APPENDIX V

Electronic only (CD Attached)

Lower Arkansas River GeoDSS User Support

Spatial-Temporal Database Description

The database hydrographic information for the study area is based on the USGS National Hydrography Dataset (NHD). The NHD data is filtered, organized and compiled in the *LAR GeoDSS* database (Figure V-1). The hydrography information includes: (1) river and stream channels, (2) lakes and reservoirs, (3) conveyance canals and drains. A USGS 30-m resolution Digital Elevation Model (DEM) is compiled into the database (Figure V-2). The compiled data contains with NRCS-SSURGO soils database (Figure V-4) combined with CSU digitized soil types. NRCS Land Use map is attached to the database (Figure V-3). The Colorado Division of Water Resources (CDWR) Irrigated fields map is imported into the database (Figure V-1). A set of aerial photos complement the visualization of the basin and satellite images covering the Valley for several dates provide foundation for remote sensing analysis of the basin characteristics. CDWR Water Rights and their transactions data is attached, in its original format, to the *LAR GeoDSS* database (facilitating the database update). Water rights are associated with spatial diversion structures using the native CDWR structures IDs and water division (WD). The temporal-varying side of the database consists of measured time series of flow rates at stream gauging stations, diverted water at the canals structures, pumped water, storage levels at the reservoirs, concentrations. Data from 43 USGS and 12 State Engineers Office gauging stations have been collected over a broad range of years, as early as 1912. More than 4500 pumping wells distributed over the alluvial valley are included in the database, each node with their associated pumpage from 1999 to 2003 (Figure V-5). Diversion records for more than 300 structures in three water districts covering the LARV are available in the database. Daily reservoir storage volumes are included for the main reservoirs. Spatial-temporal information is collected from MODFLOW-MT3DMS runs output and associated with the geo-database using a geo-referenced MODFLOW-MT3DMS modeling grid. Finally, processed NEXRAD data provides spatial-temporal hourly precipitation data collected from 1997 to 2005 (Figure V-6).

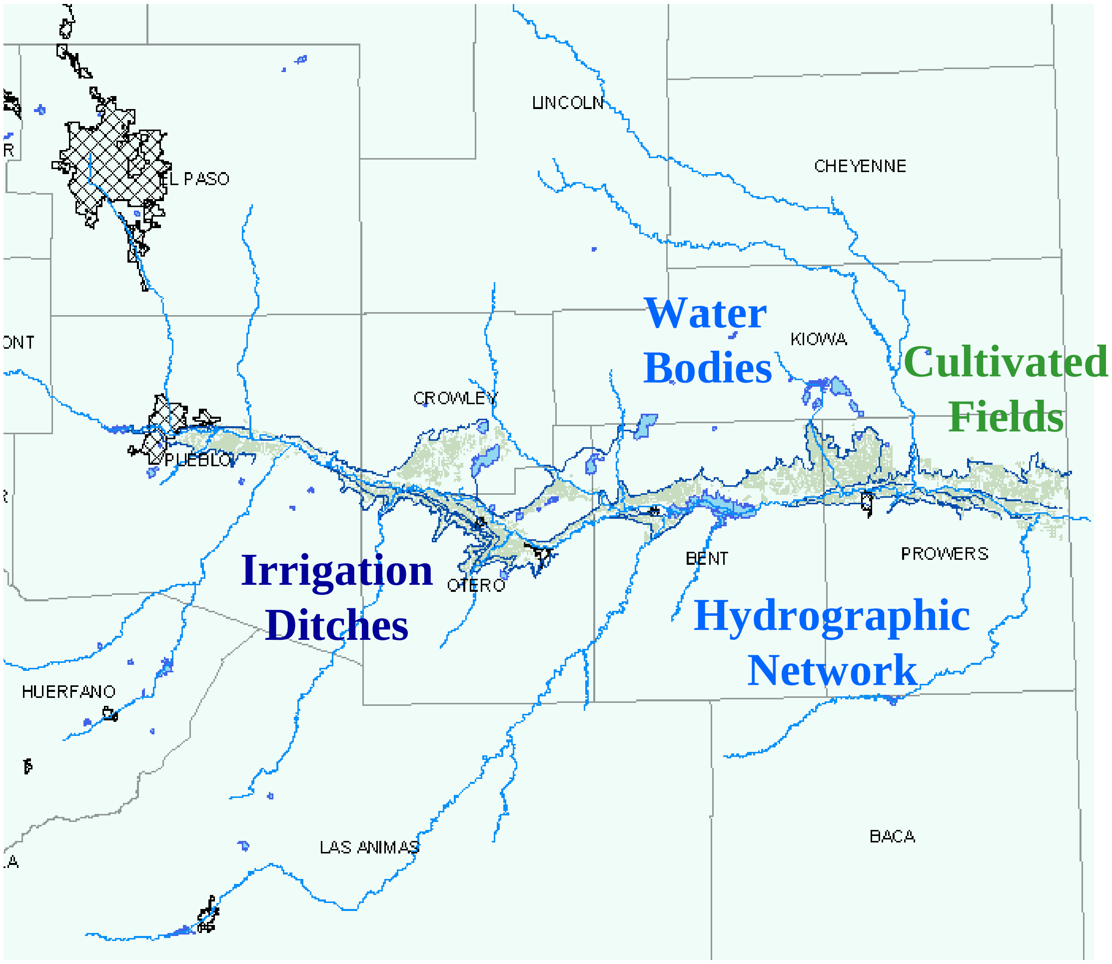


Figure V-1 – Geo-Database data sample

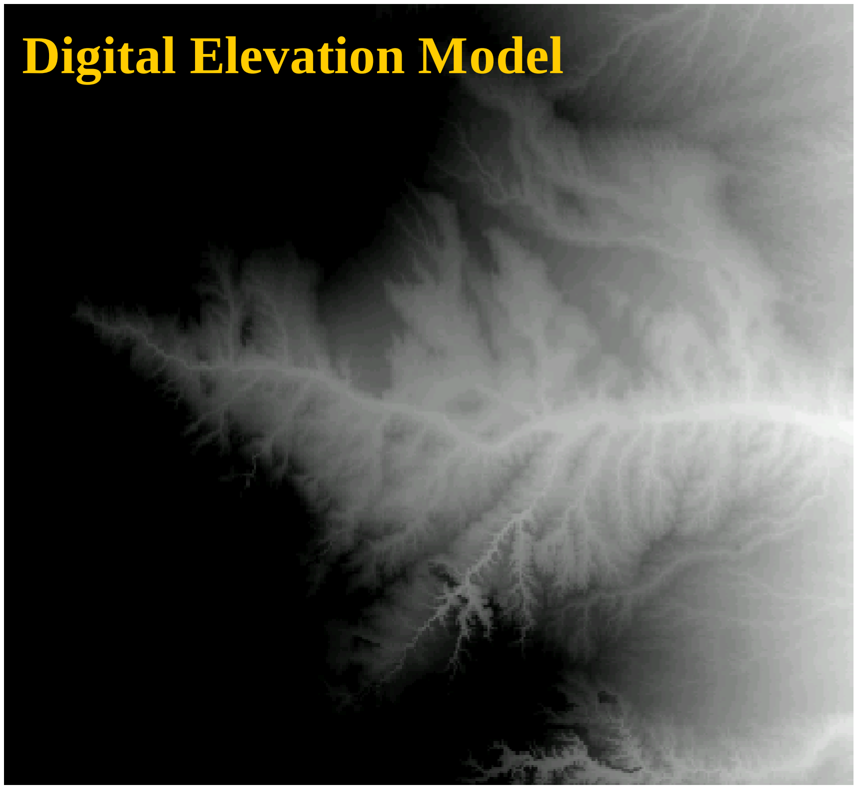


Figure V-2 – Arkansas River basin Digital Elevation Model

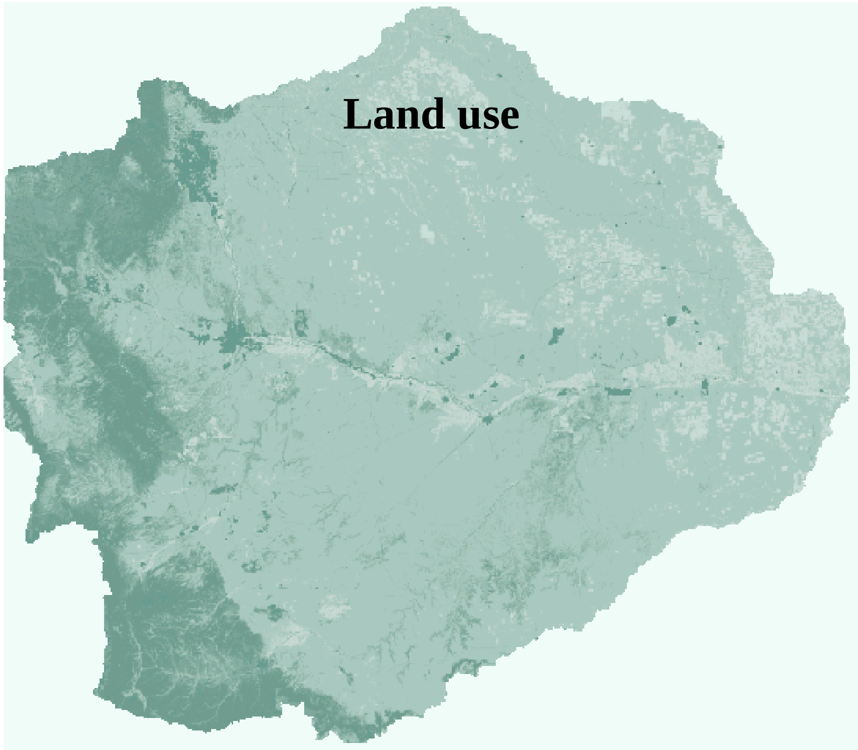


Figure V-3 – Arkansas River Land Use Map

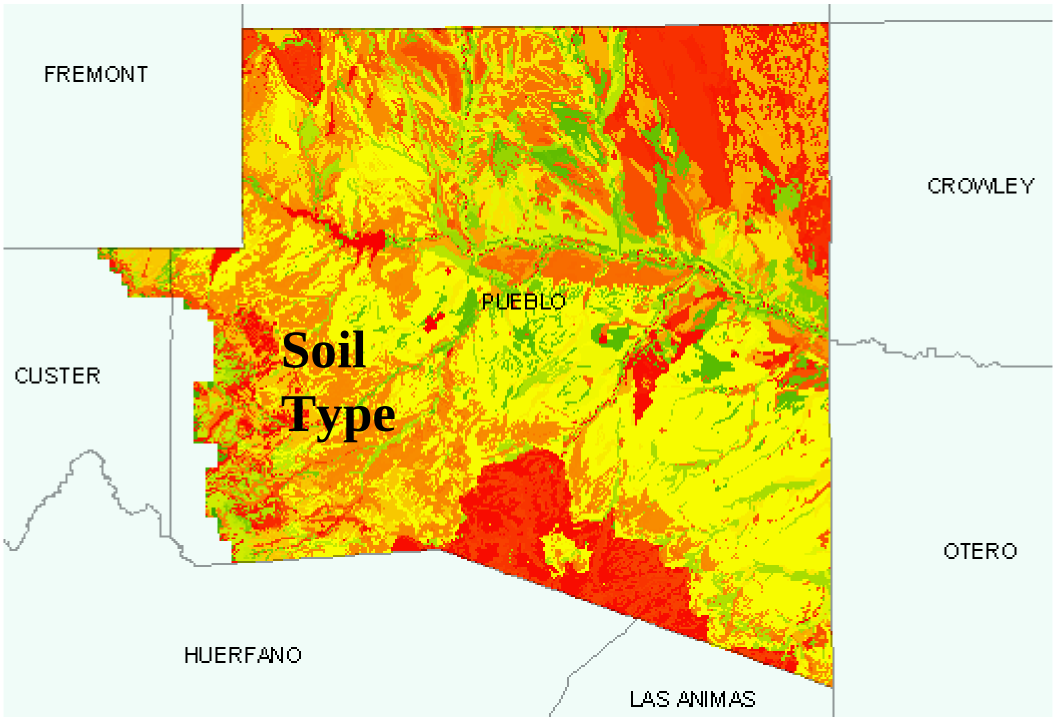
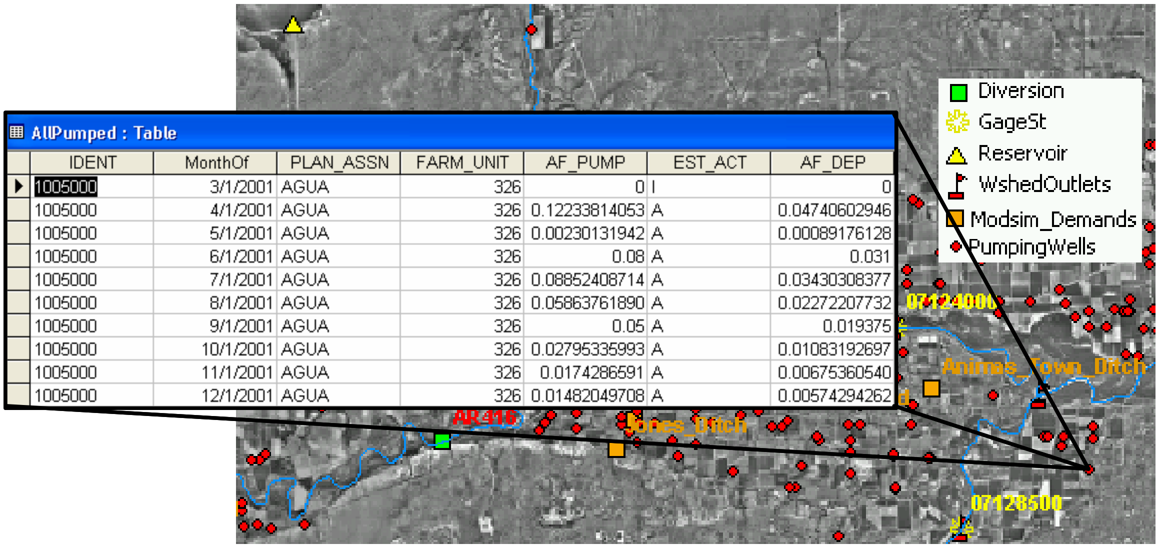


Figure V-4 – Arkansas River Soil Type Map



IDENT	MonthOf	PLAN_ASSN	FARM_UNIT	AF_PUMP	EST_ACT	AF_DEP
1005000	3/1/2001	AGUA	326	0	I	0
1005000	4/1/2001	AGUA	326	0.12233814053	A	0.04740602946
1005000	5/1/2001	AGUA	326	0.00230131942	A	0.00089176128
1005000	6/1/2001	AGUA	326	0.08	A	0.031
1005000	7/1/2001	AGUA	326	0.08852408714	A	0.03430308377
1005000	8/1/2001	AGUA	326	0.05863761890	A	0.02272207732
1005000	9/1/2001	AGUA	326	0.05	A	0.019375
1005000	10/1/2001	AGUA	326	0.02795335993	A	0.01083192697
1005000	11/1/2001	AGUA	326	0.0174286591	A	0.00675360540
1005000	12/1/2001	AGUA	326	0.01482049708	A	0.00574294262

Figure V-5 – Spatial-Temporal Database Sample

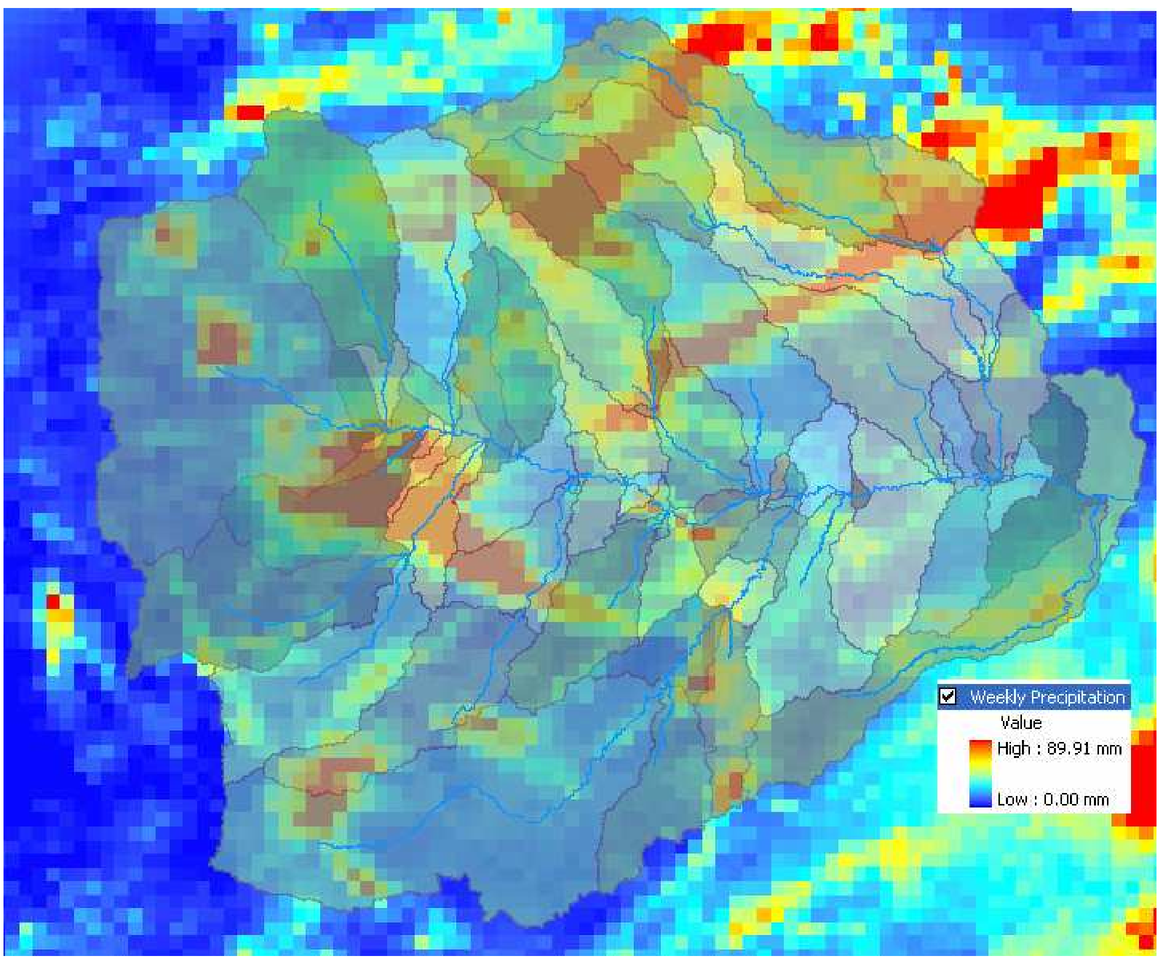


Figure V-6 – NEXRAD Precipitation Data Sample

Points and observations results of a system reconnaissance are available in the database. The points are accessed in ArcMap using the *hyperlink* tool ( ). Figure V-7 shows an example of the system reconnaissance report as generated by the *hyperlink* tool in ArcMap.

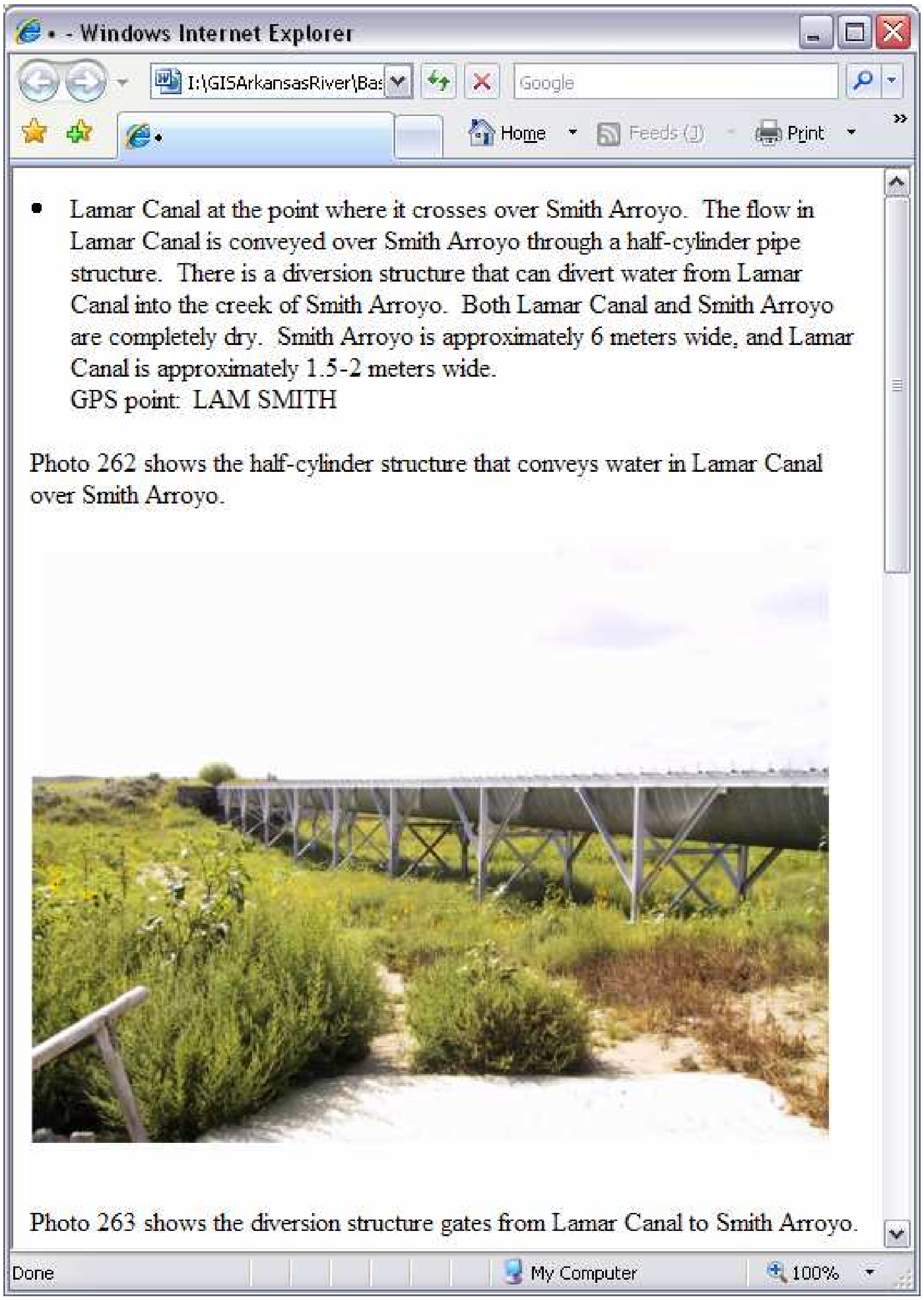


Figure V-7 – System reconnaissance report example as displayed in ArcMap

Time Series Database

The database is a native MS-Access file. The no-data is represented in the value -999. The main tables in the database are:

TSType: contains the description of the different types of data stored in the database including its units, source and unique identifier value.

USGSGaugingSt: Contains the daily mean USGS measured flows (cfs) starting in January 1998. This table uses the Gauging station node *HydroID* to identify the data and relate it with the geo-features.

USGSGaugingSt_Hist: contains daily mean USGS measured flows from the earliest available date through 1997.

DIV2GaugingStations: contains the mean daily values for stations maintained by the Colorado Division of Water Resources (CDWR). Data in this table starts in January 1998.

DIV2Historical: this table contains the daily flows for CDWR stations prior to 1998.

AllDiversionRecords: copy of the daily diversion record tables, as provided by the CDWR. The tables use the Water District (WD) and diversion structure id (ID) to identify the features. The table structure is organized in rows for each month-structure-diversion type combination and the days of a month in columns. The current table contains data from 1910 to October 2004.

AllPumped: includes monthly pumping records (acre-ft) in the Valley from April 1999 to March 2003. The table is imported into the database as provided by the CDWR. It uses the well ID to link the data with the GIS objects.

CDWRStructureIDs: contains the relational data for the CDWR diversion structure's id, name and location.

GaugesIDs: contains the relationship between the gauging station *HydroCode* (USGS or CDWR name that identifies the station) and their corresponding *HydroID* in the geodatabase. Both the *HydroCode* and *HydroID* are included in the GIS object.

NatlWeatherStations: contains climate data available for the National Weather Service (NWS) stations. The table is imported in the NWS downloaded format. The period of records currently compiled in the database is from 1999 to 2004.

Land_Based_Climate_Data_CoAgMet: stores data downloaded form the CoAgMet network, in the downloaded format.

Land_Based_Climate_Data: this table combines in a single table format (CoAgMet style) the NWS and the CoAgMet data. A utility is built in the database to process the NWS raw data format table (*NatlWeatherStations*) and import the data into this table. Figure V-8 shows the database interface to process the data into *Land_Based_Climate_Data* table.

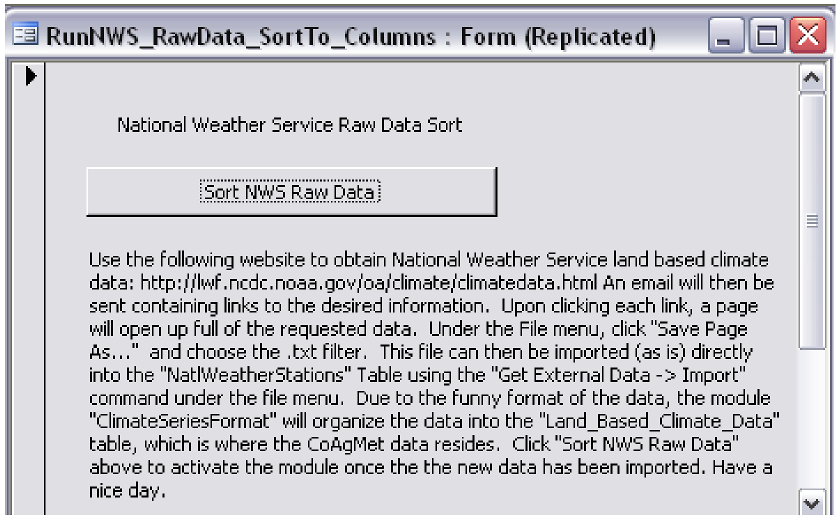


Figure V-8 – National Weather Service climate data processing tool interface

NWS_Station_Description: contains the general information for the NWS stations.

Observed_Weather_Description: holds the description of the climate data identifiers.

ReservoirData: stores reservoir storage volume and elevation at 24:00 hours for the specified date. The storage is in acre-feet and the elevation in feet. The table uses the GIS reservoir objects *HydroID* to index the data.

Even though, the flow data is imported to the Base-Network and stored there, the modeled period flows are stored in a separate table to speeds up the *LAR GeoDSS* querying process during the time series import. Manual processing is required to import the downloaded files into the database. The USGS allows batch download using a web query including all the stations. The file requires processing to be uploaded to the database.

CDWR Water Data Bank Codes

These codes are used in the CDWR diversion database to identify diversion types, water user and special transactions (e.g., alternate points of diversions, carriers). The codes are used in the times series import tools, as well as, in the alternate point of diversion and storage contracts processing.

The following rules are applied to import diversion data into the network demand nodes.

- Diversion records considered for demand time series have S=1, S=2 or S=4 (transbasin). Record flagged with S=3 (groundwater), S=5 (runoff) and S=6 are not considered to contribute with flow.
- If *S* or *U* is null data might not be interpreted correctly. There are two cases for 1998 month 7 and 8 (14-766).
- If *U*=0 then water is for storage and should bypass the demand.
- *U*=5 for recreation should also bypass the demand. The only entry is for the Fort Lyon Storage id number. It is assumed this diversion goes to the reservoir.
- *U*=*C* or *U*=*D* water does not add into structure totals. It is not included in the diversion time series.
- *U*=*P* is this water returned completely to the river? This category is for non-consumptive water. It is returned to the river.
- *T* blank is acceptable. *T*=0 doesn't not add into the surface totals because it is an administrative record only.
- *T*=1 represents an exchange record. It is probably water that passes through the structure. It might imply a discharge at other point of the network. *F* field indicates the original owner, but it is not available in all cases. This water flows through the demand node at the Colorado Canal diversion.

- *T*=3 (carrier) implies water flows to another user different than the diversion. Therefore, this water flows through (added to the demand time series), but only if the *F* code is in the model. In some cases, water is not carried to a feature in the model. These entries always have a code in the *F* field. A flag is manually added to the diversion database to simulate the Kicking Bird (17-555) canal case.
- When *T*=4, the *F* fields indicates where is the water coming from, except for some null fields for the Comanche pump station in 1986-1987.
- T=6, 7, and 8 are not considered for the diversion demand time series.

NEXRAD PRECIPITATION PROCESSING NOTES

Precipitation data was downloaded from NOAA Hydrologic Data Systems (NHDS) which is part of the National Weather Service. The data downloaded for the *LAR GeoDSS* is the hourly NEXRAD stage III data. This data is processed using the NWS algorithm and providing geo-referenced spatial precipitation raster maps. The study area is located inside the Arkansas-Red Basin River Forecast center (ABRFC). Monthly compress binary files were downloaded for the available months from 1997 to 2001. NWS was contacted to obtain data from 2002 that is not available on the web. The files are deployed in a binary compressed UNIX format which required a *perl* macro to programmatically uncompress precipitation data from monthly to hourly. The perl macro *unpack.pl* used for this job is located appended CD. Running the macro requires to store all and only the files that want to be processed in a directory. The macro is designed to run in a sub-directory using the command “perl unpack.pl ..”. This command requires the file *read_xrmg_lin* (included in the CD) in the same folder. The third argument indicates that the files to process are located in the parent directory in the directory tree. The file *read_xmrg_lin* is the executable of a C code downloaded from the NWS to convert the precipitation data in a

GIS readable ASC format. The macro produces, in the directory where it is run, a set of hourly ASC files in a format that can be read by ESRI-ArcToolBox. The VB.NET utility *ImportNexRad* process the ASC files and create precipitation summaries at different time steps. *ImportNexRad* writes and runs an AML macro to import the ASC data to ArcGrid format and assign the coordinate system.

There was a change in the raw data format from 2003. The naming convention changed and the files are only *tar* and *gz* compressed. The macro that uncompresses the raw files needed to be modified. The result files have the following name convention "*stage3_MMDDYYYY_HHz_AB.out*". The modified macro is called *unpack2003.pl* and runs in the same fashion that *unpack.pl*. In the Linux machine command prompt "*perl unpack2003.pl* .." (when the macro is placed one directory up of the tar compress files). The executable *xmrgtoasc03a.exe* is used to process data older than 2003.

WATER QUALITY DATA SOURCES

USGS discrete data is downloaded for the stations in the study area using an on-line query built with the stations id numbers. The web query has a structure as:

```
http://nwis.waterdata.usgs.gov/co/nwis/qwdata?qw_count_nu=1&parameter_cd=00095&begin_date=&end_date=&format=wide_rdb&site_
no=07137500&site_no=07099400&site_no=07099970&site_no=07130500&site_no=07109500&site_no=07124000&site_
no=07121500&site_no=07135000&site_no=07128500&site_no=07134180&site_no=07133000&site_no=07108900&site_
no=07110400&site_no=07116500&site_no=07134100&site_no=07119500&site_no=07106300&site_no=07123000&site_
no=07106500&agency_cd=USGS
```

The Specific Conductance at 25°C data was imported into the Quality database using the data type 9 to identify the discrete sampling. The dates and time are combined in a single field. The format to store the water quality data is similar to the one used to store the flow time series. Regular Specific Conductance at 25°C data is available in some stations in the studied area. The historical daily mean value was requested to the USGS, because the

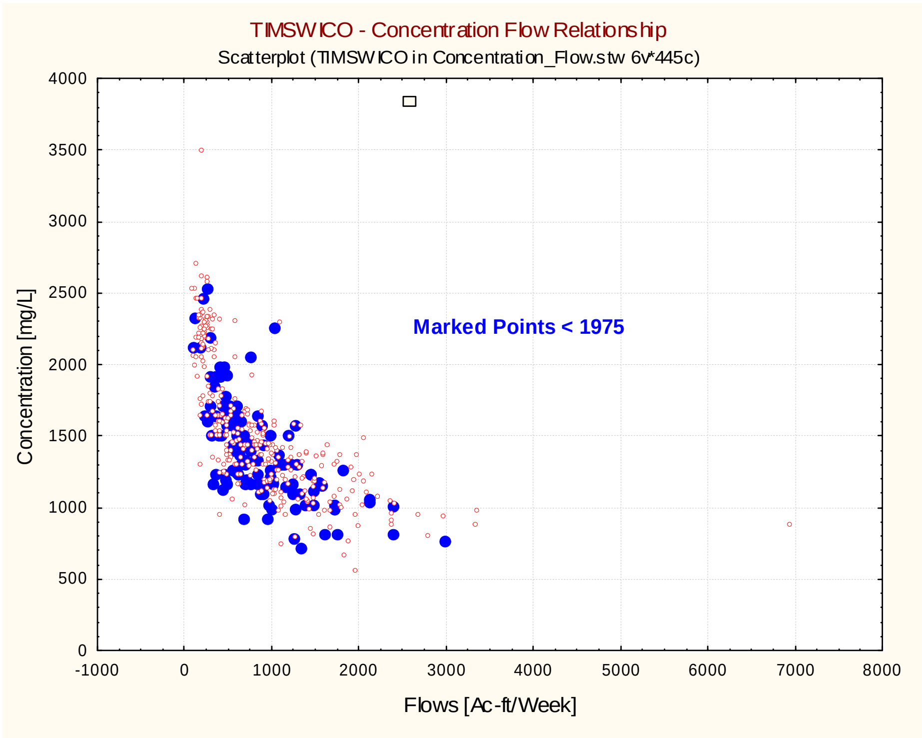
USGS web service only allows downloading data for a short period back. Bill Payne in USGS-Pueblo office provided us with the historical data for the stations in Colorado. Craig Dare, from the USGS-Kansas, provided us with daily mean for the Coolidge Station. Data was provided as a text file, processed and imported to the quality data database using queries (stored in the database for future updates). The regular mean daily data was tagged with the data type number 2.

