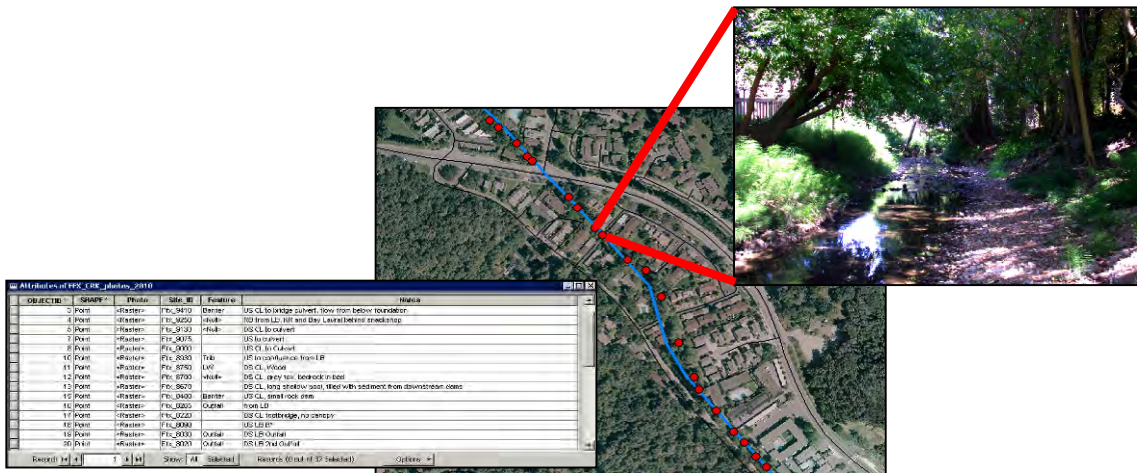


Pilot Project Ross Valley Watershed Geomorphology GIS Database Final Report August 30, 2010

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Project Description

This document describes a set of geodatabases that link spatial information to photographs of creek channels within the Ross Valley watershed.

In 2006 Smeltzer and Orum (1) completed an assessment of streambank geomorphology along the Fairfax and San Anselmo Creeks within the town of Fairfax. Appendices to that report contain approximately 280 photographs taken within the creeks, named by their location along the FEMA Flood Insurance Survey (FIS) distances, in feet, upstream from the mouth.

Over the course of this summer (2010), I have rephotographed these stream reaches, georeferenced the pictures into ArcGIS personal geodatabases, and expanded the work to include 2 miles of Ross and Corte Madera Creeks in the town of Ross. There are 475 georeferenced photographs taken in 2010, for a total of 755 pictures for the two years. See Figure 1 for a map and specific locations of the reaches surveyed.

The products of this work are six geodatabases and six folders of photographs, corresponding to the four stream reaches surveyed in 2010 and the two stream reaches surveyed in 2006.

The six geodatabases, for use in the ArcGIS program, each contain a feature class, which stores the locations of the photo points. Additional information associated with each photo, such as the picture itself, FIS distance, feature, and notes, is contained in the attribute table of that database (Figure 2). The 'Feature' field was included, upon discussion with members of the Marin County Department of Public Works, to enable searching for specific things such as bridges, tributaries and fish barriers. The 'Notes' field includes the bank and direction of the picture, as well as occasional observations. Photographs are stored within the feature class as raster images, but each record, or point, can only contain one raster, so subsequent photographs taken at a location are stored in a separate table within the geodatabase.

Each database, with the exception of Ross Creek, therefore contains a table which hold photographs and associated information where numerous pictures were taken at one location. Some sites have as many as five pictures. In order to view these pictures in their locations, the table must be linked to the feature class. This is done using a 'relate' through the FIS distance, as described in the User Guide below.

The folders of photographs, stored as jpegs and named by FIS distance, make the results of this work accessible without ArcGIS but should also be used in conjunction with the GIS for better viewing of the photographs, since rasters viewed through ArcGIS tend to have lower resolution and more contrast.

