CANADA-NEWFOUNDLAND
AGREEMENT RESPECTING
WATER RESOURCE MANAGEMENT

**TECHNICAL APPENDICES**

# FLOOD RISK MAPPING STUDY

# OF

# STEPHENVILLE, KIPPENS, AND COLD BROOK

**Prepared For: -**

**Government of Newfoundland and Labrador**
**Department of Environment**
**Water Resources Division**

**Prepared By: -**

**Sheppard Green Engineering and Associates Limited**

**In Association With: -**

**Cumming Cockburn Limited**

**May, 1996**

GOVERNMENT OF
NEWFOUNDLAND
AND LABRADOR

**Department of**
**Environment**

Environment Canada
Environnement Canada

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PROVINCE OF NEWFOUNDLAND
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CLASS "A"
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Kirk N. Peddle
SIGNATURE
May 27/96
DATE
NEWFOUNDLAND & LABRADOR

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# Appendix A

# Historical Flooding in the Stephenville Area

Source Reference (25)

# APPENDIX A
# HISTORICAL FLOODING IN THE STEPHENVILLE AREA

FLOOD OF SEPTEMBER 1 - 2, 1948

Cause: Heavy rains from tropical storm

Description:

All regions of the province felt the force of the tropical storm. Railway schedules were interrupted as a result of minor washouts along the rail line.

At Stephenville (Earnest Harmon Air Force Base), rain driven by maximum winds of 90 m.p.h. (144.8 km/hr) blanketed the area with lakes of water forcing everyone under shelter. Road damage was extensive in the Port au Port Peninsula area.

In St. John's, a gulley near the West End Fire Hall was choked with debris and water overflowed onto LeMarchant Road and flooded the fire hall basement.

Magnitude:

A 3.25 inch (82.6 mm) rainfall was recorded at Corner Brook on September 1st, with 2.41 inches (61.2 mm) falling at Deer Lake and 2.07 inches (52.6 mm) at Gander. At St. John's Torbay Airport, a rainfall of 1.89 inches (48.0 mm) was recorded.

Damages: Damage to local roads in the Port au Port area was estimated at $1,500.

FLOOD OF MAY 19-21, 1969

Cause: Heavy rainfall, snowmelt

Description:

The C.N.R. reported flood damages to their tracks at Harry's River, Black Duck and Codroy Pond in southwestern Newfoundland, disrupting rail service. Highway traffic was also disrupted by washouts. Traffic was re-routed to Stephenville Crossing through Carter's Road near St. George's.

In Stephenville, high flows were experienced on Warm Creek and Blanche Brook. Ice was apparently not a large factor in the flooding which occurred.

On Blanche Brook, the residential area upstream of Main Street was flooded as the banks were overtopped at bends in the river located near Mill Place and Maxwell Avenue. Flood waters flowed through local depressions approximately parallel to the river, flooding several basements and other property.

Most of the flood waters returned to the brook just above the Main Street Bridge, but Main Street was also overtopped near the present federal building allowing some of the overbank flow to rejoin Blanche Brook, several hundred feet below the bridge.

A backup of water at the Mississippi Drive bridge on Warm Creek caused erosion of the footing and overtopping of the roadway. Overbank flow occurred west of the bridge between the church and overpass embankment, then under the overpass to the area below the Carolina Avenue Bridge.

Near the confluence of Warm Creek and Blanche Brook, flood waters covered the field near the curling rink and the brewery. Another area flooded was on the airport side of Blanche Brook above the present St. Stephen's Recreation Centre Bridge, but no damage was reported at this location.

Magnitude:

A rainfall of 1.31 inches (33.3 mm) was recorded at Stephenville Airport on the 20th.

Damages:

No estimates of resultant damage were available. However, various municipal agencies assisted in flood relief, and the town provided fill at no cost to residents who sustained erosion damage.

FLOOD OF MAY 15-18, 1972

Cause: Spring runoff accompanied by rainfall

Description:

On the Port au Port Peninsula, flooding cut road connections, isolating several communities.

Near Lourdes, a 55-foot (17 metres) gap occurred in the highway when the water had risen six feet. The road between Point au Mal and Port au Port East was also washed out by the overflow from a culvert incapable of handling the amount of water which had been collecting.

A 75-foot (23 metre) section of highway was washed out between West Bay and West Bay Center and water was reported to be 10 feet (3 metres) deep through the gap. Another section of road between Piccadilly and West Bay was washed out. The washout was said to be in the order of 30 feet (9 metres) wide and fishermen were reported to be transporting their lobster by dory across the washout.

Telephone service to portions of the Port au Port Peninsula was disrupted when the flooding between Stephenville and Stephenville Crossing caused damage to the lines.

In Stephenville, debris carried by the flood waters of Warm Creek blocked culverts on Mississippi Drive causing water to flow over the bridge and pavement at both ends until the road was washed out. Flood waters also threatened the bridge on Carolina Avenue and temporary dykes were constructed in this area to protect the low land around the Harmon Gymnasium and the brewery.

On Missouri Drive, near Massachusetts Drive, water backed up behind a culvert bridge, overflowed onto the pavement and washed out a section of earthfill (about 10' - 15'). The remains of the structure were later removed to clear the channel and the road was never rebuilt.

A youth fell into the flood swollen waters of Warm Creek but was rescued.

FLOOD OF FEBRUARY 2-3, 1973

Cause: Rain, mild temperatures, melting snow and ice jams

Description:

In Corner Brook, minor washouts were reported to have occurred on several gravel roads throughout the city.

In Stephenville, on Blanche Brook, ice piled up across the Main Street Bridge. The wooden sidewalk on the bridge had to be replaced, but the bridge itself was not damaged. The Canada Manpower Office and Building 450 on the Harmon Complex were slightly damaged when ice was forced against them.

All buildings close to the Main Street Bridge had their parking lots blocked with ice which was piled 10 feet high in places. Water rose almost to floor level of the Indian Pallet Inn, and also flooded Minnesota Drive opposite the brewery.

A tractor, engaged in dedicing the ice jam, was reported as having slipped through the ice into the brook.

Magnitude:

It was reported as being the worst ice condition in the history of the town.

Flooding of the brewery was prevented by the temporary dykes which had been built in the spring of 1972 when similar, but less extensive flooding occurred in the area.

Damages: No estimates of the damages were published.

FLOOD OF AUGUST 1-4, 1973

Cause: Heavy rainfall for a 3-day period

Description:

On the Port au Port Peninsula damage was reported to roads. At Fox Island River, a landslide occurred upstream bringing 30-40 cords of pulpwood and trees down the river with the flood which dragged anchors taking several boats out to sea. The highway was also reported to be closed near Piccadilly, Port au Port, because of a washout.

In the Stephenville area, Highway No. 47 (Hansen Highway) was under water in at least two places and a bridge, near Wheeler's Night Club above Noel's Pond, was washed out.

Basements, in the Mill Place area, north of Main Street, were flooded as Blanche (Cold) Brook swelled to several times its normal size.

Many residents were without water for about two days when a water line was broken because of the high water and debris.

Town equipment was kept busy clearing debris (at least 15 truck loads) from the bridges on Blanche Brook, thus averting serious damage. However, concerns were expressed as to their safety, owing to the remaining blockage.

The flood waters eventually broke through the temporary dykes protecting the brewery and reached a height of about 1.5 feet (0.49 metres) above the floor level. Three private vehicles in the parking lot were also inundated. Telephone and electrical services to the building had to be cut off.

At nearby Noel's Pond, at least four families were forced to leave their homes because of the flood waters.

In Corner Brook, a number of basements were flooded as Bell's Brook rushed through and around one of two culverts intended for re-alignment of the road below Blackwood's Hill. At the confluence of Bell's Brook and Corner Brook Stream, water was reported to be washing the Bowater's oil supply line across the brook. Some water also backed up as a result of a partial blockage on Corner Brook Stream by the temporary road near the entrance to Bowater's Pulp Mill. The parking lot behind the Western Star Building on Brook Street was also inundated.

A bailey bridge had to be erected over Blow-me-down Brook (Blomidon Brook) to replace the one washed out between Frenchman's Cove and Lark's Harbour, Bay of Islands.

Near Pasadena, a water line crossing South Brook was severed by flood waters. A property adjacent to Blue Gulch Brook was eroded 6-8 feet (1.8 - 2.4 metres) when the brook rose to very high levels (photograph published*). At least one home in Pasadena was inundated.

Magnitude:

Rainfall for the three day period totalled 3.61 inches (91.7 mm) at Corner Brook, 2.92 inches (74.2 mm) at Stephenville Airport and 2.75 inches (69.9 mm) at Deer Lake.

The flooding at Stephenville was reported to be the worst in the history of the town.

The C.N.R. files stated that the following houses at Noel's Pond (Cormier Village) were inundated to the following depths:

Residence of Donald Cormier - 16 in. on main floor

Residence of Eric Cormier - 14-6 in. on main floor

Residence of Tom Cormier - 14 feet on main floor

Residence of Mrs. Mildred Hynes - 16 in. on main floor

Mrs. Vincent Cormier had no damage to her dwelling; however, she had been compensated for loss of hens and income from the sale of eggs.

Damages:

At Stephenville, the broken water main had been damaged during the 1969 flood and had been left dangerously exposed by ice gouging during the spring flood of 1973. After this, the town had spent approximately $21,000 on encasing it in concrete and burying it deep enough to avoid future problems from ice gouging. However, this was the cause of this break.

Damages to interior and equipment as well as inventories of both goods in process and finished goods at the Brewery was said to be in the order of $70,000.

No estimates were given for the damages inflicted on the residential area north of Main Street.

At Noel's Pond, the C.N.R. was blamed for the damages in that area. A brief was submitted to the C.N.R claiming damages in the order of $2,000.

Damages to the C.N.R. lines were in the order of $46,000.

FLOOD OF NOVEMBER 1-2, 1974

Cause: Heavy rainfall

Description:

In Stephenville, Blanche Brook was swollen to several times its normal size. Work crews were kept busy attempting to clear debris from structures on Carolina Avenue and the Hansen Highway in order to prevent overflow onto the roads.

At Noel's Pond, residents were also affected by flooding but no reports of damages were obtained.

Cold Brook, about five miles from Stephenville, was cut off from the Hansen Highway due to the flooding of the bridge and the washout of the fill at its approaches.

A bridge to the Labrador Linerboard Ltd. camps was reported as having been washed out.

Magnitude:

A total rainfall of 1.68 inches (42.7 mm) was recorded at the Stephenville Airport on the 1st. During a 12-hour period on the 1st, 1.29 inches (32.8 mm) of the total was reported to have fallen.

Damages: No estimates of the damage were published.

FLOOD OF DECEMBER 22-25, 1975

Cause: Rain, snow and unseasonable temperatures

Description:

In Stephenville, flooding of streets was said to be "extensive" as storm sewer systems were not able to handle the amount of water.

In Corner Brook, storm damage was reported to be quite extensive to the streets. Maple Valley Road and Blackwood Hills were reported to be hit the hardest. Road shoulders were reported as being damaged severely. Peddle's Lane, where storm sewers had been installed after the street was washed out by flooding in September, was not seriously affected.

In the Exploits River Valley, a section of the Trans Canada Highway four miles west of Grand Falls was closed because of flooding. The road was flooded to a depth of about two feet (about 0.6 metres) at 8 a.m. on December 24th. On January 8th, almost two weeks after the peak flow, part of the highway was still under water. Traffic was diverted by way of the Old Badger Road.

Magnitude:

A total of 2.05 inches (52.1 mm) of precipitation, including snow and rain was reported at Stephenville.

On December 22nd, a rainfall of 0.98 inches (24.9 mm) was recorded at Corner Brook. A rainfall of 1.79 inches (45.5 mm) was recorded on the 22nd at the Exploits Dam (Red Indian Lake).

On the Exploits River ice began to move downstream in stages as a result of the rainfall and high temperatures until it reached the area of Goodyear's gravel pit. At this point in the river, the ice was reported to have accumulated and partially blocked the channel. Increased water levels resulted upstream and subsequently began to flow through the gravel pit adjacent to the north bank until reaching the Trans Canada.

The gauging station on the Exploits River below Stony Brook (Station No. 02YD005) indicated that the flow began to increase about 7 a.m. on December 23rd and reached a value of 13,000 cfs (368 $m^3/s$) by midnight and about 22,800 cfs (645 $m^3/s$) at 4 p.m. on December 24th. The flow receded to about 6,000 cfs (170 $m^3/s$) by midnight on December 26th.

The Exploits River drainage area, above Red Indian Lake, was reported as not having contributed to the flooding as Price Newfoundland Ltd. had closed the Exploits Dam in November 1975, to increase the storage which had been depleted because of insufficient runoff. As well, the company did not require any water for the power plant because of an on-going strike at the mill.

Damages:

The highway remained closed throughout most of the winter. No estimates of damages to the highway were given. This section of highway was reported as having been vulnerable to flooding due to the low lying land areas adjacent to the river and minor flooding had been noted by highway personnel "especially in the spring of the year".

It was also noted that approximately two miles of highway would be raised several feet to prevent the recurrence of flooding in the future.

FLOOD OF DECEMBER 27-29, 1977

Cause:

Combination of rain and high temperatures on Christmas Day and Boxing Day melted the accumulation of snow

Description:

Flooding was reported across insular Newfoundland, resulting in disruption of transportation and inconvenience to many home owners.

Trains were halted because of washouts along the C.N.R. rail lines across the Province. C.N.R. officials said some 40 washouts occurred and reported that the main problems were between Clarenville and Port aux Basques. Some of the damaged sections were reported to be up to 200 feet (60 metres) in length. C.N.R. also reported flooding on the line between Clarenville and Bonavista. It was reported that about two days would be required to affect repairs to the lines and about 130 laid-off seasonal employees were called back for this operation. A derailment of a work train also occurred near Fichell's Cove when the embankment collapsed after being weakened by the high water.

Flooding was also reported in the Gull's Pond area as a result of debris blocking the bridges or culverts.

In Corner Brook, several roads were damaged and some houses were inundated with water and mud. Extensive damages were reported in the Massey Drive, Benoit's Cove and several other areas of the City where the drainage was not adequate. Some of the streets which sustained damage were the Old Humber Road, Riverside Drive, Barrett's Road and Maple View. Curbing and road shoulders were damaged on East Valley Road West Valley road, Windsor Street, Meadows and Gillams Roads. In the Riverside Drive area, tons of mud and water inundated homes on the north side of Ballan Bridge. Much of the mud flowed onto the property of Owen Legge and filled the basement apartment. Several streets in the Curling NIP (Neighbourhood Improvement Program) area were damaged. Water also overtopped the dam at the Margaret Bowater Park.

A landslide occurred at Mount Moriah which blocked the highway.

Guard rails and hydro poles along the Humber River were reported as having little support as the flooding had washed away tons of earth.

The road to Cox's Cove was closed when portions of the roadbed along a quarter mile section was reported as having slid downhill when a culvert was washed out.

East of Corner Brook, the road to Trout River was reported to be washed out, as well as, the Trans Canada Highway at Little Rapids. The [illegible] was reported to be [illegible] but it was said to be [illegible]

At King's Point, Green Bay, floodwaters tore up a 100-foot section of the main street rupturing a water line and isolating about 40 families. The pumphouse was also inundated leaving 700 people without water. Debris was reported to have punctured the dam as well.

At Buchans, several miles of old workings and tunnels at the ASARCO' mines were flooded to a depth of about eight feet as a result of the mild spell and rain. The flooding was reported as not having affected production since the flooded tunnels are used mainly for access and ventilation.

In Grand Falls, Main Street was closed for some time because it was submerged. Work crews were kept busy clearing debris from storm sewers that caused water to back up and flood low lying sections of streets and several basements. Some tenants were forced to move out of their flooded basement apartments on Goodyear Avenue.

In Gander, many basement apartments were flooded and some residents had to leave their living quarters.

Six miles (9.7 km) east of Gander, Soulis Brook overflowed a 200-foot (60 metre) section of the TCH washing out the shoulders and undermining some pavement closing it to traffic for a period until waters receded.

The TCH was also reported to have been flooded in the Port Blandford area by Southwest Brook causing problems for vehicular traffic. The water was reported to be 10 inches (0.25 metres) deep.

On the Bonavista Peninsula, numerous roads were said to have been inundated and/or washed out and were impassable to all but large trucks and four wheel drive vehicles. Two of these areas were at Lethbridge and Lockers Brook (weakened bridge).

Other gravel roads in the Province were washed out and in some cases communities were isolated. Some of these roads were in the Buchans area and the Harbour Breton Road between Pool's Cove and St. Jacques.

In St. John's, basements were flooded and roads were inundated and some washed out.

The Waterford River overflowed its banks inundating sections of Bowring Park and the Kinsman Park on Squires Avenue. On the southside of Squires Avenue the flood waters were reported to have eroded several feet of land to the rear of the homes. Flooding was also reported around Quidi Vidi Lake and in the Higgins Line area. Houses in the newly developed Spratt Place, east of Conche Drive, experienced severe basement flooding.

Problems were also experienced in the Highland Park Subdivision and on Southside Road as a result of clogged storm drains. The basement of the C.N.R. customer station and express building as well as the diesel building, tracks and parking lot on Water Street West were inundated. The problem was suspected to be related to the trunk sewer.

Magnitude:

At Corner Brook, 1.25 inches (31.8 mm) of rain and temperatures in the order of 11°C to 13°C (52°F to 55°F) were recorded. At Buchans, 1.27 inches (32.3 mm) of rain was recorded on the 27th. A rainfall of 1.80 inches (45.7 mm) was recorded at St. John's with temperatures in the order of 10°C (50°F).

Brooks and ponds were reported to be far above normal across the Province.

Residents of Riverside Drive, Corner Brook, said "problems had never occurred in that area until about three years ago when changes were made to the gravel pit on the hill behind their homes. Prior to this, the water from the pit normally flowed through a brook into the Humber River.

Damages:

In Corner Brook, damages to city streets were estimated at $100,000.

Newspaper accounts stated that highway damages could reach several hundred thousand dollars. No other estimates of damages were presented.

FLOOD OF SEPTEMBER 30 - OCTOBER 2, 1978

Cause: Heavy rainfall

Description:

A photo** was published showing a 60-foot (about 18 metres) section of C.N.R. rail bed which had been eroded by the heavy rainfall. The damaged section of road bed was on the 5.5 mile (8.8 km) spur linking the Labrador Linerboard Mill to the line at Noel's Pond near Stephenville.

Magnitude:

The mean daily discharge for Blanche Brook near Stephenville, (Station No. 02YJ002), for October 1st was 57.0 cfs (1.6 $m^3/s$).

Damages:

No information on repair plans or cost of repairs was available. The linerboard mill had been closed for a year but it was reported that a substantial sum was paid to the C.N.R. for maintenance of the spur.

* The Western Star, May 19, 1978, pg. 1

** The Western Star, October 3, 1978, pg. 3

FLOOD OF MARCH 6-9, 1979

Cause: Rain, melting snow, blockage of drainage systems by ice and debris

Description:

A four-day period of spring-like weather caused flooding and some washouts in central and western Newfoundland.

Both the Robinson's and Barachois Rivers overflowed their banks when ice collected at the bridges resulting in flooded roadways.

In Stephenville, the high flows and ice in Blanche Brook undercut footings of four 20-foot (6 metres) sections of a retaining wall causing them to collapse. Town work crews were kept busy in an attempt to fill the breach with boulders and concrete to reduce the possibility of the Labatt Brewery complex being flooded.

In the Corner Brook area, some flooding of basements and minor road damages were reported throughout the city. Some flooding was reported at the intersection of Dave's Road and Primrose Avenue and on the highway between Drake's Cove and Riverside Drive. Corner Brook Stream rose to less than two feet from the bottom of the bridge on Main Street and backed up into the sewer system through an outfall.

In the Reddiction area, on the Northern Peninsula, blockage of culverts and ditches in several places caused overflow onto the roads.

The Baie Verte Peninsula also experienced some flooding of a minor nature and a few washouts.

In Central Newfoundland, flooded streets and basements were reported in most of the towns. A section of the Bay d'Espoir highway was inundated about 25 miles (40 km) south of Bishop's Falls at a point where Antling Brook is closest to the highway. This resulted in a short closure of the highway.

Magnitude:

Total precipitation was in the order of 63 millimetres (about 2.5 inches) was reported at Corner Brook during the period. Total precipitation for March at Corner Brook was 186.1 millimetres (7.33 inches) of which 142.1 millimetres (5.59 inches) was in the form of rain. The month was described as the wettest since 1938.

The flooded section of the Bay d'Espoir highway was reported as being flooded for the first time in the road's 12 year history.

Damages:

At Stephenville, the Town Manager was reported to have said that "the complete and permanent repair to the damaged cribbing is expected to be between $100,000 and $120,000". It was reported that Alexander Engineering was contracted by the Town to carry out permanent repairs at the site. The permanent structure was reported to be an interlocking steel sheet pile facewall.

No other estimates of the damages were presented. Some photographs were published for Stephenville and the Corner Brook area.

FLOOD OF JULY 17-20, 1979

Cause: Heavy rainfall

Description:

In the Stephenville area, Blanche Brook, swollen by heavy rains, carried trees and other debris downstream which collected and jammed at the Hansen Highway Bridge. The section of Hansen Highway from Brook Street to the intersection of Queen Street was closed on the morning of the 18th. Transportation Department employees were kept busy attempting to keep debris from floating downstream causing further damage. The center pier of the bridge had been moved by the force of the debris and water. The structure collapsed around mid-day on the 19th.

Debris also was reported to have piled up where the brook runs between Carolina Avenue and Main Street but no damage resulted. Many Stephenville residents had flooded basements and the Harron Convenience Store on Carolina Avenue foundered when its basement gave way.

In Corner Brook, a few minor washouts had occurred but no serious flooding or damages were reported within the city limits.

Magnitude:

The technical services department of Bowater Newfoundland Ltd. recorded 1.66 inches (42.2 mm) of rainfall from 1:30 p.m. on the 17th until 8:00 a.m. on the 18th.

Damages:

No estimate of the damage was reported for the Harron Convenience Store; however, it was reported that they were open for business on the 19th. Hines Esso on the Hansen Highway near the collapsed bridge reported extensive losses in business and as a result was required to lay-off employees. No estimates for a replacement bridge were presented. The original bridge across Blanche Brook was built by the United States military in the mid-1950's. The newspaper accounts reported that it took about three weeks to get a Bailey Bridge in place. Some photos of the structure were published (before and after the collapse).

FLOOD OF JULY 28-29, 1979

Cause: Heavy rain and debris jams

Description:

Blanche Brook, in Stephenville, was reported to be in flood once again. The brook was said to be three or four times its normal size and debris was beginning to pile up at the site of the bridge which had collapsed during the flooding of July 19th.

Magnitude:

No information was presented. A photograph** was published showing the brook at the site of the collapsed bridge.

Damages: No description or estimates of the resultant damages were presented.

FLOOD OF AUGUST 17-18, 1979

Cause: Heavy rainfall

* The Western Star, July 18, 1979, pg. 1; The Western Star, July 19, 1979, pg. 3; and, The Western Star, July 20, 1979, pg. 1.

** The Western Star, July 30, 1979, pg. 2.

FLOOD OF APRIL 22-30, 1982

Cause: Heavy rain and melting snow

Description:

The April 22, 1982 Western Star reported Blanche Brook had begun to swell. By April 30th heavy rain and melting snow had caused basement flooding in the Blanche Brook area. Blanche Brook was reported to be swollen but not flooding.

However, the May 1, 1982 Western Star reported "extensive" basement flooding in Noels Pond, forcing some residents to leave their homes. Residents stated that the new Stephenville industrial access highway completed to gravel standard in 1981 has caused flooding in an area of the community not previously flooded. Noels Pond experiences annual flooding when Noels Pond and Warm Creek overflow with spring runoff.

Particular problems were experienced by residents of the Sunset Crescent area, Queen Street, near Cornwall Heights and along Blanche Brook as well as the Park Avenue - White's Trailer Court area.

Magnitude:

No information was presented.

Damages:

No estimate of the resultant damages were presented.

FLOOD OF JANUARY 11-13, 1983

Cause: Heavy rain and melting snow

Description:

Blanche Brook and Warm Creek swelled to rise by as much as 1.3 m in some areas. Localized areas of flooding were reported in the Town of Stephenville near Park avenue and White's Trailer Park, with mainly access routes being affected. Extensive basement flooding was reported in Noels Pond with the industrial access route to the Town of Stephenville being blamed as the major causative factor.

Magnitude:

A total precipitation of 59.4 m was recorded at the Stephenville meteorologic station, combined with a melt of 11 cm of snow cover over the 3-day period.

Damages:

No estimate of compensative damages or claims were reported.

FLOOD OF JUNE 1-3, 1983

Cause: Heavy rainfall

Description:

Flooding was reported in some areas of Noels Pond along Warm Creek while no significant flooding was reported downstream in the Town of Stephenville.

Magnitude:

The Stephenville meteorologic station recorded a total rainfall amount of 36.2 mm.

Damages:

No information was given on resultant flood damages.

**August 14, 1989:**

Flood levels near the 1:20 year floodlines, as determined in the 1984 hydrotechnical investigation, were experienced on Blanche Brook. Most bridges in the area were near or just over their capacity while river banks (especially at bends), bridges, roads, and walkways experienced damage.

**Cold Brook**

Cold Brook floods on a periodic basis with flooding generally confined to several residences and farmland; see attached plan in Appendix C. The flooding is generally caused by ice/debris blockages. Particularly, Lower Brook Farm, owned by Mr. Sam Alexander, has experienced the loss of farm land due to erosion associated with high flows. In 1989, a blockage caused the river to overflow its normal channel and flood several residences. An application was subsequently filed and approval granted (November 10, 1989) to "close" the overflow channel. Residents feel that some of the river bends should be altered to provide a straight channel to eliminate flooding.

**Kippens**

The June 7 and 8, 1995 flood event resulted in high flows which caused settlement of the concrete bridge. The footing and consequently the abutment and bridge deck settled. The bridge was subsequently restricted to one-way traffic. Some minor damage was caused to a gabion retaining wall near the property of 3 Millbrook Lane Extension.

On December 8, 1990, water levels in Gaudon's Brook were high resulting in river bank erosion at several locations. In particular, the shoulder of Millbrook Lane that runs parallel to Gaudon's Brook was eroded and a resident of Millbrook Land had a portion of personal property washed away. This event is typical of the flooding problems that exist on Gaudon's Brook and is well documented in the Western Star for an event that occurred in 1989.

**December 9, 1990:**

The banks of Warm Creek were seriously eroded and the material deposited downstream produced excessive gravel accumulations. One area of concern was the section of river between the bridges at Carolina Avenue and Mississippi Drive, where about 1.0 m of sediment

was deposited. Blanche Brook was high and the gabion structures along the banks that protect Blanche Street were undermined. Blockages occurred at the bridges on Mississippi Drive, Main Street and Carolina Avenue. Numerous culverts were washed out and most bridges experienced damage. Refer to Appendix "B" for personal account from Mr. William McNeil (Town Manager) and Mr. Mike Campbell (Public Works Superintendent).

March 9, 1995:

An ice jam in Blanche Brook caused flooding of Massachusetts Drive resulting in a section of the road being closed to traffic. The ice blockage occurred at a location on Minnesota Drive adjacent to the Integrated High School which caused water to back up and discharge into a ditch located near the old Labatt Brewery and flood Massachusetts Drive.

June 7 and 8, 1995

This event caused excessive flooding and structural damage along Blanche Brook and Noel's Pond and was investigated during the field reconnaissance program of June 19 to 22, 1995. The results of the investigation are summarized below while the pictures illustrating the damage are included in Appendix "A".

- Excessive shoulder erosion occurred along Minnesota Drive as a result of high flows in Blanche Brook. See Photograph #6 in Appendix "A".
- High flows in Blanche Brook caused shoulder erosion and the collapse of gabion retaining walls upstream of bridge on Main Road.
- Severe erosion occurred along Blanche Brook on the New Mexico Drive side of the river. See Photograph #10.
- A large parcel of land and a small section of Highway 47 was flooded in Noel's Pond as a result of high flows and a debris blockage at concrete bridge on Highway 47. Refer to Photograph #1 and #2.
- A debris blockage at the culvert installation on the Industrial Access Road caused flooding of land between Route 490 and Highway 47.

## 2.0 BACKGROUND INFORMATION

The study team conducted a literary search of the information on file at the Department of Environment (DOE) office to verify the background information made available prior to submitting proposals. This information has been summarized in this report since it has relevance with respect to the field reconnaissance program and its subsequent findings.

### 2.1 Stephenville

The Town of Stephenville has experienced periodic flooding throughout its history. The predominant cause of flooding on Blanche Brook and its tributary Warm Creek has been excessive rainfall, rapid snowmelt and ice/debris jams at various hydraulic structures. Recent events are described below while a detailed history of flooding is provided in Appendix F.

**June 7 and 8, 1995**

This event caused excessive flooding and structural damage along Blanche Brook and Noel's Pond and was investigated during the field reconnaissance program of June 19 to 22, 1995. The results of the investigation are summarized below while the pictures illustrating the damage are included in Appendix "A".

- Excessive shoulder erosion occurred along Minnesota Drive as a result of high flows in Blanche Brook. See Photograph # 6 in Appendix "A".

- High flows in Blanche Brook caused shoulder erosion and the collapse of gabion retaining walls upstream of bridge on Main Road.

- Severe erosion occurred along Blanche Brook on the New Mexico Drive side of the river. See Photograph # 10.

- A large parcel of land and a small section of Highway 47 was flooded in Noel's Pond as a result of high flows and a debris blockage at concrete bridge on Highway 47. Refer to Photograph # 1 and # 2.

- A debris blockage at the culvert installation on the Industrial Access Road caused flooding of land between Route 490 and Highway 47.

March 9, 1995:

An ice jam in Blanche Brook caused flooding of Massachusetts Drive resulting in a section of the road being closed to traffic. The ice blockage occurred at a location on Minnesota Drive adjacent to the Integrated High School which caused water to back up and discharge into a ditch located near the old Labatt Brewery and flood Massachusetts Drive.

December 9, 1990:

The banks of Warm Creek were seriously eroded and the material deposited downstream produced excessive gravel accumulations. One area of concern was the section of river between the bridges at Carolina Avenue and Mississippi Drive, where about 1.0 m of sediment was deposited. Blanche Brook was high and the gabion structures along the banks that protect Blanche Street were undermined. Blockages occurred at the bridges on Mississippi Drive, Main Street and Carolina Avenue. Numerous culverts were washed out and most bridges experienced damage. Refer to Appendix "B" for personal account from Mr. William McNeil (Town Manager) and Mr. Mike Campbell (Public Works Superintendent).

**August 14, 1989:**

Flood levels near the 1:20 year floodlines, as determined in the 1984 hydrotechnical investigation, were experienced on Blanche Brook. Most bridges in the area were near or just over their capacity while river banks (especially at bends), bridges, roads, and walkways experienced damage.

### 2.2 Cold Brook

Cold Brook floods on a periodic basis with flooding generally confined to several residences and farmland; see attached plan in Appendix C. The flooding is generally caused by ice/debris blockages. Particularly, Lower Brook Farm, owned by Mr. Sam Alexander, has experienced the loss of farm land due to erosion associated with high flows. In 1989, a blockage caused the river to overflow its normal channel and flood several residences. An application was subsequently filed and approval granted (November 10, 1989) to "close" the overflow channel. Residents feel that some of the river bends should be altered to provide a straight channel to eliminate flooding.

### 2.3 Kippens

The June 7 and 8, 1995 flood event resulted in high flows which caused settlement of the concrete bridge. The footing and consequently the abutment and bridge deck settled. The bridge was subsequently restricted to one-way traffic. Some minor damage was caused to a gabion retaining wall near the property of 3 Millbrook Lane Extension. Refer to photographs #11 and 12 in Appendix A.

On December 8, 1990, water levels in Gaudon's Brook were high resulting in river bank erosion at several locations. In particular, the shoulder of Millbrook Lane that runs parallel to Gaudon's Brook was eroded and a resident of Millbrook Lane had a portion of personal property washed

away. This event is typical of the flooding problems that exist on Gaudon's Brook and is well documented in the Western Star for an event that occurred in 1989; refer to Appendix "D".

# Appendix B

# Background for Statistical Hydrological Analysis

The following sections provide additional information describing the methodology applied in undertaking peak flow estimates by various statistical techniques:

## B.1 Statistical Analysis of Blanche Brook and Harrys River

Flood flow frequency analysis was conducted using the flow records at Blanche Brook and Harrys River. The following sections describe the analyses which were undertaken to obtain the design flood estimates.

### B.1.1 Testing the Data Base

The sample data set of maximum instantaneous flow was tested for trend, independence, homogeneity and randomness, using statistical test techniques. A summary of the sample extreme-value data set available for the Harrys River and Blanche Brook are given in the printout from the CFA-3 (49) program. The sample data set were tested for randomness, independence, trend and homogeneity using the following technique:

#### B.1.1.1 The Spearman Rank Order Serial Correlation Coefficient for Independence

If the series $Q_i$ with i ranging from 1 to N is put in chronological order, ranks assigned, and denoting the series

$Q_1, Q_2 \ldots\ldots\ldots\ldots Q_{N-1}$ by $X_i$, the rank of $Q_i$

and $Q_2, Q_3 \ldots\ldots\ldots\ldots Q_{N-1}$ by $Y_i$, the rank of $Q_i$

then the Spearman rank order serial correlation coefficient is:

$$S_1 = 1/2\,(\Sigma x_i^2 + \Sigma y_i^2 - \Sigma d_i^2)\,(\Sigma x_i^2 \Sigma y_i^2)^{-1/2} \qquad \text{B.1}$$

where

$$\Sigma x_i^2 = (m^3-m)/12-\Sigma T_x$$

$$\Sigma y_i^2 = (m^3-m)/12-\Sigma T_y$$

$d_i$ is the difference in rank between $x_i$ and $y_i$

$m = N-1$

and the summations are over the m pairs of $x_i$, $y_i$.

Ignoring for the moment the terms in T and putting them at zero, equation B.1 becomes:

$$S_i = 1-(6\Sigma d_i^2)/(m^3-m) \qquad \text{B.2}$$

the more familiar form of the Spearman rank correlation coefficient.

The terms in T adjust for tied ranks and are computed as follows. If for instance three observations in the x series were tied for ranks 17, 18 and 19 then each observation is given the rank 18; if two were tied for ranks 24 and 25, then each is ranked 24.5.

For each tied set, T is computed from:

$$T_x = (J^3 - J)/12$$

where

J is the number of observations tied at a given rank.

$\Sigma T_x$ and $\Sigma T_y$ are defined by the extension of the foregoing.

When N is 10 or greater, then the function:

$$t = S_i\,[(m-2)/(1-S_i^2)]^{1/2} \qquad \text{B.3}$$

is distributed like Student's t with m-2 degrees of freedom.

B.1.1.2 The Spearman Rank Order Correlation Coefficient Test for Trend

If the series $Q_i$ with i ranging from 1 to N is put in chronological order, ranks assigned and denoting the series:

$Q_1$, $Q_2$ .....$Q_N$ by $y_i$, the rank of $Q_i$
and 1,2, .....N by $x_i$, the sequential order of $Q_i$

then the Spearman rank order correlation coefficient $r_s$ is calculated as in equation B.1, except that m = N, $T_x$ = 0, and the summations are taken over the N pairs of $x_i$, $y_i$.

For N = 10 or greater, then the function:

$$t = r_s\,[(N-2)/(1-r_s^2)]^{1/2} \qquad \text{B.4}$$

is distributed like Student's t with N-2 degrees of freedom. The null hypothesis is that there is no trend, either upward or downward with time, and so a two-tail test is used.

B.1.1.3 The Mann-Whitney Split Sample Test for Homogeneity

The sample is split into two sub-samples, and ranks assigned. Then the Mann-Whitney U statistic is defined by the smaller of:

$$U_1 = n_1 n_2 + n_1(n_1 + 1)/2 - R_1 \qquad \text{B.5}$$

or

$$U_2 = n_1 n_2 - U_1 \qquad \text{B.6}$$

where

$n_1$ is the size of the smaller sub-sample
$n_2$ is the size of the larger sub-sample
$R_1$ is the sum of the ranks in sub-sample $n_1$

For both $n_1$ and $n_2$ less than 21, the critical values of U have been tabulated which define the region of rejection. For $n_1$ greater than 4 and $n_2$ greater than 20, the sampling distribution of U rapidly tends to normality with

$$Z = \frac{u - n_1 n_2/2}{\frac{n_1 n_2}{N(n-1)} \frac{N^3 - N}{12} - T}^{1/2}$$

$T = (J^3 - J)/12$, where J is the number of observations tied at a given rank. The summation of T is over all groups of tied observations in both sub-samples.

z is an N (0,1) variate and in the applications of the Mann-Whitney test used in this program, the region of rejection is:

z less than - 1.645 for $\alpha = 0.05$
z less than - 2.326 for $\alpha = 0.01$

### B.1.1.4 Runs Above and Below the Median for General Randomness

This randomness test is based on the order or sequence in which the individual scores or observations were obtained. Actually, the test is based on the number of runs which a sample exhibits. A run is defined as a succession of identical symbols which are followed and preceded by different symbols or by no symbols at all.

The total number of runs in a sample of any given size gives an indication of whether or not the sample is random. If very few runs occur, a time trend or some bunching due to lack of independence is suggested. If a great many run occur, systematic short-period cyclical fluctuations seem to be influencing the sample.

For example, once the median of the sample has been determined, each observation can be labelled as being above and equal to or below and equal to the median. If "A" represents above and equal to the median and "B" represents below and equal to the median, then a sample may be ordered as:

AABBBABBBBAABA

(A run represents a succession of identical symbols). For our example, each run is underscored and numbered consecutively:

| AA | BBB | A | BBBB | AA | B | A |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

This sample begins with 2 observations above or equal to the median, followed by a run of 3 observations below or equal to the median, etc.

Seven runs are observed in all: that is, the total number of runs above and below the median, RUNAB, is 7. If $n_1$ represents the number of events of type A, then $n_1 = 6$. If $n_2$ denotes the number below the median, type B, then $n_2 = 8$. Thus, the number of observations is equal to $(n_1 + n_2)$.

In order to apply this run test, one must determine $n_1$, $n_2$, and RUNAB. When critical values from of RUNAB falls between the critical values, $H_o$ is accepted. If the observed value of RUNAB is equal to or more extreme than one of the critical values, then $H_o$ is rejected.

The null hypothesis, $H_o$, is that the A's and B's occur in random order. The alternate hypothesis, $H_1$, is that the order of the A's and B's deviates from randomness.

When either $n_1$ or $n_2$ is greater than 20, the sampling distribution of RUNAB tends to normality with :

$$z = \frac{|\ RUNAB - [(2n_1n_2)/(n_1+n_2)+1]\ |}{\{2n_1n_2(2n_1n_2-n_1-n_2)\ [(n_1+n_2)^2(n_1+n_2-1)]\}^{½}} \qquad B.8$$

where z is an N(0,1) variate. This package uses a region of rejection defined by:

z greater than 1.96 for $\alpha$ = .05.
z greater than 2.575 for $\alpha$ = .01.

B.1.2 Flood Frequency Analysis

Several distributions were fitted to the available Blanche Brook and Harrys River data sets for comparison purposes, including Generalized Extreme Value Wakeby, Three Parameter Log Normal (3PLN) and Log Pearson Type III (LP3). The computer program, CFA-3 (21), provided by the Water Planning and Management Branch, Environment Canada, was utilized for this purpose and for computing the 1:20 and 1:100 year flood peaks and the corresponding 95% confidence limits. Table B.2 presents a summary of the different distributions and the corresponding standard errors.

