Preliminary Analysis of Flow Types and Land Use in Marin County, CA

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Abstract

This report provides a preliminary assessment of land use types in relation to flow types in Marin County, California. This is aimed at providing data for management of water resources for possible climate change models and delineating areas of concern for possible contaminant sources, in particular Tomales and Richardson Bays. The data was analyzed using ArcMap 10.1 (Esri) and data was collected from the Marin County GIS website. Intersections of stream buffers and land use types were mapped along with the flow types. Possible implications for management include prioritization of possible contaminant sources, allocation of recycled storm water for irrigation, and what may be necessary for future assessment. Climatic models and issues with water resources are complex and further analysis and data collection is recommended.

Introduction

This report is aimed at providing a preliminary analysis and assessment for land use in relation to flow types and possible sources of nonpoint pollution in the Marin County, California area. The data collected can also be used to assess suitability for water reuse in districts, especially in northern Marin County where most agricultural land is located.

Climate change is predicted to have large impacts on hydrology and water resources in California including lower levels of groundwater, less reliability, and smaller stream flows. These models show problems emanating later in the 21st Century around the area of San Francisco Bay (Vicuna et al. 2007). Climate change scenarios will also impact agricultural land in California and have a drastic impact on water resources available to California irrigated agricultural lands (Schlenker et al. 2007)

The Water Reuse Program for the North Bay area helps meet water quality regulations and protect water resources (NSD 2014). This is accomplished by using recycled water in place of potable water or groundwater that is expected to become limited in future years due to population growth and water stress expected in predictive models associated with climate change (Vicuna et al. 2007). The California Water Recycling Criteria (encoded in Title 22 of the California Code of Administration) allows for specified uses of recycled water, including irrigation of agricultural land. Reuse of water could have many beneficial uses in regard to many potential problems in the future.

Water quality and problematic contaminants have become an issue in the Marin County area. Pesticides have been limited in urban creek runoff in the area and increases utilization possibilities for reuse of storm drain runoff for other uses. The Tomales Bay TMDL (Total Maximum Daily Load), which is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards (EPA 2014) focuses efforts on reducing pathogen in storm water runoff in Marin County (CSTOPPP 2013). This report focuses

on a problematic area of Richardson Bay, where fecal coliform exceeds water quality standards and impacts the local recreation and economic uses in the area. Possible sources of contaminant include houseboats, vessels, and sanitary sewer overflows (CSTOPPP 2013).

Methods

We started the analysis process by looking at the Marin County website for GIS data. We chose specific layers to do analysis on water quality in the area. The layers we focused on were parcel types and stream flow lines. We loaded the data as shapefiles into ArcMap 10.1 (which is the primary file type used for vector data) to conduct an in depth analysis on the chosen location. We split parcel types into categories using the select by option in the attribute table. We selected commercial, farmland, multiple residential, single resident, agriculture, and industrial. We also split the stream flow types into categories using the select by attributes option as well. For this report we were interested in the following flow types; artificial path, canal ditch, connector, pipeline, and Stream/River. Around the flow lines we created a 150 foot buffer, which is a sufficient distance to make sure water quality and stream habitats can remain sufficient. We then used the intersect tool under the geoprocessing tab to find how many of each parcel type intersect with the flow line buffer. Once we had this information we went back into the attribute table to figure out the number of parcels that intersect and the total area of intersection with the buffer to be used for analysis purposes. Once our analysis was completed we loaded a DEM (Digital Elevation Map) of Marin County from the USGS site (United States Geographical Survey) into ArcMap to add to the background of some of our maps and give them a more realistic appearance. Once the DEM was loaded we created a hillshade effect to give the viewer a greater sense of elevation changes in the area. We found this background specifically useful in the flow type map shown below.

Results

The outcomes shown in the table and maps below could be used for further analysis of water quality in Marin County, California and to pinpoint possible problematic areas. Marin County is located in central Northern California, just north of San Francisco. Since Marin County is all one watershed, it is important to take into account the entire area to find possible problems in the watershed table.

