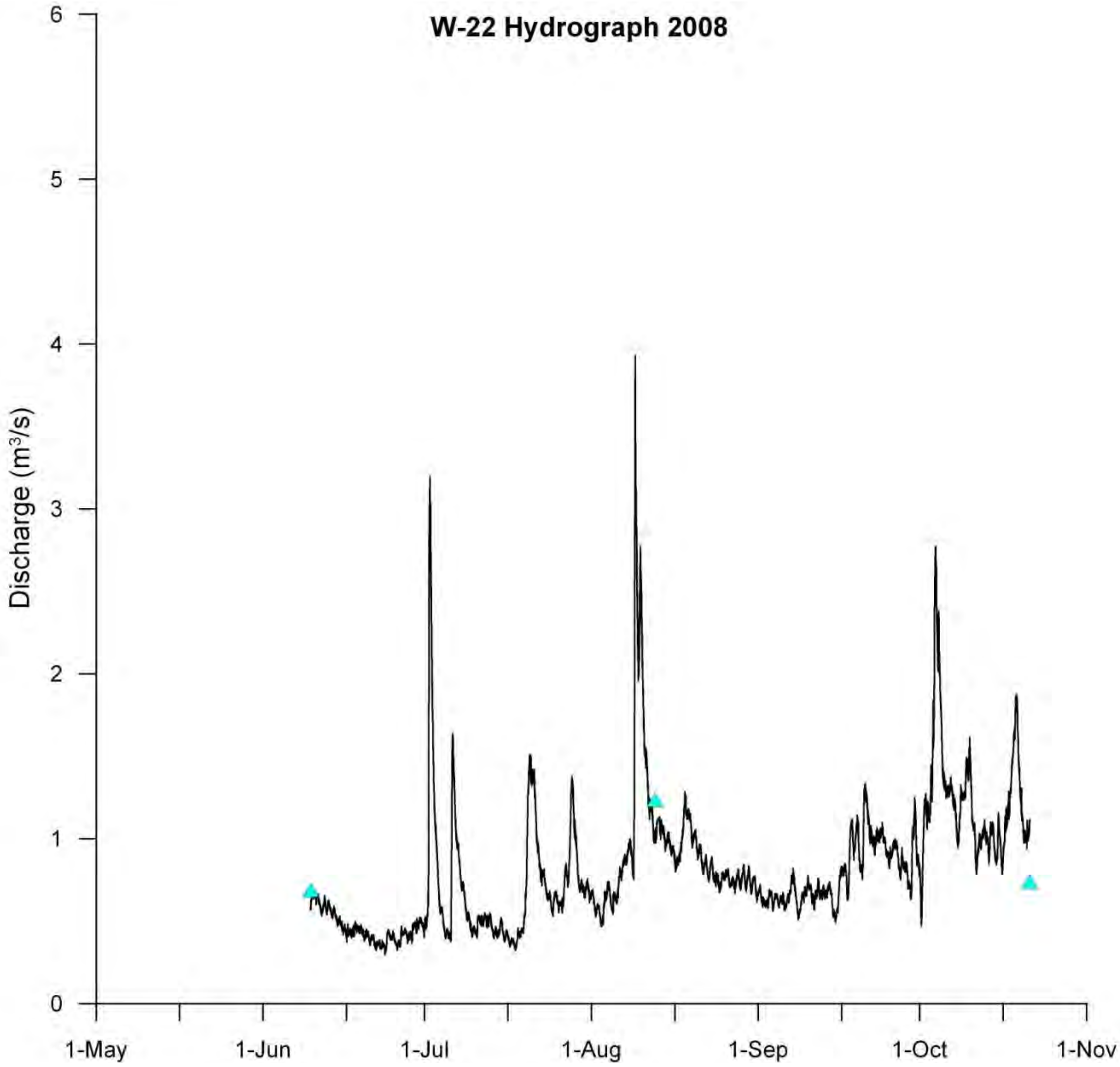

W-6 Hydrograph 2007
Discharge (m³/s)
0
2
4
6
8
10
12
14
16
18
20
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