User Guide

Loading the Database

This section describes the process of loading information into ArcGIS, if you are familiar with this process, skip down to 'Relating tabular info to geographic position'.

- Open ArcMap, either an existing or new project.
- Click the 'Add Data' button, and navigate to personal geodatabase you wish to add, such as SA_CRK_06.mdb
- Select both the table and the feature class contained therein and click 'Add'
- The feature class should appear as a series of points within your map. Note: all these files are stored as NAD_1983_StatePlane_California_III_FIPS_0403_Feet but ArcMap should be able to project them into your map 'on the fly' if you are using a different system.

- Now repeat this process for each feature class- table pair. Note that Ross Creek does not have an accompanying table, as all information is stored in the feature class.

Relating the tabular info to geographic position

Once the tables and feature classes are loaded into ArcMap they must be connected so that the software can connect the information in the table to a location (Figure 3). This is done using a 'relate' command.

- In the table of contents, right-click on a feature class. In the menu that appears scroll over 'Joins and Relates' and select 'Relate...'
- Relate the 'Site_ID' field of the feature class to the 'Site_ID' of the table that corresponds to that reach and year, as in Figure 4. The name is unimportant.
- Now repeat this process for each feature class- table pair.

Searching for Attributes

The 'Feature' field contains names of physical characteristics of the creek captured within each photograph. These include Tributaries, Outfalls, Barriers, Floodplains, Bridges, Large Wood (LW), and substrate Facies, and combinations thereof. One could search for these features by:

- Opening the attribute table or table, right-clicking on the 'Feature' header, and sorting.
- Otherwise one could export the table to a .dbf , from the 'Options' menu, and re-open it with Excel.

Viewing Photographs Through ArcMap

- Click the 'I' identify button and click on a point
- You should see a window as in Figure 5.
- Click on the hyperlink symbol on the right side of the 'Photo' row. Note that the contrast of some pictures is extreme when viewed this way, in which case following the instructions below will give a better viewing.
- To view other photos at the same location, assuming there are any and that the 'relate' is working, select them from the table of contents on the left side of the identify window.

Viewing Photographs Outside of ArcGIS

The photographs included in the database are best viewed as .jpgs for high-resolution inspection, and a file of .jpg photographs is included aside each database for this purpose. Photographs in these files are named according to their location along the streamline.

The Fairfax stationing comes from the 1977 FEMA FIS used in the 2006 report. This file is owned by Geomorph and Fairfax. The Corte Madera Creek line, which is used for the town of Ross reach, came from the 1980 FEMA flood insurance survey creekline, and is slightly different than Fairfax. This file was developed by Stetson Engineering and the County of Marin. I have tried to distribute digital versions of the stationing so that these databases can be easily added to. Both versions are used for this project by permission of Matt Smeltzer.

Data Collection Method and Discussion

- To collect field data, I used a Garmin 'GPSmap 60' GPS unit and an Optio digital camera. I carried printed thumbnail photos of the 2006 pictures, and I recorded field notes and observations about each photo point as I walked up or down stream. I tried the Marin DPW GPS camera, which also worked fine.
- Good photographs can be difficult to capture in creek channels because of the spotty lighting, therefore I recommend photographing on overcast or cloudy days.

- The GPS was accurate to between 10 and 100 feet, so my digitization process included GPS points as well as field notes, property boundaries, bridges and bends as guides.
- Locations of the points were estimated to the best of my abilities and I believe the accuracy to be within about 30 feet.
- Often the points are located a significant distance from any digital stream layer. In these cases the the Site_ID is denoted by the FIS distance orthogonal to the streamline.
- Future work should also not rely on the GPS location only since, for example, the 2006 and 2010 locations can differ by as much as ~50 feet.
- Future work using or recreating this survey could greatly benefit from a piece of technology that could digitally store and display old pictures and maps in the field.