The restoration and mitigation of contaminants from agricultural and farmland land use is a priority area. This is shown with 94.29% of the farmland intersecting the stream buffers and 84.75% of agriculture intersecting streams buffers (Table 1) primarily located in northern Marin County. This area totals 62,143 acres. Residential totals 7,309 acres intersecting the buffer areas, many of which the stream types are artificial paths with impermeable surfaces. Artificial stream types in Marin County make up 18.51% of the total flow types, the second most common after natural streams/rivers.

These results are a starting place for further water quality analysis in Marin County. More in depth analysis on other factors such as pesticide and fertilizer use, sewage treatment and dumping sites, water recreation usage, soil type etc. would need to be conducted for a more in depth analysis on issues with water resources in this area.

Table 1. This table shows the different parcel types in Marin County and the intersection with the flow line buffer

Parcel type	**Total number of parcels**	**Total number in stream buffer**	**% of total**	**Area of Intersection (Acres)**
Commercial	2,881	527	18.29	3,255.2
Farmland	35	33	94.29	12,100.856
Multiple Residential	4,746	739	15.57	690.727
Single Residential	61,932	8033	12.97	6,618.718
Agriculture	223	189	84.75	50,043.586
Industry Improved	547	57	10.42	355.887
Total	70,364	9578	13.61	73,064.9

Table 2. This table shows the different stream types in Marin County with the total number present and the % of the total each one represents.

Stream type	**Total number**	**% of total**
Artificial Path	523	18.51
Canal Ditch	218	7.72
Connector	15	0.53
Pipeline	43	1.52
Stream/river	2026	71.72

