SILVER CREEK PRESERVE
STREAM QUALITY MONITORING SUMMARY
1991 - 1994

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The Nature Conservancy of Idaho initiated water quality monitoring of Silver Creek and its tributaries in June 1991. Parameters monitored once per month include stream flow/discharge, pH, water temperature, dissolved oxygen, turbidity, conductivity, total dissolved solids, nitrates, phosphates, ammonia, sediment depths, and aquatic plant composition and cover. Data is collected in the field and water samples are analyzed in a laboratory. The information is entered into a database and summarized annually. The knowledge gained from this monitoring is being used to identify long term trends in stream flow, water quality, and sedimentation. The information is also used to help determine where restoration projects are most needed to enhance stream and water quality.

STUDY AREA

Silver Creek Preserve is located approximately 30 miles south of Sun Valley, three miles west of Picabo, ID. It is owned and managed by The Nature Conservancy of Idaho and comprises 845 acres. The Preserve is surrounded entirely by ranching and farming interests, many of which have granted conservation easements on their properties. The total area protected and cooperatively managed by TNC is 9,466 acres, including 30 miles of stream along Silver Creek and its tributaries.

Three spring creeks, (Stalker, Grove and Loving), are the primary tributaries which flow into Silver Creek (Figure 1). The land surrounding these tributaries is primarily used for ranching and farming (barley, alfalfa, potatoes, and canola). Due to decades of intensive agriculture, much of the watershed has been heavily impacted by grazing, field run off, eroding banks and deteriorating riparian communities. Since 1975, cooperative work

with local ranchers and farmers has helped restore portions of the riparian habitat. Some of these projects include fencing, restrictions on aerial spraying, maintaining setbacks from stream banks, and dredging streams for accumulated sediments.

Silver Creek's low gradient (less than one percent), alkaline chemistry (average pH = 8.3) and relatively cool, constant temperatures (40 - 60 degrees Fahrenheit) support a diverse and unique spring creek ecosystem. Dense aquatic plant cover and subsequently high dissolved oxygen levels provide for an ideal trout stream with an abundance of food. In addition, the riparian zone includes excellent habitat for deer, elk, beaver, muskrat, otter, and over one hundred species of birds.

METHODS

Six stream monitoring sites were placed permanently in Silver Creek and its major tributaries in 1991. Each site is marked by steel t-posts (on each side of the creek), and a permanent staff gauge. From 1991 through 1993, monitoring was conducted throughout the year at monthly intervals. Since October 1993, monitoring has occurred May through October only. Nitrates, phosphates, and ammonia are measured 3 times per year.

Stream flow/discharge is measured using a Marsh-McBirney (Model 201) Portable Water Flow Meter. A portable Hach One pH Meter (Model 43800) is used to measure pH. Water temperature is measured with a mercury thermometer. Dissolved oxygen is measured in stream using a YSI 55 Portable Dissolved Oxygen Meter. A LaMotte Turbidimeter (Model 2008) is used to determine turbidity in water samples. Conductivity and total dissolved solids are measured with a Hach Conductivity/TDS Meter (Model 44600). Sediment depth is measured in the stream using a probe. Aquatic plant cover is measured visually along the transect. Sampling at each site is conducted during the same time of day in order to decrease variances in parameter sampling (e.g., temperature and dissolved oxygen)(Table 1).

A detailed description of the methods is available by contacting the Silver Creek Preserve at (208) 788-2203.

Water Quality Results 1994

Stream Flow/Discharge

Peak flows in Silver Creek generally occur in late March and early April as a result of local snow-melt (Figure 2). However, Silver Creek's springs typically peak in October due to the time it takes spring-time flows from the Big Wood River to recharge Silver Creek's aquifer. Although local snow melt and surface run-off cause the highest flows in Silver Creek, these peaks do

not have the duration of the September - October peak. Silver Creek's seasonal low flows typically occur in early summer before significant aquifer recharge, and when high demands are made on local water for irrigation (Figure 2).

Water year 1992 recorded the lowest average annual discharge in Silver Creek at 107 cfs. Water year 1994 was slightly better at 127 cfs (Figure 3). The water years 1987-1994 witnessed the lowest flows since records were first taken in the 1920's. Although this decline in discharge is related to an extended drought, Silver Creek appears to be declining more than would be expected due to the drought alone. Detailed information on this topic is currently being analyzed by Dr. Charles Brockway from the University of Idaho. Summaries of his research to date are available by contacting Silver Creek Preserve at (208) 788-2203.

