

Changes in Hydrography within the Holocene Meanderbelt System of the Rio Grande

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Introduction

The Rio Grande borders Mexico and Cameron County of Southern Texas, and it is an intensely sinuous river that maintains a number of abandoned channels within its meanderbelt. A map produced by the Bureau of Economic Geology documents the Holocene-age meanderbelt of the Rio Grande, which is representative of previous hydrography of the area. Modern hydrography data is compiled by Texas Natural Resource Information Systems (TNRIS). Comparison of these two datasets can provide an estimate of the change in hydrography for the area, from the time during which fluvial sediments were deposited in the Holocene to the time at which TNRIS compiled hydrographic data.

Data Collection & Preprocessing

- Hydrography data was collected from TNRIS:

<http://tnris.org/data-catalog/entry/texas-nhd-river-streams/>

- Fluvial data was acquired from a report by the Bureau of Economic Geology:

Brown, L.F., Brewton, J.L., Evans, T.J., McGowen, J.H., White, W.A., Groat, C.G., Fisher, W.L., 1980, Environmental Geologic Atlas of the Texas Coastal Zone-- Brownsville-Harlingen Area: Bureau of Economic Geology, p. 167.

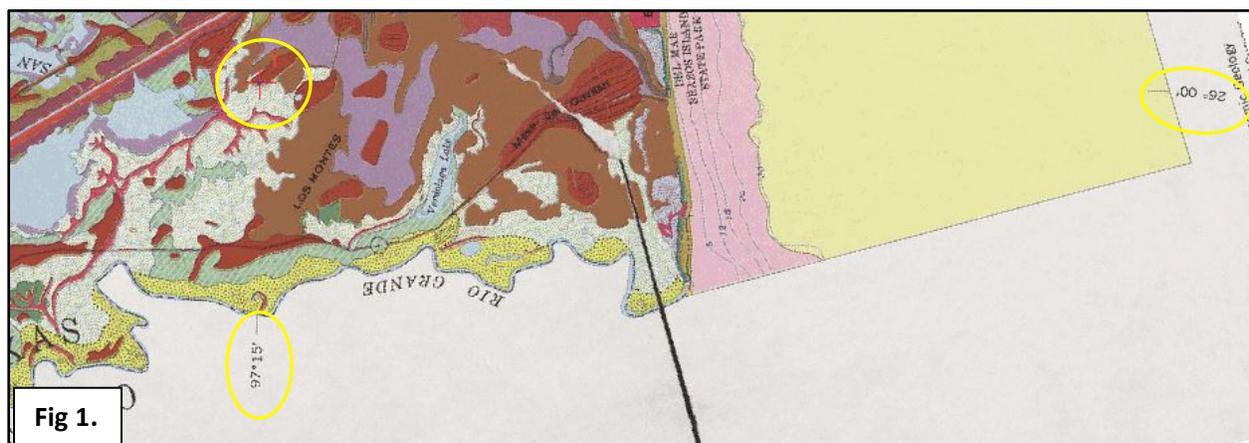
- Aerial Imagery (2014 NAIP 1M NC) was acquired from TNRIS:

<http://tnris.org/data-download/#!/county/Cameron>

To ensure consistency among datasets, all are assigned to the coordinate system of NAD1983 UTM Zone 14.

In the hydrography dataset, there is an attribute named FType, which refers to whether the flowline is a Stream/River, Artificial Path, Connector, Pipeline, Canal/Ditch, etc. The types addressed in this analysis are Stream/River, Artificial Path, and Connector. From this layer, features with of these types are selected with the "Select By Attribute" tool and a new layer is created from the selection.

To display the fluvial data from the Bureau of Economic Geology, it is necessary to upload the map into ArcMap as a .TIFF file and georeference it, so as to provide a spatial frame of reference. Four points are used as links, and they are the intersection of latitudes and longitudes provided on the map. Figure 1 indicates with yellow circles a link and its associated latitude/longitude.