Database Discussion

- Designing the database format and architecture was a significant component of this internship and this section discusses some of the considerations I discussed with Matt Smeltzer, Liz Lewis, and Laurie Williams during a few meetings at the Marin County DPW.
- I believe that, to a knowledgeable database analyst, the format of these data could very easily be incorporated into another structure or existing project such as water quality sampling locations.
- I chose to locate the photographs as independent points instead of associate them with streamlines because accurate or accepted streamlines change, as do streams themselves.
- The Site_ID field, based upon the FIS is a useful convention for attaching numerous photos to one point, but not necessary for future work.
- Features, such as outfalls and barriers, are not meant to be a comprehensive list at this point and, because this information came from field notes, are not completed for 2006 photographs at all.

Watershed Observations

My general impression of the changes observed in the watershed between 2006 and 2010, based on the photographs, is that morphological changes to the channels have largely been anthropogenic, such as streambank stabilization and culvert retrofitting. Many of the sites in which 2006 photographs show bank failure, undercutting and erosion now have stabilization structures (ie walls), are overgrown with vegetation (mostly blackberry or ivy), or show no change at all. Very few sites exhibit continued mass wasting. In-channel features, such as longitudinal gravel bars and pools are also mostly unchanged because they are caused by larger and more permanent geomorphic features which deflect and refocus the stream energy at higher flows. Places where these larger features have changed, such as the construction of walls or toppling of trees, therefore exhibit some recent changes to the bed form.

The most apparent difference between the 2006 and 2010 photographs is a significant increase in the size and density of vegetation surrounding the channel. This growth might be due to the long wet spring we had this year or interannual weather patterns. The 2006 photos were taken about six months after a 100 year flood event, so channel scour would also have removed some vegetation.

Conclusions and Further Work

This project has had numerous purposes, among them familiarizing myself with the watershed, the GIS software program, and the agencies that operate here. But this work can also be used as a valuable resource for easily finding photographs of locations or types of feature within the reaches and as a benchmark for monitoring physical changes.

Discharge records for the last 10 years would offer another explanation to why significant morphological changes have not occurred in the last four years. In my plans for future work in the watershed, derivation of hydrographs from the various rating curves and stage data will be a priority.

References

1. Smeltzer, M. and G. Orum. 2006. Geomorphic Assessment for Town of Fairfax Project Sites, Final Report. Prepared by Fluvial Geomorphology Consulting and Stetson Engineers Inc. for the Town of Fairfax Public Works Department, July 31, 2006.