For Newfoundland, Poulin (38) recommends the Gumbel distribution be used. This distribution has fixed coefficients of skew and kurtosis of 1.14 and 5.4 respectively. The Blanche Brook and Harrys River data set was found to have coefficients of skew and kurtosis of 1.23 and 5.62 respectively which tend to agree with the use of the Gumbel distribution.

The coefficients of skew and kurtosis for Blanche Brook were found to be equal to 1.35 and 6.21 respectively that also tend to support to use the Gumbel Distribution. The Generalized Extreme Value distribution includes the Gumbel Distribution as a sub-class of EV family which refers to EVI distribution and has a k parameter equal to zero. The fitted k parameter of GEV distribution for station 02YJ001 and 02YJ002 are equal to -0.07 and -0.12 respectively which are close to zero and then the distribution obtained may be viewed as Gumbel.
And therefore, the Generalized Extreme Value Distribution is recommended. The GEV distribution provides second highest flood estimates among the four distribution conservative from the flood risk point of view. Table B.2 summarizes the flood frequency analysis results for the four distributions.

Comparison of the flood frequency analysis results indicated that the Wakeby distribution provides extreme high estimates for peak flows, both for 02YJ001 and 02YJ002, than the other frequency curves. It is very unlikely that the Wakeby distribution is the right parent frequency curve to fit the data sets.

## B.2 Regional Flood Flow Estimates

### B.2.1 Regional Flood Frequency Analysis by the Method of Department of Environment and Lands

The regional flood frequency equations developed by the Department of Environment and Lands in 1990 have been applied to estimate the peak flows for the study areas. The study areas are located within southwestern region of Newfoundland. The regression equations suitable for this region are:

$$\log_{10} QP_{20} = 1.315 + 0.821 \log_{10} DA - 3.623 \log_{10} LSF \qquad B9$$

$$\log_{10} QP_{100} = 1.465 + 0.812 \log_{10} DA - 3.816 \log_{10} LSF \qquad B10$$

where:

$QP_T$ = The annual maximum instantaneous flow with recurrence interval of T years ($m^3s$).

DA = The drainage area ($km^2$)

LSF = Lakes and swamps factor (dimensionless) Table B.1 presents the parameters determined to compute the peak flows for the subwatersheds. The results are summarized in Table B.3 and B.4.

It is concluded that the estimates provided by this method for the 1:100 year flood give reasonable predictions compared with the OTTHYMO simulation results and the single station flood frequency analysis using the flood records at the gauge location at Blanche Brook.

B.2.2 Canada-Newfoundland Peak Flow Estimates

The sub-committee on "Flood Frequency Analysis" consisting of Federal and Provincial members has derived Regional Flood Flow regression equations for the Island of Newfoundland. The regression equations for Southern Newfoundland are based on using available records at hydrometric stations with at least 10 years of record and take the following form:

$$\log_{10} QP_{20} = -3.7581141 + 0.84990968 \log_{10} DA + 2.360446 \log_{10} MAR - 1.5247540 \log_{10} ACLS - 1.6244318 \log_{10} SHAPE \quad \text{B.11}$$

$$\log_{10} QP_{100} = -3.5915295 + 0.81413934 \log_{10} DA + 2.4090173 \log_{10} MAR - 1.6223283 \log_{10} ACLS - 1.4277436 \log_{10} SHAPE \quad \text{B.12}$$

where

| | | |
|---|---|---|
| $QP_T$ | = | annual instantaneous peak flow with a recurrence interval of T Years ($m^3/s$). |
| ACLS | = | area controlled by lake and swamp (% of drainage area) as determined from 1:50,000 NTS maps using criteria that lake or swamp with surface areas at least 1% of the drainage area to the lake or swamp outlet controls the area to the outlet. |
| SHAPE | = | (0.28 x basin perimeter) / DA (1/km) from Chow's Handbook on Hydrology. |
| .MAR | = | Mean Annual Runoff (mm) over the area. |
| DA | = | Drainage area ($km^2$). |

Table B.3 presents a summary of flood estimates calculated using this method.

It has been found that the flood flow estimates are fairly sensitive to parameter errors. For example, if a 10% error is assumed for each of the parameters individually, the following changes occur in $QP_{100}$ for Blanche Brook at the hydrometric station:

| + Change in Parameter | Produces Following Change |
|---|---|
| DA | +8%, -8% |
| MAR | +26%, - 22% |
| ACLS | -14%, +19% |
| SHAPE | -13%, +16% |

It is evident from the sensitivity analysis that the peak flow estimates by this technique are most sensitive to variations in the MAR and ACLS parameters. It can generally be assumed that ACLS can be estimated with fairly good accuracy (i.e., better than 10%) from topographic information. However, estimates of MAR (index of mean annual runoff) were provided by Environment Canada according to mapped values in order to improve estimates due to the short record length at the gauge location.

B.2.2 Regional Peak Flow Estimates by Poulin's Method

A secondary check on the new regional flood flow estimates was obtained by utilizing equations derived by Poulin (38). These equations were derived for Newfoundland using data up to 1969 and are based on a Gumbel frequency distribution. This technique is similar to the recent regional analysis but is somewhat out of data due to the shorter period of record used in the analysis.

The equation used to compute the return frequency flood estimate first requires the estimation of the mean annual flood (MAF) which constitutes a 1:2.33 year flood based on a Gumbel distribution. the mean annual flood is then multiplied by index factors to obtain the desired flood frequency estimate. The MAF is computed as follows:

$$MAF = C\,(DA/2.59)^{a}\,(MAR/25.4)^{b}\,(ACLS)^{c}\,(SLOPEx10E4)^{d} \qquad B13$$

where

DA = drainage area

MAR = mean annual runoff

ACLS = percentage of the drainage area controlled by lakes or swamps

SLOPE = Channel slope in % (Note: 10E4 = $10^4$)

a = 0.99252

| | | |
|---|---|---|
| b | = | 1.07620 |
| c | = | -1.08832 |
| d | = | 0.24023 |
| C | = | 5.563 |

Based on the physiographic parameters derived for Blanche Brook, the mean annual daily flood was calculated to be 49.4 $m^3/s$ at the gauge. Index factors of 2.72 and 3.49 were then determined to calculate the 1:20 and 1:100 year floods which are presented in Table B.5. Since this regional technique was derived for calculating mean daily flow rates, it was necessary to make an adjustment to instantaneous flows for comparison purposes. Based on a review of historic flow records, the ration of maximum instantaneous 1.60 and was used in adjusting the mean daily values.

It is evident by comparisons with other flood estimates that the Regional flood estimates by Poulin's method are somewhat different, although tending to confirm the CFA-3 estimates. The differences are attributed to the fact that the equations were derived based on a very limited data base and have been applied outside the range of their applicability, and due to the different frequency distributions underlying the two analyses.

Comparisons between the estimations made by the regional flood equations and by the new flood frequency analysis indicated that the floods estimated by flood flow frequency analysis provide much higher estimations for peak flows for Gauge 02YJ002. The OTTHYMO model gives similar peak flow estimations with the frequency analysis results. This indicated that the flood regional equations should be updated to reflect the new information on the flood flows records.

**Table B.1**

**Comparison of Meteorologic and Physiographic Characteristics for Blanche Brook, Cold Brook, Gaudons Creek and Harrys River Watersheds**

| | Units | Harrys River | Blanche Brook | Gaudons Creek | Cold Brook |
|---|---|---|---|---|---|
| Drainage Area - to gauge | $km^2$ | 640 | 117 | 16.4 | 21.3 |
| - to culvert | $km^2$ | 834 | 118.6 | -- | -- |
| % Forest | % | 70 | 84 | -- | -- |
| Average Yearly Precipitation | mm | 1679 | 1166 | 1166 | 1166 |
| Average Yearly Temperature | °C | 3.5 | 4.8 | 4.8 | 4.8 |
| Area controlled by swamps | % | 75 | 60 | 51 | 54 |
| Mean Annual Runoff | mm | 1320 | 1100 | 1100 | 1100 |
| Shape | - | - | 1.68 | 1.57 | 1.54 |
| LSF | - | - | 1.60 | 1.51 | 1.54 |

Table B.2
Summary of Flood Frequency Analysis
for Station 02YJ001 and 02YJ002

| Station | Return Period | Peak Flows ($m^3/s$) | | | |
|---|---|---|---|---|---|
| | | Type of Distribution | | | |
| | | G. Extreme Value | Log Normal | Log Pearson | Wakeby |
| 02YJ001 | 1:2 | 303 | 308 | 308 | 304 |
| Harrys River below Highway | 1:5 | 414 | 417 | 414 | 402 |
| Bridge | 1:10 | 492 | 490 | 485 | 484 |
| | 1:20 | 571 | 560 | 553 | 573 |
| | 1:50 | 678 | 652 | 643 | 705 |
| | 1:100 | 763 | 722 | 711 | 815 |
| 02YJ002 | 1:2 | 69 | 69.8 | 70.1 | 69.2 |
| Blanche Brook near | 1:5 | 101 | 103 | 101 | 97.6 |
| Stephenville | 1:10 | 125 | 126 | 123 | 122 |
| | 1:20 | 150 | 150 | 145 | 150 |
| | 1:50 | 186 | 183 | 175 | 193 |
| | 1:100 | 216 | 209 | 198 | 231 |

Table B.3

Comparison of Peak Flow
Estimates on Blanche Brook*

| Hydrologic Flow Estimation Method | Maximum Instantaneous Flow Rate ($m^3/s$ Recurrence Interval - Years) | |
|---|---|---|
| | 1:20 | 1:100 |
| Regional - DOEL** | 185.6 | 229.0 |
| Regional - CNFDRP | 126.1 | 162.8 |
| Regional - Poulin*** | 134.3 | 172.2 |
| OTTHYMO Model | 149.6 | 209.3 |
| Flood Frequency Analysis (Gumbel Distribution) | 150 | 216 |

* At gauge location

** DOEL - Department of Environment and Lands

*** Peaking factor of 1.6 applied to mean daily Q to yield maximum instantaneous flow rate.

## Table B.4

## Design Flow Estimates Using Regional Equations

| Watershed | Drainage Area ($km^2$) | DOEL METHOD * ($m^3/s$) | | CN-FDRP Method ($m^3/s$) | | Poulin's Method ($m^3/s$) | | OTTHYMO ($m^3/s$) | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1:20 | 1:100 | 1:20 | 1:100 | 1:20 | 1:100 | 1:20 | 1:100 |
| Blanche Brook | 118.6 | 185.6 | 229.0 | 126.1 | 162.8 | 134.3 | 172.2 | 149.6 | 209.3 |
| Cold Brook | 21.3 | 53.2 | 67.3 | 40.2 | 54.8 | 45.6 | 58.5 | 39.8 | 47.9 |
| Gaudons Creek | 16.4 | 46.1 | 58.7 | 34.5 | 48.0 | 37.7 | 48.3 | 43.8 | 50.0 |

HARRYS RIVER BELOW HIGHWAY BRIDGE - STATION NO. 02YJ001

MONTHLY MEAN DISCHARGES IN CUBIC METRES PER SECOND FOR THE PERIOD OF RECORD

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1968 | -- | -- | -- | 47.6 | 35.2 | 23.5 | 9.56 | 7.79 | 9.06 | 16.4 | 21.3 | 24.2 | --- | 1968 |
| 1969 | 10.2 | 27.4 | 9.03 | 14.3 | 83.6 | 26.2 | 7.83 | 7.73 | 16.0 | 16.9 | 23.9 | 35.1 | 23.2 | 1969 |
| 1970 | 13.3 | 22.4 | 7.87 | 12.1 | 73.1 | 30.2 | 10.1 | 10.8 | 10.5 | 13.1 | 30.3 | 20.1 | 21.1 | 1970 |
| 1971 | 5.56 | 22.0 | 19.7 | 66.5 | 46.3 | 7.70 | 10.4 | 31.3 | 17.9 | 28.5 | 23.3 | 15.2 | 24.5 | 1971 |
| 1972 | 20.5 | 14.6 | 24.8 | 18.0 | 92.7 | 67.0 | 16.9 | 10.7 | 11.9 | 42.5 | 35.2 | 28.1 | 32.0 | 1972 |
| 1973 | 17.7 | 25.8 | 25.0 | 20.5 | 77.4 | 37.4 | 23.9 | 40.5 | 15.9 | 17.9 | 32.4 | 47.2 | 31.9 | 1973 |
| 1974 | 12.3 | 11.2 | 19.1 | 31.9 | 71.9 | 46.2 | 13.8 | 9.39 | 27.4 | 33.6 | 30.5 | 21.9 | 27.5 | 1974 |
| 1975 | 7.57 | 4.53 | 11.6 | 26.8 | 85.4 | 17.0 | 5.73 | 9.38 | 23.7 | 31.0 | 44.5 | 44.0 | 26.1 | 1975 |
| 1976 | 25.6 | 20.5 | 12.8 | 44.8 | 58.0 | 12.8 | 7.73 | 7.79 | 9.99 | 33.4 | 42.4 | 29.2 | 25.4 | 1976 |
| 1977 | 17.4 | 10.5 | 9.60 | 34.7 | 73.3 | 31.2 | 28.4 | 31.0 | 22.1 | 50.5 | 34.4 | 31.9 | 31.4 | 1977 |
| 1978 | 29.8 | 12.5 | 9.28 | 19.7 | 104 | 45.8 | 16.6 | 6.20 | 6.30 | 12.5 | 26.8 | 12.0 | 25.2 | 1978 |
| 1979 | 35.6 | 16.8 | 66.1 | 24.2 | 32.3 | 9.80 | 13.7 | 12.6 | 24.4 | 30.4 | 54.7 | 29.9 | 29.3 | 1979 |
| 1980 | 13.0 | 6.25 | 5.60 | 47.9 | 53.0 | 23.3 | 15.1 | 13.4 | 24.7 | 39.7 | 44.0 | 14.6 | 25.0 | 1980 |
| 1981 | 17.6 | 21.5 | 14.8 | 47.1 | 57.4 | 20.2 | 13.0 | 19.4 | 12.6 | 23.6 | 29.0 | 40.7 | 26.4 | 1981 |
| 1982 | 10.5 | 12.9 | 15.2 | 44.5 | 114 | 28.7 | 19.8 | 14.3 | 19.4 | 22.0 | 32.5 | 34.1 | 30.8 | 1982 |
| 1983 | 39.8 | 14.5 | 17.3 | 44.5 | 23.0 | 32.9 | 16.6 | 41.9 | 18.5 | 17.6 | 26.3 | 25.8 | 26.6 | 1983 |
| 1984 | 17.3 | 29.3 | 16.9 | 35.9 | 72.5 | 35.9 | 16.5 | 14.3 | 27.0 | 12.8 | 19.0 | 23.4 | 26.7 | 1984 |
| 1985 | 11.7 | 9.30 | 12.1 | 14.8 | 80.5 | 62.3 | 10.3 | 5.55 | 11.3 | 11.5 | 14.1 | 16.1 | 21.7 | 1985 |
| 1986 | 28.1 | 10.7 | 6.63 | 70.2 | 20.8 | 22.7 | 8.27 | 8.35 | 8.19 | 13.9 | 18.0 | 14.3 | 19.1 | 1986 |
| 1987 | 9.25 | 8.29 | 9.25 | 79.4 | 39.1 | 9.21 | 4.65 | 9.21 | 18.4 | 28.8 | 37.8 | 12.8 | 22.1 | 1987 |
| 1988 | 7.56 | 6.82 | 19.9 | 41.4 | 68.7 | 22.5 | 16.1 | 9.07 | 17.2 | 25.0 | 39.0 | 16.9 | 24.2 | 1988 |
| 1989 | 12.1 | 11.0 | 9.62 | 38.2 | 74.5 | 12.1 | 6.40 | 34.2 | 22.6 | 38.0 | 39.5 | 13.0 | 26.0 | 1989 |
| 1990 | 14.4 | 17.9 | 7.47 | 45.5 | 83.5 | 30.0 | 19.0 | 19.7 | 20.1 | 39.2 | 41.4 | 75.8 | 34.6 | 1990 |
| 1991 | 13.5 | 9.35 | 14.7 | 25.7 | 83.5 | 30.2 | 8.22 | 6.08 | 34.8 | 33.4 | 24.7 | 18.3 | 25.3 | 1991 |
| 1992 | 9.30 | 4.43 | 10.8 | 23.7 | 91.6 | 32.7 | 7.50 | 7.19 | 10.4 | 28.0 | 27.7 | 18.6 | 22.8 | 1992 |
| 1993 | 9.48 | 10.0 | 12.2 | 55.9 | 109 | 18.7 | 18.9 | 15.0 | 19.9 | 36.6 | 47.9 | 37.6 | 32.7 | 1993 |
| MEAN | 16.4 | 14.4 | 15.5 | 37.5 | 69.4 | 28.3 | 13.3 | 15.5 | 17.7 | 26.8 | 32.3 | 27.0 | 26.5 | MEAN |

LOCATION - LAT 48:34:31N DRAINAGE AREA 640 km2
LONG 058:21:48W NATURAL FLOW

HARRYS RIVER BELOW HIGHWAY BRIDGE - STATION NO. 02YJ001

EXTREMES OF DISCHARGES(m3/s) FOR THE PERIOD OF RECORD

| YEAR | MAXIMUM INSTANTANEOUS DISCHARGES | | | | MAXIMUM DAILY DISCHARGES | | | MINIMUM DAILY DISCHARGES | | | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1969 | 436 | E | 08:00 NST | MAY 21 | 333 | | MAY 21 * | 3.79 | | AUG 10 | 1969 |
| 1970 | 281 | | 17:11 NST | MAY 27 | 184 | | MAY 27 | 3.87 | | AUG 11 | 1970 |
| 1971 | 183 | | 16:25 NST | OCT 11 | 121 | | APR 16 | 1.55 | | JUN 21 * | 1971 |
| 1972 | --- | | | | 228 | A | MAY 16 | 3.51 | | SEP 26 | 1972 |
| 1973 | 688 | | 17:41 NST | AUG 3 * | 260 | | AUG 3 | 6.20 | | APR 14 | 1973 |
| 1974 | 326 | | 18:31 NST | NOV 1 | 121 | | NOV 1 | 6.03 | E | AUG 25 | 1974 |
| 1975 | 430 | | 12:30 NST | DEC 23 | 261 | | DEC 23 | 3.62 | B | FEB 24 | 1975 |
| 1976 | 379 | | 16:56 NST | NOV 1 | 166 | | NOV 1 | 4.62 | | JUL 19 | 1976 |
| 1977 | 300 | | 03:46 NST | DEC 27 | 207 | | DEC 27 | 7.36 | B | FEB 21 | 1977 |
| 1978 | 340 | | 08:17 NST | JUN 9 | 186 | | JUN 9 | 3.85 | | SEP 11 | 1978 |
| 1979 | 244 | | 05:34 NST | NOV 11 | 165 | | MAR 8 | 5.42 | | JUL 16 | 1979 |
| 1980 | 442 | | 02:22 NST | NOV 6 | 219 | | NOV 6 | 3.82 | B | MAR 21 | 1980 |
| 1981 | 187 | | 20:19 NST | APR 30 | 131 | | MAY 3 | 5.91 | | JUL 27 | 1981 |
| 1982 | 281 | | 16:33 NST | APR 30 | 267 | | APR 30 | 6.20 | B | FEB 2 | 1982 |
| 1983 | 306 | | 17:51 NST | JAN 13 | 192 | | JAN 13 | 8.30 | B | MAR 3 | 1983 |
| 1984 | 208 | | 14:51 NST | MAY 15 | 137 | | MAY 15 | 6.95 | B | JAN 24 | 1984 |
| 1985 | 402 | | 12:22 NST | JUN 7 | 279 | | JUN 7 | 4.30 | | AUG 27 | 1985 |
| 1986 | 145 | | 20:00 NST | APR 17 | 142 | | APR 17 | 3.95 | B | MAR 18 | 1986 |
| 1987 | 256 | | 15:05 NST | SEP 2 | 182 | | APR 22 | 2.50 | B | MAR 18 | 1987 |
| 1988 | 268 | | 09:18 NST | NOV 29 | 157 | | NOV 29 | 3.00 | B | FEB 22 | 1988 |
| 1989 | 328 | | 16:42 NST | AUG 14 | 136 | | MAY 8 | 4.05 | B | FEB 20 | 1989 |
| 1990 | 565 | E | 16:25 NST | DEC 9 | 304 | | DEC 9 | 4.02 | B | MAR 17 | 1990 |
| 1991 | 261 | | 08:40 NST | SEP 27 | 167 | | SEP 27 | 3.32 | | AUG 15 | 1991 |
| 1992 | 285 | | 03:58 NST | MAY 15 | 238 | | MAY 15 | 2.40 | B | MAR 10 | 1992 |
| 1993 | 350 | | 09:23 NST | MAY 16 | 262 | | MAY 16 | 3.25 | B | FEB 13 | 1993 |

A - MANUAL GAUGE B - ICE CONDITIONS E - ESTIMATED R - REVISED * - EXTREME RECORD FOR THE PERIOD OF RECORD

BLANCHE BROOK NEAR STEPHENVILLE - STATION NO. 02YJ002

EXTREMES OF DISCHARGES(m3/s) FOR THE PERIOD OF RECORD

| YEAR | MAXIMUM INSTANTANEOUS DISCHARGES | | | | MAXIMUM DAILY DISCHARGES | | | MINIMUM DAILY DISCHARGES | | | YEAR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | 36.2 | | 05:20 NST | NOV 15 | --- | | | --- | | | 1978 |
| 1979 | 112 | | 03:58 NST | JUL 18 | 62.9 | | MAR 8 | 0.691 | E | JUL 1 | 1979 |
| 1980 | 71.7 | | 17:30 NST | NOV 5 | 50.9 | | APR 25 | 0.450 | B | MAR 21 | 1980 |
| 1981 | 58.6 | | 01:45 NST | DEC 4 | 39.6 | | APR 7 | 0.470 | | SEP 19 | 1981 |
| 1982 | 65.6 | | 13:00 NST | APR 30 | 60.0 | | APR 30 | 0.360 | B | MAR 5 | 1982 |
| 1983 | 88.9 | | 19:00 NST | AUG 7 | 41.6 | A | AUG 7 | 0.300 | B | MAR 2 | 1983 |
| 1984 | 43.4 | | 17:45 NST | AUG 21 | 31.3 | | FEB 6 | 0.670 | B | JAN 24 | 1984 |
| 1985 | 70.5 | | 07:34 NST | JUN 7 | 46.1 | | MAY 19 | 0.375 | B | FEB 15 | 1985 |
| 1986 | 58.7 | | 07:53 NST | APR 23 | 37.8 | | APR 17 | 0.320 | B | MAR 20 | 1986 |
| 1987 | 120 | | 14:01 NST | SEP 2 | 33.9 | | SEP 2 | 0.067 | B | MAR 17 • | 1987 |
| 1988 | 65.0 | | 08:39 NST | NOV 29 | 41.4 | | NOV 29 | 0.252 | B | FEB 26 | 1988 |
| 1989 | 173 | E | 14:48 NST | AUG 14 • | 54.6 | | AUG 14 | 0.420 | | JUL 21 | 1989 |
| 1990 | --- | | | | 87.9 | A | DEC 9 • | 0.170 | B | MAR 17 | 1990 |
| 1991 | 32.5 | E | 09:18 NST | SEP 27 | 21.9 | | MAY 5 | 0.276 | | AUG 15 | 1991 |
| 1992 | 84.5 | E | 23:46 NST | MAY 14 | 49.6 | | MAY 15 | 0.295 | B | MAR 11 | 1992 |
| 1993 | 82.0 | | 22:24 NST | MAY 1 | 62.2 | | APR 23 | 0.340 | B | FEB 13 | 1993 |

A - MANUAL GAUGE B - ICE CONDITIONS E - ESTIMATED R - REVISED • - EXTREME RECORD FOR THE PERIOD OF RECORD

Station BLANCHE BROOK NEAR STEPHENVILLE
No. 02YJ002 Parameter Flow m3/s
Latitude 48:32:56N Drainage Area Gross 120 km2 Hist. Oper. Period
Longitude 058:34:11W
Region DARTMOUTH Prov-Terr-State NF

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D Cnt | 465 | 424 | 465 | 450 | 465 | 450 | 484 | 496 | 480 | 496 | 480 | 496 | 5651 |
| D Avg | 2.43 | 1.68 | 3.06 | 8.81 | 9.64 | 4.09 | 2.96 | 3.43 | 4.07 | 5.00 | 5.69 | 4.57 | 4.60 |
| D Max | 38.7 | 31.3 | 62.9 | 62.2 | 52.2 | 44.5 | 51.8 | 54.6 | 34.8 | 33.5 | 41.4 | 87.9 | 87.9 |
| D Min | 0.349 | 0.139 | 0.067 | 0.720 | 0.384 | 0.540 | 0.318 | 0.276 | 0.382 | 0.762 | 0.537 | 0.520 | 0.067 |
| M Cnt | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 185 |
| M Std | 2.14 | 1.54 | 3.29 | 3.69 | 5.20 | 2.41 | 1.76 | 3.57 | 1.67 | 1.84 | 1.85 | 4.61 | 3.74 |
| M Skw | 2.23 | 2.44 | 2.76 | 0.241 | 0.102 | 1.32 | 0.138 | 2.36 | -0.186 | 0.212 | 0.596 | 2.93 | 1.63 |
| M Max | 8.79 | 6.48 | 13.7 | 15.3 | 17.3 | 10.5 | 6.23 | 14.3 | 6.64 | 8.52 | 9.81 | 20.3 | 20.3 |
| M Min | 0.752 | 0.542 | 0.570 | 3.79 | 1.41 | 1.19 | 0.576 | 0.732 | 1.19 | 1.79 | 2.80 | 1.19 | 0.542 |

Years: 1978-93

# Appendix C

# Flood Frequency Analysis Results
# Harrys River and Blanche Brook

WSC STATION NO=02YJ001

WSC STATION NAME=HARRYS RIVER BELOW HIGHWAY BRIDGE

| MONTH | YEAR | DATA | ORDERED | RANK | PROB. | RET. PERIOD |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) (%) | (7) (YEARS) |
| 5 | 1969 | 436.000 | 688.000 | 1 | 2.48 | 40.333 |
| 5 | 1970 | 281.000 | 565.000 | 2 | 6.61 | 15.125 |
| 10 | 1971 | 183.000 | 442.000 | 3 | 10.74 | 9.308 |
| 8 | 1973 | 688.000 | 436.000 | 4 | 14.88 | 6.722 |
| 11 | 1974 | 326.000 | 430.000 | 5 | 19.01 | 5.261 |
| 12 | 1975 | 430.000 | 402.000 | 6 | 23.14 | 4.321 |
| 11 | 1976 | 379.000 | 379.000 | 7 | 27.27 | 3.667 |
| 12 | 1977 | 300.000 | 350.000 | 8 | 31.40 | 3.184 |
| 6 | 1978 | 340.000 | 340.000 | 9 | 35.54 | 2.814 |
| 11 | 1979 | 244.000 | 328.000 | 10 | 39.67 | 2.521 |
| 11 | 1980 | 442.000 | 326.000 | 11 | 43.80 | 2.283 |
| 4 | 1981 | 187.000 | 306.000 | 12 | 47.93 | 2.086 |
| 4 | 1982 | 281.000 | 300.000 | 13 | 52.07 | 1.921 |
| 1 | 1983 | 306.000 | 285.000 | 14 | 56.20 | 1.779 |
| 5 | 1984 | 208.000 | 281.000 | 15 | 60.33 | 1.658 |
| 6 | 1985 | 402.000 | 281.000 | 16 | 64.46 | 1.551 |
| 4 | 1986 | 145.000 | 268.000 | 17 | 68.60 | 1.458 |
| 9 | 1987 | 256.000 | 261.000 | 18 | 72.73 | 1.375 |
| 11 | 1988 | 268.000 | 256.000 | 19 | 76.86 | 1.301 |
| 8 | 1989 | 328.000 | 244.000 | 20 | 80.99 | 1.235 |
| 12 | 1990 | 565.000 | 208.000 | 21 | 85.12 | 1.175 |
| 9 | 1991 | 261.000 | 187.000 | 22 | 89.26 | 1.120 |
| 5 | 1992 | 285.000 | 183.000 | 23 | 93.39 | 1.071 |
| 5 | 1993 | 350.000 | 145.000 | 24 | 97.52 | 1.025 |

--- SPEARMAN TEST FOR INDEPENDENCE ---

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE
ANNUAL MAXIMUM DAILY FLOW SERIES 1969 TO 1993 DRAINAGE AREA = 640.0000

SPEARMAN RANK ORDER SERIAL CORRELATION COEFF = -.158 D.F.= 20
CORRESPONDS TO STUDENTS T = -.714
CRITICAL T VALUE AT 5% LEVEL = 1.725 NOT SIGNIFICANT
- - - - 1% - = 2.528 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the correlation is zero.

At the 5% level of significance, the correlation is not significantly different from zero. That is, the data do not display significant serial dependence.

--- SPEARMAN TEST FOR TREND ---

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE
ANNUAL MAXIMUM DAILY FLOW SERIES 1969 TO 1993 DRAINAGE AREA = 640.0000

SPEARMAN RANK ORDER CORRELATION COEFF = .156 D.F.= 22
CORRESPONDS TO STUDENTS T = .741
CRITICAL T VALUE AT 5% LEVEL = 2.074 NOT SIGNIFICANT
- - - - 1% - = 2.819 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the serial(lag-one) correlation is zero.

At the 5% level of significance, the correlation is not significantly different from zero. That is, the data do not display significant trend.

--- RUN TEST FOR GENERAL RANDOMNESS ---

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE
ANNUAL MAXIMUM DAILY FLOW SERIES 1969 TO 1993 DRAINAGE AREA = 640.0000

THE NUMBER OF RUNS ABOVE AND BELOW THE MEDIAN (RUNAB) = 15
THE NUMBER OF OBSERVATIONS ABOVE THE MEDIAN(N1) = 12
THE NUMBER OF OBSERVATIONS BELOW THE MEDIAN(N2) = 12
Range at 5% level of significance: 8. to 18. NOT SIGNIFICANT

Interpretation: The null hypothesis is that the data are random.

At the 5% level of significance, the null hypothesis cannot be rejected. That is, the sample is significantly random.

--- MANN-WHITNEY SPLIT SAMPLE TEST FOR HOMOGENEITY ---

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE
ANNUAL MAXIMUM FLOW SERIES 1969 TO 1993 DRAINAGE AREA= 640.0000

SPLIT BY TIME SPAN, SUBSAMPLE 1 SAMPLE SIZE= 12
SUBSAMPLE 2 SAMPLE SIZE= 12

MANN-WHITNEY U = 55.5
CRITICAL U VALUE AT 5% SIGNIFICANT LEVEL = 42.0 NOT SIGNIFICANT
- - - - - 1% - - = 31.0 NOT SIGNIFICANT

Interpretation: The null hypothesis is that there is no
location difference between the two samples.

At the 5% level of significance, there is no significant
location difference between the two samples. That is, they
appear to be from the same population.

FREQUENCY ANALYSIS - GENERALIZED EXTREME VALUE DISTRIBUTION
02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 328.792 | 122.685 | .373 | 1.233 | 5.617 |
| LN X SERIES | 5.734 | .357 | .062 | .089 | 3.805 |
| L-MOM RATIO | 328.792 | 66.545 | .202 | .210 | .230 |

X(MIN)= 145.000 TOTAL SAMPLE SIZE= 24
X(MAX)= 688.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 128.286 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA L - MOMENTS

GEV PARAMETERS: U= 269.40 A= 91.744 K= -.067

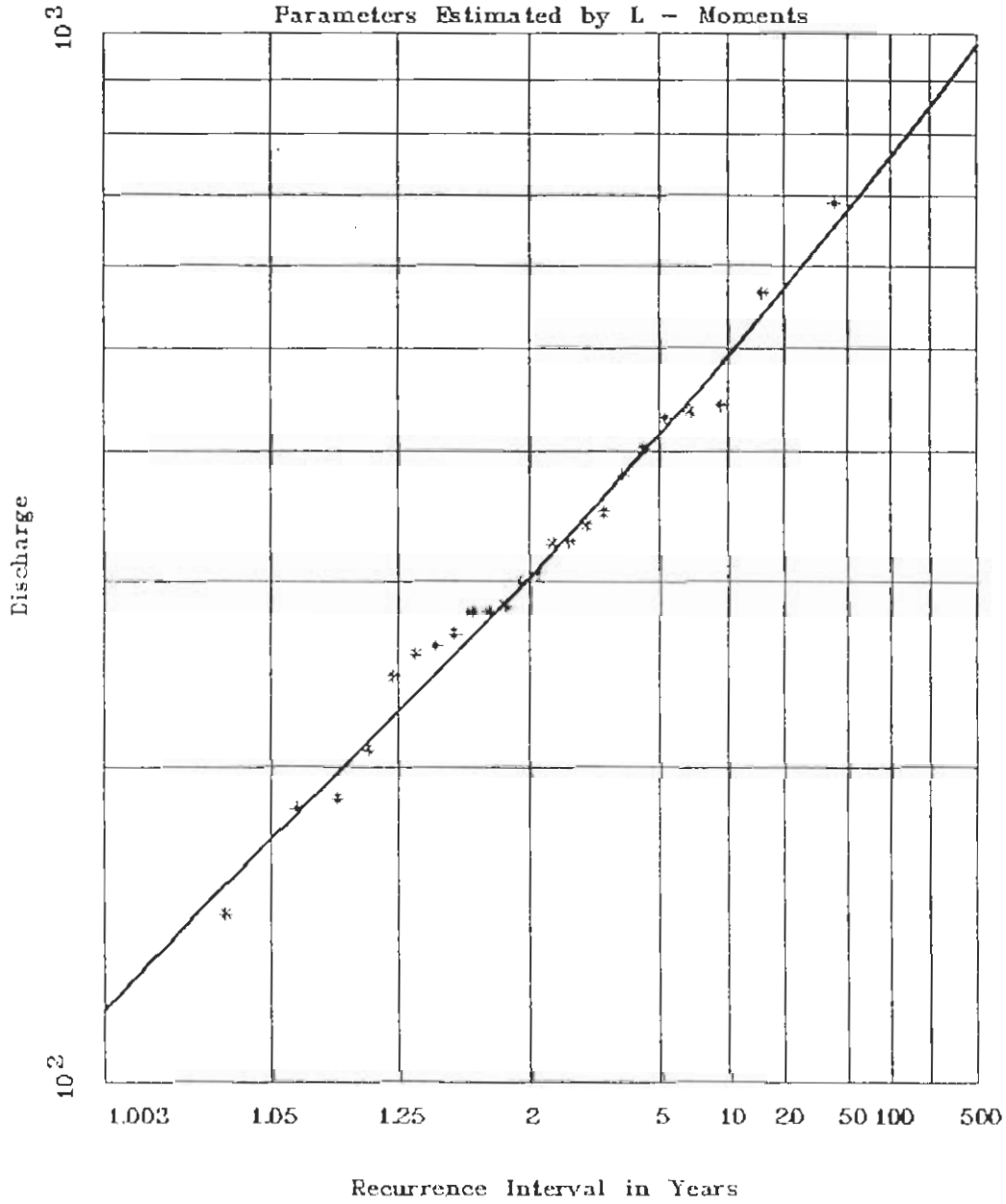
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 117 |
| 1.050 | .952 | 171 |
| 1.250 | .800 | 226 |
| 2.000 | .500 | 303 |
| 5.000 | .200 | 414 |
| 10.000 | .100 | 492 |
| 20.000 | .050 | 571 |
| 50.000 | .020 | 678 |
| 100.000 | .010 | 763 |
| 200.000 | .005 | 852 |
| 500.000 | .002 | 975 |

# Flood Frequency - Generalized Extreme Value Distribution

0ZYJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

Parameters Estimated by L - Moments



FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 328.792 | 122.685 | .373 | 1.233 | 5.617 |
| LN X SERIES | 5.734 | .357 | .062 | .089 | 3.805 |
| LN(X-A) SERIES | 5.661 | .383 | .068 | .004 | 3.813 |

X(MIN)= 145.000 TOTAL SAMPLE SIZE= 24
X(MAX)= 688.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 128.286 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

3LN PARAMETERS: A= 20.448 M= 5.661 S= .383

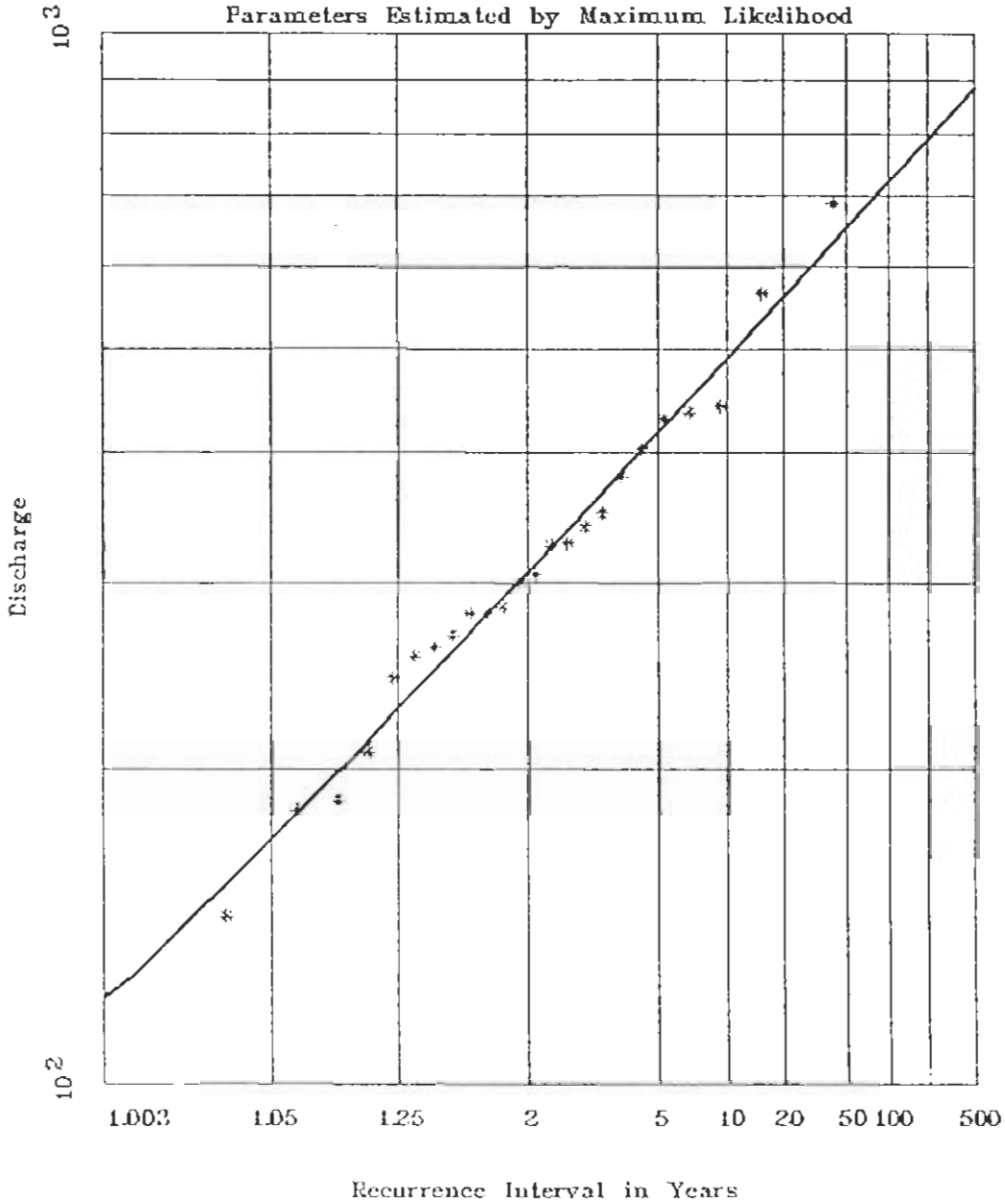
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 121 |
| 1.050 | .952 | 172 |
| 1.250 | .800 | 229 |
| 2.000 | .500 | 308 |
| 5.000 | .200 | 417 |
| 10.000 | .100 | 490 |
| 20.000 | .050 | 560 |
| 50.000 | .020 | 652 |
| 100.000 | .010 | 722 |
| 200.000 | .005 | 792 |
| 500.000 | .002 | 887 |

