WELLS CREEK WATERSHED

1994 FIELD SEASON REPORT AND ANALYSIS
MAINSTEM AND TRIBUTARY BASE FLOW DISCHARGE

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Introduction

The Wells Creek Watershed Partnership is a prototype watershed management effort led by the Department of Natural Resources. Wells Creek is located within the Blufflands Landscape of Southeast Minnesota (Figure 1). A technical committee made of federal, state and local agency staff support a citizen steering committee. The technical committee is reviewing available information and collecting new information in anticipation of future steering committee requests for assistance and project monitoring needs.

Methods

Base flow discharge measurements were made on the mainstem and tributaries of Wells Creek by DNR Waters interns and staff in July, August and October of 1994. All measurements are considered to represent near base flow conditions because no storm events occurred during or within 48 hours of the measurement period. Base flow measurements were completed at 9 sites; 7 mainstem and 2 tributary locations in July. A preliminary analysis of the initial measurements led to two additional mainstem measurement locations (sites 4a and 6a) in August to better define groundwater interaction with the mainstem. The October effort concentrated on base flow contributions of the 6 largest sub-watersheds and known springs. See Figure 2 for measurement locations and Table 1 for discharge values.

Measurements were made in general accordance with USGS methods. Flow velocities were made at 0.6 depth (measured from water surface) for 10 - 20 sites across a transect perpendicular to flow using a Marsh McBirney 201D portable water current meter.

Dissolved oxygen and water temperature were measured at sites visited in July and August using an air calibrated YSI model 57 oxygen meter.

Discussion

Mainstem Discharge

Plotting July and August discharge measurements collected longitudinally suggested that groundwater/surface water interactions are not uniform along the length of Wells Creek (Figure 3). From stream mile 15.6 (headwaters) downstream to mile 12.4 (site 6a, 284th St. Way), base flows slowly increase. From mile 12.4 to approximately 3.4 (site 4, Territorial Road), base flows increase at a relatively faster rate per mile. Downstream of mile 1.4 (site 3, Hwy 61) Wells Creek is a losing stream.

These observations are expressions of the changing hydrogeology underlying the stream reaches. In the upper most reach, base flow is supported by the Prairie du Chien and upper portion of the Jordan aquifers. Downstream from site 6a to approximately Territorial Road, base flow is further supported by the Jordan and Franconia aquifers. Between Highway 61 and its confluence with the Mississippi River, Wells Creek crosses an ancient Mississippi River channel filled with well sorted glaciofluvial sands. It is thought that the glaciofluvial sands have a greater transmissivity than the sandstone aquifers resulting in recharge of the sand aquifer by Wells Creek. The potentiometric surface of this surficial sand aquifer is controlled by water levels in Lake Pepin.

Summer base flow discharge measurements taken by the USGS, DNR Fisheries and DNR Waters over the past 35 years near Territorial Road and Highway 61 Bridges were graphed to assess trends in base flow discharge (Figure 4). The graph suggested that base flow discharge has increased significantly over the last 35 years in Wells Creek.

Base flow is supported primarily by groundwater recharge from the aquifers along and underlying the Wells Creek mainstem. Groundwater recharge does not appear to occur at discrete, structural or bedrock controlled springs. It seeps through the floodplain alluvium in a diffuse non-uniform manner along the length of the stream (except as noted above) beginning in Section 7 of Belvidere Township. No large springs have been located in the Wells Creek Watershed.

Tributary Discharges

Tributary base flow discharge to the Wells Creek mainstem represents only a small proportion of total base flow (Table 1). Tributaries on the south side of the mainstem contribute more base flow than those on the west and north sides of the mainstem. Regional groundwater flow direction in the Jordan aquifer, as determined by the USGS, suggests a greater potential for tributary base flow in tributaries on the south side of the mainstem

(Figure 5). Tributaries draining the southwest uplands with groundwater contributions restricted to Pleistocene and Cretaceous materials had no base flow in October.

A comparison of 1959, 1974 and 1986 estimates for tributary discharges made by DNR Fisheries with discharges measured by DNR Waters in 1994 suggested a possible slight increase in base flow.

Mainstem Water Quality

Dissolved oxygen (ppm) and temperature (Celsius) were measured longitudinally along Wells Creek in July and August. Dissolved oxygen concentrations remained above 5 ppm the entire length of the creek. A slight decline in dissolved oxygen concentration in a downstream direction is suggested by the graph (Figure 6). Water temperatures ranged between 15 and 20 degrees Celsius. A slight dip in temperature in the middle reach of the creek is suggested by the graph which may correspond to the increased rate in groundwater recharge noted in the previous section of this report.

