

**REPORT ON THE SLOCAN VALLEY
WATER MONITORING PROGRAM
1994 - 1995**

Presented to the Slocan Valley Watershed Alliance

by Passmore Laboratory Ltd.

Report on the Slocan Valley Water Monitoring Program 1994 - 1995

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Report on the Slocan Valley Water Monitoring Program, 1994 - 1995

Presented to the Members of The Slocan Valley Watershed Alliance

By Jennifer and Tony Yeow of Passmore Laboratory Ltd.

In May, 1994, a program was initiated to characterize the water in creeks tributary to the Slocan River. The program was sponsored by the Slocan Valley Watershed Alliance in conjunction with Passmore Laboratory Ltd.

Initially, eight creeks and the Slocan River were selected to represent the differing terrain, aspect and level of disturbance that exist in watersheds of the lower Slocan River Valley. By the summer, five more creeks and one spring were added to the program. These are located in the upper valley, from Hills to New Denver. Finally, Elliot and Jerome Creeks in the lower valley were also added to make a total of sixteen creeks and one spring.

In the fall of 1995, the volunteer coordinator for the upper valley moved from the area and water samples stopped being collected for Arthur, Bonanza, Harris, Hasty and Vevey Creeks. As of January, 1996, water samples from the lower valley only are collected.

All the creeks are sources of domestic water for residents living in the valley and each has a different level of disturbance from logging and other activities. To date, very little data that characterizes these creeks exists. However, logging operations are planned for most of the watersheds where the creeks originate. A map describing the location of the creeks is given on page 3. A summary of the physical aspects of some of the creeks is given below:

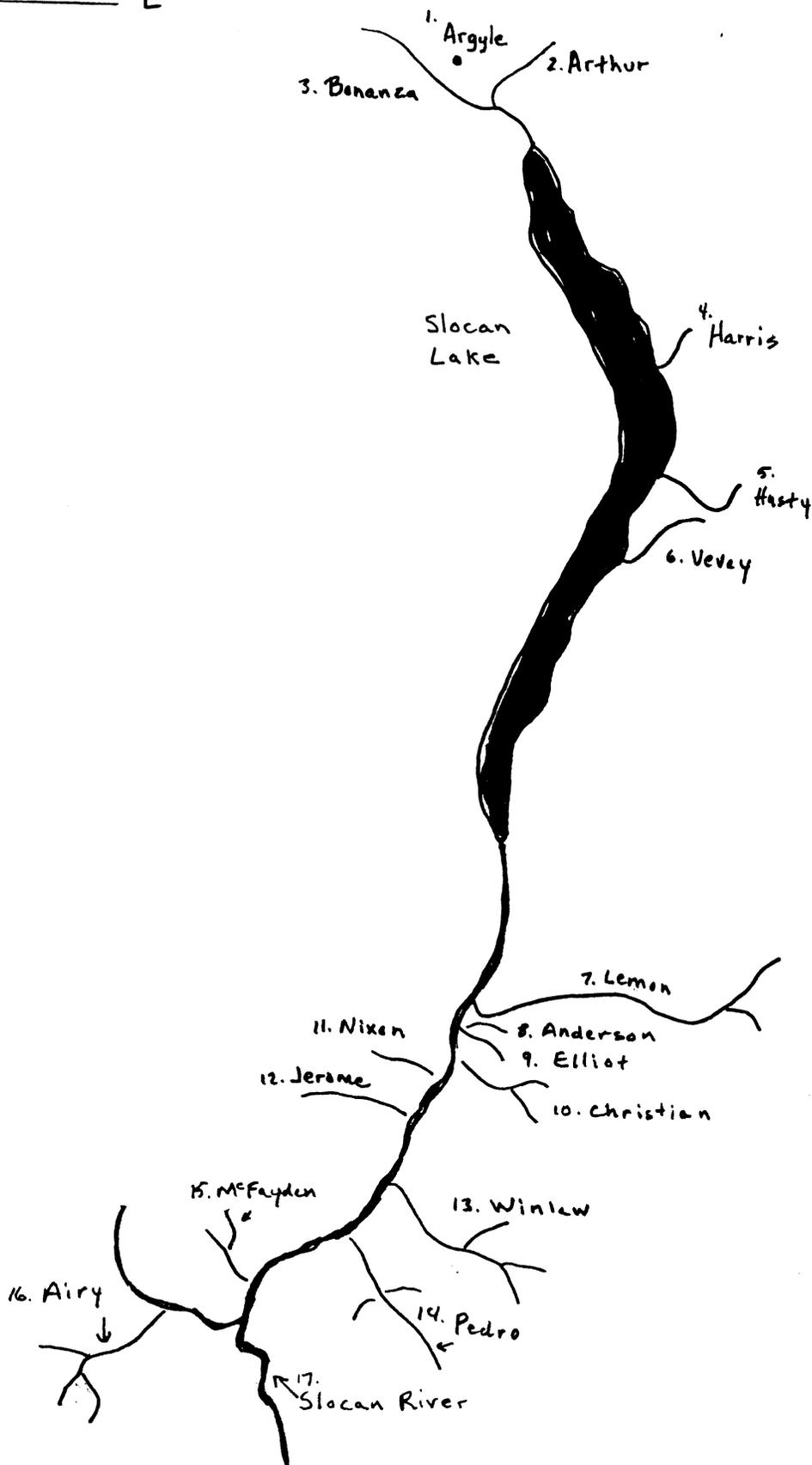
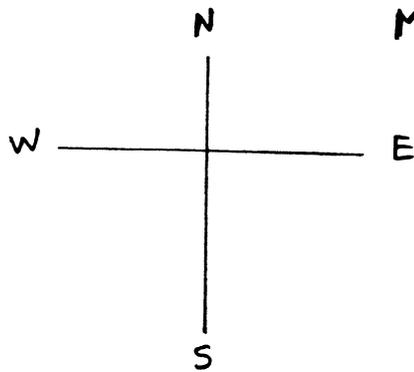
UPPER VALLEY CREEKS FROM NORTH TO SOUTH	
1.	Argyle Spring flows south, southeast. It is located next to Richard Allin's property and is his primary source of drinking water.
2.	Arthur Creek in Hills flows in a west, southwest direction. It is 2.85 square kilometers in area. There are no major tributaries. Some areas are without vegetation. Fine sediment was noted in pools and creek bottom.
3.	Bonanza Creek in Hills flows in a southeast direction into the north end of Slocan Lake. There are many tributaries including Arthur, Cadden and Owl Creeks on the east side. Bonanza has a significant fish population.
4.	Harris Creek in New Denver flows in a south, southwest direction. There are no major tributaries. The creek originates on an old growth forest in a mid elevation bench that has experienced little disturbance.
5.	Hasty Creek in Silvertown flows south initially, then changes to northwest. It originates on a mid - elevation bench. There has been some disturbance from recent private land logging on the south east slope above the creek.
6.	Vevey Creek off Red Mountain Road flows west then changes to the southwest. It originates on a mid - elevation bench. There has been some recent and old disturbance.

Physical Aspects of Creeks cont.

LOWER VALLEY CREEKS FROM NORTH TO SOUTH

7. Lemon Creek in Slocan City flows in a west direction. Its watershed is 178 square kilometers. It has many tributaries and has experienced major disturbance from many years of clear - cut logging and extensive road building.
8. Anderson Creek between Appledale and Lemon Creek flows in a south west direction. It originates on Slocan ridge and flows underground at times. It has been tended by Don Roht who uses it as a water source for his land.
9. Elliot Creek in Appledale flows in a west direction. It originates on top of Slocan ridge. There has been no major disturbances in the upper elevation levels. On the map the creek appears to originate approximately 2/3 of the way up the ridge.
10. Christian Creek in Appledale flows in a west direction. It originates high on Slocan ridge. Its watershed has not had any recent disturbance from forest removal and it has no major tributaries.
11. Nixon Creek in Appledale flows in an east direction. It originates on the top of Perry's ridge and has some disturbance from selective logging in the 1970's.
12. Jerome Creek in Appledale flows in an east direction. It originates of top of Perry's ridge. There has been no major disturbance at the higher elevation. There was selective logging in the lower level during 1994.
13. Winlaw Creek in Winlaw flows in a west, northwest direction. Its watershed is 40.7 square kilometers and has three major tributaries. The north tributary is the largest. Slides have occurred on some sections of its slopes but there has been no major disturbance from forest removal. Winlaw is a fish - bearing creek.
14. Pedro Creek in Winlaw flows in a northwest direction. It originates high on Slocan ridge and its watershed is 17.1 square kilometers. The watershed was logged during the 1970's. It flows over an active geological fault.
15. McFayden Creek in Vallican flows south, southeast. It originates on the top of Perry's ridge. Its watershed is 5.7 square kilometers and is characterized by very steep slopes. There has been no disturbance from forest removal in the upper elevation and little disturbance in the lower elevation.
16. Airy Creek in Passmore flows in an east, northeast direction. The watershed is 58 square kilometers. It is a large, cold, north - sloped watershed with 3 main tributaries. All three valleys have had extensive disturbance from logging that started in the 1940's and continues today. It is located in Tree Farm license number 3.
17. Slocan River at the Passmore Bridge flows southeast. All the creeks in the study area flow into the Slocan River above this bridge.

Map showing Locations of Creeks in the Monitoring Program



I. SUMMARY OF TESTING PROGRAM

Resident participants in the program performed the water chemistry tests in the field. They also sent samples to Passmore Laboratory for further tests. Some residents also collected temperature and flow data. A summary of the program is as follows:

1. Field Testing Using the Hach Kit

The parameters measured here were Acidity, Alkalinity, Hardness, pH, and Oxygen.

All tests in the field were performed using the Hach brand Water Ecology Kit, Model AL-36B. The kit uses "Drop Count Titration" methodology.

Some of the field test results were confirmed in the laboratory on samples collected at the time of testing.

The upper valley participants did not measure oxygen and pH.

2. Sample Collection for Laboratory Tests

Resident Participants were instructed to collect water samples in 2 liter plastic containers that were supplied to them. The sampling procedures are outlined in "Wildland Water Quality Sampling and Analysis", by J.D. Stednick pages 33-35 on depth integration sampling techniques. Residents sampled a cross section of the creek channel. Water samples were collected at sites located above the water users intakes for Arthur, Harris, Anderson, Jerome and McFayden Creeks. They were collected below user intakes at the other creeks. After collection, the samples were taken to Earthborn Organics Market in Passmore. Here, they were held in a cooler and picked up by laboratory staff the same day.

3. Bacteriological Tests

Water samples were aseptically collected by a technician and put on test the same day for Fecal Coliforms. The analysis was performed in accordance with methods outlined in section 9221B-C of the Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association.

4. Sediment Studies on Airy and McFayden Creeks

A series of water samples collected from Airy and McFayden Creeks were tested solely for turbidity, conductivity and suspended sediment. The purpose for these tests was:

- a. To determine if a relationship exists between turbidity and suspended sediment readings on the same sample. The studies reviewed in literature to date indicate that a relation may ^{exist} between these two parameters. Suspended Sediment is recognized as a more definitive indicator of disturbance from forest management activities. However, turbidity is more commonly used in water quality monitoring studies because it is relatively easy to measure.

4. Sediment Studies on Airy and McFayden Creeks cont.

- b. To relate levels of Suspended Sediment and Turbidity to the degree of disturbance within a watershed.
- c. To compare a large and relatively small watershed with regard to their sediment levels.

5. Staff Gauge Installation on Large Creeks

The large creeks include: Bonanza, Lemon, Winlaw, Pedro, Airy, and the Slocan River. Lemon Creek and the Slocan River are currently monitored for flow by Water Survey Canada. In the fall of 1994 a gauge was installed on Airy and in the fall of 1995 a gauge was installed on Pedro. These gauges measure relative water level only and the gauge readings should be used in conjunction with cross-sectional area and velocity to determine flow. These measurements need to be taken 10 to 12 times during the first year. Eventually, a hydrograph or flow level over time is developed.

6. Weir Installation on smaller creeks

The smaller creeks include: Arthur, Harris, Hasty, Vevey, Anderson, Christian, Nixon, Jerome, Elliot, and McFayden.

The first weir was installed on Harris creek in October, 1994 at the Anderson property. This weir was installed in conjunction with John Harris, a former employee of Water Survey Canada, and a specialist in weir construction.

The second weir was installed on Christian Creek in the summer, 1994 with assistance from Terry Anderson and Dick Dejong of the Water Management Branch, Dept of Environment. This weir was built as a temporary structure and should be replaced.

McFayden Creek has a weir that was installed years ago by Water Survey Canada. It was read as part of a program that ended April, 1995.

A gauge was installed on Jerome Creek in the fall of 1994 as a temporary measure.

This gauge will allow us to record relative water level until a weir can be constructed.

7. Volunteer Recording

North Valley Creeks :-

Debbie Abbott coordinated sample collection and testing. She also took readings on Bonanza Creek. She was assisted here by Colleen Bowman. Richard Allin collected data on Argyle Spring. Daniel Hellier took readings on Arthur Creek. John Anderson took readings on Harris Creek in New Denver. Sally Hammond and Wendy Harlock took readings on Hasty Creek. Paul Gibbons records temperature and water quality data on Vevey Creek near Red Mountain Road.

7. Volunteer Recording cont'

South Valley Creeks :-

Terry Knight and Don Roht took readings on Lemon Creek. Don Roht also took readings on Anderson Creek. Daystar took readings for Elliot Creek and Linda Mandala took readings for Christian Creek. She also measured air and water temperatures and flow levels and performed water quality tests. Frank Nixon took readings on Nixon Creek. Christine Cowren took gauge measurements on Jerome Creek. Muffin Benedict performed water quality tests on Jerome. Winlaw Creek air and water temperatures were recorded by Peter and Leslie Vogelaa. Phil Larstone performed the water quality tests for Winlaw. Pedro Creek air and water temperature and relative water level were recorded by Russ Younggreen. The McFayden - Airy Suspended Sediment Study was conducted with help from Barry Burgoon, who also performed water quality tests on McFayden. Airy Creek water temperature and gauge readings and water quality tests were done by Carl Schlicting. Jennifer Yeow took readings on the Slocan River at Passmo Bridge. The above volunteers did a great job and are to be commended.

II. BACTERIOLOGICAL TEST RESULTS

UPPER VALLEY CREEKS FROM NORTH TO SOUTH

Creek Name	Time Collected 1994	Confirmed Coliforms * MPN per 100ml	Fecal Coliforms MPN per 100ml
Arthur	Sept 27 @ 2:00PM	2.2	lt 2
Harris	Sept 27 @ 4:00PM	3.6	3.6
Hasty	Sept 27 @ 4:45PM	5.1	**lt 2

LOWER VALLEY CREEKS FROM NORTH TO SOUTH

ANDERSON

Date / Time	Water Temperature in degrees Centigrade	Presumptive Coliforms per 100 ml	Fecal Coliforms per 100 ml
9/27/94 @ 6:00 PM		12	12
10/17/94 @ 7:00 PM		1.1	1.1
2/18/95 @ 10:30 AM	2.0	1.1	1.1
4/6/95 @ 1:15 PM	5.0	6	lt 1.1
5/28/95 @ 4:15 PM	11.0	5.1	lt 1.1
9/29/95 @ 2:45 PM	10.5	2	1.1

CHRISTIAN

10/17/94 @ 5:30PM		1.1	lt 1.1
2/25/95 @ 9:00AM	4.0	5.1	5.1
4/6/95 @ 2:00PM	6.0	lt 1.1	lt 1.1
5/28/95 @ 4:00PM	9.0	16.0	7.0
6/5/95 @ 11:00AM	9.0	lt 1.1	lt 1.1
9/29/95 @ 1:00PM	9.0	lt 1.1	lt 1.1

* MPN means Most Probable Number

** Means Less Than

II BACTERIOLOGICAL TEST RESULTS cont.

LOWER VALLEY CREEKS

NIXON

Date / Time	Water Temperature in Degrees Centigrade	Presumptive Coliforms MPN per 100ml	Fecal Coliforms MPN per 100ml
2/18/95 @ 10:45AM	1.0	3.0	lt 1.1
9/29/95 @ 1:45PM	13.0	5.1	lt 1.1

JEROME

2/18/95 @ 11:30AM	3.0	lt 1.1	lt 1.1
4/6/95 @ 2:30PM	5.0	lt 1.1	lt 1.1
9/29/95 @ 2:15PM	8.0	lt 1.1	lt 1.1

WINLAW

2/18/95 @ 10:10AM	1.2	1.1	1.1
4/6/95 @ 10:00AM	4.0	5.1	1.1
5/28/95 @ 5:00PM	9.0	6.9	2.2
9/29/95 @ 12:30PM	10.0	lt 1.1	lt 1.1

PEDRO

2/18/95 @ 10:00AM	0.7	lt 1.1	lt 1.1
4/6/95 @ 9:30AM	4.0	1.1	1.1
5/28/95 @ 6:30PM	7.0	6.9	1.1
9/29/95 @ 12:00PM	10.5	1.1	1.1

McFAYDEN

7/4/94 @ 4:00PM	-	2.0	2.0
9/28/94 @ 11:30AM	12.0	6.9	lt 1.1
2/18/95 @ 3:30PM	1.0	1.1	lt 1.1
4/6/95 @ 3:30PM	4.0	1.1	1.1
9/29/95 @ 5:00PM	11.0	2.2	lt 1.1

lt = less than

II. BACTERIOLOGICAL TEST RESULTS cont.

LOWER VALLEY CREEKS

AIRY

Date/Time	Water Temperature in Degrees Centigrade	Presumptive Coliforms MPN per 100ml	Fecal Coliforms MPN per 100 ml
7/3/93 @ 1:25PM	12.5	7	lt 1.1
6/3/94 @ 3:13PM	8.0	1.1	lt 1.1
7/4/94 @ 4:00PM	10.0	13.0	2
9/28/94 @ 3:15PM	10.0	9.2	lt 1.1
2/18/95 @ 3:45PM	- 0.5	1.1	1.1
4/6/95 @ 4:10PM	3.5	1.1	1.1
5/27/95 @ 5:00PM	8.0	lt 1.1	lt 1.1
9/29/95 @ 5:30PM	8.0	9.2	1.1

51
36
J
2
A
M
S

OTHER CREEKS / RIVERS

Location	Date / Time	Presumptive Coliforms MPN per 100ml	Fecal Coliforms MPN per 100ml
Erhard Spring in Slocan	10/13/94	lt 1.1	lt 1.1
Elliot Creek	2/25/95 9:45AM	lt 1.1	lt 1.1
Slocan River at Passmore Bridge	5/28/95 7:00PM	16.1	12.0

✓
✓
✓

II. BACTERIOLOGICAL TEST RESULTS cont.

COMMENTS:

The Fecal Coliform levels in all creeks tested were quite low. In instances where high counts were seen e.g Anderson, Sept 27, 1994 and Christian, May 28, 1995 subsequent samples taken within a fairly short time period were low.