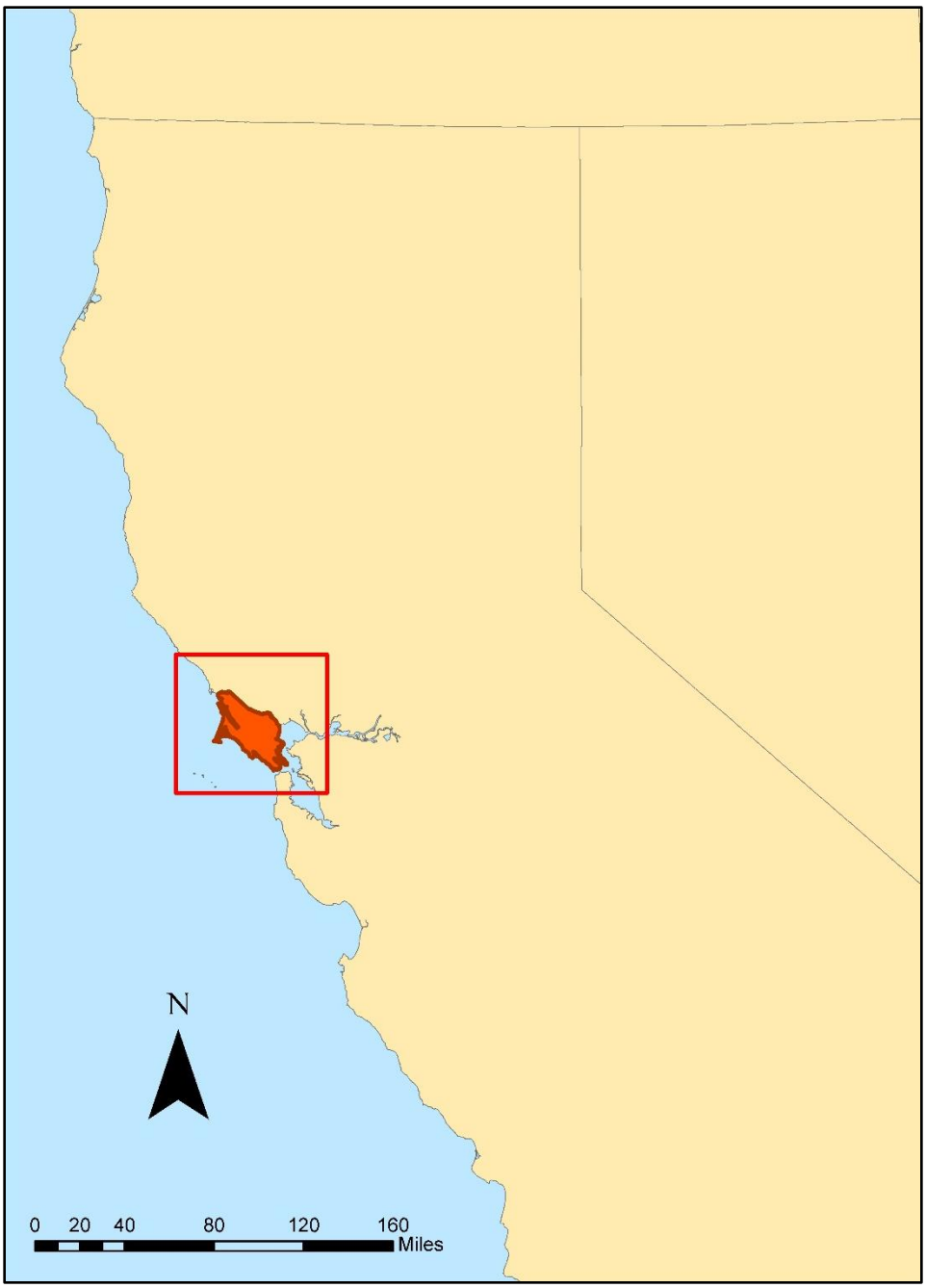

Figure 1. This is a locator map of the area of study, Marin County, which is located in north central California