Table 1. Discharge measurements in cubic feet per second.
M = mainstem T = tributary S = Spring

Site	Location Description	July 8,11,12	August 18,19	October 26,28
1 T	Pleasant Valley Outlet	*	-	-
2 M	County Highway 2 Bridge	41.2	36.7	-
3 M	State Highway 63 Bridge	43.0	39.9	-
4 M	Territorial Road Bridge	36.2	39.8	36.5
4a M	West Florence Trail Bridge	-	32.3	-
5 T	6133 acre sub-watershed	1.2	1.1	1.4
6 M	County Highway 5 Bridge	23.8	24.0	-
6a M	End of 284th Street Way	-	14.8	16.4
7 T	Clear Creek ** 2925 acre sub-watershed	0.9	.9	1.2
8 M	Wells Creek upstream of confluence with Clear Creek	10.3	12.7	13.2
9 M	341st Street Way Bridge	8.3	9.8	10.3
10 T	3274 acre sub-watershed	-	-	0.6
11 M	County Highway 3 Bridge	7.4	8.7	8.6
12 S	Spring	-	-	0.0
13 T	4700 acre sub-watershed	-	-	2.33
14 T	6000 acre sub-watershed	-	-	0.0
15 T	3363 acre sub-water shed	-	-	0.0
16 T	255 acre sub-watershed **	-	-	0.5

* It was initially thought that discharge could be calculated by subtracting the site 2 discharge measurement from the site 3 discharge measurement. However, it was determined that Wells Creek was a losing stream in this reach and no discharge could be calculated.