Water Temperature

Water temperature in Silver and its tributaries remains relatively constant throughout the year because the system is spring fed (Table 1). However, low flow levels in recent years have resulted in higher than normal summer water temperatures, which in turn resulted in high aquatic plant growth and widely fluctuating dissolved oxygen levels. This condition ultimately resulted in a fish kill during the summer of 1992, when dissolved oxygen levels reached lethally low levels (see below).

Dissolved Oxygen

On a typical summer day, Silver Creek's dissolved oxygen levels are lowest just before sunrise and peak mid-day (Table 3). Due to the abundance of plants, this fluctuation can be dramatic, and it is important for managers to track dissolved oxygen levels throughout these periods. On June 23, 1992, a fish kill of over 50 large trout occurred when dissolved oxygen levels reached 2.5 ppm at the Point of Rocks Fish and Game access several miles downstream of the Preserve.

During the hot and dry summer of 1994, fish kills were a serious concern again, and the Creek was monitored closely for water temperature and dissolved oxygen. Dissolved oxygen fluctuated the most on June 29 - from 3.2 ppm at 6:00 am to 15.7 ppm at 4:00 pm near the Stalker Creek Bridge. These high and low data were collected separately from the monthly water quality monitoring.

Management actions taken to minimize stress on the fish include posting signs to warn anglers of weak fish, and asking anglers to postpone fishing until an hour or two after sunrise. Fortunately, most fishing occurs mid-morning when the water is

cool and dissolved oxygen has risen to normal levels.

Conductivity

In Silver Creek, conductivity is used to monitor fluctuations in dissolved ions. There is a back-ground conductivity in the system due to the origin of the spring water (Table 1). As water moves through the carbonate aquifer underlying the area north of Silver Creek, it picks up calcium, magnesium, carbonates, and other ions. Increases in conductivity in Silver Creek would most likely be seasonal, either from spring run off or fertilizer input. The conductivity overall is at a healthy and consistent level in the Silver Creek system.

Turbidity

Spring and summer of 1992 and 1994 saw minimal fluctuations in turbidity because of low snow packs and little spring run-off. The winter of 1993, which experienced heavy snow fall, provided a large spring run-off and created turbid water well into July.

Due to the relatively constant flow and low gradient in Silver Creek and its tributaries, the movement of suspended particulates through the system is minimal. This, coupled with a history of sediment loading from grazing and agriculture has resulted in significant sediment build up in the system. Improved riparian management upstream of the Preserve has most likely resulted in less turbid water overall, but our data does not cover enough time to depict these changes.

pH

pH levels in Silver Creek and its tributaries consistently range between 8 and 9 (Table 1). Due in large part to its alkaline nature, Silver Creek provides optimum growing conditions for cold water plant and animal life.

Sediment Depth

Sediment depth in Silver Creek and its tributaries tends to be higher in the slower moving tributaries. Fast moving streams have a better ability to flush out sediment, whereas slow streams leave more suspended particulates on the bottom. The transects at Grove and Silver Creeks have the least sediment and fastest moving currents of our six monitoring sites. On the other hand, Stalker, Chaney, and Loving Creeks all have slower currents and deeper sediments (Figure 4).

Significant changes in sediment depths occurred in 1993 when

the stream system experienced high snow melt levels. Grove Creek underwent the most dramatic change - from 27% gravel cover in 1992 (at the transect) to 75% in 1993 (Figure 5). The flush of snow melt and rise in discharge exposed gravel beds and improved spawning habitat by pushing plants and sediments out of Grove Creek. Other sections of stream in the Silver Creek system experienced similar changes, and several lateral and point bars were formed on the Preserve by the settling of sediments.

Aquatic Plant Cover

In general, the faster moving streams (Grove, Stalker at bridge, and Silver) tend to have an abundant growth of Chara, an alga that flourishes in cold, alkaline streams. The slower moving portions of the system tend to be dominated by potomogeton and other plants (Figure 6). The greatest changes observed in bottom cover also occurred in 1993 when spring-time snow melt flushed the system (Figure 5).

Nitrates, Phosphates, and Ammonia

Sampling for nutrients in Silver Creek began in July 1993. Water samples were analyzed for ammonia, nitrate, nitrite, ortho phosphate, and total phosphorous. All samples tested for nitrite and ortho phosphates were below detection thresholds. Ammonia is highly pH and temperature dependent and should readily convert to nitrate where sufficient oxygen is present.