A slight increase in Fecal Coliforms was observed in the spring and summer. However, this trend was not always consistent.

Specifically, Fecal Coliforms were not detected in Arthur, Hasty, Nixon, Elliot and Jerome. They were detected in Harris, Anderson, Christian, Winlaw, Pedro, McFayden, Airy, and the Slocan River. Argyle, Bonanza, Vevey, and Lemon were not tested.

A review of Central Kootenay Health Unit Records for 1993-1994 indicates that high levels eg. greater than 10 cells per 100 ml were frequently found in most of the water systems tested. The following points may explain why the values obtained by the Health Department differ from those in the present study.

1. Due to the fact that their mandate is related to health, The Health Department always collects water samples from household taps rather than from creek sources. In private testing, we have always found significantly higher Fecal Coliform counts in water from taps as compared with direct creek water. This may be due to higher water temperatures in household pipes, rough surfaces of pipes that allow bacteria to grow and/or joints or angles in plumbing. Here, water flow may slow, allowing bacteria to grow.
2. The Health Department currently uses the Membrane Filtration Method to enumerate Fecal Coliforms. The Membrane Filtration Method is documented to be less specific for the presence of E.coli, the most important Fecal Coliform, than the Multiple Tube Fermentation method* which is the one used in this study. It is known that Coliforms and organisms that give the same biochemical reactions as Coliforms breed in water distribution systems (Standard Methods 17th edition pages 9-98 and 9-104). Therefore when using the Membrane Filtration method, it is important to perform further confirmation tests for the specific presence of E.coli.

On the other hand, the Multiple Tube Fermentation test by its very nature, incorporates some of these confirmation tests and is therefore more specific for E. coli. than the Membrane Filtration method. Thus, whenever there is a doubt about test results the Multiple Tube Fermentation method is referred to as the standard. However, it is lengthy and costly as compared with Membrane Filtration. For this reason, the Membrane Filtration method is now used in most large testing programs. Please refer to the "Summary of Bacterial Testing in Water" written by Jennifer Ycove May, 1993

* This method is often referred to as the MPN method meaning Most Probable Number.

III. WATER CHEMISTRY TEST RESULTS

A. Hardness and Conductivity

Both hardness and conductivity values are directly related to the concentration of minerals in the water. Hardness measures the calcium and magnesium ion concentration and is expressed in terms of calcium carbonate. Conductivity measures the ability of the water to conduct an electric current. It is measured in μ mhos per centimeter at 25 degrees C. The tests performed to date on the creeks in our study confirm the relation between conductivity and hardness. An example of a correlation between these two tests is given in Chart 1 for Winlaw Creek.

Hardness and conductivity values are characteristic to each creek depending on the solubility of minerals in the rock, volume of water and temperature. Chart 2 shows that generally the upper valley creeks have higher hardness and conductivity levels than creeks in the lower valley. Please refer to Appendix 1 for the table of average values for each creek.

When creeks are high, the mineral content is less, hardness and conductivity are lower. When flow levels are low, the mineral content in the water is higher and hardness and conductivity levels increase. An example of the variation in conductivity readings during the spring and summer is given in Chart 3 for Airy Creek.

In the chart it can be seen that conductivity values are high at the beginning of spring before run off begins. The lowest levels occur at the end of May and throughout June when flow levels are high. They increase again in August and September when flow levels drop off. Of particular interest is the dramatic increase in conductivity on 7/26/95. This sample was taken right after it began to rain after a two week dry spell. Please refer to the Data Sheets given in Appendix 1 for individual readings.

B. Acidity, pH, and Alkalinity

Acidity measures the ability of water to neutralize a base (sodium hydroxide) and is influenced by many factors. In unpolluted surface waters, the major acidic component is from the dissolved carbon dioxide which forms weak carbonic acid; this is unstable and easily lost thus accounting for the inherent variability of the acidity values.

The acidity levels for the majority of creeks was low and fairly consistent throughout the year viz. Argyle, Arthur, Bonanza, Harris, Hasty, Vevey, Pedro, McFayden, Airy & the Slocan River. See Chart 4. Lemon, Anderson, Elliot Christian, Jerome and Winlaw exhibited somewhat higher variability, particularly Elliot and Jerome which require further readings before conclusions can be drawn.

A further factor which contributes to the stability of acidity readings is alkalinity. Alkaline waters buffer the effects of acid rain and other acid inputs such as dissolved carbon dioxide and humic/plant acids.

B. Acidity, pH, and Alkalinity

The alkalinity of clean surface waters is mainly due to carbonate, bicarbonate and hydroxide with some lesser amounts of borates, phosphates, silicates and other bases. Because of its dependence on the presence of ionic species, the alkalinity values (Chart 5A) follow the same trend as the conductivity values (Chart 2), and serve to characterize the creeks according to dissolved solids content.

The pH was within the range of 6 - 8 for all creeks. See Chart 5. The upper valley creeks were slightly higher (more alkaline) and Airy and McFayden were lower. The pH results support the alkalinity results (Chart 5A), which indicate that Argyle, Arthur, Harris, Anderson, Elliot and Christian are quite alkaline. Airy had the lowest alkalinity. Individual readings for Acidity, Alkalinity, and pH are given in the Data Sheets, Appendix 1.

- C. Oxygen was initially measured. In consultation with Al Isaacson, hydrologist, we were informed that because of the high turbulence in all the local creeks, oxygen content would always be at saturation levels and not a useful parameter to track. This parameter can be taken in the future if requested and the results to date are in Appendix 1.

IV. PHYSICAL TESTS - SEDIMENT AND TURBIDITY

An increased sediment load is often the most obvious adverse effect of forest management activities on creeks. The sediment measurement tests performed during 1994 - 1995 included:

1. Turbidity readings on water samples submitted every 1 - 3 months for all 17 creek sites (see Appendix 1 for individual turbidity readings).
2. Intensive turbidity measurements on McFayden and Airy Creeks (Charts 8,9,10).
3. Intensive suspended sediment measurements on McFayden and Airy Creeks (Charts 6,7,7A).

No strong pattern was discernible on the turbidity readings on creeks other than Airy and McFayden where data was collected more intensively. Occasional high readings would appear in the sample but without weather data and a more intensive approach as was done with McFayden/Airy, these values cannot be interpreted. However from the current data, one can say that occasional high turbidity values representing high sediment loads do occur in some of the creeks from time to time viz. Jerome and Nixon and to a lesser extent Bonanza and Harris. An intensive sediment study of these 4 creeks may be interesting in the future.

A comparison between McFayden and Airy turbidity levels indicated that McFayden's was considerably lower. McFayden turbidity levels were all less than 1 NTU while Airy had 10 out of 18 greater than 1 NTU between May 6 and June 6. See Chart 8. There also appears to be a correlation between the occurrence of high Turbidity readings and the occurrence of high suspended sediment readings. If one compares Charts 6,7,7A and 8, it is readily apparent that high turbidity readings occur with high suspended sediment values. This study indicates that there is definitely a relationship between these 2 parameters - especially at high levels. The relationship is less distinct at lower levels. This relationship will be confirmed with subsequent suspended sediment and turbidity readings for Airy and McFayden and may not apply to other creeks.

During the spring run - off of 1995, Airy Creek suspended sediment values appeared to peak 4 times. See Chart 6. The first was on May 6th with 13.6 mg/l. After dropping, levels went up on the 10th to 18mg/l. After another drop, levels rose to 46.8 and 22.2mg/l on the 15th and 17th of May. After another drop, levels rose to 57.0mg/l on May 28th at the same time that the gauge reading reached a maximum for the year to that date. After these high readings, the gauge continued to rise but suspended sediment levels dropped.

McFayden suspended sediment also showed an increase between May 2 - 18th. See Chart 7. After dropping, they again rose at the end of May and mid June. Other elevated levels occurred on May 12, 16, and 18th at 2.4, 3.2, and 2.4 mg/l. A comparison between the two creeks indicated that McFayden Creek suspended sediment levels were consistently lower than Airy. In fact, the highest reading for McFayden (which occurred at the same time as Airy's highest reading) was 5.2 mg/l on May 30th. This value was approximately one tenth of Airy's reading of 57 mg/l during the same time period. See Chart 7A. Chart 7A also shows that the movement of sediment in Airy and McFayden Creeks occurs at nearly the same time, peaking at 29th to the 30th of May, 1995. Whether these 2 creeks are always synchronous in sediment deposition is a good question. However, they appear to be synchronous for 1995.

IV. PHYSICAL TESTS - SEDIMENT AND TURBIDITY cont'

The main question arising from this study is: Why does Airy have so much more sediment than McFayden? Possible reasons may be --

1. Airy has a much larger watershed than McFayden (58sq. km vs. 5.7sq km).
2. Airy has a higher degree of disturbance because of forest removal and roads.
3. Airy's soil structure may significantly differ from McFayden resulting in greater amount of fine particulate being carried away during runoff.

V. TEMPERATURE

Temperature is an important, easily measured parameter. We have been fortunate in that some of the resident participants have consistently taken air and water temperature readings over short and long periods of time.

1. Vevey Creek temperature measurements are given in Appendix 1 and in Chart 11.
2. Christian Creek temperature measurements are given in Appendix 1 and Chart 12.
3. Winlaw Creek temperature measurements are given in Appendix 1 and Chart 13.
4. Pedro Creek temperature measurements are given in Appendix 1 and Chart 14.

VI. FLOW MEASUREMENTS

Flow is one of the most important measurements in the monitoring program. A summary of the work to date is given:

1. The Harris Creek weir is being read by John Anderson. Readings are recorded on the Harris Creek Data Sheet, Appendix 1. The readings for 1995 are incomplete.
2. Pedro Creek now has a gauge that has been installed just above the user intakes. Russ Youngreen is currently taking readings. The gauge needs to be calibrated.
3. The Christian Creek weir is read by Linda Mandala. The flow levels readings are given in in the Appendix and Chart 15.
4. Jerome Creek has a gauge that is read by Christine Cowren. It has not been calibrated.
5. McFayden Creek has a weir that was installed and used for many years by Water Survey Canada. It is no longer read and needs cleaning. We have taken some readings and they are recorded on the McFayden Creek Data Sheet pg.2.
6. Airy Creek has a gauge that was built and installed by Carl Schlicting. Twice, we have calculated flow based on cross sectional area and velocity for Airy Creek. The calculations for flow based on these measurement are given in Appendix 1 and gauge readings are given in Airy Data Sheet pg 2.