# Flood Frequency - Three Parameter Lognormal Distribution

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

Parameters Estimated by Maximum Likelihood



FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 328.792 | 122.685 | .373 | 1.233 | 5.617 |
| LN X SERIES | 5.734 | .357 | .062 | .089 | 3.805 |

X(MIN)= 145.000 TOTAL SAMPLE SIZE= 24
X(MAX)= 688.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 128.286 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

LP3 PARAMETERS: A= .1407E-01 B= 615.2 LOG(M)= -2.924
M = .5374E-01

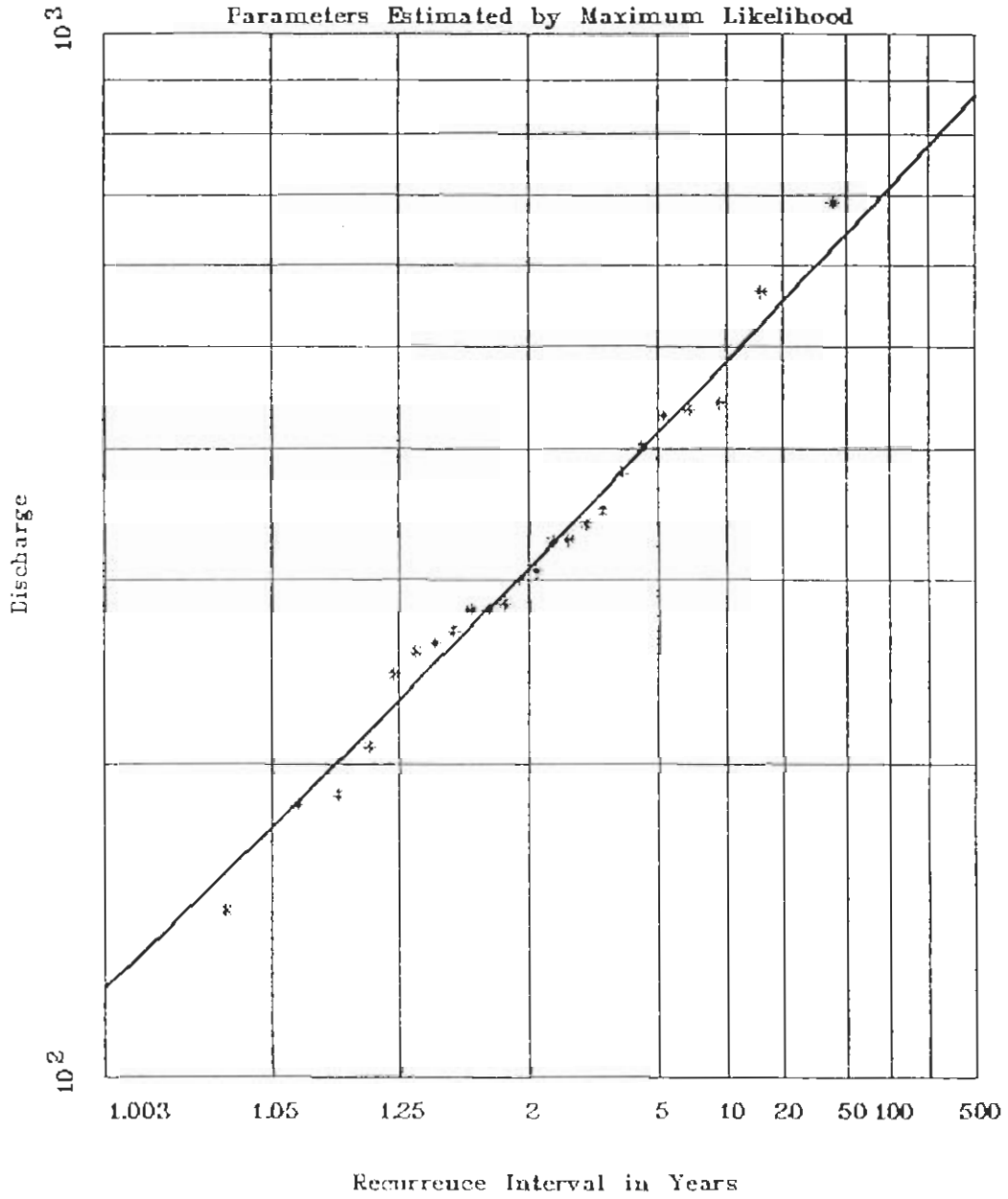
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 122 |
| 1.050 | .952 | 174 |
| 1.250 | .800 | 230 |
| 2.000 | .500 | 308 |
| 5.000 | .200 | 414 |
| 10.000 | .100 | 485 |
| 20.000 | .050 | 553 |
| 50.000 | .020 | 643 |
| 100.000 | .010 | 711 |
| 200.000 | .005 | 780 |
| 500.000 | .002 | 874 |

# Flood Frequency - Log Pearson Type III Distribution

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

Parameters Estimated by Maximum Likelihood



FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 328.792 | 122.685 | .373 | 1.233 | 5.617 |
| LN X SERIES | 5.734 | .357 | .062 | .089 | 3.805 |
| L-MOM RATIO | 328.792 | 66.545 | .202 | .210 | .230 |

X(MIN)= 145.000 TOTAL SAMPLE SIZE= 24
X(MAX)= 688.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 128.286 NO. OF ZERO FLOWS= 0

THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED VIA L-MOMENTS

M= 96.513 A= 140.838 B= 9.02 C= 714.175 D= .129

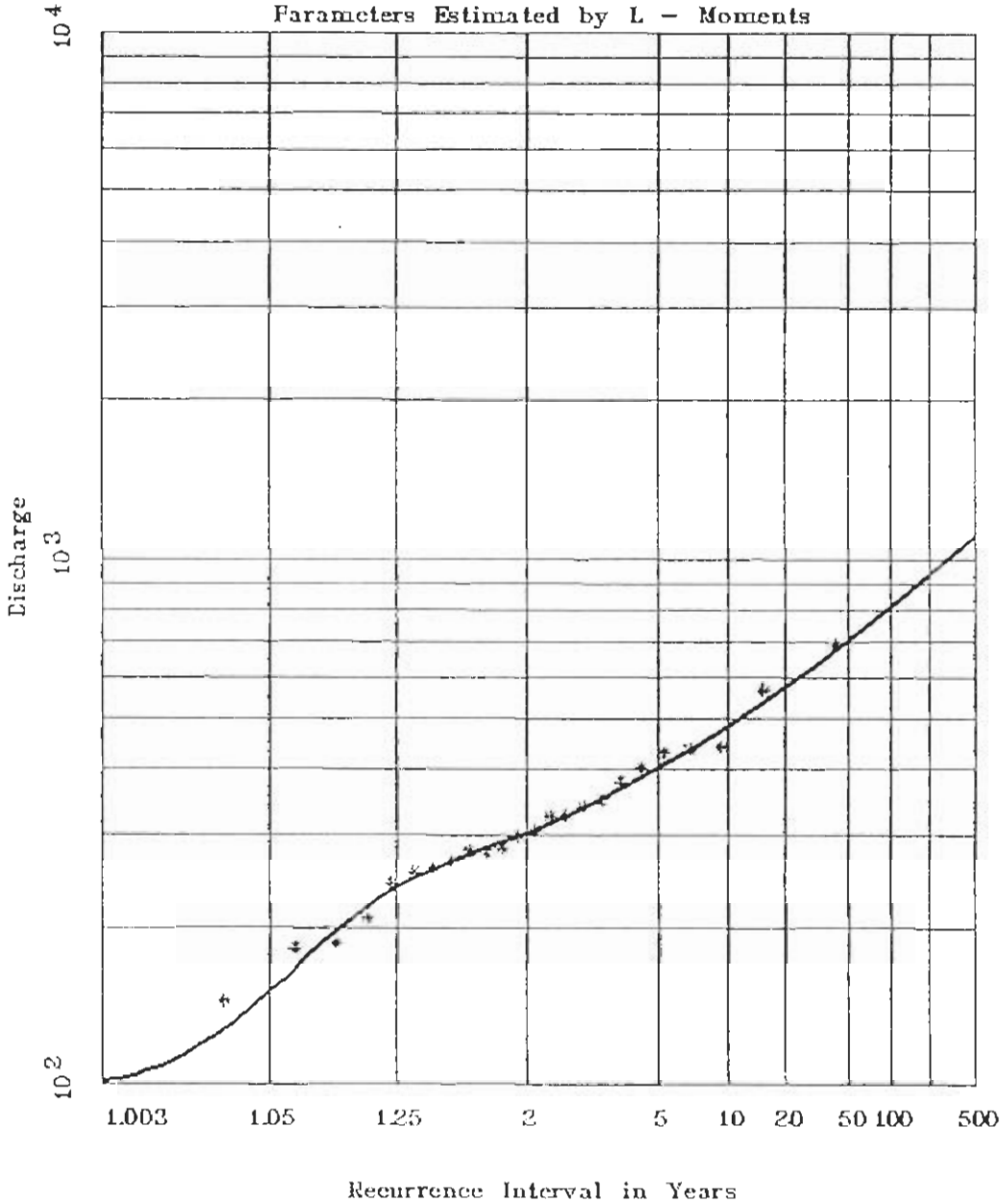
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 101 |
| 1.050 | .952 | 151 |
| 1.250 | .800 | 239 |
| 2.000 | .500 | 304 |
| 5.000 | .200 | 402 |
| 10.000 | .100 | 484 |
| 20.000 | .050 | 573 |
| 50.000 | .020 | 705 |
| 100.000 | .010 | 815 |
| 200.000 | .005 | 936 |
| 500.000 | .002 | 1110 |

# Flood Frequency – Wakeby Distribution

02YJ001 HARRYS RIVER BELOW HIGHWAY BRIDGE

Parameters Estimated by L – Moments



WSC STATION NO=02YJ002

WSC STATION NAME=BLANCHE BROOK NEAR STEPHENVILLE

| MONTH | YEAR | DATA | ORDERED | RANK | PROB. | RET. PERIOD |
|---|---|---|---|---|---|---|
| (1) | (2) | (3) | (4) | (5) | (6) (%) | (7) (YEARS) |
| 11 | 1978 | 36.200 | 173.000 | 1 | 3.95 | 25.333 |
| 6 | 1979 | 112.000 | 120.000 | 2 | 10.53 | 9.500 |
| 11 | 1980 | 71.700 | 112.000 | 3 | 17.11 | 5.846 |
| 12 | 1981 | 58.600 | 88.900 | 4 | 23.68 | 4.222 |
| 4 | 1982 | 65.600 | 84.500 | 5 | 30.26 | 3.304 |
| 8 | 1983 | 88.900 | 82.000 | 6 | 36.84 | 2.714 |
| 8 | 1984 | 43.400 | 71.700 | 7 | 43.42 | 2.303 |
| 6 | 1985 | 70.500 | 70.500 | 8 | 50.00 | 2.000 |
| 4 | 1986 | 58.700 | 65.600 | 9 | 56.58 | 1.767 |
| 9 | 1987 | 120.000 | 65.000 | 10 | 63.16 | 1.583 |
| 11 | 1988 | 65.000 | 58.700 | 11 | 69.74 | 1.434 |
| 8 | 1989 | 173.000 | 58.600 | 12 | 76.32 | 1.310 |
| 9 | 1991 | 32.500 | 43.400 | 13 | 82.89 | 1.206 |
| 5 | 1992 | 84.500 | 36.200 | 14 | 89.47 | 1.118 |
| 5 | 1993 | 82.000 | 32.500 | 15 | 96.05 | 1.041 |

--- SPEARMAN TEST FOR INDEPENDENCE ---

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE
ANNUAL MAXIMUM DAILY FLOW SERIES 1978 TO 1993 DRAINAGE AREA = 117.0000

SPEARMAN RANK ORDER SERIAL CORRELATION COEFF = -.500 D.F.= 11
CORRESPONDS TO STUDENTS T =-1.915
CRITICAL T VALUE AT 5% LEVEL = 1.796 NOT SIGNIFICANT
- - - - 1% - = 2.718 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the correlation is zero.

At the 5% level of significance, the correlation is not significantly different from zero. That is, the data do not display significant serial dependence.

--- SPEARMAN TEST FOR TREND ---

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE
ANNUAL MAXIMUM DAILY FLOW SERIES 1978 TO 1993 DRAINAGE AREA = 117.0000

SPEARMAN RANK ORDER CORRELATION COEFF = -.182 D.F.= 13
CORRESPONDS TO STUDENTS T = -.668
CRITICAL T VALUE AT 5% LEVEL =-2.160 NOT SIGNIFICANT
- - - - 1% - =-3.012 NOT SIGNIFICANT

Interpretation: The null hypothesis is that the serial(lag-one) correlation is zero.

At the 5% level of significance, the correlation is not significantly different from zero. That is, the data do not display significant trend.

--- RUN TEST FOR GENERAL RANDOMNESS ---

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE
ANNUAL MAXIMUM DAILY FLOW SERIES 1978 TO 1993 DRAINAGE AREA = 117.0000

THE NUMBER OF RUNS ABOVE AND BELOW THE MEDIAN (RUNAB) = 10
THE NUMBER OF OBSERVATIONS ABOVE THE MEDIAN(N1) = 7
THE NUMBER OF OBSERVATIONS BELOW THE MEDIAN(N2) = 7
Range at 5% level of significance: 4. to 12. NOT SIGNIFICANT

Interpretation: The null hypothesis is that the data are random.

At the 5% level of significance, the null hypothesis cannot be rejected. That is, the sample is significantly random.

--- MANN-WHITNEY SPLIT SAMPLE TEST FOR HOMOGENEITY ---

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE
ANNUAL MAXIMUM FLOW SERIES 1978 TO 1993 DRAINAGE AREA= 117.0000

SPLIT BY TIME SPAN, SUBSAMPLE 1 SAMPLE SIZE= 6
SUBSAMPLE 2 SAMPLE SIZE= 9

MANN-WHITNEY U = 18.0
CRITICAL U VALUE AT 5% SIGNIFICANT LEVEL = 12.0 NOT SIGNIFICANT
- - - - - 1% - - = 7.0 NOT SIGNIFICANT

Interpretation: The null hypothesis is that there is no
location difference between the two samples.

At the 5% level of significance, there is no significant
location difference between the two samples. That is, they
appear to be from the same population.

FREQUENCY ANALYSIS - GENERALIZED EXTREME VALUE DISTRIBUTION
02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 77.507 | 36.155 | .466 | 1.346 | 6.207 |
| LN X SERIES | 4.257 | .445 | .105 | .086 | 3.908 |
| L-MOM RATIO | 77.507 | 19.695 | .254 | .251 | .266 |

X(MIN)= 32.500 TOTAL SAMPLE SIZE= 15
X(MAX)= 173.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 25.998 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA L - MOMENTS

GEV PARAMETERS: U= 59.44 A= 25.397 K= -.120

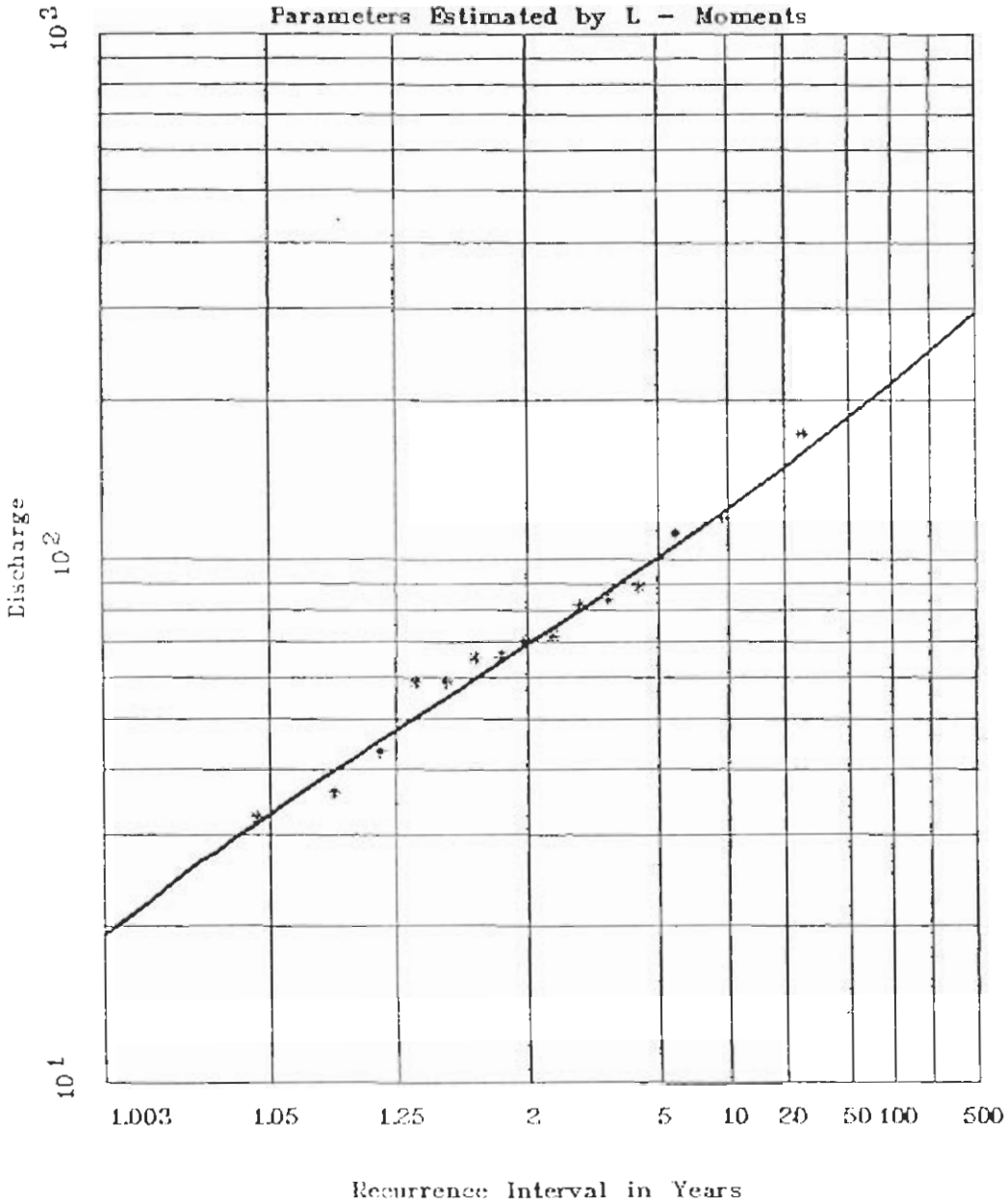
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 19.2 |
| 1.050 | .952 | 33.0 |
| 1.250 | .800 | 47.7 |
| 2.000 | .500 | 69.0 |
| 5.000 | .200 | 101 |
| 10.000 | .100 | 125 |
| 20.000 | .050 | 150 |
| 50.000 | .020 | 186 |
| 100.000 | .010 | 216 |
| 200.000 | .005 | 248 |
| 500.000 | .002 | 294 |

# Flood Frequency - Generalized Extreme Value Distribution

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

**Parameters Estimated by L - Moments**



FREQUENCY ANALYSIS - THREE-PARAMETER LOGNORMAL DISTRIBUTION
02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 77.507 | 36.155 | .466 | 1.346 | 6.207 |
| LN X SERIES | 4.257 | .445 | .105 | .086 | 3.908 |
| LN(X-A) SERIES | 4.126 | .507 | .123 | -.072 | 3.873 |

X(MIN)= 32.500 TOTAL SAMPLE SIZE= 15
X(MAX)= 173.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 25.998 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

3LN PARAMETERS: A= 7.856 M= 4.126 S= .507

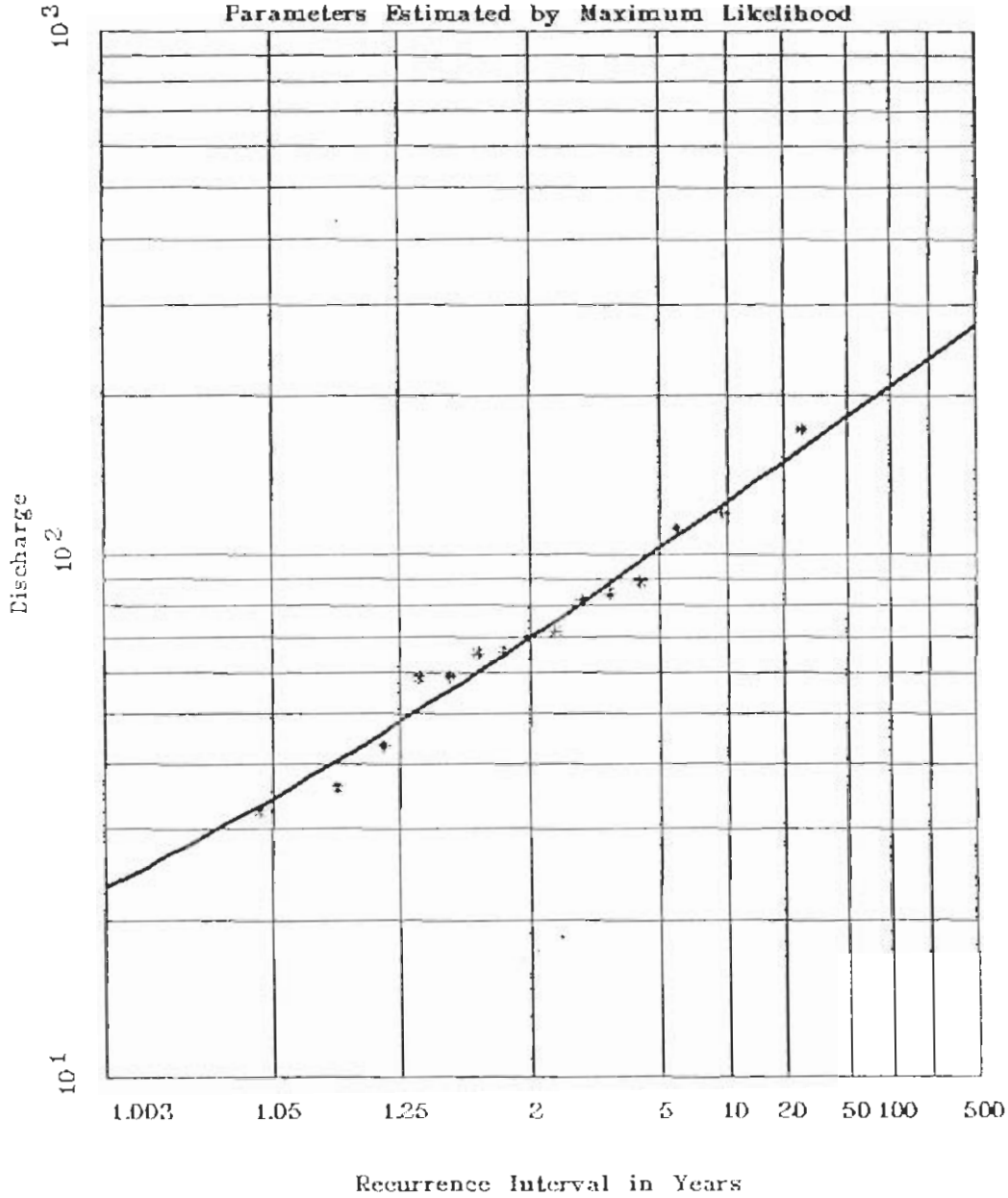
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 23.2 |
| 1.050 | .952 | 34.4 |
| 1.250 | .800 | 48.3 |
| 2.000 | .500 | 69.8 |
| 5.000 | .200 | 103 |
| 10.000 | .100 | 126 |
| 20.000 | .050 | 150 |
| 50.000 | .020 | 183 |
| 100.000 | .010 | 209 |
| 200.000 | .005 | 236 |
| 500.000 | .002 | 274 |

# Flood Frequency - Three Parameter Lognormal Distribution

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

**Parameters Estimated by Maximum Likelihood**



FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 77.507 | 36.155 | .466 | 1.346 | 6.207 |
| LN X SERIES | 4.257 | .445 | .105 | .086 | 3.908 |

X(MIN)= 32.500 TOTAL SAMPLE SIZE= 15
X(MAX)= 173.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 25.998 NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MAXIMUM LIKELIHOOD

LP3 PARAMETERS: A= .2169E-01 B= 392.8 LOG(M)= -4.264
M = .1407E-01

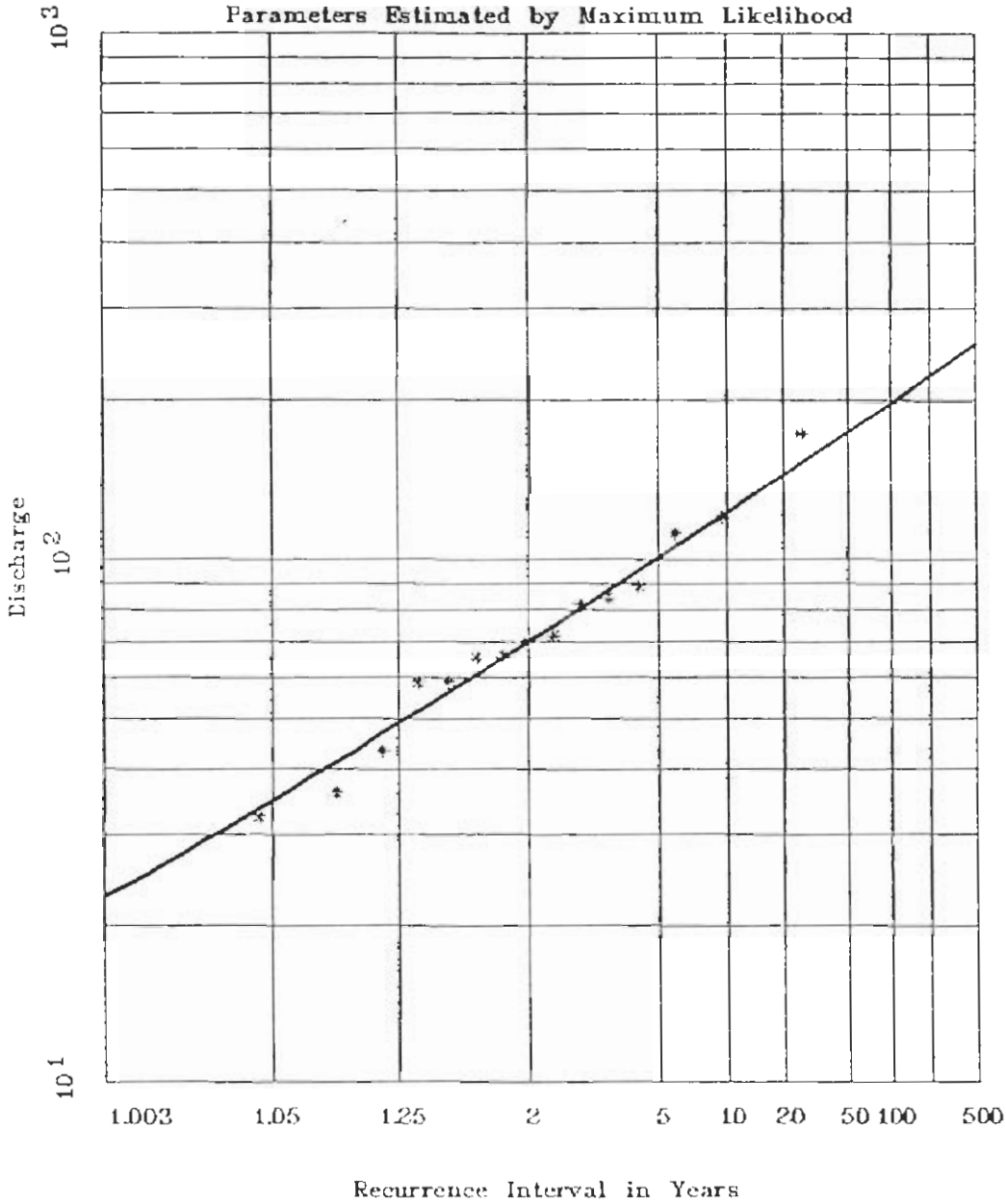
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 22.7 |
| 1.050 | .952 | 34.9 |
| 1.250 | .800 | 49.1 |
| 2.000 | .500 | 70.1 |
| 5.000 | .200 | 101 |
| 10.000 | .100 | 123 |
| 20.000 | .050 | 145 |
| 50.000 | .020 | 175 |
| 100.000 | .010 | 198 |
| 200.000 | .005 | 223 |
| 500.000 | .002 | 257 |

# Flood Frequency - Log Pearson Type III Distribution

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

Parameters Estimated by Maximum Likelihood



FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

SAMPLE STATISTICS

| | MEAN | S.D. | C.V. | C.S. | C.K. |
|---|---|---|---|---|---|
| X SERIES | 77.507 | 36.155 | .466 | 1.346 | 6.207 |
| LN X SERIES | 4.257 | .445 | .105 | .086 | 3.908 |
| L-MOM RATIO | 77.507 | 19.695 | .254 | .251 | .266 |

X(MIN)= 32.500 TOTAL SAMPLE SIZE= 15
X(MAX)= 173.000 NO. OF LOW OUTLIERS= 0
LOWER OUTLIER LIMIT OF X= 25.998 NO. OF ZERO FLOWS= 0

THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED VIA L-MOMENTS

M= 13.750 A= 37.091 B= 8.57 C= 138.284 D= .181

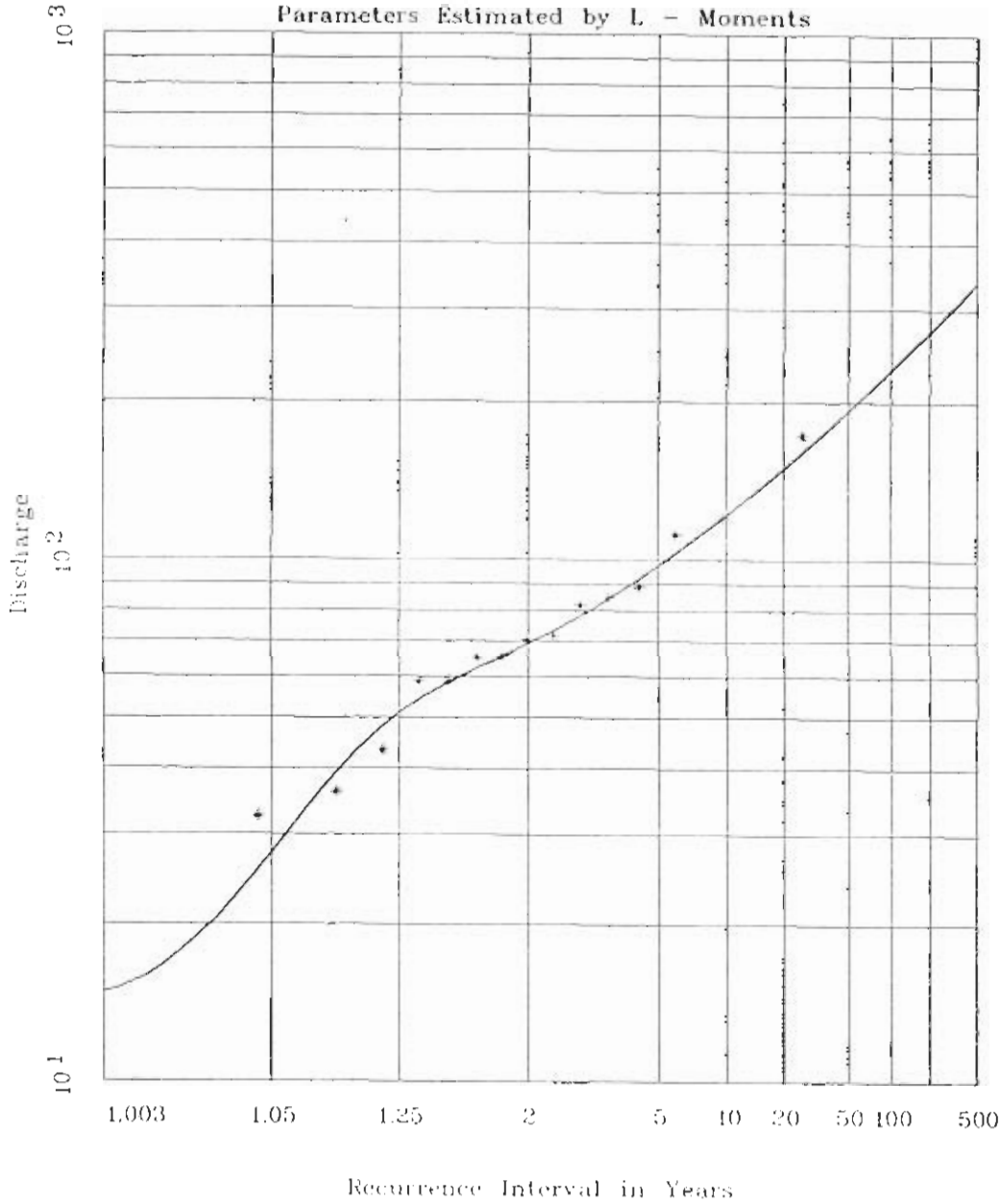
FLOOD FREQUENCY REGIME

| RETURN PERIOD | EXCEEDANCE PROBABILITY | FLOOD |
|---|---|---|
| 1.003 | .997 | 14.8 |
| 1.050 | .952 | 27.6 |
| 1.250 | .800 | 51.1 |
| 2.000 | .500 | 69.2 |
| 5.000 | .200 | 97.6 |
| 10.000 | .100 | 122 |
| 20.000 | .050 | 150 |
| 50.000 | .020 | 193 |
| 100.000 | .010 | 231 |
| 200.000 | .005 | 273 |
| 500.000 | .002 | 338 |

# Flood Frequency - Wakeby Distribution

02YJ002 BLANCHE BROOK NEAR STEPHENVILLE

**Parameters Estimated by L - Moments**



# Appendix C.1

# Background For Deterministic Analyses

The following sections provide additional information concerning the methodology applied in determining the parameters for use in the OTTHYMO model for peak flow estimates.

## C.1 Hydrological Input Parameters

In order to assess the response of the watershed to a rainfall event, the time to peak and recession constant for the unit hydrograph must be determined. The following describes the various methods used to develop these parameters.

### C.1.1 Time to Peak and Recession Constant

a) The assessment of the time to peak parameter, $T_p$, for each subwatershed involved the application of the following equation developed for OTTHYMO (44):

$$T_p = 4.63\ DA.^{422}\ SLP\text{-}.^{46}\ (L^2/DA).^{133} \qquad (C.1)$$

where:

DA = area of watershed ($mi^2$)
SLP = slope of watershed (ft./mi)
L = length of watershed (mi)

b) The initial determination of the hydrograph recession constant, K, involved the application of the following equation as given in the publication on the program OTTHYMO (44):

$$K = 27.0\ DA.^{231}\ SLP\text{-}.^{777}\ (L^2/DA).^{124} \qquad (C.2)$$

where:

DA = watershed area ($mi^2$)
L = watercourse length (mi)
SLP = slope of watercourse (ft/mi)

Note: The above equations were originally (empirically) developed using the English system of units.

The initial parameter estimates are summarized in Table C.1.

### C.1.2 Model Calibration

The hydrologic model was calibrated by computing unit hydrograph parameters (k and $T_p$) at the gauge location and for each subcatchment. In order to determine the unit hydrograph parameters of the watershed at the gauge location, the Collins hydrograph deconvolution method (31) was applied to a number of historical runoff events. This method was selected as it is one of a few ways to separate a runoff event into a series of incremental hydrographs which are directly proportional (peak flow rate and runoff volume) to consecutive periods of varying runoff intensity. the Collins method involves finding a set of coefficients which describe the unit hydrograph shape by a series of trial and error approximations. The coefficients of the unit hydrograph were obtained for a number of events which were used to obtain an average set of values. From the deconvoluted unit hydrograph, parameters K and $T_p$ were calculated directly and compared with the values estimated from equations C.1 and C.2.

It was found that the parameter values calculated using the empirical equations had to be increased slightly to match the deconvoluted unit hydrograph characteristics. The subwatershed unit hydrograph parameters were adjusted accordingly and are presented in Table C.2.

### C.1.3 Soil Cover Complex Number

The soil cover complex number, for each of the 10 subcatchments which comprise the Blanche Brook watershed, was calculated based on the method outlined by the Soil Conservation Service (41).

Using the values summarized in Table C.3, weighted curve numbers as presented in Table C.4 were calculated for each subwatershed.

CN numbers for average soil moisture conditions can be converted to the AMC III condition (saturated soil moisture conditions) by utilizing the relationships given in Table C.5.

### C.1.4 Reservoir Characteristics

As described in the report, Noels Pond was modelled using the storage indication method available as a subroutine in the OTTHYMO computer model. Field measurements were obtained for the outlet structures and topographic maps were used to obtain the available storage.

The outflow/storage characteristics of Noels Pond were obtained from existing 1:12,500 scale mapping and hydraulic computations for the outlet structure. The preliminary HEC-2 backwater model was utilized to obtain outflow rates from the pond during high flow periods when the structure operates as a submerged weir. Manual calculations were utilized to compute outflows during low flow periods.

Based on a review of the reservoir operations procedures, the reservoir was assumed to have the stop logs in place for summer design events (rainfall) and the stop logs removed for spring design events (rainfall plus snowmelt). Table C.6 presents the outflow storage characteristics for each condition at the outlet structure.

## C.2 Rainfall Analysis

An analysis of historical rainfall events was carried out to determined a temporal distribution for the design rainfall events. The events selected were recent storms which occurred in the vicinity of the study area and are representative of rainfall events for Blanche Brook. Dimensionless mass curves were derived for each storm and an average temporal distribution was determined.

The resulting distribution was also compared to recent analyses by the Atmospheric Environment Services (AES) of Environment Canada for the Atlantic Provinces and it was found that both temporal distributions were very similar. The AES distribution was used to simulate design events since it would result in slightly more conservative peak flow estimates. Table C.7 presents a comparison of the two rainfall temporal distributions computed.

Figure C.1 presents the intensity duration characteristics of rainfall (summer and spring) and rainfall plus melt events. Total precipitation amounts for various storms are also presented in Table C.8.

## C.3 Snowmelt Analysis

### C.3.1 Atmospheric Environment Service Snowmelt Analysis

As discussed in the main text, the snowmelt analysis was undertaken using an algorithm derived from an energy budget method developed by the U.S. Army Corps of Engineers for forested areas. This algorithm uses recorded meteorologic data to compute various return frequency snowmelt amounts. It is preferred to use recorded meteorologic data because major spring runoff events are usually a combination of rainfall plus snowmelt conditions. Because the meteorologic inputs to such events (rainfall, temperature, snowpack, etc.) are

not mutually exclusive (i.e., are somewhat dependent upon each other), their combined probability is not easily calculated.