Nitrate levels in 1994 samples were higher than the 1993 samples, and all samples were higher than EPA Guidelines (0.3 mg/L). Although there is no legal water quality standard for nitrates in Idaho, the levels are double the EPA guidelines and should be monitored closely in Silver Creek (Table 2).

Total Phosphorous detected in Silver Creek has been quite variable. The first two samples taken in 1993 were below detection thresholds of 0.05 mg/L. The third sample taken on September 27, was 0.2 mg/L, or twice the EPA standard of 0.1 mg/L. All other samples were below the EPA standard (Table 2).

Table 1. Flow and water quality parameters at 6 permanent sites (measured monthly) in Silver Creek and tributaries, June 1991 - September 1994. Three sites were visited morning (am) only and 3 sites afternoon (pm) only.

Site		Flow (cfs)	Water Temp (deg. F.)	Turbidity (ntu)	pH	Conductivity (mS/cm)	Total Dissolved Solids (g/L)	Dissolved Oxygen (ppm)
EPA Standards			**<72**	**<50.0**	**6.5 - 9**			**>6**
StFr (pm)	Average	6.9	54	5.0	8.3	0.416	0.205	8.4
	Maximim	16.4	71	18.6	8.9	0.639	0.319	11.5
	Minimum	1.4	32	0.8	7.5	0.300	0.149	3.9
Chan (pm)	Average	16.6	54	1.9	8.6	0.347	0.172	11.2
	Maximim	31.1	68	10.1	8.9	0.399	0.199	15.0
	Minimum	9.3	32	0.4	8.1	0.306	0.152	7.5
StBr (am)	Average	33.6	49	4.9	8.2	0.382	0.190	8.7
	Maximum	99.5	65	57.6	8.7	0.449	0.224	14.2
	Minimum	17.9	33	0.7	7.8	0.294	0.166	5.8
Grov(pm)	Average	55.4	57	2.2	8.5	0.358	0.177	10.6
	Maximum	79.8	70	10.0	9.0	0.390	0.194	14.0
	Minimum	38.7	40	0.4	8.1	0.311	0.155	7.9
Silv (am)	Average	103.6	49	3.0	8.3	0.368	0.182	9.0
	Maximum	249.0	63	13.9	8.8	0.426	0.213	12.0
	Minimum	59.9	32	0.8	8.0	0.320	0.160	6.3
Love (am)	Average	25.7	51	2.1	8.3	0.398	0.201	9.3
	Maximum	54.1	66	4.8	8.8	0.481	0.239	12.0
	Minimum	11.0	36	1.2	7.7	0.320	0.180	7.5

StFr = Stalker Creek (upper) at Fraser Cabin, Chan = Chaney Creek, StBr = Stalker Creek at Bridge, Grov = Grove Creek, Silv = Silver Creek, Love = Loving Creek.

Table 2. Nutrient levels (mg/L) in Silver Creek measured below the S-turns and the confluence of Kilpatrick Pond and Lower Slough, July 1993 - April 1997.

Date	ammonia	nitrate	nitrite	Ortho P	total P
7/28/93	<.05	0.62	<.01	<.05	<.05
8/31/93		0.73	<.01	<.05	<.05
9/27/93		0.83	<.01	<.05	0.20
10/5/93		0.79			
3/8/94	<.05	0.98	<.01	<.05	0.08
7/5/94	0.06	1.12	<.01	<.05	0.09
10/18/94	<.05	1.14	<.01	<.05	<.05
7/12/95	<.05	0.60	<.01	0.01	0.02
3/20/97	<.05	0.81	<.01	0.01	0.03**
*EPA standard**	*0.30*	*0.3****			*0.10*

< signifies samples were below detection levels

*these are EPA legal standards for cold water biota streams

** it should be noted that another sampling point where runoff enters the lower slough had a level of 1.68 on same date.

*** this is a guideline only and is not a legal EPA standard.

Table 3. Water temperature and dissolved oxygen levels in Silver Creek taken at Visitor Center and Picabo Bridge during heat wave, summer of 1994 (June 29 - July 13). All readings taken at sunrise and late afternoon

Site		Water Temp. F. am	D. O. (in ppm.) am	Water Temp. F. pm	D. O. (in ppm.) pm
Visitor Center	maximum	63	6.6	74	12.9
	minimum	54	5.1	58	9.7
Picabo Bridge	maximum	69	6.3	78	13.8
	minimum	60	4.6	65	10.4
EPA Standard		<72	>6ppm		