** USGS maps show a spring at tributary headwater.

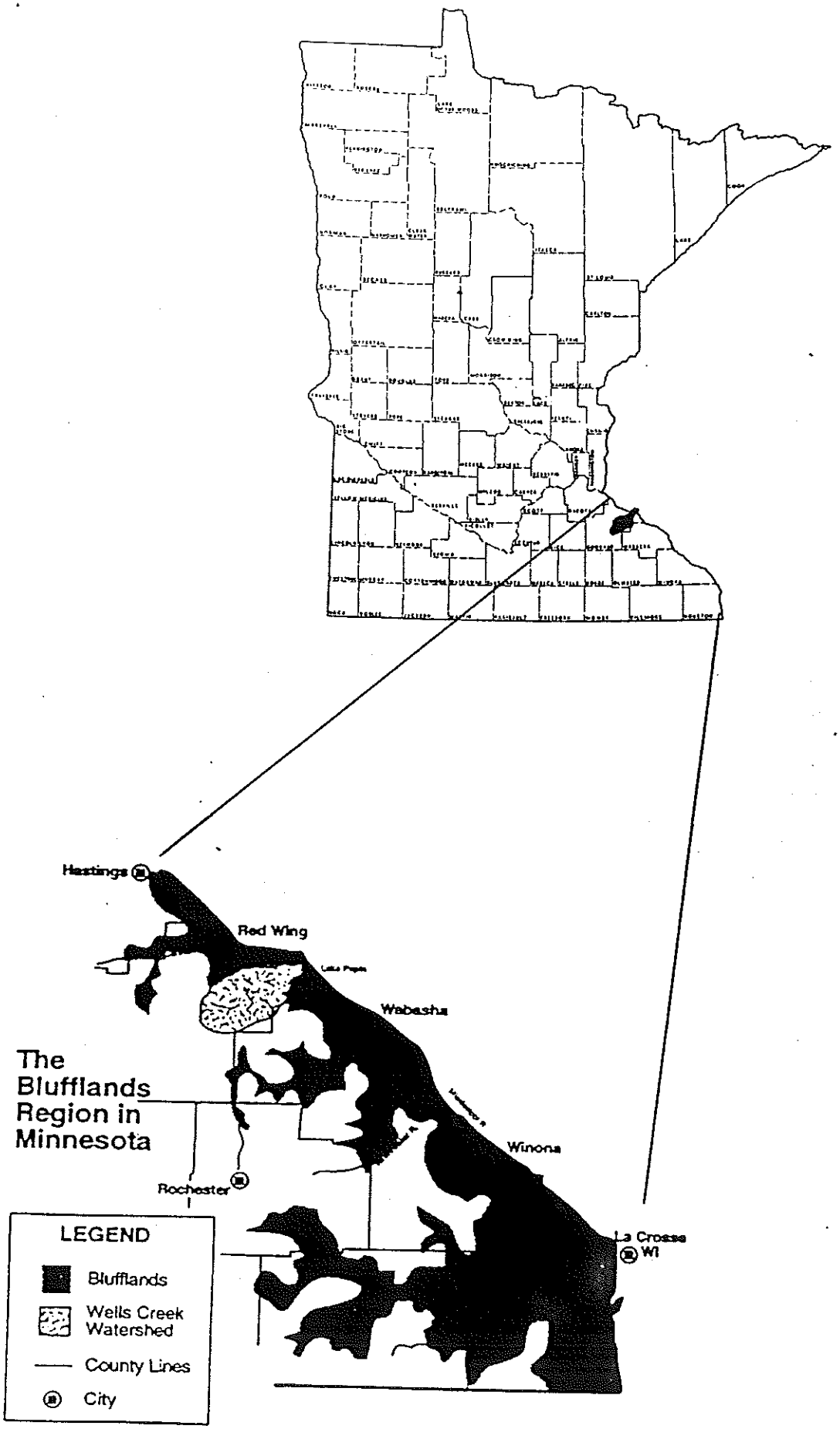

Figure 1. Wells Creek Watershed location map.