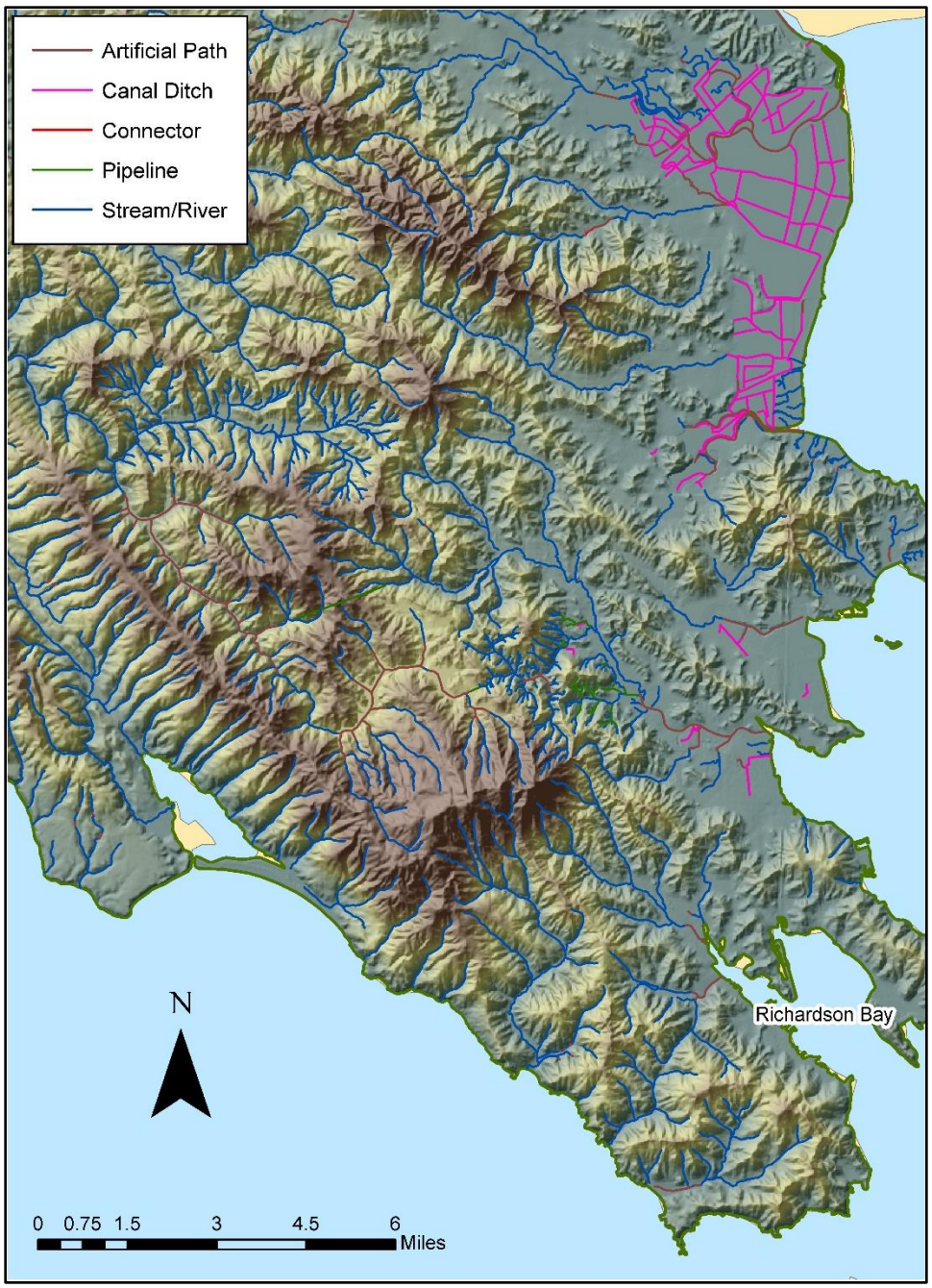

Figure 2. This map shows the different flow types in Marin County. This view is primarily of southern Marin. Each flow type is represented by a different color as shown in the legend above. Richardson Bay, located in Southern Marin has been labeled since it is an area of particular concern.