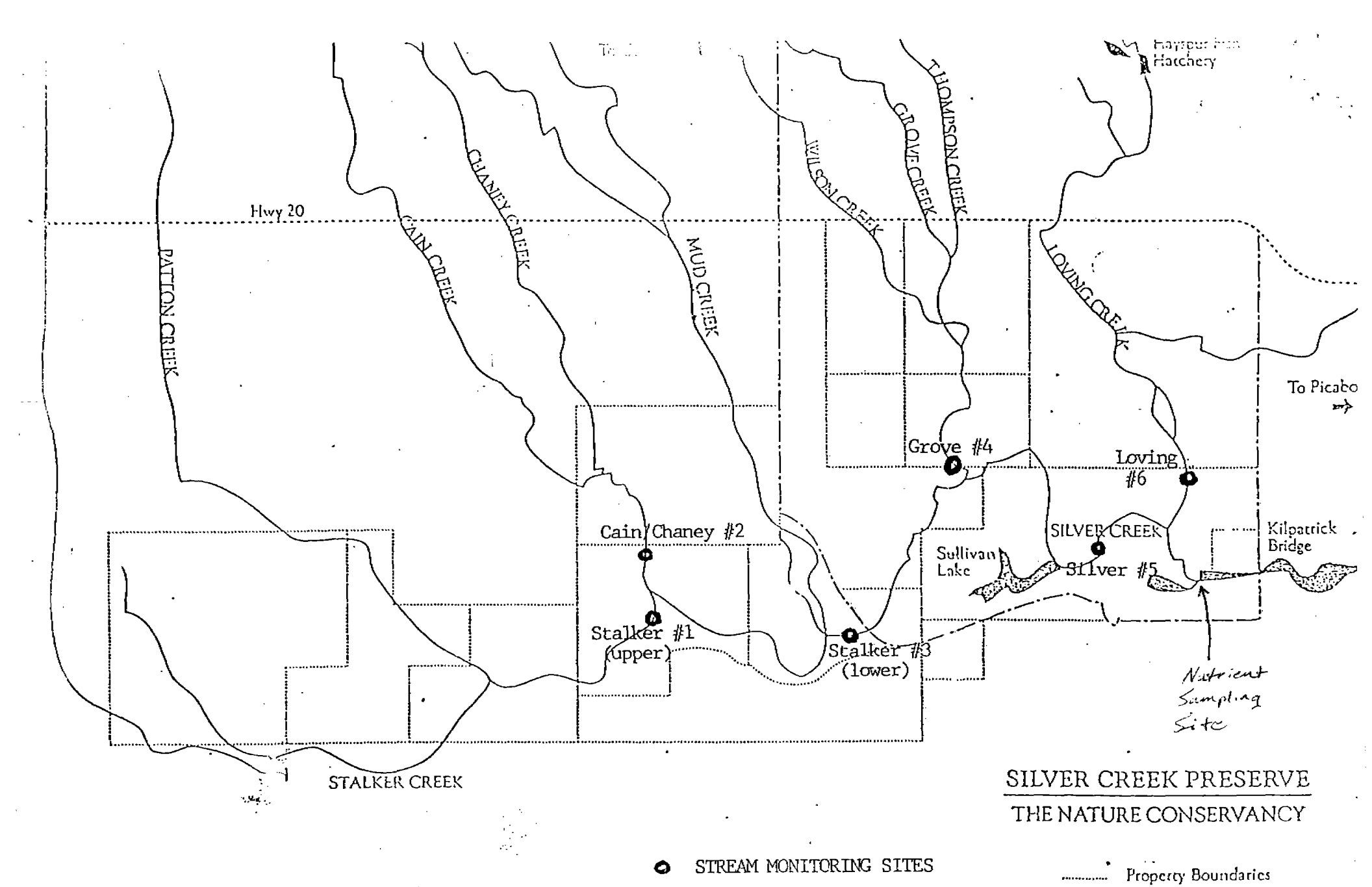

Hatchery
Hwy 20
PATTON CREEK
CAIN CREEK
CHANEY CREEK
MUD CREEK
WILSON CREEK
GROVE CREEK
THOMPSON CREEK
LOVING CREEK
To Picabo
Grove #4
Loving #6
Cain/Chaney #2
SILVER CREEK
Kilpatrick Bridge
Sullivan Lake
Silver #5
Stalker #1 (upper)
Stalker #3 (lower)
Nutrient Sampling Site
STALKER CREEK
SILVER CREEK PRESERVE
THE NATURE CONSERVANCY
STREAM MONITORING SITES
Property Boundaries
Dirt Road
Paved Highway
Streams

Figure 1.