Therefore, the rainfall plus snowmelt was established by analysis of available data for the Stephenville meteorologic station.. This analysis was undertaken by staff of AES and uses historical meteorologic data to obtain the 1 to 10 day melt plus rainfall totals available for runoff.

### C.3.2 Snowmelt Flow Simulations

The 1:100 and 1:20 year spring snowmelt plus rainfall design events were also simulated with the OTTHYMO model. Based on the spring snowmelt flow simulations, the 1:100 year and 1:20 year peak flows at the gauge location were computed to be 130.3 $m^3/s$ and 83.8 $m^3/s$ respectively. As discussed in Section 3.0, these spring peak flow estimates were found to be considerably smaller in magnitude than comparable summer rainfall events (See Table 3.6). Therefore, it was concluded that summer meteorologic design events should be utilized for estimating peak design flow rates within the study area.

Table C.1

Stephenville, OTTHYMO Modelling, November, 1995

| Basin No. | Area ($km^2$) | Length (km) | Slope (m/m) | Tp (Hour) | K | CN |
|---|---|---|---|---|---|---|
| 1011 | 21.3 | 12.9 | 0.018 | 1.82 | 1.65 | 87 |
| 1012 | 25.9 | 11.2 | 0.013 | 2.16 | 2.09 | 87 |
| 102 | 15.48 | 9.75 | 0.0207 | 1.65 | 1.58 | 87 |
| 103 | 1.16 | 1.08 | 0.0333 | 0.35 | 0.48 | 89 |
| 201 | 35.4 | 12.55 | 0.0208 | 2.24 | 1.84 | 88 |
| 202 | 9.08 | 3.72 | 0.0188 | 1.15 | 1.91 | 92 |
| 203 | 6.89 | 4.29 | 0.0334 | 0.84 | 0.82 | 88 |
| 204 | 1.85 | 1.43 | 0.0236 | 0.51 | 0.71 | 90 |
| 300 | 1.52 | 1.59 | 0.0158 | 0.59 | 0.97 | 91 |
| 400 | 16.4 | 7.2 | 0.011 | 1.81 | 2.03 | 88 |

* Parameter values are initial estimates from the empirical equations C.1 and C.2.

Table C.2
Summary of Typical Runoff Curve Numbers

| Land Use | Hydrologic Soil Group* | | | | |
|---|---|---|---|---|---|
| | B | BC | C | CD | D |
| Residential | 85 | 88 | 90 | 91 | 92 |
| Row Crop | 71 | 74 | 78 | 79 | 91 |
| Forest | 66 | 71 | 77 | 80 | 83 |
| Pasture | 69 | 74 | 79 | 82 | 84 |

* Based on Antecedent Moisture Condition II
Source: Reference (41)

TABLE C.3

Computed Subwatershed Curve Numbers

| Sub-Watershed | CN (AMC II) | CN (AMC III) |
|---|---|---|
| 101 | 73 | 87 |
| 102 | 73 | 87 |
| 103 | 76 | 89 |
| 201 | 75 | 88 |
| 202 | 82 | 92 |
| 203 | 75 | 88 |
| 204 | 78 | 90 |
| 300 | 80 | 91 |
| Weighted Average | 75 | 88 |

TABLE C.4

Relationship Between AMC II and AMC III

| CN for AMC II | Corresponding CN for AMC III |
|---|---|
| 100 | 100 |
| 95 | 98 |
| 90 | 96 |
| 85 | 94 |
| 80 | 91 |
| 75 | 88 |
| 70 | 85 |
| 65 | 82 |
| 60 | 78 |
| 55 | 74 |
| 50 | 70 |
| 45 | 65 |
| 40 | 60 |
| 35 | 55 |
| 30 | 50 |
| 25 | 43 |
| 20 | 37 |
| 15 | 30 |
| 10 | 22 |
| 5 | 13 |

AMC II The average condition
AMC III Highest runoff potential. Soils in the watershed are saturated from antecedent rains

Source: Reference (41)

TABLE C.5

Reservoir Characteristics

| Stop Logs Out | | Stop Logs In | |
|---|---|---|---|
| Outflow ($m^3/s$) | Storage (hec-m) | Outflow ($m^3/s$) | Storage (hec-m)* |
| 0 | 0 | 0 | 0 |
| 1.3 | 8.7 | 1.0 | 1.7 |
| 3.6 | 23.3 | 4.0 | 3.6 |
| 3.9 | 33.1 | 7.0 | 8.2 |
| 4.2 | 35.1 | 9.5 | 13.3 |
| 4.6 | 36.8 | 12.0 | 18.1 |
| 4.9 | 38.7 | 15.0 | 24.4 |
| 8.0 | 43.3 | 17.0 | 30.7 |
| 11.5 | 48.4 | 20.5 | 37.7 |
| 14.9 | 53.2 | 24.5 | 44.6 |
| 16.0 | 59.5 | 28.0 | 54.3 |
| 18.0 | 65.8 | 31.5 | 61.2 |
| 22.0 | 72.8 | 35.0 | 70.9 |
| 25.5 | 79.7 | 39.0 | 76.1 |
| 29.0 | 89.4 | 55.0 | 81.7 |
| 33.0 | 96.3 | 64.0 | 85.9 |
| 37.0 | 106.0 | | |
| 44.5 | 111.2 | | |
| 62.0 | 116.8 | | |
| 73.0 | 121.0 | | |

* Storage in hectare-metres; note that one hectare-metre equals 10,000 $m^3$

TABLE C.6

Rainfall Distribution Comparison

for the 12-hour Design Storms (a)

| Time (hours) | (b) Design Storm Distribution Estimated by Analysis of Historical Events | (c) AES 12-hour Design Storm Distribution (%) (4) |
|---|---|---|
| 0 - 1 | 3 | 5 |
| 1 - 2 | 11 | 8 |
| 2 - 3 | 8 | 8 |
| 3 - 4 | 6 | 10 |
| 4 - 5 | 11 | 10 |
| 5 - 6 | 13 | 14 |
| 6 - 7 | 9 | 13 |
| 7 - 8 | 13 | 8 |
| 8 - 9 | 10 | 10 |
| 9 - 10 | 9 | 8 |
| 10 - 11 | 6 | 4 |
| 11 - 12 | 1 | 2 |
| | 100 | 100 |

Notes:

(a) Percent of total rainfall over 12-hour period. Distribution given reflects the percentage of the total rainfall that falls over the period

(b) Source - Analysis of historical rainfall events by CCL, 1983

(c) Source - Analysis by Environment Canada (4)

Table C.7
Precipitation Summary

| Return Period (years) | Rainfall* (mm) | | | |
|---|---|---|---|---|
| | 6 hr. | 12 hr. | 24 hr. | Rain* Melt** (mm) 24 hr. |
| 2 | 35.8 | 44.2 | 57.1 | 35.0 |
| 5 | 46.8 | 55.4 | 73.9 | 49.9 |
| 10 | 54.1 | 62.8 | 85.1 | 59.8 |
| 25 | 63.3 | 72.1 | 99.2 | 72.2 |
| 50 | 70.2 | 79.1 | 109.7 | 81.4 |
| 100 | 77.0 | 85.9 | 120.1 | 90.6 |

* Based on AES analysis at Stephenville meteorological station (13 years data).

** Based on AES analysis of melt plus rain events.

# Appendix D

# Summary of HEC-2 Results

**********

REC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991

**********

BLANCHE BROOK AND WARM CREEK, 1:20 AND 1:100 YEAR FLOOD

SUMMARY PRINTOUT

| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| | 501.000 | 150.00 | 1.50 | 44.57 | 2.86 | 2.88 | .00 | 1.26 | .84 |
| * | 501.000 | 210.00 | 1.56 | 44.82 | 2.92 | 3.85 | .00 | 1.76 | 1.16 |
| * | 502.100 | 150.00 | 2.43 | 10.00 | 3.14 | 5.30 | .93 | .00 | .00 |
| * | 502.100 | 210.00 | 3.15 | 10.16 | 3.86 | 5.90 | 1.59 | .00 | .00 |
| * | 502.000 | 150.00 | 3.04 | 10.13 | 3.75 | 4.35 | .62 | .00 | .00 |
| * | 502.000 | 210.00 | 3.37 | 10.31 | 4.58 | 4.91 | .72 | .00 | .00 |
| | 502.200 | 150.00 | 3.17 | 10.16 | 3.89 | 4.18 | .13 | .00 | .00 |
| | 502.200 | 210.00 | 3.95 | 12.51 | 4.66 | 4.90 | .08 | .00 | .03 |
| | 502.300 | 150.00 | 3.19 | 10.16 | 3.90 | 4.18 | .01 | .00 | .00 |
| * | 502.300 | 210.00 | 4.19 | 10.38 | 4.90 | 4.54 | .23 | .00 | .00 |
| * | 503.000 | 150.00 | 4.14 | 198.10 | 4.39 | .79 | .96 | .48 | .32 |
| * | 503.000 | 210.00 | 5.33 | 221.49 | 5.58 | .57 | 1.15 | .38 | .30 |
| | 504.000 | 150.00 | 4.17 | 220.76 | 3.93 | .62 | .03 | .47 | .44 |
| | 504.000 | 210.00 | 5.34 | 390.29 | 5.10 | .43 | .01 | .30 | .29 |
| * | 505.000 | 150.00 | 4.18 | 55.15 | 3.78 | 1.63 | .01 | 1.24 | .85 |
| * | 505.000 | 210.00 | 5.34 | 80.88 | 4.94 | 1.39 | -.01 | 1.04 | .72 |
| * | 506.000 | 150.00 | 4.42 | 31.33 | 3.19 | 2.95 | .24 | 1.85 | 2.10 |
| * | 506.000 | 210.00 | 5.43 | 34.78 | 4.20 | 2.66 | .09 | 1.74 | 2.00 |
| | 507.000 | 150.00 | 5.29 | 32.55 | 2.54 | 2.99 | .86 | 2.28 | 1.98 |
| | 507.000 | 210.00 | 5.95 | 48.36 | 3.20 | 3.01 | .52 | 2.31 | 1.51 |
| | 508.000 | 150.00 | 6.11 | 76.30 | 2.35 | 2.55 | .82 | 1.71 | 1.00 |
| | 508.000 | 210.00 | 6.62 | 89.78 | 2.86 | 2.38 | .67 | 1.67 | 1.09 |

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| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| | 509.000 | 150.00 | 6.60 | 66.97 | 2.44 | 2.37 | .49 | 1.51 | 1.49 |
| | 509.000 | 210.00 | 6.96 | 71.05 | 2.80 | 2.52 | .35 | 1.62 | 1.63 |
| * | 510.100 | 88.00 | 6.81 | 22.10 | 2.18 | 2.22 | .21 | .00 | .00 |
| * | 510.100 | 108.80 | 7.26 | 364.18 | 2.63 | 1.50 | .30 | .46 | .00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 510.000 | 88.00 | 6.81 | 22.10 | 2.18 | 2.22 | .00 | .00 | .00 |
| | 510.000 | 108.80 | 7.27 | 365.99 | 2.64 | 1.45 | .01 | .46 | .00 |
| * | 511.000 | 88.00 | 6.75 | 21.29 | 1.76 | 3.56 | -.07 | 3.49 | 1.46 |
| * | 511.000 | 108.80 | 6.95 | 22.26 | 1.96 | 3.75 | -.31 | 3.70 | 1.63 |
| * | 512.000 | 88.00 | 7.94 | 91.73 | 1.86 | 1.93 | 1.19 | 1.62 | .77 |
| * | 512.000 | 108.80 | 8.13 | 100.81 | 2.05 | 1.87 | 1.17 | 1.56 | .86 |
| * | 513.000 | 88.00 | 8.72 | 37.29 | 1.65 | 2.80 | .79 | 1.72 | 2.55 |
| * | 513.000 | 108.80 | 8.83 | 38.19 | 1.16 | 3.07 | .70 | 1.85 | 2.81 |
| | 514.000 | 88.00 | 9.74 | 22.57 | 1.99 | 2.63 | 1.02 | .00 | .00 |
| | 514.000 | 108.80 | 9.91 | 22.99 | 2.16 | 2.97 | 1.08 | .00 | .00 |
| | 514.100 | 88.00 | 9.85 | 22.87 | 2.10 | 2.44 | .11 | .00 | .00 |
| | 514.100 | 108.80 | 10.07 | 23.41 | 2.32 | 2.65 | .16 | .00 | .00 |
| * | 515.000 | 88.00 | 11.07 | 29.93 | 1.11 | 3.14 | 1.22 | 1.88 | 1.64 |
| * | 515.000 | 108.80 | 11.23 | 30.53 | 1.27 | 3.35 | 1.16 | 2.03 | 1.78 |
| | 516.000 | 88.00 | 12.40 | 24.33 | 1.45 | 3.24 | 1.35 | 1.69 | 2.61 |
| | 516.000 | 108.80 | 12.53 | 24.76 | 1.58 | 3.59 | 1.31 | 1.92 | 2.91 |
| * | 517.000 | 88.00 | 13.78 | 39.43 | 1.96 | 3.41 | 1.38 | 1.11 | 2.09 |
| * | 517.000 | 108.80 | 13.99 | 49.78 | 2.17 | 3.46 | 1.46 | 1.13 | 1.95 |
| * | 518.000 | 88.00 | 15.65 | 28.09 | 1.20 | 3.17 | 1.87 | 2.28 | 3.21 |
| * | 518.000 | 108.80 | 15.81 | 28.51 | 1.36 | 3.40 | 1.81 | 2.43 | 3.42 |
| * | 519.000 | 88.00 | 16.78 | 25.74 | 1.80 | 2.70 | 1.13 | 1.54 | 2.13 |
| * | 519.000 | 108.80 | 16.96 | 26.32 | 1.98 | 2.96 | 1.15 | 1.72 | 2.35 |
| * | 520.000 | 88.00 | 17.95 | 35.25 | 1.35 | 3.13 | 1.16 | 2.11 | 1.93 |
| * | 520.000 | 108.80 | 18.09 | 37.43 | 1.49 | 3.33 | 1.14 | 2.21 | 2.09 |
| | 521.000 | 88.00 | 19.60 | 30.98 | 1.61 | 3.82 | 1.65 | 1.85 | 1.43 |
| | 521.000 | 108.80 | 19.75 | 35.32 | 1.76 | 3.30 | 1.65 | 1.85 | 1.28 |
| * | 522.000 | 88.00 | 21.99 | 44.39 | 1.65 | 3.15 | 2.39 | 2.09 | 1.69 |
| * | 522.000 | 108.80 | 22.17 | 53.72 | 1.83 | 3.21 | 2.42 | 2.25 | 1.85 |
| * | 523.000 | 88.00 | 23.90 | 23.62 | 1.83 | 3.64 | 1.90 | 1.94 | 1.58 |
| * | 523.000 | 108.80 | 24.17 | 28.40 | 2.10 | 3.67 | 2.00 | 1.94 | 1.64 |



| | STCNO | Z | CWTEV | TOPWID | DEPTH | VCH | DIFMAX | VECS | VSCS |
|---|---|---|---|---|---|---|---|---|---|
| * | 524.000 | 88.00 | 26.91 | 24.04 | 1.55 | 5.52 | 5.01 | .00 | .00 |
| * | 524.000 | 108.80 | 27.09 | 25.08 | 1.73 | 3.51 | 2.92 | .00 | .00 |
| | 525.100 | 64.00 | 28.30 | 21.37 | 1.56 | 1.99 | 1.40 | .00 | .00 |
| | 525.100 | 79.00 | 28.52 | 21.37 | 1.78 | 2.15 | 1.43 | .00 | .00 |
| | 525.000 | 64.00 | 28.40 | 21.37 | 1.66 | 1.87 | .10 | .00 | .00 |
| | 525.000 | 79.00 | 28.62 | 21.37 | 1.88 | 2.02 | .10 | .00 | .00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 526.000 | 64.00 | 28.51 | 25.03 | 2.62 | 1.92 | .11 | .00 | .00 |
| | 526.000 | 79.00 | 28.74 | 26.45 | 2.85 | 2.00 | .11 | .00 | .00 |
| * | 527.000 | 64.00 | 30.88 | 25.85 | 1.10 | 2.69 | 2.37 | .00 | .00 |
| * | 527.000 | 79.00 | 31.02 | 26.54 | 1.24 | 2.87 | 2.28 | .00 | .00 |
| * | 528.000 | 64.00 | 34.70 | 40.85 | 1.27 | 1.71 | 3.82 | .00 | .00 |
| * | 528.000 | 79.00 | 34.86 | 45.23 | 1.43 | 1.79 | 3.83 | .00 | .00 |
| | -509.000 | 64.00 | 6.60 | 66.97 | 2.44 | 1.03 | -28.10 | .69 | .61 |
| | -509.000 | 79.00 | 6.96 | 71.06 | 2.80 | .96 | -27.89 | .66 | .61 |
| * | 601.000 | 73.80 | 6.80 | 39.04 | 1.75 | 2.79 | .20 | 1.64 | 1.19 |
| * | 601.000 | 103.70 | 7.11 | 44.53 | 2.06 | 2.96 | .14 | 1.76 | 1.36 |
| | 602.000 | 73.80 | 7.33 | 40.38 | 2.40 | 2.37 | .53 | 1.30 | 1.04 |
| | 602.000 | 103.70 | 7.60 | 42.97 | 2.67 | 2.66 | .50 | 1.56 | 1.26 |
| * | 603.000 | 73.80 | 8.08 | 45.10 | 1.81 | 3.25 | .76 | 1.79 | 1.59 |
| * | 603.000 | 103.70 | 8.30 | 51.17 | 2.03 | 3.54 | .69 | 1.93 | 1.81 |
| | 604.100 | 73.80 | 8.55 | 35.97 | 2.25 | 3.53 | .47 | .00 | .51 |
| * | 604.100 | 103.70 | 9.07 | 161.51 | 2.77 | 2.55 | .78 | .65 | .87 |
| * | 604.000 | 73.80 | 9.34 | 221.42 | 3.04 | .86 | .79 | .54 | .61 |
| | 604.000 | 103.70 | 9.30 | 214.45 | 3.00 | 1.32 | .23 | .78 | .91 |
| | 604.200 | 73.80 | 9.35 | 223.25 | 3.05 | .84 | .01 | .53 | .61 |
| | 604.200 | 103.70 | 9.33 | 218.60 | 3.03 | 1.26 | .02 | .77 | .88 |
| | 604.300 | 73.80 | 9.35 | 223.84 | 3.05 | 1.11 | .00 | .39 | .45 |
| | 604.300 | 103.70 | 9.32 | 218.98 | 3.02 | 1.63 | -.01 | .56 | .65 |
| * | 604.400 | 73.80 | 9.39 | 211.39 | 2.56 | .50 | .04 | .26 | .35 |
| * | 604.400 | 103.70 | 9.42 | 213.05 | 2.59 | .68 | .10 | .36 | .48 |
| * | 605.000 | 73.80 | 9.89 | 22.26 | 2.05 | 2.86 | .00 | 1.62 | 1.43 |
| * | 605.000 | 103.70 | 9.43 | 22.64 | 2.09 | 3.93 | .06 | 1.95 | 2.03 |
| * | 606.000 | 73.80 | 9.94 | 9.77 | 2.07 | 4.37 | .55 | .62 | .03 |
| * | 606.000 | 103.70 | 10.96 | 59.54 | 3.09 | 3.27 | 1.53 | .87 | .84 |

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| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| * | 607.100 | 73.80 | 10.29 | 12.14 | 2.11 | 4.11 | .35 | .69 | .03 |
| * | 607.100 | 103.70 | 11.50 | 167.17 | 3.32 | 1.41 | .54 | .71 | .49 |
| * | 607.000 | 73.80 | 10.87 | 80.58 | 2.69 | 2.56 | .58 | .84 | .27 |
| | 607.000 | 103.70 | 11.50 | 167.04 | 3.32 | 1.41 | .00 | .71 | .49 |
| * | 607.200 | 73.80 | 11.11 | 92.19 | 2.83 | 1.44 | .24 | .54 | .66 |
| | 607.200 | 103.70 | 11.51 | 98.71 | 3.23 | 1.34 | .01 | .64 | .69 |
| * | 607.300 | 73.80 | 11.13 | 49.74 | 1.95 | 2.07 | .02 | .85 | .00 |
| * | 607.300 | 103.70 | 11.50 | 91.31 | 2.52 | 2.08 | -.01 | .85 | .00 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 608.000 | 73.80 | 11.72 | 27.15 | 1.96 | 2.75 | .59 | 1.13 | .65 |
| * | 608.000 | 103.70 | 11.97 | 31.03 | 2.21 | 3.22 | .46 | 1.42 | .78 |
| * | 609.000 | 73.80 | 14.07 | 31.20 | 1.65 | 3.45 | 2.35 | 1.22 | 1.14 |
| * | 609.000 | 103.70 | 14.35 | 34.37 | 1.93 | 3.80 | 2.39 | 1.48 | 1.33 |
| * | 610.100 | 73.80 | 15.97 | 28.02 | 1.91 | 3.22 | 1.90 | 2.30 | .68 |
| * | 610.100 | 103.70 | 16.23 | 29.09 | 2.17 | 3.52 | 1.87 | 2.54 | .94 |
| * | 610.000 | 73.80 | 16.96 | 40.61 | 2.90 | 1.49 | .99 | 1.00 | .49 |
| * | 610.000 | 103.70 | 17.30 | 47.94 | 3.24 | 1.71 | 1.07 | 1.08 | .57 |
| | 610.200 | 73.80 | 17.00 | 32.24 | 1.79 | 1.71 | .05 | .79 | .21 |
| | 610.200 | 103.70 | 17.34 | 36.10 | 2.13 | 1.93 | .04 | .92 | .33 |
| | 611.000 | 73.80 | 17.03 | 18.85 | 2.04 | 2.83 | .03 | 1.48 | .78 |
| * | 611.000 | 103.70 | 17.29 | 20.02 | 2.30 | 3.45 | -.05 | 1.86 | .97 |
| | 612.000 | 73.80 | 17.55 | 19.07 | 2.24 | 3.46 | .53 | 1.00 | .93 |
| | 612.000 | 103.70 | 17.93 | 25.52 | 2.62 | 3.92 | .64 | 1.03 | 1.09 |
| * | 613.000 | 73.80 | 18.41 | 29.92 | 2.40 | 2.26 | .85 | 1.21 | .45 |
| * | 613.000 | 103.70 | 18.87 | 34.39 | 2.86 | 2.40 | .94 | 1.37 | .45 |
| | 614.000 | 73.80 | 18.88 | 58.83 | 2.12 | 1.64 | .47 | 1.01 | .58 |
| | 614.000 | 103.70 | 19.31 | 65.42 | 2.55 | 1.72 | .44 | 1.09 | .61 |
| | 615.000 | 73.80 | 19.18 | 88.84 | 1.57 | 1.48 | .30 | 1.00 | .53 |
| | 615.000 | 103.70 | 19.56 | 90.09 | 1.95 | 1.51 | .25 | 1.06 | .56 |
| * | 616.000 | 73.80 | 19.81 | 14.77 | 1.91 | 3.97 | .63 | 2.07 | 1.04 |
| * | 616.000 | 103.70 | 20.23 | 16.70 | 2.33 | 4.34 | .68 | 2.28 | 1.17 |
| * | 617.100 | 73.80 | 22.22 | 118.25 | 3.03 | 3.16 | 2.40 | .75 | .94 |
| * | 617.100 | 103.70 | 22.39 | 140.42 | 3.20 | 3.23 | 2.15 | 1.19 | 1.00 |
| * | 617.000 | 73.80 | 22.89 | 198.90 | 3.49 | .99 | .67 | .56 | .35 |
| * | 617.000 | 103.70 | 22.99 | 205.39 | 3.59 | 1.22 | .60 | .74 | .44 |



| | SECNO | Q | CWSEL | TOPW1B | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| | 618.000 | 73.80 | 22.88 | 89.06 | 3.69 | 1.09 | -.01 | .69 | .22 |
| | 618.000 | 103.70 | 22.98 | 89.06 | 3.79 | 1.44 | -.01 | .93 | .29 |
| * | 619.000 | 73.80 | 22.95 | 60.85 | 3.89 | .78 | .05 | .54 | .20 |
| * | 619.000 | 103.70 | 23.05 | 62.10 | 4.01 | 1.05 | .08 | .72 | .27 |
| * | 620.000 | 73.80 | 22.97 | 174.79 | 3.46 | .23 | .04 | .22 | .08 |
| * | 620.000 | 103.70 | 23.15 | 176.99 | 3.62 | .30 | .08 | .28 | .10 |
| * | 621.000 | 73.80 | 23.22 | 37.99 | 2.84 | 1.68 | .25 | .59 | .75 |
| * | 621.000 | 103.70 | 23.46 | 38.61 | 3.08 | 2.09 | .33 | .76 | .95 |
| * | 622.100 | 73.80 | 23.36 | 15.08 | 2.73 | 3.33 | .14 | .02 | .90 |
| * | 622.100 | 103.70 | 23.88 | 158.12 | 3.25 | 2.55 | .42 | .16 | .83 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 622.000 | 73.80 | 23.37 | 15.14 | 2.74 | 3.71 | .01 | .00 | 1.22 |
| | 622.000 | 103.70 | 24.12 | 176.43 | 3.49 | 1.41 | .24 | .37 | .95 |
| * | 622.200 | 73.80 | 24.27 | 200.45 | 3.64 | .75 | .90 | .24 | .56 |
| | 622.200 | 103.70 | 24.19 | 189.93 | 3.56 | 1.23 | .07 | .35 | .87 |
| | 622.300 | 73.80 | 24.27 | 200.54 | 3.64 | .94 | .00 | .19 | .45 |
| | 622.300 | 103.70 | 24.19 | 190.80 | 3.56 | 1.49 | .00 | .27 | .67 |
| * | 623.800 | 73.80 | 24.25 | 33.94 | 3.80 | 1.57 | -.02 | .72 | .60 |
| * | 623.800 | 103.70 | 24.16 | 33.94 | 3.71 | 2.30 | -.03 | 1.06 | .89 |
| | 624.100 | 73.80 | 24.32 | 84.88 | 3.45 | 1.00 | .07 | .01 | .21 |
| | 624.100 | 103.70 | 24.31 | 83.69 | 3.44 | 1.41 | .16 | .01 | .29 |
| | 624.000 | 73.80 | 24.34 | 87.61 | 3.47 | .99 | .02 | .00 | .21 |
| | 624.000 | 103.70 | 24.36 | 90.14 | 3.49 | 1.38 | .05 | .00 | .31 |
| | 624.200 | 111.10 | 24.32 | 84.82 | 3.45 | 1.47 | -.02 | .00 | .26 |
| | 624.200 | 133.70 | 24.34 | 87.89 | 3.47 | 1.75 | -.02 | .00 | .32 |
| * | 624.300 | 111.10 | 24.42 | 160.87 | 3.67 | .82 | .10 | .37 | .26 |
| * | 624.300 | 133.70 | 24.49 | 163.88 | 3.74 | .95 | .15 | .43 | .31 |
| | 624.400 | 111.10 | 24.42 | 161.17 | 3.67 | .82 | .00 | .37 | .26 |
| | 624.400 | 133.70 | 24.49 | 164.21 | 3.74 | .95 | .00 | .43 | .31 |
| * | 625.100 | 111.10 | 24.50 | 28.51 | 4.06 | 1.84 | .03 | .46 | .90 |
| * | 625.100 | 133.70 | 25.38 | 111.55 | 4.94 | 1.51 | .90 | .60 | .54 |
| * | 625.200 | 111.10 | 24.31 | 25.89 | 3.13 | 3.49 | -.19 | .00 | .00 |
| * | 625.200 | 133.70 | 25.69 | 68.95 | 3.91 | 4.03 | -.30 | .00 | 1.04 |
| | 625.300 | 111.10 | 24.43 | 26.82 | 3.25 | 3.49 | .11 | .00 | .00 |
| * | 625.300 | 133.70 | 26.10 | 256.86 | 4.92 | .91 | 1.01 | .38 | .84 |



| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| * | 625.000 | 111.10 | 25.06 | 62.53 | 3.88 | 1.72 | .63 | .00 | .64 |
| * | 625.000 | 133.70 | 26.11 | 257.49 | 4.93 | .94 | .01 | .24 | .40 |
| * | 626.000 | 111.10 | 25.25 | 369.34 | 4.17 | .22 | .19 | .10 | .13 |
| * | 626.000 | 133.70 | 26.15 | 387.22 | 5.07 | .19 | .04 | .09 | .11 |
| | 627.000 | 111.10 | 25.25 | 301.35 | 4.19 | .19 | .00 | .16 | .12 |
| | 627.000 | 133.70 | 26.15 | 321.35 | 5.09 | .17 | .00 | .14 | .11 |
| * | 628.000 | 111.10 | 25.26 | 144.03 | 4.26 | .60 | .01 | .28 | .31 |
| * | 628.000 | 133.70 | 26.15 | 154.16 | 5.15 | .51 | .00 | .24 | .27 |
| * | 628.100 | 111.10 | 25.28 | 69.35 | 3.78 | 1.14 | .02 | .72 | .79 |
| * | 628.100 | 133.70 | 26.16 | 74.29 | 4.66 | .91 | .01 | .60 | .66 |
| * | 629.100 | 111.10 | 25.36 | 513.92 | 3.26 | 1.89 | .08 | .37 | .41 |
| * | 629.100 | 133.70 | 26.20 | 573.13 | 4.10 | .48 | .04 | .19 | .19 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 629.200 | 111.10 | 25.37 | 514.83 | 3.27 | 1.74 | .01 | .36 | .40 |
| | 629.200 | 133.70 | 26.20 | 573.22 | 4.10 | .48 | .00 | .19 | .19 |
| * | 629.000 | 81.60 | 25.47 | 495.55 | 3.20 | .14 | .10 | .08 | .08 |
| * | 629.000 | 95.80 | 26.21 | 505.70 | 3.94 | .11 | .01 | .07 | .07 |
| * | 630.000 | 81.60 | 25.48 | 460.93 | 3.40 | .18 | .00 | .13 | .13 |
| | 630.000 | 95.80 | 26.21 | 504.27 | 4.13 | .12 | .00 | .10 | .10 |
| * | 631.000 | 81.60 | 25.48 | 273.25 | 3.68 | 1.04 | .00 | .38 | .38 |
| * | 631.000 | 95.80 | 26.21 | 428.10 | 4.41 | .46 | .00 | .20 | .21 |
| * | 632.000 | 81.60 | 25.71 | 160.59 | 1.40 | 1.13 | .23 | .76 | .40 |
| * | 632.000 | 95.80 | 26.25 | 206.06 | 1.94 | .69 | .04 | .53 | .25 |
| | 632.800 | 81.60 | 25.72 | 161.79 | 1.41 | 1.12 | .01 | .76 | .40 |
| | 632.800 | 95.80 | 26.26 | 206.20 | 1.95 | .69 | .00 | .52 | .25 |
| | 632.900 | 81.60 | 25.74 | 162.90 | 1.43 | 1.09 | .02 | .74 | .39 |
| | 632.900 | 95.80 | 26.26 | 206.56 | 1.95 | .68 | .00 | .52 | .24 |
| * | 632.100 | 81.60 | 25.93 | 9.66 | 2.83 | 4.51 | .24 | .00 | .00 |
| * | 632.100 | 95.80 | 26.59 | 373.33 | 2.44 | 2.24 | .15 | .71 | .29 |
| * | 632.200 | 81.60 | 27.02 | 596.24 | 3.07 | .32 | 1.05 | .21 | .05 |
| * | 632.200 | 95.80 | 26.48 | 396.52 | 2.58 | 1.55 | .09 | .61 | .00 |
| * | 632.300 | 81.60 | 27.02 | 1139.17 | 3.87 | .19 | .00 | .11 | .02 |
| * | 632.300 | 95.80 | 26.58 | 811.58 | 2.63 | .65 | .10 | .25 | .09 |
| * | 632.400 | 81.60 | 27.02 | 921.53 | 3.15 | .55 | .00 | .19 | .05 |
| * | 632.400 | 95.80 | 26.59 | 395.28 | 2.72 | 1.10 | .01 | .42 | .14 |

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| | SFDAD | Q | DANU | [illegible] | [illegible] | VEL | SFDAX | VLCD | VACB |
|---|---|---|---|---|---|---|---|---|---|
| | 632.500 | 81.60 | 27.02 | 922.30 | 3.15 | .36 | .00 | .19 | .05 |
| | 632.500 | 95.80 | 26.59 | 395.29 | 2.72 | 1.09 | .00 | .42 | .00 |
| * | 633.000 | 81.60 | 27.03 | 374.58 | 2.52 | .29 | .01 | .19 | .22 |
| * | 633.000 | 95.80 | 26.66 | 322.40 | 2.35 | .53 | .07 | .30 | .42 |
| * | 634.000 | 81.60 | 27.04 | 679.89 | 1.33 | .20 | .01 | .18 | .11 |
| * | 634.000 | 95.80 | 26.71 | 636.97 | 1.00 | .35 | .05 | .32 | .20 |
| * | 635.000 | 81.60 | 28.13 | 84.01 | 1.13 | 2.74 | 1.10 | .00 | .87 |
| * | 635.000 | 95.80 | 28.20 | 84.22 | 1.20 | 2.82 | 1.49 | .00 | .97 |
| * | 636.000 | 81.60 | 29.90 | 162.91 | .69 | 1.24 | 1.77 | .14 | 1.21 |
| * | 636.000 | 95.80 | 29.96 | 175.10 | .75 | 1.31 | 1.77 | .15 | 1.25 |
| * | 637.000 | 81.60 | 33.70 | 24.10 | 1.65 | 3.35 | 3.80 | .47 | .00 |
| * | 637.000 | 95.80 | 34.12 | 99.90 | 2.08 | 2.59 | 4.16 | .46 | .60 |

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HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991

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GAUDONS CREEK - 1:20 AND 1:100 YEAR FLOOD

SUMMARY PRINTOUT

| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLCB | VRCB |
|---|---|---|---|---|---|---|---|---|---|
| * | 701.000 | 39.82 | 11.94 | 19.69 | 1.75 | 3.06 | .00 | .00 | 1.32 |
| * | 701.000 | 47.92 | 12.10 | 22.30 | 1.91 | 3.11 | .00 | .00 | 1.44 |
| * | 702.000 | 39.82 | 12.41 | 21.34 | 1.36 | 2.88 | .47 | .00 | .51 |
| * | 702.000 | 47.92 | 12.60 | 29.37 | 1.55 | 2.78 | .50 | .00 | .82 |
| * | 703.000 | 39.82 | 13.23 | 9.73 | 1.54 | 3.43 | .87 | .00 | .00 |
| * | 703.000 | 47.92 | 13.39 | 9.85 | 1.70 | 3.64 | .79 | .00 | .00 |
| | 702.100 | 39.82 | 13.49 | 9.92 | 1.80 | 2.83 | .26 | .00 | .00 |
| | 702.100 | 47.92 | 13.68 | 10.06 | 1.99 | 3.00 | .29 | .00 | .00 |
| | 703.200 | 39.82 | 13.59 | 10.00 | 1.90 | 2.62 | .11 | .00 | .00 |
| | 703.200 | 47.92 | 13.79 | 10.15 | 2.10 | 2.79 | .11 | .00 | .00 |
| | 703.300 | 39.82 | 13.60 | 10.01 | 1.91 | 2.61 | .01 | .00 | .00 |
| | 703.300 | 47.92 | 13.80 | 10.15 | 2.11 | 2.78 | .01 | .00 | .00 |
| | 704.000 | 39.82 | 14.05 | 15.86 | 1.62 | 2.82 | .45 | .00 | .00 |
| | 704.000 | 47.92 | 14.27 | 17.79 | 1.84 | 2.86 | .47 | .02 | .00 |
| * | 705.000 | 39.82 | 15.58 | 12.31 | 1.52 | 3.19 | 1.33 | .00 | .00 |
| * | 705.000 | 47.92 | 15.52 | 12.84 | 1.66 | 3.34 | 1.26 | .00 | .00 |
| * | 706.000 | 39.82 | 16.76 | 15.43 | 1.17 | 2.97 | 1.38 | .00 | .03 |
| * | 706.000 | 47.92 | 16.87 | 15.80 | 1.28 | 3.15 | 1.35 | .00 | .05 |
| * | 707.000 | 39.82 | 17.77 | 26.19 | 1.14 | 2.60 | 1.02 | 1.14 | .85 |
| * | 707.000 | 47.92 | 17.88 | 27.44 | 1.25 | 2.73 | 1.00 | 1.23 | 1.09 |
| * | 708.000 | 39.82 | 19.12 | 37.28 | 1.52 | 2.52 | 1.34 | 1.16 | .00 |
| * | 708.000 | 47.92 | 19.20 | 41.33 | 1.60 | 2.62 | 1.33 | 1.29 | .00 |



| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLCB | VRCB |
|---|---|---|---|---|---|---|---|---|---|
| * | 709.000 | 39.82 | 20.42 | 15.22 | 1.57 | 3.15 | 1.30 | .00 | 1.43 |
| * | 709.000 | 47.92 | 20.56 | 16.43 | 1.71 | 3.32 | 1.35 | .00 | 1.60 |
| * | 710.000 | 39.82 | 21.67 | 29.45 | 1.39 | 2.72 | 1.25 | .98 | 1.91 |
| * | 710.000 | 47.92 | 21.76 | 30.67 | 1.48 | 2.87 | 1.20 | 1.19 | 2.04 |

HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991

COLD BROOK - 1:20 AND 1:100 YEAR FLOOD

SUMMARY PRINTOUT

| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| * | 801.000 | 43.82 | 105.39 | 12.84 | 1.69 | 3.25 | .00 | .00 | .00 |
| * | 801.000 | 50.55 | 105.50 | 13.15 | 1.80 | 3.38 | .00 | .00 | .00 |
| * | 801.000 | 43.82 | 105.74 | 13.78 | 2.04 | 2.41 | .35 | .00 | .00 |
| * | 801.000 | 50.55 | 105.87 | 14.13 | 2.17 | 2.51 | .37 | .00 | .00 |
| | 801.100 | 43.82 | 105.74 | 13.76 | 2.04 | 2.42 | .00 | .00 | .00 |
| | 801.100 | 50.55 | 105.88 | 14.11 | 2.18 | 2.53 | .00 | .00 | .00 |
| | 801.200 | 43.82 | 105.80 | 13.92 | 2.10 | 2.31 | .06 | .00 | .00 |
| | 801.200 | 50.55 | 105.93 | 14.27 | 2.23 | 2.42 | .06 | .00 | .00 |
| | 801.300 | 43.82 | 105.80 | 13.93 | 2.10 | 2.31 | .01 | .00 | .00 |
| | 801.300 | 50.55 | 105.94 | 14.28 | 2.24 | 2.42 | .01 | .00 | .00 |
| * | 802.000 | 43.82 | 105.86 | 13.61 | 1.65 | 3.00 | .06 | .00 | .00 |
| * | 802.000 | 50.55 | 105.99 | 15.07 | 1.78 | 3.09 | .05 | .03 | .00 |
| | 803.000 | 43.82 | 107.16 | 41.48 | 1.87 | 1.80 | 1.30 | 1.05 | .02 |
| | 803.000 | 50.55 | 107.26 | 45.39 | 1.97 | 1.80 | 1.27 | 1.17 | .32 |
| * | 804.000 | 43.82 | 108.14 | 48.27 | 1.43 | 1.92 | .93 | .69 | 2.40 |
| * | 804.000 | 50.55 | 108.19 | 49.57 | [illegible] | [illegible] | .93 | [illegible] | [illegible] |
| * | 805.000 | 43.82 | 108.94 | 114.55 | [illegible] | [illegible] | .79 | .55 | .56 |
| * | 805.000 | 50.55 | 108.98 | 117.21 | 1.13 | 1.75 | .79 | .60 | .91 |
| * | 806.000 | 43.82 | 109.28 | 64.85 | 1.46 | 2.14 | .35 | .72 | .78 |
| * | 806.000 | 50.55 | 109.33 | 63.81 | 1.51 | 2.23 | .35 | .88 | .87 |
| * | 807.000 | 43.82 | 110.65 | 17.32 | 1.05 | 2.93 | 1.37 | .00 | .00 |
| * | 807.000 | 50.55 | 110.75 | 17.66 | 1.15 | 3.05 | 1.41 | .00 | .00 |