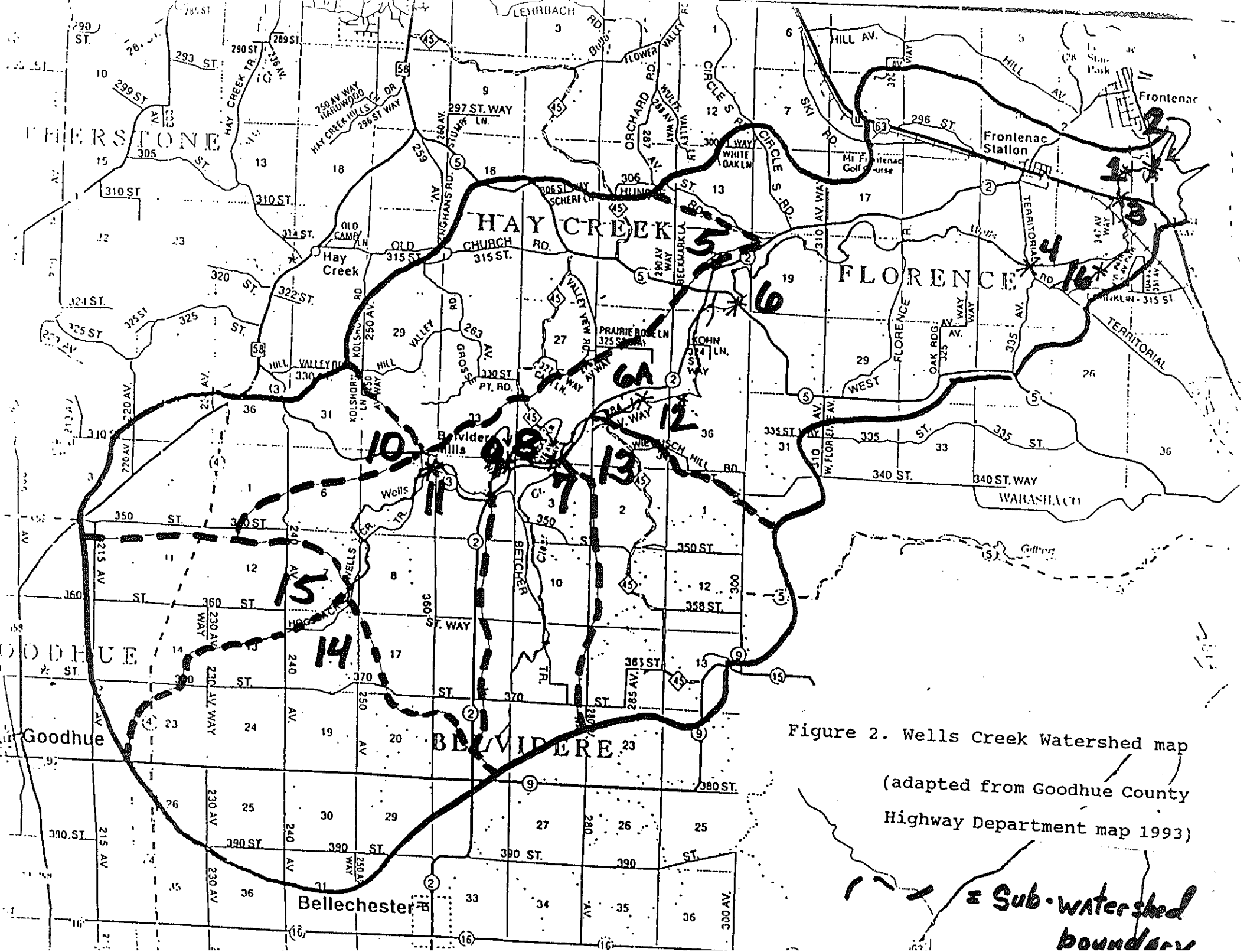

Figure 2. Wells Creek Watershed map (adapted from Goodhue County Highway Department map 1993)

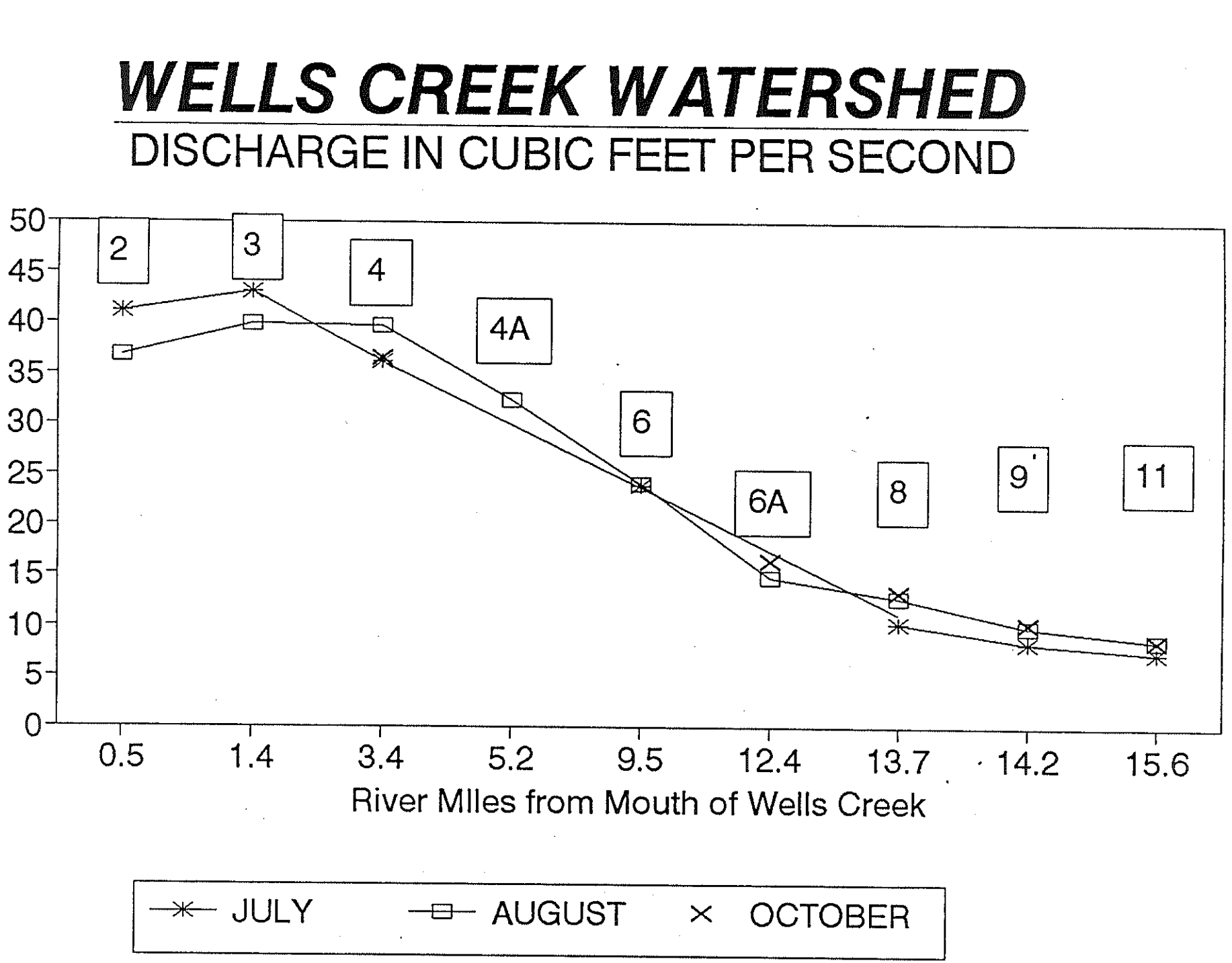
WELLS CREEK WATERSHED
DISCHARGE IN CUBIC FEET PER SECOND
50
45
40
35
30
25
20
15
10
5
0
2
3
4
4A
6
6A
8
9
11
0.5
1.4
3.4
5.2
9.5
12.4
13.7
14.2
15.6
River Miles from Mouth of Wells Creek
JULY
AUGUST
OCTOBER