Figure 2

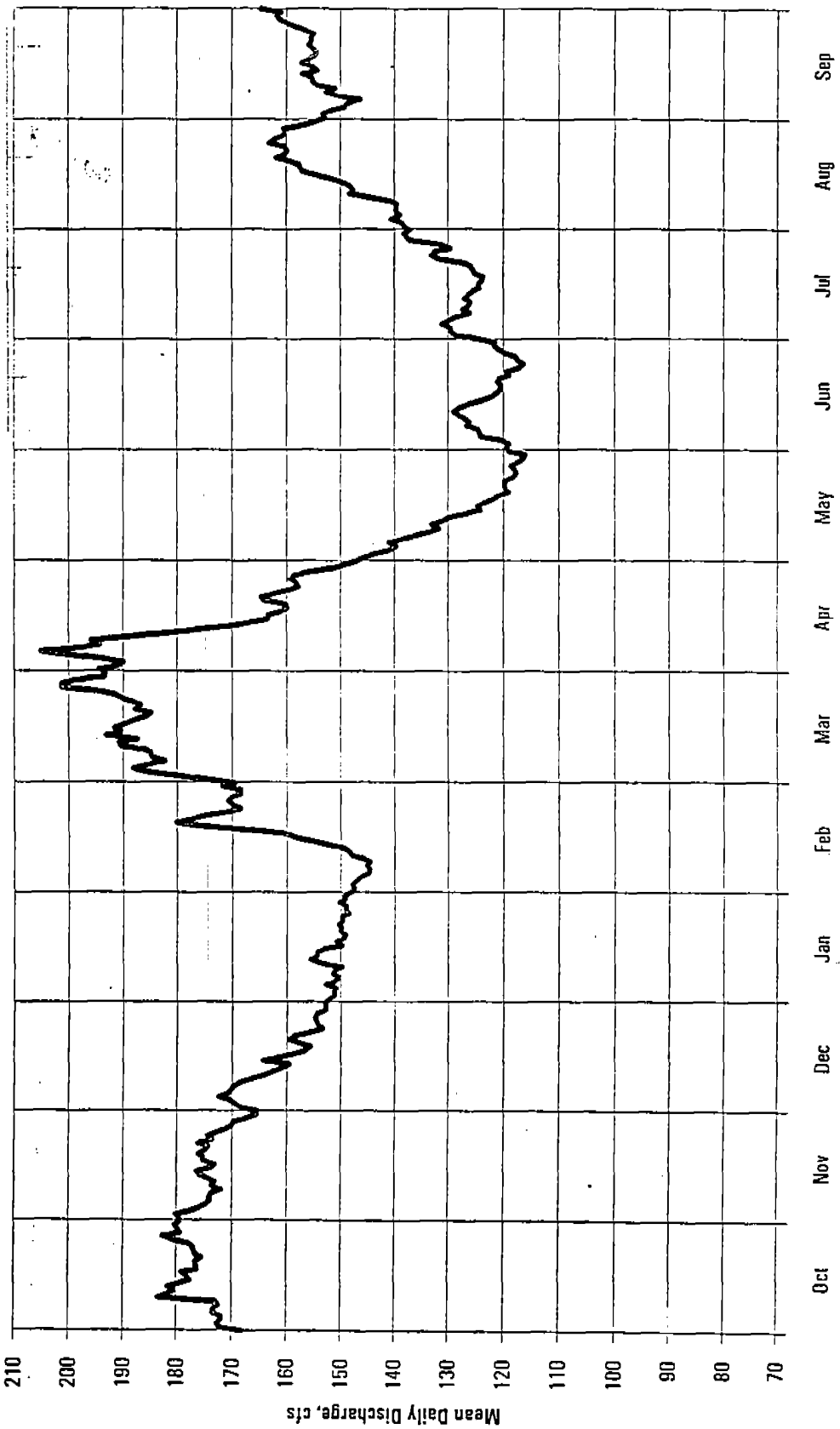

Mean Daily Discharge at Sportsman's Access
Mean Daily Discharge, cfs
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep