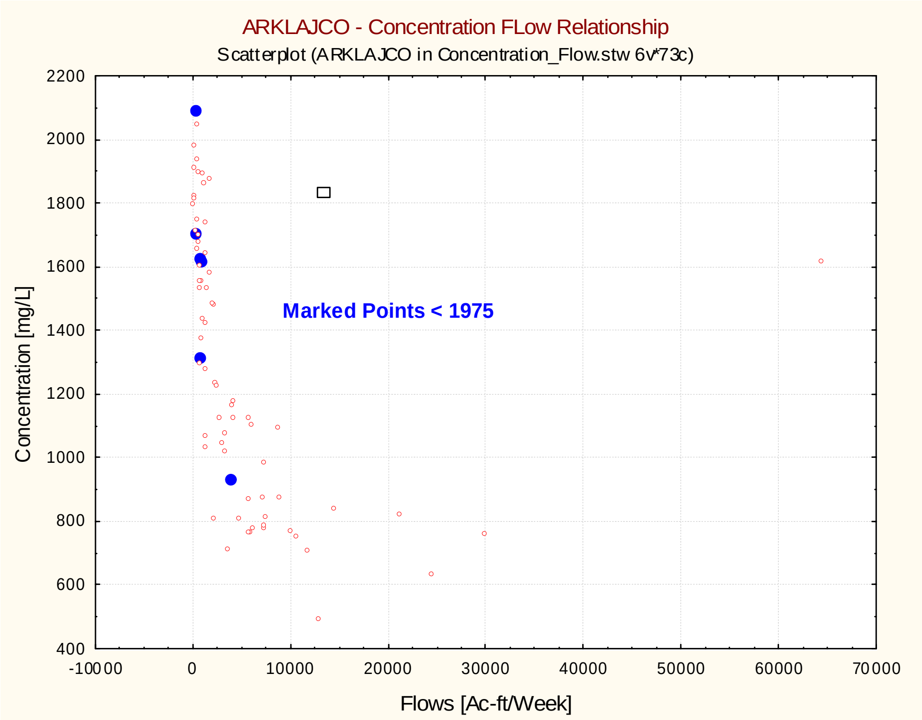
CONCENTRATION AND FLOW RELATIONSHIP

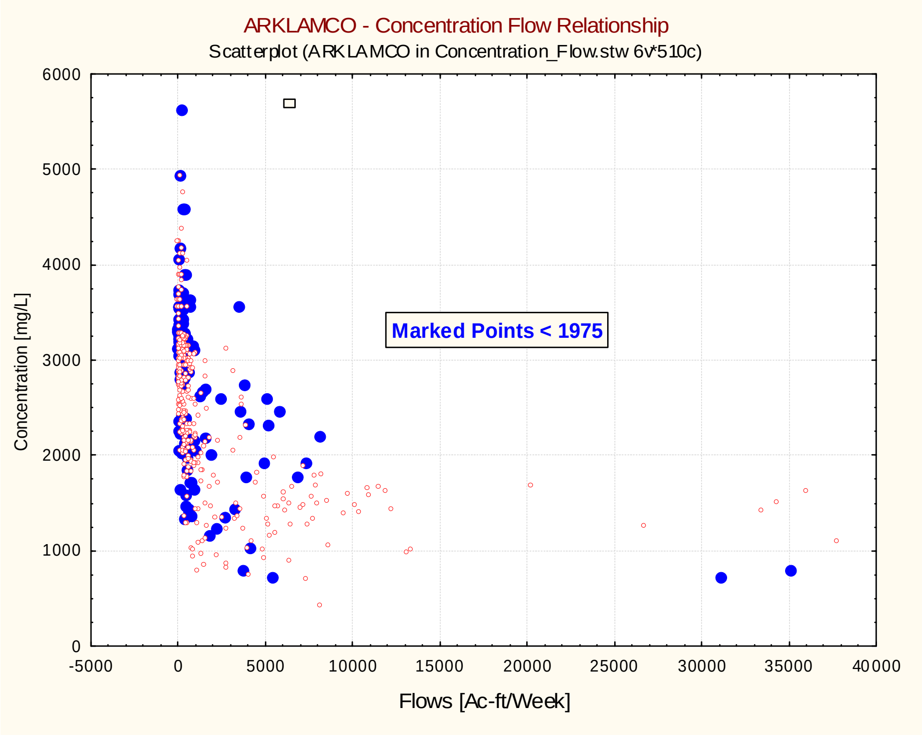
Nodes that have sporadic water quality measured events are modeled in the *LAR GeoDSS* using a simple concentration-flow relationship. Concentration is implemented using the MODSIM time series object, which allows using the previous available value if no value is defined for a time step. However, the flow changes significantly between measured events to assume that concentration remains constant between events. The methodology implemented to address these situations develops an equation to predict concentration as a function of the flow. The concentration-flow relationship is found fitting linear and nonlinear equations to the available measured events. Weekly time steps from 1945 to 2004 are used to build the dataset for the regression equation analysis. The flow-concentration pairs assume that averages of available grab samples over a week are representative of the weekly flows concentration. The data is analyzed and processed in STATISTICA(StatSoft®) software to find the equation that best fit every set of observed concentration and flow pairs. The equation to represent the relationship is selected using the coefficient of determination (r^2) and the ability to reasonably predict high-flows cases that are usually fewer than low flow cases.

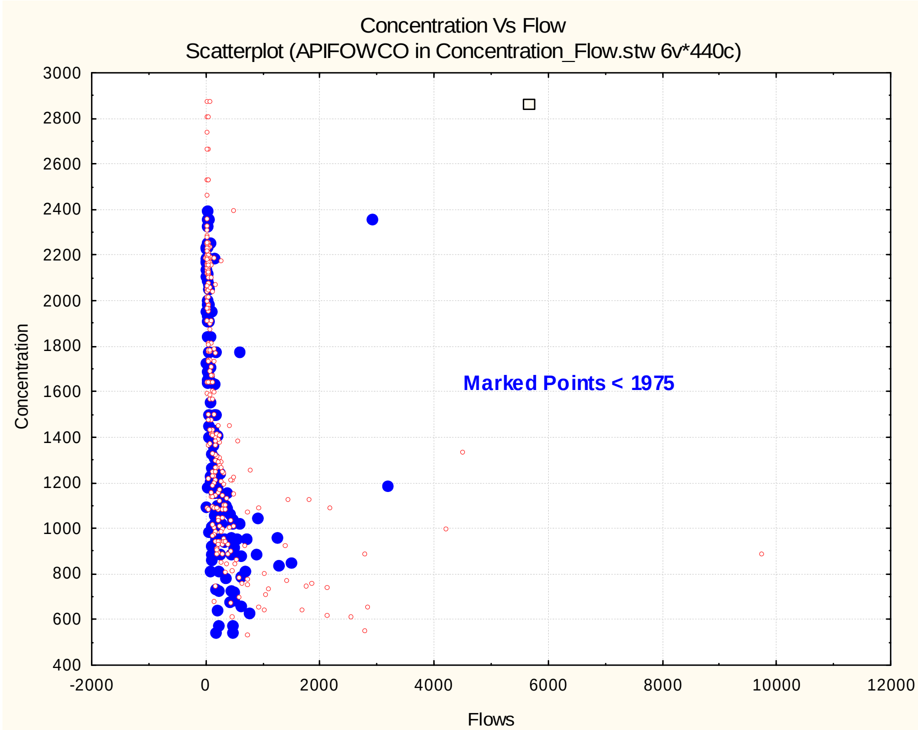
Historical Period Behavior Analysis

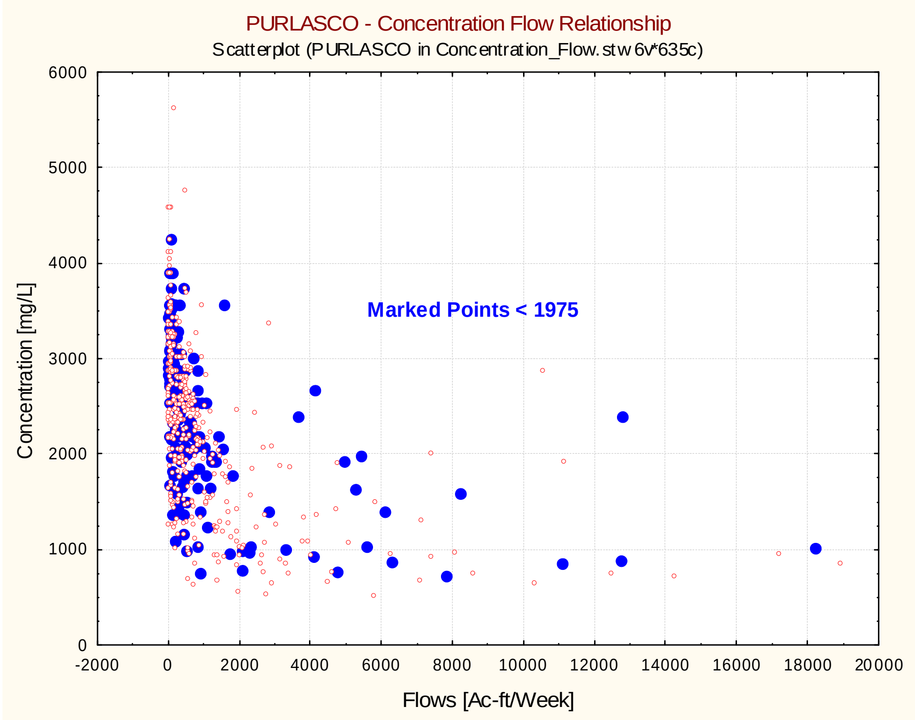
Pueblo Reservoir began operations in 1975. An analysis of the temporal flow-concentration relationship was carried out to observe if the change in the way that the system operates has a noticeable influence in the flow concentration relationship. The following plots illustrate the flow-concentration relationship, highlighting in blue the data prior to 1975.

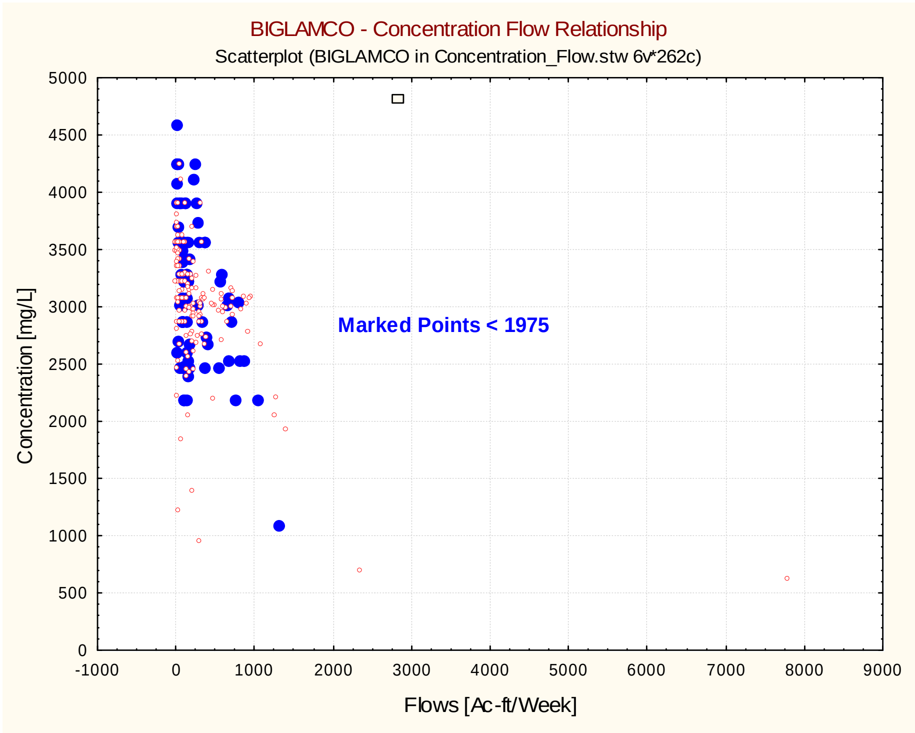



ARKLAJCO - Concentration FLow Relationship
Scatterplot (ARKLAJCO in Concentration_Flow.stw 6v*73c)
Marked Points < 1975
Concentration [mg/L]
Flows [Ac-ft/Week]
2200
2000
1800
1600
1400
1200
1000
800
600
400
-10000
0
10000
20000
30000
40000
50000
60000
70000


ARKLAMCO - Concentration Flow Relationship
Scatterplot (ARKLAMCO in Concentration_Flow.stw 6v*510c)
Marked Points < 1975
Concentration [mg/L]
Flows [Ac-ft/Week]
6000
5000
4000
3000
2000
1000
0
-5000
0
5000
10000
15000
20000
25000
30000
35000
40000


Concentration Vs Flow
Scatterplot (APIFOWCO in Concentration_Flow.stw 6v*440c)
Marked Points < 1975
Concentration
Flows
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
-2000
0
2000
4000
6000
8000
10000
12000


PURLASCO - Concentration Flow Relationship
Scatterplot (PURLASCO in Concentration_Flow.stw 6v*635c)
Marked Points < 1975
Concentration [mg/L]
Flows [Ac-ft/Week]
6000
5000
4000
3000
2000
1000
0
-2000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000



From the previous graphs, it is not perceived a clear trend difference in the concentration-flow relationship in later data to 1975. A statistical temporal analysis was performed to corroborate the no change in flow-concentration relationship after the reservoir starts operations. The procedure used a regression equation similar to the equation on Cain et al. (1987) analysis. The regression equation is of the form:

$$Log(TDS) = a + bLog(Q) + cZ + dZLog(Q) \qquad \text{(V-1)}$$

Where, *TDS* = weekly averaged total dissolved solids. *Z* = dummy variable with value of 1 for cases prior Jan 1st 1976 and 0 otherwise. The regression analysis determines *a*, *b*, *c*, and *d*. The STATISTICA software fitting results showed that coefficients *c*, and *d* are close to zero and not statistically significant. Therefore, in this analysis for practical purposes, there is not significant benefit on separating the data and using only the data later than 1975 to develop the regression equations, i.e., all the available data will be used in the regression analysis.

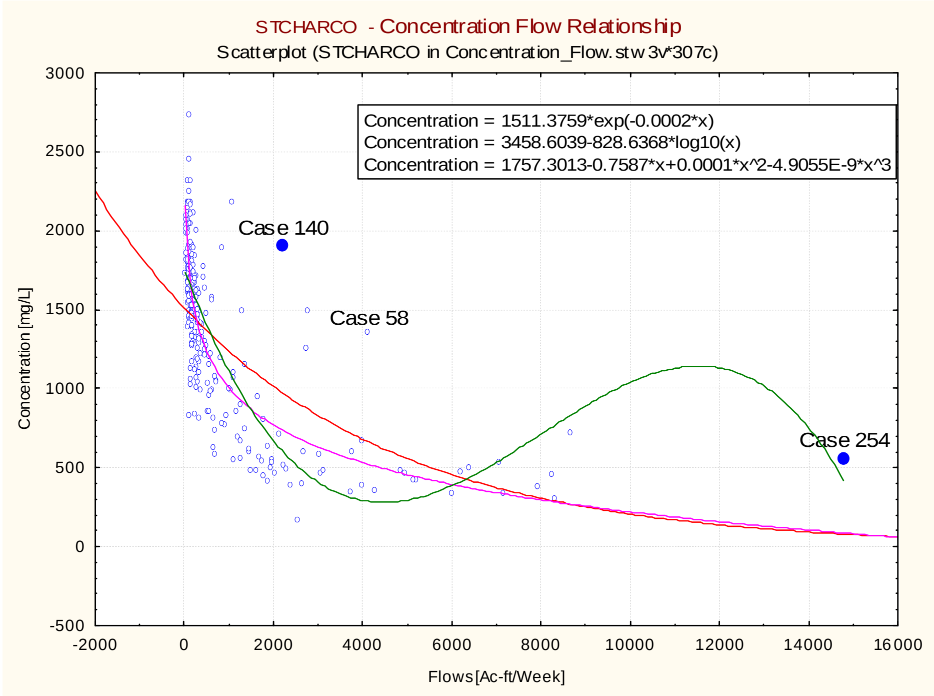
The flow concentration plots show a large spread of concentrations recorder for low flows indicating that the process is influenced by other factors, i.e., it cannot be explained only with flow. Further work should explore a more robust concentration predictor using other characteristics and conditions at the measuring points.

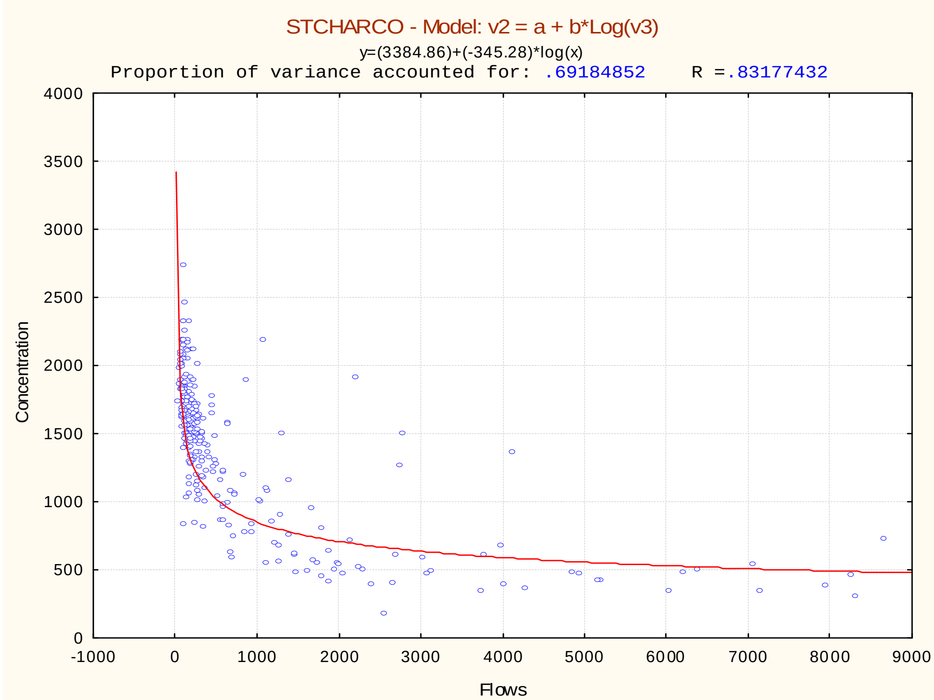
Regression Equations

Following is a summary of the relationship by station in the study area. Different forms of the regression equation were tested. In each case the MSE, r^2 and the low flows performance were used to select the representative equation. Extreme outliers were removed in an attempt to improve the equation predictability. These points are identified with their case id and highlighted in blue in the station regression plots. The developed equations were significant at the 95-percent probability.

SAINT CHARLES RIVER AT VINELAND

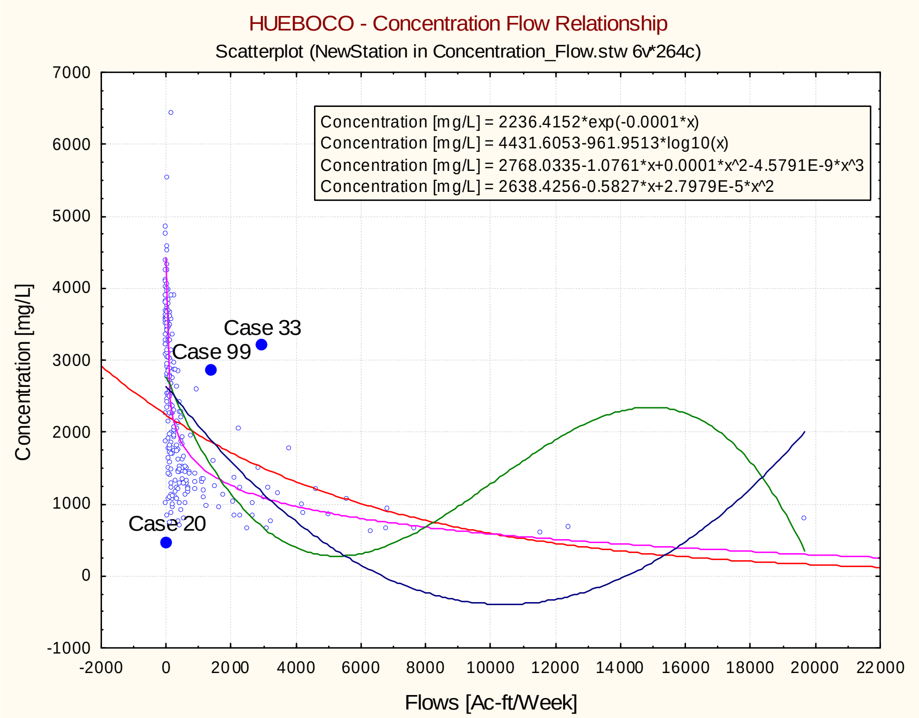
Name	STCHARCO
Period Available	1978 – 2004
Filter	Flow < 10000 acre-ft/week – There is a single point about 15000 acre-ft/week
Non Linear Fitted Equation	y=(3384.86)+(-345.28)*log(x)
Cases Excluded	140 and 254

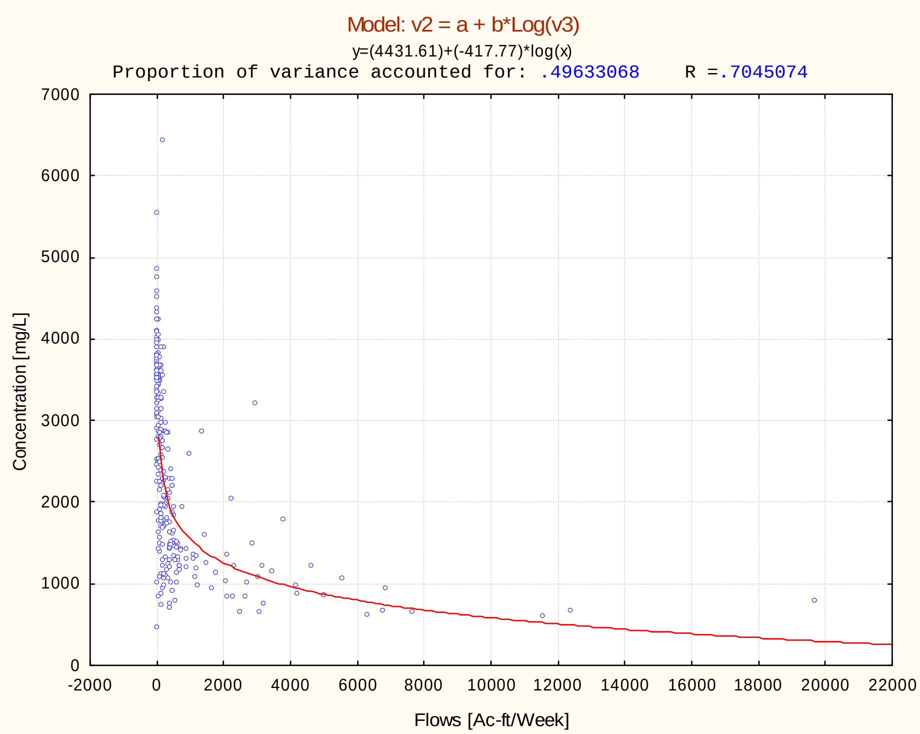

STCHARCO - Concentration Flow Relationship
Scatterplot (STCHARCO in Concentration_Flow.stw 3v*307c)
Concentration = 1511.3759*exp(-0.0002*x)
Concentration = 3458.6039-828.6368*log10(x)
Concentration = 1757.3013-0.7587*x+0.0001*x^2-4.9055E-9*x^3
Case 140
Case 58
Case 254
Concentration [mg/L]
Flows [Ac-ft/Week]


STCHARCO - Model: v2 = a + b*Log(v3)
y=(3384.86)+(-345.28)*log(x)
Proportion of variance accounted for: .69184852 R =.83177432
Concentration
Flows

HUERFANO RIVER NEAR BOONE

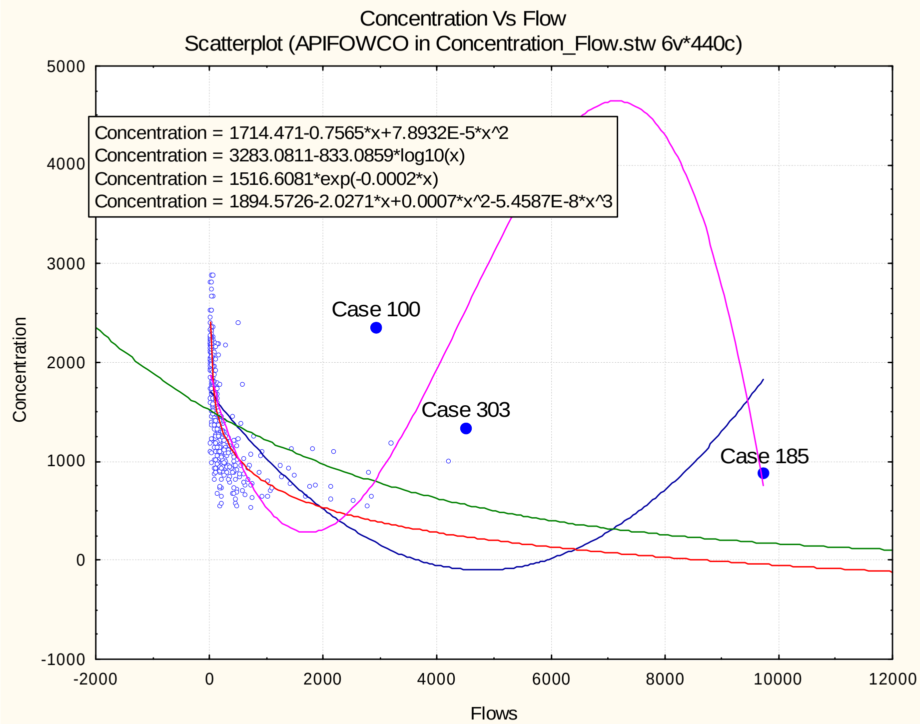
Name	HUEBOCO
Period Available	1979 – 2003 (264 Cases)
Filter	
Non Linear Equation	y=(4431.61)+(-417.77)*log(x)
Cases Excluded	20, 33, and 99

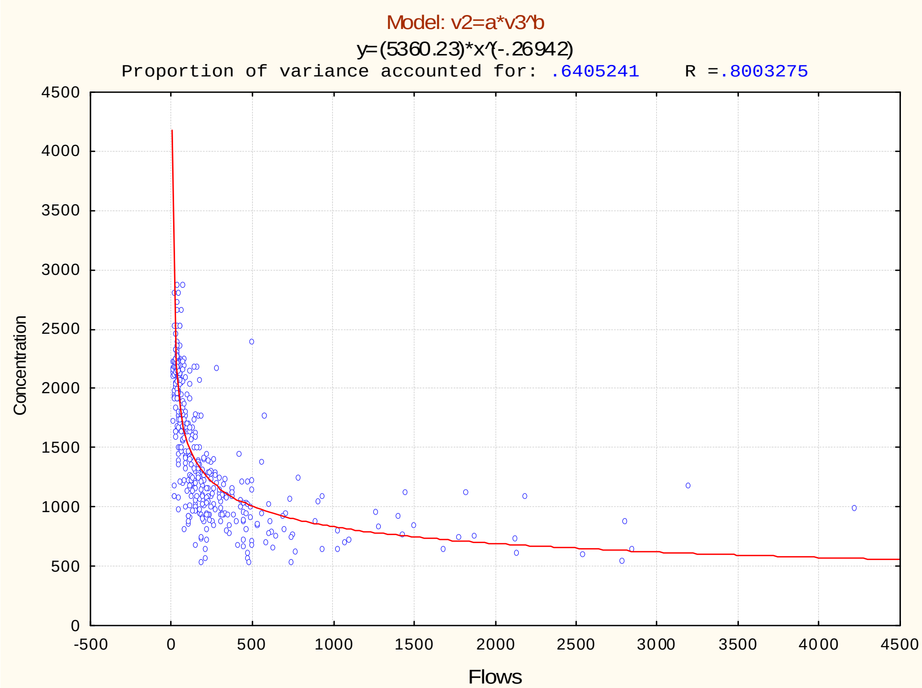




APISHAPA RIVER NEAR FOWLER

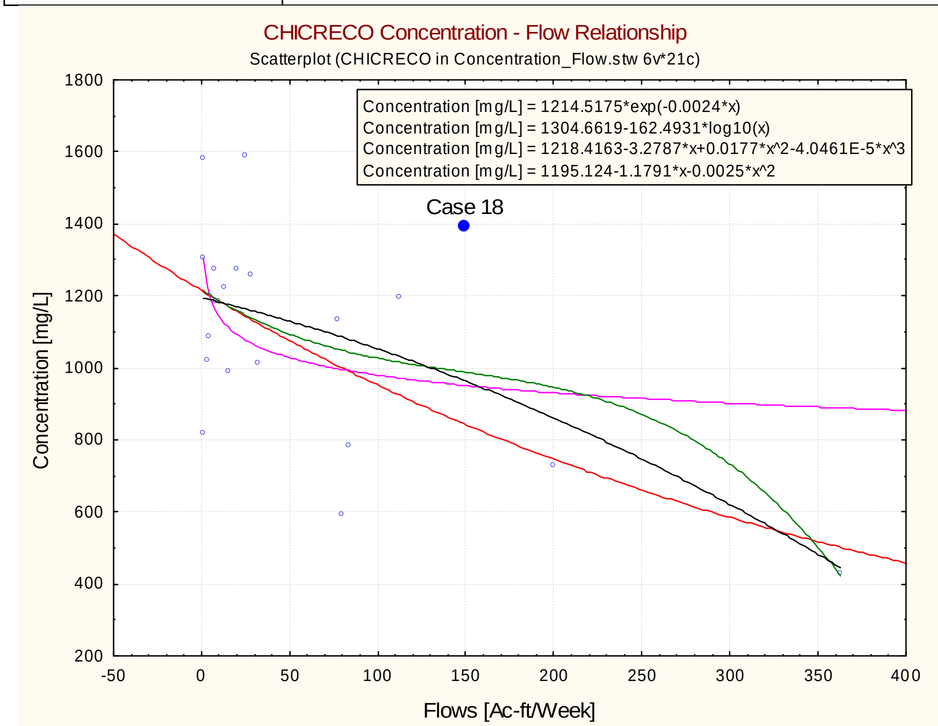
Name	APIFOWCO
Period Available	1963 – 2003
Filter	
Non Linear Fitted Equation	y=(5360.23)*x^(-.26942)
Cases Excluded	100, 185 and 303

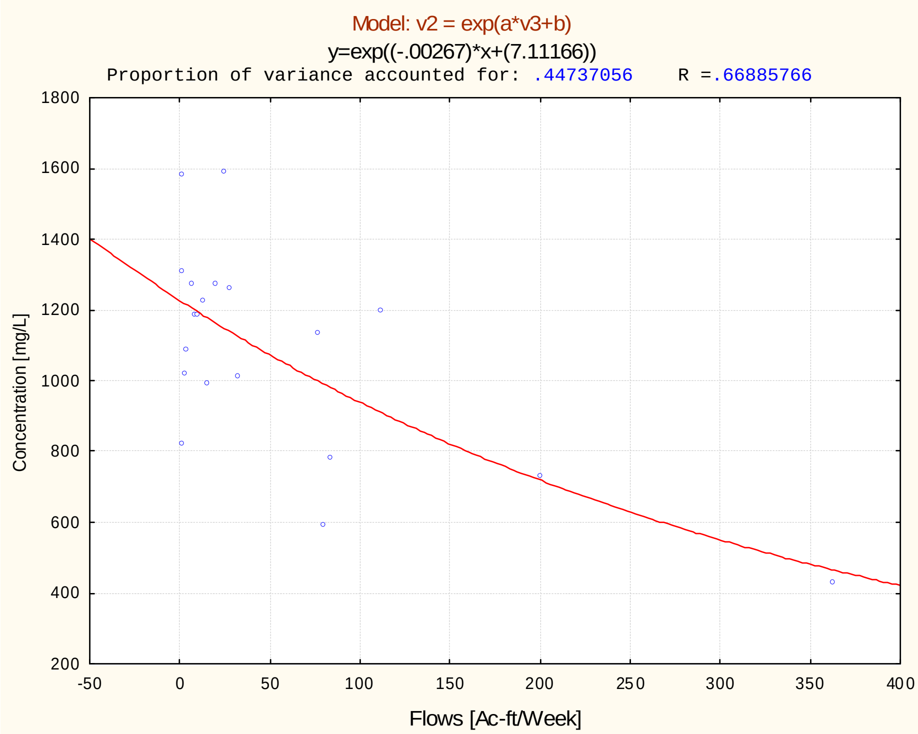




CHICO CREEK NEAR PUEBLO CHEMICAL DEPOT

Name	CHICRECO
Period Available	1997 – 2000
Filter	Concentration > 0
Non Linear Equation	y=exp((-.00267)*x+(7.11166)) – Very few points to derive equation
Cases Excluded	18



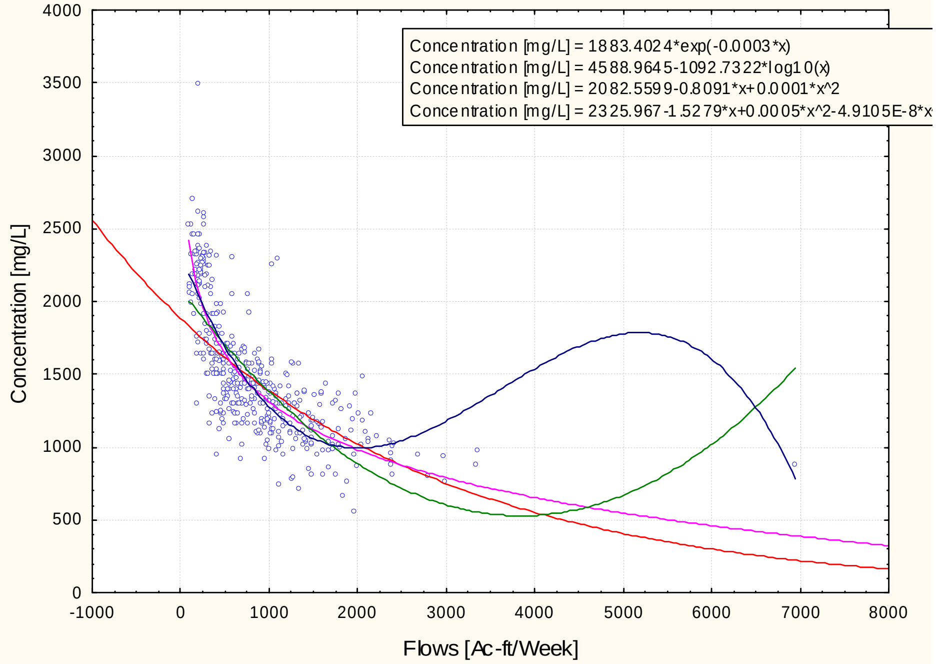


TIMPAS CREEK AT MOUTH NEAR SWINK, CO.