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| | SECNO | Q | CWSEL | TOPWID | DEPTH | VCH | DIFWSX | VLOB | VROB |
|---|---|---|---|---|---|---|---|---|---|
| * | 808.000 | 43.82 | 112.24 | 99.85 | 1.51 | 1.82 | 1.59 | .57 | .00 |
| * | 808.000 | 50.55 | 112.31 | 101.33 | 1.56 | 1.83 | 1.56 | .65 | .00 |
| * | 809.000 | 43.82 | 115.65 | 93.32 | 1.42 | 1.76 | 3.44 | 1.08 | 1.59 |
| * | 809.000 | 50.55 | 115.68 | 98.86 | 1.45 | 1.86 | 3.37 | 1.19 | 1.74 |
| | 810.000 | 43.82 | 119.43 | 70.85 | 1.05 | 1.79 | 3.78 | 1.77 | .03 |
| | 810.000 | 50.55 | 119.48 | 75.87 | 1.13 | 1.78 | 3.80 | 1.80 | .56 |

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T1       FLOOD RISK MAPPING STUDY OF STEPHENVILLE, KIPPENS, AND COLD BROOK (NF)
T2       HEC-2 INPUT FILE (H7439100.DAT), CCL JOB #7439, OCTOBER 1995
T3       COLD BROOK, BLANCHE BROOK, AND WARM CREEK - 1:20 YEAR FLOOD PROFILE
J1             2                                1                       1.5
J2     1              -1
J3    38       43       1       4       8      26      51      55      56
J6     1
NC  .035     .035    .033    .300    .500
QT     2   150.0   210.0
*
* STEPHENVILLE, BLANCHE BROOK
*
* FIRST CROSS SECTION (FROM THE PREVIOUS STUDY)
X1 501.0       17   71.00   98.00     0.0     0.0
GR 10.18        0   10.09   16.00    8.89   18.00    4.89   24.00    3.18   28.00
GR  3.11    31.00    2.17   40.00    1.64   54.00    0.93   56.00    0.93   70.00
GR  0.88    71.00   -1.36   85.00    0.71   98.00    2.35  100.00    3.13  125.00
GR  3.68   155.00    3.89  185.00
*
* B1  KIN PLACE BRIDGE (NEAR RECREATION CENTRE)
* CROSS SECTION SBB-1, BLANCHE BROOK (TRANS 1)
X1 502.1       11   22.58    33.0  146.00   82.00  130.00
X3  10.0                                                     4.35    4.35
GR  4.36        0    4.49   13.09    4.35   22.58   -0.57   23.17   -0.35   26.73
GR -0.37    28.31   -0.55   29.51   -0.71    32.5    4.35      33    4.24   39.81
GR  3.87    50.54
*
X1 502.0                            1.00    1.00    1.00
BT    11        0    4.36    4.36   13.09    4.49    4.49   22.58    4.35    4.35
BT 23.17     4.35    3.85   26.73    4.35    3.85   28.31    4.35    3.85   29.51
BT  4.35     3.85   32.50    4.35    3.85   33.00    4.35    4.35   39.81    4.24
BT  4.24    50.54    3.87    3.87
*
X1 502.2                            5.00    5.00    5.00
X2                                          1.00
*
X1 502.3                            1.00    1.00    1.00
X3  10.0                                                     4.35    4.35
NC  .035     .035    .035    .100    .300
*
* CROSS SECTION BBK-3, BLANCHE BROOK (FROM PREVIOUS STUDY)
X1 503.0       22  103.20  127.70   18.00   18.00   12.00
GR  6.06        0    5.86    4.50    5.75    6.10    5.22    8.40    4.55   16.10
GR  3.98    30.00    2.93   50.00    2.60   60.00    1.88   90.00    1.63  103.20
GR  0.87   104.20   -0.25  116.00    0.87  127.70    2.66  131.80    3.09  152.20
GR  3.79   157.40    3.75  187.40    3.73  207.60    3.96  210.60    3.85  217.40
GR  3.88   223.00    8.00  241.00
NC  .035     .035    .040
*
* CROSS SECTION SBB-2, BLANCHE BROOK (TRANS 2 PLUS BBK-4 FROM PREVIOUS STUDY)
X1 504.0       34  152.52  181.21   70.00  265.00  154.00
GR  6.99        0    5.61   30.00    4.92   60.00    4.68   90.00    4.87   99.20
GR  4.39   102.60    3.67  114.20    4.27  120.00    3.48  122.20    2.56  125.00
GR  2.16   152.52    1.60  153.21    0.99  154.60    0.63  155.54    0.24  157.51
GR  0.39   158.66    0.60  161.18    0.58  164.68    0.54  167.35    0.51  168.90
GR  0.61   171.08    0.63  174.05    1.04  174.28    1.16  175.90    3.34  180.41
GR  3.68   181.21    3.65  185.01    2.50  190.78    1.97  196.05    2.03  210.89
GR  2.22   227.38    3.56  258.88    3.43  262.18    5.70  463.28
NC  .035     .035    .033    .300    .500
*
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* CROSS SECTION SBB-3A, BLANCHE BROOK (TRANS 3A)
X1 505.0      21   50.93   57.11  100.00  165.00  125.00
GR  4.45       0    4.46   17.15    2.23   20.41    1.88   25.81    1.88   27.67
GR  1.62   39.22    0.90   50.93    0.72   52.61    0.53   54.07    0.40   55.20
GR  0.40   56.07    0.91   57.11    1.08   57.48    1.46   57.64    1.75   59.48
GR  4.62   64.55    5.00   65.06    4.95   68.82    3.55   74.56    3.43   77.01
GR  3.51   80.88
*
* CROSS SECTION SBB-3, BLANCHE BROOK (TRANS 3)
X1 506.0      18   29.56   39.41  220.00  285.00  250.00
GR  7.15       0    7.08    3.59    7.00   18.46    3.91   23.43    3.33   25.97
GR  2.67   26.16    2.63   28.27    2.11   29.56    1.71   30.31    1.23   31.17
GR  1.41   34.50    1.79   37.34    2.09   39.41    2.83   50.10    3.34   51.99
GR  5.64   56.15    8.50   61.41    7.34   97.84
*
*  STOP HERE
*
* CROSS SECTION SBB-4, BLANCHE BROOK (TRANS 4)
X1 507.0      19   25.58   41.09  270.00  320.00  300.00
GR  7.27       0    7.01    2.09    6.57    4.58    6.99    7.49    6.65   11.45
GR  3.54   18.71    3.39   25.58    3.15   31.32    3.00   34.93    2.89   38.04
GR  2.75   39.59    3.10   40.93    3.46   41.09    3.61   42.96    6.61   47.79
GR  7.47   49.29    7.73   59.63    6.42   67.32    5.21   91.69
*
* CROSS SECTION SBB-4A, BLANCHE BROOK (TRANS 4A)
X1 508.0      17   46.98   57.34  200.00  220.00  210.00
GR  6.87       0    6.76    2.35    6.09   12.35    5.20   16.15    4.74   20.90
GR  5.00   31.73    4.15   46.98    3.81   50.48    3.76   52.26    3.81   54.46
GR  3.83   57.34    4.19   57.37    4.61   58.89    7.00   63.25    5.95   73.39
GR  5.62   88.32    5.65   98.42
*
* CROSS SECTION SBB-5, BLANCHE BROOK (TRANS 5)
X1 509.0      20   52.96   67.86  180.00  200.00  190.00
GR  9.21       0    9.13    1.48    7.99    3.99    7.58   25.57    7.46   34.45
GR  5.83   45.53    5.51   46.95    5.06   52.96    4.71   57.73    4.43   61.53
GR  4.20   63.92    4.16   66.26    4.74   66.39    5.06   67.86    7.84   72.83
GR  8.24   78.89    7.72   84.93    5.60   90.55    5.47  105.88    5.35  124.54
*
QT     2    88.0   108.8
* B2  MINNESOTA DRIVE BRIDGE (@ BLANCHE BK CONFLUENCE WITH WARM CK)
* CROSS SECTION BBX-7 (FROM PREVIOUS STUDY)
X1 510.1      29  452.30  476.04   34.00   70.00   75.00
X3  10.0                                                   6.82    7.29
GR 10.00       0    7.10    1.00    7.10  200.00    6.85  230.00    6.82  260.00
GR  6.88  290.00    7.09  320.00    7.31  350.00    7.73  380.00    8.00  410.00
GR  8.04  440.00    8.17  452.20    7.29  452.30    4.63  452.31    4.89  459.60
GR  7.29  459.61    7.29  460.40    4.89  460.41    5.24  467.87    7.29  467.88
GR  7.29  468.72    5.24  468.73    5.23  476.03    7.29  476.04    8.18  476.90
GR  8.20  500.00    8.23  530.00    8.61  560.00    9.51  590.00
SB  1.05    1.54    1.40    0.00   23.70    1.64   58.68
*
X1 510.0                            9.00    9.00    9.00
X2                  1.00    7.29    6.82
X3  10.0                                                   6.82    8.18
BT  29.0           10.00   10.00    1.00    7.10    7.10  200.00    7.10    7.10
BT 230.0    6.85    6.85  260.00    6.82    6.82  290.00    6.88    6.88  320.00
BT  7.09    7.09  350.00    7.31    7.31  380.00    7.73    7.73  410.00    8.00
BT  8.00  440.00    8.04    8.04  452.20    8.17    8.17  452.30    8.17    7.29
BT 452.3    8.17    7.29  459.60    8.17    7.29  459.61    8.17    7.29  460.40
BT  8.17    7.29  460.41    8.17    7.29  467.87    8.18    7.29  467.88    8.18
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BT  7.29  468.72    8.18    7.29  468.73    8.18    7.29  476.03    8.18    7.29
BT476.04    8.18    7.29  476.90    8.18    8.18  500.00    8.20    8.20  530.00
BT  8.23    8.23  560.00    8.61    8.61  590.00    9.51    9.51
NC 0.035    0.04    0.04    0.1     0.3
*
* CROSS SECTION SBB-6, BLANCHE BROOK (TRANS 6)
X1 511.0      12   41.16   48.14   10.00   10.00   10.00
GR 10.23       0   10.44   20.02    8.70   24.95    5.44   31.76    5.53   37.23
GR  5.33   41.16    5.07   43.13    4.99   45.95    5.91   48.14    9.10   56.43
GR 10.75   60.55   10.73   78.86
*
* CROSS SECTION SBB-7, BLANCHE BROOK (TRANS 7)
X1 512.0      15   18.17   40.26  100.00  160.00  120.00
GR  7.51       0    7.61    5.88    8.73    7.74    8.79   10.62    6.89   13.82
GR  6.47   18.17    6.08   20.63    6.49   24.22    6.69   29.61    6.55   34.96
GR  6.78   40.26    7.99   43.25    7.57   50.56    7.52   82.81    8.39  116.11
*
* CROSS SECTION SBB-8, BLANCHE BROOK (TRANS 8)
X1 513.0      14    4.40   24.95  125.00  100.00  110.00
GR  9.50       0    9.58    2.29    7.72    4.40    7.67    8.23    7.73   14.03
GR  7.79   14.51    7.89   24.95    7.85   32.66    7.82   38.34    8.73   40.57
GR  9.59   46.82    9.06   54.73    9.61   82.22    9.85  107.10
* B3  MAIN STREET BRIDGE
* CROSS SECTION SBB-9, BLANCHE BROOK (TRANS 9)
X1 514.0      13   14.93   47.44  120.00  100.00  110.00
X3  10.0                                                   13.24   13.24
GR 13.49       0   13.24   14.93   10.69   18.75    8.55   21.77    8.66   25.60
GR  8.14   29.45    7.81   32.24    7.75   34.63    7.75   38.58    8.11   40.84
GR 10.16   43.15   13.10   47.44   13.24   63.66
SB  1.05    1.54    1.40    0.00   23.70    1.64  118.02
*
X1 514.1                            9.00    9.00    9.00
X2                  1.00   13.10   13.10
X3  10.0                                                   13.24   13.22
BT   -13       0   13.49   13.49   14.93   13.24   13.24   18.75   13.24   12.84
BT         21.77   13.24   12.84   25.60   13.24   12.84   29.45   13.24   12.84
BT         32.24   13.24   12.84   34.63   13.24   12.84   38.58   13.24   12.84
BT         40.84   13.24   12.84   43.15   13.24   12.84   47.44   13.24   13.10
BT         63.66   13.24   13.24
NC 0.035    0.04    0.04    0.1     0.3
* CROSS SECTION SBB-10, BLANCHE BROOK (TRANS 10)
X1 515.0      13   14.81   41.37   90.00  110.00  130.00
GR 11.86       0   11.91    7.77   12.13   11.26   10.19   14.81    9.96   18.51
GR 10.04   22.80   10.06   29.72    9.97   34.63   10.21   41.37   11.63   44.25
GR 12.03   55.48   12.72   67.36   12.70   75.35
* CROSS SECTION SBB-11, BLANCHE BROOK (TRANS 11)
X1 516.0      13   12.82   31.51   70.00   95.00  100.00
GR 13.63       0   13.74    6.26   13.54    8.58   11.53   12.82   11.02   16.83
GR 10.95   21.27   11.15   25.72   11.16   31.51   11.62   34.56   13.15   36.05
GR 14.31   53.54   14.81   61.72   14.82   68.23
*
* CROSS SECTION SBB-12, BLANCHE BROOK (TRANS 12)
X1 517.0      15   13.81   23.11   95.00   80.00  100.00
GR 14.66       0   14.59    6.45   14.34   13.03   12.03   13.81   11.88   16.76
GR 11.82   19.98   12.21   23.11   13.03   32.28   13.95   33.97   13.56   54.91
GR 13.58   60.97   14.77   66.58   15.82   81.10   16.07   90.92   16.05   97.47
*
* CROSS SECTION SBB-13, BLANCHE BROOK (TRANS 13)
X1 518.0      12    7.88   23.23   55.00   65.00   70.00
GR 16.25       0   16.27    4.17   14.51    7.88   14.45   11.40   14.73   17.03
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GR 14.72    23.23    14.53    26.25    14.52    29.76    14.66    32.98    18.24    35.07
GR 18.45    42.31    18.38    48.94
*
* CROSS SECTION SBB-14, BLANCHE BROOK (TRANS 14)
X1 519.0       13    10.83    28.09   110.00   110.00   100.00
GR 17.38        0    17.56     4.73    17.58     6.86    15.56    10.83    15.33    17.91
GR 14.98    20.33    15.03    24.31    15.27    28.09    15.74    30.59    15.52    32.47
GR 21.01    39.84    21.93    57.63    21.43    65.72
*
* CROSS SECTION SBB-15, BLANCHE BROOK (TRANS 15)
X1 520.0       12    13.41    33.72   100.00   120.00   110.00
GR 19.23        0    19.41     6.11    19.45     8.47    16.76    13.41    16.60    16.39
GR 16.82    19.78    16.69    24.88    17.07    33.72    17.32    38.54    18.57    54.40
GR 19.16    65.45    23.41    80.70
*
* CROSS SECTION SBB-16, BLANCHE BROOK (TRANS 16)
X1 521.0       11    34.91    52.41   130.00   150.00   160.00
GR 20.20        0    21.44    13.19    19.44    21.16    19.70    28.95    18.34    34.91
GR 18.24    38.01    18.01    40.81    18.01    44.09    17.99    47.66    18.30    52.41
GR 20.10    55.96
*
* CROSS SECTION SBB-17, BLANCHE BROOK (TRANS 17)
X1 522.0       14    18.98    33.14   180.00   170.00   180.00
GR 22.17        0    22.33     5.75    23.04    12.87    22.77    14.93    21.80    16.04
GR 20.88    18.98    20.34    23.09    20.42    25.20    20.59    28.40    20.89    33.14
GR 21.45    43.95    22.47    48.05    22.13    61.13    21.71    82.16
*
* CROSS SECTION SBB-18, BLANCHE BROOK (TRANS 18)
X1 523.0       13     6.79    21.09   140.00   120.00   130.00
GR 23.85        0    25.21     2.85    22.72     6.79    22.30    13.03    22.17    15.25
GR 22.07    17.95    22.21    20.20    22.55    21.09    22.99    21.43    24.06    27.04
GR 23.75    30.96    24.76    34.04    25.08    49.10
*
* CROSS SECTION BBK-21 (FROM PREVIOUS STUDY)
X1 524.0       29   124.90   155.20   145.00    72.00   110.00
X3  10.0                                                          28.01    28.01
GR 33.71        0    33.24    10.40    31.85    13.80    32.16    30.00    31.81    34.90
GR 31.50    43.80    31.02    60.00    29.93    90.00    28.54   120.00    28.01   124.90
GR 25.66   131.50    25.36   138.60    25.66   144.70    26.20   150.00    28.00   155.20
GR 28.01   171.10    28.06   175.70    26.74   179.10    26.44   180.00    26.74   186.40
GR 28.77   191.00    28.11   196.30    27.99   210.00    27.84   213.60    29.37   219.60
GR 29.70   240.00    30.16   270.00    31.14   300.00    31.74   315.00
NC  0.10     0.09     0.05     0.50     0.80
QT     2     64.0     79.0
*
* B4 HANSEN HIGHWAY BRIDGE (ROUTE 460, FROM PREVIOUS STUDY)
* CROSS SECTION BBK-22 (FROM PREVIOUS STUDY)
X1 525.1       23   221.00   242.38   150.00    40.00    90.00
X3  10.0                                                          29.74    29.74
GR 36.20        0    35.39    30.00    34.28    60.00    33.21    90.00    32.41   120.00
GR 31.83   150.00    31.45   180.00    31.36   210.00    31.34   220.90    29.74   221.00
GR 26.84   221.01    26.74   231.70    26.87   242.37    29.74   242.38    31.34   242.50
GR 31.38   262.70    31.39   270.00    31.22   300.00    30.93   330.00    30.78   360.00
GR 30.84   390.00    31.12   411.00    36.00   525.00
SB            1.54     1.50             21.36            62.44
*
X1 525.0                                10.00    10.00    10.00
X2                     1.00    29.74    30.78
X3  10.0                                                          31.34    30.78
BT  23.0        0    36.20    36.20    30.00    35.39    35.39    60.00    34.28    34.28
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BT  90.0    33.21    33.21   120.00    32.41    32.41   150.00    31.83    31.83   180.00
BT 31.45    31.45   210.00    31.36    31.36   220.90    31.34    31.34   221.00    31.34
BT 29.74   221.01    31.34    29.74   231.70    31.34    29.74   242.37    31.34    29.74
BT242.38    31.34    29.74   242.50    31.34    31.34   262.70    31.38    31.38   270.00
BT 31.39    31.39   300.00    31.22    31.22   330.00    30.93    30.93   360.00    30.78
BT 30.78   390.00    30.84    30.84   411.00    31.12    31.12   525.00    36.00    36.00
NC  0.10     0.10     0.04     0.10     0.30
*
* CROSS SECTION BBK-23 (FROM PREVIOUS STUDY)
X1 526.0       17    25.50    63.20   125.00     5.00    24.00
X4   1.0    25.89    40.80
GR 32.36        0    30.06     3.70    30.06    25.50    28.13    30.00    27.50    31.80
GR 27.09    35.60    27.09    46.00    27.52    48.00    27.72    51.20    30.07    60.00
GR 30.61    63.20    30.37    90.00    30.87   120.00    30.78   150.00    30.84   180.00
GR 31.12   201.00    36.00   316.00
NC  0.10     0.10    0.055     0.30     0.50
*
* CROSS SECTION BBK-24 (FROM PREVIOUS STUDY)
X1 527.0       15    11.20    40.70   185.00   105.00   170.00
X3  10.0                                                          31.22    31.97
GR 38.88        0    36.48     4.00    32.48    10.00    31.22    11.20    29.88    14.20
GR 29.78    24.20    29.98    34.60    30.09    35.70    31.97    40.70    31.05    42.80
GR 30.85    47.70    32.84    53.50    33.22    70.00    32.94   100.00    40.00   100.10
*
* UPSTREAM STUDY LIMIT - BLANCHE BROOK
*
* CROSS SECTION BBK-25 (FROM PREVIOUS STUDY)
X1 528.0       18    27.50    89.90   195.00   260.00   245.00
X3  10.0                                                          35.48    35.51
GR 36.47        0    35.17     8.20    35.47    13.50    34.37    19.30    35.37    22.30
GR 35.48    27.50    34.42    55.10    33.43    57.50    33.47    69.70    33.82    87.50
GR 35.51    89.90    35.40   102.50    35.15   117.50    35.90   123.50    34.74   131.00
GR 36.24   135.10    35.67   147.50    36.67   177.50
NC  0.04    0.045     0.04     0.30     0.50
*
* STEPHENVILLE, WARM CREEK
*
* CROSS SECTION SBB-5, BLANCHE BROOK (TRANS 5)
X1-509.0       20    52.96    67.86
GR  9.21        0     9.13     1.48     7.99     3.99     7.58    25.57     7.46    34.45
GR  5.83    45.53     5.51    46.95     5.06    52.96     4.71    57.73     4.43    61.53
GR  4.20    63.92     4.16    66.26     4.74    66.39     5.06    67.86     7.84    72.83
GR  8.24    78.89     7.72    84.93     5.60    90.55     5.47   105.88     5.35   124.54
QT     2     73.8    103.7
*
* CROSS SECTION SWC-36, WARM CREEK (BLANCHE BROOK TRANS 36)
X1 601.0       14    13.25    24.64   100.00    75.00   105.00
GR  7.61        0     7.38     2.32     5.26    13.25     5.07    15.98     5.05    19.04
GR  5.16    22.23     5.18    24.64     5.39    25.64     8.59    31.09     9.08    47.56
GR  7.59    53.68     7.20    72.35     6.66    78.22     6.17    93.11
*
* CROSS SECTION SWC-21, WARM CREEK (TRANS 21)
X1 602.0       14    17.32    26.91    90.00    90.00    90.00
GR 10.82        0    10.66     2.73     6.86    10.59     6.61    14.70     5.62    17.32
GR  5.21    20.68     4.97    22.00     4.93    23.64     5.41    26.91     7.90    30.89
GR  8.21    33.42     7.68    36.47     6.49    43.21     6.56    58.49
*
* CROSS SECTION SWC-22, WARM CREEK (TRANS 22)
X1 603.0       12    13.15    21.37   120.00   120.00   120.00
GR  7.77        0     8.46     3.16     8.92    10.28     8.90    10.82     7.80    11.13
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GR  6.69   13.15    6.27   15.47    6.44   17.84    6.78   21.37    7.58   31.16
GR  7.59   43.21    8.44   63.06
*
* B5 CAROLINA AVENUE BRIDGE
*
* CROSS SECTION SWC-3 (FROM PREVIOUS STUDY, SECTION 223)
X1 604.1      19  135.50  145.68   40.00   50.00   60.00
X3  10.0                                                     8.58     8.35
GR 10.00       0    9.30   30.00    8.79   60.00    8.75   90.00     9.26  120.00
GR  9.50  135.00    8.58  135.50    6.55  135.51    6.30  140.59     6.95  145.67
GR  8.58  145.68    9.51  146.00    9.45  150.00    8.94  180.00     8.35  210.00
GR  8.72  240.00    9.32  270.00   10.71  300.00   11.70  330.00
*
X1 604.0                            2.00    2.00    3.00
BT 19.00       0   10.00   10.00   30.00    9.30    9.30   60.00     8.79    8.79
BT 90.00    8.75    8.75  120.00    9.26    9.26  135.00    9.50     9.50  135.50
BT  9.50    8.58  135.51    9.50    8.58  140.59    9.50    8.58   145.67    9.51
BT  8.58  145.68    9.51    8.58  146.00    9.51    9.51  150.00     9.45    9.45
BT180.00    8.94    8.94  210.00    8.35    8.35  240.00    8.72     8.72  270.00
BT  9.32    9.32  300.00   10.71   10.71  330.00   11.70   11.70
*
X1 604.2                            5.00    5.00    6.00
X2                                          1.00
*
X1 604.3                            2.00    2.00    3.00
X3  10.0                                                     8.75     8.35
*
* CROSS SECTION SWC-4 (FROM PREVIOUS STUDY, SECTION 224)
X1 604.4   28.00  102.60  134.20   65.00   25.00   38.00
GR 10.04       0    9.10    2.20    9.57    4.60    8.61   30.00     8.87   57.00
GR  8.17   58.90   11.08   65.50   13.09   75.10   13.79   77.40    13.79   81.90
GR 13.70   85.30   12.41   90.00    9.29  102.60    8.11  112.80     7.08  121.30
GR  6.83  124.20    7.10  129.10    8.86  134.20    8.10  139.60     8.14  150.00
GR  8.29  160.60    8.20  180.00    8.12  208.70    8.58  210.00     8.59  228.40
GR  8.69  232.50    8.57  238.70   11.70  316.00
*
* CROSS SECTION SWC-23, WARM CREEK (TRANS 23)
X1 605.0       8    4.60   16.43   50.00   70.00   60.00
GR  8.45       0    9.14    2.35    7.76    4.60    7.34    7.25     7.69   16.43
GR  9.22   20.24   10.05   29.90   12.12   38.34
*
* CROSS SECTION SWC-24, WARM CREEK (TRANS 24)
X1 606.0      11   27.24   36.30   90.00  100.00   90.00
GR 10.63       0   10.53   25.81    9.86   27.05    8.44   27.24    8.10   30.25
GR  7.87   32.88    8.09   36.30    9.88   36.40   10.68   40.04   10.41   56.06
GR 12.06   66.50
*
* B6 MISSISSIPPI DRIVE BRIDGE
* CROSS SECTION WC-6 (FROM PREVOUS STUDY, CROSS SECTION 226)
X1 607.1      18   83.00   92.16   10.00   10.00   10.00
X3  10.0                                                     9.98     9.98
GR 11.87       0   11.24    4.50   10.94   30.00   10.36   46.10    10.11   48.00
GR 10.09   48.60   10.38   50.00   10.55   57.50   10.66   82.90     9.98   83.00
GR  8.18   83.01    8.36   87.58    8.43   92.15    9.98   92.16    10.72   92.20
GR 10.92  117.50   10.93  147.50   11.65  175.60
SB          1.60    1.50            9.14            15.14
*
X1 607.0                           10.50   10.50   10.50
X2                  1.00    9.98   10.09
X3  10.0                                                    10.09    10.72
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BT 18.00        0   11.87   11.87    4.50   11.24   11.24   30.00   10.94   10.94
BT 46.10    10.36   10.36   48.00   10.11   10.11   48.60   10.09   10.09   50.00
BT 10.38    10.38   57.50   10.55   10.55   82.90   10.66   10.66   83.00   10.66
BT  9.98    83.01   10.66    9.98   87.58   10.68    9.98   92.15   10.72    9.98
BT 92.16    10.72    9.98   92.20   10.72   10.72  117.50   10.92   10.92  147.50
BT 10.93    10.93  175.60   11.65   11.65
NC  0.04    0.045    0.04    0.10    0.30
*
* CROSS SECTION WC-7 (FROM PREVOUS STUDY, CROSS SECTION 227)
X1 607.2       19  101.30  116.60   40.00   18.00    5.00
X4   1.0    10.64   50.00
GR 16.80        0   10.56   52.00   10.94   55.00   10.98   66.00   10.61   80.00
GR 10.34    97.30   10.22  101.30    8.55  104.70    8.28  108.10    8.50  113.40
GR 10.01   116.60   10.38  130.20   10.44  133.50   12.41  148.20   12.63  160.00
GR 12.98   172.00   12.71  180.80   12.61  187.00   12.54  191.40
NC  0.06    0.095    0.045
*
* CROSS SECTION WC-8 (FROM PREVOUS STUDY, CROSS SECTION 228)
X1 607.3       20   76.00   99.20   20.00   40.00   34.00
GR 12.12        0   11.48    4.00   11.43   28.00   10.55   30.00   10.55   31.20
GR 11.07    33.00   11.27   40.00   11.17   45.00   10.50   53.00   10.97   60.00
GR 11.46    67.40    9.75   71.10   10.35   76.00    9.23   78.60    9.18   82.50
GR  9.18    87.00    9.80   92.20   12.68   97.20   14.48   99.20   14.68  105.80
*
* NH  4.00    0.035   23.30    0.095   57.40    0.04   65.80    0.095   76.50
*
* CROSS SECTION SWC-26, WARM CREEK (TRANS 26)
X1 608.0       11   13.57   27.66  112.00  110.00  115.00
GR 11.91        0   11.70    3.54   10.86    5.92   11.11   12.67   10.13   13.57
GR  9.76    15.43    9.94   17.68    9.90   20.46   10.23   24.64   10.43   27.66
GR 14.83    37.30
*
* CROSS SECTION SWC-27, WARM CREEK (TRANS 27)
X1 609.0       13   23.07   34.91  240.00  220.00  200.00
GR 15.66        0   14.11   13.33   13.56   21.32   12.86   23.07   12.42   25.90
GR 12.53    28.28   12.54   31.16   12.86   34.91   13.42   39.35   13.02   42.35
GR 13.47    44.16   20.50   55.57   21.08   63.76
*
* W1 WEIR ON WARM CREEK NEAR TRANSFORMER SUB-STATION
*
* CROSS SECTION WC-11 (PREVIOUS STUDY, SECTION 2211)
*
X1 610.1       16   54.50   73.51   35.00   25.00   25.00
X3  10.0                                                   14.06   14.06
GR 19.82        0   16.83   21.00   17.61   27.40   17.50   35.10   16.72   38.60
GR 16.50    45.50   14.99   49.20   15.30   54.50   14.53   60.70   15.94   60.71
GR 15.96    67.10   14.06   67.11   14.07   73.50   15.46   73.51   16.04   75.00
GR 18.70    78.60
SB           1.50    1.10           19.01           0.001
*
X1 610.0                            3.00    3.00    3.00
X2                   1.00   14.06   14.47
X3  10.0                                                   15.10   15.46
BT 16.00        0   19.82   19.82   21.00   16.83   16.83   27.40   17.61   17.61
BT 35.10    17.55   17.50   38.60   17.00   16.72   45.50   16.59   16.50   49.20
BT 15.10    14.99   54.50   15.39   15.30   60.70   14.53   14.53   60.71   16.02
BT 15.94    67.10   16.02   15.96   67.11   14.85   14.06   73.50   14.85   14.07
BT 73.51    15.46   15.46   75.00   16.30   16.04   78.60   18.70   18.70
NC  0.05    0.070   0.040    0.10    0.30
*
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X1 610.2        9   13.00   40.00   30.00   28.00   31.00
GR 17.85        0   16.93    9.00   15.64   13.00   15.79   18.00   15.39   22.00
GR 15.27    28.20   15.21   38.00   16.62   40.00   18.00   42.00
NC  0.05    0.095   0.040
*
* CROSS SECTION SWC-28, WARM CREEK (TRANS 28)
X1 611.0       12    8.58   20.48   50.00   50.00   50.00
GR 18.38        0   17.59    3.42   17.20    5.83   16.34    6.35   15.27    8.58
GR 14.99    10.41   14.99   12.77   15.04   15.73   14.99   18.48   15.36   20.48
GR 16.21    23.27   17.83   26.27
*
* CROSS SECTION SWC-29, WARM CREEK (TRANS 29)
X1 612.0       10   13.78   24.21  100.00  100.00  100.00
GR 18.96        0   18.36    2.70   17.45   12.83   16.07   13.78   15.31   16.09
GR 15.56    19.01   16.02   24.21   16.85   28.22   17.75   31.40   18.81   41.28
*
* CROSS SECTION SWC-30, WARM CREEK (TRANS 30)
X1 613.0       10   16.76   27.86  100.00  100.00  100.00
GR 17.99        0   17.25    9.70   16.71   16.76   16.26   20.55   16.01   22.00
GR 16.21    23.51   16.42   26.63   16.71   27.86   18.47   30.00   18.79   34.39
*
* CROSS SECTION SWC-31, WARM CREEK (TRANS 31)
X1 614.0       15   38.49   46.90  140.00  140.00  140.00
GR 20.23        0   19.98    6.49   18.13   18.30   17.54   28.55   17.27   33.33
GR 17.30    36.85   17.15   38.49   16.76   40.26   16.94   41.85   17.10   44.68
GR 17.20    46.90   17.37   56.25   17.33   65.58   19.54   75.27   23.20   80.62
*
* CROSS SECTION SWC-32, WARM CREEK (TRANS 32)
X1 615.0       15   44.88   48.59  130.00  130.00  130.00
GR 20.24        0   20.20    9.57   19.14   11.12   18.23   15.27   17.71   21.39
GR 18.14    24.84   18.09   37.22   17.94   44.88   17.70   47.14   17.61   48.59
GR 18.65    57.72   17.86   75.64   17.86   94.65   18.39   98.39   22.28  105.79
*
* CROSS SECTION SWC-33, WARM CREEK (TRANS 33)
X1 616.0       13   16.67   26.81   40.00   40.00   40.00
GR 20.82        0   20.87    5.15   20.12   12.86   18.71   15.41   18.52   16.67
GR 18.05    17.50   17.90   19.51   17.99   21.23   18.18   23.55   18.53   26.81
GR 19.00    27.77   21.04   28.80   21.72   30.62
NC 0.035    0.070   0.040    0.50    0.80
*
* C1 CULVERT UNDER RAILWAY SPUR LINE, NEAR BASEBALL FIELD
* CROSS SECTION WC-17 (FROM PREVIOUS STUDY, SECTION 2217)
*
X1 617.1    22.00   53.10   57.00   95.00  120.00  105.00
X3  10.0                                            21.32   21.32
GR 28.80        0   21.93   23.00   22.18   53.00   20.68   53.10   19.19   53.11
GR 19.19    54.07   19.23   54.08   19.23   55.04   19.28   55.05   19.28   56.01
GR 19.25    56.02   19.25   56.98   20.74   57.00   22.09   83.00   22.08  109.00
GR 21.45   113.00   21.55  120.50   22.06  128.00   22.25  143.00   22.47  173.00
GR 22.62   203.00   23.15  233.00
SB           2.05    1.50            3.90            4.67            19.83   19.25
*
X1 617.0    22.00   53.10   57.00   18.60   18.60   18.60
X2                   1.00   21.05   22.47
X3  10.0                                            22.54   22.47
BT 22.00        0   28.80   28.80   23.00   22.54   21.93   53.00   22.54   22.18
BT 53.10    22.54   20.70   53.11   22.54   20.70   54.07   22.54   20.70   54.08
BT 22.54    20.62   55.04   22.54   20.62   55.05   22.54   20.57   56.01   22.54
BT 20.57    56.02   22.54   21.05   56.98   22.54   21.05   57.00   22.54   21.05
BT 83.00    22.54   22.09  109.00   22.54   22.08  113.00   22.54   21.45  120.50