Figure 3.

WELLS CREEK SUMMER BASE FLOWS

TERRITORIAL ROAD AND HWY 61 COMBINED

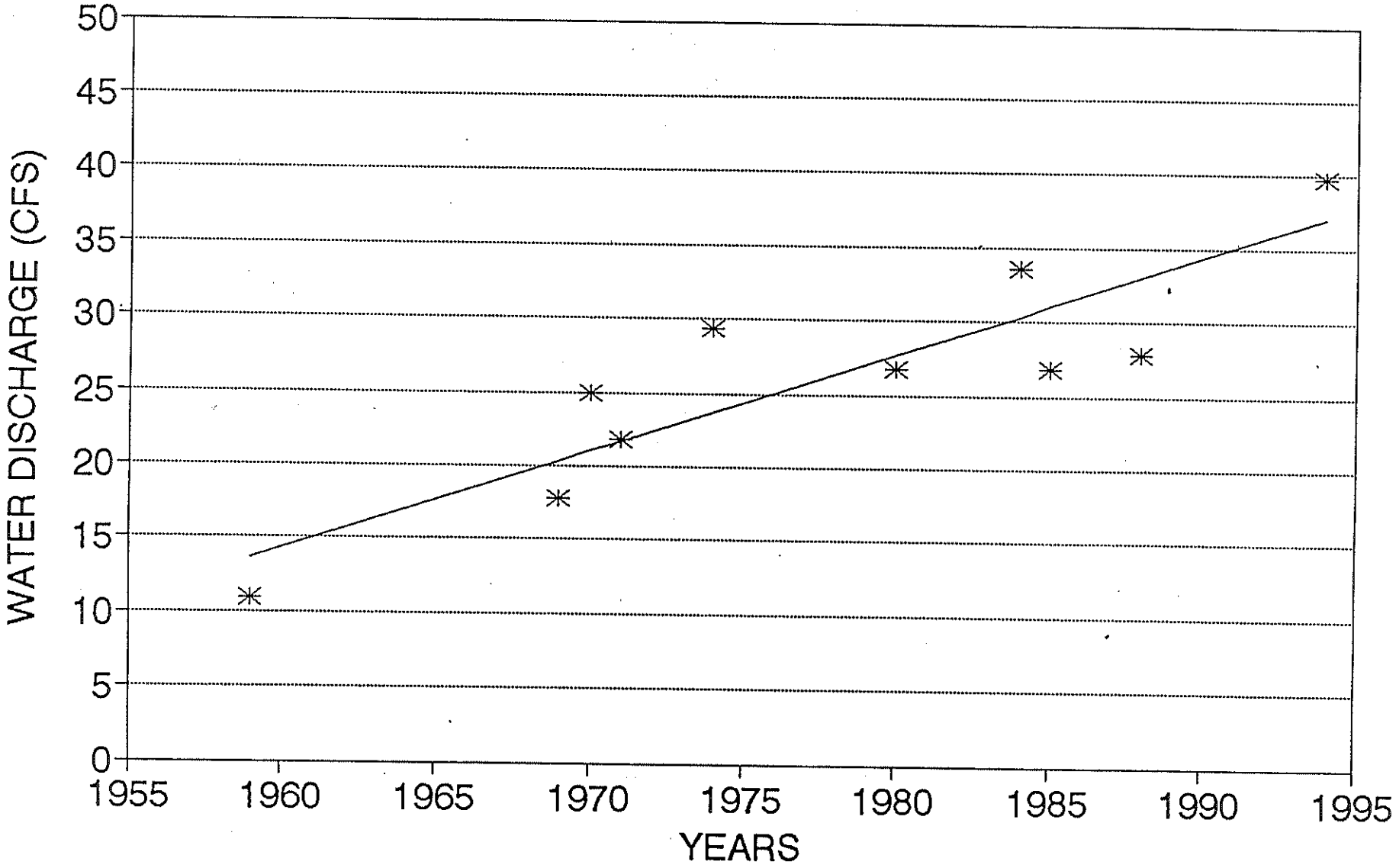

Figure 4.