Name	TIMSWICO
Period Available	1967 – 2003
Non Linear Equation	y=(10757.5)*x^(-.30695)
Cases Excluded	None

TIMSWICO - Concentration Flow Relationship

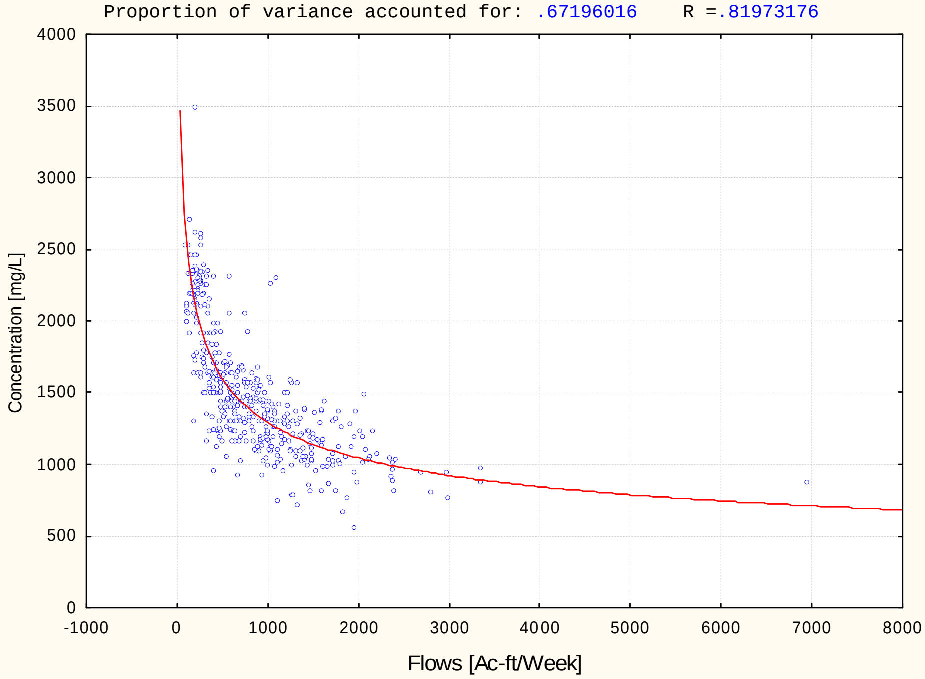
Scatterplot (TIMSWICO in Concentration_Flow.stw 6v*445c)



Model: v2=a*v3^b

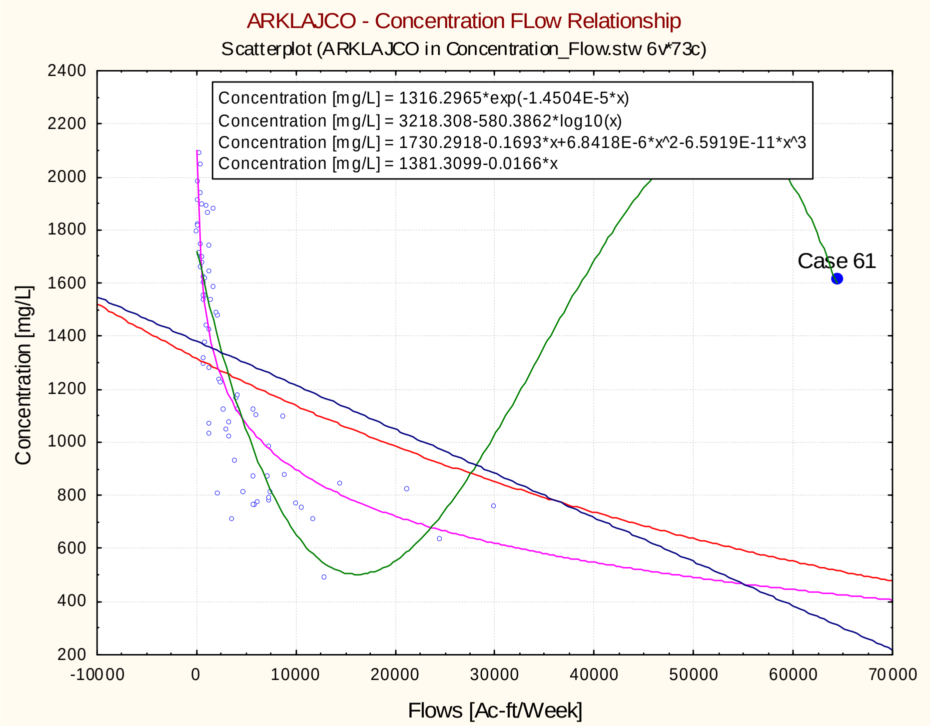
y=(10757.5)*x^(-.30695)

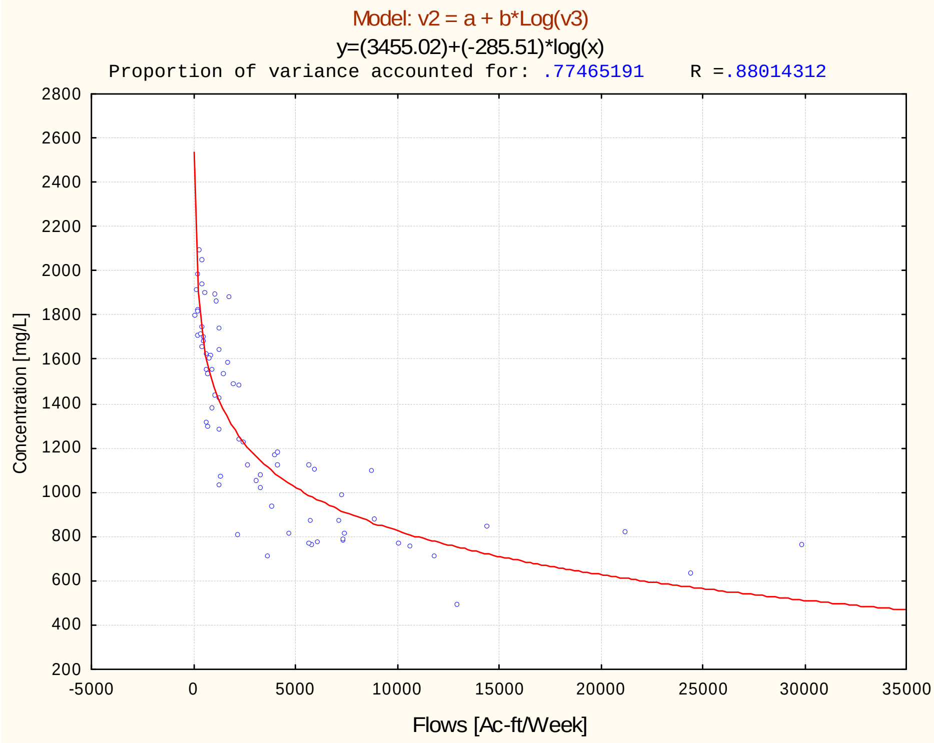
Proportion of variance accounted for: .67196016 R =.81973176



ARKANSAS RIVER AT LA JUNTA

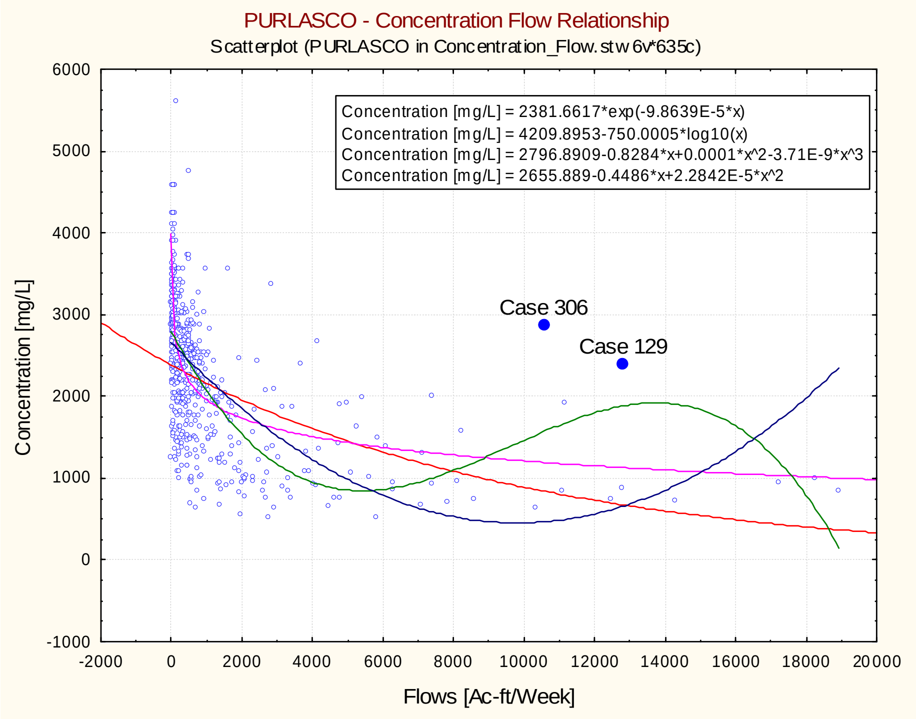
Name	ARKLAJCO
Period Available	1961 – 2002 (73 cases)
Non Linear Equation	y=(3455.02)+(-285.51)*log(x)
Cases Excluded	18

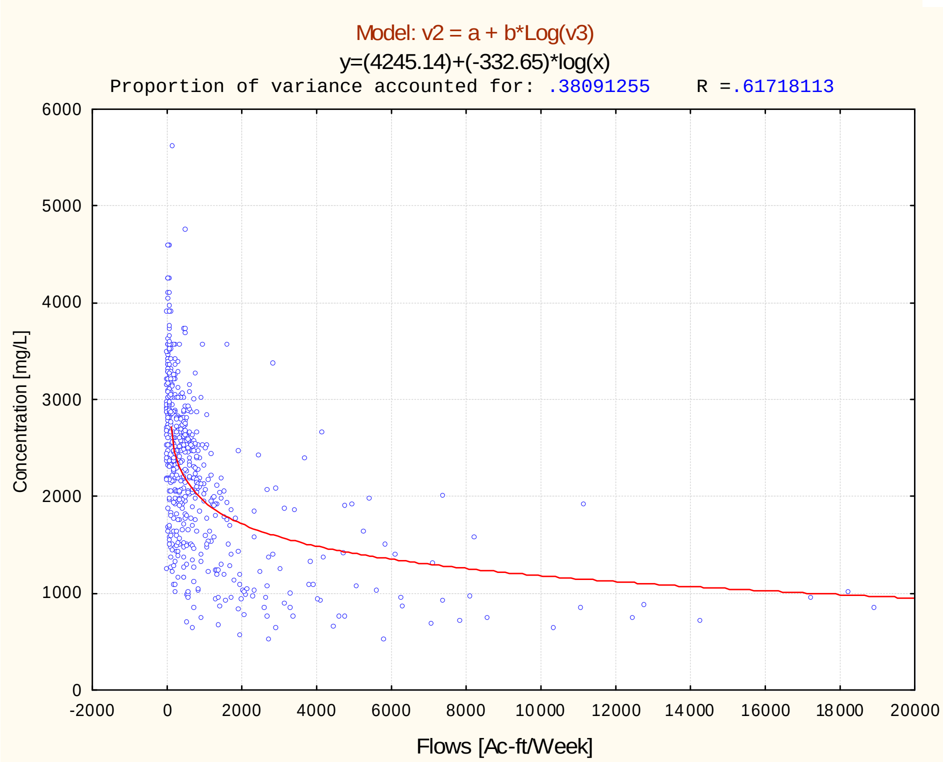




PURGATOIRE RIVER NEAR LAS ANIMAS

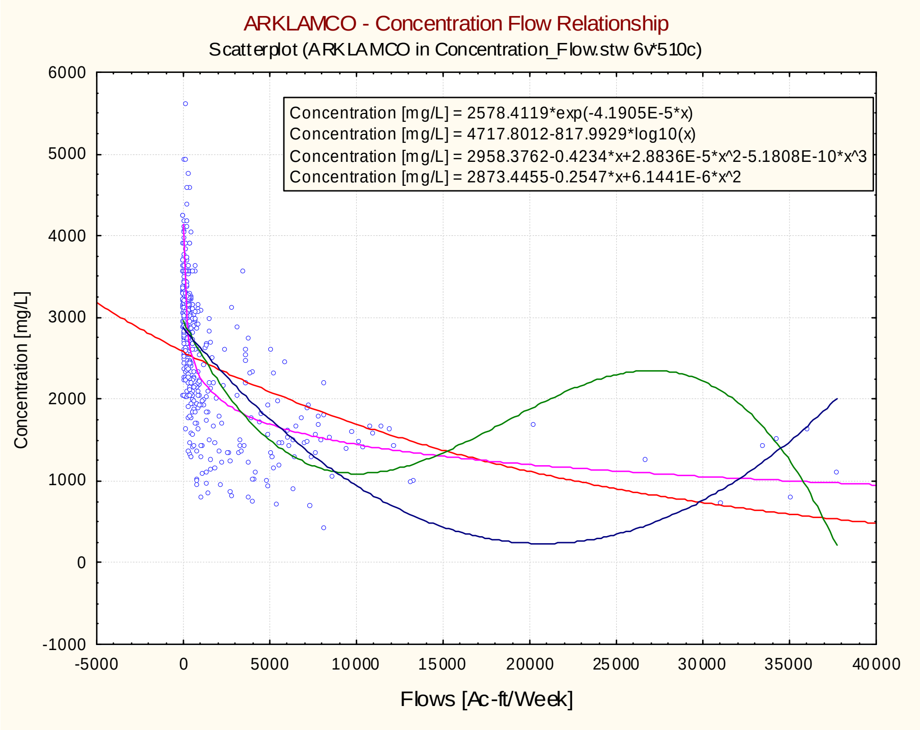
Name	PURLASCO
Period Available	1961 – 2003 (635 Cases)
Non Linear Equation	y=(4245.14)+(-332.65)*log(x)
Cases Excluded	306,129

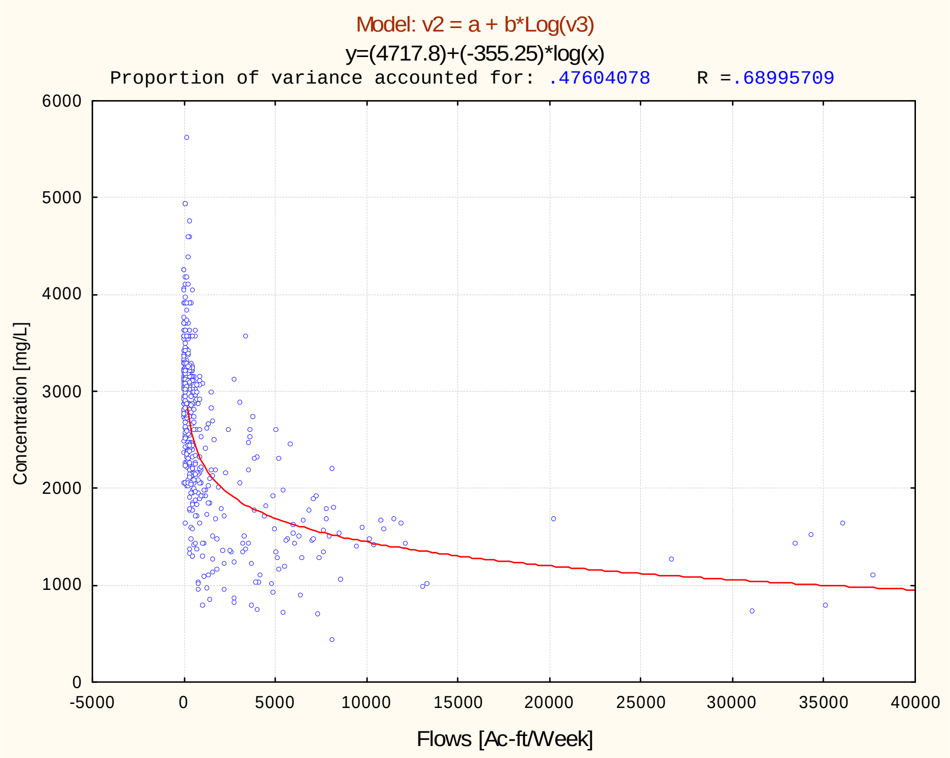




ARKANSAS RIVER AT LAMAR

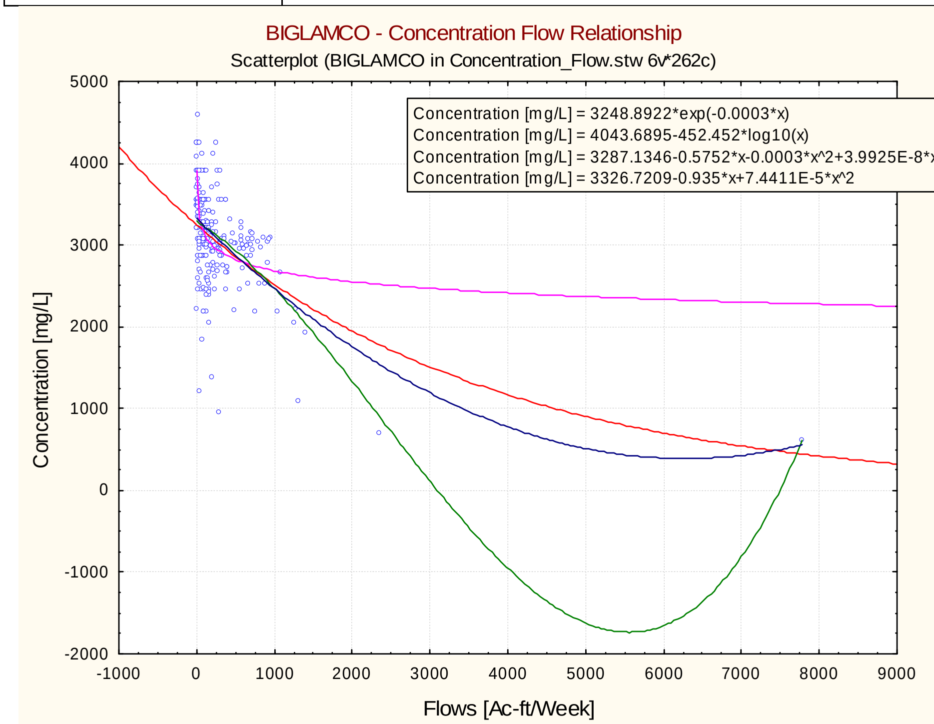
Name	ARKLAMCO
Period Available	1963 – 2003 (510 Cases)
Non Linear Equation	y=(4717.8)+(-355.25)*log(x)
Cases Excluded	None

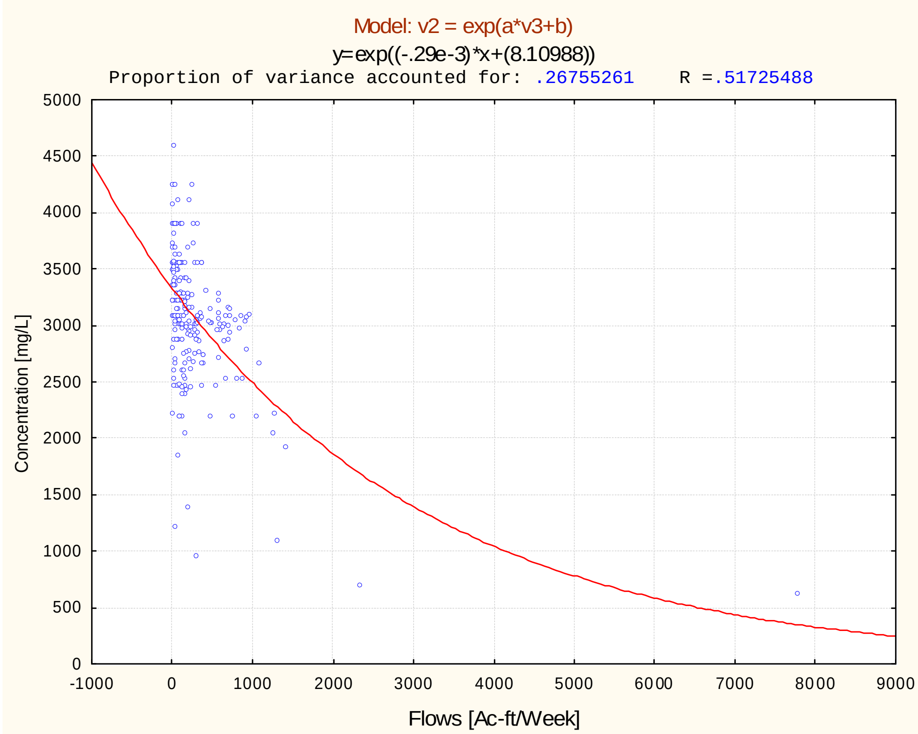




BIG SANDY CREEK NEAR LAMAR

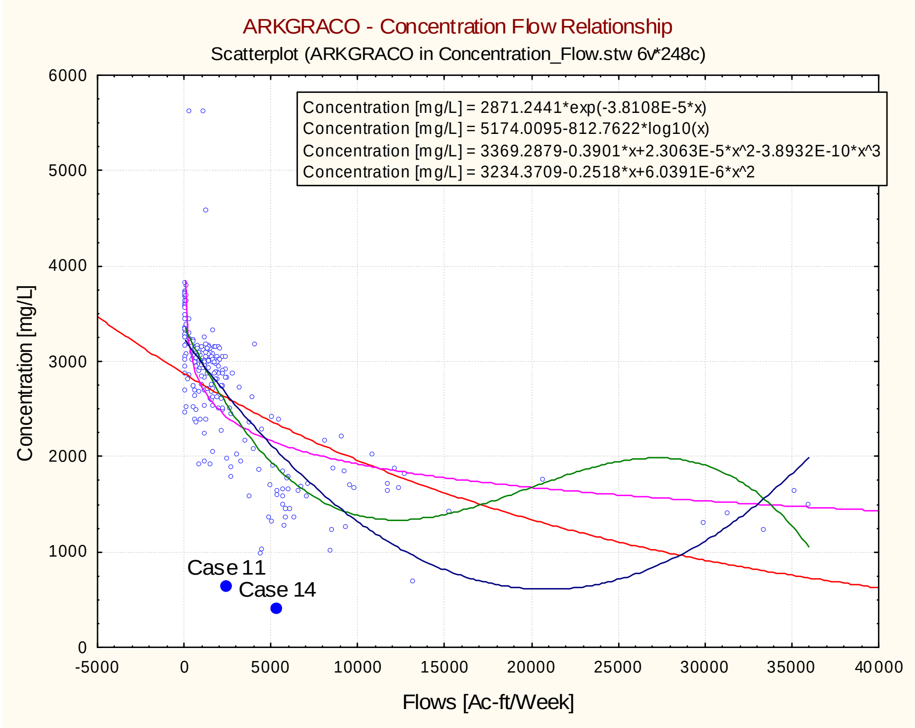
Name	BIGLAMCO
Period Available	1968 – 2003 (262 Cases)
Non Linear Equation	y=exp((-.29e-3)*x+(8.10988)) – Few cases for large flow exp function better behavior

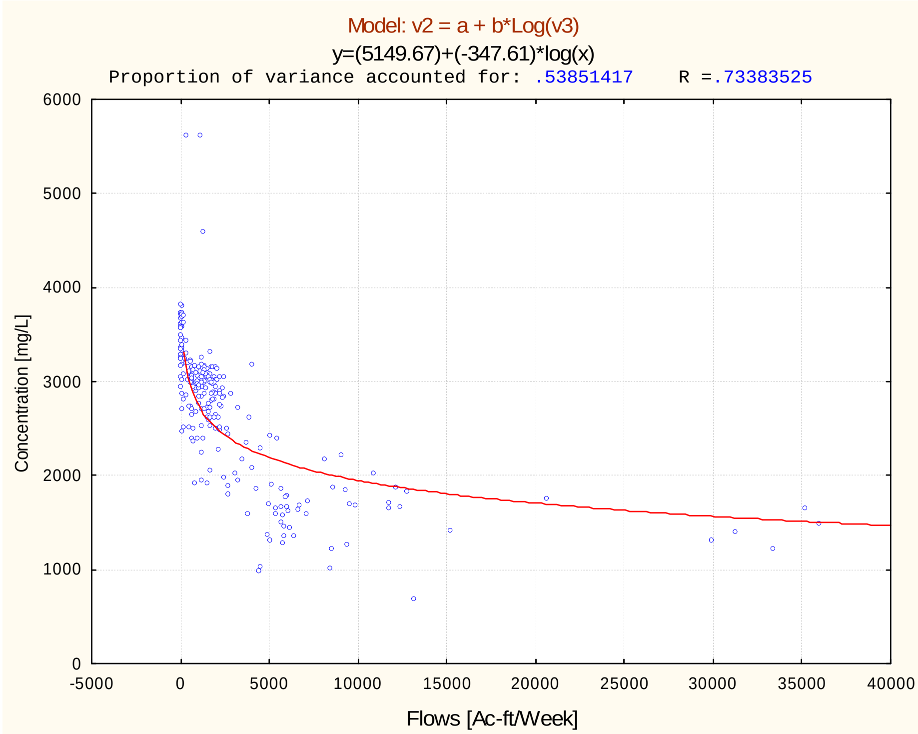




ARKANSAS RIVER NEAR GRANADA

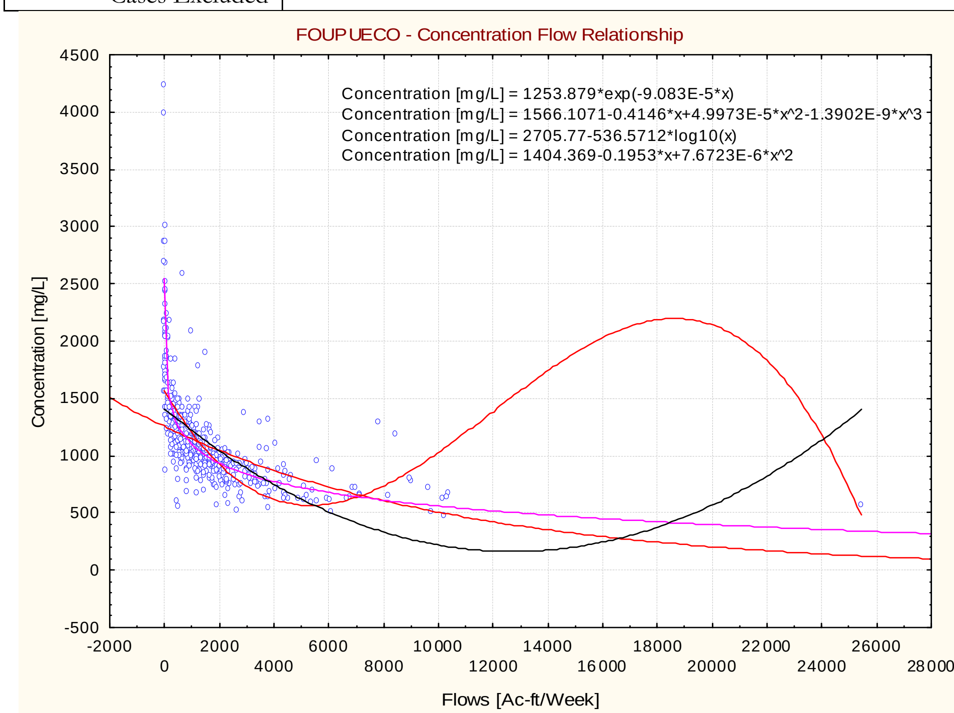
Name	ARKGRACO
Period Available	1981 – 2003 (248 Cases)
Non Linear Equation	y=(5149.67)+(-347.61)*log(x) – Better behavior for large flows
Cases Excluded	11,14

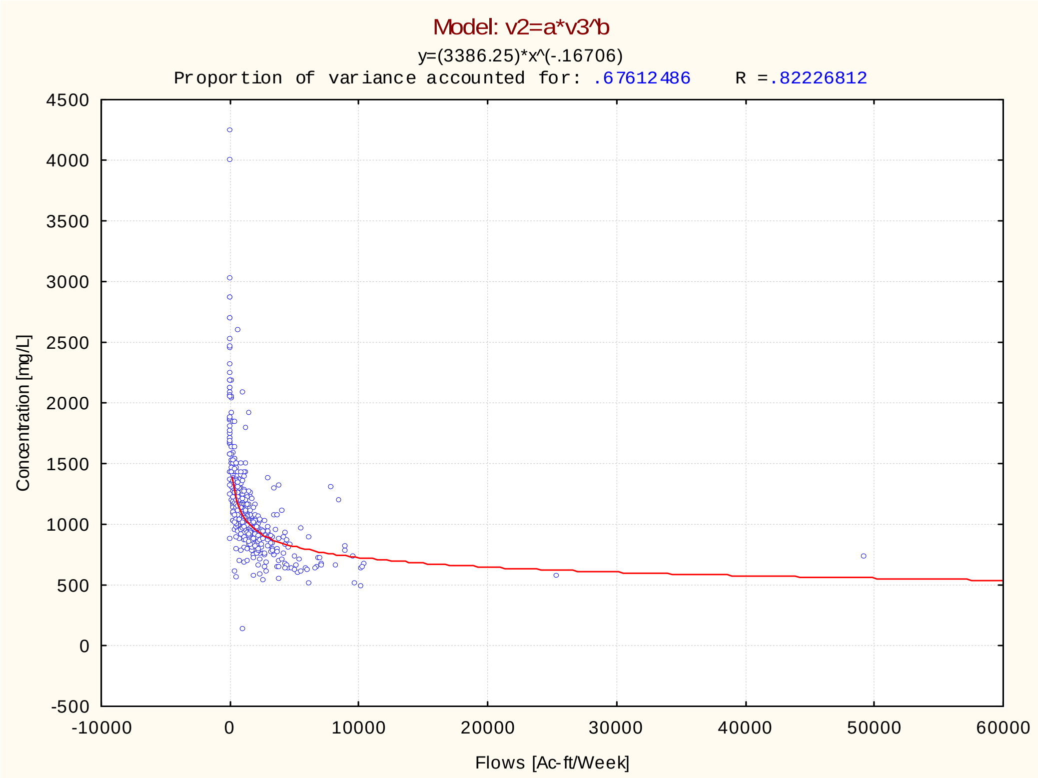




FOUNTAIN CREEK AT PUEBLO

Name	FOUPUECO
Period Available	1963 – 2004 (584 Cases)
Non Linear Equation	y=(3386.25)*x^0.1671
Cases Excluded	





IMPORTING WATER RIGHTS FROM THE CDWR DATABASE

The water rights database contains the CDWR *Admin Number* in the *HNUMBER* field, which is an indicator of the priority as a float number. This number takes into account rules in decrees in which the law prioritize rights differently than the prior date rule.

The current CDWR database implements code fields in the following fields:

1. *adj_type*: O (Original) or S (Supplemental)
2. *status_type*: A (Absolute) or C (Conditional). Sometimes there is a C followed by an A.
3. *tranfer_type*: TT (transfer To) or TF (Transfer From)
4. *assoc_type*: AP (Alternate Point) or EX (Exchange)
5. *aband*: AB (Abandoned)

The column *adj_type* is not processed because both original and supplemental implies a positive amount in the water right calculation. The *Status_type* column is processed to account for *CA* cases, which are a conditional right made absolute. This entry should not repeat the conditional entry. Separate entries are found for *TT* and *TF* transactions. These amounts are correspondingly added/subtracted from the original right and the new point of diversion (these entries have the same *AdminNo*). *AP* transaction will be assigned to a separate water right entry for further processing. *AB* transactions are subtracted from the original right. *EX* transactions are added to the water right amount.