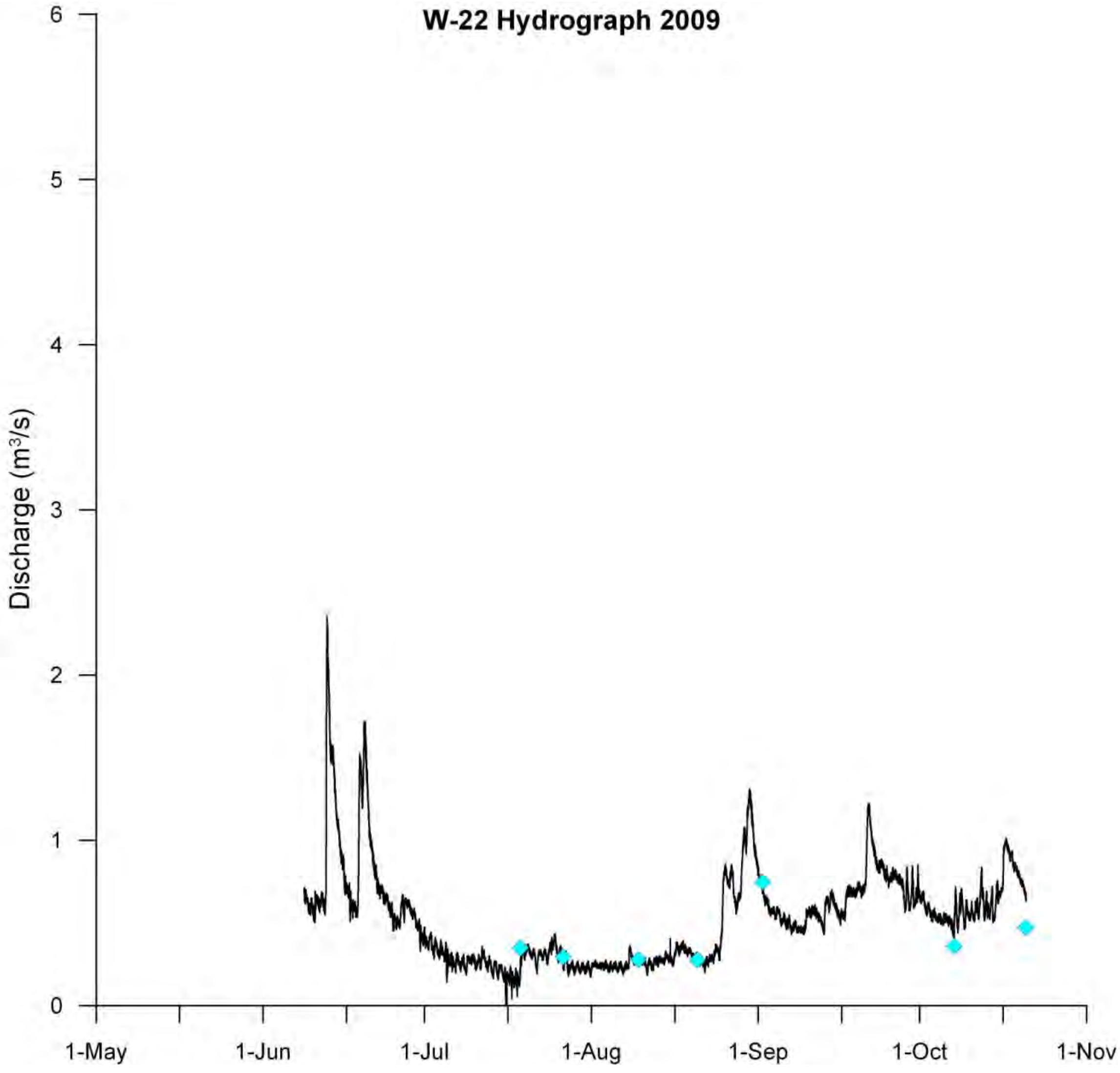

W-6 Hydrograph 2008
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