WELLS CREEK WATERSHED
REGIONAL GROUNDWATER FLOW DIRECTION
USGS HYDROLOGIC ATLAS 543 1975

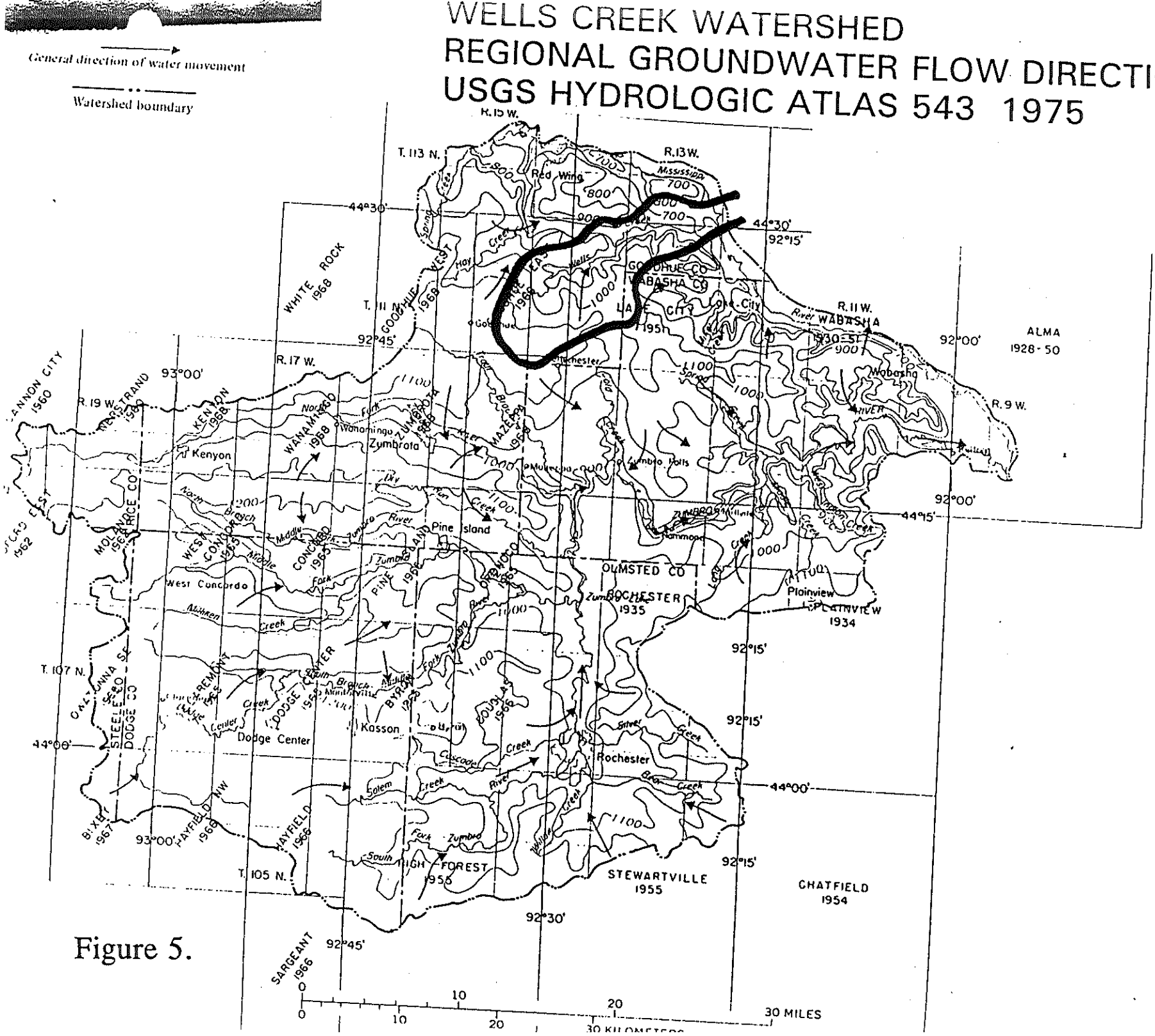

Figure 5.