Figure 3

Mean Annual Flow, Silver Creek @ Sportsmans Access

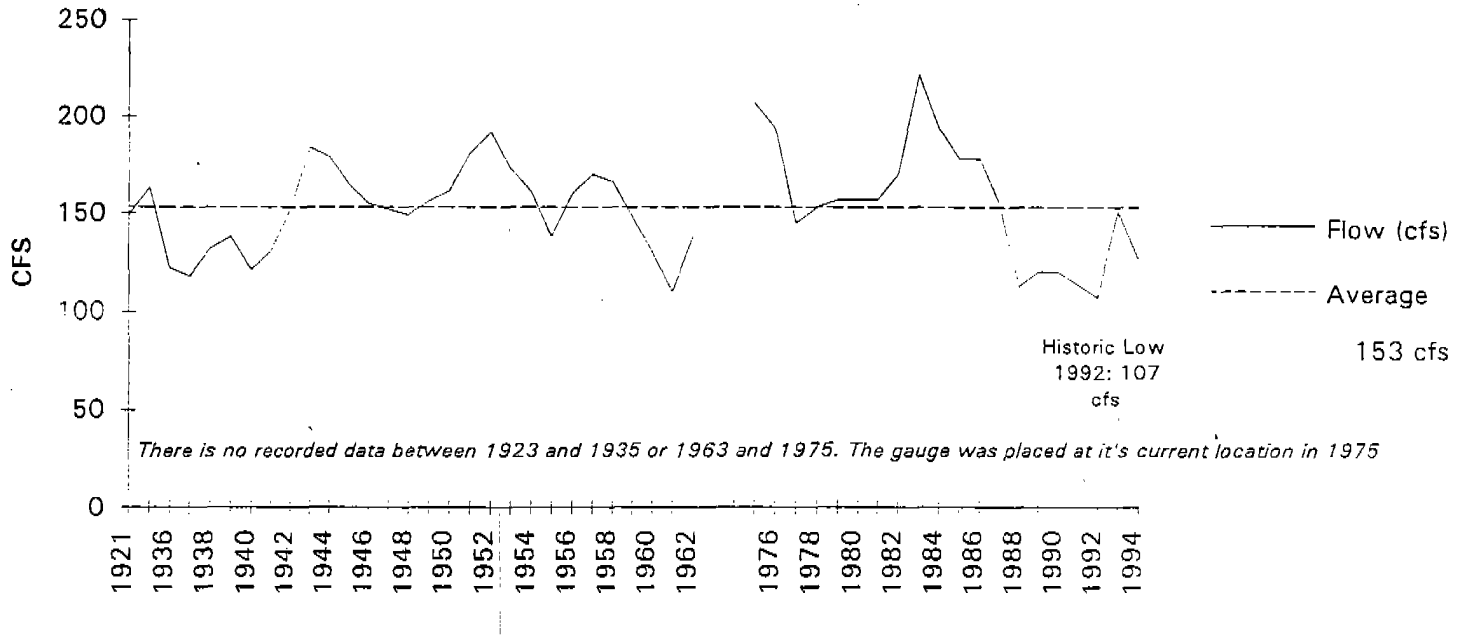


Figure 4

Sediment Depth of Silver Creek and Tributaries in Relation to Flows