ArcGIS Processing

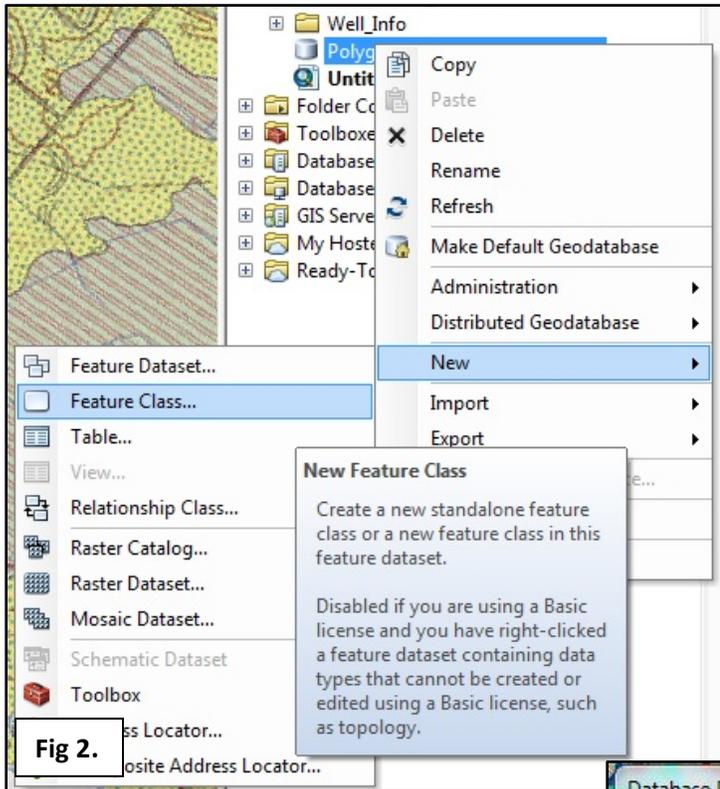


Fig 2.

To digitize fluvial features, it is necessary to create a personal geodatabase and create a new feature class (Figure 2).

Attributes, such as "Fluv_Att" and "Sed_Type" are created to distinguish fluvial attributes, such as meanderbelt or floodbasin, and sediment types, such as sand/silt or mud/silt. For each attribute, a domain is created (Figure 3).