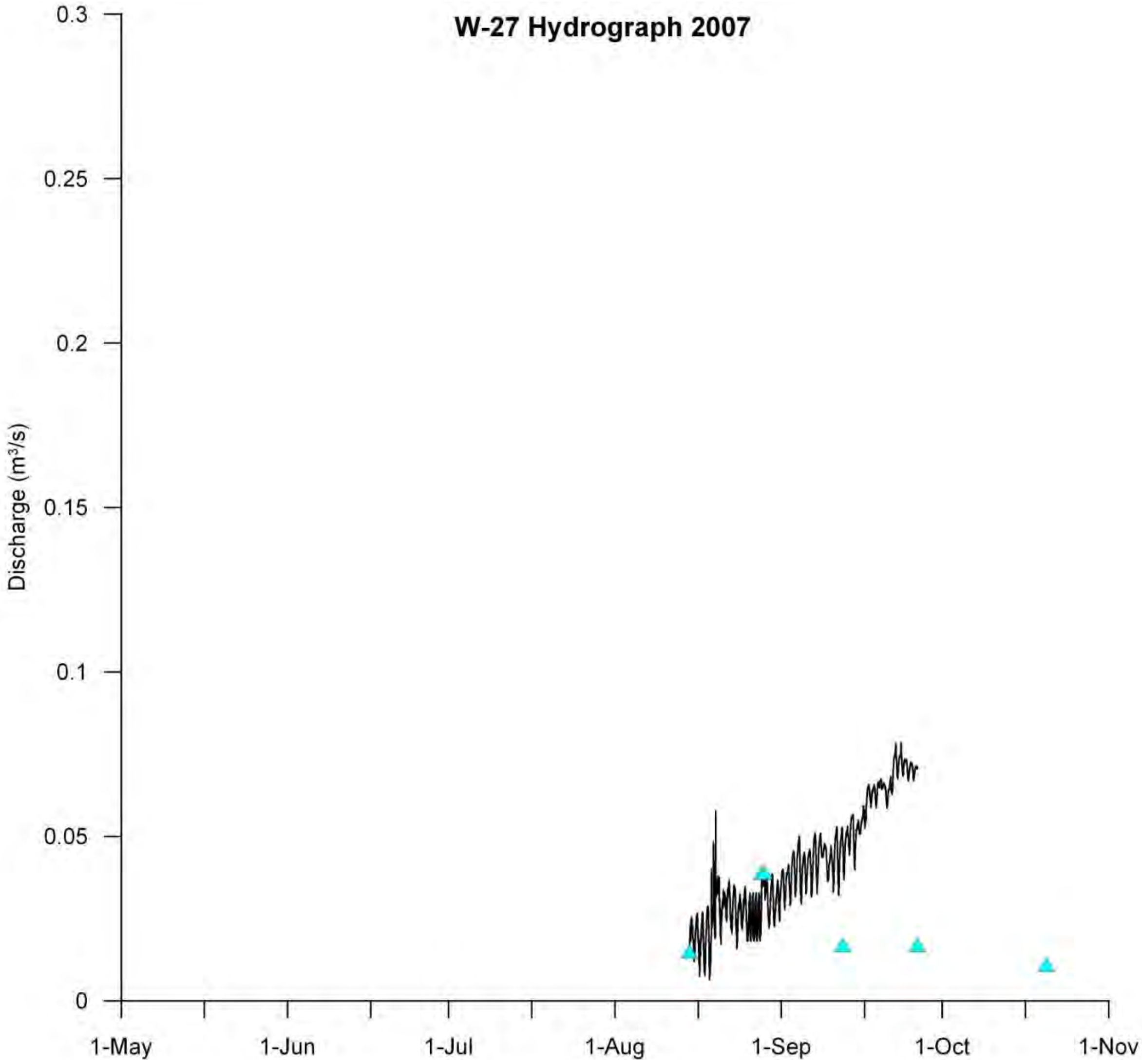

W-6 Hydrograph 2009
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