The *LAR GeoDSS Water Rights Import* tool reads the user specified water rights database for all the demand nodes in the network that contain a Water District (*WD*) and the structure id (*ID*). Entries for each structure are queried initially grouping them by the *HNUMBER*. Later for each *HNUMBER*, the entries are processed according to the information provided by code fields and rules explained above. The result of this operation is added to the MODSIM water right control. All the processed transactions are added to the comments (*Notes*) field. In the import operation, the *HNUMBER* is imported into the cost field.

A conversion factor of 13.8842 is used to convert from the database original units (cfs) to acre-ft/week. The rights associated cost are set starting at -5000 for the most senior and adding 10 units to the subsequent right chronologically ordered by adjudication date. The CDWR *HNUMBER* field in the database, imported into the *cost* column, is used to sort the rights entries. This number cannot be used directly as cost because it is positive. The seasonal capacity of the Fort Lyon Canal is set to 15229 acre-ft according to the note on the water right database entry. At this stage, the *Southern Col power* node is not connected to the network making all the water rights associated with it to be discarded.

The alternate points of diversion are flagged in the description of the water right for later processing (when creating the APD using the *LAR GeoDSS* tool). The name convention for the storage links includes the (*WD*)*ID* after the string "_OWNER_AT" corresponding to the place where water is stored.

Table V-1 presents the processed water rights implemented in the *LAR GeoDSS*. The amounts are expressed in acre-ft/week. The cost column shows the MODSIM modeled link cost. The notes column contains the summary of the transactions used to compute each right.

Table V-1 – Modeled Water Rights in the *LAR GeoDSS*

Demand Node	Water Right Date	Amount	Cost	Notes
Booth_Ditch	4/1/1861	0	-5000	_APD_TO_(14)501 4109 BOOTH DITCH(|6.2->0:ALT PT TO WARRANT BARNES & BAXTER FOR MUNICIPAL USE ONLY|)
Booth_Ditch	4/1/1861	0	-4990	_APD_TO_(14)591 4109 BOOTH DITCH(|0.8->0:REMAINS AS ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Southside	4/1/1861	0	-4980	_APD_TO_(14)501 4109 PBWW SOUTHSIDE INTAKE(|0.8->0:ALT PT TO WARRANT BARNES & BAXTER FOR MUNICIPAL USE ONLY||6.2->0:ALT PT TO WARRANT BARNES & BAXTER FOR MUNICIPAL USE ONLY|)
Bessemer_Ditch	4/30/1861	28	-4960	4138 BESSEMER DITCH(|2:TF WARRANT BARNES & BAXTER 11/28/1903||0:CHANGE 166.745 SHARES TO INCLUDE DOMESTIC USE ST CHARLES MESA WD|)
Booth_Ditch	4/30/1861	11	-4950	4138 BOOTH DITCH(|0.8:TF WARRANT BARNES & BAXTER DITCH 501 3/10/1903|)
Bessemer_Ditch	12/31/1861	278	-4940	4383 BESSEMER DITCH(|20:TF EXCELSIOR DITCH|)
Excelsior_Ditch	12/31/1861	0	-4930	4383 EXCELSIOR DITCH(|60:ORIGINAL RIGHT||40->-40:TT ROCKY FORD HIGHLINE||20->-20:TT BESSEMER DITCH|)
Rocky_Fort_Highline	12/31/1861	555	-4920	4383 ROCKY FORD HIGHLINE(|40:TF EXCELSIOR DITCH|)
Booth_Ditch	4/1/1864	0	-4900	_APD_TO_(14)591 5205 BOOTH DITCH(|8->0:REMAINS AS ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Southside	4/1/1864	0	-4890	_APD_TO_(14)591 5205 PBWW SOUTHSIDE INTAKE(|8->0:ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
Bessemer_Ditch	5/31/1864	52	-4870	5265 BESSEMER DITCH(|3.74:TF CANON CITY & OIL CREEK 509 IN DIST 12 (FREMONT COUNTY DECREE)|)

Bessemer_Ditch	6/30/1866	42	-4860	6025 BESSEMER DITCH(|3:TF ROGERS DITCH 586 IN ORIGINAL ADJ|)
Bessemer_Ditch	7/31/1866	0	-4850	6056 BESSEMER DITCH(|1.2->0:ALT PT TO COTTONWOOD IRRIGATING 2 936 IN DIST 11 LTD 1183 AF/YR|)
Bessemer_Ditch	12/31/1866	0	-4830	6209 BESSEMER DITCH(|1.2->0:ALT PT TO KELLER PUMP 710 (ZOELLER) IN DISTRICT 15|)
Bessemer_Ditch	1/8/1867	35	-4810	6217 BESSEMER DITCH(|2.5:TF ARKANSAS DITCH|)
Bessemer_Ditch	5/31/1867	71	-4800	6360 BESSEMER DITCH(|5.13:TF CANON CITY & OIL CREEK 509 IN DIST 12 (FREMONT COUNTY DECREE)|)
Rocky_Fort_Highline	9/21/1867	8	-4790	6473 ROCKY FORD HIGHLINE(|0.6:TF ENTERPRISE DITCH IN ORIGINAL ADJ|)
Oxford_F_Ditch	9/21/1867	186	-4780	6473 OXFORD FARMERS DITCH(|13.4->13.4:TF ENTERPRISE DITCH IN ORIGINAL ADJ; SEE 84CW179 WINTER WATER|)
Rocky_Fort_Highline	7/1/1869	222	-4770	7122 ROCKY FORD HIGHLINE(|16:TF BALLOW HILL DITCH 505 04/27/1900|)
PBWW_Northside	5/31/1870	23	-4750	7456 PBWW NORTHSIDE INTAKE(|1.666:TF RICHIE DITCH 583|)
Bessemer_Ditch	11/30/1870	20	-4730	7639 BESSEMER DITCH(|1.47:TF HAMP-BELL DITCH|)
Hamp-Bell_Ditch	11/30/1870	14	-4720	7639 HAMP-BELL DITCH(|2.5:ORIGINAL RIGHT||1.47->-1.47:TT BESSEMER DITCH|)
Bessemer_Ditch	12/31/1870	47	-4710	7670 BESSEMER DITCH(|3.4:TF BARNUM DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
PBWW_Southside	1/31/1871	6	-4700	7701 PBWW SOUTHSIDE INTAKE(|0.4:TF BROOKS DITCH 780|)
PBWW_Northside	1/31/1871	11	-4690	7701 PBWW NORTHSIDE INTAKE(|0.8:TF BROOKS DITCH 780|)
PBWW_Northside	1/31/1871	0	-4680	_APD_TO_(14)590 7701 PBWW NORTHSIDE INTAKE(|0.4->0:ALT PT TO PBWW SS INTAKE (BROOKS DITCH PRIORITY)|)
Keesee_Ditch	3/13/1871	125	-4670	7742 KEESEE DITCH(|9:ORIGINAL RIGHT|)
PBWW_Southside	3/31/1871	22	-4660	7760 PBWW SOUTHSIDE INTAKE(|1.6:TF HOBSON DITCH 573|)
PBWW_Northside	3/31/1871	0	-4650	_APD_TO_(14)590 7760 PBWW NORTHSIDE INTAKE(|1.6->0:ALT PT TO SS INTAKE (HOBSON DITCH PRIORITY)|)
Booth_Ditch	12/31/1871	14	-4640	8035 BOOTH DITCH(|1:ORIGINAL RIGHT|)
Booth_Ditch	12/31/1871	0	-4630	_APD_TO_(14)591 8035 BOOTH DITCH(|1->0:REMAINS AS ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Southside	12/31/1871	0	-4620	_APD_TO_(14)591 8035 PBWW SOUTHSIDE INTAKE(|1->0:ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Northside	12/31/1871	0	-4610	_APD_TO_(14)591 8035 PBWW NORTHSIDE INTAKE(|1->0:ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Southside	3/21/1872	21	-4600	8116 PBWW SOUTHSIDE INTAKE(|1.533->1.533:TF FIELDS DITCH 781|)
PBWW_Northside	3/21/1872	43	-4590	8116 PBWW NORTHSIDE INTAKE(|3.067->3.067:TF FIELDS DITCH 781|)
PBWW_Northside	3/21/1872	0	-4580	_APD_TO_(14)590 8116 PBWW NORTHSIDE INTAKE(|1.533->0:ALT PT TO PBWW SS INTAKE (FIELDS DITCH PRIORITY)|)
PBWW_Southside	4/1/1872	0	-4570	_APD_TO_(14)535 8127 PBWW SOUTHSIDE INTAKE(|1.1556->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
Bessemer_Ditch	12/31/1872	0	-4550	8401 BESSEMER DITCH(|2.6->0:ALT PT TO COTTONWOOD IRRIGATING 2 936 IN DIST 11 LTD 1183 AF/YR|)
Bessemer_Ditch	9/18/1873	28	-4530	8662 BESSEMER DITCH(|2:TF CAPE HORN RANCH DITCH PRIOR TO 1899 - NO DECREE|)
Bessemer_Ditch	12/31/1873	0	-4520	8766 BESSEMER DITCH(|0.15->0:ALT PT TO KELLER PUMP 710 (ZOELLER) IN DISTRICT 15|)
PBWW_Southside	4/1/1874	347	-4500	8857 PBWW SOUTHSIDE INTAKE(|25:ORIGINAL SS RIGHT|)
PBWW_Southside	4/1/1874	0	-4490	_APD_TO_(14)535 8857 PBWW SOUTHSIDE INTAKE(|0.963->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)

PBWW_Northside	4/1/1874	278	-4480	8857 PBWW NORTHSIDE INTAKE(|20:ORIGINAL NORTHSIDE INTAKE RIGHT|)
PBWW_Northside	4/1/1874	0	-4470	_APD_TO_(14)535 8857 PBWW NORTHSIDE INTAKE(|0.963->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
PBWW_Northside	4/1/1874	0	-4460	_APD_TO_(14)590 8857 PBWW NORTHSIDE INTAKE(|25->0:ALT PT TO PBWW SS INTAKE ORIGINAL RIGHT|)
Rocky Ford Ditch	5/15/1874	1552	-4450	8901 ROCKY FORD DITCH(|111.76:DIVERSIONS LIMITED SEE 83CW0018 AWARDED APD AT PUEBLO RESERVOIR|)
Catlin_Canal	4/10/1875	305	-4440	9231 CATLIN CANAL(|22:TF LAS ANIMAS CONSOLIDATED (JONES) ADMINISTERED AS 12/03/1884|)
Las_Animas_Consol	4/10/1875	310	-4430	9231 LAS ANIMAS CONSOLIDATED(|44.3->44.3:AKA JONES DITCH (ID 671) ADMINISTERED AS 12/3/1884 SEE 80CW052||22->-22:TT CATLIN CANAL ID 552|)
Lamar_Canal	11/30/1875	219	-4420	9465 LAMAR CANAL(|15.75:ORIGINAL RIGHT WITH 2 ALT PTS IN ORIGINAL DECREE|)
Bessemer_Ditch	12/31/1876	42	-4410	9862 BESSEMER DITCH(|2.5:TF CAPE HORN RANCH DITCH PRIOR TO 1899 - NO DECREE||0.5:TF CAPE HORN RANCH DITCH|)
PBWW_Southside	10/1/1878	0	-4400	_APD_TO_(14)535 10501 PBWW SOUTHSIDE INTAKE(|0.5778->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
PBWW_Northside	10/1/1878	0	-4390	_APD_TO_(14)535 10501 PBWW NORTHSIDE INTAKE(|0.5778->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
Bessemer_Ditch	12/31/1878	6	-4380	10592 BESSEMER DITCH(|0.41->0.41:TF HAMP-BELL DITCH|)
Hamp-Bell_Ditch	12/31/1878	4	-4370	10592 HAMP-BELL DITCH(|0.7->0.7:ORIGINAL RIGHT||0.41->-0.41:TT BESSEMER DITCH|)
Bessemer_Ditch	5/4/1881	194	-4360	11447 BESSEMER DITCH(|14:TF COLLIER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Collier_Ditch	5/4/1881	0	-4350	11447 COLLIER DITCH(|14:ORIGINAL RIGHT||14->-14:TT BESSEMER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Bessemer_Ditch	6/20/1881	28	-4340	11494 BESSEMER DITCH(|2:TF I.N. SATER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Booth_Ditch	12/31/1881	28	-4330	11688 BOOTH DITCH(|2:ORIGINAL RIGHT|)
Booth_Ditch	12/31/1881	0	-4320	_APD_TO_(14)591 11688 BOOTH DITCH(|2->0:REMAINS AS ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Southside	12/31/1881	0	-4310	_APD_TO_(14)589 11688 PBWW SOUTHSIDE INTAKE(|2->0:ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
PBWW_Northside	12/31/1881	0	-4300	_APD_TO_(14)591 11688 PBWW NORTHSIDE INTAKE(|2->0:ALT PT TO BOOTH DITCH FOR MUNICIPAL USE ONLY|)
Bessemer_Ditch	3/31/1882	111	-4290	11778 BESSEMER DITCH(|8:TF COLLIER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Collier_Ditch	5/31/1882	111	-4280	11839 COLLIER DITCH(|8:TF CAWLFIELD NO 2 IN ORIGINAL ADJ|)
Bessemer_Ditch	12/31/1882	0	-4270	12053 BESSEMER DITCH(|0.6->0:ALT PT TO KELLER PUMP 710 (ZOELLER) IN DISTRICT 15|)
PBWW_Southside	12/31/1883	0	-4240	_APD_TO_(14)535 12418 PBWW SOUTHSIDE INTAKE(|0.3852->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
PBWW_Northside	12/31/1883	0	-4230	_APD_TO_(14)535 12418 PBWW NORTHSIDE INTAKE(|0.3852->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
Keesee_Ditch	12/31/1883	62	-4220	12418 KEESEE DITCH(|4.5:ORIGINAL RIGHT|)
Rocky_Fort_Highline	3/7/1884	451	-4210	12485 ROCKY FORD HIGHLINE(|32.5:TF LAS ANIMAS CONSOLIDATED 556 IN DISTRICT 17|)
Las_Animas_Consol	3/7/1884	76	-4200	12485 LAS ANIMAS CONSOLIDATED(|5.5:TF LAS ANIMAS TOWN DITCH ID 652 SEE 95CW156 & 80CW052|)
Animas_Town_Ditch	3/7/1884	0	-4190	12485 LAS ANIMAS TOWN DITCH(|38:ORIGINAL RIGHT||5.5->-5.5:TT LAS ANIMAS CONSOLIDATED ID 556||32.5->-32.5:TT ROCKY FORD HIGHLINE ID 542 IN DISTRICT 14|)

Fort_Lyon_Storage	4/15/1884	0	-4180	_APD_TO_(17)553 12524 FORT LYON STORAGE CANAL(|164.64->0:APD UNDER FORT LYON WW DECREE, NOT ACTIVE IN LIEU OF 84CW179|)
Fort_Lyon_Canal	4/15/1884	2286	-4170	12524 FORT LYON CANAL(|164.64->164.64:ORIGINAL RIGHT|)
Catlin_Canal	12/3/1884	3443	-4160	12756 CATLIN CANAL(|248:ORIGINAL RIGHT|)
Catlin_Canal	12/3/1884	-305	-4150	12756 CATLIN CANAL(|22->-22:TT LAS ANIMAS CONSOLIDATED ID 556|)
Las_Animas_Consol	12/3/1884	305	-4140	12756 LAS ANIMAS CONSOLIDATED(|22:TF CATLIN CANAL ID 552 SEE ALSO 80CW052|)
Bessemer_Ditch	12/31/1884	0	-4130	12784 BESSEMER DITCH(|0.6->0:ALT PT TO KELLER PUMP 710 (ZOELLER) IN DISTRICT 15|)
Buffalo_Canal	1/29/1885	937	-4110	12813 BUFFALO CANAL (ARKANSAS)(|67.5:ORIGINAL RIGHT|)
Rocky_Fort_Highline	6/30/1885	417	-4100	12965 ROCKY FORD HIGHLINE(|30:TF BALLOW HILL DITCH 505 04/27/1900|)
Rocky_Fort_Highline	3/11/1886	28	-4090	13219 ROCKY FORD HIGHLINE(|2:TF ALLEN DITCH IN ORIGINAL ADJ|)
PBWW_Southside	4/1/1886	34	-4080	13240 PBWW SOUTHSIDE INTAKE(|2.46:TF HOBSON DITCH 573|)
PBWW_Northside	4/1/1886	0	-4070	_APD_TO_(14)590 13240 PBWW NORTHSIDE INTAKE(|2.46->0:ALT PT TO SS INTAKE (HOBSON DITCH PRIORITY)|)
Fort_Bent_Canal	4/1/1886	386	-4060	13240 FORT BENT CANAL(|27.77:ORIGINAL RIGHT|)
Lamar_Canal	11/4/1886	1001	-4050	13457 LAMAR CANAL(|72.09->72.09:ORIGINAL RIGHT WITH 2 ALT PTS IN ORIGINAL DECREE|)
Amity_Canal	2/21/1887	3936	-4040	13566 AMITY CANAL(|283.5:|)
Oxford_F_Ditch	2/26/1887	1611	-4030	13571 OXFORD FARMERS DITCH(|116:ORIGINAL RIGHT|)
Fort_Lyon_Storage	3/1/1887	0	-4020	_APD_TO_(17)553 13574 FORT LYON STORAGE CANAL(|597.16->0:APD UNDER FORT LYON WW DECREE, NOT ACTIVE IN LIEU OF 84CW179|)
Fort_Lyon_Canal	3/1/1887	8291	-4010	13574 FORT LYON CANAL(|597.16->597.16:ORIGINAL RIGHT|)
Collier_Ditch	3/10/1887	56	-4000	13583 COLLIER DITCH(|4:TF CAWLFIELD NO 2 IN ORIGINAL ADJ|)
Lamar_Canal	4/16/1887	189	-3990	13620 LAMAR CANAL(|13.64:ORIGINAL RIGHT WITH 2 ALT PTS IN ORIGINAL DECREE|)
Bessemer_Ditch	5/1/1887	4471	-3980	13635 BESSEMER DITCH(|364:ORIGINAL RIGHT||20->-20:TT EXCELSIOR DITCH||22->-22:TT COLLIER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Excelsior_Ditch	5/1/1887	278	-3970	13635 EXCELSIOR DITCH(|20:TF BESSEMER DITCH|)
Collier_Ditch	5/1/1887	305	-3960	13635 COLLIER DITCH(|22:TF BESSEMER DITCH PRIOR TO TRANSFER STATUTE OF 1899 - NO DECREE|)
Hyde_Ditch	5/10/1887	325	-3950	13644 HYDE DITCH(|23.44:ORIGINAL RIGHT|)
Catlin_Canal	11/14/1887	1347	-3940	13832 CATLIN CANAL(|97:ORIGINAL RIGHT|)
PBWW_Southside	12/17/1887	0	-3930	_APD_TO_(14)535 13865 PBWW SOUTHSIDE INTAKE(|14.445->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
PBWW_Northside	12/17/1887	0	-3920	_APD_TO_(14)535 13865 PBWW NORTHSIDE INTAKE(|14.445->0:APD FROM WEST PUEBLO DITCH FOR ALL USES|)
Las_Animas_Consol	3/13/1888	1111	-3910	13952 LAS ANIMAS CONSOLIDATED(|80:AKA RIVERSIDE DITCH (ID 672) SEE ALSO 80CW052|)
Booth_Ditch	3/30/1888	0	-3900	13969 BOOTH DITCH(|2.1->2.1:ORIGINAL RIGHT; MUELLER & GOLDSMITH ENL & EXT||2.1->-2.1:ABANDONED W-145; MUELLER & GOLDSMITH ENL & EXT|)
Hamp-Bell_Ditch	12/31/1888	22	-3890	14245 HAMP-BELL DITCH(|1.6:ORIGINAL RIGHT|)
Fort_Bent_Canal	3/10/1889	455	-3880	14314 FORT BENT CANAL(|32.77:|)
X-Y_Canal	7/22/1889	958	-3870	14448 X-Y IRRIGATING DITCH(|69:ORIGINAL RIGHT|)
Fort_Lyon_Canal	8/12/1889	4932	-3860	14469 FORT LYON CANAL(|355.2:FOR STORAGE IN PRINCE RES TT THURSTON RES SEE W-27|)
Fort_Bent_Canal	9/11/1889	162	-3850	14499 FORT BENT CANAL(|11.7->11.7:|)
Lamar_Canal	9/11/1889	0	-3840	14499 LAMAR CANAL(|11.7->11.7:ORIGINAL RIGHT WITH 2 ALT PTS IN ORIGINAL DECREE||11.7->-11.7:|)
Holbrook_Canal	9/25/1889	2152	-3830	14513 HOLBROOK CANAL(|155:ORIGINAL RIGHT AKA

				LAKE CANAL|)
Bessemer_Ditch	12/31/1889	0	-3820	14610 BESSEMER DITCH(|0.525->0:ALT PT TO KELLER PUMP 710 (ZOELLER) IN DISTRICT 15|)
Excelsior_Ditch	1/6/1890	555	-3800	14616 EXCELSIOR DITCH(|40:TF ROCKY FORD HIGHLINE CANAL|)
Rocky_Fort_Highline	1/6/1890	5248	-3790	14616 ROCKY FORD HIGHLINE(|418:ORIGINAL RIGHT||40->-40:TT EXCELSIOR DITCH|)
Otero_Canal	3/3/1890	1708	-3780	14672 OTERO CANAL(|123:ORIGINAL RIGHT|)
Rocky Ford Ditch	5/6/1890	559	-3770	14736 ROCKY FORD DITCH(|96.54:ORIGINAL RIGHT LIMITED TO 8 CFS 840 AF/5YR PER 83CW018||56.28->-56.28:ORIGINAL RIGHT PARTIALLY ABANDONED|)
Colorado_Canal	6/9/1890	10500	-3760	14770 COLORADO CANAL(|756.28:ORIGINAL RIGHT; SEE 84CW179 WINTER WATER|)
Lamar_Canal	7/16/1890	2558	-3750	14807 LAMAR CANAL(|184.27:ORIGINAL RIGHT WITH 2 ALT PTS IN ORIGINAL DECREE|)
Fort_Bent_Canal	8/12/1890	372	-3740	14834 FORT BENT CANAL(|26.77:|)
Manvel_Canal	10/14/1890	750	-3730	14897 MANVEL CANAL(|54:ORIGINAL RIGHT|)
Rocky_Fort_Highline	12/31/1890	35	-3720	14975 ROCKY FORD HIGHLINE(|2.5:TF ALLEN DITCH IN ORIGINAL ADJ|)
Graham_Ditch	8/24/1891	847	-3710	15211 GRAHAM DITCH(|61:ORIGINAL RIGHT|)
Booth_Ditch	4/15/1893	0	-3700	15811 BOOTH DITCH(|3.2:ORIGINAL RIGHT; CHRISTIAN FINK ENL & EXT||0.8->-0.8:TT WARRANT BARNES & BAXTER DITCH 501 3/10/1903||2.4->-2.4:ABANDONED W-145|)
Holbrook_Canal	8/30/1893	6178	-3690	15948 HOLBROOK CANAL(|445:ORIGINAL RIGHT|)
Fort_Lyon_Storage	8/31/1893	0	-3680	_APD_TO_(17)553 15949 FORT LYON STORAGE CANAL(|171.2->0:APD UNDER FORT LYON WW DECREE, NOT ACTIVE IN LIEU OF 84CW179|)
Fort_Lyon_Canal	8/31/1893	2377	-3670	15949 FORT LYON CANAL(|171.2->171.2:ORIGINAL RIGHT|)
Fort_Lyon_Canal	8/1/1896	15967	-3660	20186.17015 FORT LYON CANAL(|1150:GREAT PLAINS RES SAME RIGHT AS TABULATED UNDER KICKINGBIRD ID 555|)
Kicking_Bird_Canal	8/1/1896	15967	-3650	20186.17015 KICKINGBIRD CANAL(|1150:CARRIED BY FT LYON MAIN CANAL TO STORAGE IN GREAT PLAINS RES|)
Fort_Lyon_Storage	9/29/1902	0	-3640	20186.19264 FORT LYON STORAGE CANAL(|400:FOR STORAGE IN HORSE & ADOBE CREEK RES CANCELLED BY 11/8/1928||400->-400:8/30/1922 DECREE CANCELLED BY 11/8/1928 DECREE|)
Otero_Canal	2/2/1903	4650	-3630	20186.1939 OTERO CANAL(|334.92:ORIGINAL RIGHT|)
Holbrook_Canal	10/10/1903	8331	-3620	20186.1964 HOLBROOK CANAL(|600:ORIGINAL RIGHT FOR STORAGE IN DYE RESERVOIR 3510|)
Fort_Lyon_Storage	1/25/1906	11663	-3610	20478 FORT LYON STORAGE CANAL(|840:FOR STORAGE IN HORSE & ADOBE CREEK RES AMENDS 8/30/22 & 2/23/27|)
SissonStubbs_Ditch	12/1/1891	250	-3600	20570.1531 SISSON & STUBBS DITCH 1(|18:ORIGINAL RIGHT|)
SissonStubbs_Ditch	12/1/1891	-76	-3590	20570.1531 SISSON & STUBBS DITCH 1(|5.5->-5.5:TT SISSON STUBBS WELL 17760 ID 5808|)
SissonStubbs_Ditch	12/1/1891	-76	-3580	20570.1531 SISSON & STUBBS DITCH 1(|5.5->-5.5:TT SISSON STUBBS WELL 17759 ID 5809|)
SissonStubbs_Ditch	12/1/1895	100	-3570	20570.16771 SISSON & STUBBS DITCH 1(|7.2->7.2:ORIGINAL RIGHT|)
SissonStubbs_Ditch	12/1/1895	-46	-3560	20570.16771 SISSON & STUBBS DITCH 1(|3.3->-3.3:TT TRUST WELL NO 2 ID 5609|)
SissonStubbs_Ditch	12/1/1895	-54	-3550	20570.16771 SISSON & STUBBS DITCH 1(|3.9->-3.9:TT TRUST WELL NO 1 ID 5610|)
Fort_Lyon_Storage	6/12/1908	11663	-3530	21347 FORT LYON STORAGE CANAL(|840:FOR STORAGE IN HORSE CREEK RES AMENDS 8/30/22 & 2/23/27 DECREES|)
Fort_Lyon_Storage	12/29/1908	11663	-3520	21547 FORT LYON STORAGE CANAL(|840:FOR STORAGE IN ADOBE CREEK RES AMENDS 8/30/22 & 2/23/27 DECREES|)
Consolidated_Ext	4/15/1909	622	-3510	21654 CONSOLIDATED EXTENSION(|44.8->44.8:DECREED @ HIGHLAND DITCH POINT OF DIVERSION SEE 80CW052|)
Fort_Bent_Canal	1/1/1893	694	-3500	21857.15707 FORT BENT CANAL(|50:ORIGINAL RIGHT|)

Amity_Canal	4/1/1893	6942	-3490	21857.15797 AMITY CANAL(|500:ORIGINAL RIGHT|)
Keesee_Ditch	9/3/1893	208	-3480	21857.15952 KEESEE DITCH(|15:ORIGINAL RIGHT|)
Fort_Bent_Canal	12/31/1900	1111	-3470	21857.18627 FORT BENT CANAL(|80:ORIGINAL RIGHT|)
Fort_Lyon_Storage	3/1/1910	20354	-3460	21974 FORT LYON STORAGE CANAL(|1466:FOR STORAGE IN HORSE & ADOBE CREEK RES AMENDS 8/30/22 & 2/23/27|)
Fort_Lyon_Canal	4/24/1980	7553	-3450	47596 FORT LYON CANAL(|544:EXCHANGE FROM JOHN MARTIN RES ART III LTD TO 15,228.95 AF/YR|)
Fort_Lyon_Canal	4/24/1980	8414	-3440	51134.47596 FORT LYON CANAL(|606:CONDITIONAL EXCHANGE FROM JOHN MARTIN RES ART III|)
Baldwin_Stubbs	11/30/1907	305	0	21152 BALDWIN STUBBS DITCH(|22:ORIGINAL RIGHT|)
Riverside_Diary	1/1/1883	14	0	12054 RIVERSIDE DAIRY DITCH(|1:SEE 84CW179 WINTER WATER|)

MODELING ALTERNATE POINTS OF DIVERSION (APD)

Capacities on the APD links are set to historical diversions in three steps. First, the routine searches for all the entries containing the flag T=4 in the diversion records database and assures that there exist links to model these diversions. While creating the APD modeling links, all links in the network are checked for flags created during the water rights processing. If the link description starts with "_APF_TO_" then the name is changed in preparation for the population of historical diversions. If no link is found with the corresponding flag a new link is created in the network at the location of the alternate diversion. If a new link is created, it is tagged with a description that starts with "Alternate Point of Diversion of (". The APDs have a link cost of -80000 minus the link number, to overcome any natural flow right in the system for water allocation. The APD links have a name that starts with the name of the node that are flowing to followed by "_APD_TO_" and the "(*WD*)*ID*" of the structure to which the water right belongs to. *WD* = the CDWR water district id, *ID* = the CDWR structure id. The created water rights include the *alter_Wd* and *alter_ID* in their names. APDs are not modeled when its *alter_WD* and *alter_ID* is not present in the network. It is assumed that the database records totalize the alternate diversions in a single entry for each user (*WD-ID*). In cases where the same original owner has several rights at an APD (recorded in the water rights database) several flagged links will model flow to the APD node. Only the first link found will change its name for APD modeling, the other will remain in the network with zero capacity. Second, the database processing assigns the total diverted time series at the alternate point to the corresponding APD link capacity. The final step of the implementation consists in reducing the capacity of the original right by the amount of water diverted at the alternate point. This adjustment is achieved converting the original right link capacity to a variable time series link capacity; where, the capacity is calculated subtracting the alternate diversion from the original right for every single time step.

Since the links created based on the diversion records lack of information about the original right in the network, an error is introduced by modeling the diversion but not adjusting the original right, i.e., the original right is able to divert the full entitlement.

MODELING STORAGE WATER DIVERSION

A routine in the *LAR GeoDSS* is developed to query storage water data from the diversion records and automatically create a single or multiple storage owners links. The tool uses the field *S*=2 to identify diversion records belonging to storage water contracts. The links are created parallel to the water rights and APD links. The links are created as high priority link with a cost = -80000 minus the link number. The *F* field in the diversion records database provides information about the storage location of the water. The links name uses the information in the *F* field. The link name contains the diversion node name, followed by "_OWNER_AT_", and the *WD*(*ID*) of the source of the water structure. In the case of creating a single storage modeling link, the multiple source reservoir ids are inserted into the link description, the link name takes the first *WD*(*ID*) found in the database. Information coded in the link names could be used to carry water accounting of the reservoir water. Diversion records are assigned to time series of the storage contract modeling links capacity (acre-ft/week in this case study).

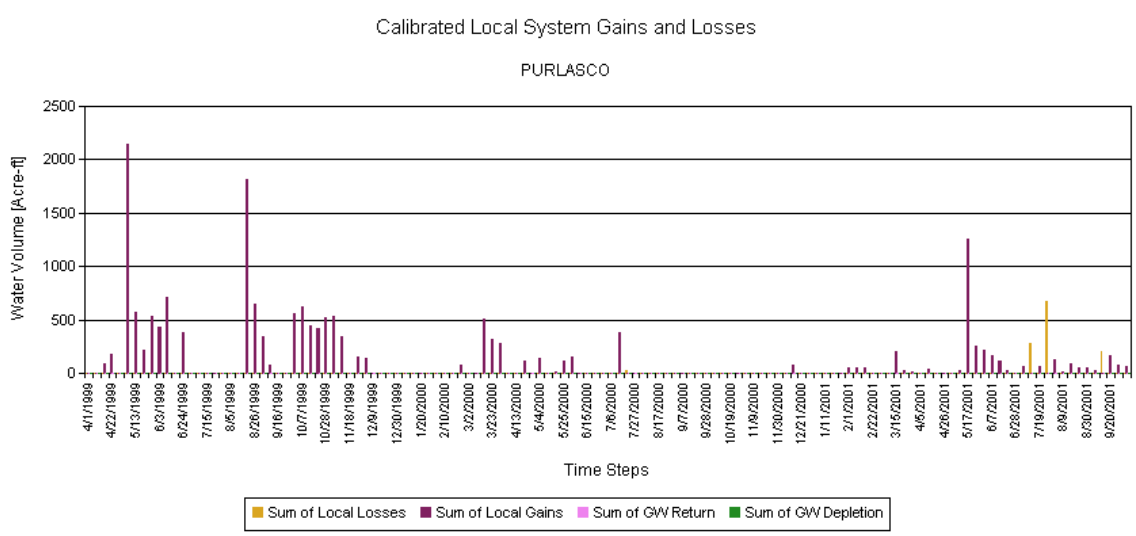
DETAILED GAINS AND LOSSES ANALYSIS

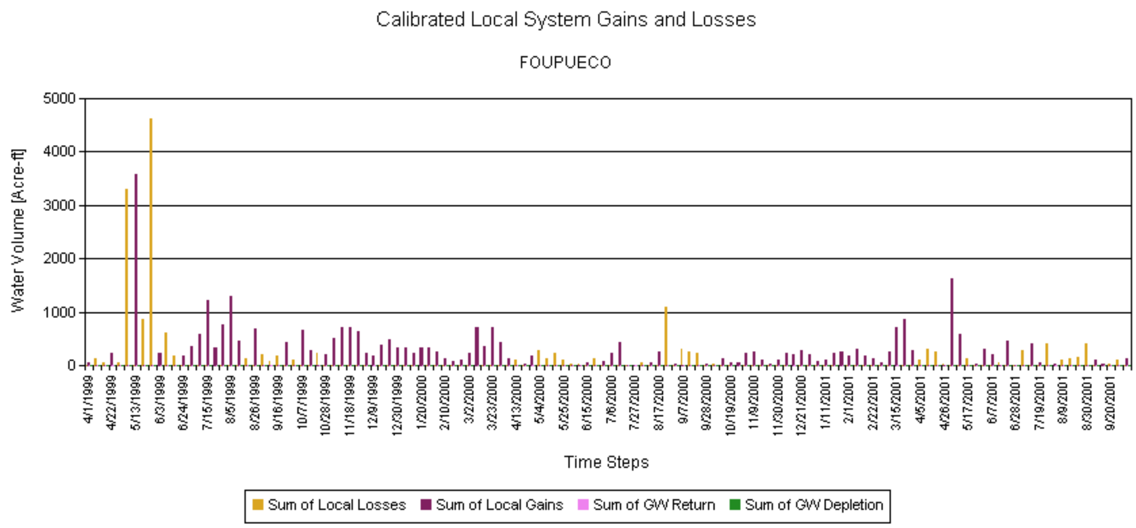
The following plots illustrate the local gains and losses for all the calibration reaches in the *LAR GeoDSS*. The analysis is carried out with and without ANN-based stream-aquifer interaction.