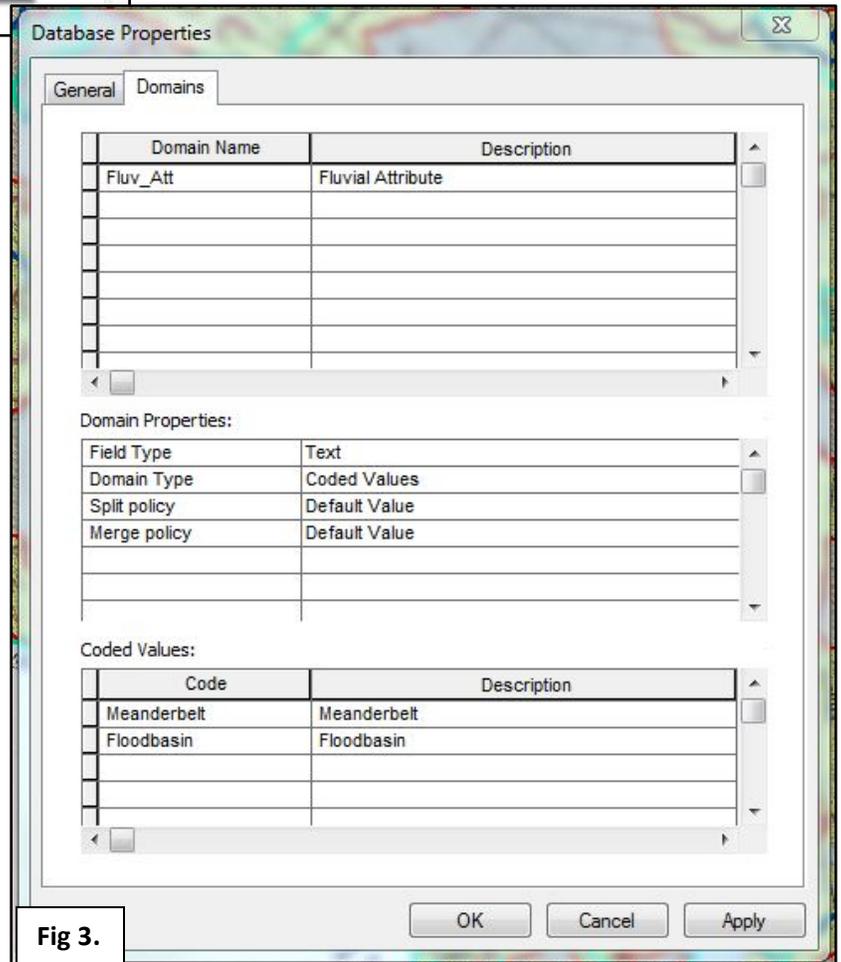
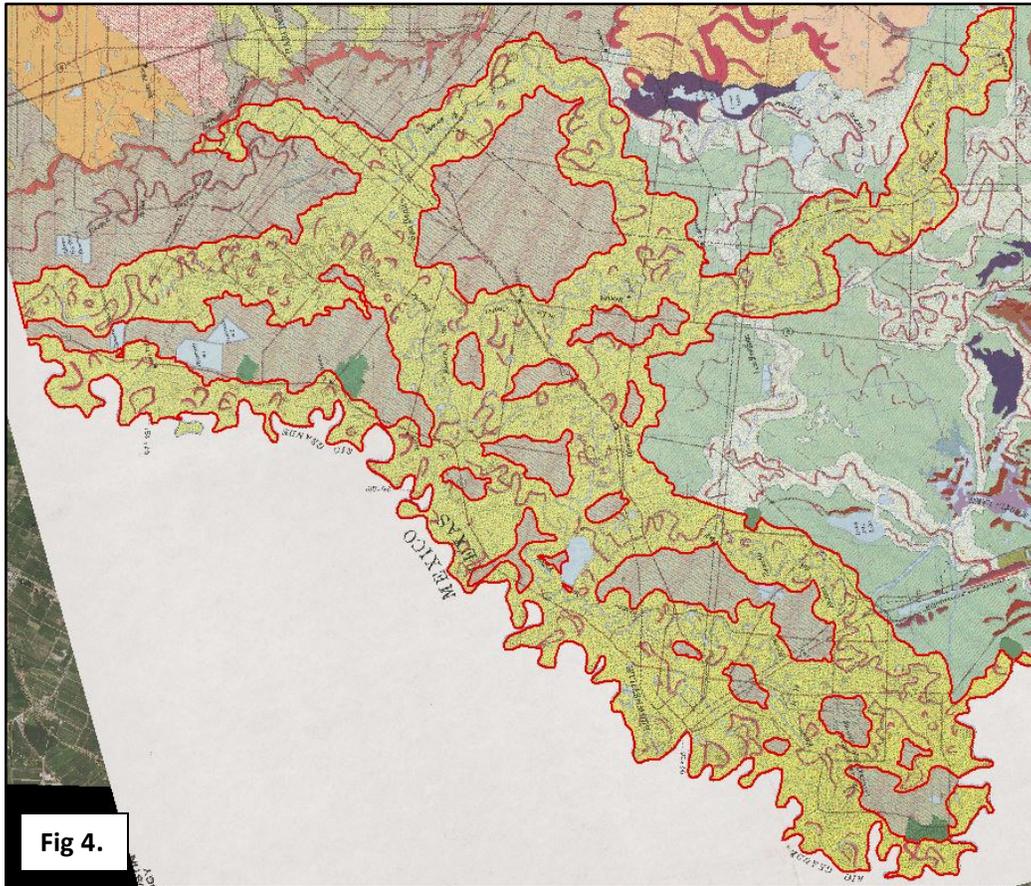