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BT 22.54    21.55  128.00   22.54   22.06  143.00   22.54   22.25  173.00   22.47
BT 22.47   203.00   22.62   22.62  233.00   23.15   23.15
GR 28.80        0   21.93   23.00   22.18   53.00   20.70   53.10   19.48   53.11
GR 19.48    54.07   19.40   54.08   19.40   55.04   19.45   55.05   19.45   56.01
GR 19.83    56.02   19.83   56.98   20.05   57.00   22.09   83.00   22.08  109.00
GR 21.45   113.00   21.55  120.50   22.06  128.00   22.25  143.00   22.47  173.00
GR 22.62   203.00   23.15  233.00
NC 0.035    0.095    0.040    0.30    0.50
*
*
* CROSS SECTION SWC-34, WARM CREEK (TRANS 34)
X1 618.0       13   36.40   47.32   20.00   15.00   15.00
GR 21.94        0   22.22   29.16   20.18   32.19   19.70   36.40   19.39   38.89
GR 19.19    41.21   19.46   43.50   19.77   47.32   20.17   49.37   22.22   52.70
GR 22.49    62.57   22.63   74.97   22.86   89.06
*
* CROSS SECTION SWC-35, WARM CREEK (TRANS 35)
X1 619.0        9    7.46   27.43  120.00   80.00   90.00
GR 22.08        0   19.93    7.46   19.60   12.92   19.11   14.84   19.04   19.09
GR 19.04    22.85   19.79   27.43   20.31   32.84   23.25   64.31
*
* CROSS SECTION WC-20 (FROM PREVIOUS STUDY, SECTION 2220)
*
X1 620.0       17  226.30  240.30  300.00  515.00  460.00
X4   1.0    21.88  100.00
GR 30.00        0   21.10  130.00   20.25  160.00   20.53  190.00   20.80  220.00
GR 20.77   226.30   20.15  226.70   19.51  233.80   20.15  238.40   20.60  240.30
GR 20.63   250.00   21.25  258.20   24.38  263.90   26.32  267.30   26.77  273.60
GR 26.87   276.20   27.49  280.00
NC 0.075    0.065    0.04
*
* CROSS SECTION SWC-21 (NOELS' POND OUTLET, TRANS 5)
*
X1 621.0        9   39.48   49.65  450.00  450.00  450.00
GR 25.31        0   24.46   24.31   22.68   28.89   20.92   39.48   20.58   43.35
GR 20.38    46.22   20.85   49.65   21.72   54.58   21.40   65.51
*
* B7A RAILWAY TRESTLE NEAR BRIDGE NO.7 (CONNECTICUT DRIVER)
*
* CROSS SECTION WC-22 (FROM PREVIOUS STUDY, SECTION 2222)
X1 622.1    31.00   76.80   87.38   75.00   50.00   65.00
X3  10.0                                                    23.15   22.93
GR 24.64        0   24.21   30.00   24.04   60.00   23.80   76.75   23.15   76.80
GR 20.63    76.81   20.63   78.71   23.15   78.72   23.15   79.57   20.63   79.58
GR 20.65    81.63   23.15   81.64   23.15   82.54   20.65   82.55   20.73   84.60
GR 23.15    84.61   23.15   85.46   20.73   85.47   20.73   87.37   23.15   87.38
GR 23.80    87.40   23.75   90.00   23.59  120.00   23.44  150.00   23.46  180.00
GR 23.83   204.00   23.82  212.00   22.93  219.00   24.15  222.00   24.49  234.00
GR 25.28   254.00
*
X1 622.0                            2.00    2.00    2.00
BT 31.00        0   24.64   24.64   30.00   24.21   24.21   60.00   24.04   24.04
BT 76.75    23.80   23.80   76.80   23.80   23.15   76.81   23.80   23.15   78.71
BT 23.80    23.15   78.72   23.80   23.15   79.57   23.80   23.15   79.58   23.80
BT 23.15    81.63   23.80   23.15   81.64   23.80   23.15   82.54   23.80   23.15
BT 82.55    23.80   23.15   84.60   23.80   23.15   84.61   23.80   23.15   85.46
BT 23.80    23.15   85.47   23.80   23.15   87.37   23.80   23.15   87.38   23.80
BT 23.15    87.40   23.80   23.80   90.00   23.75   23.75  120.00   23.59   23.59
BT150.00    23.44   23.44  180.00   23.46   23.46  204.00   23.83   23.83  212.00
BT 23.82    23.82  219.00   22.93   22.93  222.00   24.15   24.15  234.00   24.49
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BT 24.49   254.00    25.28    25.28
*
X1 622.2                                7.00     7.00     7.00
X2                                                        1.00
*
X1 622.3                                2.00     2.00     2.00
X3  10.0                                                          23.80    23.93
NC 0.045    0.060    0.035
*
* CROSS SECTION SWC-223, WARM CREEK (TRANS 4)
X1 623.0       11    21.00    30.33    15.00    30.00    20.00
GR 24.11        0    23.79     8.10    22.73    16.03    20.62    21.00    20.45    22.25
GR 20.65    23.95    20.59    25.64    20.73    28.27    21.05    30.33    21.39    31.64
GR 23.84    33.94
NC 0.040    0.035    0.035
*
* B7 CONNECTICUT DRIVE BRIDGE @ OUTLET OF NOELS POND
*
* CROSS SECTION WC-24 (FROM PREVIOUS STUDY, SECTION 2224)
X1 624.1    21.00    71.50    93.64    14.00     7.00    12.00
X3  10.0                                                          24.04    24.04
GR 25.50        0    24.39    50.00    24.67    71.00    24.04    71.50    21.21    71.51
GR 20.96    82.21    24.06    82.22    24.06    82.92    20.96    82.93    20.87    93.63
GR 24.07    93.64    24.70    94.00    24.10   124.00    24.04   150.00    24.37   180.00
GR 25.25   210.00    26.69   240.00    28.09   270.00    28.78   300.00    29.01   330.00
GR 28.41   360.00
SB  0.95     1.53     1.50             22.10     0.70    65.13
*
X1 624.0                                9.00     9.00     9.00
X2                     1.00    24.07    24.04
X3  10.0                                                          24.39    24.04
BT 21.00        0    25.50    25.50    50.00    24.39    24.39    71.00    24.67    24.67
BT 71.50    24.67    24.04    71.51    24.67    24.04    82.21    24.69    24.06    82.22
BT 24.69    24.06    82.92    24.69    24.06    82.93    24.69    24.06    93.63    24.70
BT 24.07    93.64    24.70    24.07    94.00    24.70    24.70   124.00    24.10    24.10
BT150.00    24.04    24.04   180.00    24.37    24.37   210.00    25.25    25.25   240.00
BT 26.69    26.69   270.00    28.09    28.09   300.00    28.78    28.78   330.00    29.01
BT 29.01   360.00    28.41    28.41
QT     2    111.1    133.7
*
X1 624.2    17.00    71.00    94.00    10.00    10.00    10.00
GR 25.50        0    24.39    50.00    24.67    71.00    21.21    71.50    20.96    82.00
GR 20.96    83.00    20.87    93.00    24.70    94.00    24.10   124.00    24.04   150.00
GR 24.37   180.00    25.25   210.00    26.69   240.00    28.09   270.00    28.78   300.00
GR 29.01   330.00    28.41   360.00
*
* W2 NOELS POND OUTLET WEIR
* SEE THE PREVIOUS HEC-2 MODEL INPUT FILE
*
X1 624.3    21.00    40.00    72.80     5.00     5.00     5.00
X3  10.0                                                          20.80    20.80
GR 26.50        0    23.50    30.00    22.87    37.30    21.97    40.00    20.75    40.05
GR 20.75    57.40    20.75    57.41    20.75    59.70    20.75    59.71    21.96    72.80
GR 22.78    75.40    23.92    81.90    23.95    85.40    24.10   124.00    24.04   150.00
GR 24.37   180.00    25.25   210.00    26.69   240.00    28.09   270.00    28.78   300.00
GR 29.01   330.00
SB          1.50     1.50             32.80             0.001
*
X1 624.4                                1.00     1.00     1.00
X2                     1.00    20.75    20.80
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X3  10.0                                                          22.87    21.97
BT 21.00        0   26.50   26.50   30.00   23.50   23.50   37.30    22.87    22.87
BT 40.00    22.87   21.97   40.05   21.97   20.75   57.40   21.97    20.75    57.41
BT 20.80    20.75   59.70   20.80   20.75   59.71   21.96   20.80    72.80    21.96
BT 21.96    75.40   22.78   22.78   81.90   23.92   23.92   85.40    23.95    23.95
BT124.00    24.10   24.10  150.00   24.04   24.04  180.00   24.37    24.37   210.00
BT 25.25    25.25  240.00   26.69   26.69  270.00   28.09   28.09   300.00    28.78
BT 28.78   330.00   29.01   29.01
NC 0.035    0.035   0.030    0.30    0.50
*
* B7B CULVERT UNDER ROUTE 490, AT INLET TO NOELS POND, FROM PREVIOUS STUDY
*
* NOTES:  CULVERTS ASSUMED 100% FREE OF ANY DEBRIS BLOCKAGE
*
X1 625.1    18.00  104.00  123.93 2400.00 2140.00 2265.00
X3  10.0                                                          23.95    23.13
X5   1.0    24.50
GR 28.00        0   25.95   28.00   25.81  100.00   23.95  104.00    20.44   104.01
GR 20.44   112.90   23.95  112.91   23.13  120.00   20.68  120.01    20.68   121.92
GR 23.13   121.93   23.13  122.00   20.68  122.01   20.68  123.92    23.13   123.93
GR 25.81   138.00   24.82  238.00   28.00  350.00
*
X1 625.2    18.00  104.00  123.93    5.00    5.00    5.00
BT 18.00        0   28.00   28.00   28.00   25.95   25.95  100.00    25.81    25.81
BT104.00    25.81   23.87  104.01   25.81   23.87  112.90   25.81    23.87   112.91
BT 25.81    23.87  120.00   25.81   23.19  120.01   25.81   23.19   121.92    25.81
BT 23.19   121.93   25.81   23.19  122.00   25.81   23.48  122.01    25.81    23.48
BT123.92    25.81   23.48  123.93   25.81   23.48  138.00   25.81    25.81   238.00
BT 24.82    24.82  350.00   28.00   28.00
GR 28.00        0   25.95   28.00   25.81  100.00   23.87  104.00    21.18   104.01
GR 21.18   112.90   23.87  112.91   23.19  120.00   21.29  120.01    21.29   121.92
GR 23.19   121.93   23.48  122.00   21.21  122.01   21.21  123.92    23.48   123.93
GR 25.81   138.00   24.82  238.00   28.00  350.00
*
X1 625.3                            8.00    8.00    8.00
X2                                                  1.00
*
X1 625.0                            5.00    5.00    5.00
X3  10.0                                                          25.81    24.82
NH  4.00     0.07  180.00   0.085  198.80   0.035  216.00    0.06   410.00
*
X1 626.0    16.00  198.80  216.00  170.00   10.00  245.00
GR 30.00        0   22.80   15.00   22.80  180.00   25.70  187.70    25.79   193.20
GR 26.56   196.30   25.28  197.50   25.21  198.80   22.28  203.00    21.08   209.00
GR 22.28   215.10   22.43  216.00   22.44  245.10   22.44  370.00    25.81   395.00
GR 28.00   410.00
NH  9.00     0.04  100.00   0.120  142.80   0.040  160.00    0.15   187.50    0.095
NH208.70     0.04  217.50   0.095  236.20   0.070  360.70   0.095   440.00    0.000
*
X1 627.0    32.00  208.30  218.20  195.00   50.00  130.00
GR 30.00        0   22.55   40.00   22.55  100.00   26.69  113.50    30.08   126.70
GR 30.77   130.00   32.18  137.80   33.47  142.80   33.13  151.60    32.20   154.00
GR 32.10   158.80   31.38  160.00   28.44  167.70   28.03  174.40    26.80   179.40
GR 22.52   187.50   22.27  190.00   22.18  203.30   22.57  208.30    22.26   208.70
GR 21.06   213.00   22.27  217.50   22.57  218.20   22.49  220.00    22.44   236.20
GR 22.06   250.00   21.89  280.00   21.77  310.00   22.11  340.00    21.75   360.70
GR 26.10   410.00   28.00  440.00
NC 0.060    0.060   0.035    0.60    0.80
*
X1 628.0    11.00   70.60   78.40  170.00  240.00  205.00
```

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GR 28.00       0   22.74   40.00   22.68   70.60   22.20   71.00   21.00   73.00
GR 22.21   77.50   22.99   78.40   22.57  100.00   22.53  110.00   22.53  155.00
GR 28.00  175.00
NC 0.050   0.050   0.035
*
X1 628.1                           85.00   85.00   85.00    0.50    0.50
*
*
* B7C RAILWAY TRESTLE UPSTREAM OF ROUTE 490 (FROM PREVIOUS STUDY)
*
X1 629.1   17.00  298.00  306.24   85.00   85.00   85.00
X3  10.0                                                   24.40   24.40
GR 27.00       0   25.00   40.00   24.90   56.00   25.20  105.00   25.00  190.00
GR 25.00  297.00   24.40  298.00   22.70  298.01   22.10  302.10   22.70  306.23
GR 24.40  306.24   25.00  307.00   25.00  410.00   24.90  465.00   25.00  525.00
GR 26.00  585.00   27.00  605.00
SB          1.50    1.50            8.23           18.93
*
X1 629.2                            5.00    5.00    5.00
X2                  1.00   24.40   24.90
X3  10.0                                                   24.90   24.90
BT 17.00    0.00   27.00   27.00   40.00   25.00   25.00   56.00   24.90   24.90
BT105.00   25.20   25.20  190.00   25.00   25.00  297.00   25.00   25.00  298.00
BT 25.00   24.40  298.01   25.00   24.40  302.10   25.00   24.40  306.23   25.00
BT 24.40  306.24   25.00   24.40  307.00   25.00   25.00  410.00   25.00   25.00
BT465.00   24.90   24.90  525.00   25.00   25.00  585.00   26.00   26.00  605.00
BT 27.00   27.00
*
QT      2    81.6    95.8
X1 629.0   17.00  270.00  279.10  180.00  190.00  180.00
GR 28.00       0   23.63   45.00   23.19  210.00   23.27  240.00   23.58  270.00
GR 22.57  270.60   22.27  274.60   22.62  278.80   22.98  279.10   23.38  290.00
GR 22.72  291.30   22.72  295.40   23.30  295.90   23.27  300.00   23.30  310.00
GR 23.50  515.00   28.00  530.00
NC                          0.10    0.30
NH  5.00    0.04  428.30   0.095  436.00   0.040  560.00    0.03  597.00   0.320
NH610.00
*
X1 630.0   24.00  410.00  429.50  350.00  610.00  570.00
GR 28.00       0   25.50  140.00   23.60  185.00   24.29  260.00   24.15  290.00
GR 24.21  320.00   24.20  350.00   24.23  380.00   24.44  410.00   24.30  411.00
GR 23.08  411.50   22.08  412.50   23.08  428.30   24.00  429.50   23.69  433.30
GR 24.30  436.00   24.43  440.00   24.35  470.00   24.30  500.00   24.19  530.00
GR 24.02  560.00   24.11  590.00   24.15  597.00   28.00  610.00
NC  0.04    0.04   0.035    0.30    0.50
*
X1 631.0   21.00  327.10  342.40  190.00  140.00  225.00
GR 28.00       0   24.80  105.00   26.20  185.00   25.60  210.00   24.90  300.00
GR 25.03  312.30   24.01  314.00   24.17  319.50   23.85  320.30   24.02  325.60
GR 24.59  327.10   24.21  328.30   23.82  328.70   21.80  335.00   23.82  341.20
GR 24.76  342.40   24.21  357.70   24.89  358.70   24.90  385.00   26.00  485.00
GR 28.00  502.00
NC 0.045   0.095   0.050    0.30    0.50
*
X1 632.0   18.00  388.30  419.50   85.00  255.00  170.00
X4   1.0   26.30  300.00
GR 28.00       0   25.01  340.00   25.40  370.00   24.61  373.90   25.29  388.30
GR 24.51  393.60   24.35  400.00   24.51  413.60   24.31  418.00   25.13  419.50
GR 24.81  430.00   24.73  437.30   24.41  438.40   24.74  440.80   25.41  442.80
GR 25.35  460.00   27.16  555.00   28.00  557.00
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*
X1 632.8                                5.00     5.00     5.00
*
X1 632.9                                5.00     5.00     5.00
NC                              0.80    1.00
*
* B8A RAILWAY TRESTLE DOWNSTREAM OF ROUTE 460 (FROM PREVIOUS STUDY)
*
X1 632.1   17.00  555.00  565.51   10.00    10.00    10.00
X3  10.0                                                      26.10    26.10
GR 27.20       0   26.80   90.00   26.20   195.00    26.20   500.00    26.70   550.00
GR 26.10  555.00   24.26  555.01   23.95   560.00    26.10   560.01    26.10   560.86
GR 23.95  560.87   24.26  565.50   26.10   565.51    26.70   570.00    27.20   680.00
GR 27.30  830.00   27.80 1080.00
SB  1.25    1.72    1.50            10.50     0.85    20.80
*
X1 632.2                                5.00     5.00     5.00
X2                  1.00   26.10   26.20
X3  10.0                                                      26.20    26.70
BT 17.00    0.00   27.20   27.20   90.00    26.80    26.80   195.00    26.20    26.20
BT500.00   26.20   26.20  550.00   26.70    26.70   555.00    26.70    26.10   555.01
BT 26.70   26.10  560.00   26.70   26.10   560.01    26.70    26.10   560.86    26.70
BT 26.10  560.87   26.70   26.10  565.50    26.70    26.10   565.51    26.70    26.10
BT570.00   26.70   26.70  680.00   27.20    27.20   830.00    27.30    27.30  1080.00
BT 27.80   27.80
*
X1 632.3                               10.00    10.00    10.00     1.90
*
*
* B8 ROUTE 460 BRIDGE NEAR THE COMMUNITY OF NOELS POND (FROM PREVIOUS STUDY)
*
*
X1 632.4   19.00  545.10  563.40   10.00    10.00    10.00
X3  10.0                                                      25.87    25.87
GR 27.20       0   26.80   90.00   26.20   195.00    26.20   320.00    26.20   420.00
GR 26.80  545.00   25.87  545.10   23.87   545.11    24.27   554.16    25.87   554.17
GR 25.87  555.27   24.27  555.28   24.47   563.38    25.87   563.40    26.80   564.00
GR 26.80  618.00   26.70  765.00   26.90   910.00    27.20  1040.00
SB  1.25    1.63    1.50            18.25     1.10    34.25
*
X1 632.5                               12.00    12.00    12.00
X2                  1.00   25.87   26.20
X3  10.0                                                      26.20    26.70
BT 19.00    0.00   27.20   27.20   90.00    26.80    26.80   195.00    26.20    26.20
BT320.00   26.20   26.20  420.00   26.20    26.20   545.00    26.80    26.80   545.10
BT 26.80   25.87  545.11   26.80   25.87   554.16    26.80    25.87   554.17    26.80
BT 25.87  555.27   26.80   25.87  555.28    26.80    25.87   563.38    26.80    25.87
BT563.40   26.80   25.87  564.00   26.80    26.80   618.00    26.80    26.80   765.00
BT 26.70   26.70  910.00   26.90   26.90  1040.00    27.20    27.20
NH  6.00    0.03  302.70   0.095  329.50    0.030   337.50    0.035   348.60    0.040
NH364.60   0.035  490.00
*
X1 633.0   31.00  329.50  351.60  140.00    10.00    50.00
GR 28.00       0   25.96  190.00   25.99   209.50    25.91   239.50    25.92   269.50
GR 25.65  302.70   25.08  306.70   25.61   327.50    26.38   329.50    25.57   333.50
GR 24.75  337.50   24.51  340.00   24.75   344.10    24.90   348.60    25.78   351.60
GR 25.06  355.30   24.62  364.60   24.96   370.00    24.88   373.10    25.80   374.90
GR 25.71  400.00   26.04  409.10   25.46   411.40    26.65   416.00    26.67   427.50
GR 26.40  440.60   25.67  443.90   26.74   452.60    26.80   460.00    27.15   467.80
GR 27.16  490.00
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NH  9.00     0.03   335.50    0.035   345.70    0.040   355.50    0.035   366.30    0.040
NH368.80    0.035   378.00    0.095   390.00    0.035   420.00    0.045   780.00
NC                             0.10     0.30
*
X1 634.0    23.00   345.70   366.30    40.00   180.00   130.00
GR 28.00        0    25.96   190.00    26.55   270.00    25.73   300.00    26.92   330.00
GR 26.90   331.40    25.94   335.50    25.72   336.10    25.72   339.90    25.72   342.80
GR 26.71   345.70    25.87   355.50    25.71   360.00    25.87   364.60    26.10   366.30
GR 25.75   368.80    27.22   372.80    26.23   375.40    26.18   378.00    26.20   390.00
GR 25.95   420.00    25.95   760.00    28.00   780.00
NH  4.00     0.12    20.00    0.035    45.00    0.040    52.00    0.035   134.70
NC                             0.60     0.80
*
X1 635.0    17.00    18.10    45.00   460.00   210.00   260.00
GR 33.77        0    30.32     4.50    28.57     8.10    29.04    13.80    28.84    18.10
GR 27.29    20.00    27.00    22.00    27.29    24.10    27.55    27.20    27.23    30.80
GR 27.00    37.30    27.43    45.00    27.68    52.00    27.66    82.00    28.09   102.90
GR 28.99   104.70    29.09   134.70
NC 0.120    0.035    0.035     0.10     0.30
*
X1 636.0    23.00   105.60   125.50   250.00   160.00   250.00
GR 35.03        0    35.08     2.80    30.09    12.00    29.85    14.60    30.42    16.90
GR 29.65    21.60    30.37    30.00    30.36    60.00    30.37    90.00    30.29   105.60
GR 29.53   107.40    29.21   114.10    29.49   122.90    31.15   125.50    30.12   127.50
GR 29.76   140.10    30.22   150.00    30.20   180.00    29.55   210.00    29.22   240.00
GR 29.22   270.00    30.00   335.00    36.00   360.00
NH  5.00     0.10    24.90    0.035    39.10    0.100    46.40    0.050    94.10    0.035
NH135.00
*
*
* UPSTEAM STUDY LIMIT - WARM CREEK (FROM PREVIOUS STUDY)
*
*
X1 637.0    16.00    24.90    46.40   355.00   340.00   350.00
GR 41.34        0    41.29     4.40    40.14     7.60    37.74    11.70    35.14    35.50
GR 33.19    24.90    32.40    25.20    32.04    29.40    32.40    34.10    32.72    39.10
GR 32.84    43.00    33.70    46.40    33.95    64.10    33.94    94.10    34.00   120.00
GR 40.00   135.00
*
EJ
T1       FLOOD RISK MAPPING STUDY OF STEPHENVILLE, KIPPENS, AND COLD BROOK (NF)
T2       HEC-2 INPUT FILE (H7439100.DAT), CCL JOB #7439, OCTOBER 1995
T3       COLD BROOK, BLANCHE BROOK, AND WARM CREEK - 1:100 YEAR FLOOD PROFILE
J1             3                                  1                          1.5
J2    15              -1
ER
* B3  MAIN STREET BRIDGE
* CROSS SECTION SBB-9, BLANCHE BROOK (TRANS 9)
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T1        FLOOD RISK MAPPING STUDY OF STEPHENVILLE, COLD BROOK (NF)
T2        HEC-2 INPUT FILE (C7439.DAT), CCL JOB #7439, JANUARY 1996
T3        COLD BROOK - 1:20 YEAR FLOOD PROFILE
J1              2                                1                        1.5
J2      1               -1
J3     38       43        1        4        8       26       51       55       56
J6      1
NC   .035     .035     .033     .300     .500
QT      2    43.82    50.55
*
* STEPHENVILLE, COLD BROOK
*
* FIRST CROSS SECTION (FROM THE SURVEY )
X1 801.0       15    119.2    136.0      0.0      0.0      0.0
GR107.68    100.0   107.37    115.0   106.94    119.2   105.15    121.4   104.35    123.9
GR104.23    124.5   104.10    127.4   103.70    129.0   104.04    130.7   104.44    132.0
GR104.56    132.8   106.86    136.0   107.25    139.5   107.27    144.9   108.50    160.0
*
* THE BRIDGE
X1    801       15    119.2    136.0      4.0      6.0      5.0
X3     10                                                         106.9    106.9
GR107.68    100.0   107.37    115.0   106.94    119.2   105.15    121.4   104.35    123.9
GR104.23    124.5   104.10    127.4   103.70    129.0   104.04    130.7   104.44    132.0
GR104.56    132.8   106.86    136.0   107.25    139.5   107.27    144.9   108.31    160.0
SB    1.5      1.5      1.6     14.0     16.8             54.4
X1 801.1                                1.00     1.00     1.00
X2                        1   106.94   107.25
X3     10                                                         106.9    106.9
BT    -15    100.0   107.68   107.68    115.0   107.37   107.37    119.2    106.94   106.94
BT           121.4   106.94   106.00    123.9   106.94   106.00    124.5    106.94   106.00
BT           127.4   106.94   106.00    129.0   106.94   106.00    130.7    106.94   106.00
BT           132.0   106.94   106.00    132.8   106.94   106.00    136.0    106.86   106.86
BT           139.5   107.25   107.25    144.9   107.27   107.27    160.0    108.31   108.31
*
X1 801.2                                5.00     5.00     5.00
*
X1 801.3                                1.00     1.00     1.00
NC   .035     .035     .035     .100     .300
*
X1    802       13    108.1    123.6     23.0     28.0     25.0
GR113.20     50.0   106.29    100.0   105.94    108.1   104.96    108.5   104.61    110.0
GR104.38    110.5   104.21    112.3   104.46    113.5   104.60    114.5   105.03    119.5
GR106.55    123.6   107.17    129.1   114.41    160.0
*
X1    803       13    108.2    143.3    128.0    130.0    125.0
GR114.65     50.1   106.86    100.0   106.78    108.2   106.47    114.4   105.80    123.1
GR105.45    125.0   105.29    126.5   105.78    128.1   107.14    129.3   106.93    133.5
GR107.43    143.3   107.08    147.5   114.65    180.0
*
X1    804       13    172.7    208.9     90.0     98.0     95.0
GR114.19    100.0   109.49    132.5   108.86    152.5   107.99    172.7   106.71    173.6
GR106.73    175.9   106.91    177.6   108.00    186.7   108.07    197.7   107.75    208.9
GR107.48    210.3   107.10    212.3   115.00    251.0
*
X1    805       14    138.6    162.6    122.0    130.0    125.0
GR113.98     50.0   108.77    100.0   108.63    117.6   109.25    138.6   108.55    142.5
GR108.05    154.9   107.85    158.0   107.99    161.8   108.60    162.6   108.28    173.5
GR108.77    182.6   108.53    205.2   108.30    218.5   113.50    272.5
*
X1    806       13    108.9    133.6     85.0     90.0     84.0
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GR115.0      45.0  109.17   100.0  109.10   108.9  108.82   116.4  108.54   123.1
GR108.07    128.2  107.82   131.0  108.03   133.1  109.28   133.6  109.10   138.9
GR109.32    144.5  108.93   152.2  109.91   189.0
*
X1   807       11   141.3   163.2   105.0   101.0   110.0
GR113.50     42.0  111.16   100.0  111.10   120.3  111.05   137.1  110.82   141.3
GR109.70    143.8  109.60   146.5  109.68   152.4  109.86   157.8  113.46   163.2
GR113.36    175.5
*
X1   808       16   174.9   201.4   195.0   205.0   190.0
GR116.20     50.0  111.90   100.0  112.18   125.2  112.16   148.6  112.25   169.7
GR111.82    174.9  111.01   175.3  110.73   177.9  111.08   179.9  111.29   180.9
GR111.30    181.8  111.27   183.2  111.20   184.8  111.64   189.5  111.10   195.0
GR116.11    201.4
*
X1   809       16   128.6   188.2   212.0   225.0   210.0
GR121.00     54.0  115.36   100.0  115.87   116.2  115.25   128.6  114.38   129.7
GR114.23    130.7  114.38   132.2  115.17   138.2  115.77   149.4  115.60   165.6
GR115.37    177.6  116.16   188.2  115.14   201.1  115.44   219.0  115.96   241.9
GR121.23    301.0
*
X1   810       18   130.2   172.2   250.0   265.0   260.0
GR122.00     45.0  119.05   100.0  118.92   108.1  119.29   120.0  120.39   123.4
GR118.84    126.1  118.77   127.8  120.32   130.2  119.42   132.0  119.13   136.5
GR119.48    142.7  118.84   163.2  118.35   170.7  119.34   172.2  119.75   181.5
GR119.50    191.3  119.80   198.7  122.45   250.0
EJ
T1       FLOOD RISK MAPPING STUDY OF STEPHENVILLE, COLD BROOK (NF)
T2       HEC-2 INPUT FILE (C7439.DAT), CCL JOB #7439, JANUARY 1996
T3       COLD BROOK - 1:100 YEAR FLOOD PROFILE
J1            3                                1                        1.5
J2     15              -1
ER
```
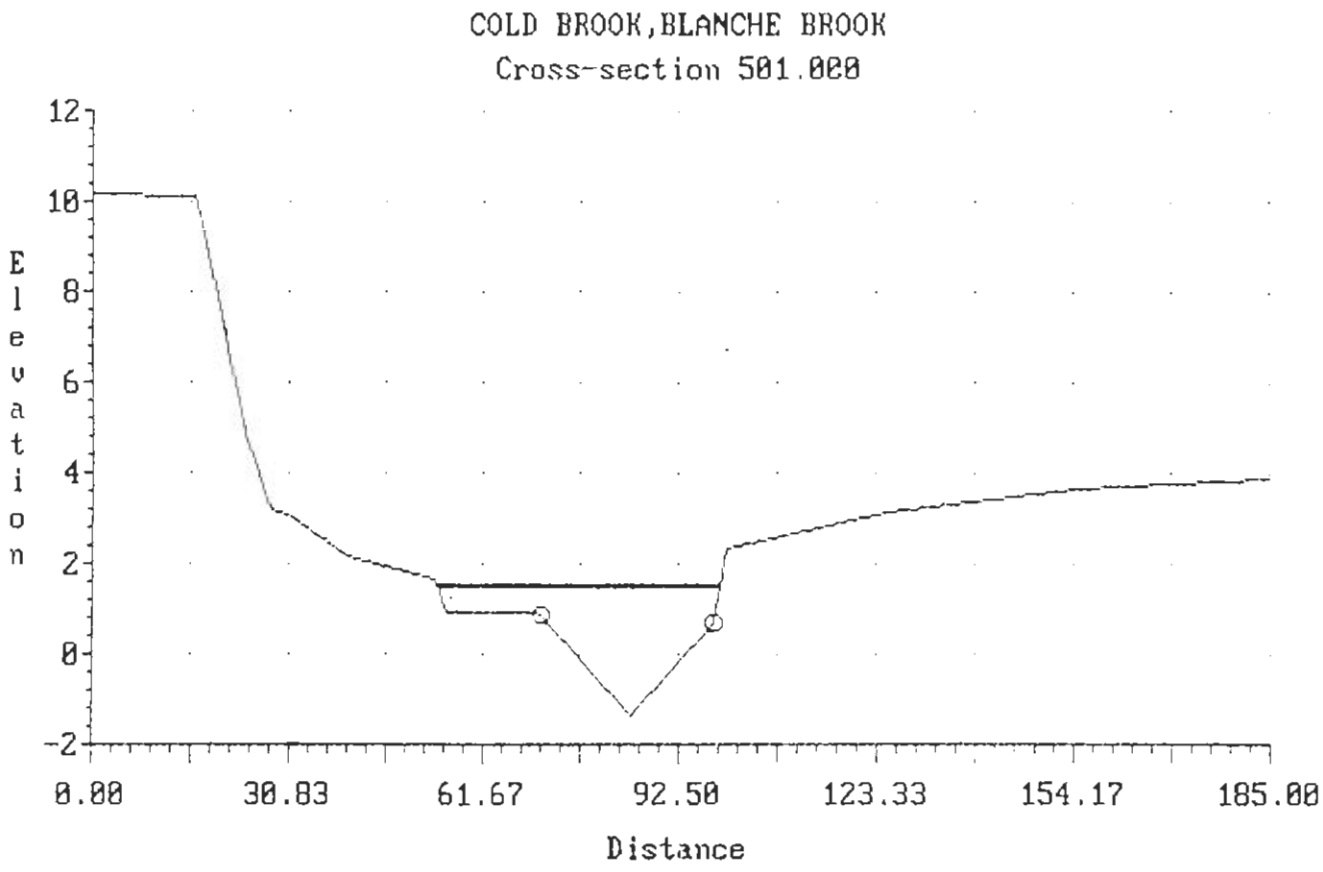
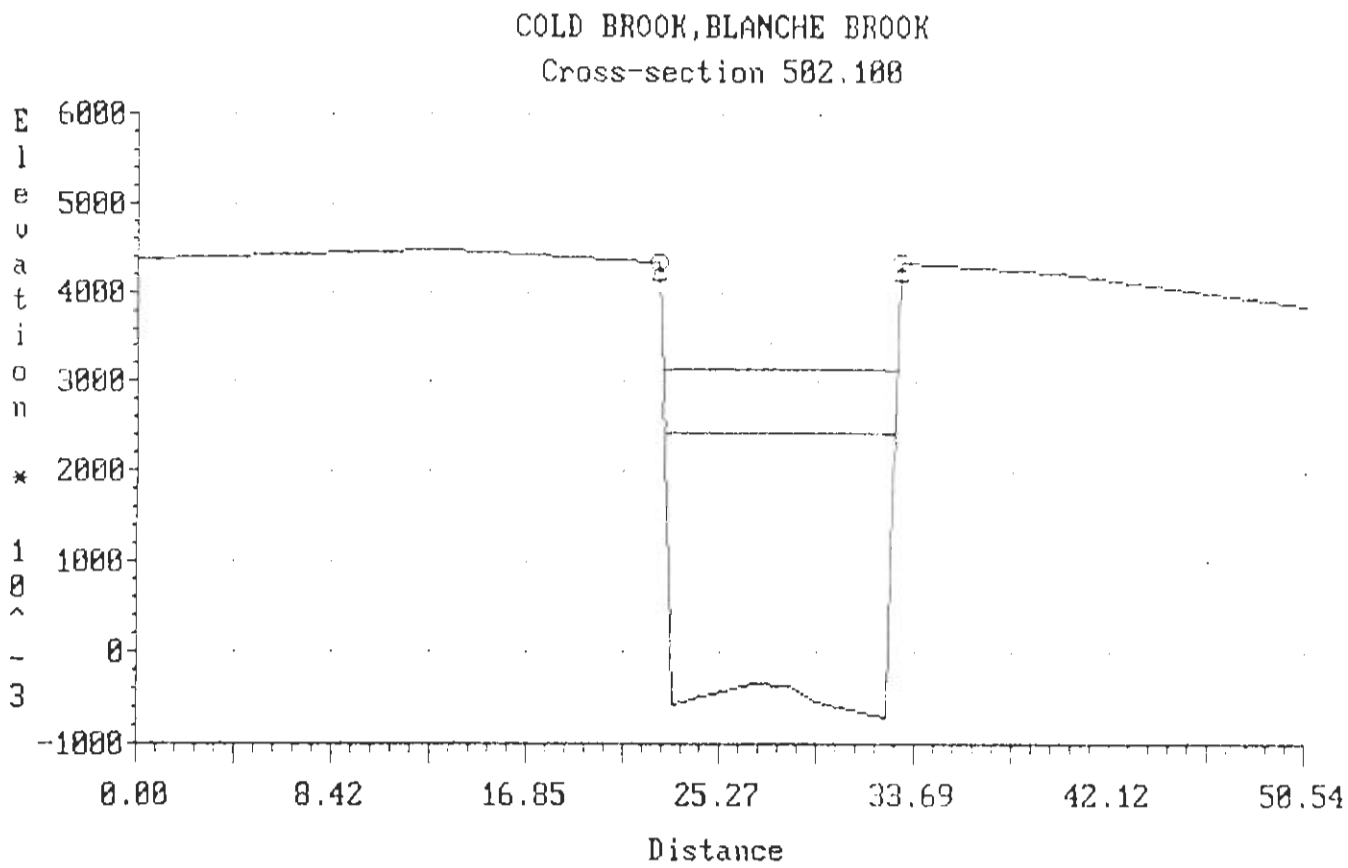
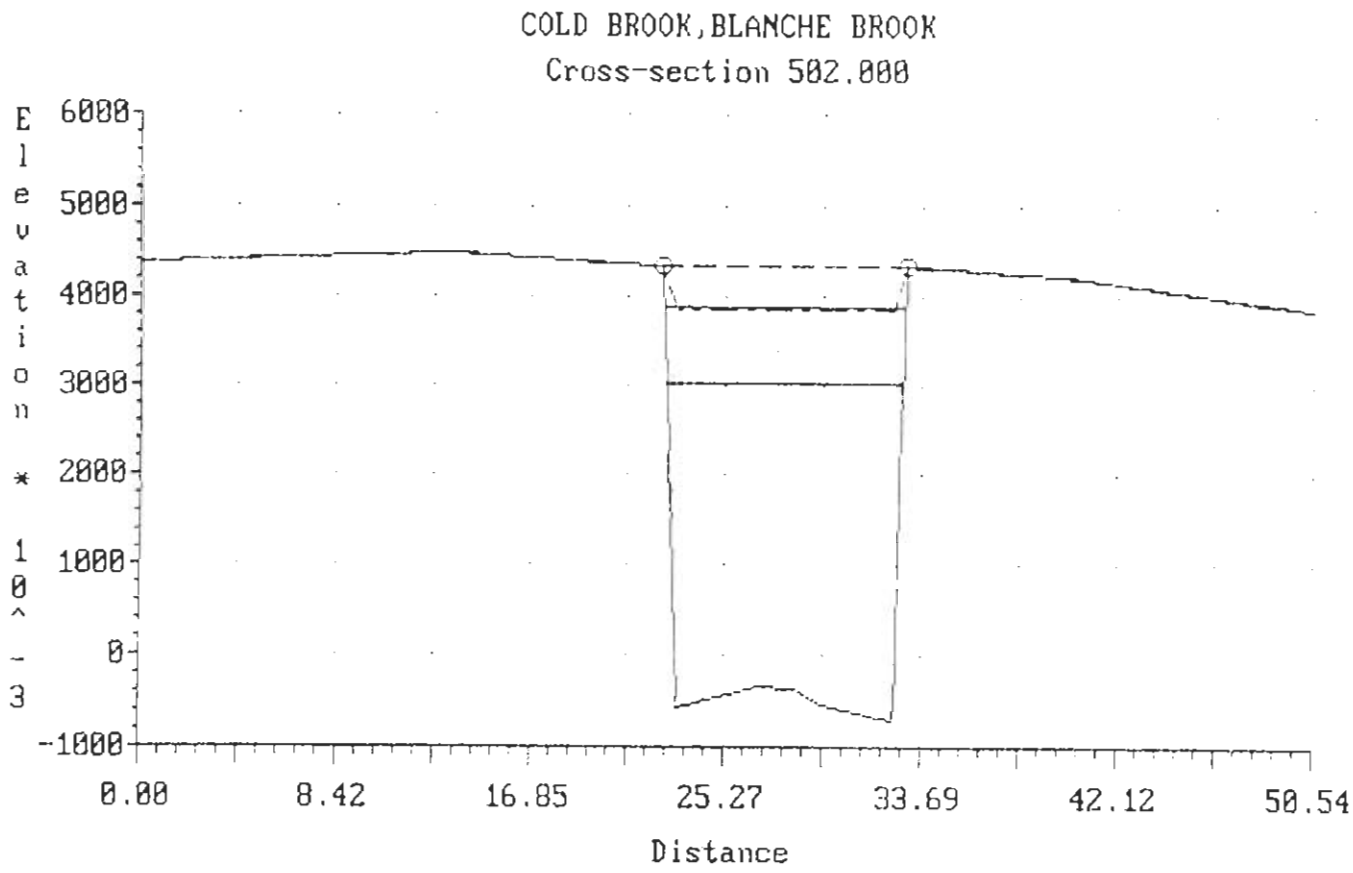
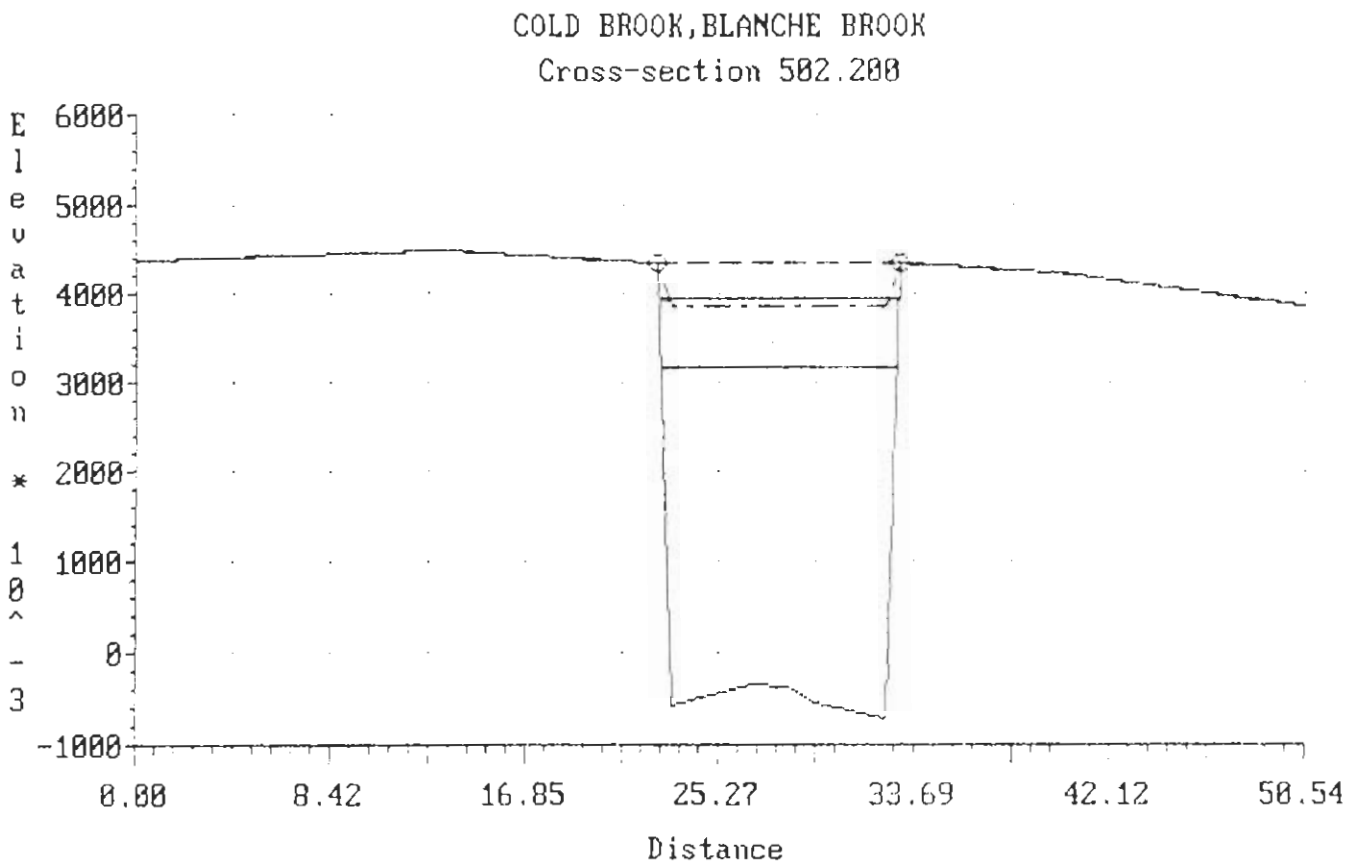

```
T1       FLOOD RISK MAPPING STUDY OF STEPHENVILLE, GAUDONS BROOK (NF)
T2       HEC-2 INPUT FILE (G7439.DAT), CCL JOB #7439, JANUARY 1996
T3       GAUDONS CREEK - 1:20 YEAR FLOOD PROFILE
J1             2                                1                        1.5
J2     1              -1
J3    38      43       1       4       8      26      51      55      56
J6     1
NC  .035    .035    .033    .300    .500
QT     2   39.82   47.92
*
* STEPHENVILLE, GAUDONS BROOK
*
* FIRST CROSS SECTION (FROM THE SURVEY 1B)
X1   701       8   107.2   116.0     0.0     0.0
GR 13.10   100.0   12.95   107.2   10.19   109.6   10.27   111.1   10.46   114.8
GR 11.17   116.0   12.13   130.7   13.50   160.0
*
X1   702       9   100.0   117.6    16.0    20.0    15.0
GR 13.25   100.0   11.30   107.6   11.05   109.9   11.11   112.0   11.10   113.9
GR 11.19   115.5   12.52   117.6   12.26   123.3   13.54   156.0
*
* THE BRIDGE
X1   703      11   120.0   130.6    30.0    40.0    35.0
X3    10                                                   14.5    14.5
GR 15.25    43.0   14.52   100.0   14.29   120.0   12.16   121.0   12.06   121.7
GR 11.84   123.5   11.69   127.1   12.10   128.2   12.78   130.1   14.55   130.6
GR 15.08   148.4
SB   1.5     1.5     1.6    55.0    10.6           30.74
X1 702.1                           1.00    1.00    1.00
X2                    1   14.59   14.59
X3    10                                                   14.5    14.5
BT   -11    43.0   15.25   15.25   100.0   14.52   14.52   120.0   14.52   14.29
BT         121.0   14.52   14.29   121.7   14.52   14.29   123.5   14.52   14.29
BT         127.1   14.52   14.29   128.2   14.52   14.29   130.1   14.52   14.29
BT         130.6   14.55   14.55   148.4   15.08   15.08
*
X1 703.2                           5.00    5.00    5.00
*
X1 703.3                           1.00    1.00    1.00
NC  .035    .035    .035    .100    .300
*
X1   704      14   115.0   133.7    50.0    62.0    65.0
GR 16.34    54.0   14.74   100.0   14.73   105.6   14.21   108.1   14.59   115.0
GR 12.90   117.0   12.62   121.9   12.43   124.2   12.46   126.2   12.60   127.9
GR 13.12   130.2   15.62   133.7   16.25   141.3   16.30   154.0
*
X1   705      12   110.2   126.6    50.0    75.0    65.0
GR 16.96   100.0   16.98   105.5   16.69   110.2   14.38   114.8   14.06   117.8
GR 13.86   119.5   14.06   121.2   14.68   124.0   16.29   126.6   16.15   132.0
GR 17.63   136.8   17.62   144.8
*
X1   706      13   107.9   123.8    72.0    75.0    70.0
GR 18.65    52.0   17.14   100.0   17.77   106.6   17.28   107.9   16.02   109.9
GR 15.77   111.9   15.59   112.6   15.66   114.8   15.73   118.0   15.86   121.4
GR 16.53   123.8   18.55   127.0   18.93   138.0
*
X1   707      12   110.8   128.5    32.0    40.0    38.0
GR 18.75   100.0   18.61   108.9   17.17   110.8   16.90   117.9   16.63   119.7
GR 16.75   121.9   16.81   125.9   17.66   128.5   17.55   133.7   17.91   137.7
GR 19.22   140.1   19.23   147.9
```