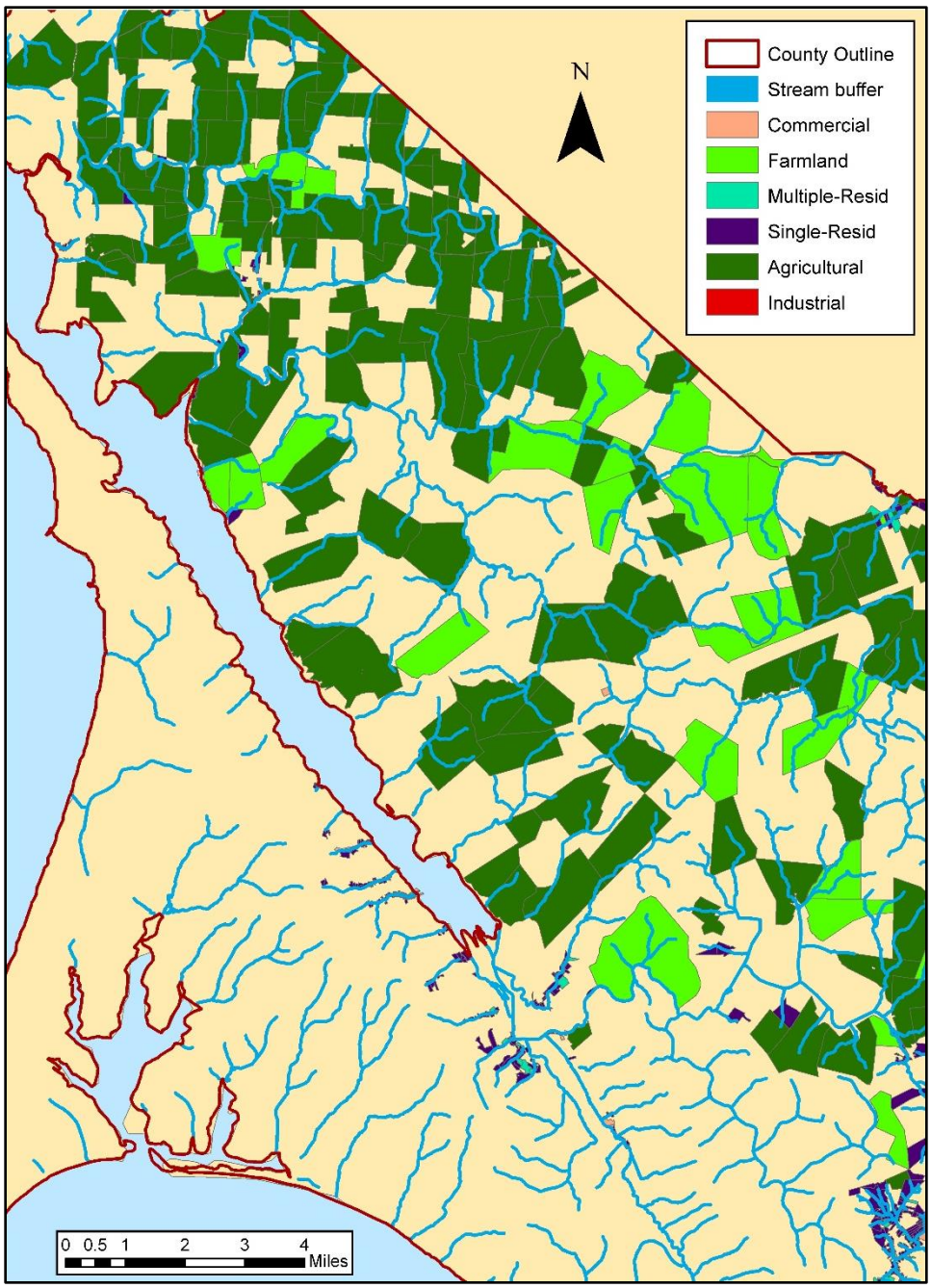

Figure 3. This map shows different parcel types in northern Marin County that intersect with the stream buffer (light blue). As you can see Northern Marin is composed primarily of agriculture, farming, and single residential land use types.