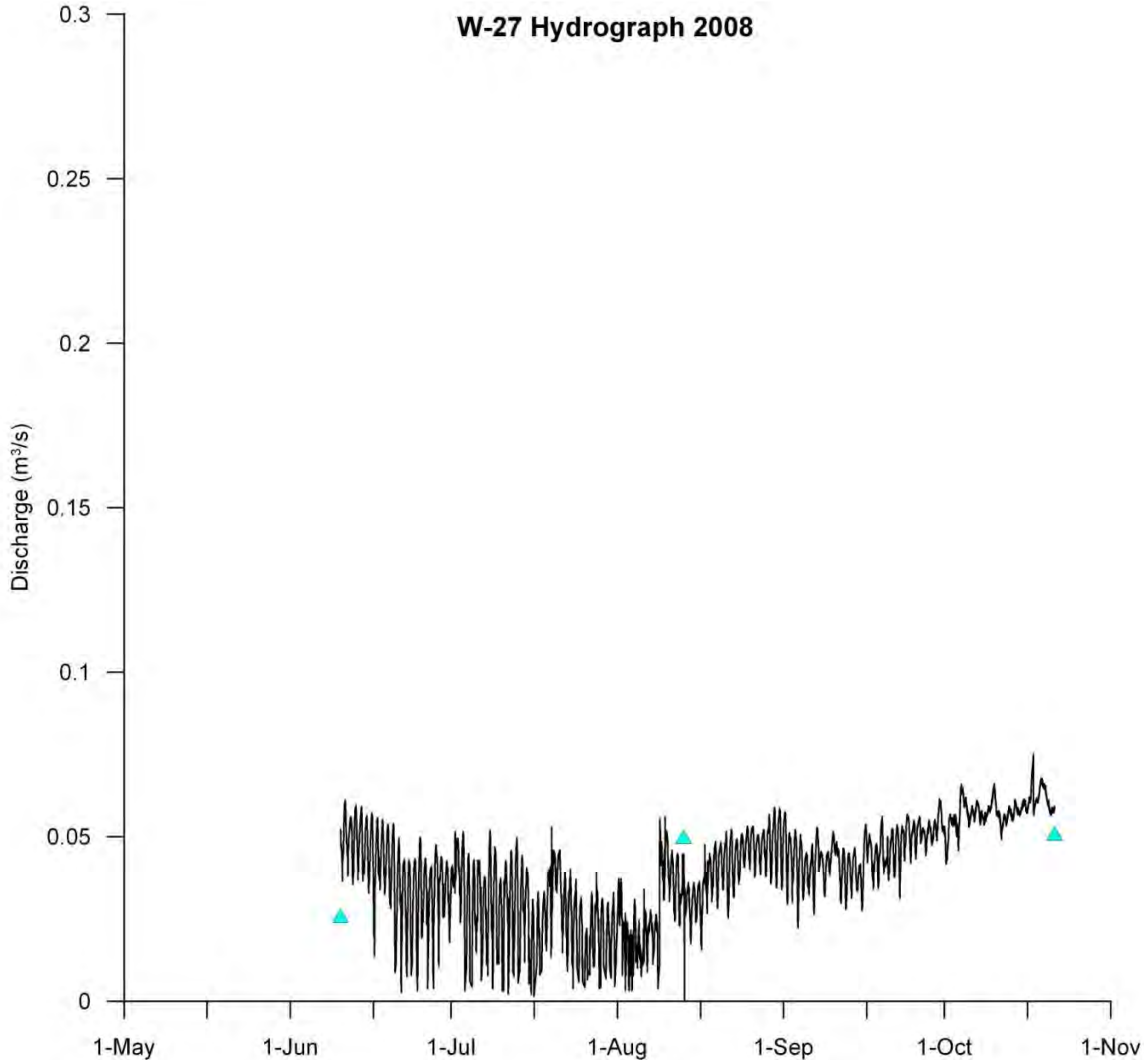

W-20 Hydrograph 2009
Discharge (m³/s)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