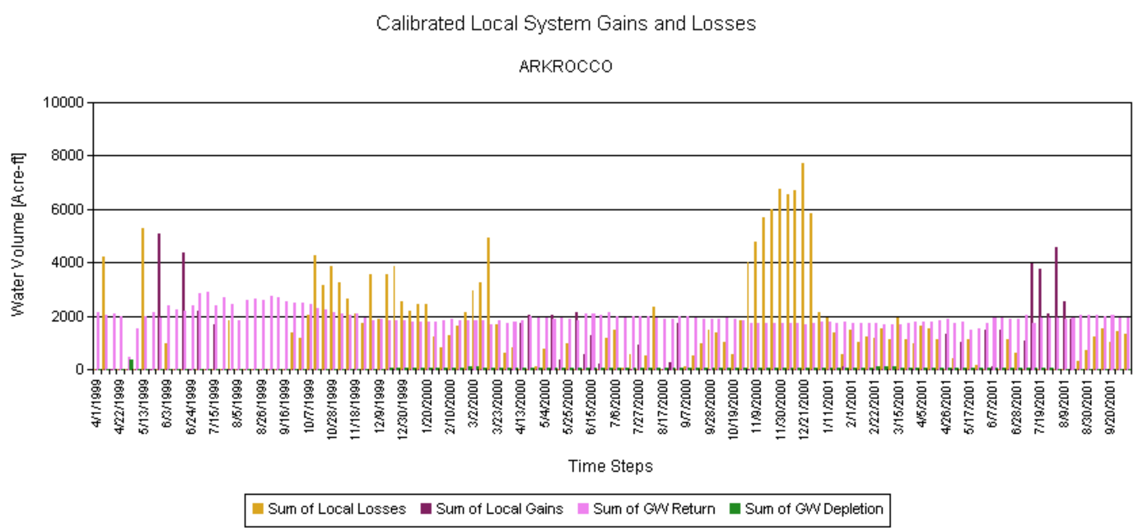
Calibration with ANN stream-aquifer Interaction Prediction

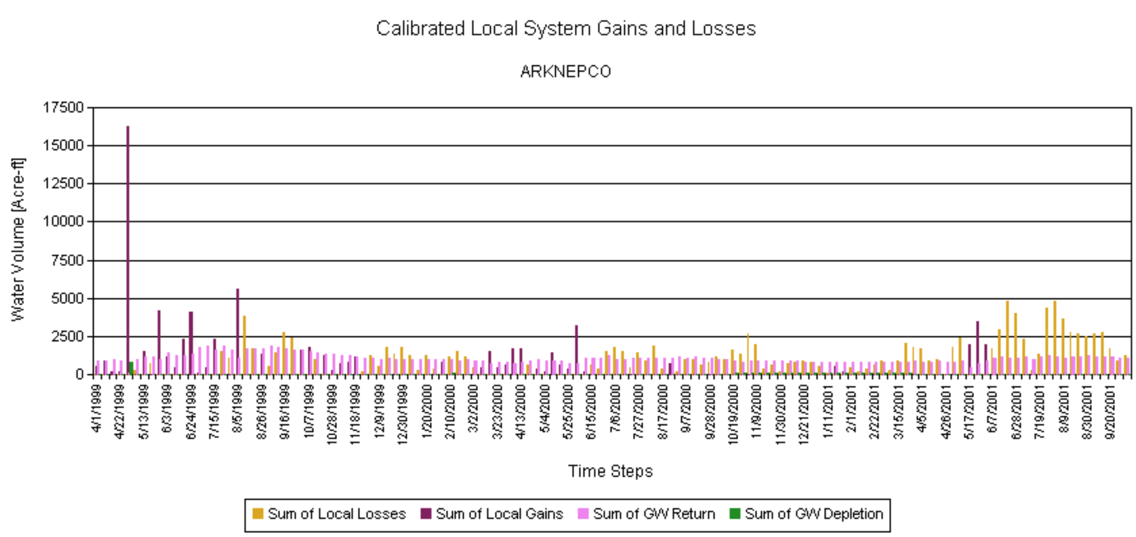
Intermediate Control Points Reaches

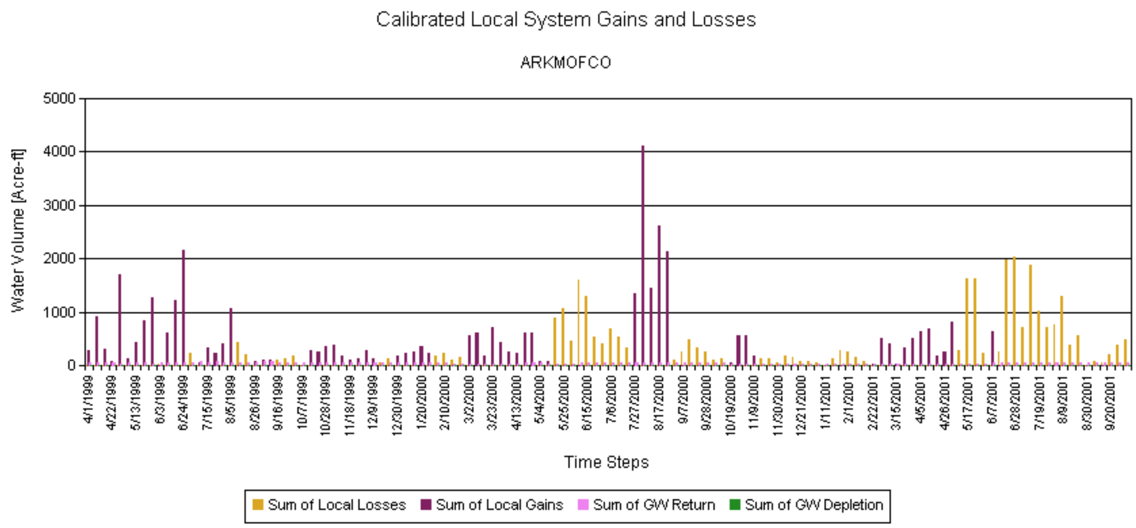
These results include summary of the total contributions of the ANN-based aquifer stream interaction Some of the calibration reaches outside the grouping areas don't model stream-aquifer interaction. In this cases, computed gains and losses include the stream-aquifer interaction.



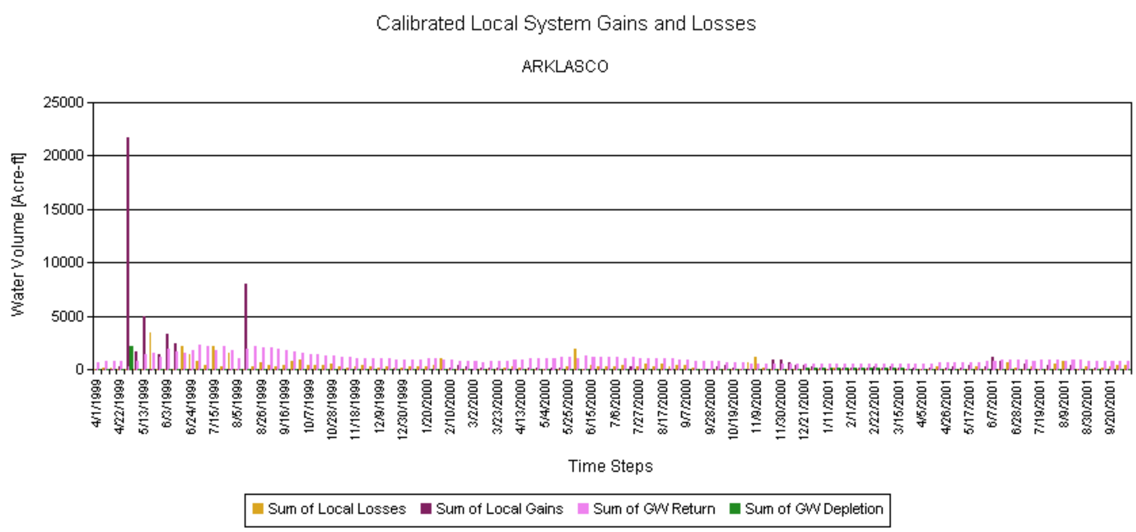

Calibrated Local System Gains and Losses
FOUPUECO
Water Volume [Acre-ft]
5000
4000
3000
2000
1000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion


Calibrated Local System Gains and Losses
ARKROCCO
Water Volume [Acre-ft]
10000
8000
6000
4000
2000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

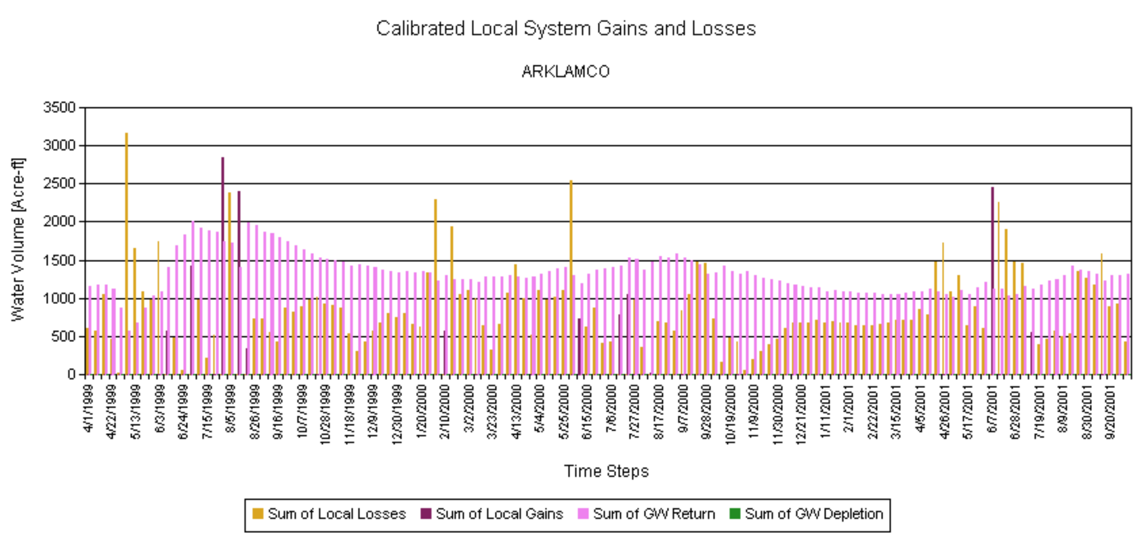

Calibrated Local System Gains and Losses
ARKNEPCO
Water Volume [Acre-ft]
17500
15000
12500
10000
7500
5000
2500
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion



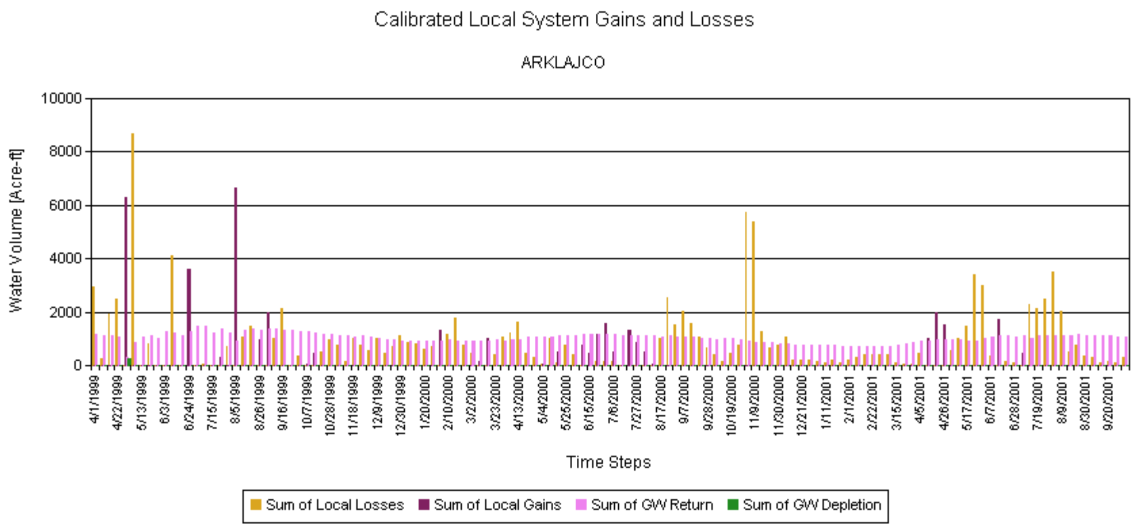
Calibrated Local System Gains and Losses
ARKMOFCO
Water Volume [Acre-ft]
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

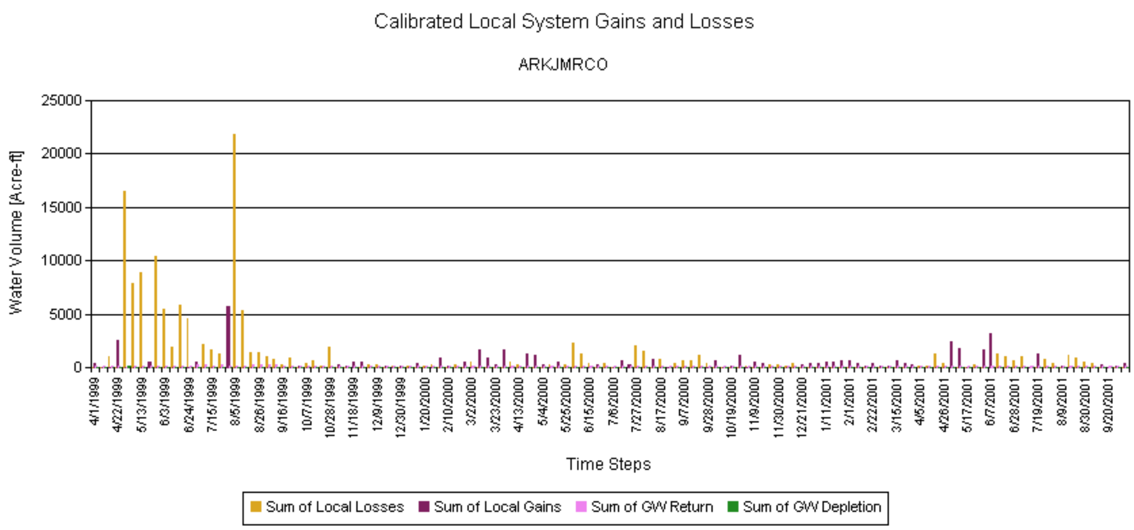


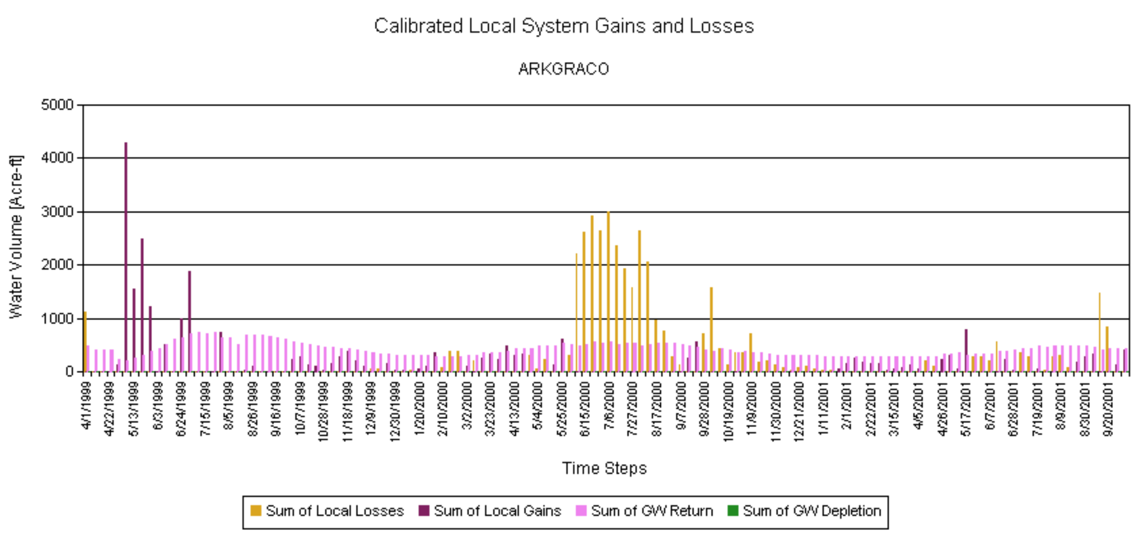
Calibrated Local System Gains and Losses
ARKLASCO
Water Volume [Acre-ft]
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion



Calibrated Local System Gains and Losses
ARKLAMCO
Water Volume [Acre-ft]
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

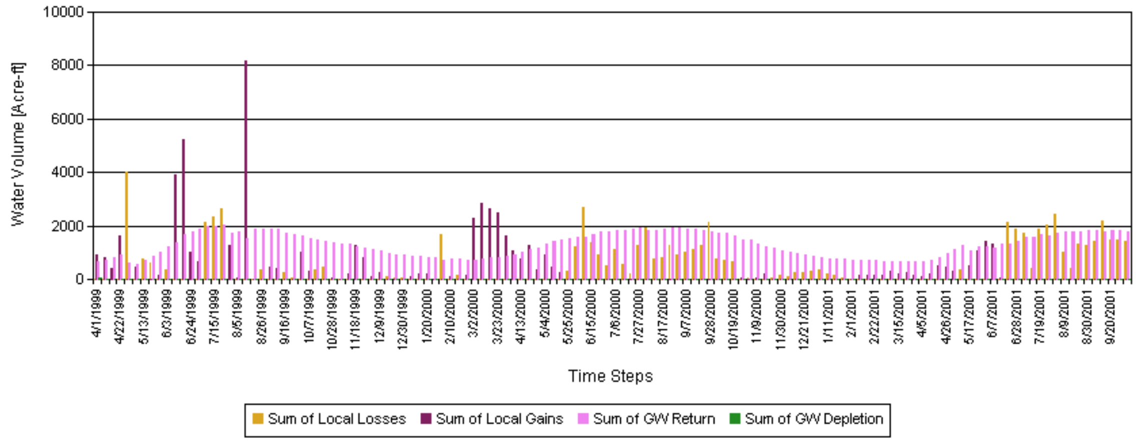

Calibrated Local System Gains and Losses
ARKLAJCO
Water Volume [Acre-ft]
10000
8000
6000
4000
2000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion


Calibrated Local System Gains and Losses
ARKJMRCO
Water Volume [Acre-ft]
25000
20000
15000
10000
5000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion


Calibrated Local System Gains and Losses
ARKGRACO
Water Volume [Acre-ft]
5000
4000
3000
2000
1000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

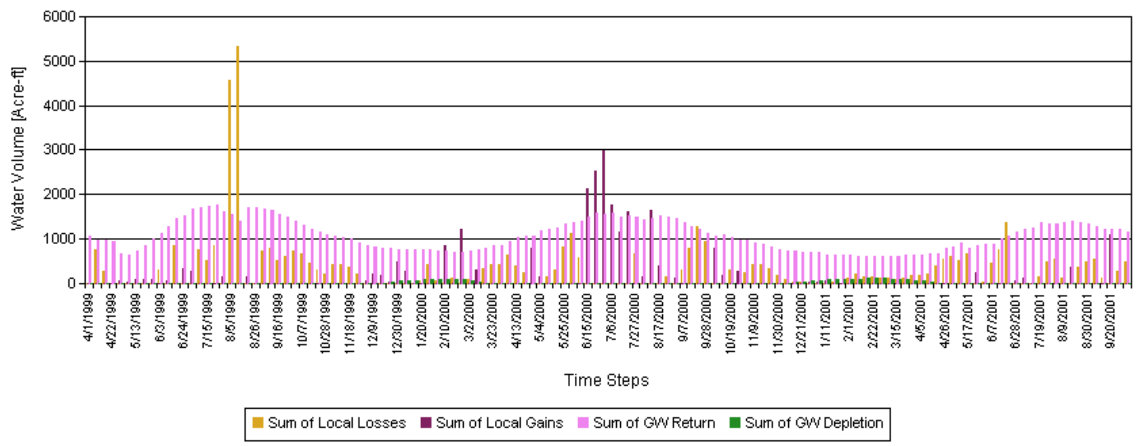
Calibrated Local System Gains and Losses

ARKCOOKS



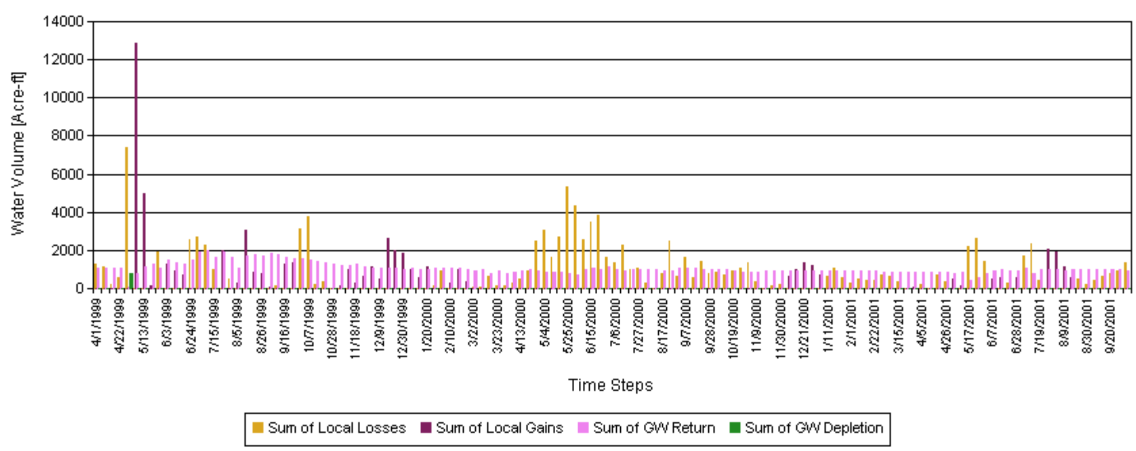
Calibrated Local System Gains and Losses

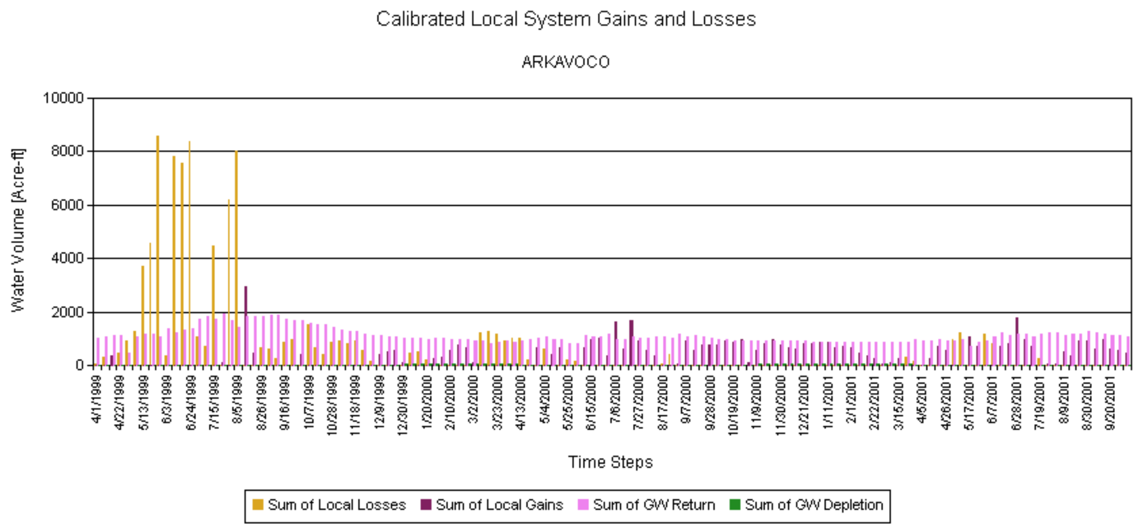
ARKCARCO

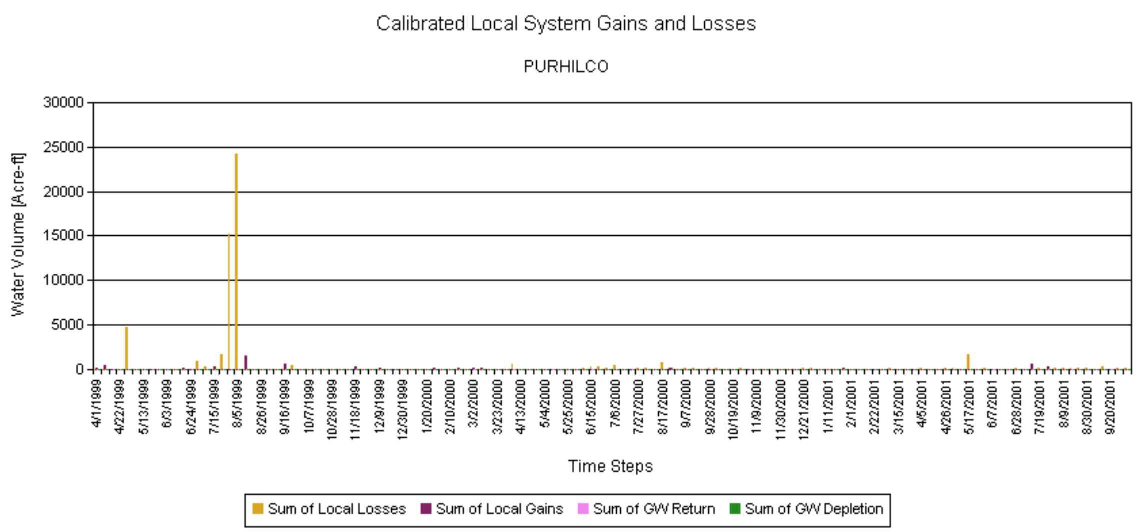


Calibrated Local System Gains and Losses

ARKCACCO

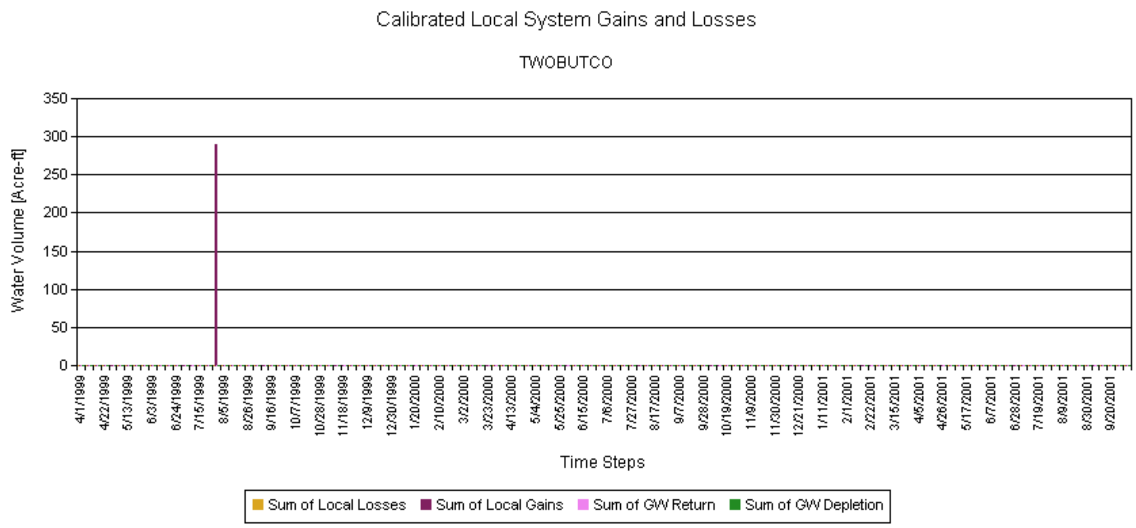




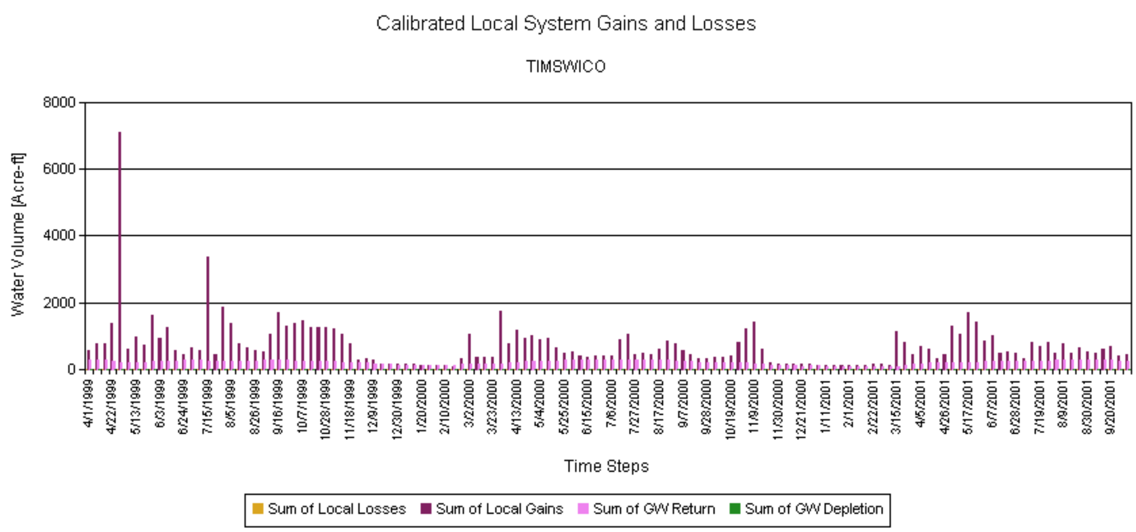


System Source Reaches

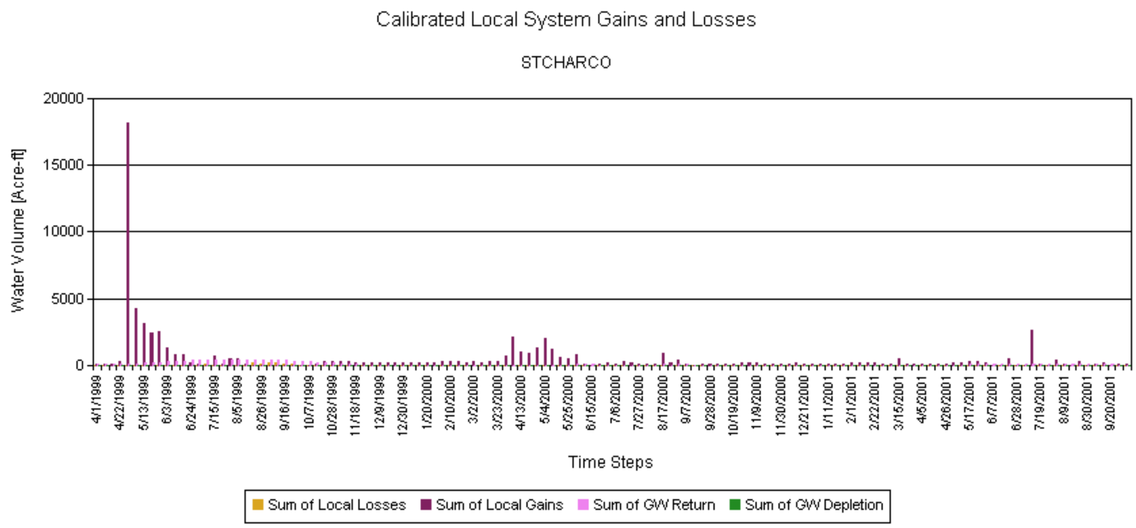
The following plots show the ANN-based stream-aquifer interaction contributions to the system source reaches.