Figures

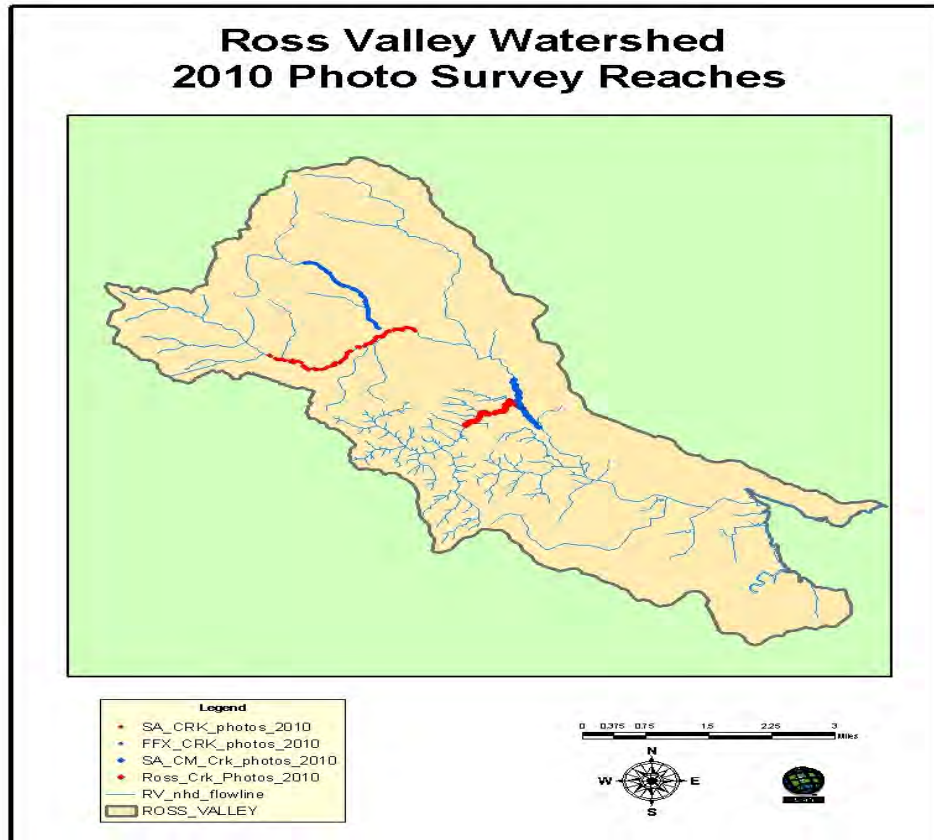


Figure 1

Ross Valley map and locations of reaches included in this project.

Town of Fairfax (upstream):

San Anselmo Creek (in red) from Pastori Rd to Cascade Canyon Preserve

Farifax Creek (in blue) from confluence with San Anselmo Creek upstream through Whitehill School

Town of Ross (downstream):

Corte Madera Creek (in blue) from upstream end of the concrete channel to Barber Ave behind Sunnyside nursery and Insalata's restaurant.

Ross Creek (red) from confluence with San Anselmo Creek upstream to Natalie Coffin Greene Park.

Attributes of FFX_CRK_photos_2010						
OBJECTID*	SHAPE*	Photo	Site_ID	Feature	Notes	
4	Point	<Raster>	Ffx_9250	<Null>	RB from LB, RR and Bay Laurel behind snackshop	
5	Point	<Raster>	Ffx_9130	<Null>	DS CL to culvert	
7	Point	<Raster>	Ffx_9075		US to culvert	
8	Point	<Raster>	Ffx_9000		US CL to Culvert	
10	Point	<Raster>	Ffx_8930	Trib	US to confluence from LB	
11	Point	<Raster>	Ffx_8750	LW	DS CL, Wood	
12	Point	<Raster>	Ffx_8700	<Null>	DS CL, grey fox, bedrock in bed	
13	Point	<Raster>	Ffx_8670		DS CL, long shallow pool, filled with sediment from downstream dams	
15	Point	<Raster>	Ffx_8480	Barrier	US CL, small rock dam	
16	Point	<Raster>	Ffx_8265	Outfall	from LB	
17	Point	<Raster>	Ffx_8220		DS CL footbridge, no canopy	

Record: 1 | Show: All Selected | Records (0 out of 37 Selected) | Options

Figure 2
Sample attribute table for a feature class. Fields include the photograph, Site_ID (the FIS distance), pertinent features, and field notes.

Attributes of FFX_CRK_photos_2010						
OBJECTID*	SHAPE*	Photo	Site_ID	Feature	Notes	
4	Point	<Raster>	Ffx_9250	<Null>	RB from LB, RR and Bay Laurel behind snackshop	
5	Point	<Raster>	Ffx_9130	<Null>	DS CL to culvert	
7	Point	<Raster>	Ffx_9075		US to culvert	
8	Point	<Raster>	Ffx_9000		US CL to Culvert	
10	Point	<Raster>	Ffx_8930	Trib	US to confluence from LB	
11	Point	<Raster>	Ffx_8750	LW	DS CL, Wood	
12	Point	<Raster>	Ffx_8700	<Null>	DS CL, grey fox, bedrock in bed	
13	Point	<Raster>	Ffx_8670		DS CL, long shallow pool, filled with sediment from downstream dams	
15	Point	<Raster>	Ffx_8480	Barrier	US CL, small rock dam	
16	Point	<Raster>	Ffx_8265	Outfall	from LB	
17	Point	<Raster>	Ffx_8220		DS CL footbridge, no canopy	