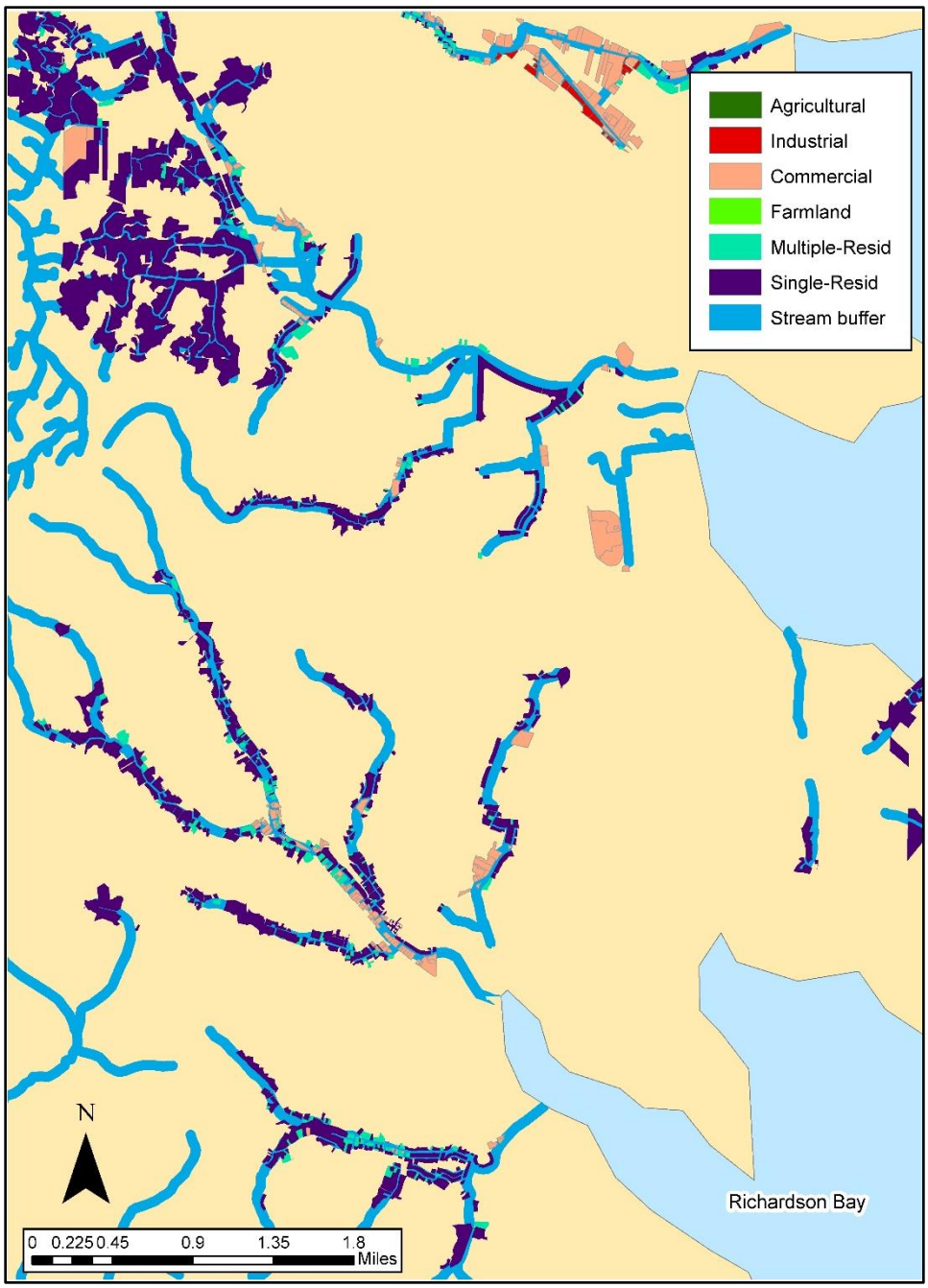

Figure 4. This map shows parcel types that intersect with the stream buffer (light blue) in southern Marin County. Richardson Bay is labeled again since it is an area of particular concern. As you can see southern Marin is composed mostly of single residential, multiple residential, commercial, and industrial land use types.

Conclusion

The area of interest around Marin County, CA has many possible sources of contamination into different flow types that pose management concerns. The developed area intersects many buffered areas of streams that allow runoff and further mitigation in the future will be necessary. Problematic sources are residential land use types intersecting with artificial pathways creating a pronounced effect of contaminants and farmland/agricultural intersecting with natural waterways delivering possible harmful runoff into the watershed. Most of the area around Richardson Bay is improved residential and is considered at highest risk and a possible source for contaminants of fecal coliform.

Possible allocations of storm water runoff onto agricultural lands and other uses will alleviate concerns in regard to future climate change models. This goal is only feasible if proper measures are taken to reduce contaminants in runoff areas and with best management practices (BMP's) in place for the delivery onto agricultural land.

This report was designed as a preliminary assessment of flow types in relation to proximity of land use types. It is important to further delineate the areas needed for restoration with and analysis of soil types to show efficacy of managing water resources on the agricultural land. Further data collection and identification of possible contaminant sources will be necessary for future management action.

Acknowledgements

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Bibliography

EPA (2014) "Laws & Regulations." *Laws, Rules, Regulations & Dockets*. Environmental Protection Agency, 13 Sept. 2013. Web. 20 Nov. 2014. <http://water.epa.gov/lawsregs/>.

MCSTOPP (2013). *Marin County Stormwater Pollution Prevention Program Annual Report*. Tech. San Rafael: Marin County Department of Public Works, 2013. Web. 17 Nov. 2014. <http://www.marincounty.org/depts/pw/divisions/mcstoppp/>

NSD (2014) *Water Recycling at Napa Sanitation District*. Napa Sanitation District, Sept. 2014. Web. 17 Nov. 2014. <http://www.napasan.com>.

Schlenker, W., Hanemann, W., and Fisher, A. (2007). "Water Availability, Degree Days, and the Potential Impact of Climate Change on Irrigated Agriculture in California." Climatic Change, 10.1007/s10584-005-9008-z, 19-38. Online publication date: 1-Mar-2007.

Vicuna, S., Maurer, E. P., Joyce, B., Dracup, J. A. and Purkey, D. (2007), The Sensitivity of California Water Resources to Climate Change Scenarios. JAWRA Journal of the American Water Resources Association, 43: 482–498. doi:10.1111/j.1752-1688.2007.00038.x