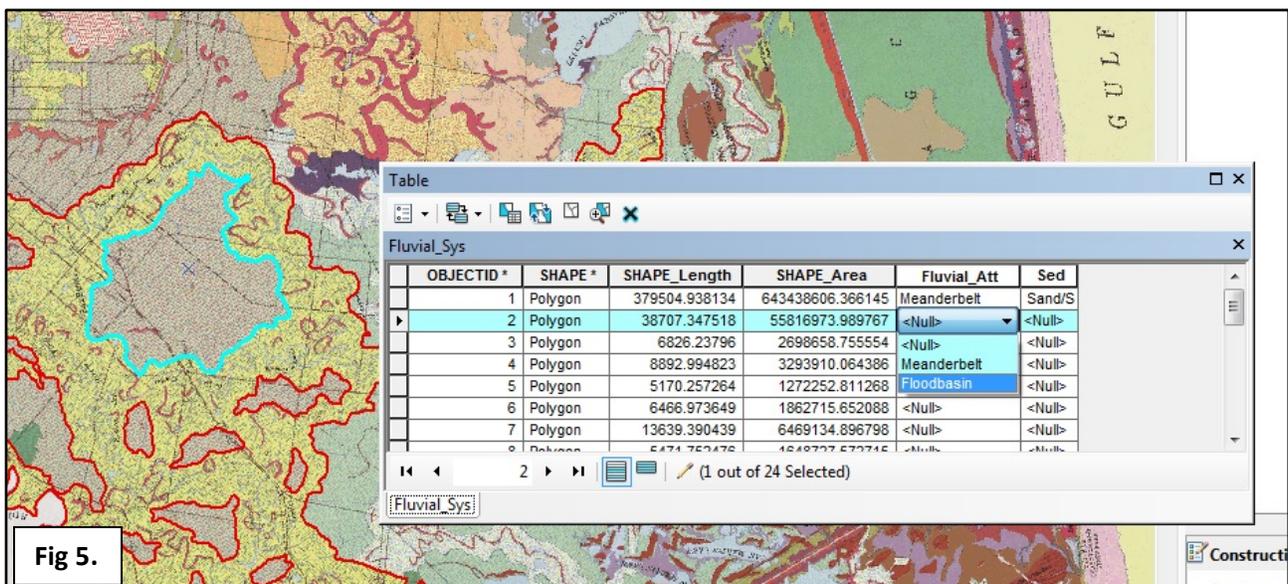