Record: 1 | Show: All Selected | Records (0 out of 37 Selected) | Options

Feature Class Attributes

Linked with a 'Relate' command

Attributes of More_FFX_CRK_Photos_2010					
OBJECTID*	Site_ID	Photo	Feature	Notes	
6	Ffx_9000	<Raster>		DS CL	
7	Ffx_9000	<Raster>	<Null>	DS RB	
8	Ffx_8700	<Raster>	<Null>	US RB, wooden retaining wall	
9	Ffx_8700	<Raster>	<Null>	DS CL narrow bedrock reach	
10	Ffx_8700	<Raster>	Outfall	LB outfall, Concrete, slightly undercut	
12	Ffx_8480	<Raster>	<Null>	US RB	
13	Ffx_8480	<Raster>	<Null>		

Record: 1 | Show: All Selected | Records (0 out of 25 Selected)

Table contains all subsequent photos at same location

Figure 3
Attributes of a feature class and table for the same database showing the common field used to link tabular information to locations.

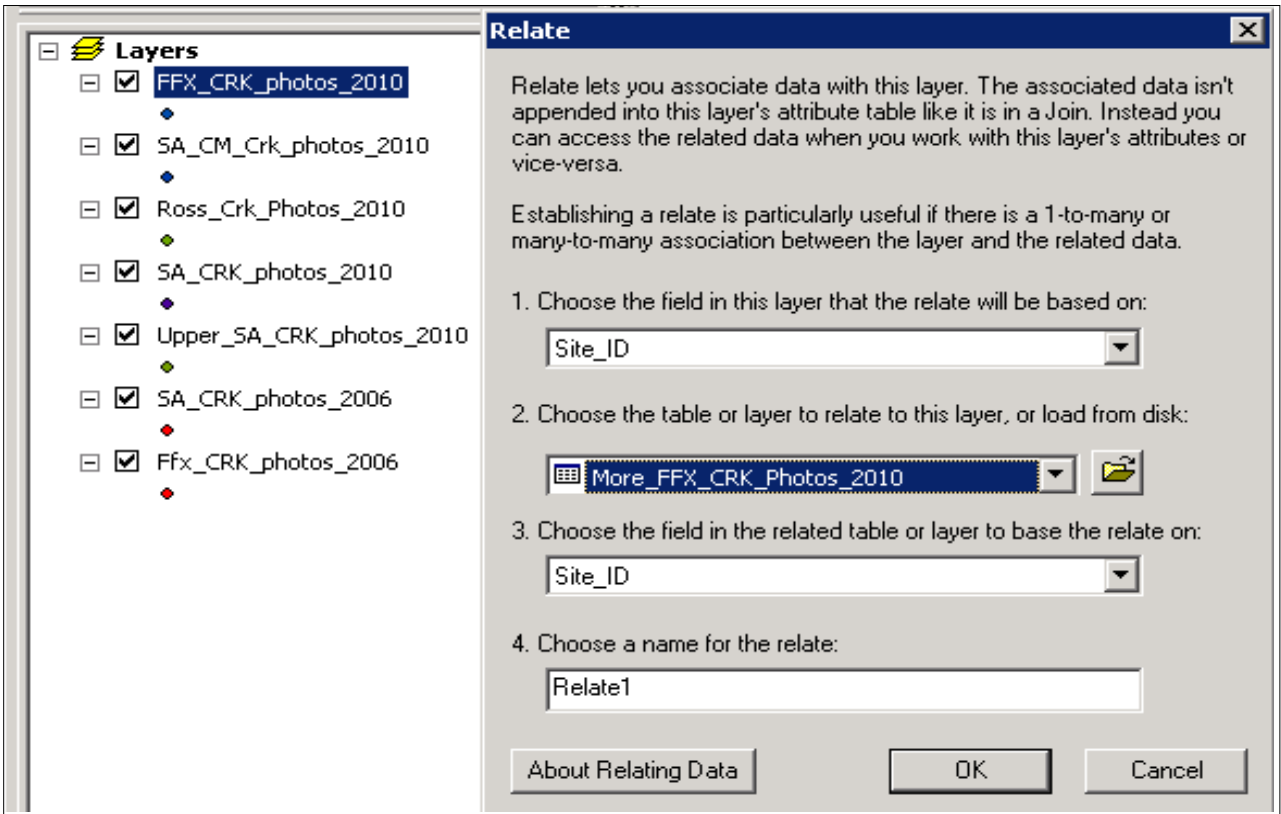


Figure 4
The 'Relate' window showing the link between the Fairfax Creek feature class and its table.

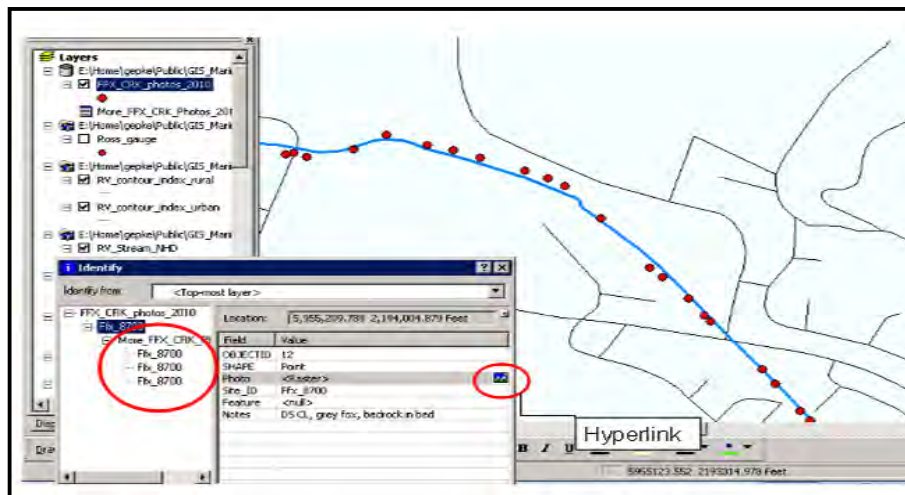


Figure 5
Example of how to view rasters using the 'Identify' tool. Supplemental photographs are accessed through the table of contents circled on the left.



Figures A-1 a: picture 32460 DS TO CL from 2006 (above, on left)
b: SA_32460 from 2010 (on right)

In San Anselmo Creek behind the Fairfax post office. Most photographs, like this one, show very little morphologic change.