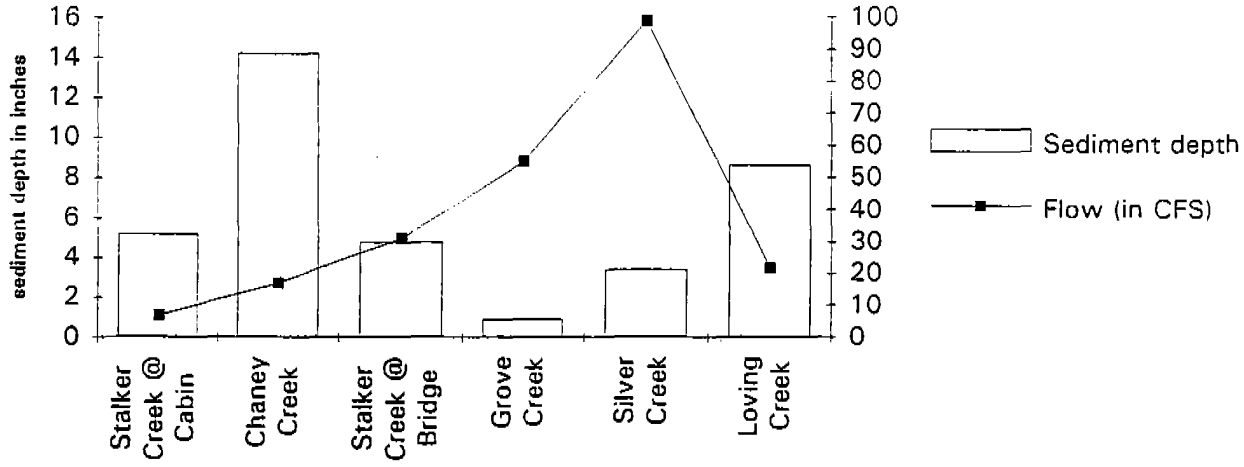


Figure 5

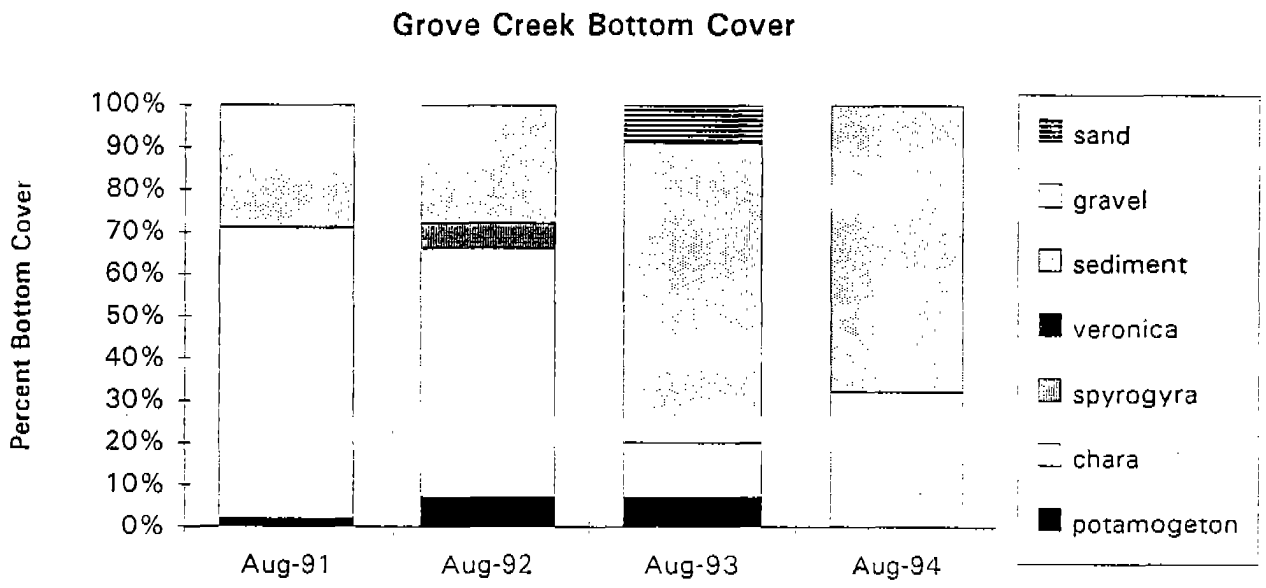
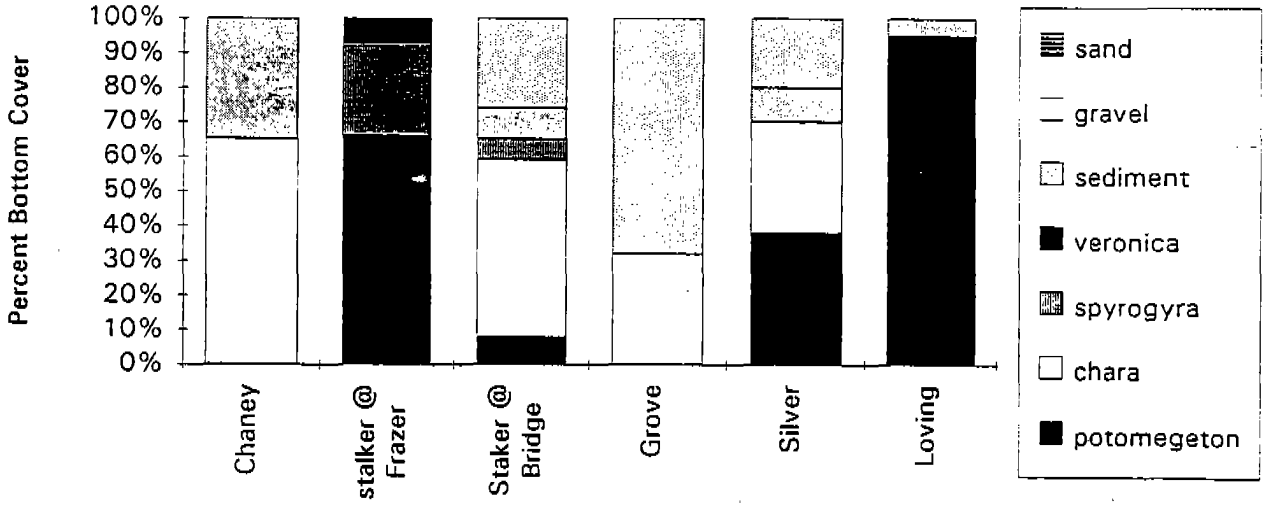