A Comparison of Hardness and Conductivity Values for Winlaw Creek 1994 - 1995

Chart1

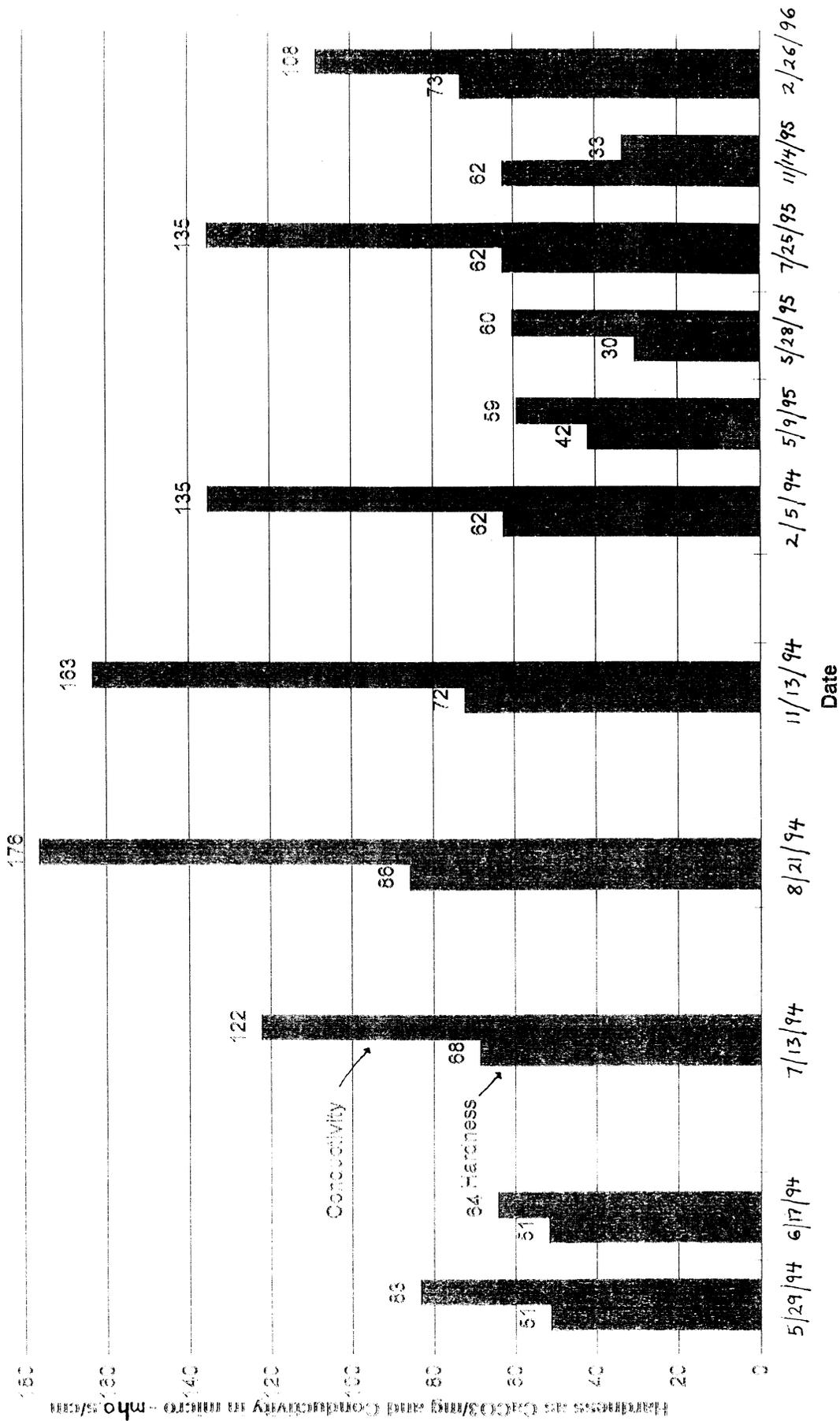


Chart 2

Average Conductivity for Slocan Valley Creeks 1994 - 1995

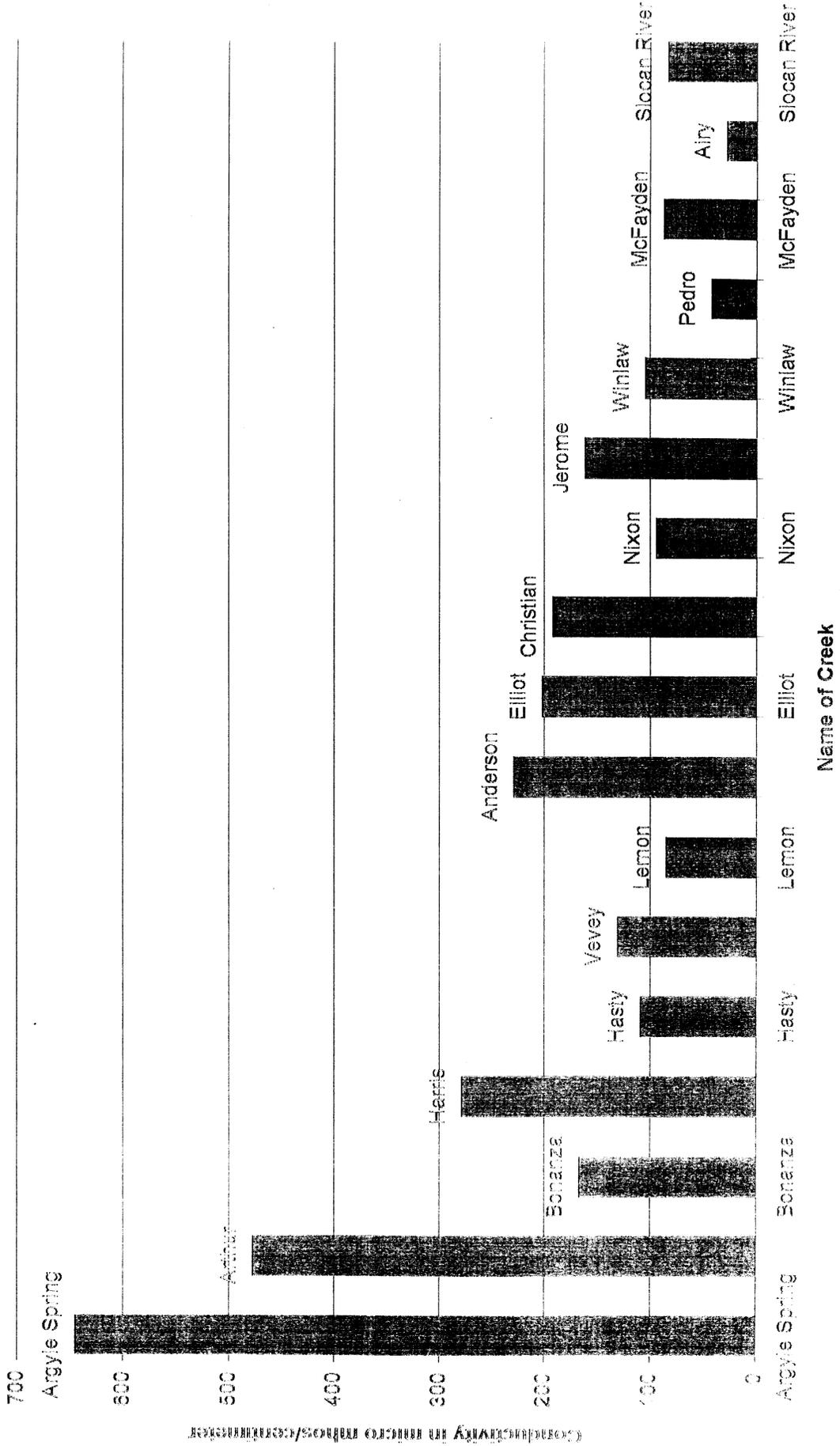


Chart 2A

Average Hardness for Creeks and a Spring in the Slokan Valley 1994 - 1995

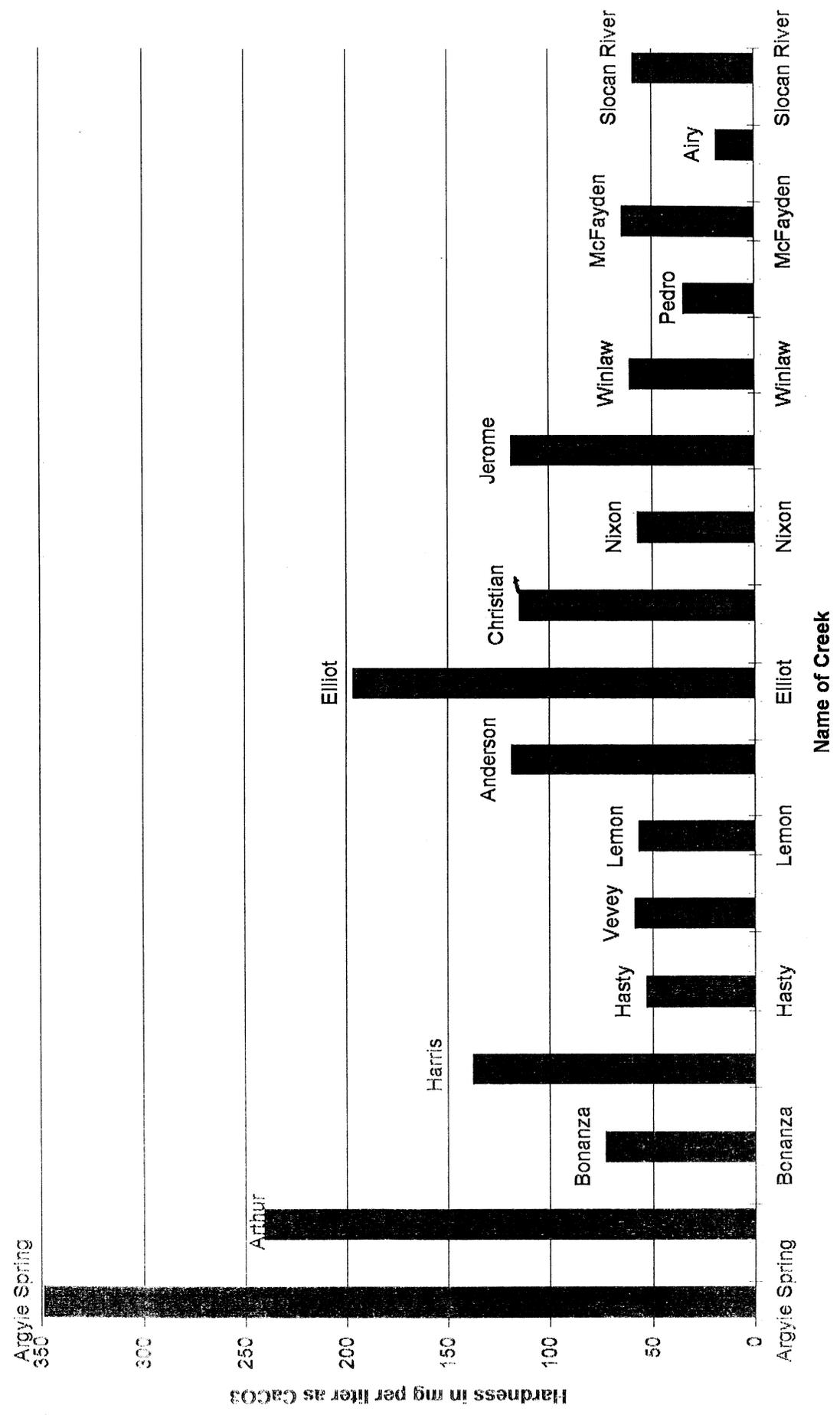


Chart 3

Airy Creek Conductivity Values May, 1994 - February, 1996

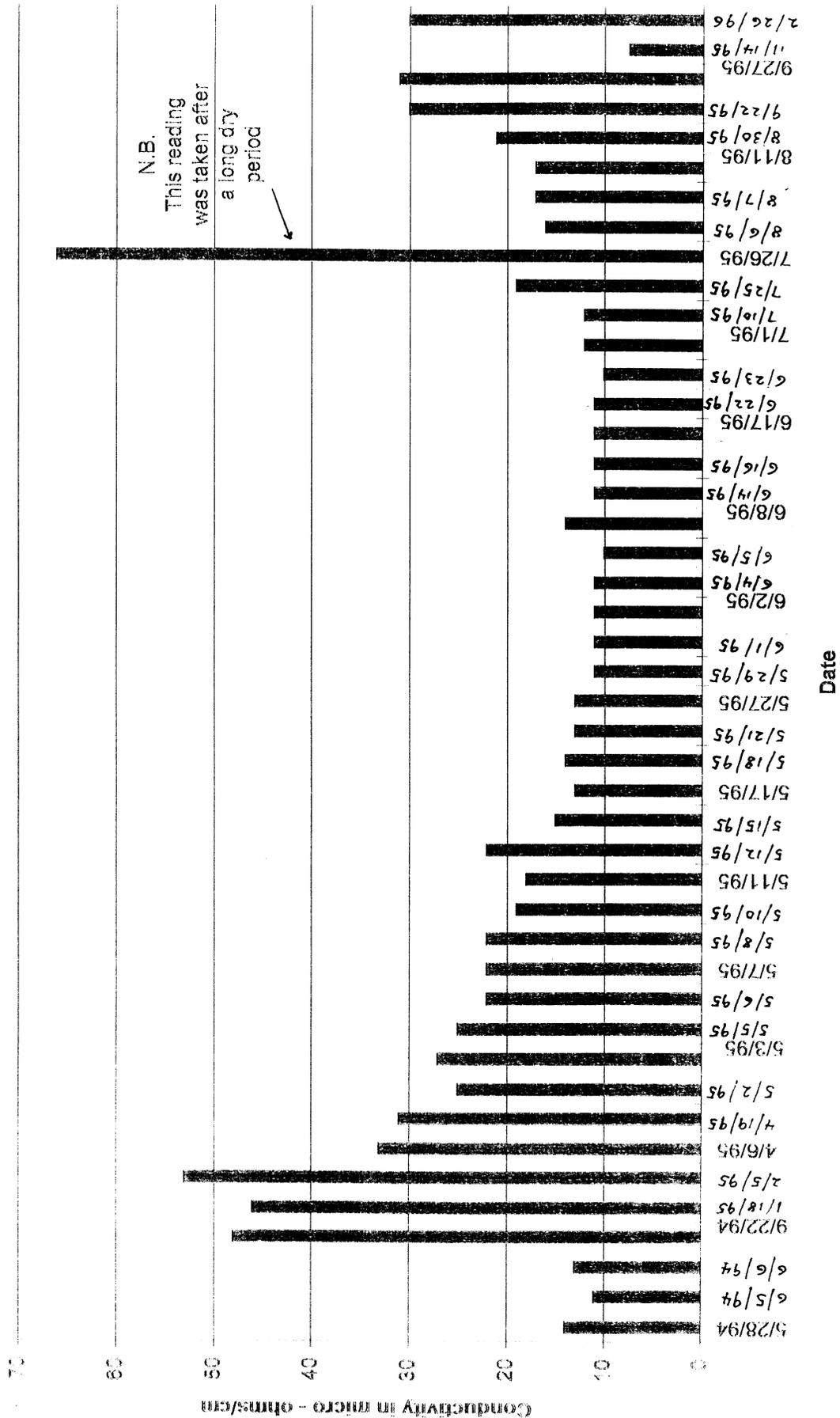
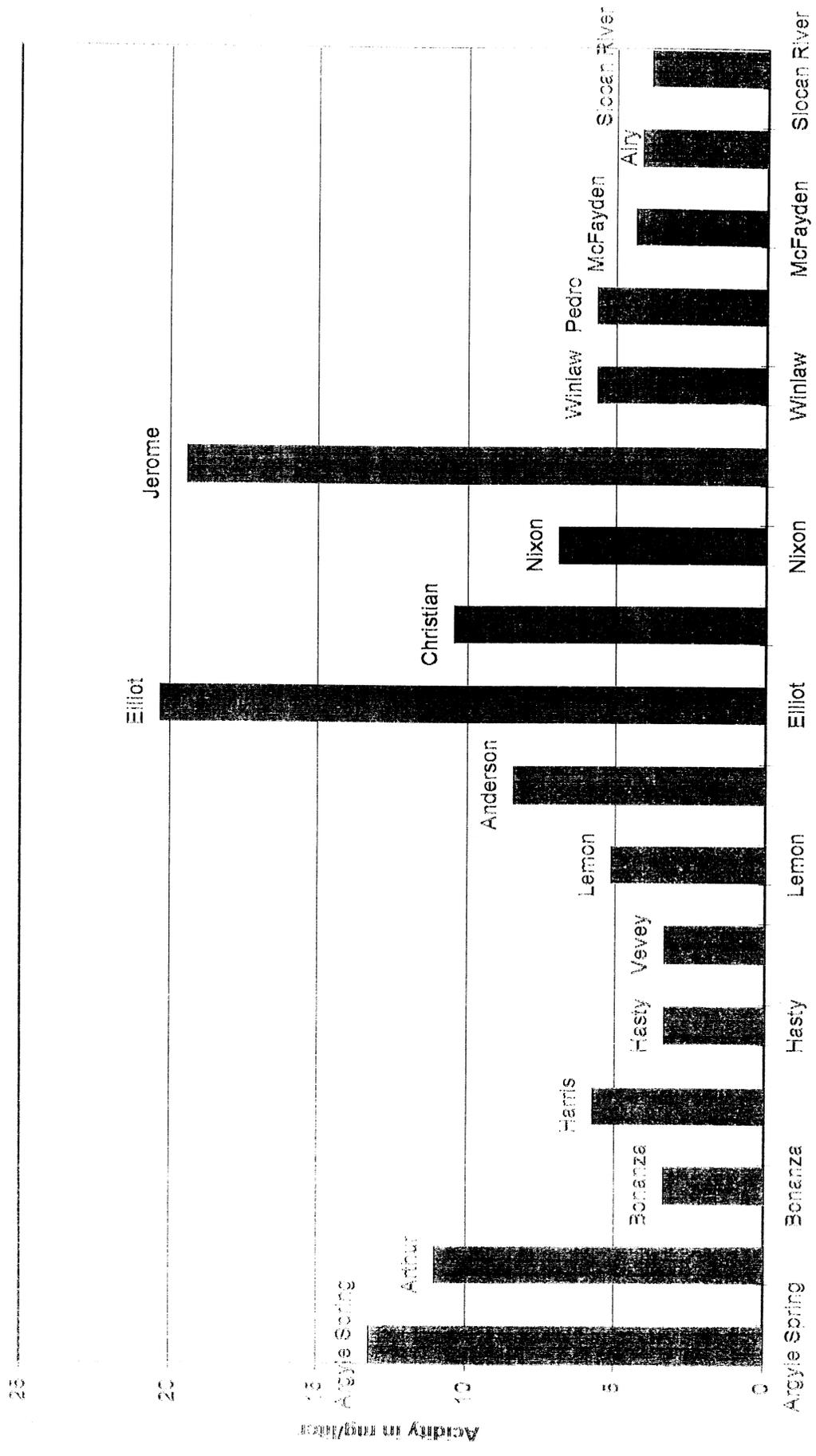


Chart 4

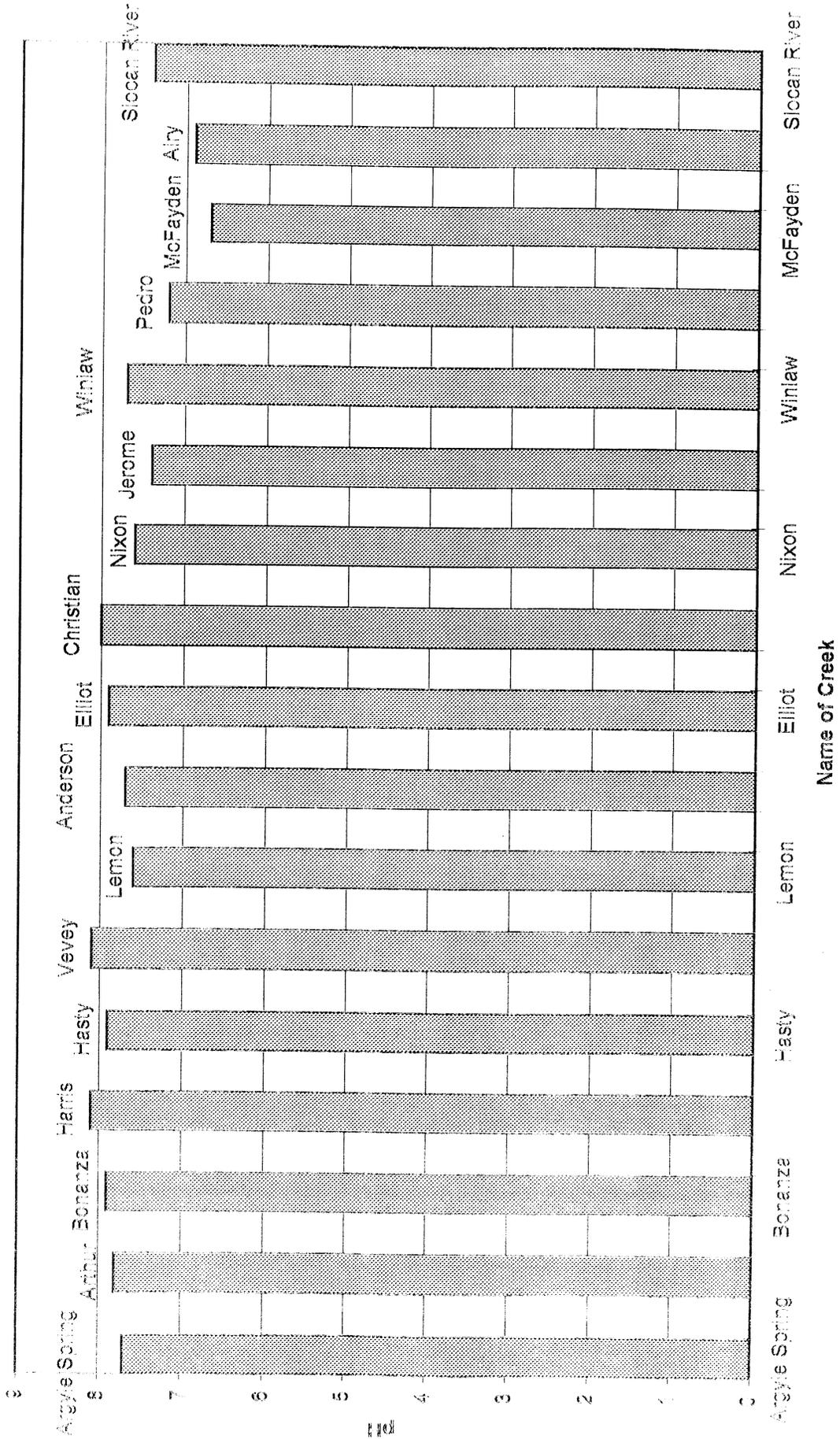
Average Acidity for Slocan Valley Creeks 1994 - 1995