Fig 3.

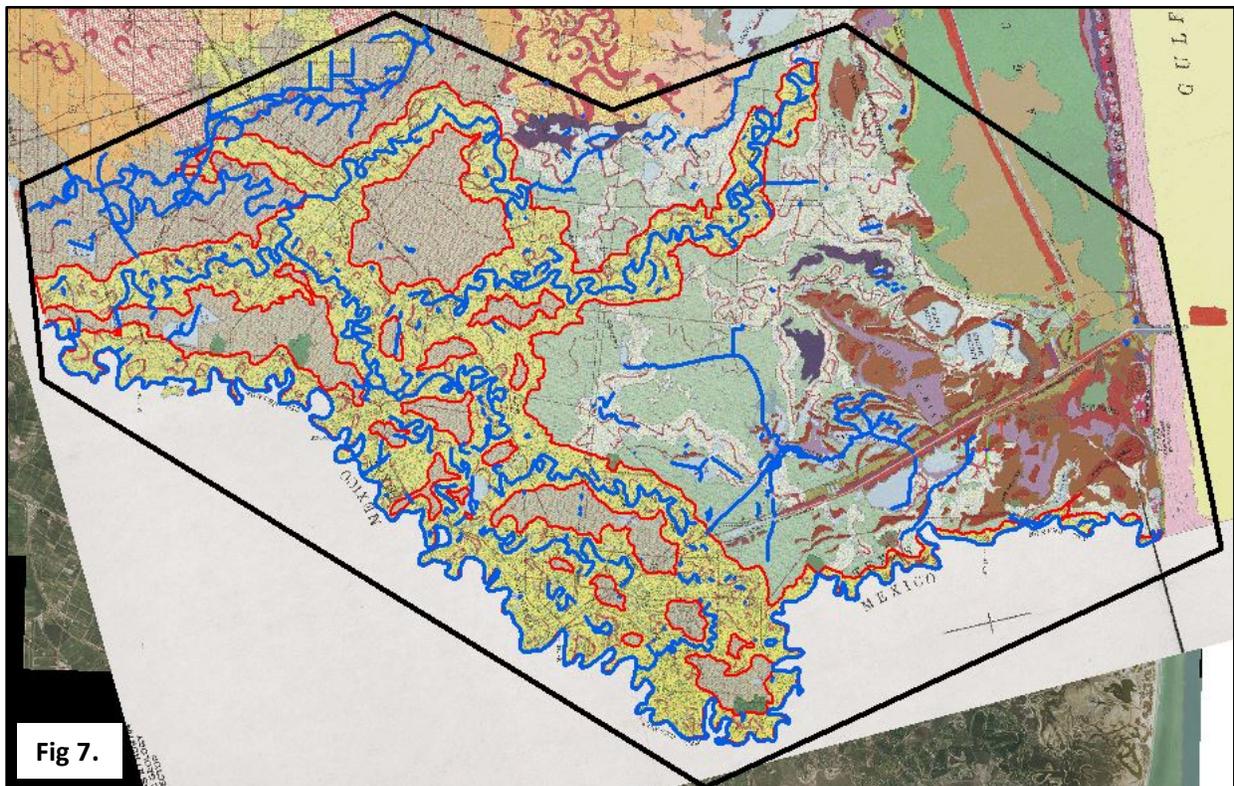
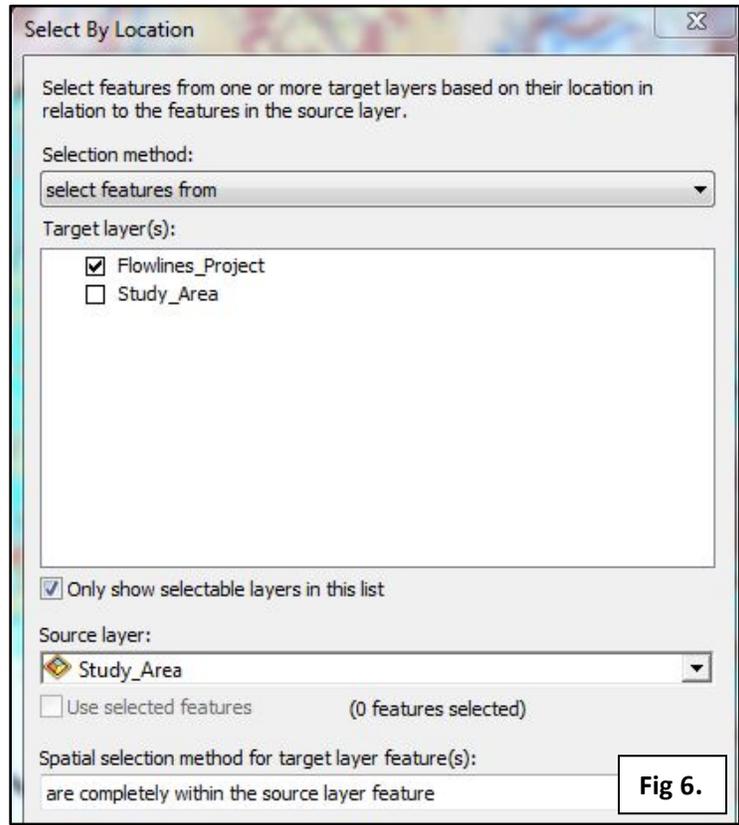
To begin creating polygonal features, editing mode is turned on for the newly created feature class. The meanderbelt is then digitized as polygonal features. The polygon features trace the outline of the fluvial attribute in question, the meanderbelt. The meanderbelt on the map provided by the Bureau of Economic Geology is represented by the yellow fill, while the polygons created in ArcGIS are shown in red in Figure 4.