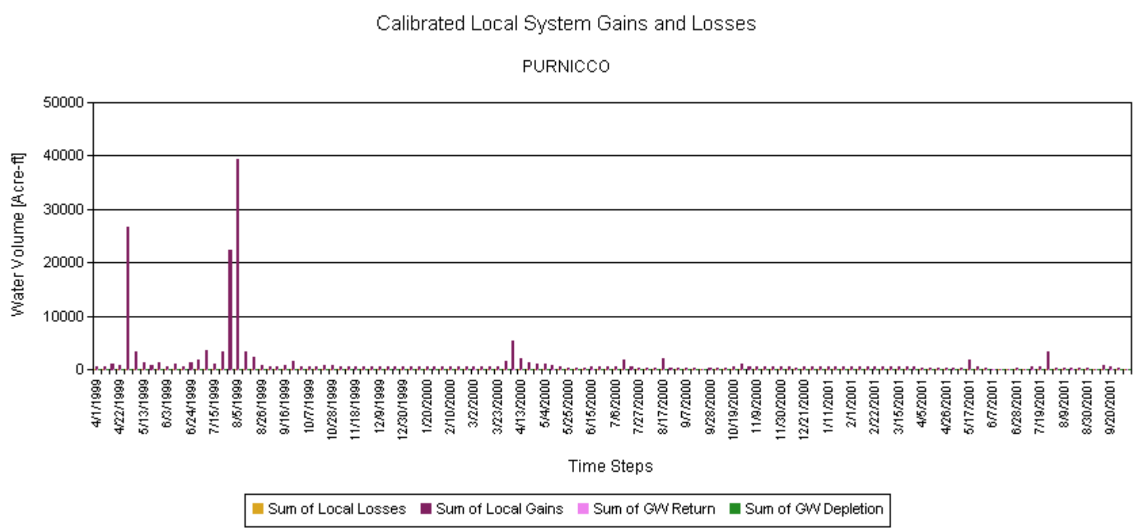


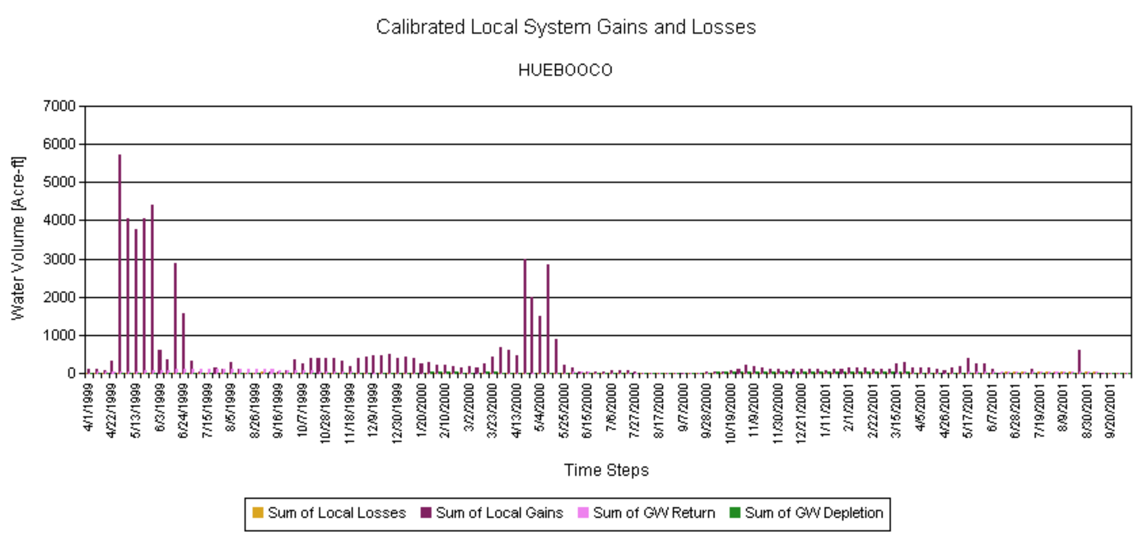
Calibrated Local System Gains and Losses
TWOBUTCO
Water Volume [Acre-ft]
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion



Calibrated Local System Gains and Losses
TIMSWICO
Water Volume [Acre-ft]
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

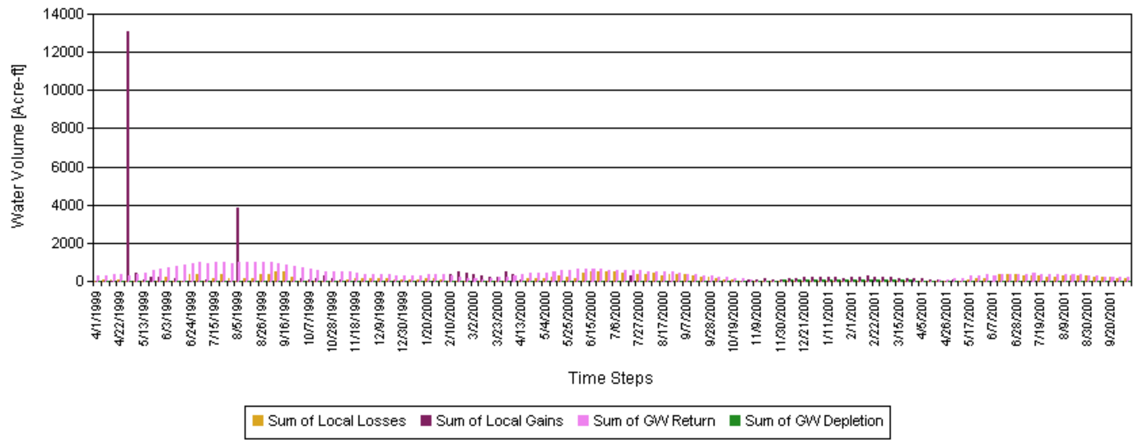

Calibrated Local System Gains and Losses
STCHARCO
Water Volume [Acre-ft]
20000
15000
10000
5000
0
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion


Calibrated Local System Gains and Losses
PURNICCO
Water Volume [Acre-ft]
50000
40000
30000
20000
10000
0
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion


Calibrated Local System Gains and Losses
HUEBOOCO
Water Volume [Acre-ft]
7000
6000
5000
4000
3000
2000
1000
0
Time Steps
Sum of Local Losses
Sum of Local Gains
Sum of GW Return
Sum of GW Depletion

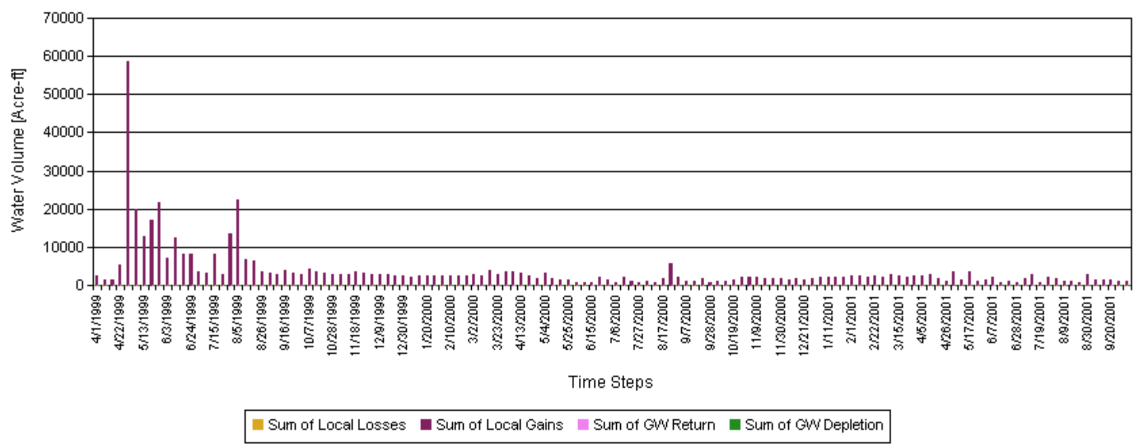
Calibrated Local System Gains and Losses

HRC194CO



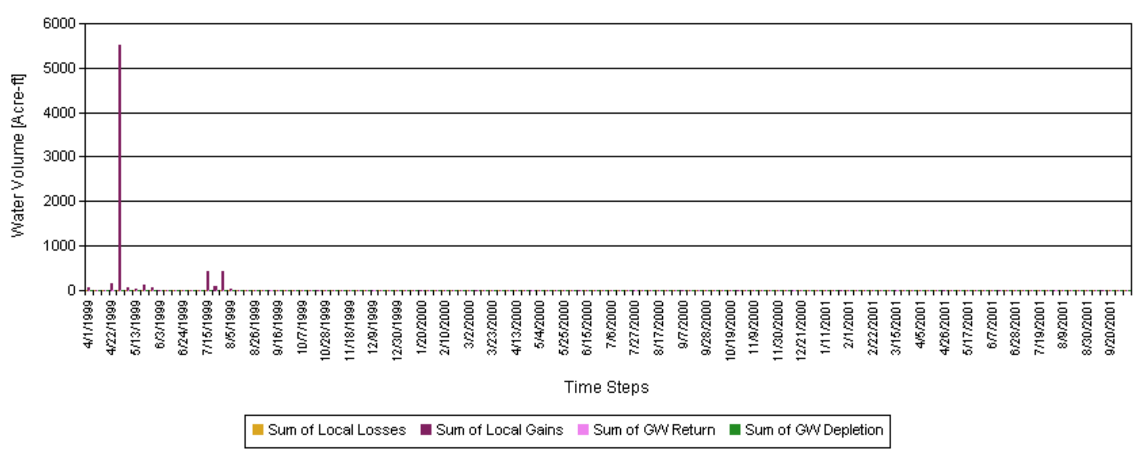
Calibrated Local System Gains and Losses

FOUPINCO



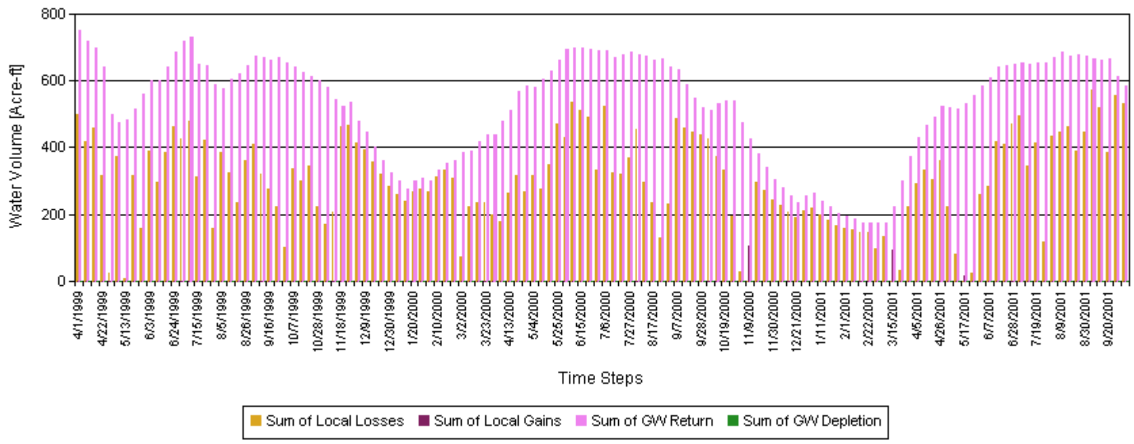
Calibrated Local System Gains and Losses

CHICRECO



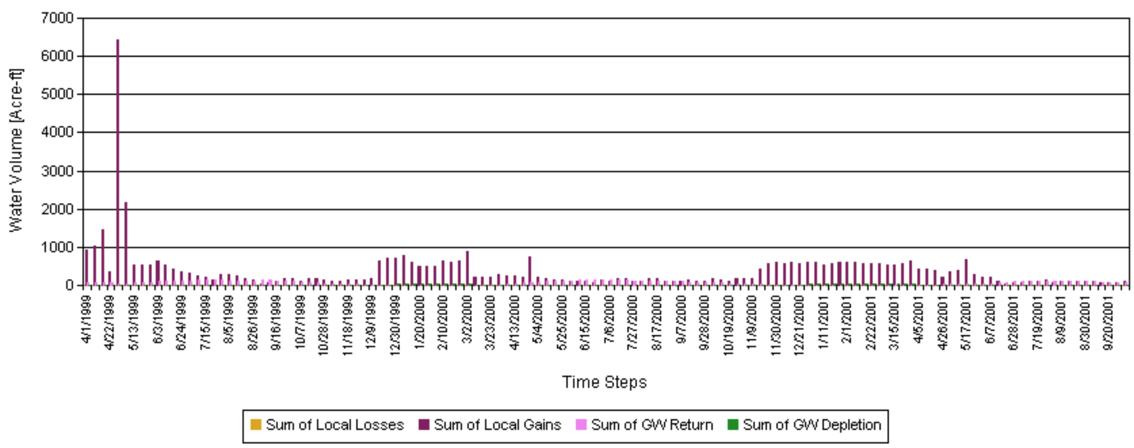
Calibrated Local System Gains and Losses

CANSWKCO



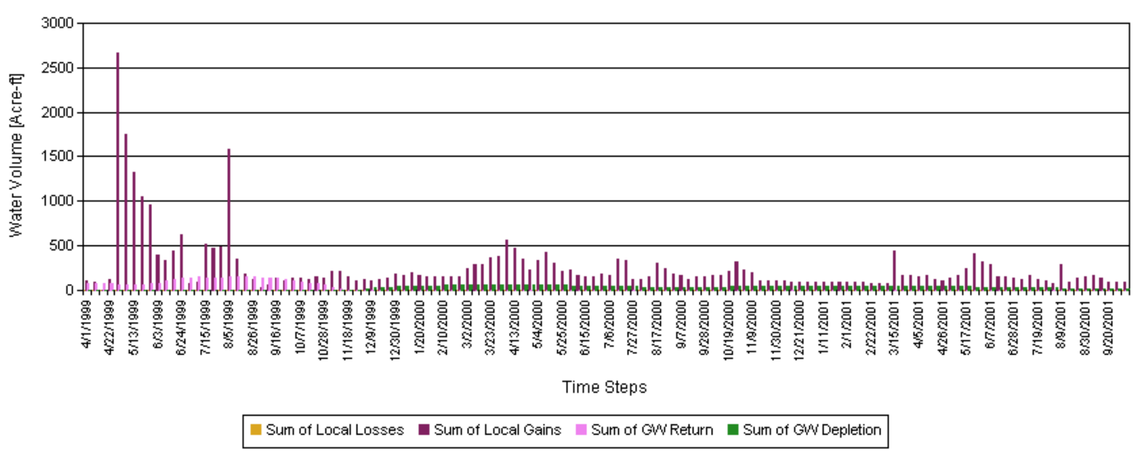
Calibrated Local System Gains and Losses

BIGLAMCO



Calibrated Local System Gains and Losses

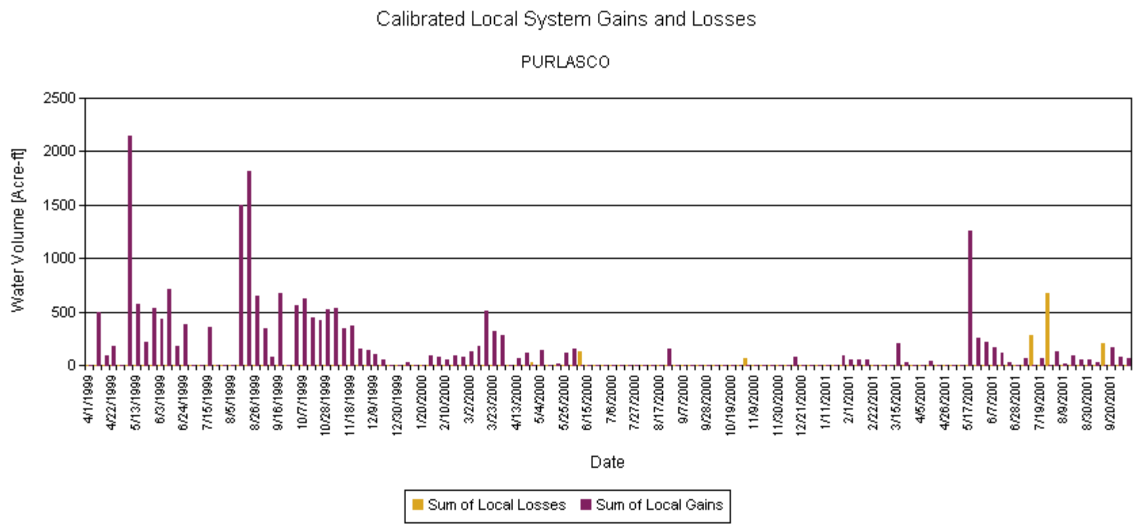
APIFOWCO

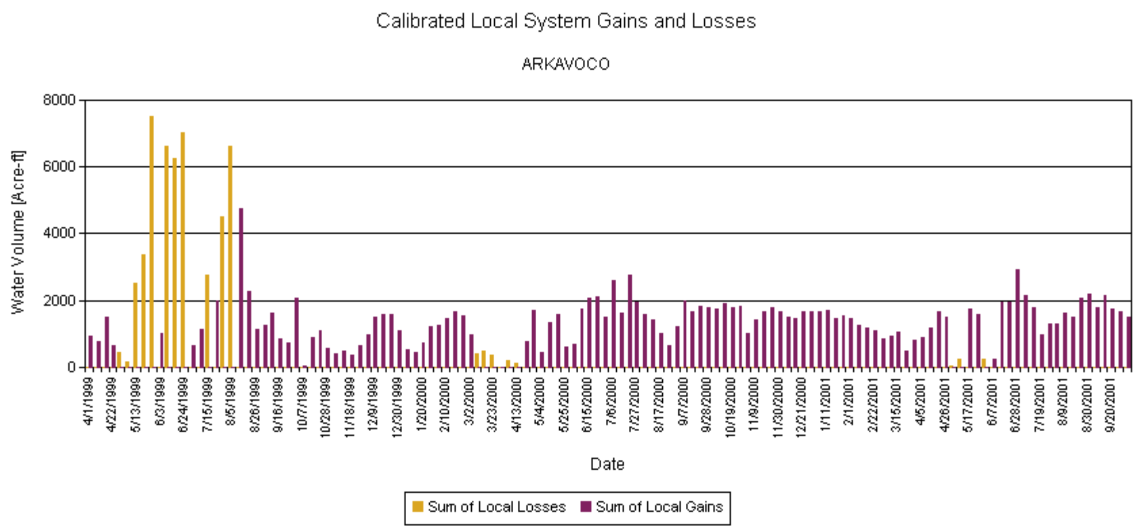


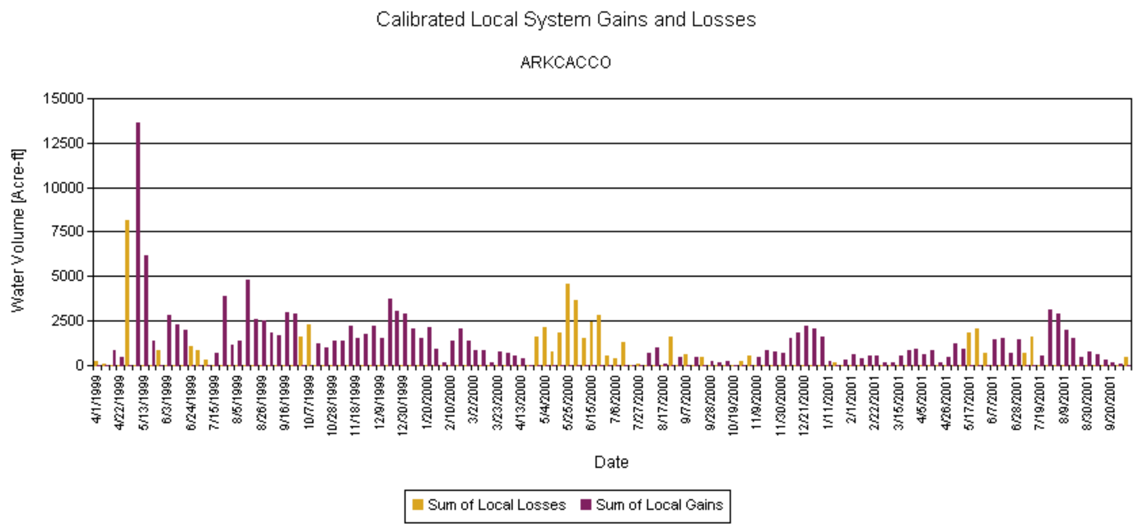
Surface Water Only Calibration

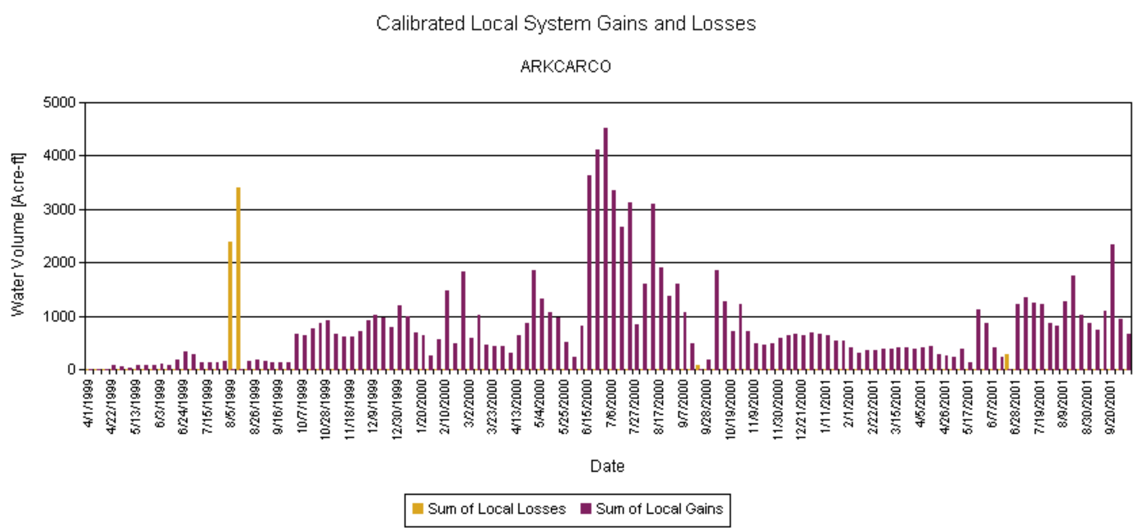
Intermediate Control Points

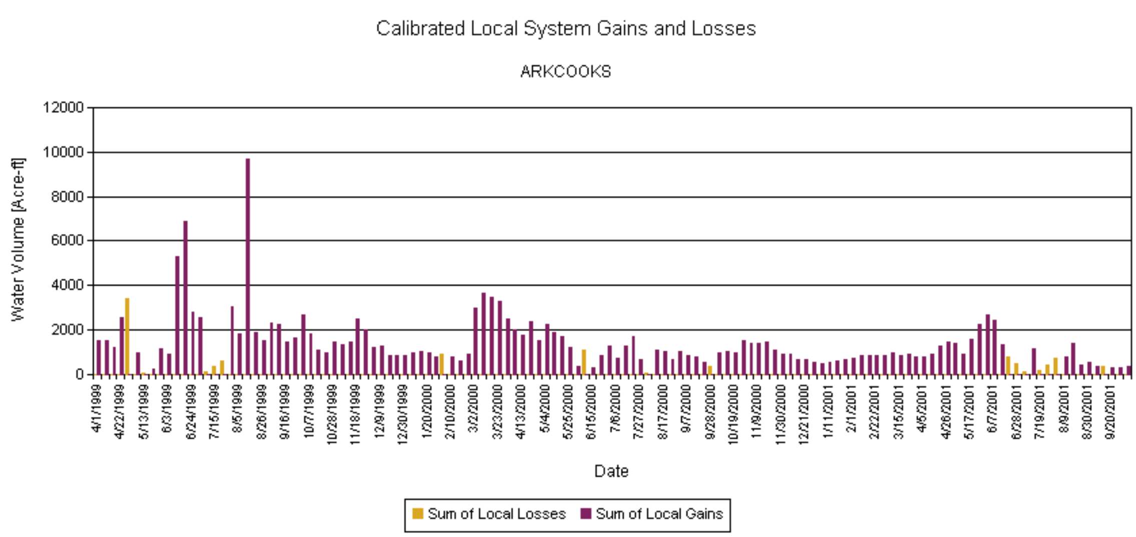
The following results correspond to the surface water only calibration. These results represent total expected gains and losses including the stream-aquifer interaction.

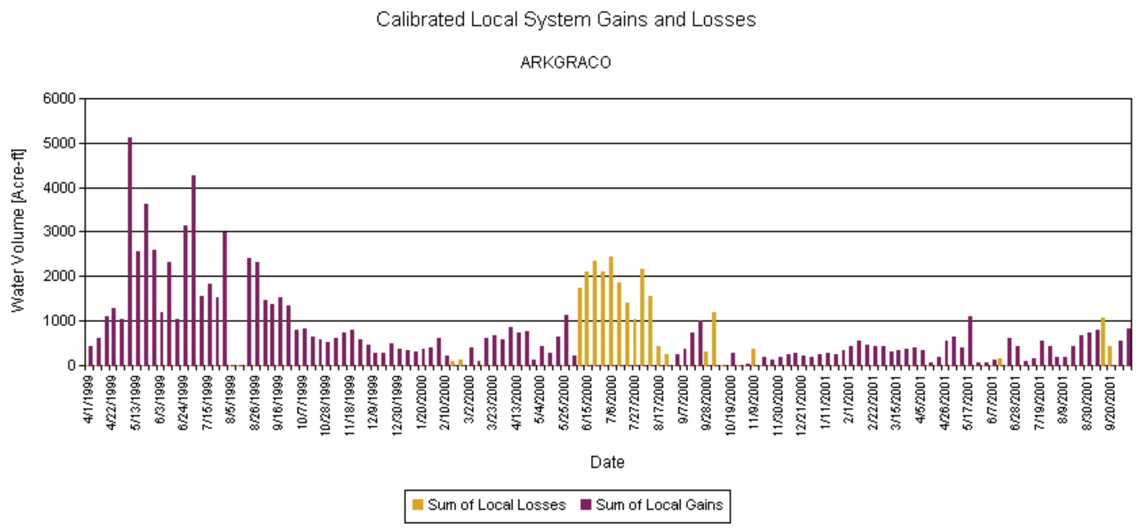


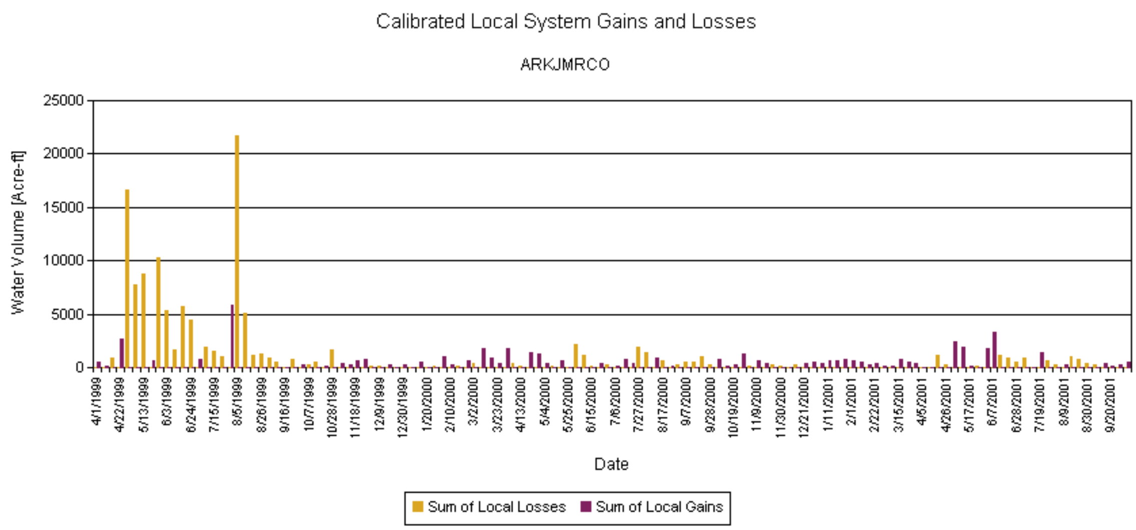


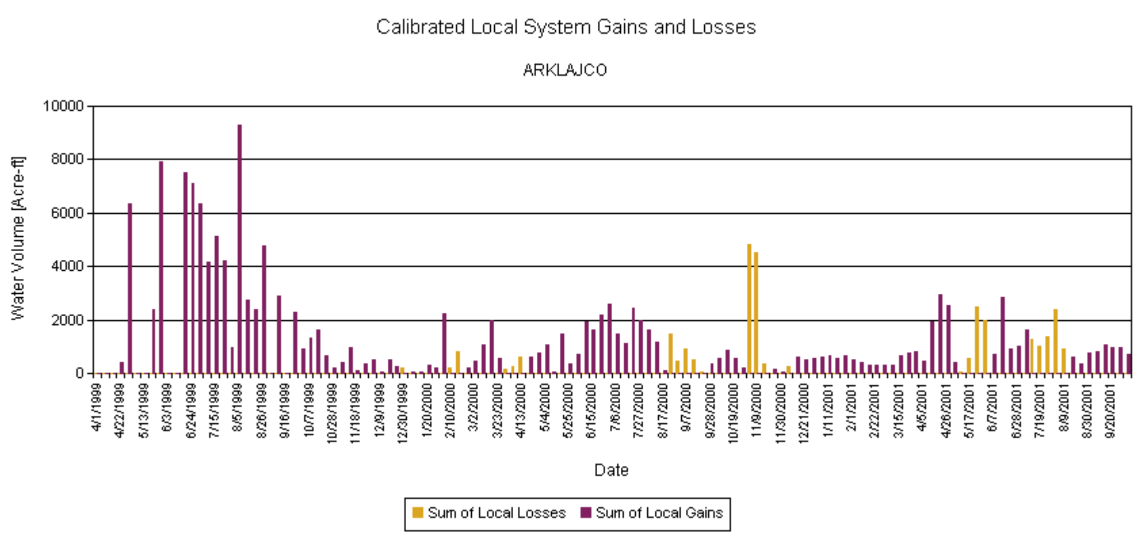

Calibrated Local System Gains and Losses
ARKCACCO
Water Volume [Acre-ft]
15000
12500
10000
7500
5000
2500
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
ARKCARCO
Water Volume [Acre-ft]
5000
4000
3000
2000
1000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
ARKCOOKS
Water Volume [Acre-ft]
12000
10000
8000
6000
4000
2000
0
4/1/1999 4/22/1999 5/13/1999 6/3/1999 6/24/1999 7/15/1999 8/5/1999 8/26/1999 9/16/1999 10/7/1999 10/28/1999 11/18/1999 12/9/1999 12/30/1999 1/20/2000 2/10/2000 3/2/2000 3/23/2000 4/13/2000 5/4/2000 5/25/2000 6/15/2000 7/6/2000 7/27/2000 8/17/2000 9/7/2000 9/28/2000 10/19/2000 11/9/2000 11/30/2000 12/21/2000 1/11/2001 2/1/2001 2/22/2001 3/15/2001 4/5/2001 4/26/2001 5/17/2001 6/7/2001 6/28/2001 7/19/2001 8/9/2001 8/30/2001 9/20/2001
Date
Sum of Local Losses
Sum of Local Gains

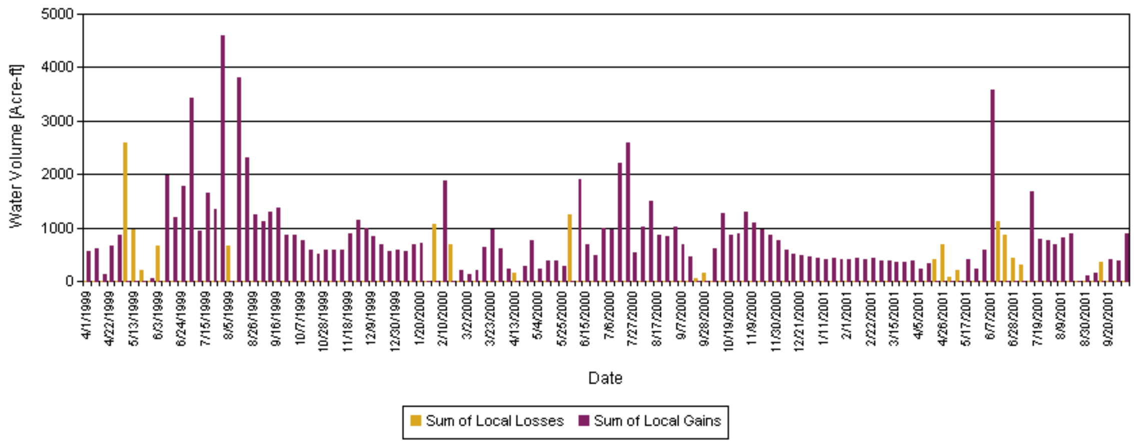

Calibrated Local System Gains and Losses
ARKGRACO
Water Volume [Acre-ft]
6000
5000
4000
3000
2000
1000
0
4/1/1999
4/22/1999
5/13/1999
6/3/1999
6/24/1999
7/15/1999
8/5/1999
8/26/1999
9/16/1999
10/7/1999
10/28/1999
11/18/1999
12/9/1999
12/30/1999
1/20/2000
2/10/2000
3/2/2000
3/23/2000
4/13/2000
5/4/2000
5/25/2000
6/15/2000
7/6/2000
7/27/2000
8/17/2000
9/7/2000
9/28/2000
10/19/2000
11/9/2000
11/30/2000
12/21/2000
1/11/2001
2/1/2001
2/22/2001
3/15/2001
4/5/2001
4/26/2001
5/17/2001
6/7/2001
6/28/2001
7/19/2001
8/9/2001
8/30/2001
9/20/2001
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
ARKJMRCO
Water Volume [Acre-ft]
25000
20000
15000
10000
5000
0
4/1/1999
4/22/1999
5/13/1999
6/3/1999
6/24/1999
7/15/1999
8/5/1999
8/26/1999
9/16/1999
10/7/1999
10/28/1999
11/18/1999
12/9/1999
12/30/1999
1/20/2000
2/10/2000
3/2/2000
3/23/2000
4/13/2000
5/4/2000
5/25/2000
6/15/2000
7/6/2000
7/27/2000
8/17/2000
9/7/2000
9/28/2000
10/19/2000
11/9/2000
11/30/2000
12/21/2000
1/11/2001
2/1/2001
2/22/2001
3/15/2001
4/5/2001
4/26/2001
5/17/2001
6/7/2001
6/28/2001
7/19/2001
8/9/2001
8/30/2001
9/20/2001
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
ARKLAJCO
Water Volume [Acre-ft]
10000
8000
6000
4000
2000
0
4/1/1999
4/22/1999
5/13/1999
6/3/1999
6/24/1999
7/15/1999
8/5/1999
8/26/1999
9/16/1999
10/7/1999
10/28/1999
11/18/1999
12/9/1999
12/30/1999
1/20/2000
2/10/2000
3/2/2000
3/23/2000
4/13/2000
5/4/2000
5/25/2000
6/15/2000
7/6/2000
7/27/2000
8/17/2000
9/7/2000
9/28/2000
10/19/2000
11/9/2000
11/30/2000
12/21/2000
1/11/2001
2/1/2001
2/22/2001
3/15/2001
4/5/2001
4/26/2001
5/17/2001
6/7/2001
6/28/2001
7/19/2001
8/9/2001
8/30/2001
9/20/2001
Date
Sum of Local Losses
Sum of Local Gains