Name of Creek

Chart 5

Average pH for Creeks in the Slocan Valley 1994 - 1995



Name of Creek

Chart 5A

Average Alkalinity for Siocan Valley Creeks 1994 - 1995

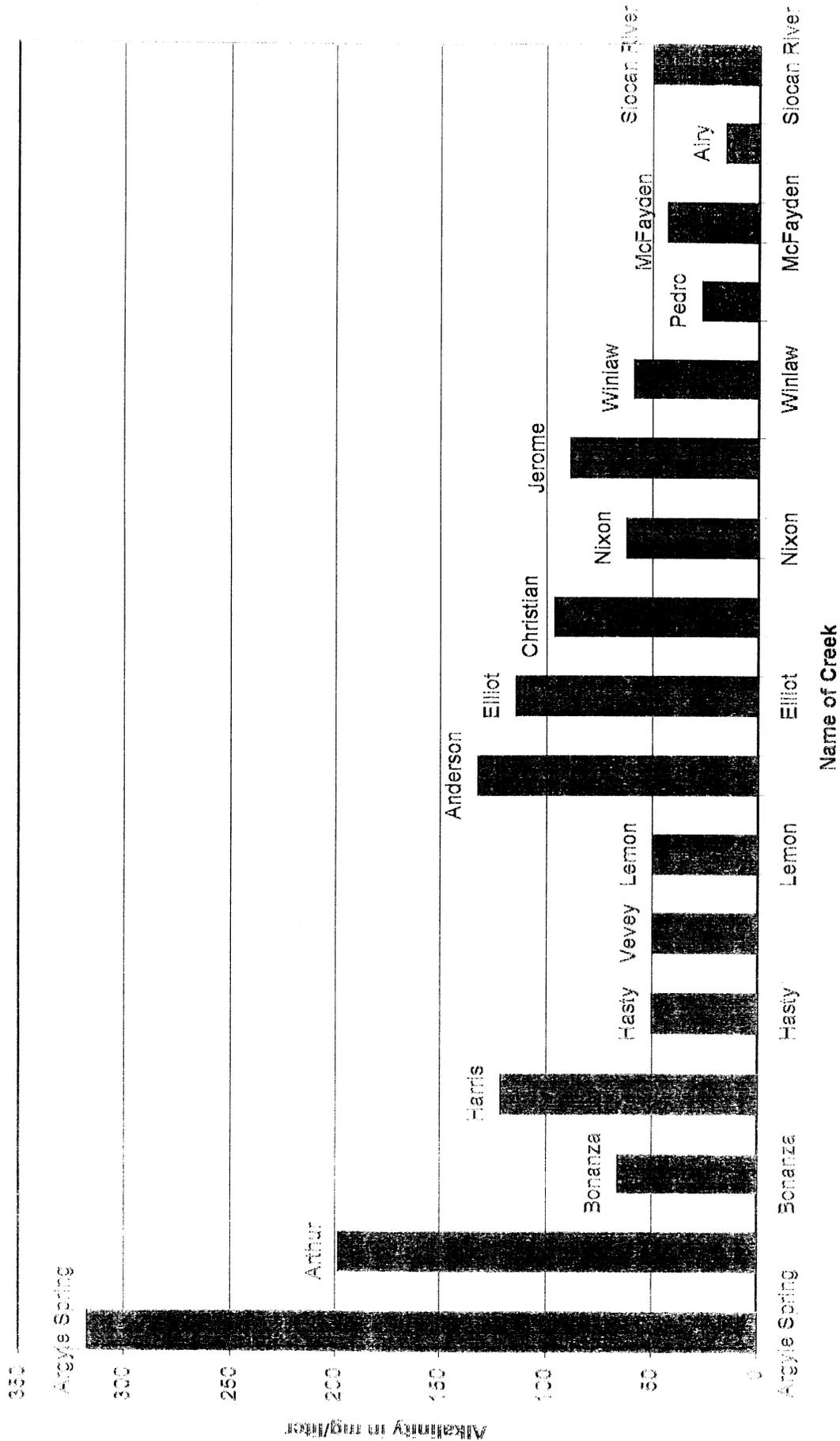


Chart 6

Alty Creek Suspended Sediment Readings May - September, 1995

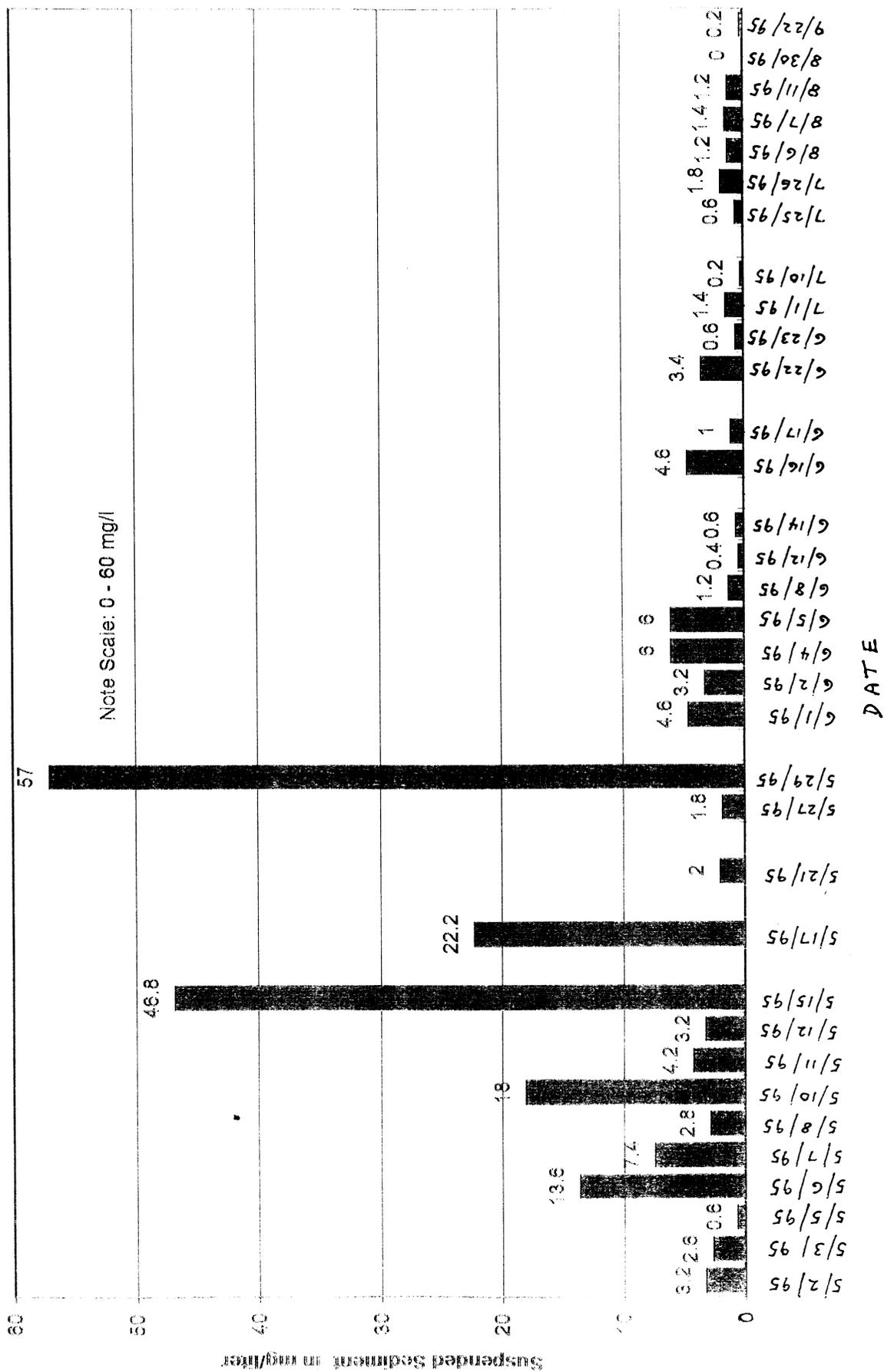


Chart 7

McFayden Creek Suspended Sediment May - September, 1995

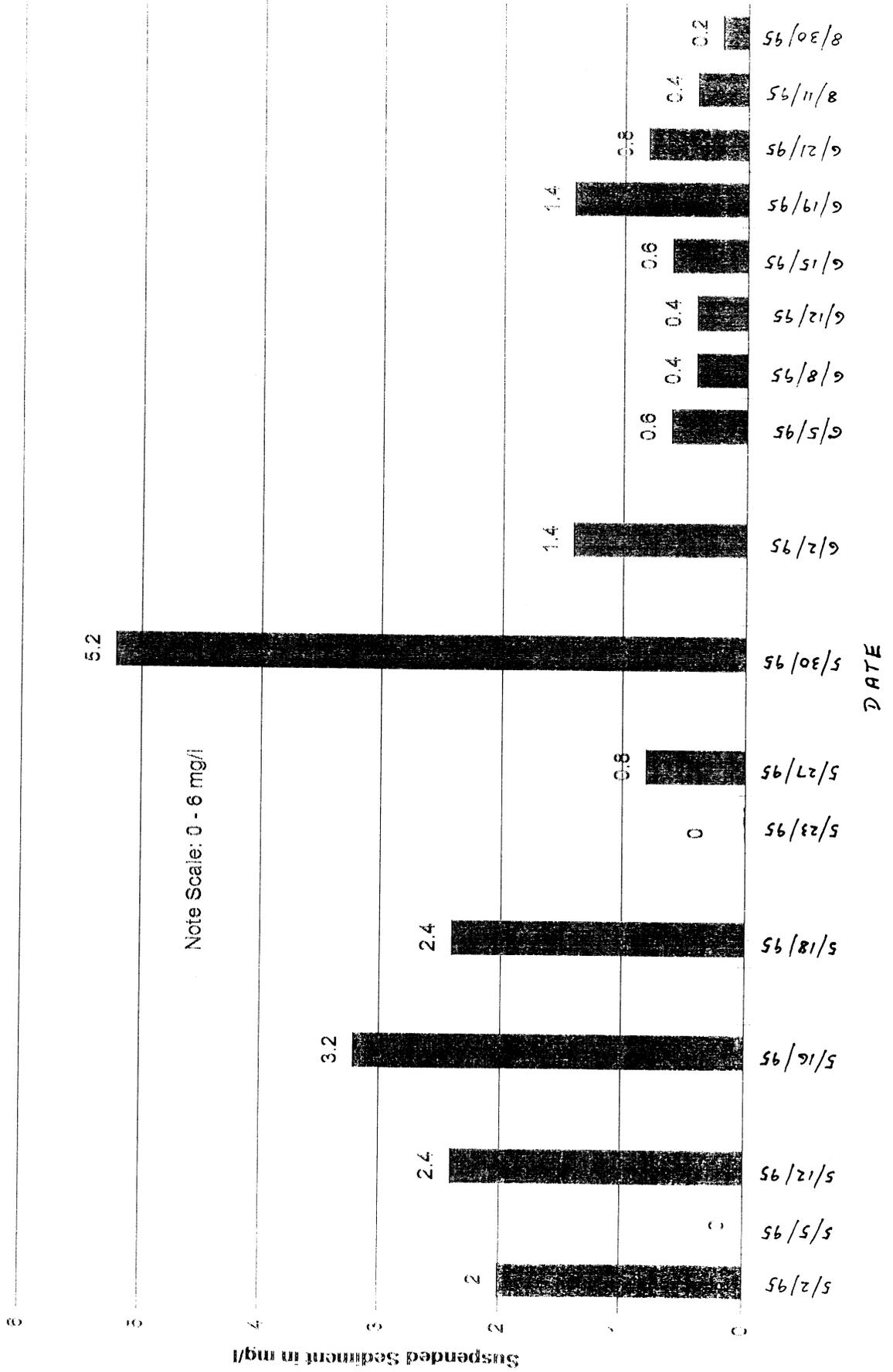


Chart 7A

Airy and McFayden Creek Suspended Sediment Values

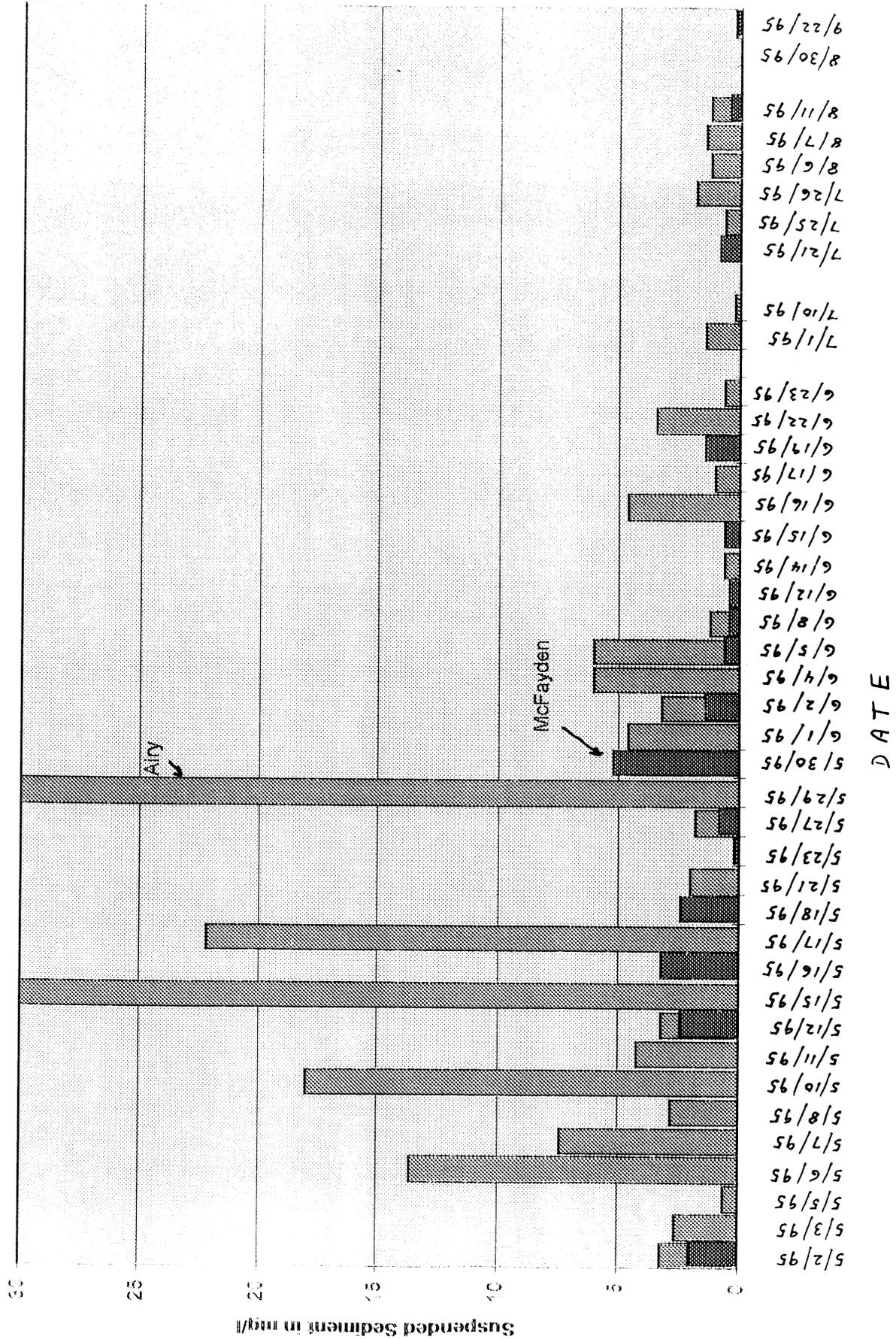


Chart 8

Airy and McFayden Creeks Turbidity Readings May - September, 1995