WELLS CREEK WATERSHED

DISSOLVED OXYGEN AND TEMPERATURE 1994

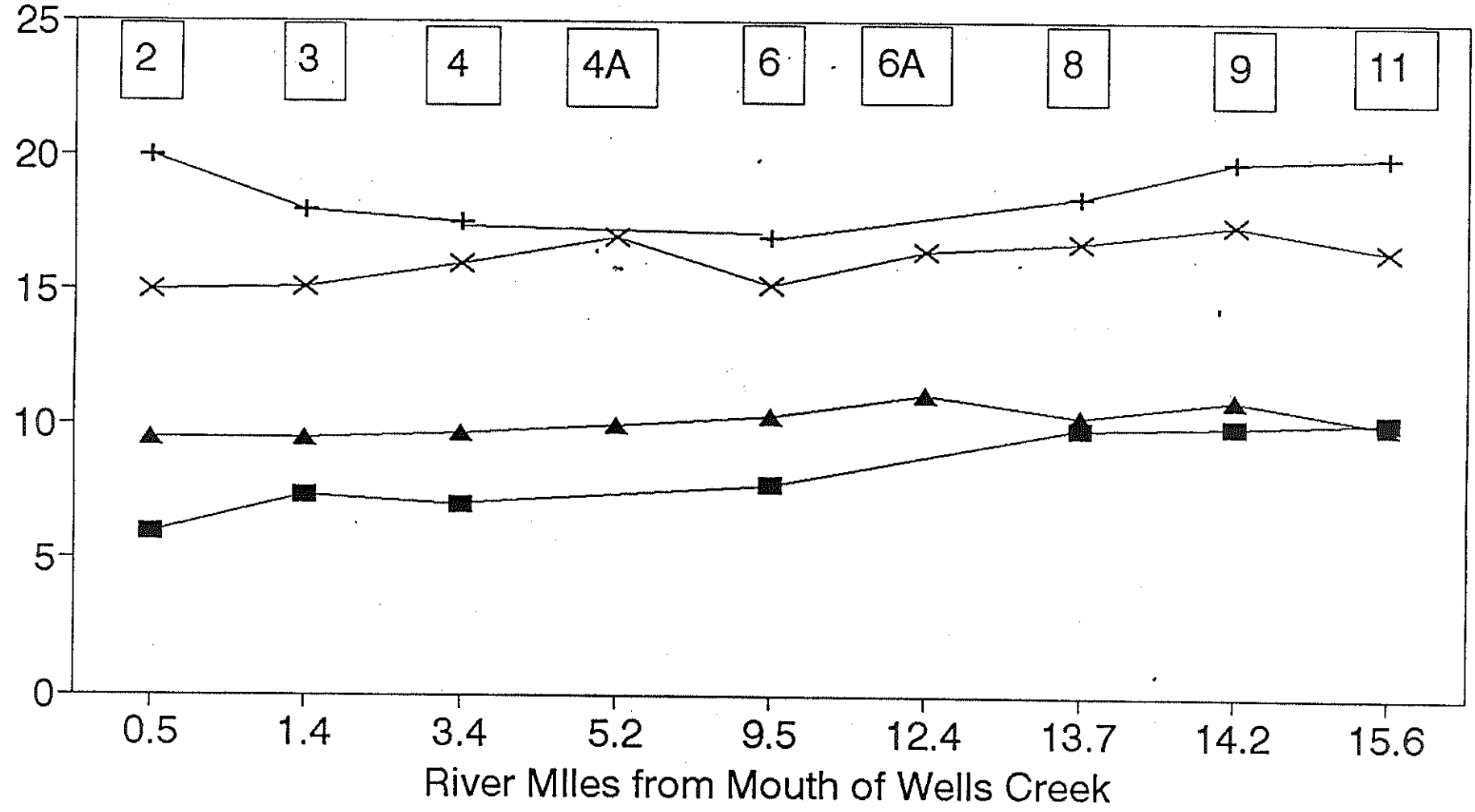

Figure 6.