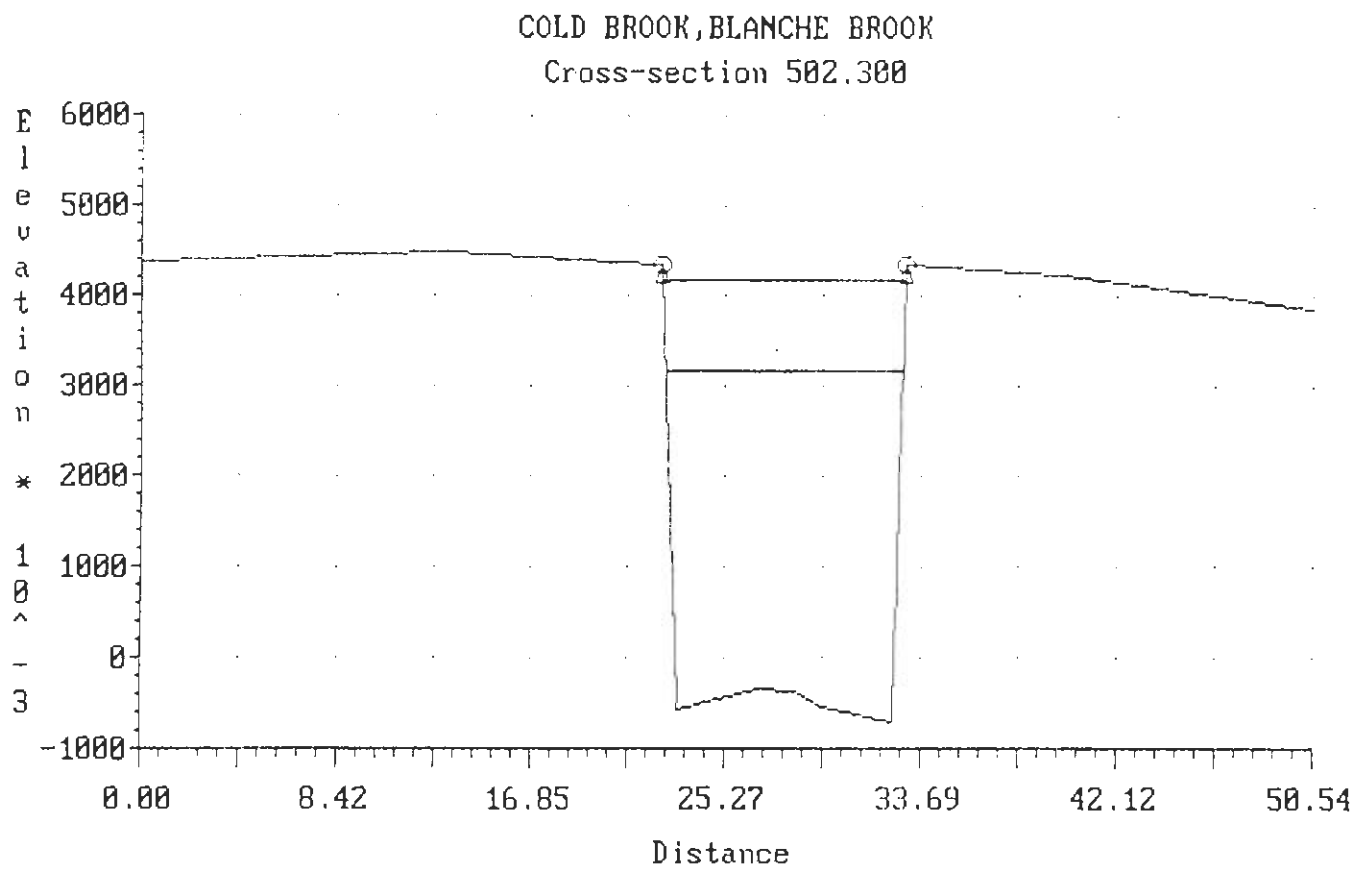
```
*
X1    708       13    108.5    121.9     61.0     70.0     60.0
GR 20.12     43.0    18.71    100.0    18.69    106.6    19.30    108.5    18.12    111.3
GR 18.21    114.5    17.98    116.9    17.79    118.9    17.60    120.4    17.94    121.4
GR 19.26    121.9    19.61    131.9    20.09    144.5
*
X1    709       10    107.4    117.8     55.0     60.0     62.0
GR 21.75    100.0    20.76    107.4    19.40    109.3    19.10    110.7    18.86    112.0
GR 18.85    113.8    19.03    115.1    19.72    117.8    20.70    125.2    20.91    132.8
*
X1    710       15    120.8    130.5     70.0     75.0     72.0
GR 23.94    100.0    23.93    105.7    23.29    110.0    21.28    114.9    21.61    119.1
GR 21.68    120.8    20.69    122.3    20.28    123.5    20.29    124.2    20.45    125.2
GR 20.54    126.5    20.68    127.4    20.94    130.5    21.10    138.2    23.95    165.0
EJ
T1       FLOOD RISK MAPPING STUDY OF STEPHENVILLE, GAUDONS BROOK (NF)
T2       HEC-2 INPUT FILE (G7439.DAT), CCL JOB #7439, JANUARY 1996
T3       GAUDONS CREEK - 1:100 YEAR FLOOD PROFILE
J1              3                                 1                        1.5
J2     15               -1
ER
```

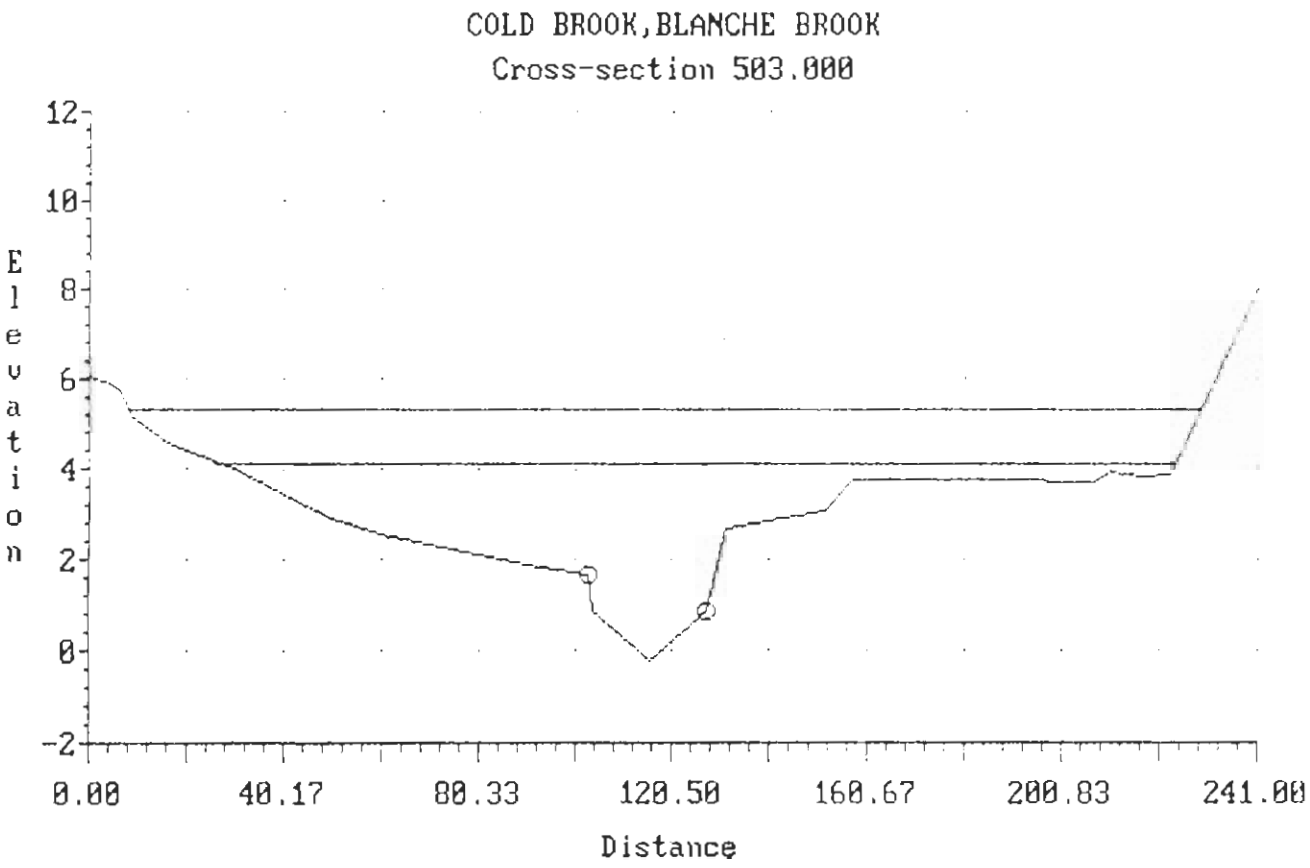

COLD BROOK,BLANCHE BROOK
Cross-section 501.000
Elevation
12
10
8
6
4
2
0
-2
0.00
30.83
61.67
92.50
123.33
154.17
185.00
Distance

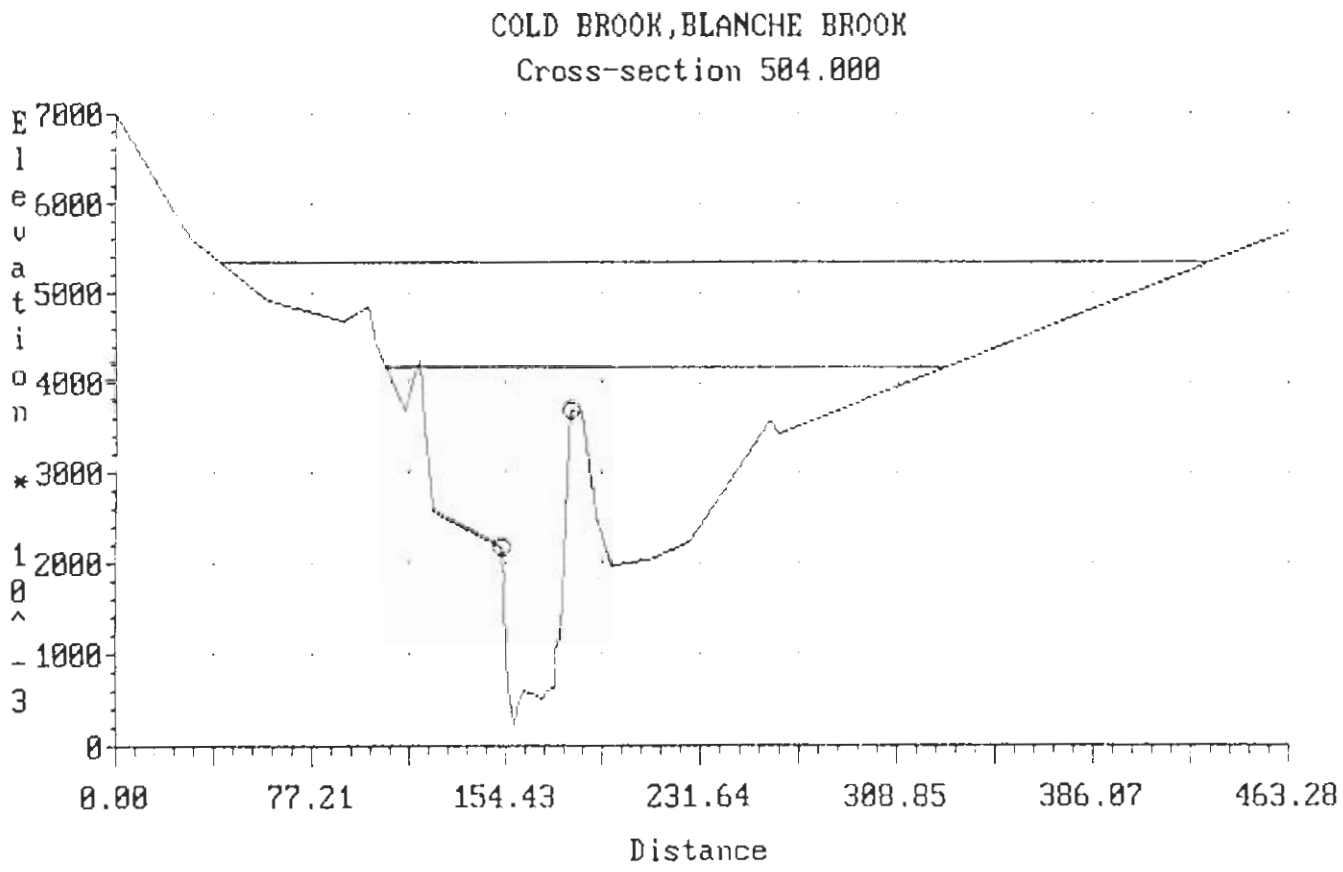

COLD BROOK,BLANCHE BROOK
Cross-section 502.100
Elevation * 10^-3
6000
5000
4000
3000
2000
1000
0
-1000
0.00
8.42
16.85
25.27
33.69
42.12
50.54
Distance

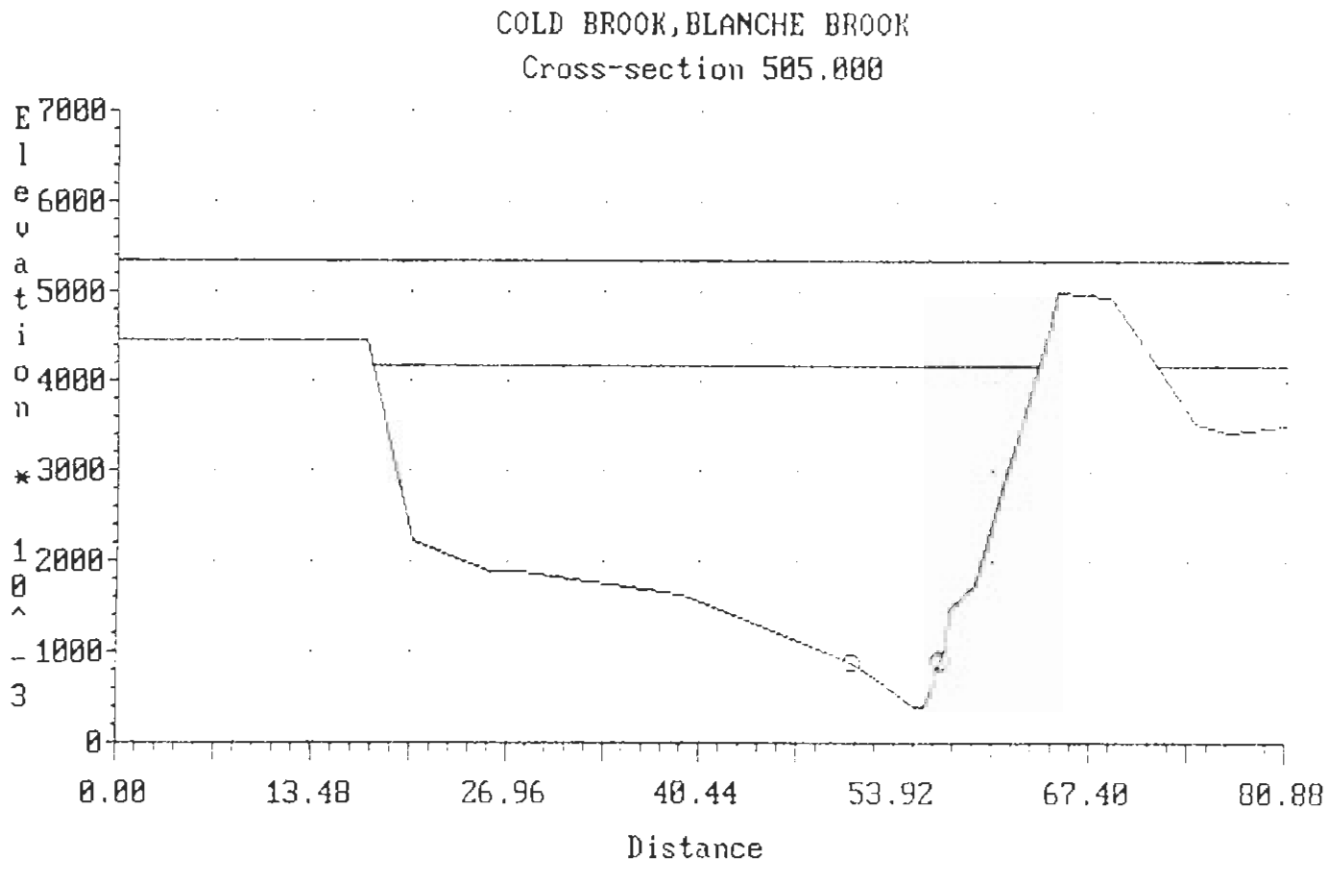

COLD BROOK,BLANCHE BROOK
Cross-section 502.000
Elevation * 10^-3
6000
5000
4000
3000
2000
1000
0
-1000
0.00
8.42
16.85
25.27
33.69
42.12
50.54
Distance

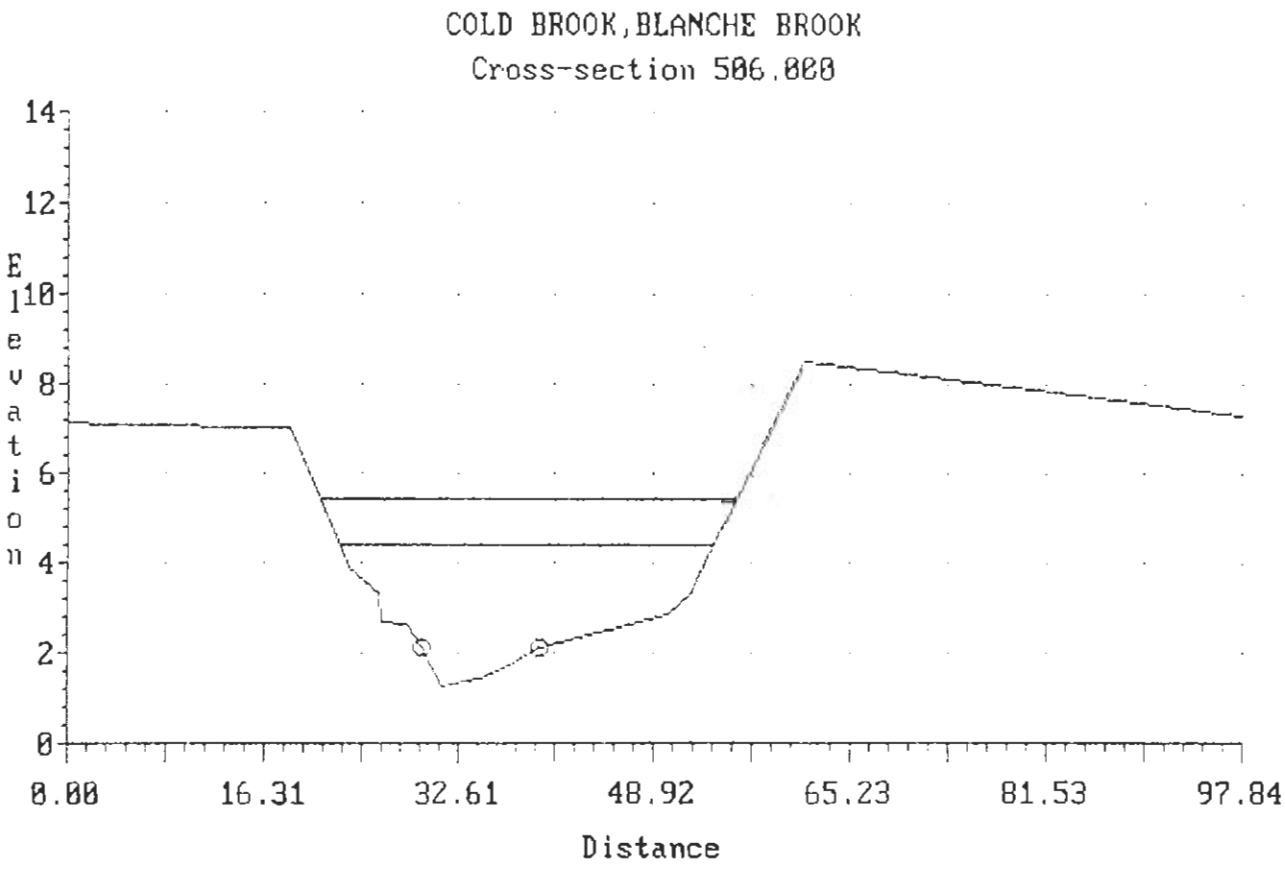

COLD BROOK,BLANCHE BROOK
Cross-section 502.200
Elevation * 10^-3
6000
5000
4000
3000
2000
1000
0
-1000
0.00
8.42
16.85
25.27
33.69
42.12
50.54
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 502.300
Elevation * 10^-3
6000
5000
4000
3000
2000
1000
0
-1000
0.00
8.42
16.85
25.27
33.69
42.12
50.54
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 503.000
Elevation
12
10
8
6
4
2
0
-2
0.00
40.17
80.33
120.50
160.67
200.83
241.00
Distance

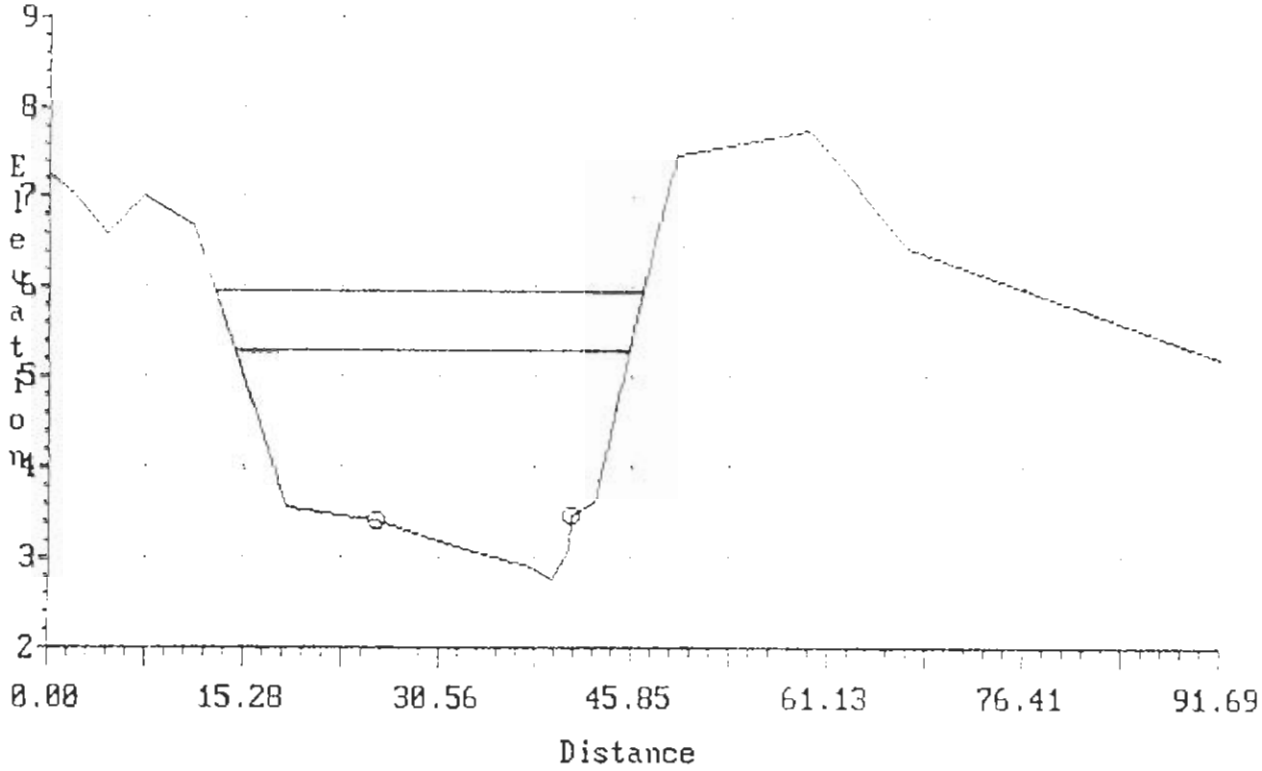

COLD BROOK,BLANCHE BROOK
Cross-section 504.000
Elevation *10^-3
7000
6000
5000
4000
3000
2000
1000
0
0.00
77.21
154.43
231.64
308.85
386.07
463.28
Distance

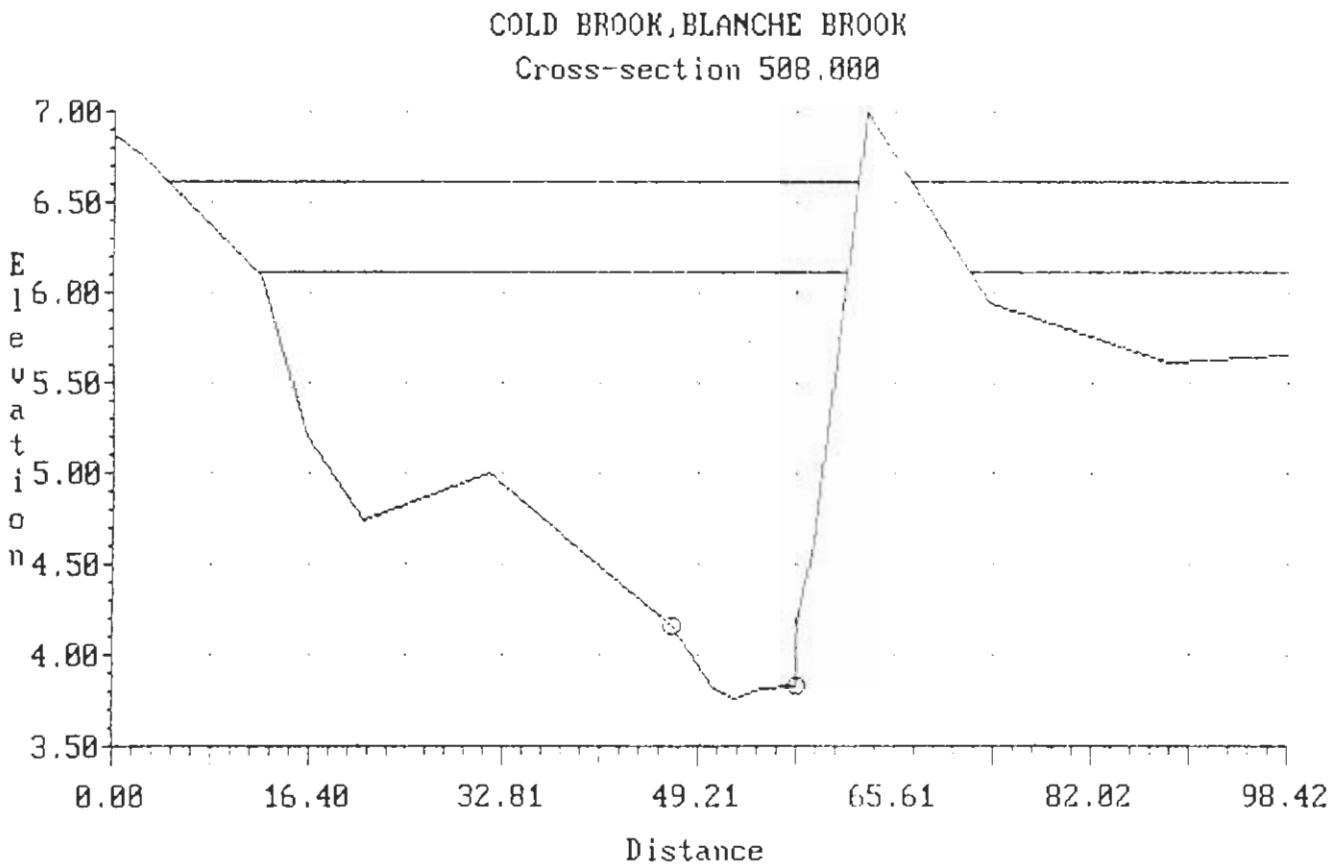

COLD BROOK,BLANCHE BROOK
Cross-section 505.000
Elevation *10^-3
7000
6000
5000
4000
3000
2000
1000
0
0.00
13.48
26.96
40.44
53.92
67.40
80.88
Distance

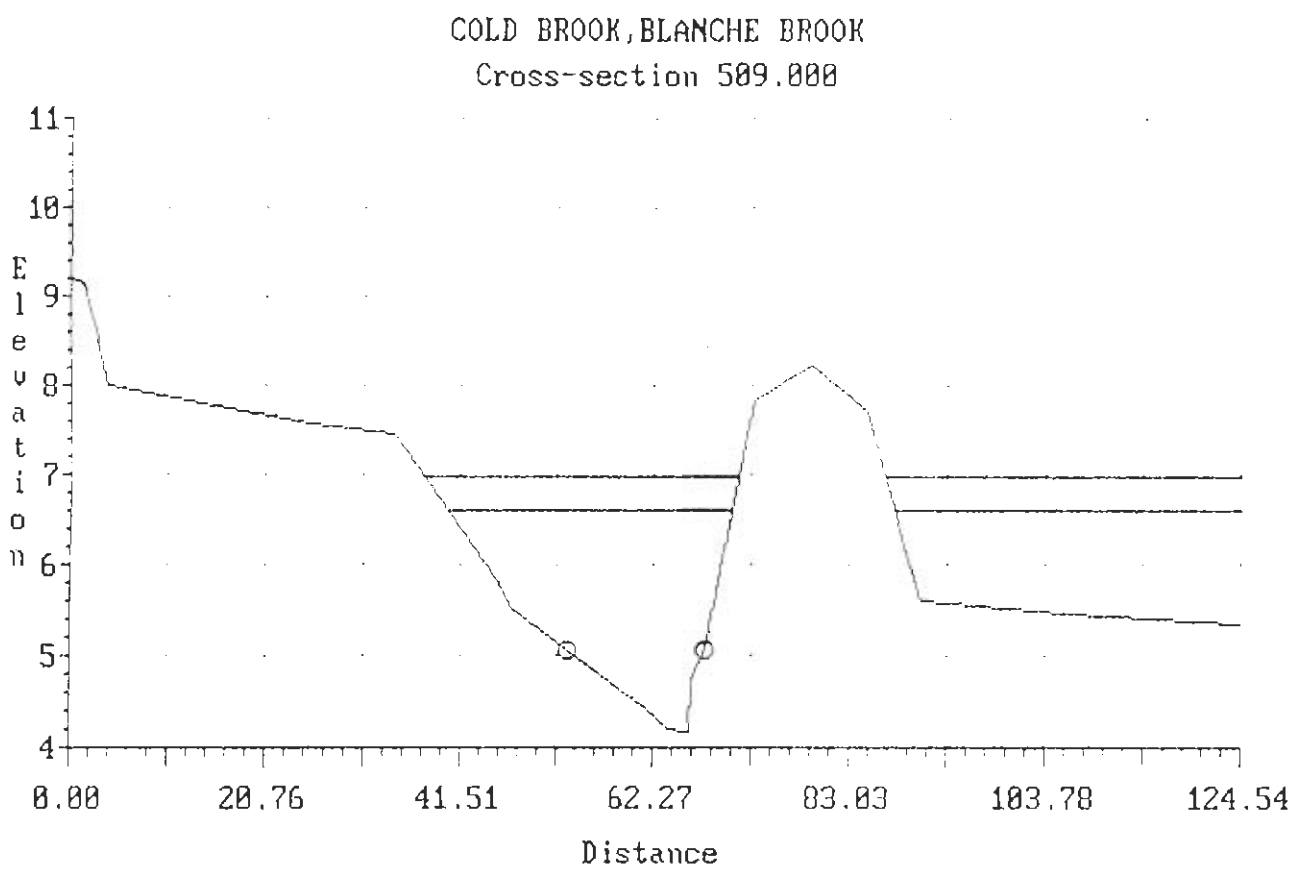

COLD BROOK,BLANCHE BROOK
Cross-section 506.000
Elevation
14
12
10
8
6
4
2
0
0.00
16.31
32.61
48.92
65.23
81.53
97.84
Distance

COLD BROOK,BLANCHE BROOK

Cross-section 507.000

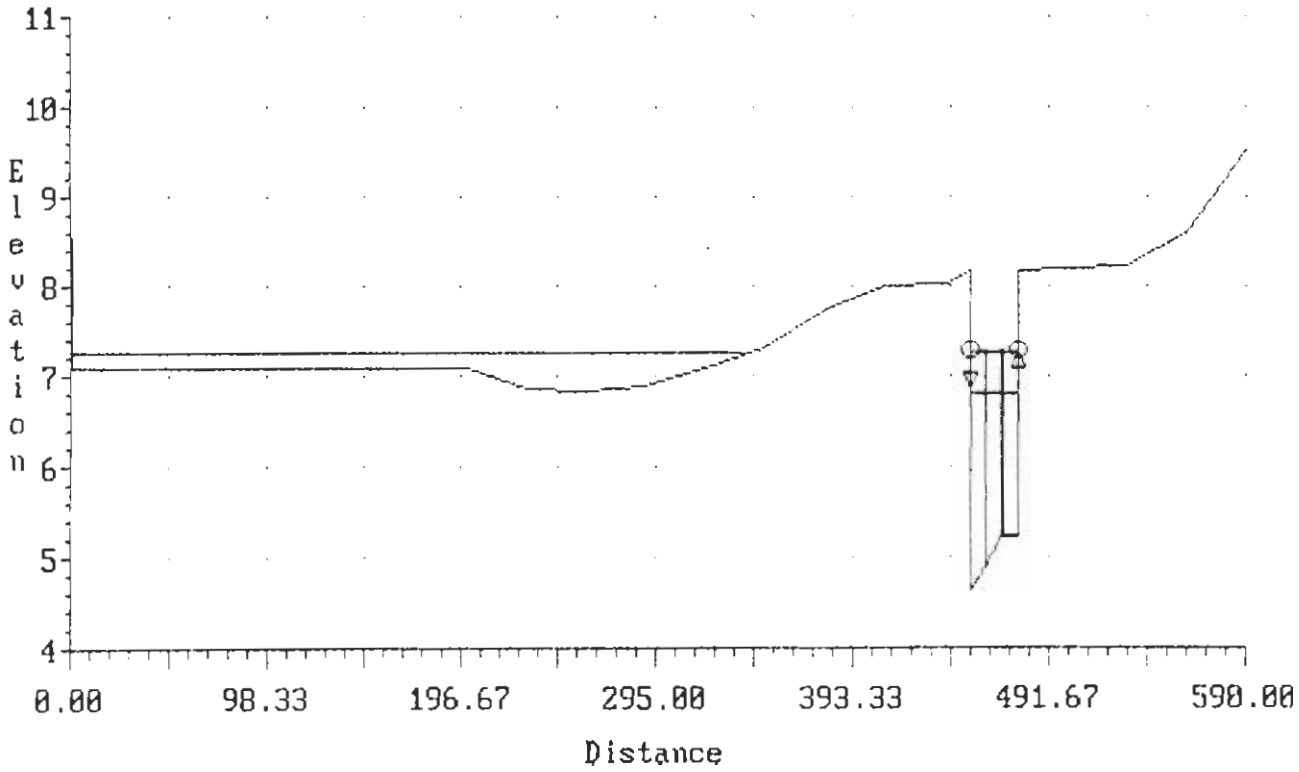



COLD BROOK,BLANCHE BROOK
Cross-section 508.000
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
Elevation
0.00
16.40
32.81
49.21
65.61
82.02
98.42
Distance