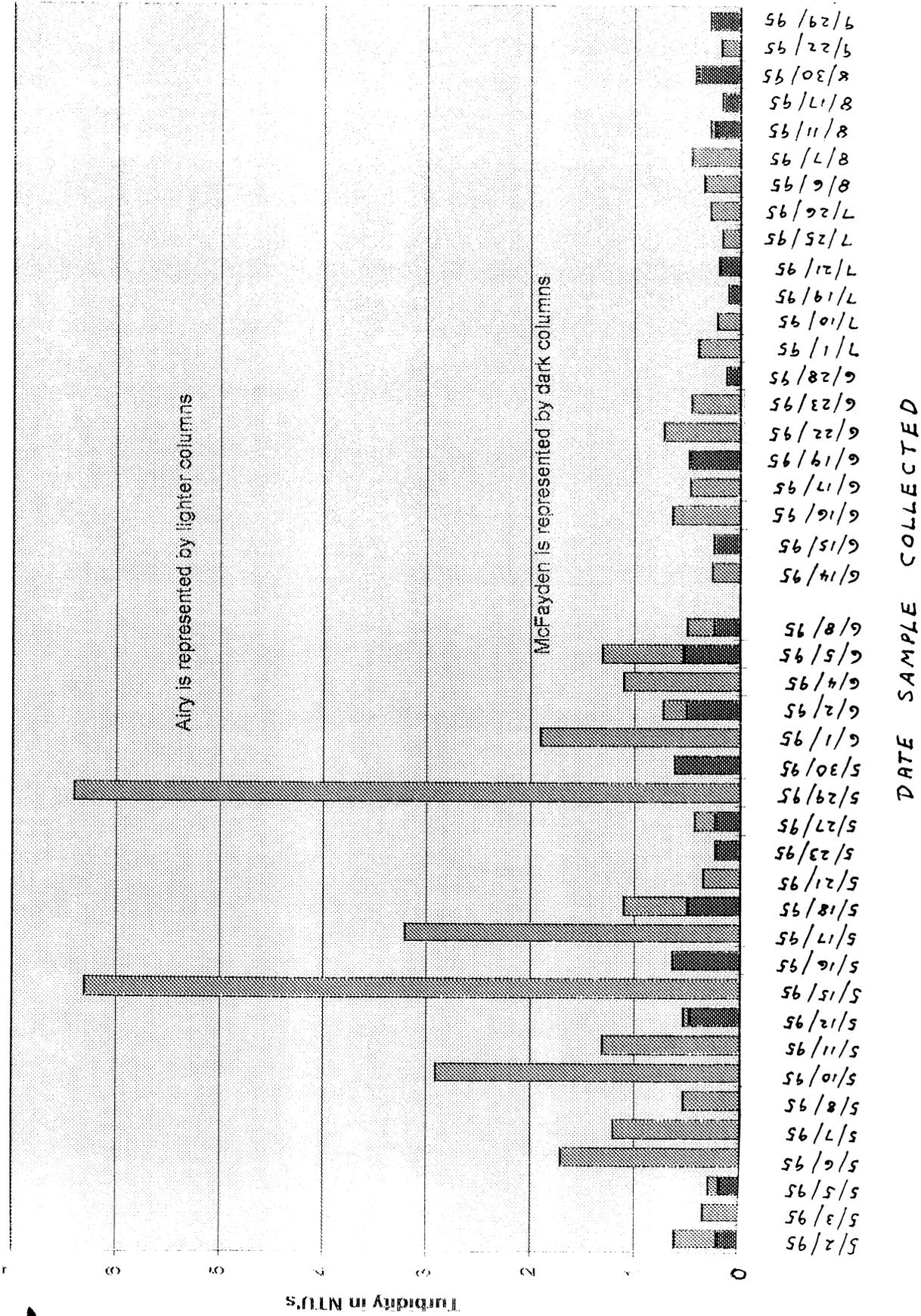


Chart 9

Airy Creek Turbidity Readings May - September, 1995

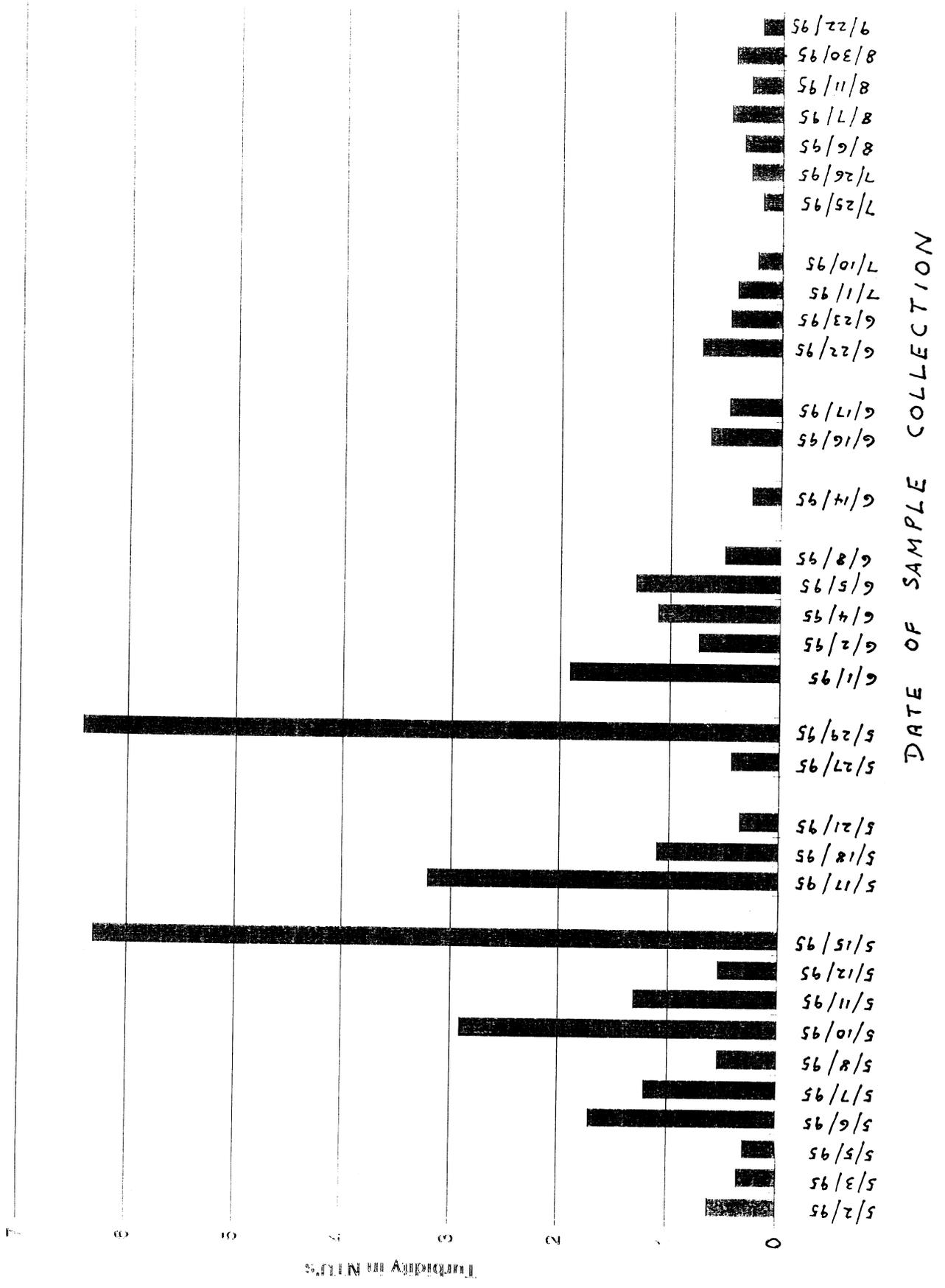
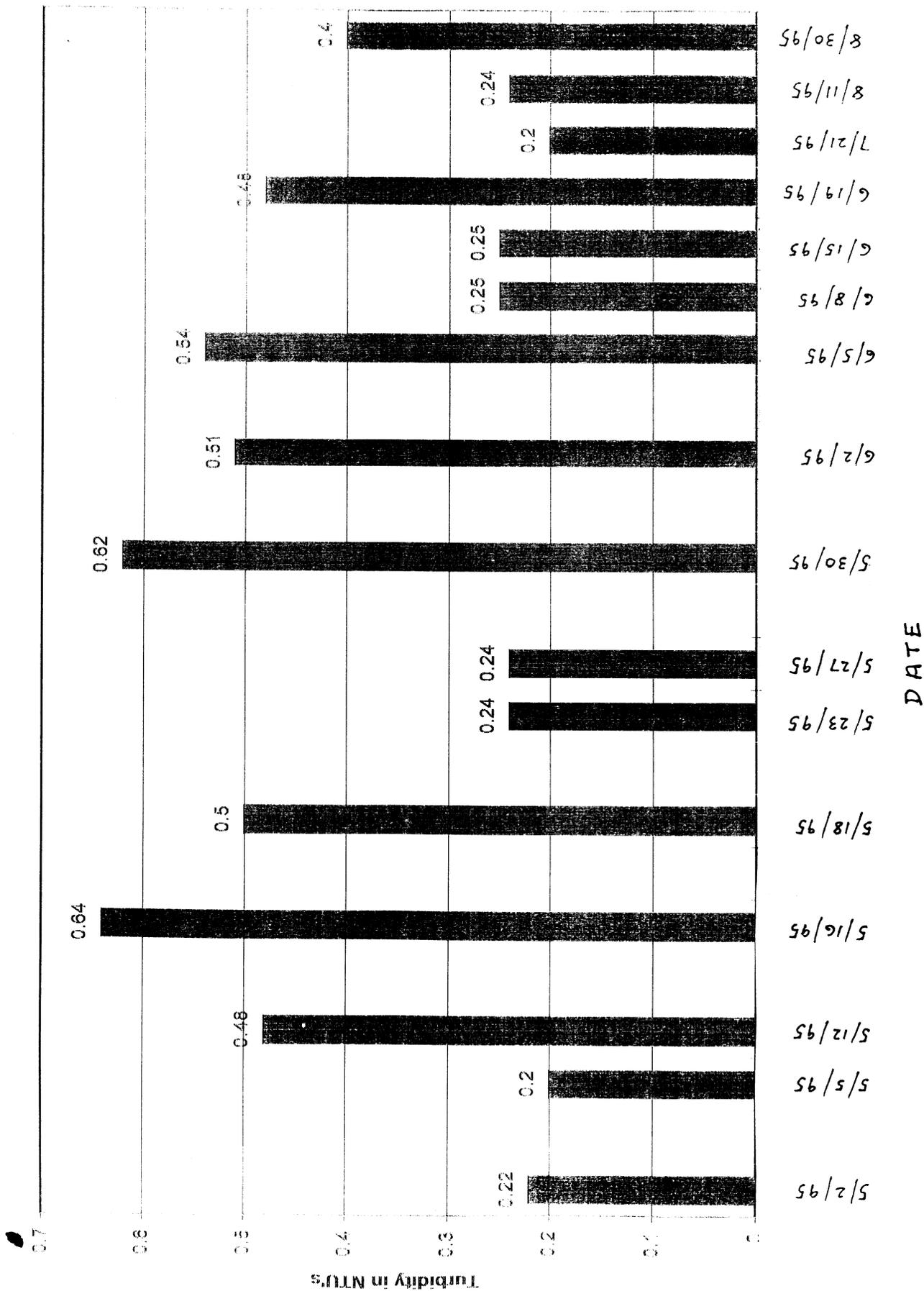


Chart 10

McFayden Creek Turbidity Readings Taken Between May - August, 1995



Vevey Creek Temperature Values Taken Between 7:40AM - 10:30AM 1994 - 1995

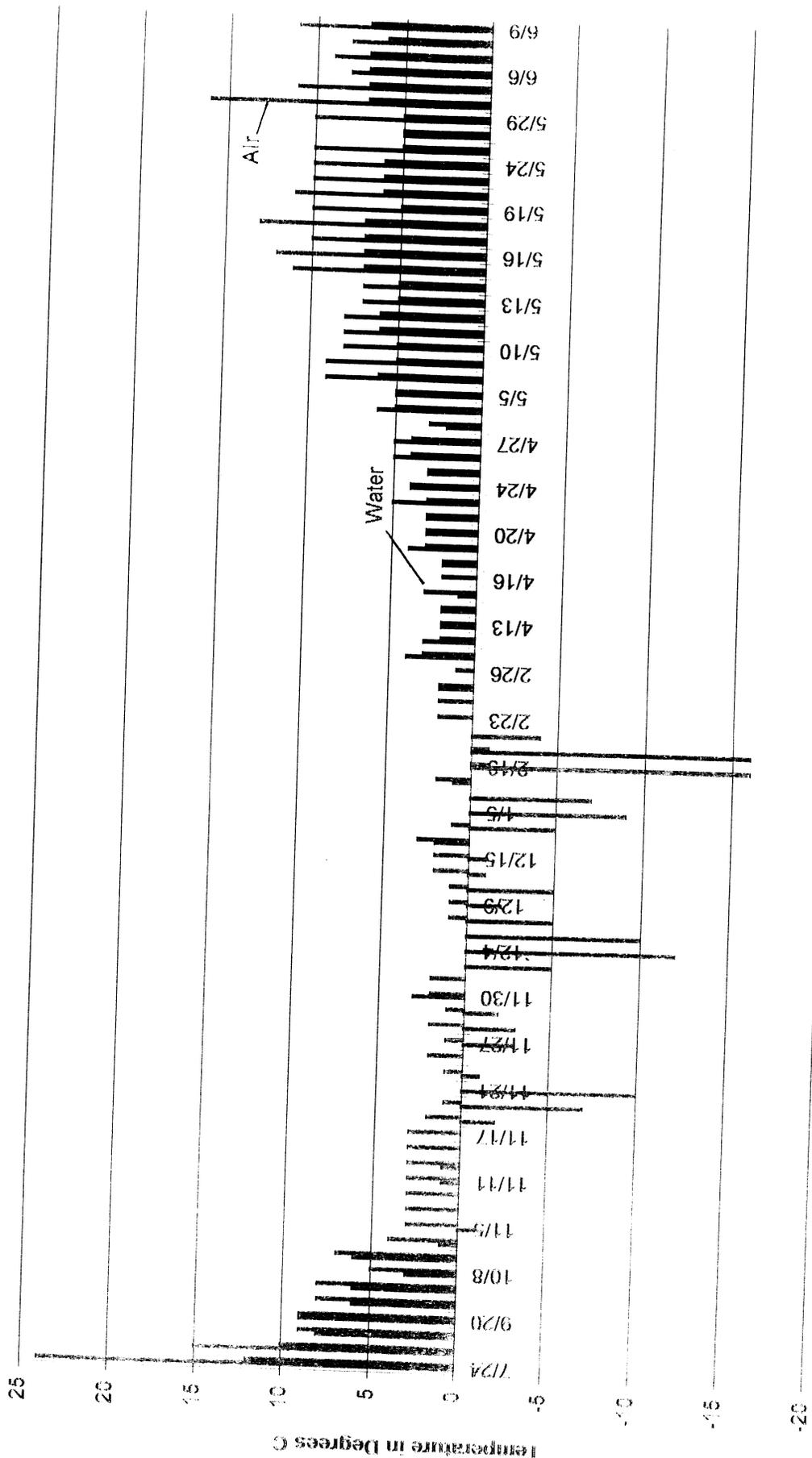


Chart 12

Christian Creek Air and Water Temperatures Taken Between 7:00AM - 11:00AM
1994 - 1995

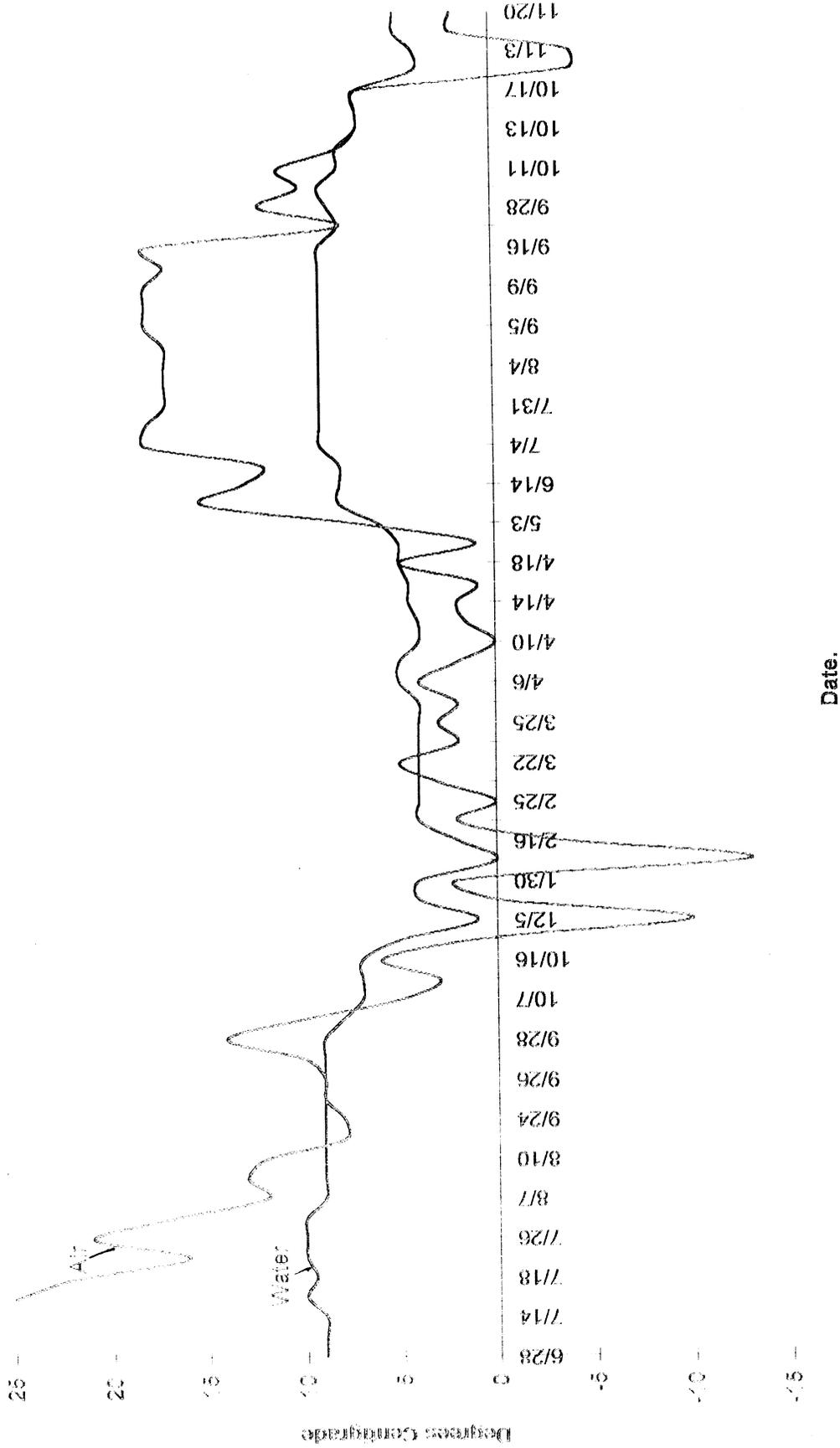
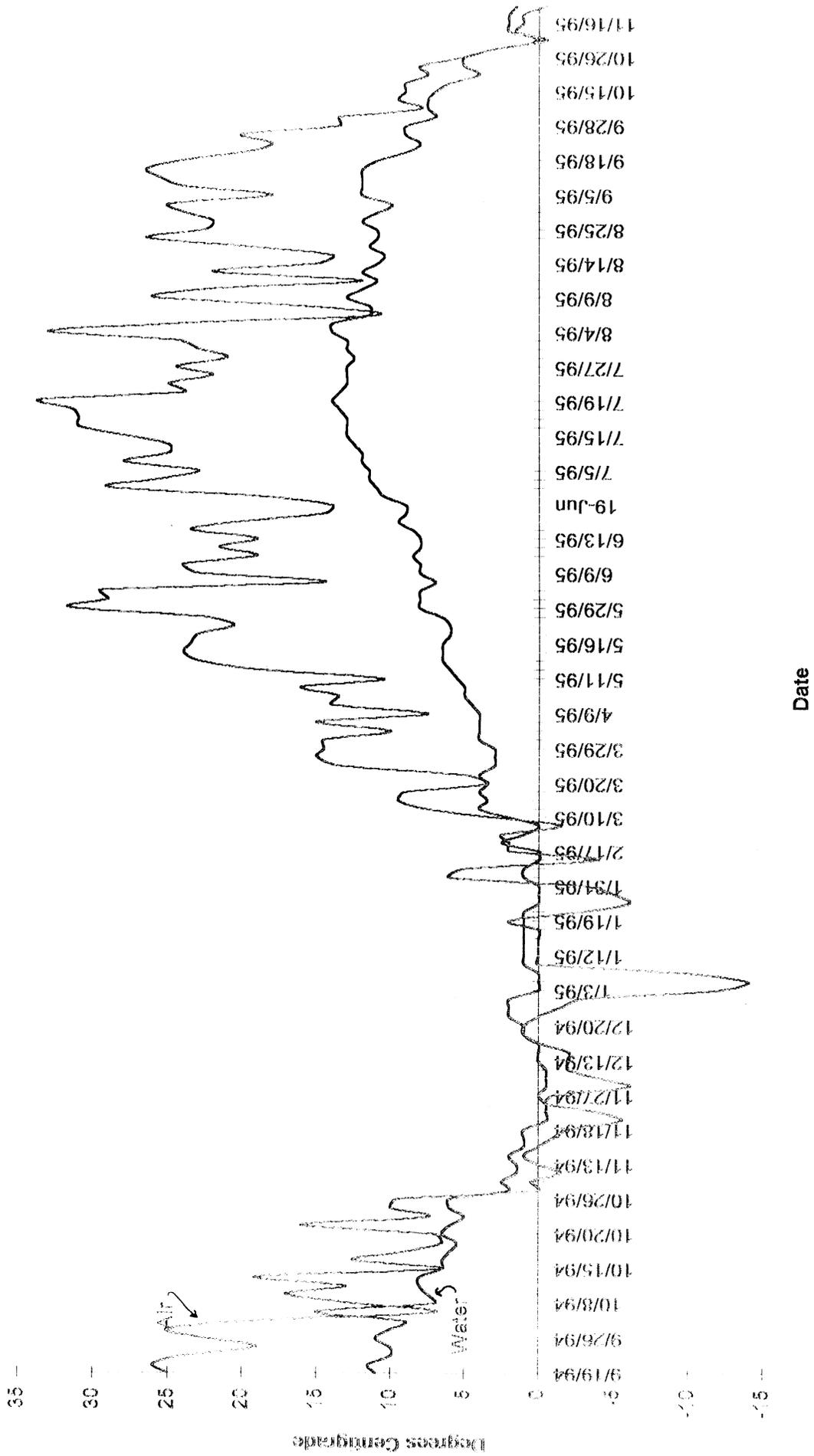