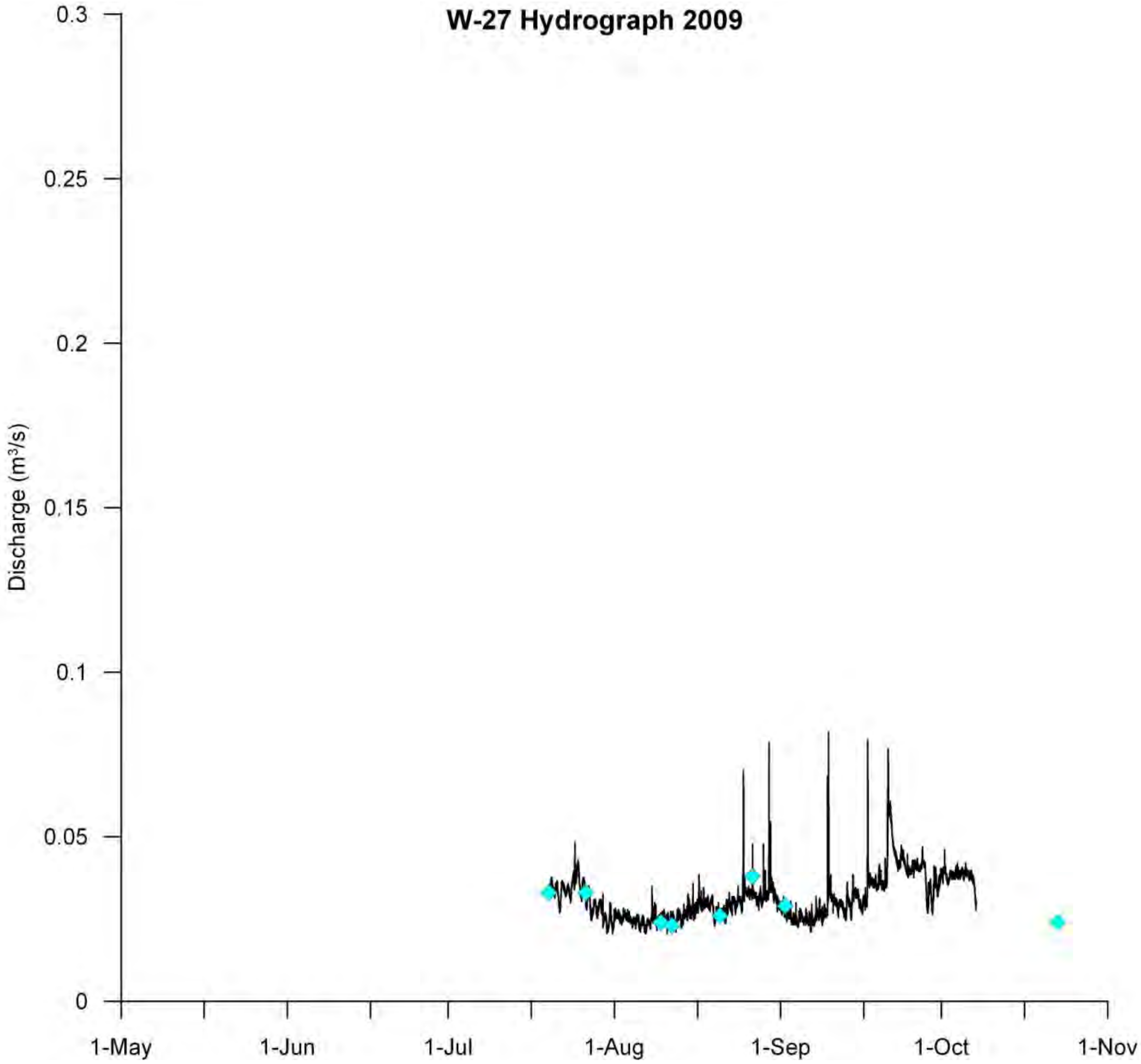

W-22 Hydrograph 2007
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov

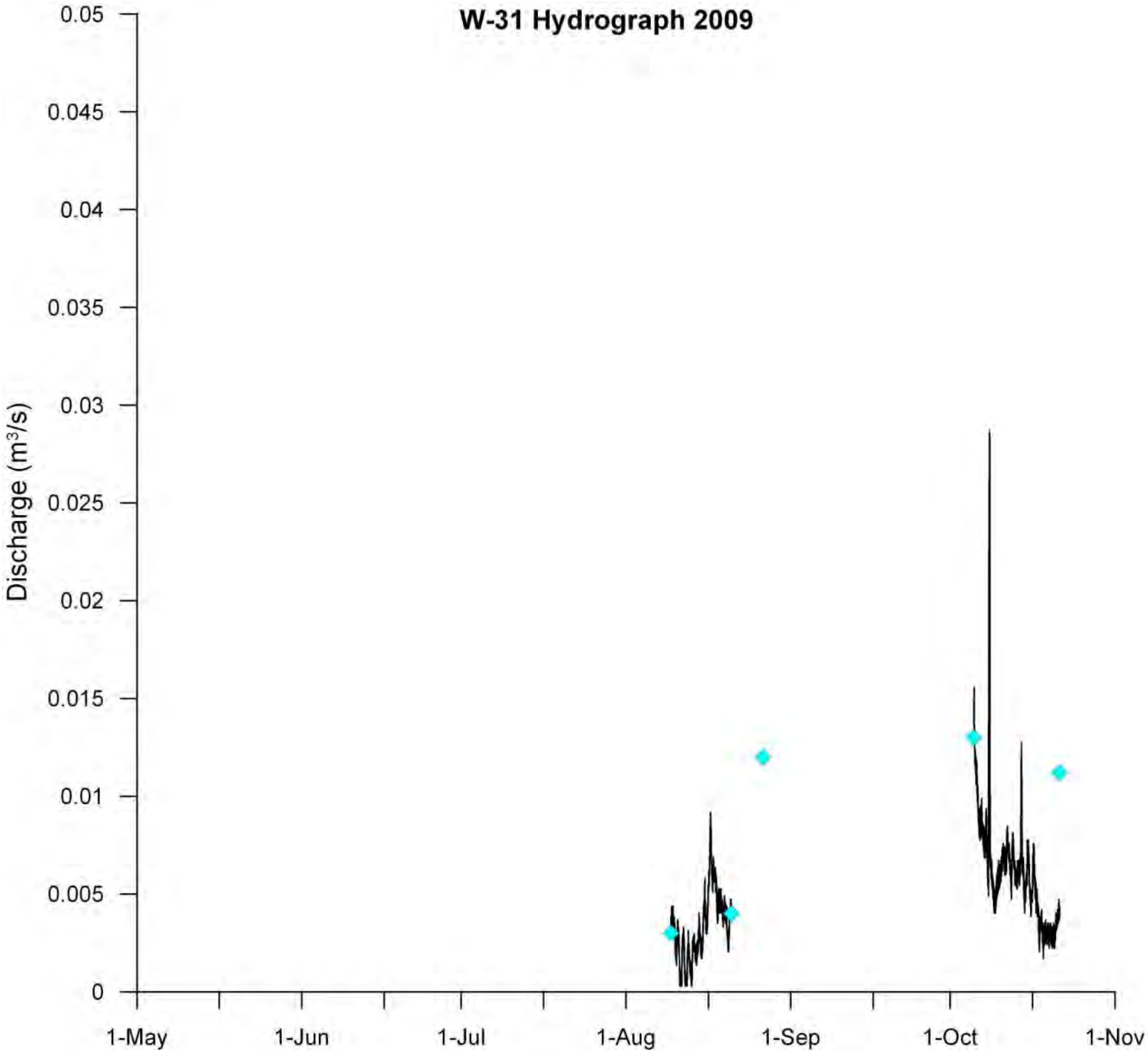

W-22 Hydrograph 2008
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov


W-22 Hydrograph 2009
Discharge (m³/s)
0
1
2
3
4
5
6
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov


W-27 Hydrograph 2007
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov


W-27 Hydrograph 2008
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov


W-27 Hydrograph 2009
Discharge (m³/s)
0.3
0.25
0.2
0.15
0.1
0.05
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov


W-31 Hydrograph 2009
Discharge (m³/s)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
1-Nov