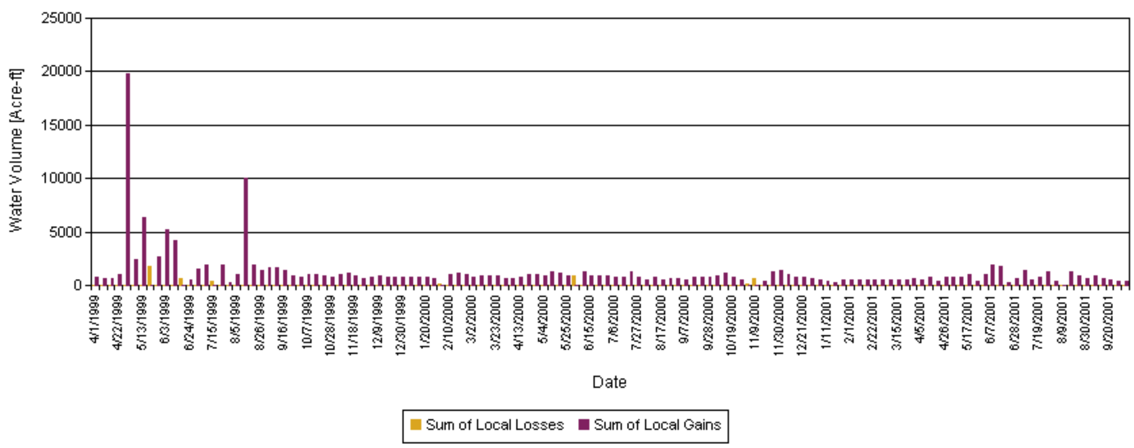
Calibrated Local System Gains and Losses

ARKLAMCO



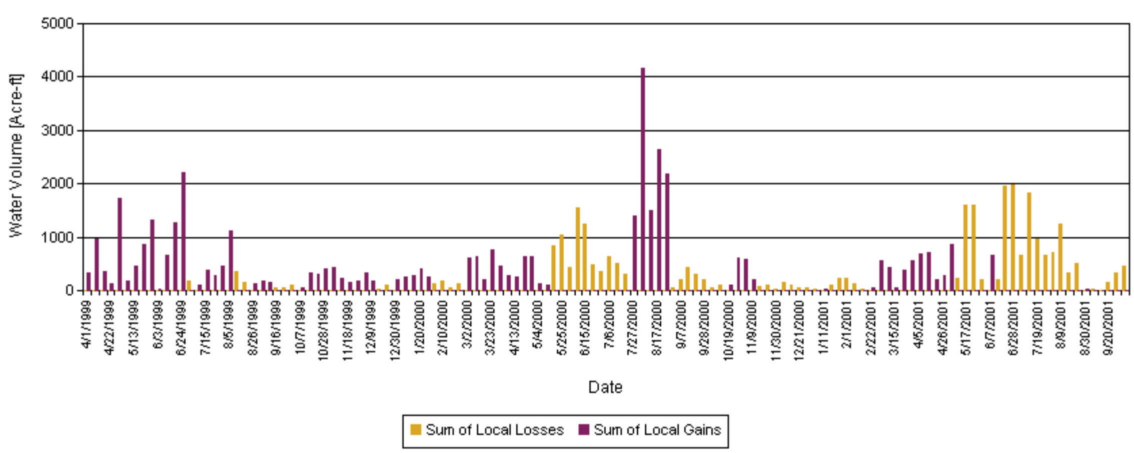
Calibrated Local System Gains and Losses

ARKLASCO



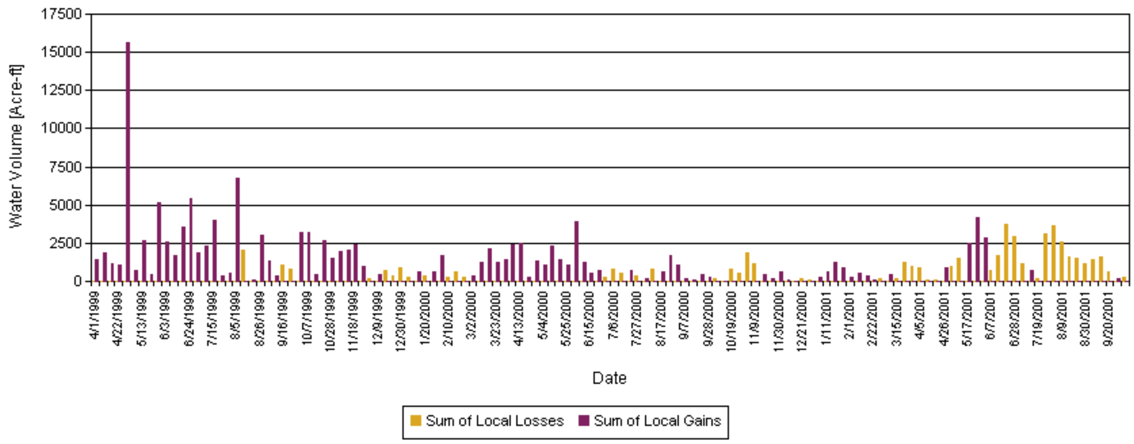
Calibrated Local System Gains and Losses

ARKMOFCO



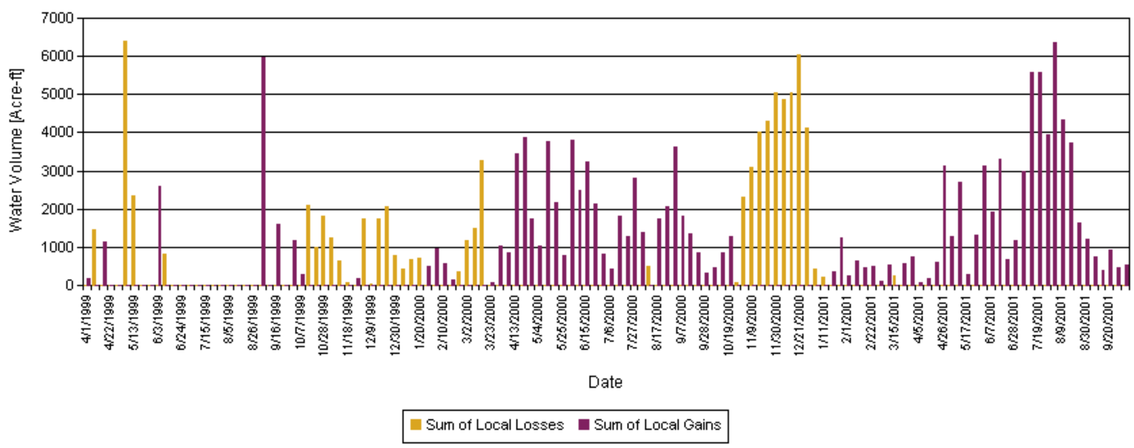
Calibrated Local System Gains and Losses

ARKNEPCO



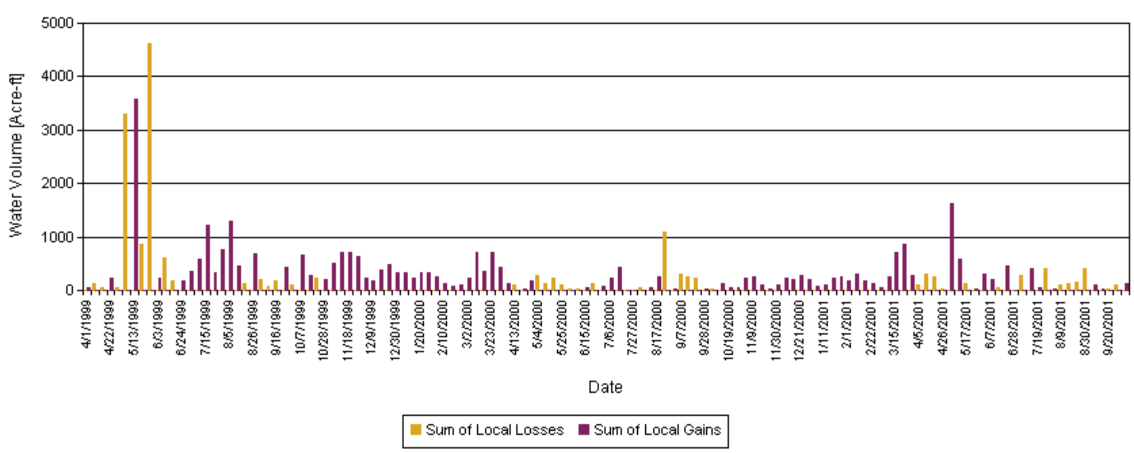
Calibrated Local System Gains and Losses

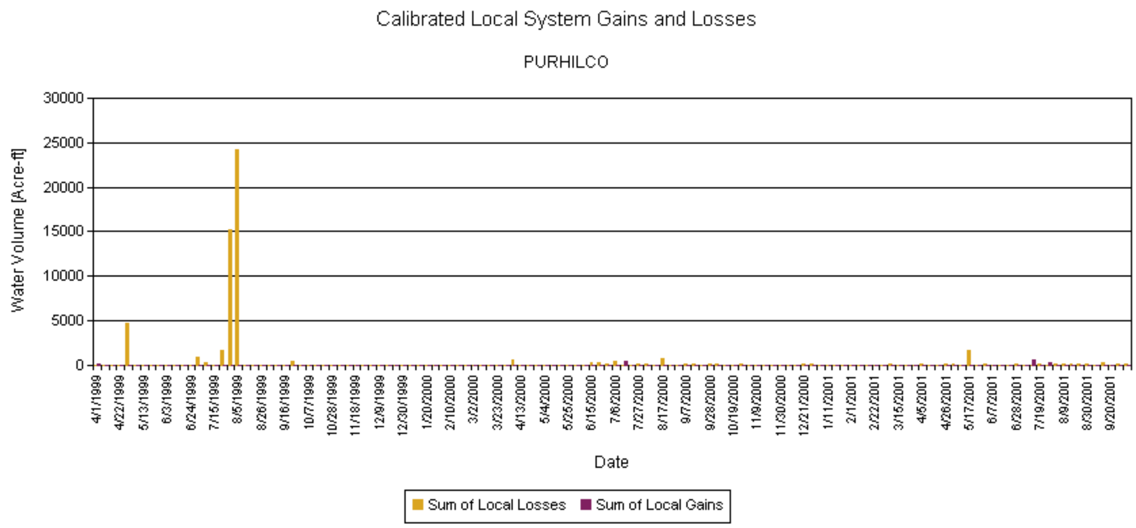
ARKROCCO



Calibrated Local System Gains and Losses

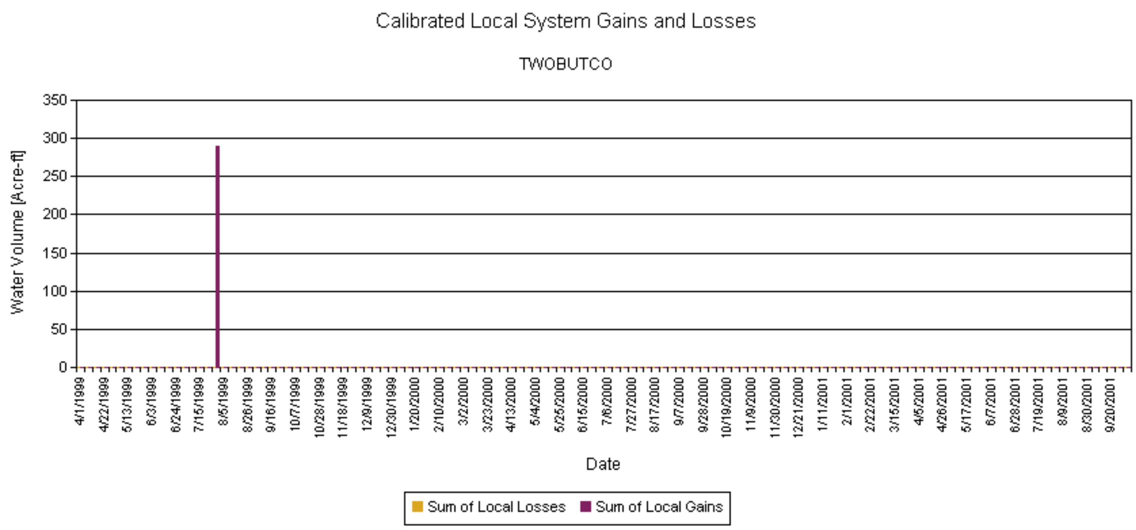
FOUPUECO

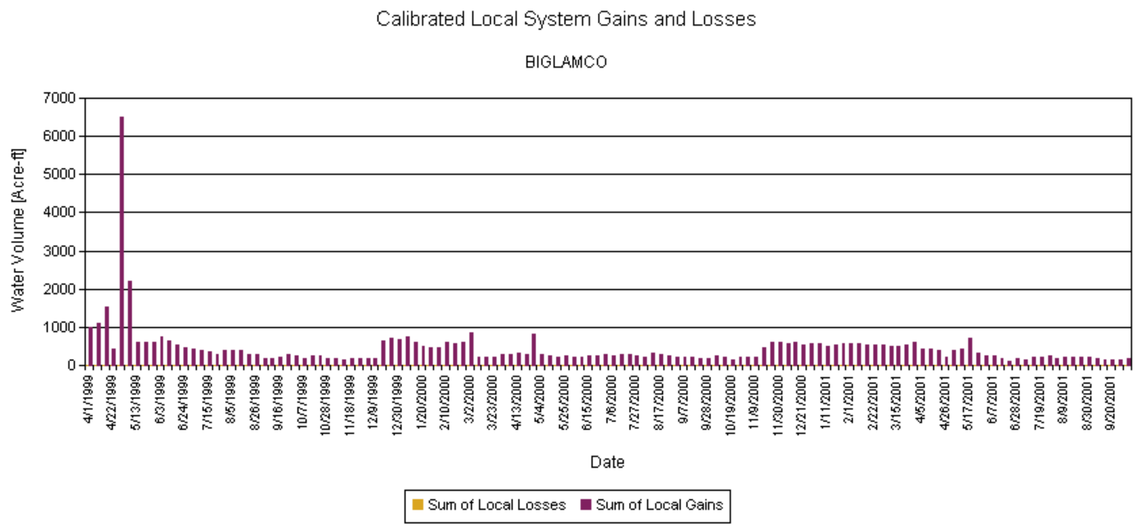


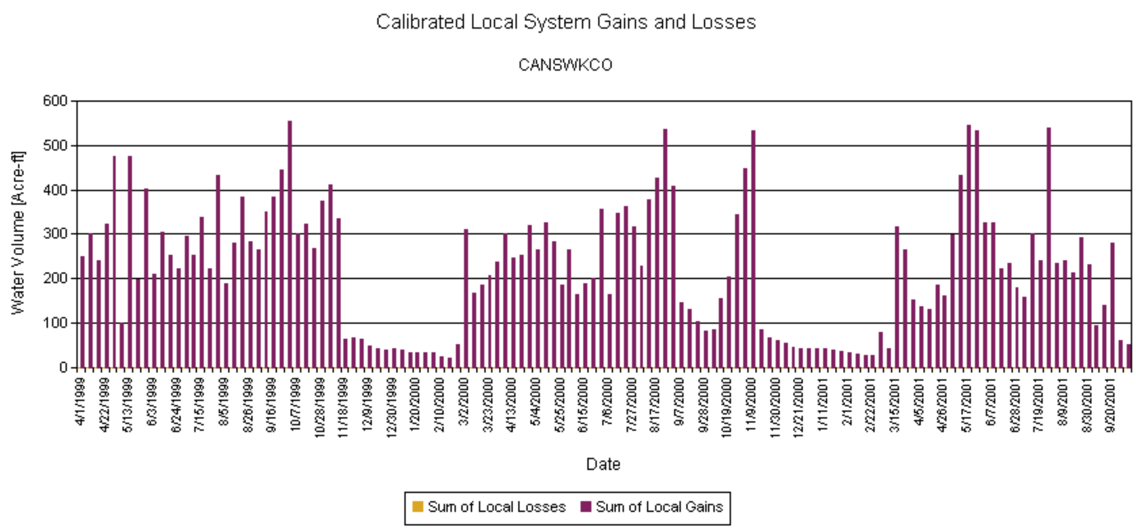


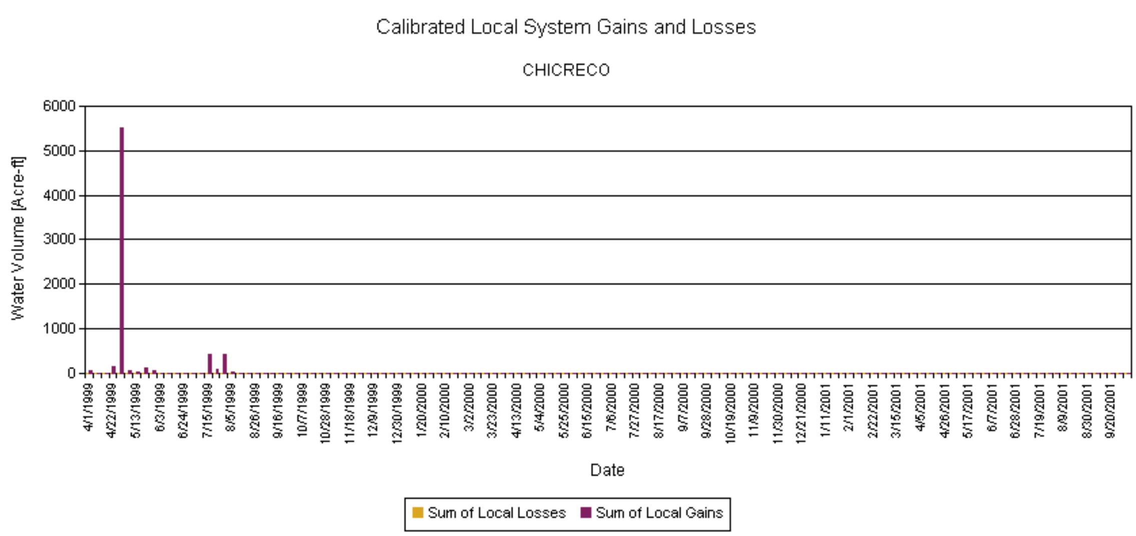
System Source Reaches

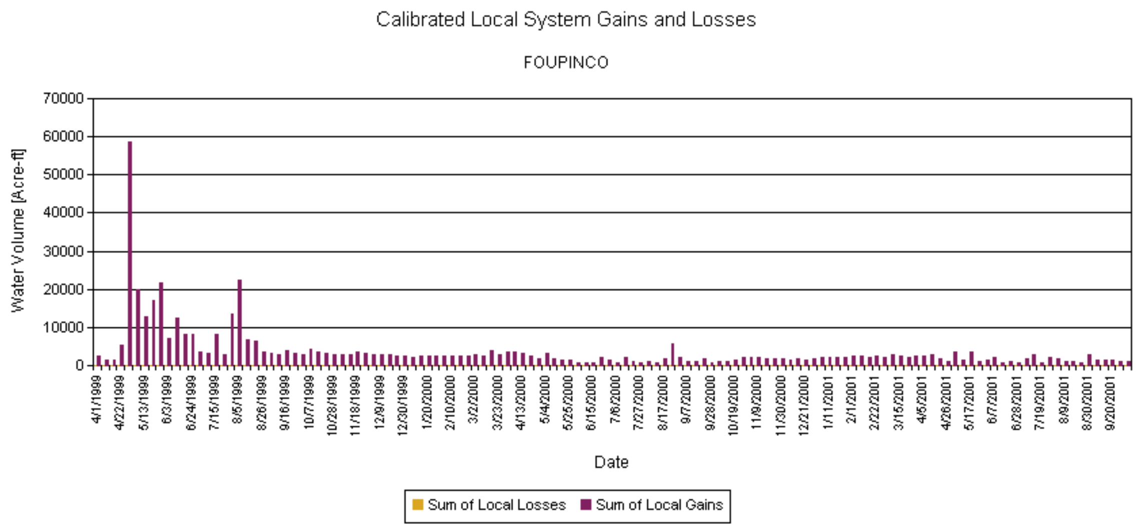
The following plots represent the total system inflow at the system source reaches for the surface water only calibration. These values include stream-aquifer interaction.

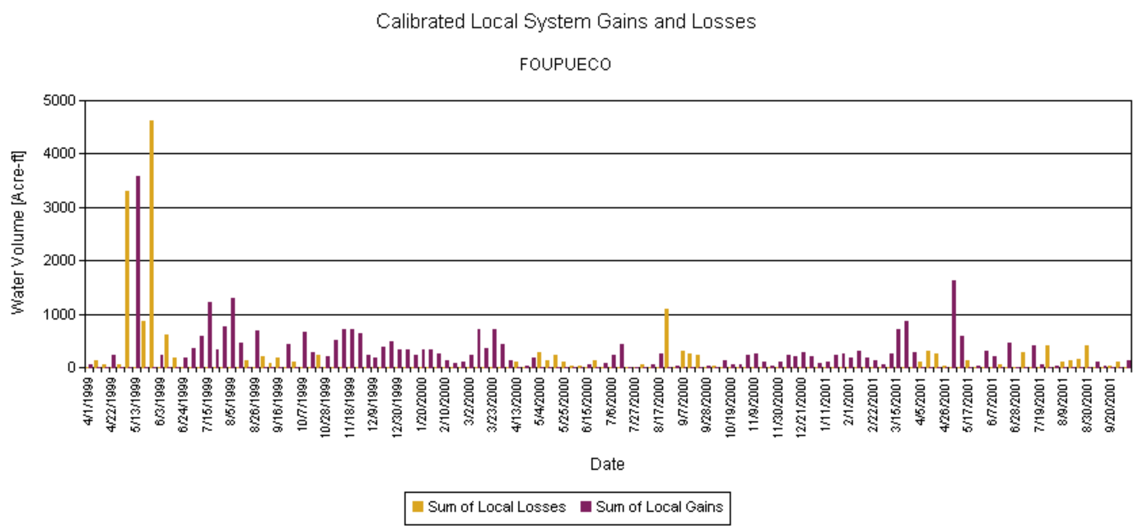


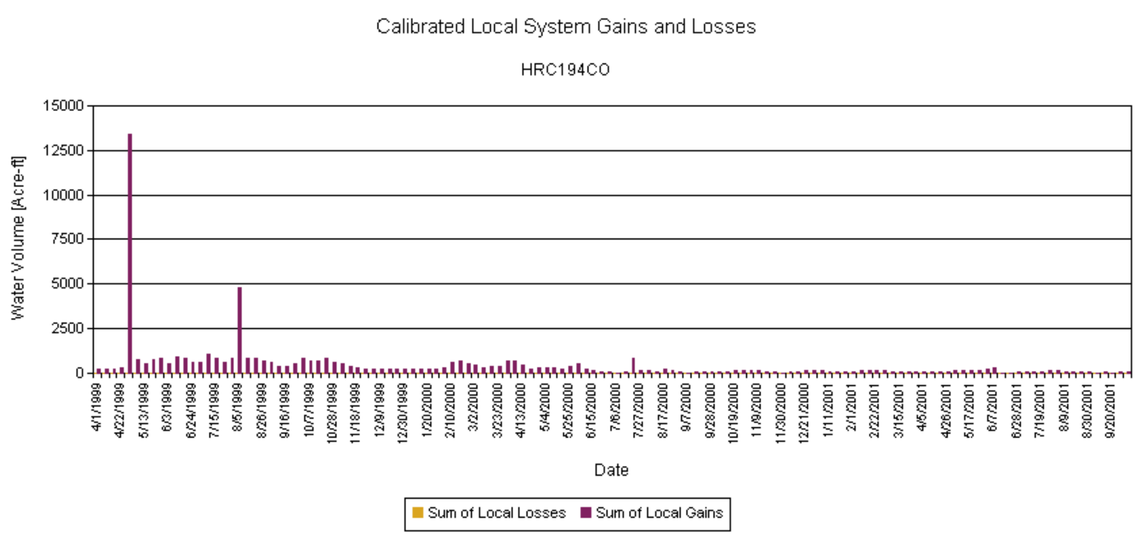

Calibrated Local System Gains and Losses
BIGLAMCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

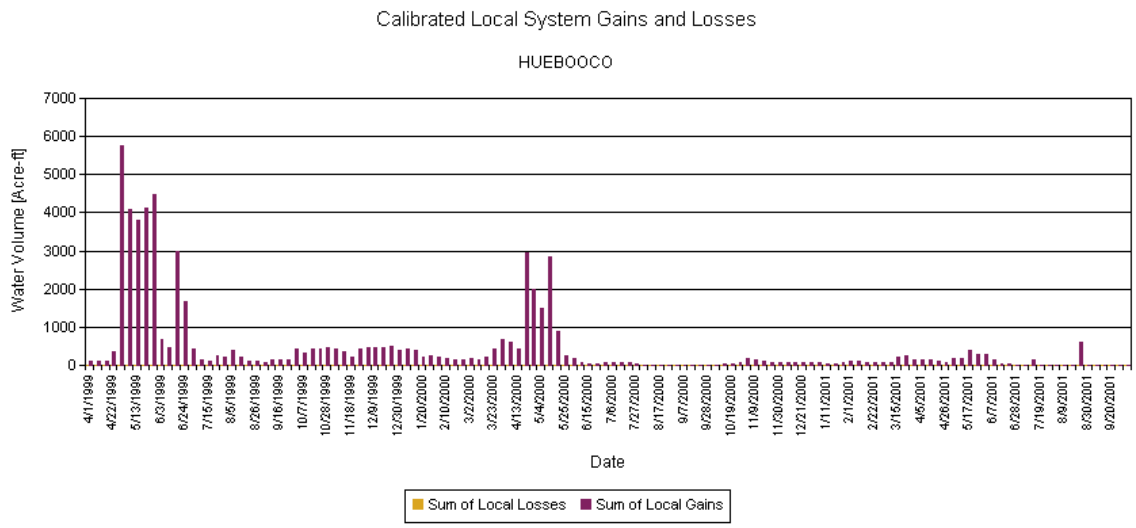

Calibrated Local System Gains and Losses
CANSWKCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

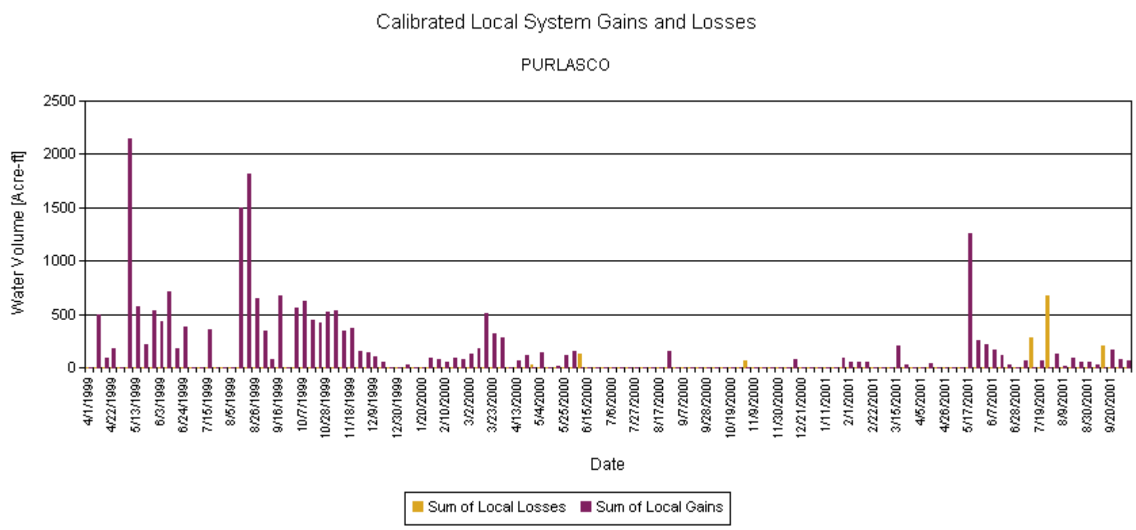

Calibrated Local System Gains and Losses
CHICRECO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

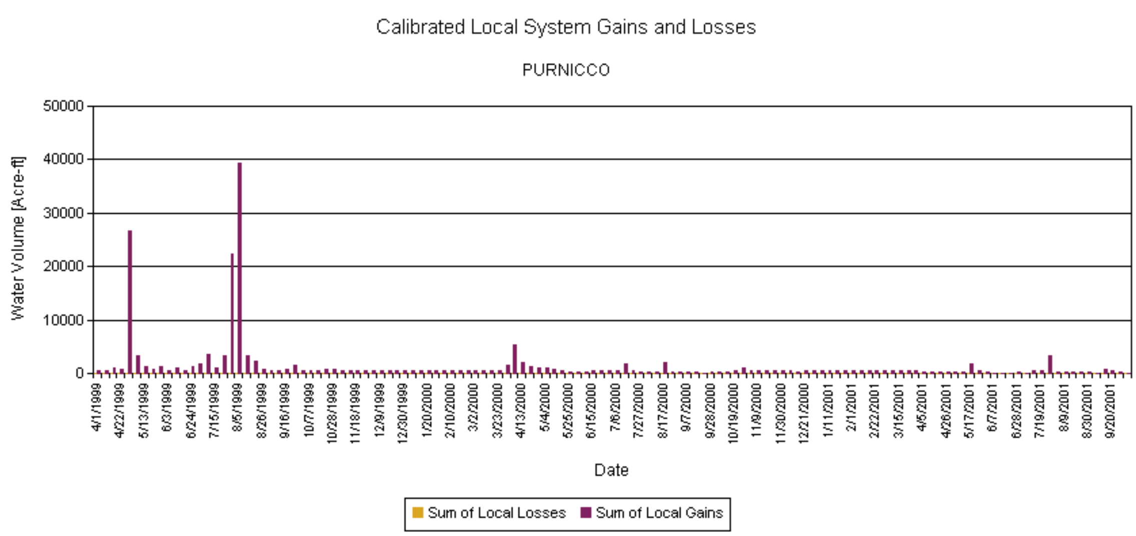

Calibrated Local System Gains and Losses
FOUPINCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

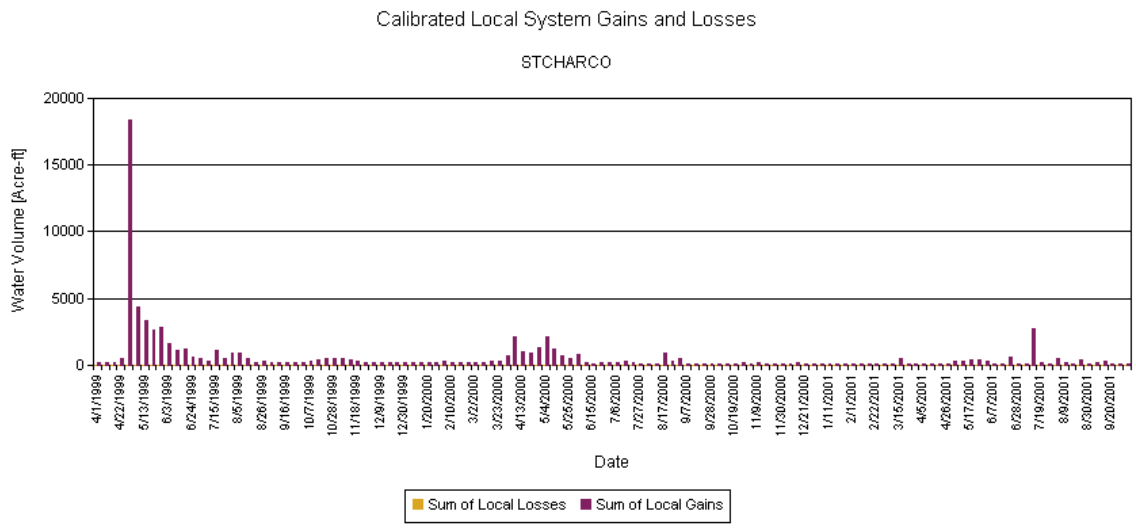

Calibrated Local System Gains and Losses
FOUPUECO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