Chart 13

Winlaw Creek Air and Water Temperatures Taken between 2:00PM - 6:00PM 1994 - 1995



pg: 29

Chart 14

Pedro Creek Air and Water Temperatures Taken Between 8:00AM and 11:00AM 1994 - 1995

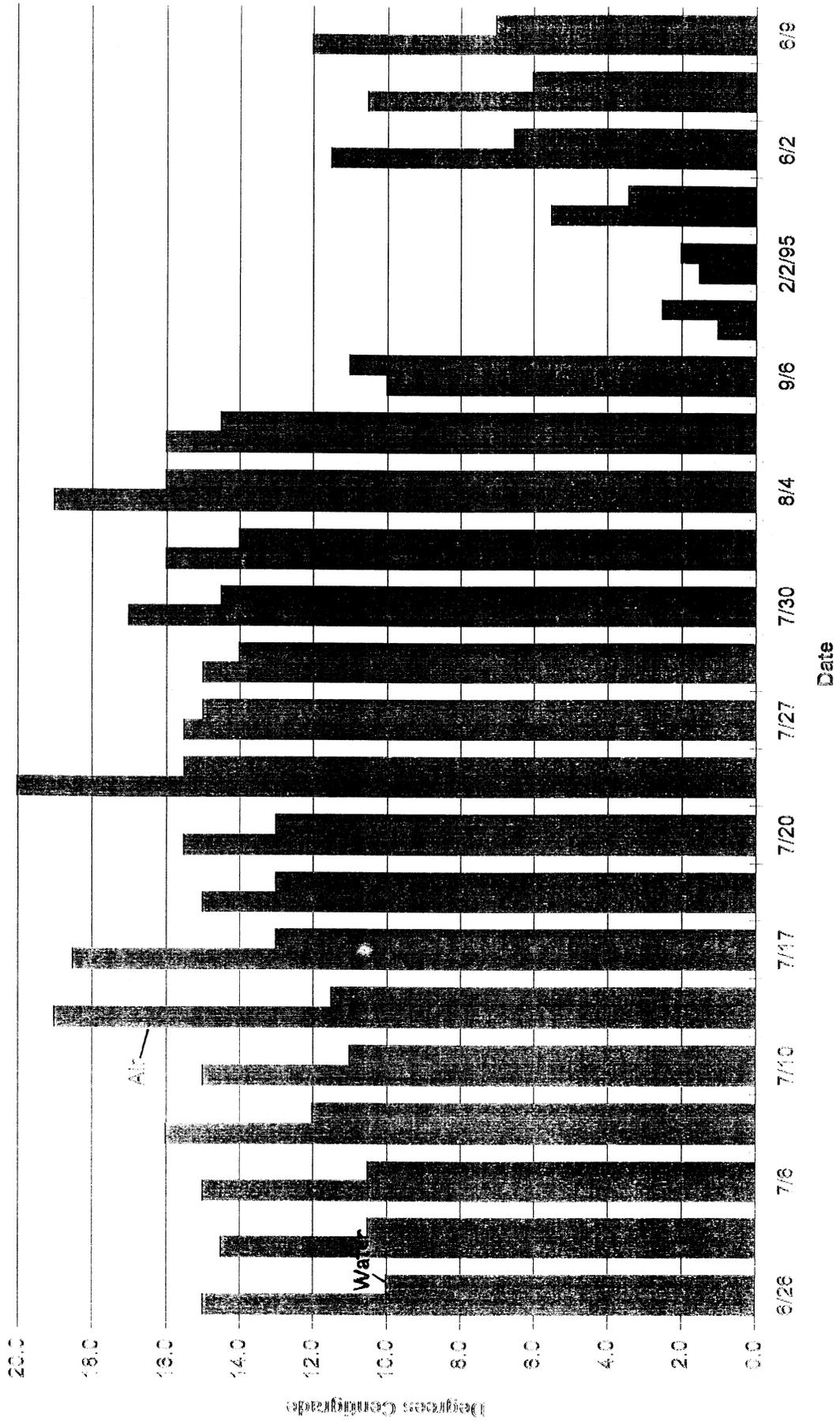
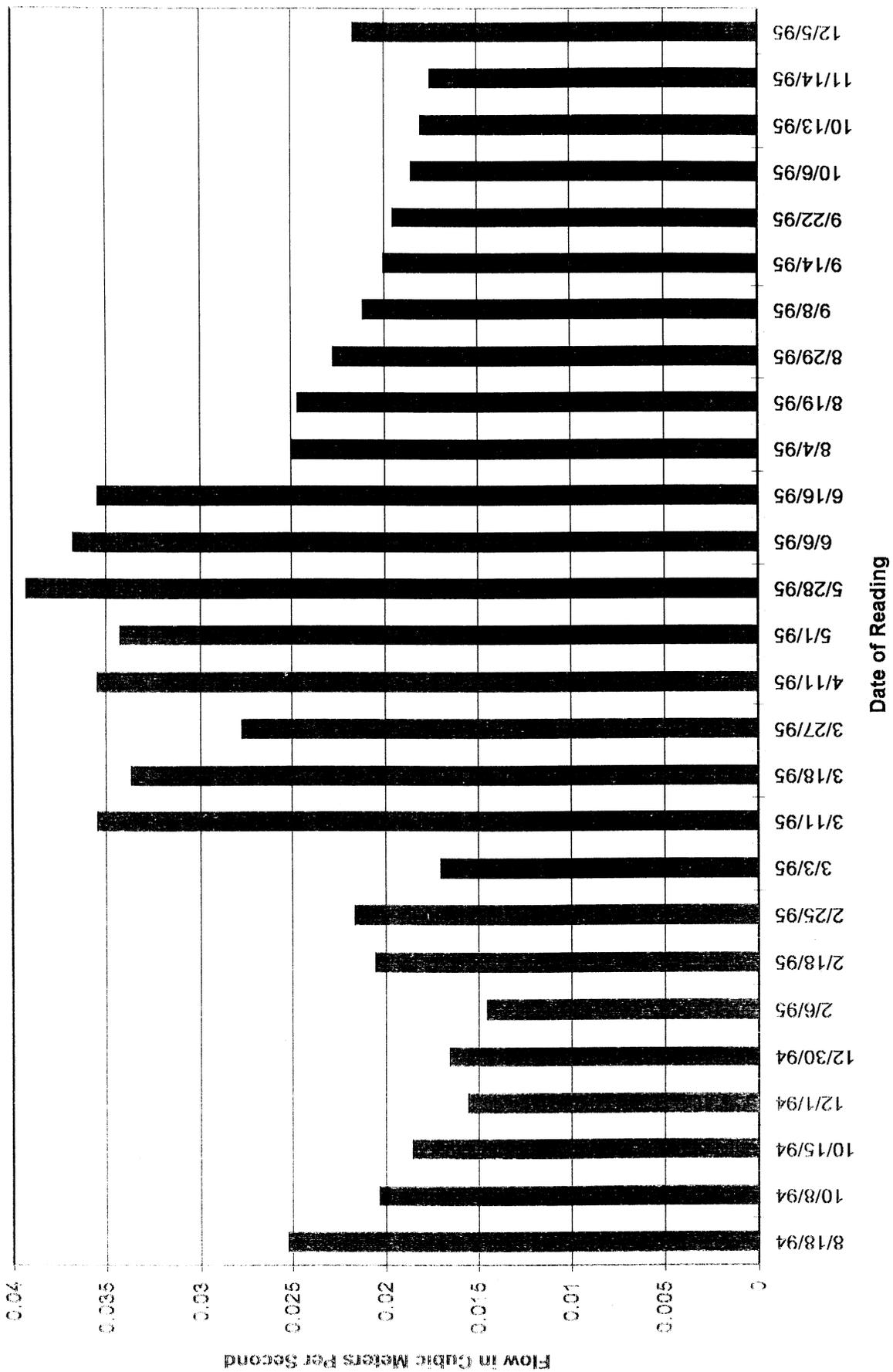


Chart 15

Christian Creek Flow Levels 1994 - 1995



Lemon Creek

Resident Participant: Don Rohit

Terry Knight

Notes: Testing began June, 1994. Sample collected at the bridge.

Date	Time	Weather	Air Temp °C	Water Temp °C	pH	Acidity mg/l	Alkalinity mg/l	Hardness mg/l	O ₂ mg/l	Turbidity NTU	Conductivity $\mu\text{mhos/cm}$	Initials
6/22/94	1:30PM	Sunny, warm	29	9	7.5	11.4	21	51	8	0.26	41	TK
6/22/94		Quality Control			7.2	lt 4		24				JY
7/18/94	4:00PM	Sun, clouds	24	14	8.6	4.6	41	51	6	0.2	66	TK
7/18/94		Quality Control			7.9	lt 4		16				JY
8/17/94	3:30PM	Clear periods	28	13	8.3		55	51	10	0.15	122	DR
9/17/94		Quality Control				lt 4	82	70				JY
11/24/94	4:15PM	Cloudy	1	1	7	6.8	48	62	11	0.25	110	DR
11/24/94					7.2			80				JY
					color wheel							
3/2/95	3:30AM	Clear	-2	0	7.5	4.6	64	73	12	0.2	102	DR
4/6/95		Quality Control						86				JY
7/31/95	3:30 AM	Sunny, with cloud	28	14.5	7.5	13.7	34	52	9	0.18	66	JY

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Christian Creek

Resident Participant: Linda Mandala

Notes: Testing began May, 1993. Sample collected near Linda Mandala's house

Date	Time	Weather	Air Temp °C	Water Temp °C	pH	Acidity mg/l	Alkalinity mg/l	Hardness mg/l	Ca mg/l	Turbidity NTU	Conductivity		Initials
											µmhos/cm	µmhos/cm	
5/29/94	1:50PM	Rainy	10		8	25	89	120	13	0.2	213		JY
6/20/94	1:30PM	Sunny after rainy days		8.2	7.5	25	89	137	13	0.34	173		LM
6/20/94		Quality Control				H4		90					JY
6/20/94								94 (kit)					JY
7/14/94	7:30AM	Sunny, warm, few clouds, sunny past few days	12	9	8.6	9.1	103	120	9	0.31	188		LM
7/14/94		Quality Control			8.4			80					JY
5/23/94	10:00AM	Sunny	20	9.5	8.5	6.8	96	170	9	0.2	239		LM
6/23/94		Quality Control			8.0 (color wheel)								JY
7/17/94	9:00AM	Partly cloudy, cold, wet, all day snow	1	5	8	6.8	103	125	12.5	0.35	239		LM
7/17/94		Quality Control			7.6			90					JY
2/7/95	12:00PM	Sunny	5	5	8.3	6.4	103	135	12	0.3	229		LM
4/8/95										0.84	170		TY
5/8/95	6:00PM	Rainy	12	6	8	6.8	89	83	11	0.74	137		LM

Winlaw Creek

Resident Participant: Phil Larstone

Notes: Testing begins June, 1994. Samples taken near the highway 6 bridge.

Date	Time	Weather	Air Temp °C	Water Temp °C	pH	Acidity mg/l	Alkalinity mg/l	Hardness mg/l	O ₂ mg/l	Turbidity NTU	Conductivity		Initial
											µmhos/cm		
5/26/94	10:05AM	Rain, sun, mixed	7.8	5.5	7.4	9.1	41	51	12	0.08	83		JY
6/7/94	4:22 PM	Rain prev day, cloudy	17.0	7.9	7.5	9.1	41	51	10	0.19	54		PL
6/17/94		Quality Control			7.0	2.5	44						JY
7/13/94	8:10AM	Clear	17.5	10.5	8.4	4.6	62	68	12	0.13	122		PL
7/13/94		Quality Control			7.8		52						JY
8/21/94	12:00PM	Sunny, clear for months	28.5	12.5	8.4	6.8	82	86	10	0.12	176		PL
8/21/94		Quality Control			8.0								JY
11/13/94	3:00PM	Overcast, no rain in 24 hours	0.0	1.5	8.0	4.6	68	72	14	0.30	163		PL
1/17/94		Quality Control			7.7								JY
2/5/94	5:05PM	Overcast, no rain	1.0	1.5	7.5	4.6	62	62	13	0.30	135		PL
4/6/95										0.47	100		JY
5/9/95	9:35AM	Clear, sunny	12.0	5.0	7.5	6.8	41	42	12	0.78	59		PL
5/28/95		Quality Control						30		0.52	60		AY
7/25/95	6:40PM	Overcast	21.0	13.0	8.0	6.8	75	62	10	0.15	135		PL
8/14/95	9:45AM	Overcast		0.5	7.5	4.6	68	62		0.18	33		JY
2/26/96	10:15AM	Clear		-2.0	7.5	2.3	61	73		0.62	108		JY

Pedro Creek

Participant: Russ Younggreen

Notes: Testing began May, 1994. Samples taken near Russ Younggreen's house, below users intake

Date	Time	Weather	Air Temp °C	Water Temp °C	pH	Acidity mg/l	Alkalinity mg/l	Hardness mg/l	O ₂ mg/l	Turbidity NTU	Conductivity <small>µmhos/cm</small>	Initials
5/29/94	7:00PM	Drizzle			7.7					0.32	25	JY
5/5/94	12:00PM	Rain prev. day								0.15	27	TY
5/13/94	1:15PM	Rain	18		6.7					0.15	32	JY
5/13/94	10:45AM	Overcast, rain prev. day		6	6.8	9.1	21	34	11	0.2	34	RY
7/10/94	9:30AM	Sun, clear		11	7.8	4.6	27	34	9	0.07	53	RY
7/10/94		Quality Control			7.9		20					JY
5/13/94	8:30AM	Slight overcast	16	14.5	7.5	4.6	34	51	9	0.18	82	RY
11/11/94	8:05AM	Overcast, light snow	1	2.5	7.6	4.6	27	52	13	0.25	69	RY
11/11/94		Quality Control			6.8 cw 7.3 mtr			22				JY
2/2/95	9:00AM	Partly overcast	1.5	1.8	7	6.8	27	31	13	0.2	52	RY
4/6/95												
4/26/95	12:00PM	Overcast		4.8	6.8	6.8	27	31	11	0.3	38	TY
5/28/95										0.24	42	RY
5/30/95	5:30PM	Creek flow up, brown, sunny								1.9	18	TY
7/23/95	11:30AM	Sun, partial overcast	26	15	7.3	4.6	27	31	10	0.18	53	RY
11/14/95	9:30AM	Overcast		0	6.7	4.6	21	21		0.23	32	JY
2/26/96	10:10AM	Clear		-2	7	4.6	27	31		0.37	38	JY

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McFayden Creek

Resident: Barry Burgoon

Notes: Testing began May, 1994. Samples collected above user intakes at the weir.

Date	Time	Weather	Air Temp °C	Water Temp °C	pH	Acidity mg/l	Alkalinity mg/l	Hardness mg/l	O ₂ mg/l	Turbidity NTU	Conductivity μ mhos/cm	Initials
5/27/94	12:50PM	Partly Cloudy	13	7	4.5	30	27	34	12	0.11	52	JY
5/5/94	2:30PM	Heavy rain earlier, 24 hr		7						0.5	48	TY
6/24/94	11:30AM	Sunny, warm, thunderstorms previous day		10.5	5.5		34	103	11	0.22	59	BB
6/24/94		Quality Control				2.7		29				JY
6/28/94	4:00PM	Sunny, warm		13	6.8	3		33		0.13	71	BB
7/19/94	2:00PM	Hot, dry	22	13	8.3	4.6	41		10	0.11		BB
7/19/94		Quality Control			7.4	4.8		40				JY
8/27/94	12:00PM	Warm day	14	12	8.3	4.6	55	86	14	0.24	137	BB
11/27/94	11:00AM	Snow		0.5	4.5	4.6	55	83	3	0.3	130	BB
11/27/94		Quality Control			7							JY
3/7/95	12:00PM	Cloudy, cold	-0.5	0.5	7.3	4.6	48	83	11	0.23	107	BB
4/8/95		Quality Control						42		0.15	104	JY
5/8/95	2:00PM	Sunny, warm	13	8	4.5	4.6	27		8	0.28	47	BB
5/8/95		Quality Control						21				JY
8/17/95	3:00PM	Showers, cool	11	10.5	7.5	4.6	48		9	0.17	88	BB
9/29/95	5:00PM	Clear	4	11						0.28	102	JY
11/14/95	12:00PM	Cloudy		1	7.3	4.6	41	52		0.27	94	JY
2/27/96	12:30PM	Clear		-2	7.5	4.6	48	62		0.25	94	JY

Airy Creek

Resident Participant: Carl Schilling

Rain measurements taken from the Vallican Weather Station (John Fearing's Records).
 Suspended Sediment readings taken between May - August, 1995.
 Readings taken at the lower Airy Bridge.