Figures A-2 a: picture 32678 DS TO RB FAILURE from 2006 (above, on left)
b: SA_32740 from 2010 (on right)

In San Anselmo Creek, 200 feet upstream, the right bank scarp has changed little in four years. Marin Town and Country Club has removed the building that was perched over the cliff, and the 2010 photograph shows the wall on the left bank that probably directed flows to the right.



Figures A-3 a: picture 1597 DS TO MERWIN RD BDGE INLET from 2006 (on left)
b: Ffx_1625 from 2010 on right

In Fairfax creek at Merwin Rd, gabion baskets, which in 2006 were recently added as stabilization on right bank, are now very overgrown and protrude even farther into the channel.



Figures A-4 a: picture 6513 DS TO LB from 2006 (on left)
b: Ffx_6475

Farther upstream on the Fairfax Creek, one instance of erosion on the left bank, possibly due to channel alterations farther upstream.



Figures A-5 a: picture 7782 US TO SFD CULVERT SITE, from 2006 (on left)
b: Ffx_7780, from 2010 (on right)

Fairfax Creek, further upstream: tree removal and streambank stabilization below the Sir Francis Drake Blvd culvert.



Figure A-6 picture SA_CM_37515_5
Corte Madera Creek at Lagunitas Bridge in Ross before construction.
Ross photographs do not have 2006 versions.