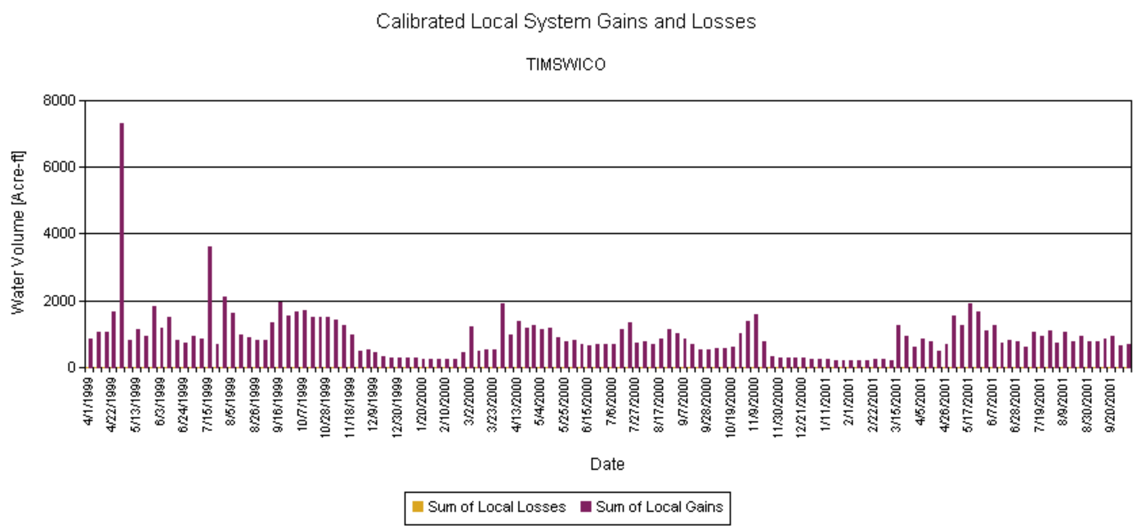

Calibrated Local System Gains and Losses
HRC194CO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
HUEBOOCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains


Calibrated Local System Gains and Losses
PURLASCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

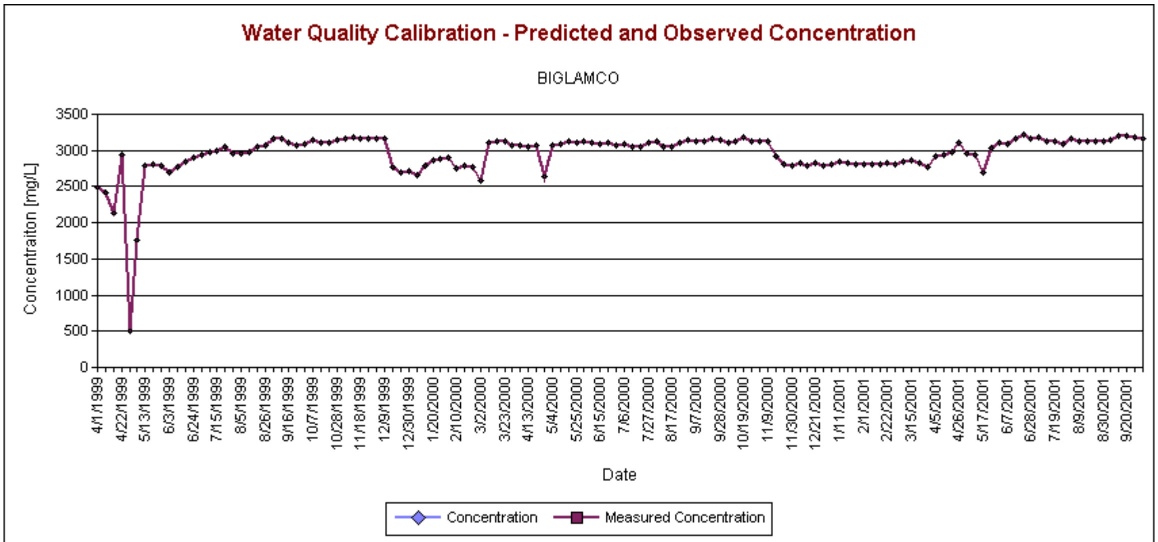

Calibrated Local System Gains and Losses
PURNICCO
Water Volume [Acre-ft]
Date
Sum of Local Losses
Sum of Local Gains

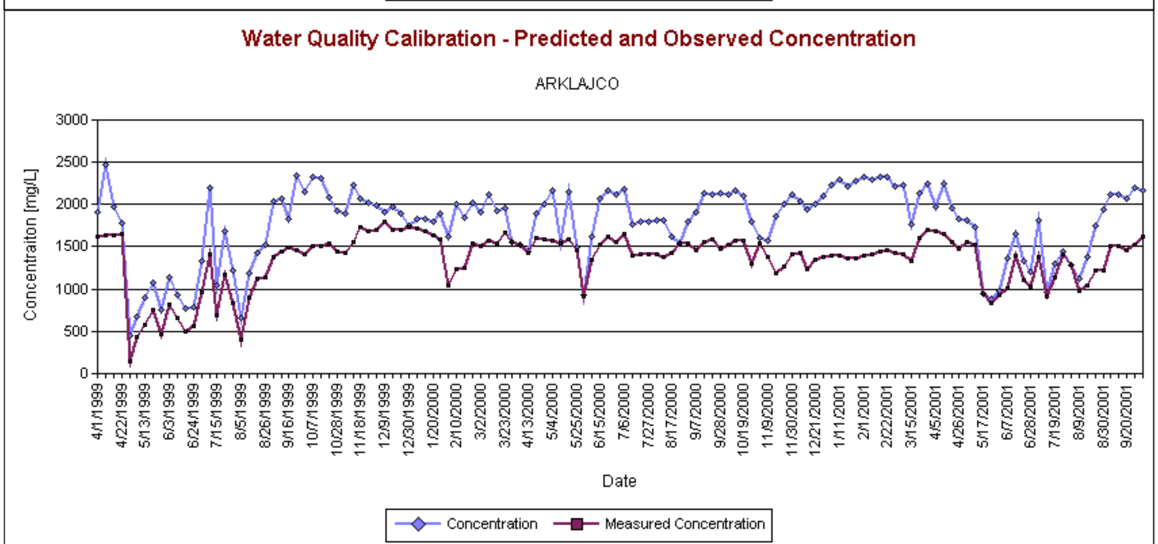


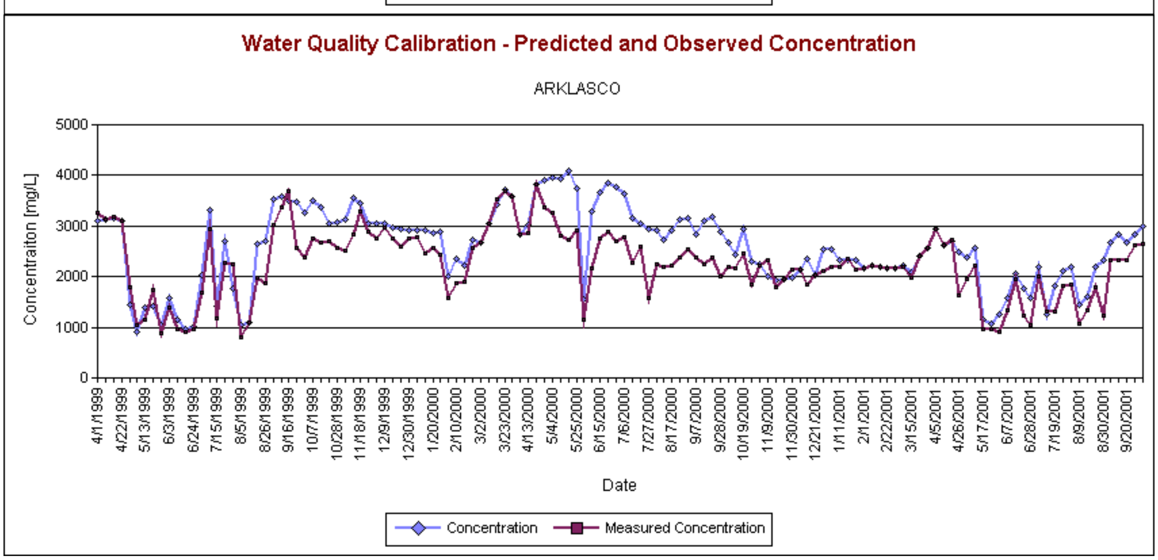


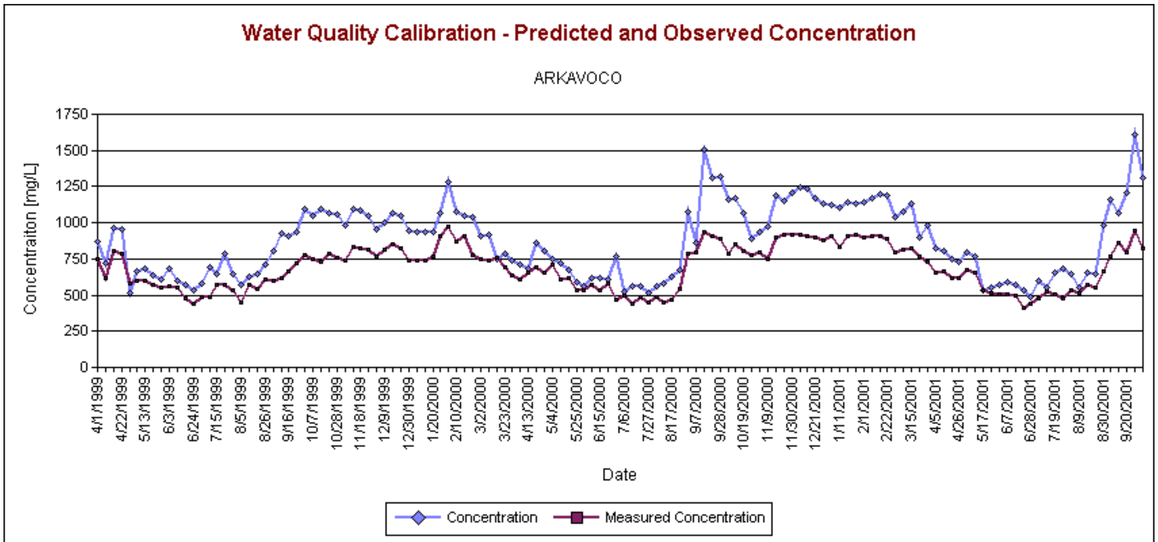
WATER QUALITY CALIBRATION DETAILED ANALYSIS

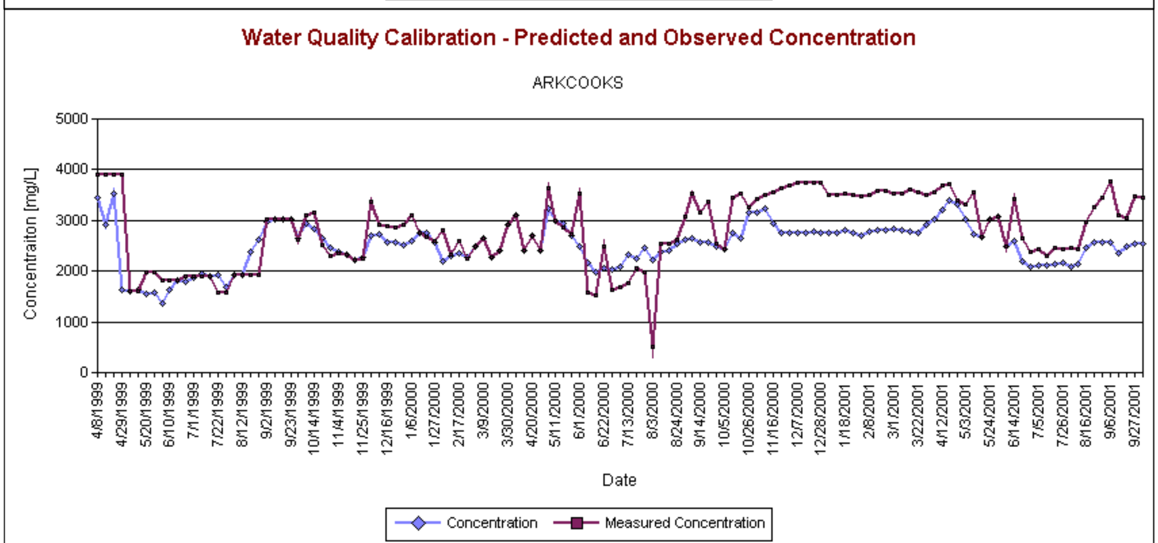
In this section the calibrated concentration is compared with the measured concentrations at the system control points. The following plots compare the calibrated and measured concentration at the water quality gauging stations. The calibrated concentrations are achieved assigning, for each time step, concentrations at the unknown system sources, within the user specified range of valid concentrations.

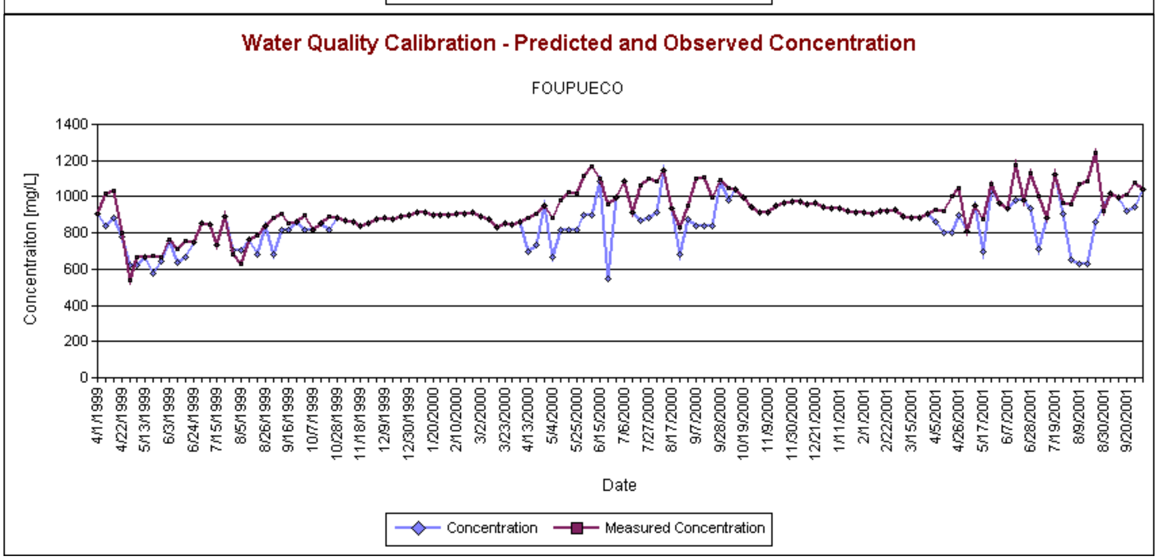

Water Quality Calibration - Predicted and Observed Concentration
BIGLAMCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

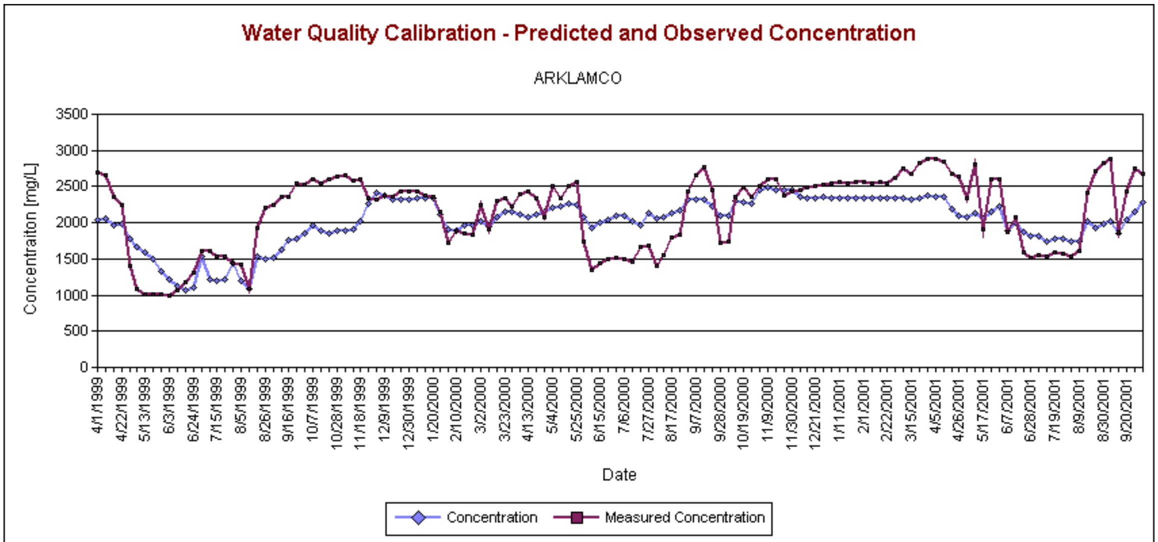

Water Quality Calibration - Predicted and Observed Concentration
ARKLAJCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

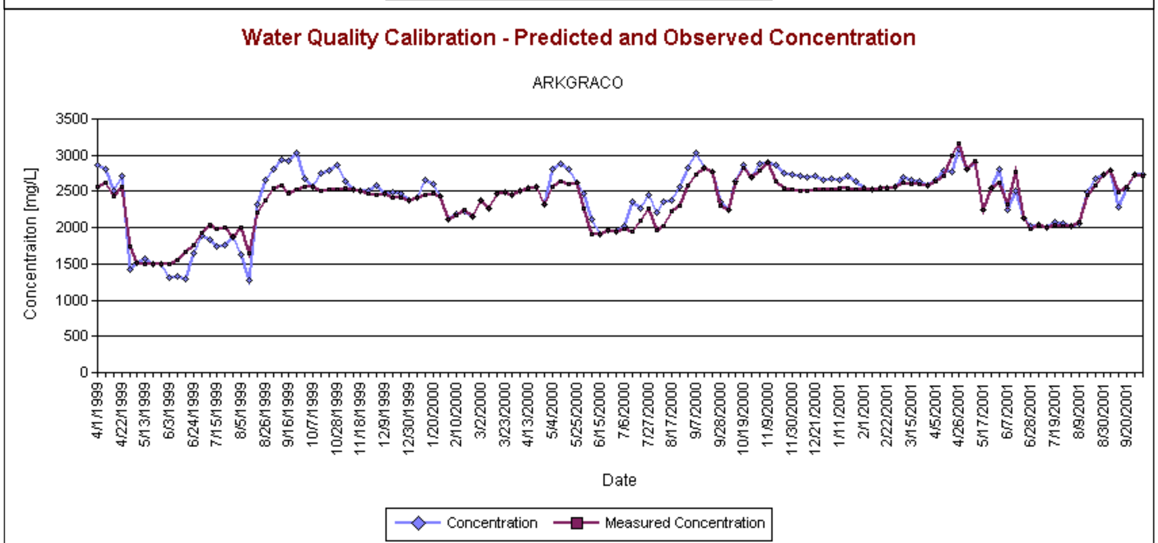

Water Quality Calibration - Predicted and Observed Concentration
ARKLASCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

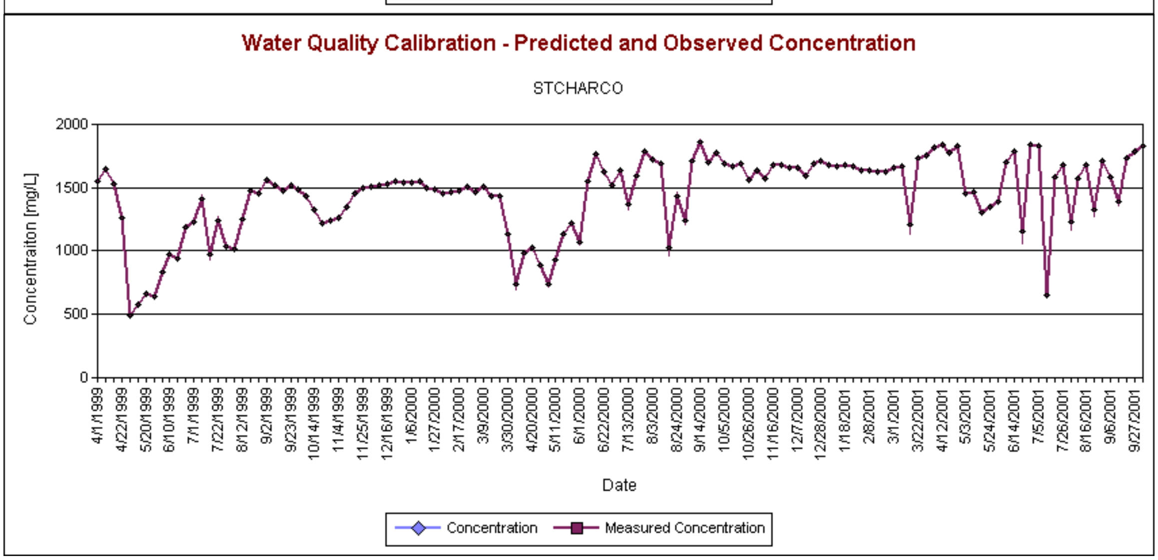

Water Quality Calibration - Predicted and Observed Concentration
ARKAVOCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

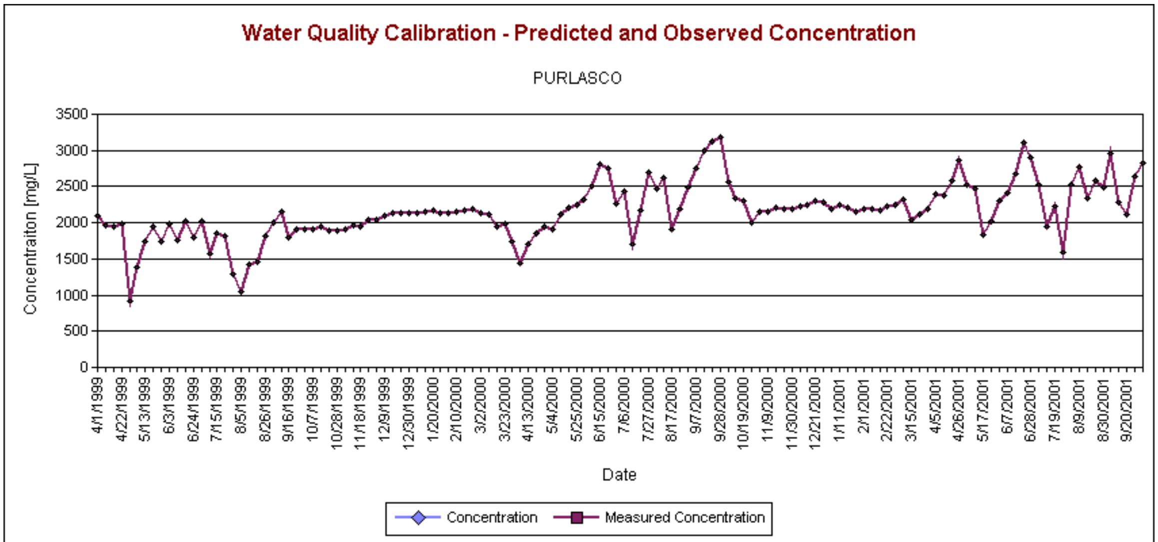

Water Quality Calibration - Predicted and Observed Concentration
ARKCOOKS
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

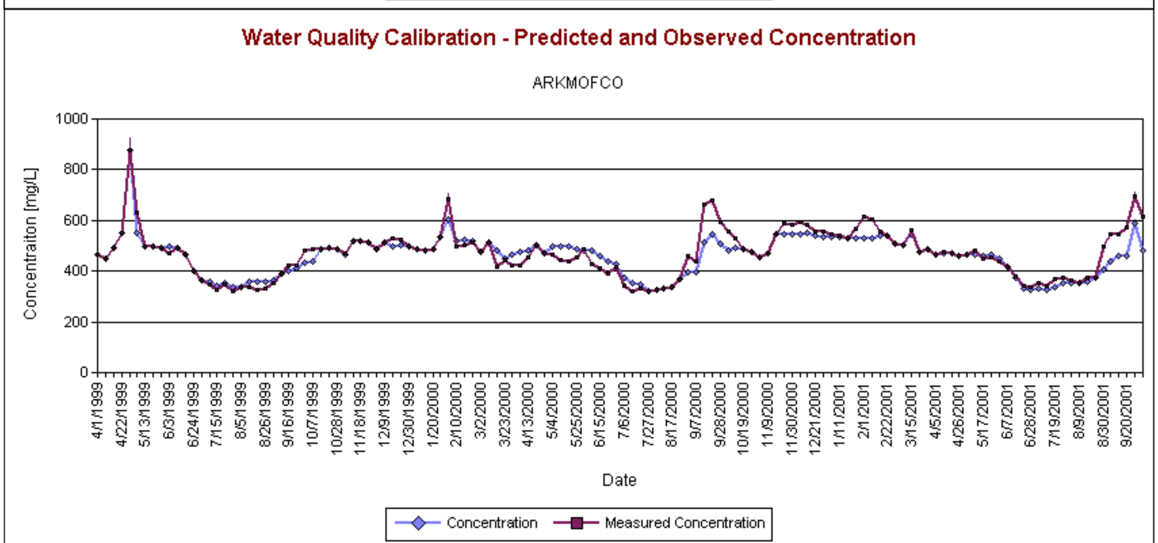

Water Quality Calibration - Predicted and Observed Concentration
FOUPUECO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

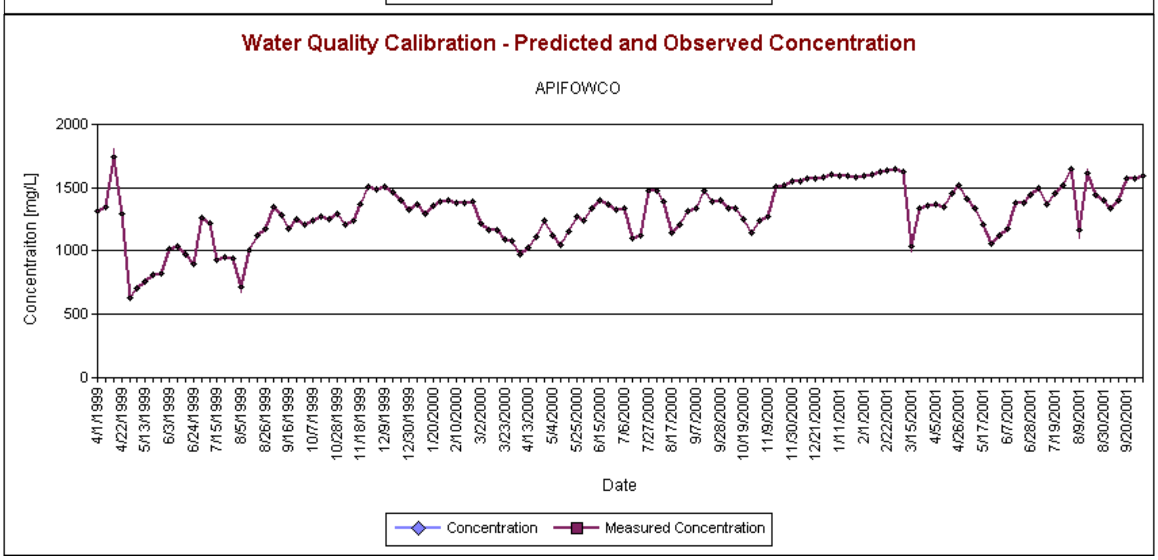

Water Quality Calibration - Predicted and Observed Concentration
ARKLAMCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

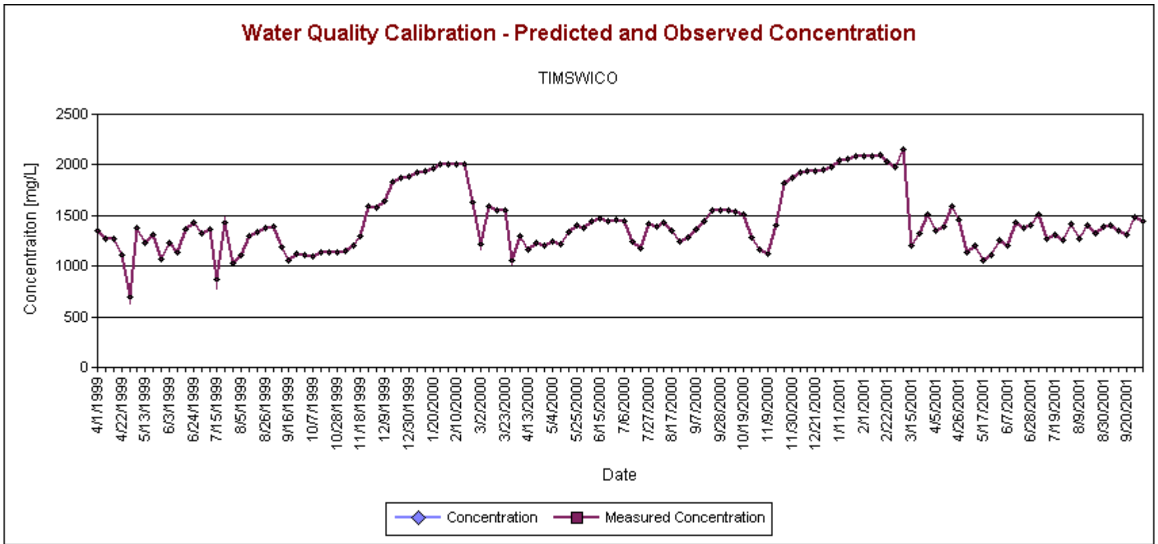

Water Quality Calibration - Predicted and Observed Concentration
ARKGRACO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

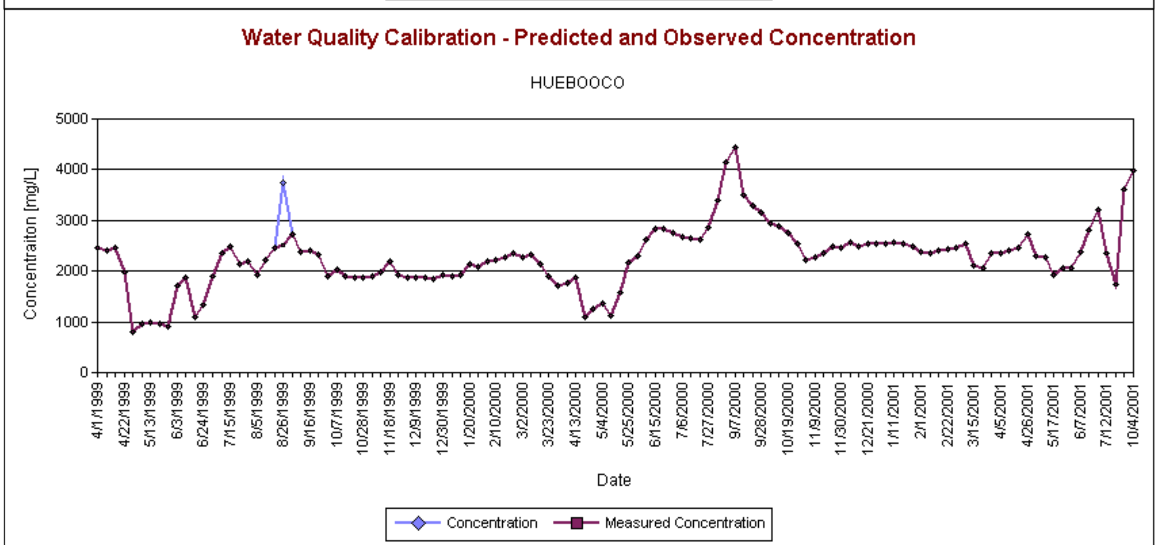

Water Quality Calibration - Predicted and Observed Concentration
STCHARCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

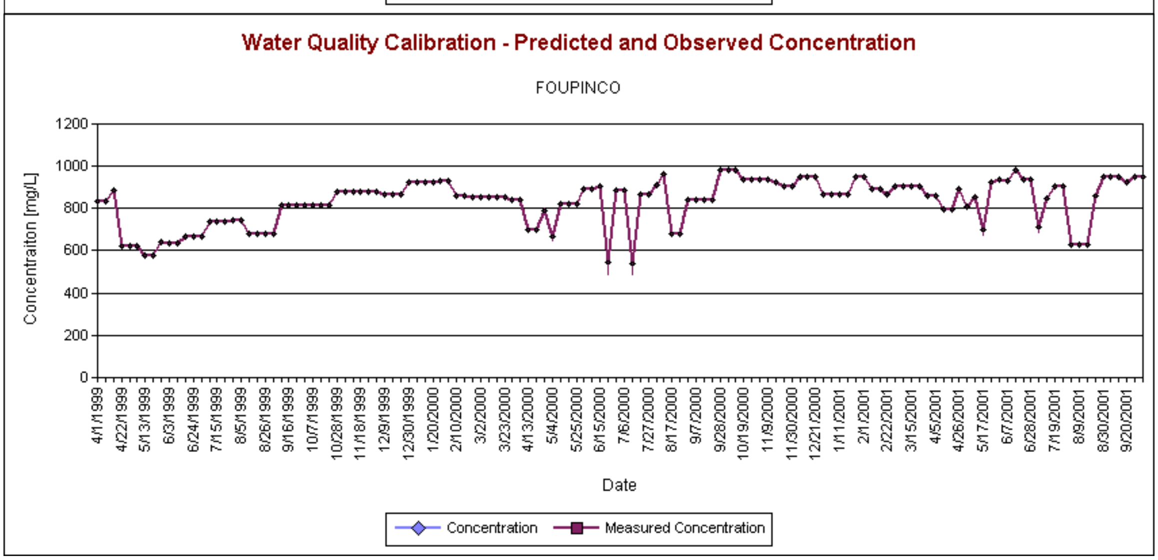

Water Quality Calibration - Predicted and Observed Concentration
PURLASCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration


Water Quality Calibration - Predicted and Observed Concentration
ARKMOFCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration


Water Quality Calibration - Predicted and Observed Concentration
APIFOWCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration


Water Quality Calibration - Predicted and Observed Concentration
TIMSWICO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration


Water Quality Calibration - Predicted and Observed Concentration
HUEBOOCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration


Water Quality Calibration - Predicted and Observed Concentration
FOUPINCO
Concentraiton [mg/L]
Date
Concentration
Measured Concentration

Differences between the modeled and the measured concentration were analyzed, verifying that there are not more sources that can be modified to closer match the measured concentration at the downstream station of the reach.