Figure 6



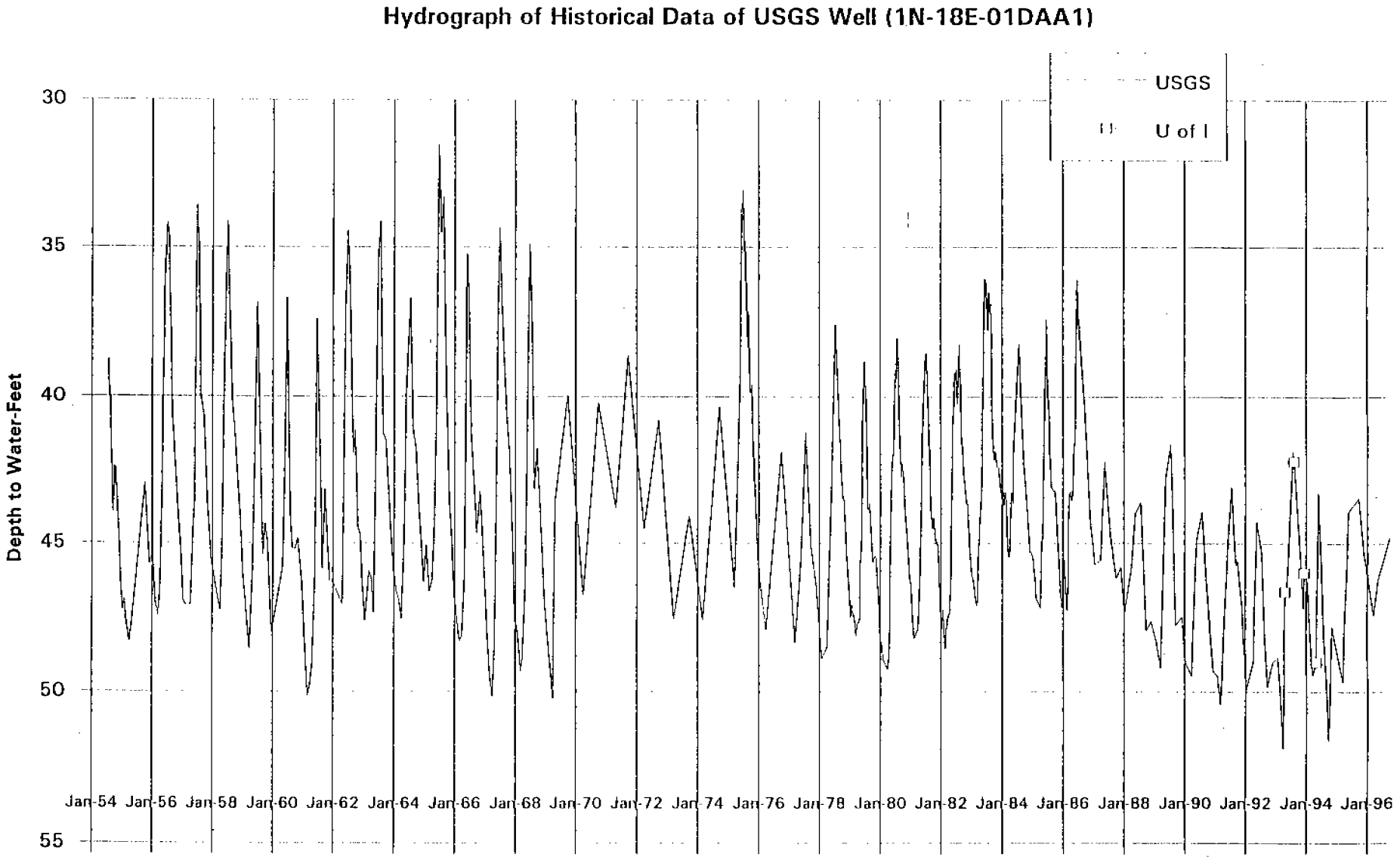


Figure 7. Note overall downward trend.

From Brockway 1997, unpublished data