Date	Time	Weather	Air Temp °C	Water Temp °C	Turbidity NTU	Conductivity mhos/cm	Suspended Sediment mg/l	Duplicate Sediment mg/l	Lower Airy Creek Bridge Gauge Readings
5/2/95	4:00PM	Rain 5.9mm	14		0.62	25	3.2		24
5/3/95	4:15PM	Rain 1.7mm			0.35	27	2.6		24.5
5/5/95		Rain 1.9mm		5	0.3	25	0.6		25
5/6/95		Rain 0.9 mm		5	1.7	22	13.6		27
5/7/95		Rain 7mm		5	1.2	22	7.4		28
5/8/95	4:20PM			5	0.54	22	2.8		28
5/10/95		Rain 8mm		4.5	2.9	19	18		31
5/11/95		Rain 6.6mm		4.5	1.3	18	4.2		31
5/12/95		Rain 2.6mm		5	0.54	22	3.2		29
5/15/95				4.5	6.3	15	46.8	49.2	36
5/17/95				4.5	3.2	13	22.2	17.0	37
5/18/95	4:00PM				1.1	14			
5/21/95				6	0.35	13	2		34
5/27/95		Airy Bridge			0.43	13	1.8		
5/29/95				5.5	6.4	11	57.0	62.4	40
6/1/95				8	1.9	11	4.6	7.0	39
6/2/95	1:16PM	Rain 5.9mm		7	0.73	11	3.2		41
6/4/95					1.1	11	6		41
6/5/95		Rain all day		6	1.3	10	6	7.2	42.5
6/8/95	4:00PM			5	0.5	14	1.2		32
6/12/95	1:45PM	Rain .5mm		9			0.4		31
6/14/95		Rain 2.2mm		7	0.26	11	0.6		30

Alry Creek

Resident Participant: Carl Schilling

Turbidity, Conductivity, and Suspended Sediment Values Taken During the Time Period
May - August 1995

Date	Time	Weather	Air Temp °C	Water Temp °C	Turbidity NTU	Conductivity mhos/cm	Suspended Sediment mg/l	Duplicate Susp. Sediment mg/l		Lower Edge Gauge Reading
6/16/95		Rain 7mm		9.4	0.64	11	4.6	7.0		34
6/17/95	8:30PM	Rain 5.2mm		7	0.47	11	1.0			35
6/22/95		Rain 2.8mm		9.5	0.72	11	3.4			33
6/23/95				11	0.46	10	0.6			33
7/7/95	8:50 AM	Rain 1mm		11.5	0.4	12	1.4	1.6		30
7/10/95		Rain 5.1mm		12.5	0.22	12	0.2			25
7/25/95	3:00PM			14	0.17	19	0.6			
7/26/95		Rain 8.8mm		14	0.28	66	1.8			21
8/6/95	12:55PM	Steady rain		12	0.34	16	1.2			22
8/7/95	10:30AM	Rain all night		11	0.46	17	1.4	2.0		25
8/11/95	4:00PM	Rain 3.8		12	0.28	17	1.2			
8/30/95					0.42	21	110.2			
9/22/95	5:30PM			8.5	0.18	30	0.2			13
9/27/95	5:00PM			9	0.32	31				13.5
11/4/95	1:30PM	Cloud		0	0.22	7.4				
2/26/96	2:30PM	Cloud Cover		-2	0.34	30				

Average Values for Creeks

Average	Values		For	Slocan		Valley	Creeks
	1994	1995		to	1995		
	Average Conductivity µmhos/cm	AV pH	AV Acidity in mg/l	Average Alkalinity in mg/l	Average Hardness in mg/l CaCO3		
Argyle Spring	644	7.7	13.2	317	348		
Arthur	476	7.8	11	198	240		
Bonanza	166	7.9	3.3	65.8	72.4		
Harris	278	8.1	5.7	121	137		
Hasty	108	7.9	3.3	49.6	52.6		
Vevey	130	8.1	3.3	49.2	58.1		
Lemon	84	7.6	5.1	49.3	56.1		
Anderson	228	7.7	8.4	132	118		
Elliott	201	7.9	20.3	114	196		
Christian	191	8	10.4	95.9	114		
Nixon	93	7.6	6.9	61.7	56.5		
Jerome	160	7.4	19.4	88.2	118		
Winlaw	103	7.7	5.6	58.1	60		
Pedro	41	7.2	5.6	26.1	33.9		
McFayden	86	6.7	4.3	42.4	63.6		
Airy	27	6.9	4.1	15.3	18.2		
Slocan River	82	7.4	3.8	49.4	58.3		

APPENDIX 1

Vevey Temperature Values

Vevey Creek

Resident Participant: Paul Gibbons

Notes:

Temperature Values recorded at Hydro Installation.
Readings began July, 1994

Date	Time	Air Temp	Water Temp
		°C	°C
7/24	9:45AM	24	12
8/29	10:10 AM	15	10
9/17	8:45AM	8	9
9/20	8:45AM	9	9
9/23	9:02AM	6	8
10/3	9:05AM	6	8
10/8	9:45AM	3	5
10/14	9:30AM	6	7
11/2	8:00 AM	1	4
11/5	8:30 AM	-1	3
11/7	9:00 AM	0	3
11/9	9:30 AM	0	3
11/11	8:35 AM	1	3
11/12	10:00 AM	1	3
11/14	10:00 AM	0	3
11/17	9:20 AM	0	3
11/19	9:15 AM	-2	2
11/20	9:15 AM	-7	1
11/21	9:30 AM	-10	0
11/23	9:30 AM	-1	1
11/25	10:00 AM	0	2
11/27	9:15 AM	-3	1
11/28	9:15 AM	-3	2
11/29	10:00AM Snow	-2	1
11/30	9:20AM Overcast,	3	2
12/1	9:40AM Sun/Cloud	0	2
12/3	9:40AM Sun/cloud	-5	0
12/4	9:45AM Sun/cloud	-12	0
12/5	10:30AM Snow	-10	0
12/8	9:35AM Snow	-5	1
12/9	9:30AM Cloud	-2	1
12/10	10:00AM Snow	-5	1
12/11	10:45AM Sun/cloud	-2	1
12/13	9:30AM Snow	-1	2
12/15	10:15AM Snow	-1	2
12/17	10:45AM Rain	1	2
12/23	9:45AM Fog	2	3
12/29	10:30AM Sun	-5	1
12/31	11:35AM Snow	-8	0
1/1	12:00PM Snow	-8	0

Vevey Temperature Values

Date	Time	Air Temp	Water Temp
1/2	11:30AM Snow/sun	-9	0
1/5	10:00AM Snow/sun	-9	0
1/8	10:00AM Snow	-7	0
1/12	9:45AM Fog	1	2
2/13	9:30AM Sun	-16	-1
2/14	10:00AM Sun	-16	-1
2/15	10:30AM Snow	-4	0
2/22	10:55AM Sun	2	2
2/23	9:35AM Sun/cloud	0	2
2/24	9:05AM Cloud	0	2
2/25	9:30AM Sun/cloud	2	2
2/26	9:20AM Sun	0	1
4/9	2:45PM Cloud	10	5
4/11	9:15AM Sun/cloud	4	3
4/12	9:50AM Sun/cloud	3	2
4/13	9:30AM Rain	2	2
4/14	9:30AM Sleet	2	2
4/15	9:45AM Sun/cloud	1	3
4/16	9:30AM Sun	0	2
4/17	9:20AM Sun	2	2
4/18	9:15AM Sun	4	3
4/20	9:35AM Cloud	3	3
4/22	9:20AM Sun	3	3
4/23	9:30AM Sun	5	3
4/24	9:00AM Sun/cloud	4	4
4/25	8:35AM Fog	3	3
4/26	8:11Am Cloud	5	4
4/27	8:30AM Sun	5	4
5/1	7:40AM Sun	2	3
5/4	9:15AM Sun/cloud	6	5
5/5	9:40AM Overcast	5	5
5/6	10:10AM Overcast	9	6
5/9	9:00AM Sun	9	5
5/10	8:00Am Showers	8	5
5/11	9:15AM Rain	8	6
5/12	9:15AM Rain	8	6
5/13	9:10AM Sun	7	5
5/14	9:00AM Sun	7	5
5/15	9:05AM Sun	11	7
5/16	9:15AM Sun	12	7
5/17	9:55AM Sun	10	7
5/18	10:00AM Sun	13	7
5/19	9:30AM Sun	10	5
5/20	10:15AM Sun	11	6
5/23	9:40AM Sun	10	6
5/24	8:30AM Sun	10	6
5/25	8:50AM Cloud	10	5
5/26	10:10AM Sun	5	5
5/29	8:50AM Sun	10	5
5/30	9:40AM Sun	16	7
6/4	8:00AM Sun/cloud	11	7

Vevey Temperature Values

Date	Time	Air temp	Water Temp
6/5	10:50AM Cls/shwrs	10	8
6/6	8:00AM Rain	8	7
6/7	9:15AM Sun	9	7
6/8	8:00AM Sun	8	6
6/9	9:00AM Sun	11	7
6/10	2:55PM Sun	22	9

Christian Creek

Linda Mandala

Notes:

Temperature readings begin May, 1994

Date	Weather	Time	Air Temperature
		MORNING TEMPS ONLY (AM)	Degrees C
6/28		9:30AM	
7/10		9:30AM	
7/14		7:30AM	
7/17	Sunny, hot	11:00AM	25
7/18	Rain last night, mixed/clouds/warm	10:30AM	22
7/22	Hot, sunny	8:00AM	16
7/26	Hot	9:00AM	21
8/3	Hot	8:00AM	17
8/7	Cloudy and sunny but cooler	8:00AM	12
8/9	Sunny but cool, rain yesterday PM	8:00AM	13
8/10		9:00AM	12
9/23		7:46AM	8
9/24		7:45AM	8
9/25		8:30AM	9
9/26		7:00AM	9
9/27		7:45AM	10
9/28		8:00AM	14
10/6		8:00AM	10
10/7		7:00AM	5
10/8		7:00AM	3
10/16		8:00AM	6
11/17	Partly cloudy, wet snow	9:00AM	1
12/5	Cold	9:00AM	-10
12/11	Melting slightly	10:00AM	0
1/30	Warm/wet	10:00AM	2
2/13		8:30AM	-13
2/16		9:00AM	-3
2/17		10:00AM	2
2/25		9:00AM	0
3/12		8:00AM	3
3/22		8:00AM	5
3/24		8:00AM	2
3/25		10:00AM	3
4/4		7:30AM	2
4/6		7:00AM	4
4/7		6:30AM	2

Christian Temperatures (Morning)

Date	Weather	Time	Air Temperature
		MORNING TEMPS ONLY (AM)	Degrees C
4/10		7:00AM	0
4/12		8:00AM	1.5
4/14		9:00AM	2
4/16		9:00AM	1
4/18		8:00AM	5
4/20		6:30AM	1
5/3		7:15AM	7
6/12	Partly cloudy	8:30AM	15
6/14	Cloudy	9:00AM	13
6/18	Partly Cloudy	8:00AM	12
7/4	Cloud/sun/rain	10:00AM	18
7/5	"	10:00AM	18
7/31	Sun	10:00AM	17
8/2		9:00AM	17
8/4		9:00AM	17
9/1		9:00AM	17
9/5		8:30AM	18
9/7		8:30AM	18
9/9		7:30AM	18
9/9		7:00AM	17
9/14		7:00am	18
9/16		7:00am	8
9/23		8:30AM	12
9/28		10:00AM	10
9/29		8:00AM	11
10/11		11:00AM	8
10/12		8:30AM	7
10/13		8:30AM	7
10/15		9:00AM	7
10/17		9:00AM	7
11/2		10:00AM	-4
11/3		9:00AM	-4
11/17		10:00AM	2
11/20		11:00AM	2

Christian Creek

Linda Mandala

Notes:

Temperature readings begin May,
1994

Date	Weather	Time	Air Temperature	Water
		AFTERNOONS TEMPS ONLY (PM)	Degrees C	Temperature Degrees C
6/20		1:30PM		9
7/1		1:30PM		9
7/12		1:30PM		9
7/13		5:00PM		9.5
7/16	Sunny, hot	6:00PM	24	10
7/17	Sunny, hot	6:30PM	23	10
7/18		6:30PM	22	9.5
7/22	Hot	8:00PM	22	11
7/26	Hot	6:30PM	20	11
8/4	Hot, thunderstrms, rain last night	7:30PM	20	11
9/24		6:00PM		10
9/26		6:30PM	14	10
10/7		7:00PM	10	8
10/12		6:00PM	8	8
10/22		4:30PM	6	6
10/25		5:00PM	6	7
12/3	Cold/clear	3:30PM	-3	3
12/15	Cloudy, snowy	4:30PM	-15	3
1/4	Cold, partly cloudy	3:00PM	-7	2
2/2	Sunny	3:00PM	5	5
2/6	Warm/partly sunny	2:30PM	5	5
2/7	Sunny	12:00PM	5	5
2/12		2:00PM	-2	2
2/15		1:00PM	-3	2
2/18		12:00PM	3	4
2/19		3:00PM	3	4
2/27		4:00PM	0	3
3/1		3:30PM	-1	3
3/3		2:30PM	5	3
3/9		4:30PM	2	4
3/11		12:00PM	5	5
3/17		12:00PM	6	5
3/29		4:00PM	13	5
4/1		12:00PM	5	5
4/11		2:00PM	11	4.5
5/1		7:30PM	10	6
5/4		6:30PM	15	7
5/5		6:30PM	2	8

Christian.xls Temp data (afternoon)

Date	Weather	Time	Air Temperature Degrees C	Water Temperature Degrees C
		AFTERNOON TEMPS ONLY (PM)		
5/6		6:00PM	12	6
6/6	Rainy, cool	1:30PM	13	8
6/22	Clouds/sun/rain/mixed	8:00PM	17	9
7/6	Sun	8:30PM	22	10
7/8	Sun	1:30PM	22	10
7/12	Sun	1:30PM	22	10
9/10		7:30PM	22	10
9/12		6:30PM	22	10
9/13		6:30PM	21	9.5
9/17		4:00PM	17	9
9/18		4:00PM	15	8
9/22		5:00PM	9	10
9/25		5:00PM	8	8
9/26		4:00PM	9	10
9/27		3:00PM	9	10
10/2		7:30PM	5	7
10/4		1:30PM	13	8
10/5		6:00PM	13	8
10/9		3:00PM	12	8
10/18		5:00PM	6	6
10/19		6:00PM	6	6
10/27		5:00PM	6	6
10/29		5:00PM	4	5
10/30		2:00PM	4	5
10/31		4:00PM	4	5
11/5		12:00PM	2	5
11/7		12:00PM	2	5
11/10		1:00PM	3	4

Christian.xls Temp data (afternoon)

Date	Weather	Time	Air Temperature Degrees C	Water Temperature Degrees C
		AFTERNOON TEMPS ONLY (PM)		
5/6		6:00PM	12	6
6/6	Rainy, cool	1:30PM	13	8
6/22	Clouds/sun/rain/mixed	8:00PM	17	9
7/6	Sun	8:30PM	22	10
7/8	Sun	1:30PM	22	10
7/12	Sun	1:30PM	22	10
9/10		7:30PM	22	10
9/12		6:30PM	22	10
9/13		6:30PM	21	9.5
9/17		4:00PM	17	9
9/18		4:00PM	15	8
9/22		5:00PM	9	10
9/25		5:00PM	8	8
9/26		4:00PM	9	10
9/27		3:00PM	9	10
10/2		7:30PM	5	7
10/4		1:30PM	13	8
10/5		6:00PM	13	8
10/9		3:00PM	12	8
10/18		5:00PM	6	6
10/19		6:00PM	6	6
10/27		5:00PM	6	6
10/29		5:00PM	4	5
10/30		2:00PM	4	5
10/31		4:00PM	4	5
11/5		12:00PM	2	5
11/7		12:00PM	2	5
11/10		1:00PM	3	4

Winlaw Air, Water Temps.