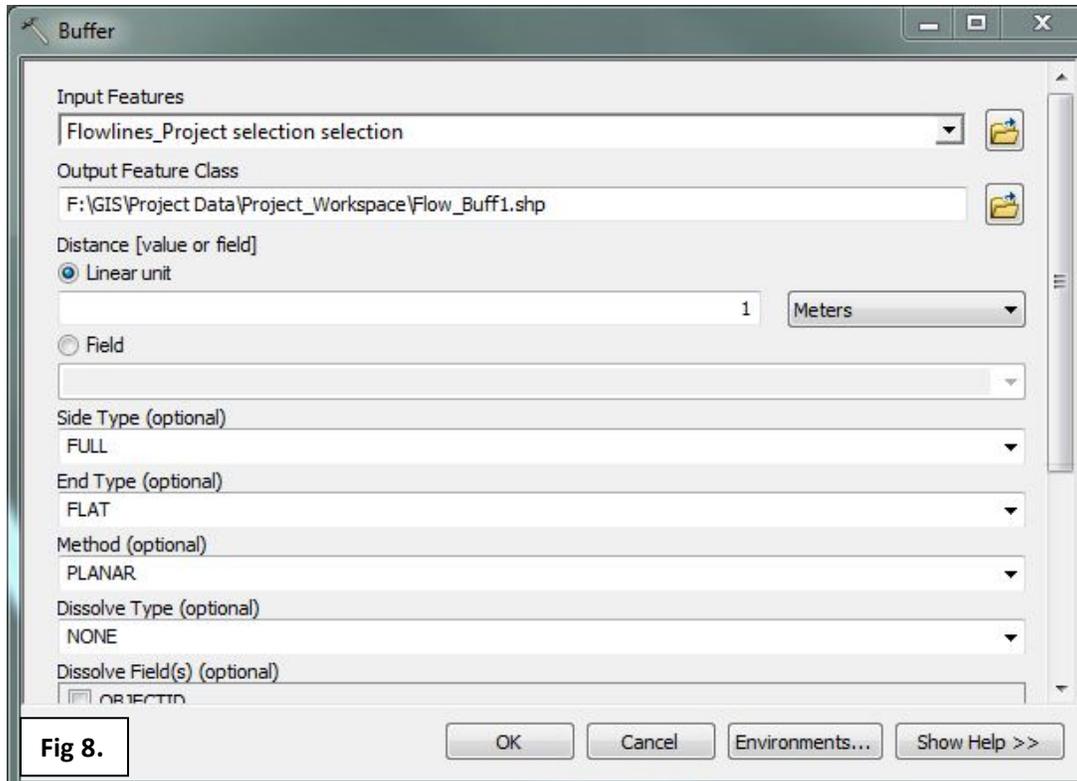
Some polygons created encompass the meanderbelt, while some encompass the floodbasin, so it is necessary to distinguish the fluvial attributes by populating the attribute table with their respective domain types. To do this, editing mode is turned on and the attribute table is opened. Under each attribute for each polygon, the null value is selected and then replaced with a domain type from the drop down menu (Figure 5).



Since the hydrography dataset includes flowlines for the entire state of Texas, it is necessary to create a new layer from a selection of flowlines that are within the study area. With the drawing tool, a study area polygon is created and then converted to a shapefile. Then, flowlines are selected using the select by location tool (Figure 6). Additionally, flowlines located beyond the Texas border are manually removed from the selection because there is no data regarding meanderbelts in Mexico. Figure 7 shows flowlines in blue and the study area in black.



The next step is to quantify the extent of flowlines within the meanderbelt as well as outside of the meanderbelt. Since flowlines are quantified by a length and the meanderbelt is quantified by an area, it is necessary to create a buffer around the flowlines to provide an area. A buffer of 1 meter is created for all flowlines within the study area (Figure 8). Then, a “Shape_Area” attribute is added and the calculate geometry tool is utilized to calculate area for the buffered flowlines.



To select buffered flowlines within meanderbelt polygons, the select by location tool is utilized. Flowlines that fall within floodbasins are manually deselected. The selection is then inverted to select flowlines outside of the meanderbelt polygons. The areas are recorded in Table 1. The actual area of meanderbelt polygon is calculated by subtracting floodbasin polygon areas from the total area (Table 2).

Results

Today, 41.75% of flowline areas fall within the meanderbelt, and are consistent with previous regimes of hydrography, while 58.24% lie outside of the meanderbelt. Hydrography within the meanderbelt accounts for 1% of the total area.

Flowline Area Inside	Flowline Area Outside	Total Area
595285	830341	1425626

Table 1: Flowline areas in square meters.

Total Meanderbelt Area (Including Floodbasins)	Floodbasin Area	Actual Meanderbelt Area
658709327	115311346	543397980

Table 2: Areas of fluvial polygons in square meters.