Resident Participant Peter & Leslie Vogelgar

Winlaw Creek Air and Water Temperatures, 1994 - 1995

Morning 8 - 11 AM
 Mid-day 11 - 2 PM
 Afternoon 2 - 6 PM
 Evening 6 PM - 12 AM

Date	Weather	Air Temp.		Water Temp.		Air Temp.		Water Temp.	
		Morning	Mid day	Mid day	Mid day	Afternoon	Evening	Afternoon	Evening
9/19/94	Clear, sunny bas; few days, above nrm temp					25	11		
9/20/94	Still clear, sunny		21.5	10		26	11.5		
9/21/94	Still clear all night and day, beautiful day!	18	9			24	10		
9/22/94	Clear all day	8	7.5	19	10	19	10		
9/23/94	"	7.5	8						
9/25/94	"	9	8	21	9.5				
9/26/94	"					22.5	11		
9/27/94	Dark in afternoon					25	10	16	
9/28/94	Some cloud					19	9	10	
9/29/94	"							23	
9/30/94	Still clear, some mixed cloud	20	9.5						10.5
10/1/94	Overcast and raining	12	10						
10/3/94	Crilly night, no frost, clear sunny	10	6.5						
10/4/94	Clear night, some frost	1	5	9	6				
10/5/94	"	5	5						
10/6/94	Clear, sunny again					7	15		
10/8/94	"					12.5	7		
10/10/94	Some cloud, warm night					17	7.5		
10/11/94	"					13	8		
10/12/94	Warm, some overcast, some sunny spells	8	7			19	8		
10/15/94	Rain, cool nights					6.5	6.5		
10/16/94	Clear day					12.5	6.5		
10/17/94	Cloudy					9	6		
10/19/94	"					6.5	5.5		
10/20/94	Low cloud, may be showers		6			7	6.5		
10/21/94	Quite a bit of rain last night					16	6		
10/22/94	Cloudy					7.5	5		
10/24/94	Mild night, some rain					10	6		

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
10/25/94 Light frost, overcast	1.5		4					
10/26/94 Low cloud, raining					9.5	6		6
10/27/94 Water level up, good rain								
10/28/94	3		5					
10/29/94 Clear and sunny				6	9.5			
10/30/94								
10/31/94 2" fresh snow, overcast					0	2		
11/2/94 Snow melting, overcast					0.5	2.5		
11/3/94 Chilly, overcast	-0.5		1	-1.5	1	1.5		
11/4/94 4" snow still falling	-1		0					
11/7/94 2" more snow, overcast				0	1			
11/9/94			2		2			
11/10/94 Some snow last night				0	1.5			
11/12/94						0		1.5
11/13/94 Melting today								
11/14/94 More snow falling	0		1			1		2
11/15/94 Raining, snow above						0		1
11/16/94 Heavy snow						-1		1
11/17/94 fresh snow, mild - clear day	1		1.5			-2		1
11/18/94 Afternoon - some cloud						-5.5		-0.5
11/21/94 - 12 degrees C last night, lots of ice on creek						-4		-0.5
11/22/94				0	-0.5			
11/23/94 High cloud						-0.5		-0.5
11/24/94 Grey - thick ice						-1		0
11/27/94 More new snow				-1	0			
11/28/94 mild, some sun				-1	-0.5			
11/29/94 Cool night, 3" new snow				4	0			
11/30/94 Warm wind - lots of melt								
12/1/94 Water level highest since start, 4" over stepping	0		1					
12/6/94 Very cold over weekend, lots of ice	-8		-0.5					
12/7/94 Small hole						-6		-0.5
12/8/94 Snowing						-4		-0.5
12/9/94 Overcast, some sun, 5" snow last night	-3.5		-0.5	-5.5	-0.5			
12/10/94								
12/11/94						-2		-0.5
12/13/94						-2		0
12/14/94 Pond open again/overcast						-2		0

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
12/18/94					0	0		
12/19/94					1	1		
12/20/94					1	1		
12/27/94			1	2				
12/29/94					0	2		
12/24/94					-1.5	2		
12/29/94					-3	2		
1/3/95					-12	0		
1/4/95					-14	0		
1/6/95					-10	0		
1/9/95					0	1		
1/12/95					0	1		
1/14/95					0	1		
1/16/95					0	1		
1/17/95					0	1		
1/19/95					2	1		
1/20/95					-3	1		
1/22/95			-5	0				
1/23/95					-6	0		
1/24/95					-5	0		
1/31/95					-3	0		
2/1/95					6	1		
2/6/95					5	1		
2/7/95			11	1				
2/10/95			3	0				
2/12/95					-4	0		
2/17/95					2	0		
2/21/95			10	2				
2/24/95					2	2.5		
2/25/95						3		
2/26/95						2		
2/27/95					2.5	1		
2/28/95			-1.5	0				
3/1/95	-4.5	-0.5						
3/2/95					-1.5	0		
3/3/95			3	0				
3/7/95	-3	0						

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
3/1/95								
3/14/95					7.5		4	
3/16/95	0	3						3.5
3/17/95								
3/18/95			3.5	3.5			3.5	
3/19/95								
3/20/95								
3/21/95								
3/22/95			3	3				
3/23/95			5	4				
3/25/95			7.5	3				
3/26/95			6	3				
3/27/95					13.5		3	
3/28/95					15		3	
3/29/95					14.5		3	
3/30/95					14.5		4	
4/2/95					10		4	
4/3/95					15		4	
4/4/95			6.5	4				
4/5/95			10	4				
4/6/95			12	4				
4/7/95			5.5	4				
4/8/95					7.5		4	
4/9/95			10	4				
4/11/95			10	4.5				
4/12/95			9	3				
4/13/95			9	4				
4/14/95	5	3						
4/15/95			6	3				
4/17/95			13.5	4				
4/18/95					14		4.5	
4/20/95	2	3						
4/21/95					13.5		5	
4/24/95			9	5				
4/25/95			11	5				
4/26/95					16		5	
5/10/95	11	5						

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
5/1/95 Rainy, 0"	11.5		5		10.5	5.5		
5/2/95 Mixed, 0"								
5/3/95 Sunny, 0"					19	6		
5/4/95 Sunny					23	6.5		
5/5/95 "					24	6.5		
5/6/95 "+1"					23.5	6.5		
5/7/95 Sunny, -2"					23	6		
5/8/95 "					20.5	6		
5/22/95 -4"			20	6				
5/24/95 Sunny -4", -3"					22.5	6.5	17.5	7
5/25/95 Mixed, -4"							17	6
5/26/95 Sunny, -4"	15		5					
5/28/95 Sunny, HOT, -2"								
5/29/95 " -1"					31.5	8	30.5	7.5
5/30/95 " C			30	7.5				
5/31/95 " +1"					29	8		
6/1/95 " 0"					29.5	8		
6/2/95 Light rain, overcast, 0"					14.5	7		
6/3/95 Mixed, -1", Sunny, -2"	16.5		7				22	8
6/4/95 Sunny, -2"							18	8
6/5/95 Overcast, some rain, -1"	14		7					
6/6/95 Overcast, lots of rain -2"			10	6.5				
6/7/95 Clear, sunny -4"			21	7				
6/8/95 " -5"	15		8					
6/9/95 " -6"					23	8		
6/10/95 Clear AM/some cloud, -8"					24	8		
6/11/95 Rain overnight, sunny afternoon					19	8.5		
6/12/95 Sunny with few clouds, -9"					21.5	8		
6/13/95 Cloudy, -9"					19	8		
6/15/95 Rain/sunny -10"					23.5	8.5		
6/16/95 Alternate sun and cloud -11"					20	9.5		
6/18/95 Cool, cloudy day step					14.5	9		
19-Jun Alternate sun, cloud step					14	9		
6/20/95 Cloudy, cool step	14.5	8.5						
6/21/95 Cloudy, humid step			19	9				
6/22/95 Overcast, some rain, step			17.5	9.5				
6/23/95 Sunny, step					19	10.5		

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
6/24/95 Sunny					29	11		
6/25/95 Sunny							27.5	11
6/27/95 Sunny	10.5	9						
6/28/95 Sunny							21	10
6/30/95 Sunny					25.5	11.5	18	9.5
7/1/95 Hot day/cool evening							23	11.5
7/2/95 Overcast	16	10.5						
7/4/95 Mixed			22	11				
7/5/95 Sunny, some cloud,					23	11.5		
7/6/95 Sunny,					28	12		
7/7/95 Cloudy,					25	12		
7/8/95 Cloudy,					25	12.5		
7/10/95 Mixed day,			24.5	12			15.5	12
7/11/95 Sunny			20.5	10.5			17.5	11.5
7/12/95 Sunny,			24	12				
7/13/95 "			25	12.5				
7/14/95 Clear day					28	13		
7/15/95 Clear day					31	13		
7/16/95 Clear day					31	13		
7/17/95 "					31.5	13.5		
7/18/95 Clear day					33.5	14		
7/19/95 Clear day					24	13.5		
7/20/95 Some overcast								
7/21/95 Light rain			18	12				
7/22/95 Intermittent cloud			26	13.5				
7/24/95 "					25	13		
7/25/95 "	16	12						
7/26/95 Rain, cloudy					22	13		
7/27/95 Sunny					24.5	13		
7/29/95 Mixed,					21	12.5		
7/31/95 Mixed,					23	13		
8/2/95 Overcast,					24.5	13		
8/4/95 Clear and sunny					33	14		
8/5/95 Sunny am/ cloudy pm					24	14		
8/6/95 Raining			13.5	12				
8/7/95 Still grey and rainy					11	11.5		
8/8/95 Cloudy but warm					16	11.5		

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
8/9/95 Clear, etc hot					28	13		
8/10/95 Cloudy but warm			20.5	11				
8/11/95 Mixed, Windy					22	12		
8/12/95 Rainy, chilly					12	11		
8/13/95 Cloudy, sunny breaks					22	12		
8/14/95 Cloudy, showers					15	11		
8/15/95 Thunder showers					14	10.5		
8/16/95 Mixed, no rain					20	11.5		
8/19/95 Clear, some clouds			19	10				
8/20/95 Clear			16.5	10				
8/21/95 Clear			25	11				
8/22/95 Clear			27	11				
8/23/95 Clear					26.5	11		
8/24/95 Clear			21	10.5				
8/25/95 Clear					22.5	11		
8/26/95 Clear			18	9.5				
8/27/95					22	12		
8/28/95 Clear	14.5		9				17	11.5
8/30/95 Clear (rain yesterday)			21	11				
8/31/95 Clear					24	11		
9/2/95 Sunny, nights cool					25	10		
3-Sep "								
9/5/95 Mixed,					18	12		
9/6/95 Mixed,					24	12		
7-Sep Overcast,	9.5		10					
9/8/95 Clear, -11.5, similar weather, unable to record					25.5	12		
9/15/95 Clear,					26.5	12		
9/16/95 Clear	13		10					
9/18/95 Clear, hot days					24	11		
9/20/95 "					19.5	9		
9/21/95 Clear,			9.5	7				
9/22/95 Semi - covered					18	8		
9/23/95 Clear, 12.25	6		8		20	9		
9/25/95 Light cloud			19.5	8				
9/26/95 Light rain	11							
9/27/95 Light rain	10							
9/28/95 Periodic showers					13.5	9		

Winlaw Air, Water Temps.

	AIR morning	WATER morning	AIR mid-day	WATER mid-day	AIR afternoon	WATER afternoon	AIR evening	WATER evening
9/29/95 Partially cloudy. Sat. 30th - rain: Sun, 31st - clear.			17.5	9.5				
2-Oct: Cloudy	4.5	6						
10/3/95 Cloud, some warm rain	7.5	7						
4-Oct: Clear	4	6			13.5	7		
10/5/95 Clear - light cloud	9	7						
10/6/95 Cloudy bright			9.5	6.5				
10/8/95						8	7.5	
10/11/95 Sunny						9.5	7.5	
10/12/95 Mixcd cloud					9	7		
10/13/95 Clear					6	6		
10/16/95 Mixcd rain								
10/17/95 Rain	5	5.2			9	6		
10/18/95 Rain last night - clearing -4.5, 2:00PM, clear -	-1	3						
10/19/95 Clear			6	4.5				
21-Oct: Overcast					7.5	4		
10/22/95 Clear (first evening)					8	5		
10/24/95 Overcast, some sun			4.5	4.5				
10/25/95 1:00PM, Overcast, light rain					5	5		
10/26/95 Clear day	0	3						
10/27/95 Good frost					3	3		
10/28/95 Good frost - clear day.	-6	-0.5						
11/1/95 Clear			1.5	0				
11/2/95 Clear	-1.5	0						
11/4/95 Snowing					-0.5	0		
11/7/95 Snowing			-0.5	1				
11/8/95 Raining			0.5	1.5				
11/9/95 Clear	-7	-1						
11/10/95 Clear	0	1						
11/13/95 Snowing					1.5	2		
11/15/95 Cloudy						1	2	
11/16/95 Cloudy, melting +3 at noon	1.5	2						
11/17/95 low cloud, light rain	6	3						
11/18/95 Part cloud - lots of rain last night					1	2		
11/19/95 Clear, sunny.					-0.5	1.5		
11/21/95 High overcast								

Pedro Creek

Resident Participant: Russ Youngreen

Notes: Air and Water Temperatures taken below the bridge at Russ Youngreen's house. Readings were taken from June, 1994 - November, 1995

Date	Time		Air Temp.	Water Temp
6/16/94	10:45 AM			6.0
6/22	12:00PM		24.5	11.5
6/22	6:30PM		22.5	12.0
6/24	12:00PM		24.0	11.5
6/24	6:00PM		20.0	12.0
6/26	8:45AM		15.0	10.0
6/30	9:00AM		14.5	10.5
7/2	4:20PM		14.0	10.5
7/6	9:30AM		15.0	10.5
7/6	5:30PM		22.0	12.0
7/9	9:30AM		16.0	12.0
7/9	6:30PM		22.0	13.0
7/10	9:30AM	Clear	15.0	11.0
7/10	12:00PM		25.0	11.0
7/11	12:00AM		25.0	11.0
7/11	6:00PM		22.0	13.0
7/12	10:00AM		19.0	11.5
7/17	9:30AM		18.5	13.0
7/17	5:30PM		23.0	14.5
7/19	8:55AM		15.0	13.0
7/20	8:30AM		15.5	13.0
7/20	6:00PM	Intense sun	27.5	15.0
7/24	8:45AM		20.0	15.5
7/24	5:30PM	Creek lower	28.5	17.5
7/27	8:30AM		15.5	15.0
7/28	8:30AM		15.0	14.0
7/28	6:00PM		26.0	16.3
7/30	9:00AM		17.0	14.5
7/31	8:30AM		16.0	14.0
8/4	8:30AM	Rain previous PM	19.0	16.0
8/16	8:30AM	Slight overcast, sun, haze	16.0	14.5
9/6	9:00AM	Sun/cloud	10.0	11.0
9/6	5:30PM	Partly overcast	19.0	
11/11	8:05AM	Creek level up mixed snow/rain	1.0	2.5
2/2/95	9:00AM		1.5	2.0
4/22	5:00PM		4.5	11.0
4/26	9:00AM	Clear, sun	5.5	3.4
4/26	12:00PM	Overcast	12.0	5.0

11/11	8:05AM	Creek level up mixed snow/rain	1.0	2.5
2/2	9:00AM		1.5	2.0
4/22	5:00PM		4.5	11.0
4/26	9:00AM	Clear, sun	5.5	3.4
4/26	12:00PM	Overcast	12.0	5.0
5/15	5:00PM	Sun/turbid creek at high point	16.0	5.0
5/28	1:00PM	Sun	16.0	4.5
5/30	5:30PM		19.0	7.0
6/2	10:00AM		11.5	6.5
6/2	6:00PM		11.5	7.0
6/8	9:00AM		10.5	6.0
6/9	9:00AM	Sun with cloud	12.0	7.0
7/17	6:00PM		26.0	14.5
7/23	11:30PM	sun, partial overcast	26.0	15.0
11/14	9:30 AM	overcast		0.0

DATA SHEET FLOW MEASUREMENT

Name: Alysha + Jennifer Group: S.V. W.A. Date: June 9/95

Time: 10:30 AM Stream Name: Arroyo at lower bridge

Site: lower bridge Site Location: Latitude: gauge reading = 31"

Longitude: _____

Weather: Sunny

Air Temperature: _____ Water Temperature: 7.0°C

Reach Length in Meters: 49.2

Velocity in Seconds:

1	23.22	6	23.13
2	22.79	7	
3	25.16	8	
4	28.60	9	
5	29.95	10	

REACH = $\frac{49.2 \text{ meters}}{25.47 \text{ SECS}} = 1.93 \text{ m/sec.}$

Corrected Velocity: 1.93

m/sec. x 0.3 correction factor FOR ROUGH BOTTOM STREAM

Cross Sectional Area at one ft. intervals:

1	.1312	11	2.297	21	1.143	31	
2	.426	12	1.968	22	0.984	32	
3	.623	13	2.297	23	0.820	33	
4	.230	14	2.952	24	0.984	34	
5	2.297	15	2.297	25	1.312	35	
6	1.640	16	2.952	26	1.640	36	
7	1.312	17	2.852	27	0.984	37	
8	1.968	18	2.952	29	0.229	38	
9	2.788	19	1.968	29	0.492	39	
10	2.297	20	1.312	30		40	

Sum 46.252 ft
x 0.0929

Flow = Av Corrected Vel. x Cross Sect. Area

1.54

4.296

4.296 sq.m

6.633 cubic meters/sec

DATA SHEET FLOW MEASUREMENT

Name: *Jennifer yow* Group: *SOWA* Date: *July 25/95*
Joan yow
 Time: *12:00 pm* Stream Name: *AIRY at lower bridge*
 Site: *lower bridge* Site Location: Latitude: _____
 Longitude: _____
 Weather: *Sunny* gauge reading = *18"*
 Air Temperature: _____ Water Temperature: _____

Reach Length in Meters: *49.2*

Velocity in Seconds:

1	<i>53.48</i>	6
2	<i>51.80</i>	7
3	<i>57.98</i>	8
4	<i>51.62</i>	9
5	<i>56.74</i>	10

$$\frac{49.2}{54.324} = .906 \text{ m/sec}$$

Corrected Velocity: *.906* m/sec. (x 0.8 correction) =Cross Sectional Area ^(in ft) at one ft. intervals: *.7248*

1	<i>.328</i>	11	<i>1.476</i>	21	<i>0</i>	31
2	<i>.393</i>	12	<i>1.542</i>	22	<i>.984</i>	32
3	<i>.164</i>	13	<i>1.476</i>	23	<i>1.378</i>	33
4	<i>.524</i>	14	<i>1.476</i>	24	<i>.984</i>	34
5	<i>.721</i>	15	<i>1.181</i>	25	<i>1.246</i>	35
6	<i>.820</i>	16	<i>1.246</i>	26	<i>.689</i>	36
7	<i>1.181</i>	17	<i>1.312</i>	27	<i>.492</i>	37
8	<i>.984</i>	18	<i>1.509</i>	28	<i>.426</i>	38
9	<i>1.148</i>	19	<i>1.017</i>	29	<i>.328</i>	39
10	<i>1.312</i>	20	<i>.394</i>	30	<i>.131</i>	40

Sum *26.862*

x 0.0929

Flow Av Corrected Vel. x Cross Sect. Area

*.7248**2.495**2.495* sq.m*1.808* cubic meters/sec.

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