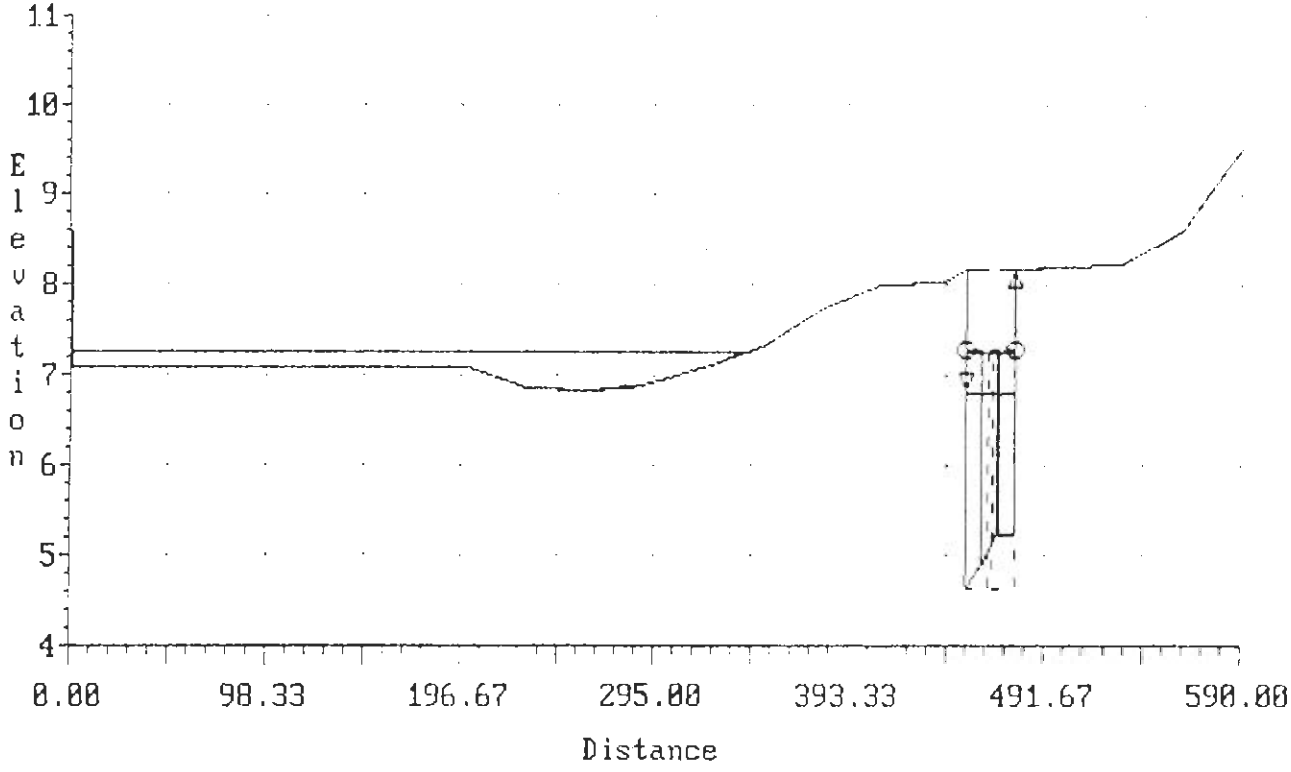

COLD BROOK,BLANCHE BROOK
Cross-section 509.000
Elevation
11
10
9
8
7
6
5
4
0.00
20.76
41.51
62.27
83.03
103.78
124.54
Distance

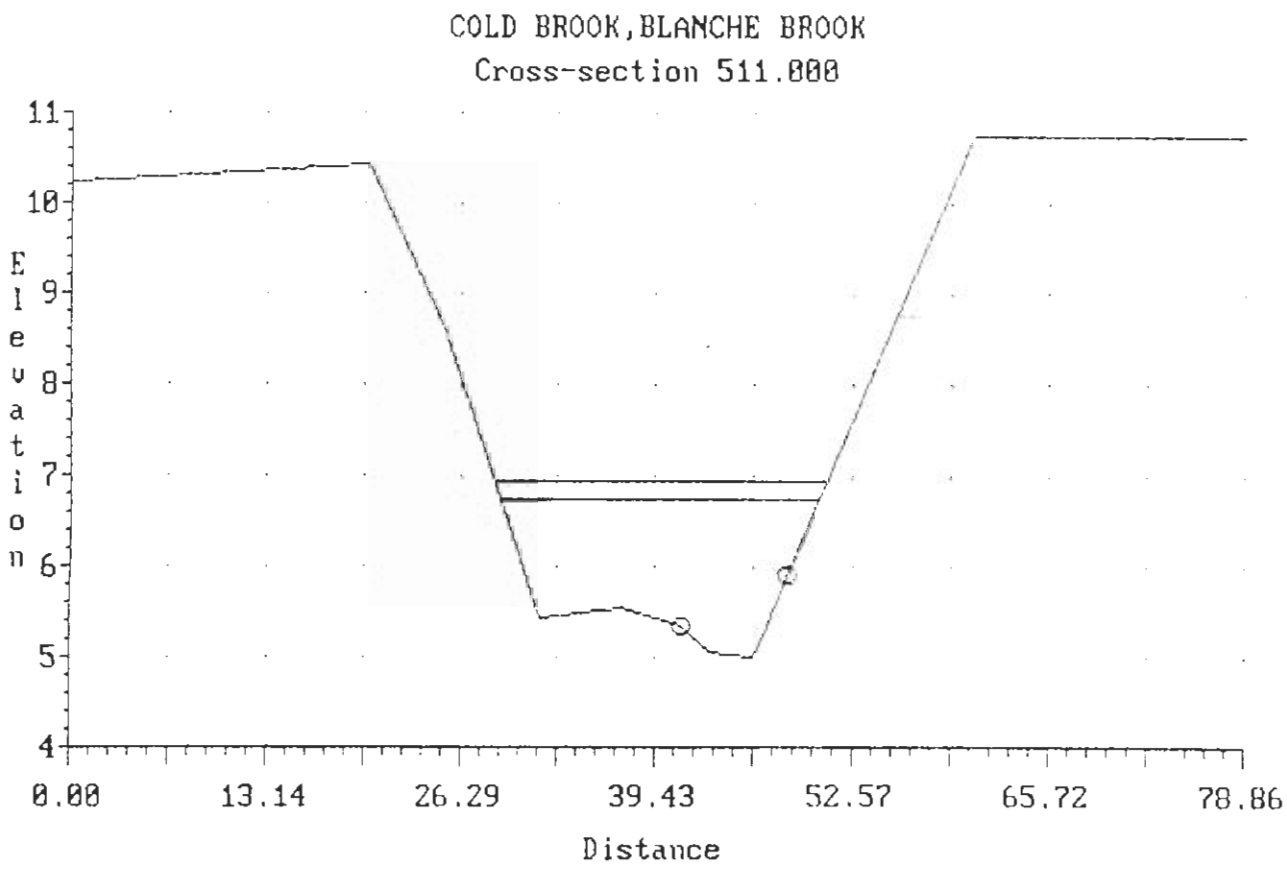
COLD BROOK,BLANCHE BROOK

Cross-section 510.100

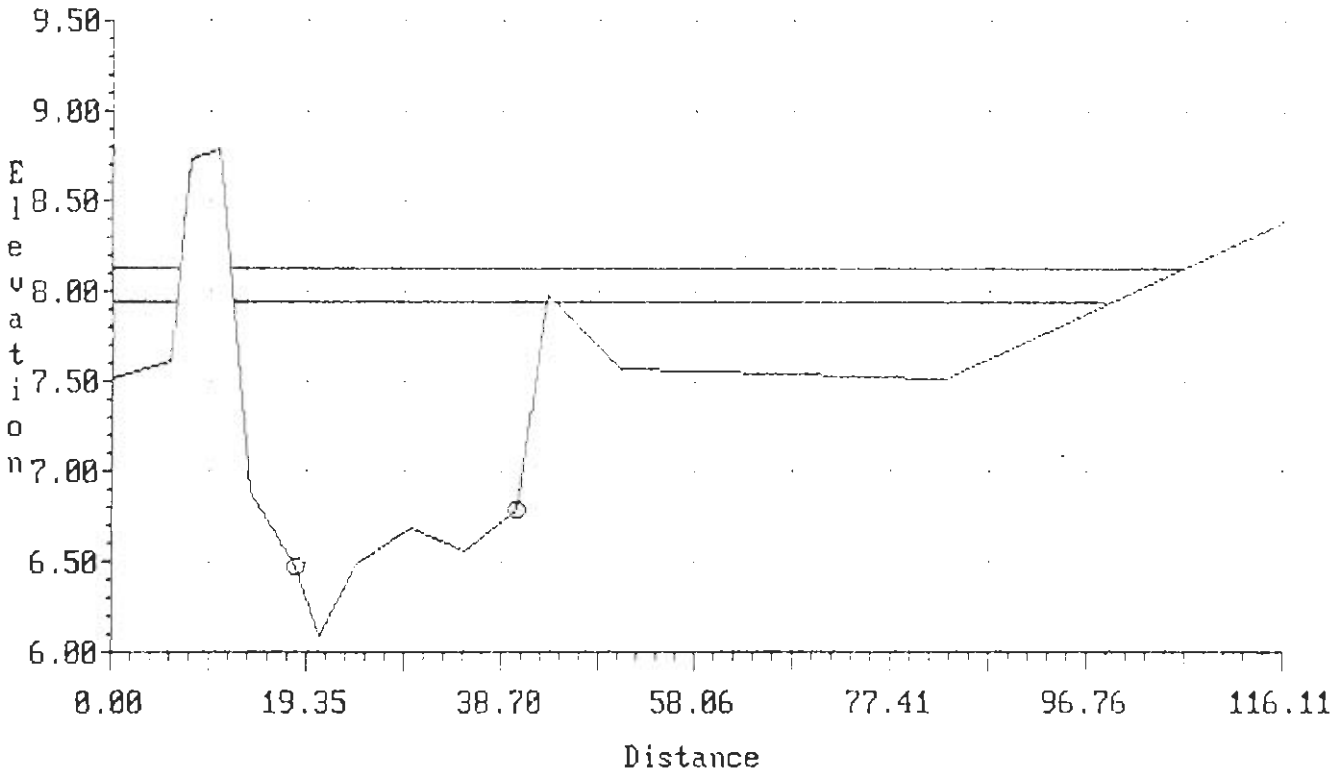


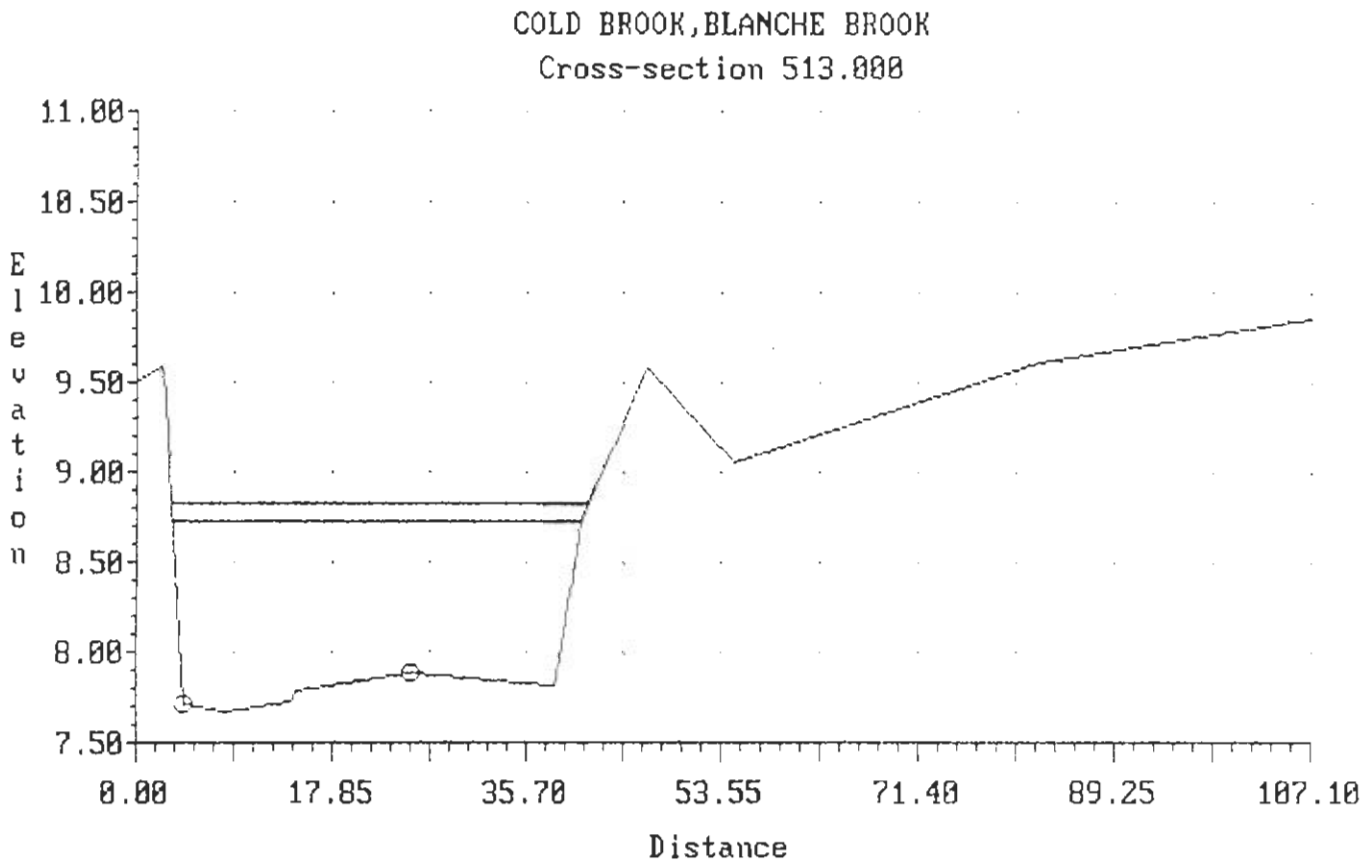
COLD BROOK,BLANCHE BROOK
Cross-section 510.000

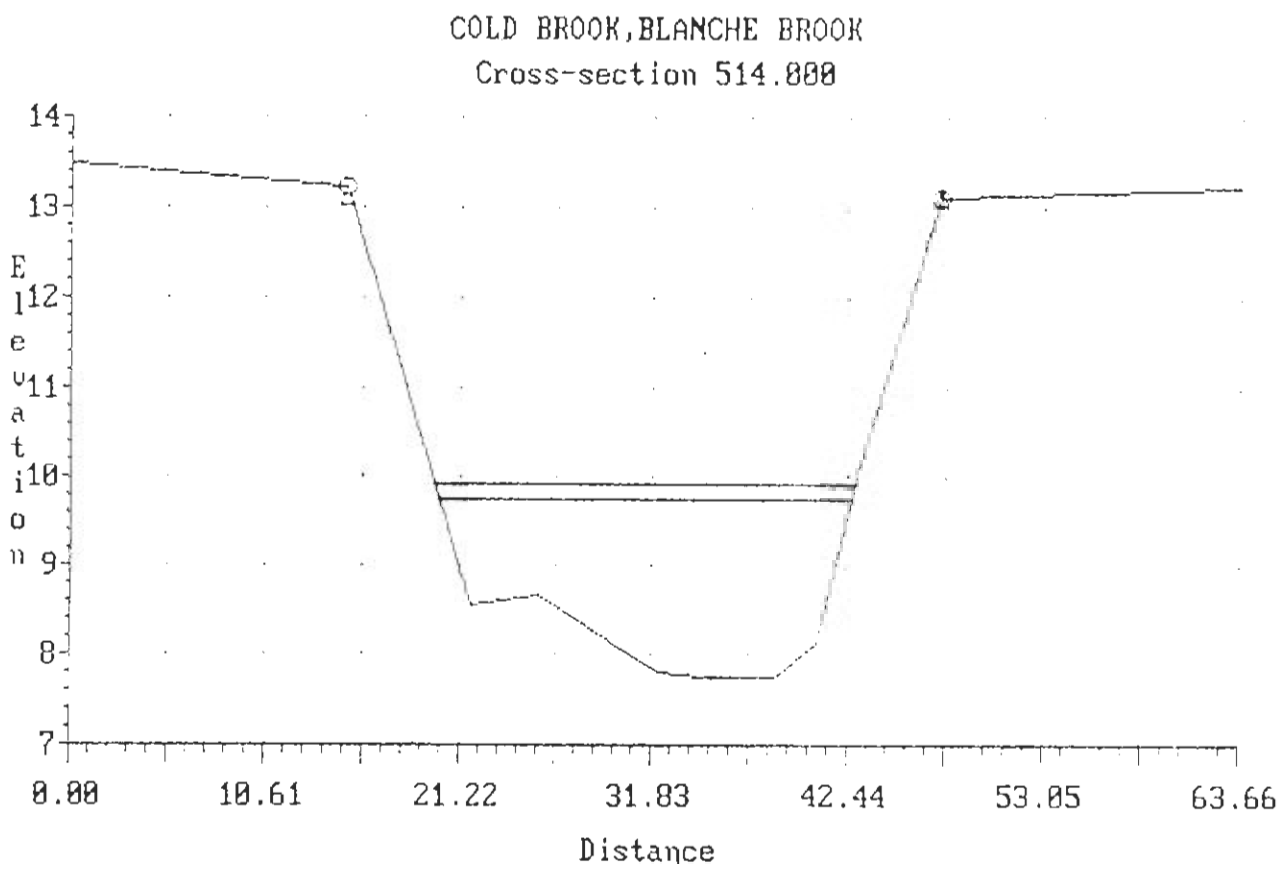


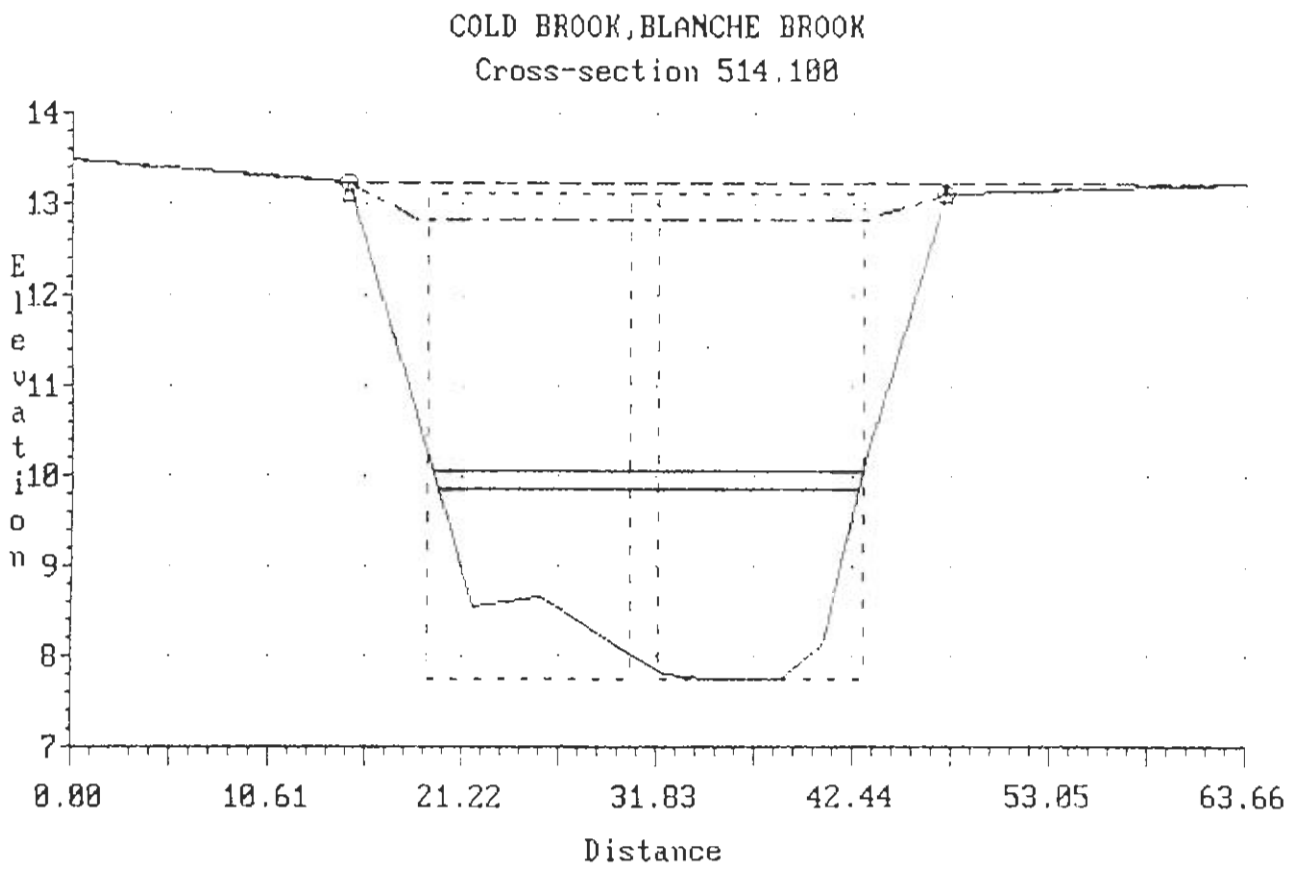

COLD BROOK,BLANCHE BROOK
Cross-section 511.000
Elevation
11
10
9
8
7
6
5
4
0.00
13.14
26.29
39.43
52.57
65.72
78.86
Distance

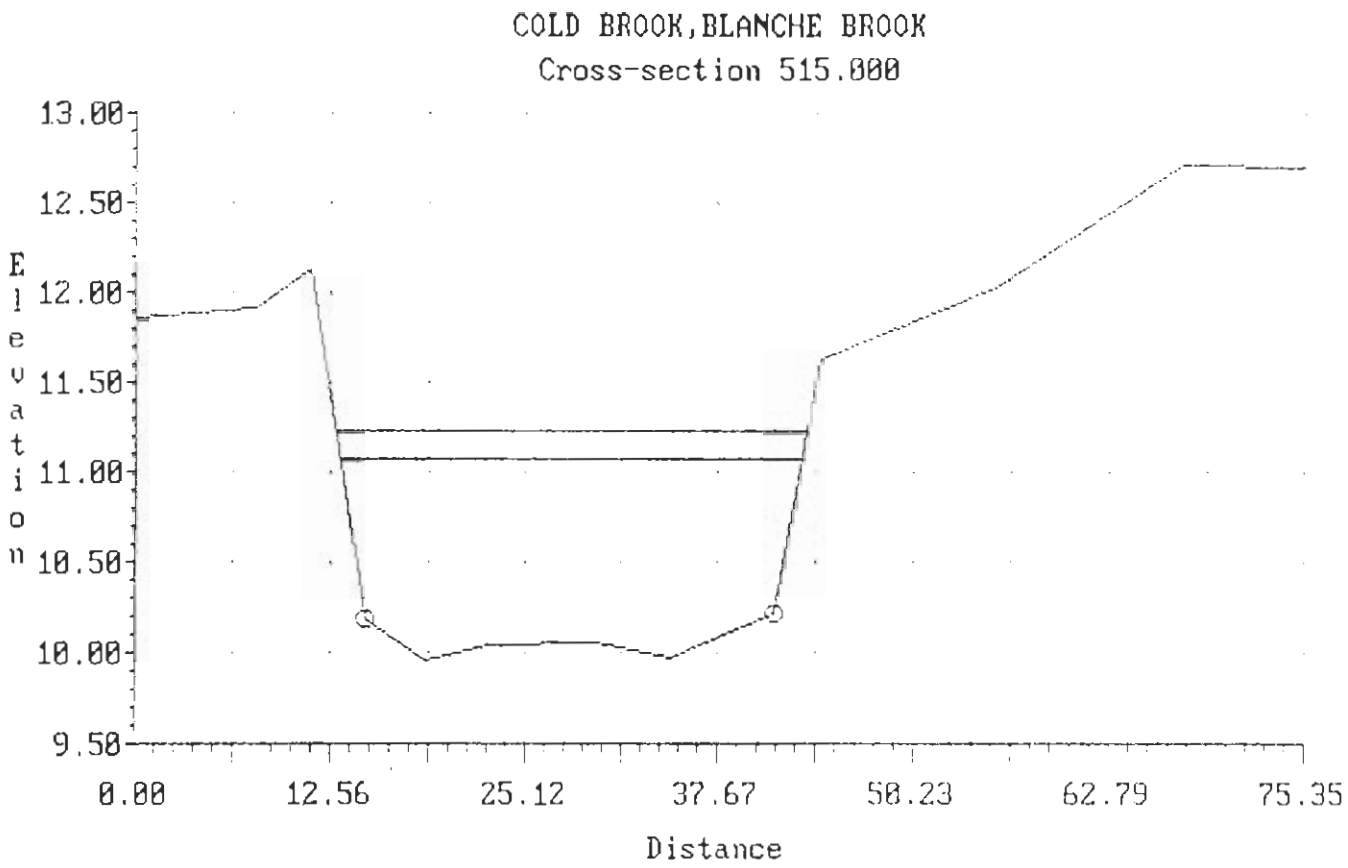
COLD BROOK,BLANCHE BROOK
Cross-section 512.000

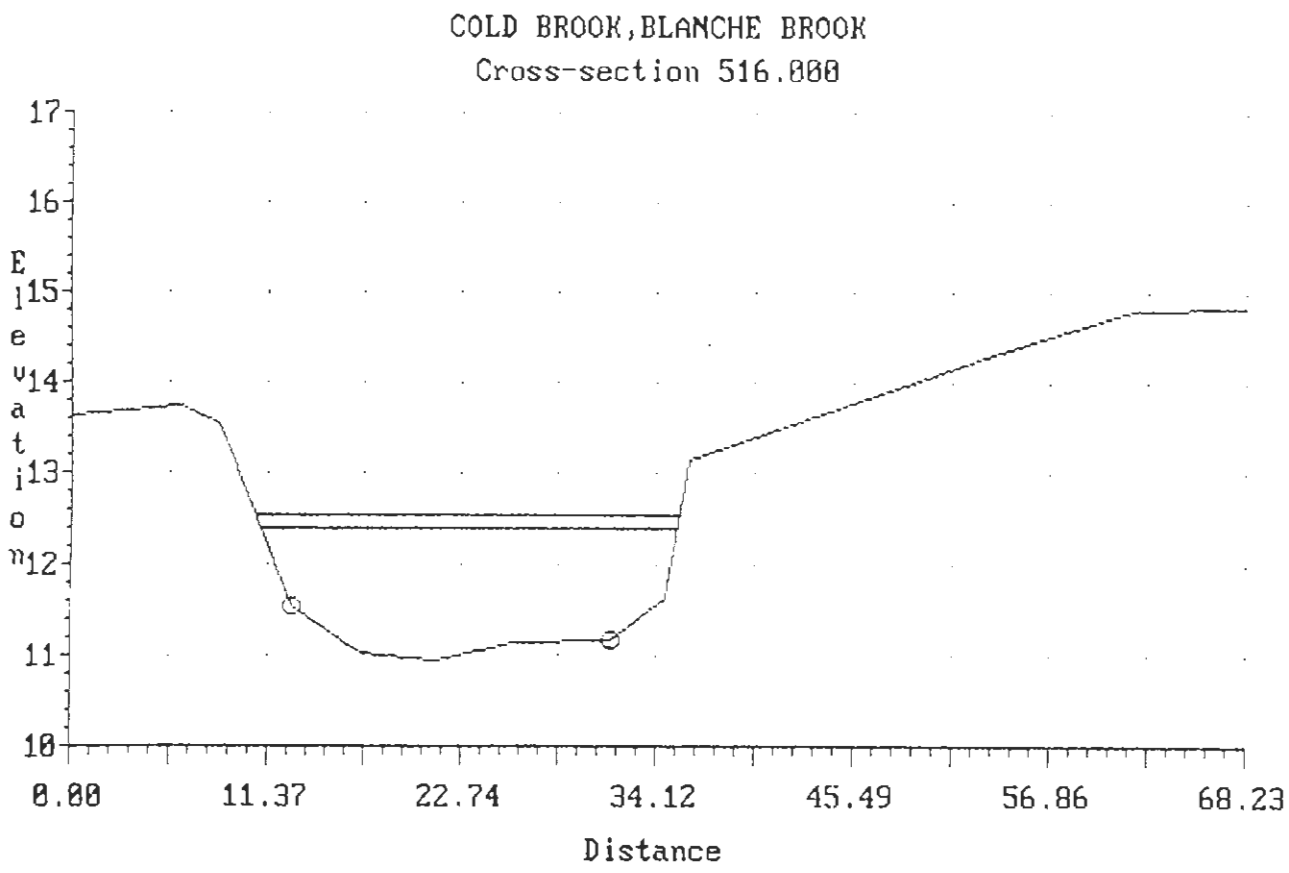


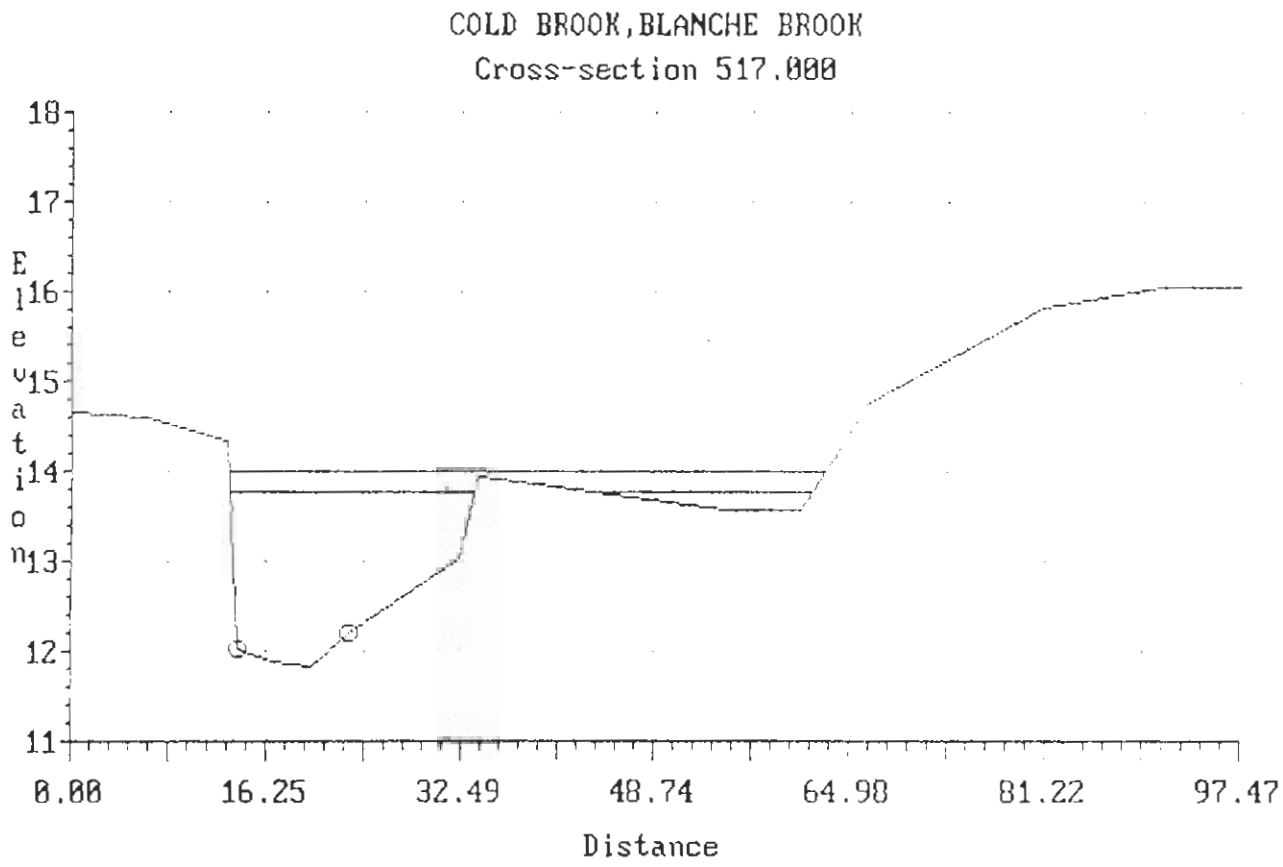

COLD BROOK,BLANCHE BROOK
Cross-section 513.000
Elevation
11.00
10.50
10.00
9.50
9.00
8.50
8.00
7.50
0.00
17.85
35.70
53.55
71.40
89.25
107.10
Distance

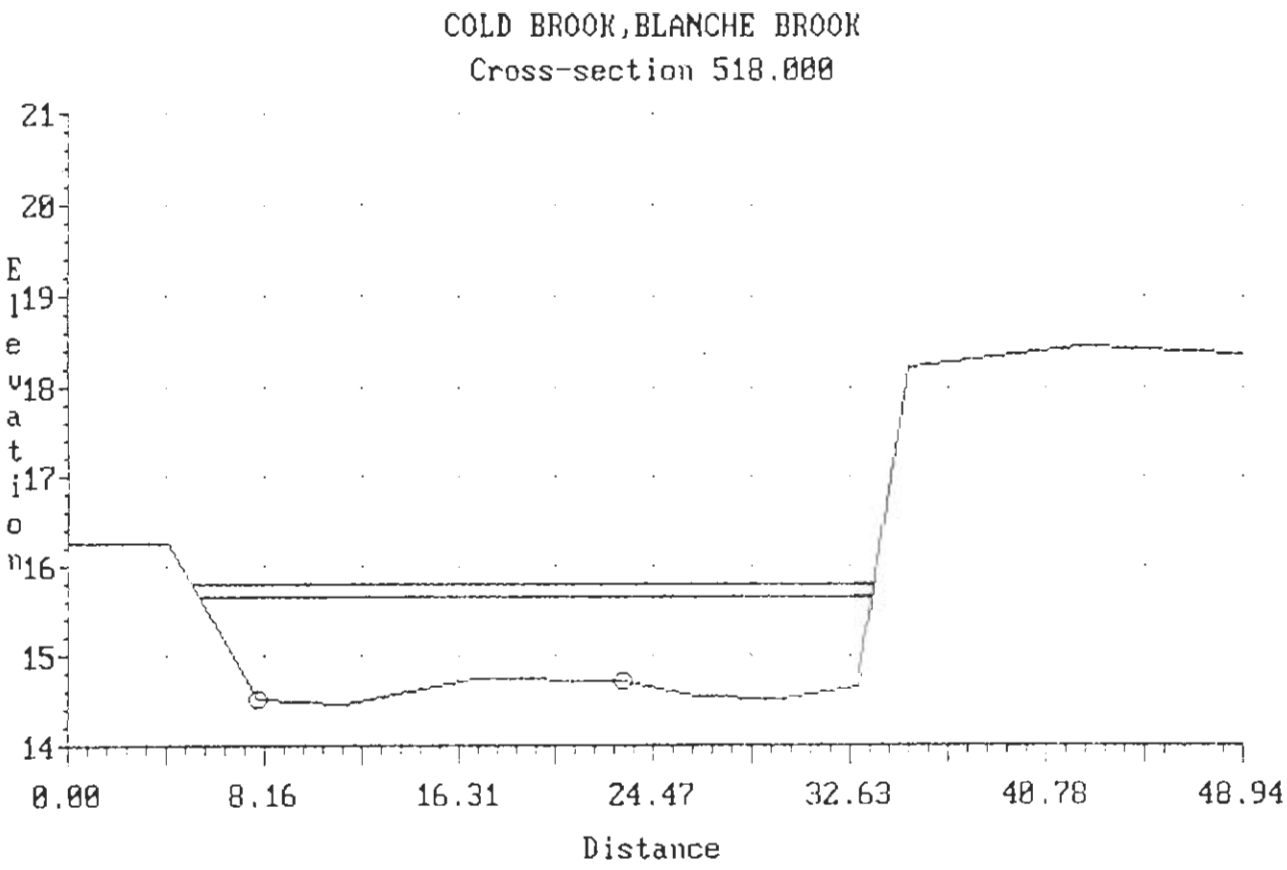

COLD BROOK,BLANCHE BROOK
Cross-section 514.000
Elevation
14
13
12
11
10
9
8
7
0.00
10.61
21.22
31.83
42.44
53.05
63.66
Distance

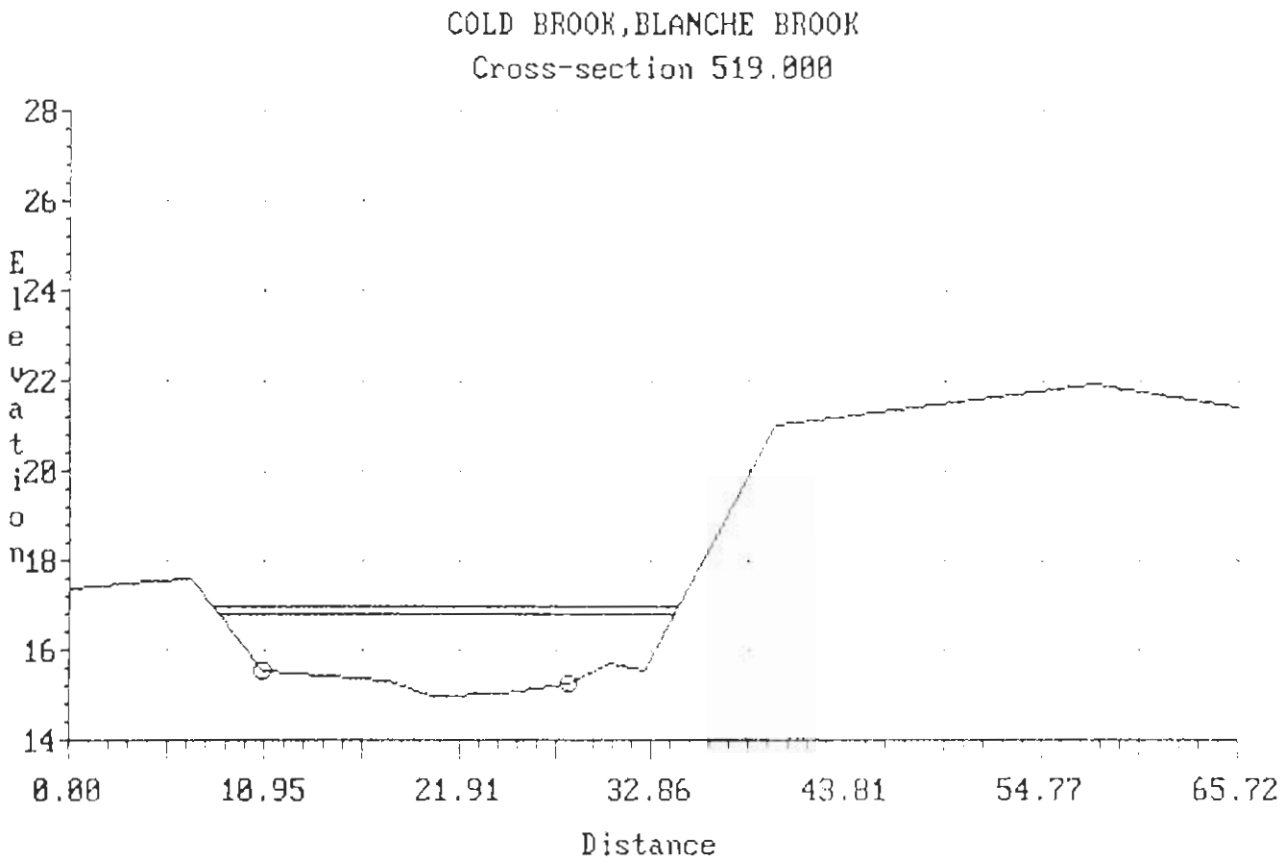

COLD BROOK,BLANCHE BROOK
Cross-section 514.100
Elevation
14
13
12
11
10
9
8
7
0.00
10.61
21.22
31.83
42.44
53.05
63.66
Distance

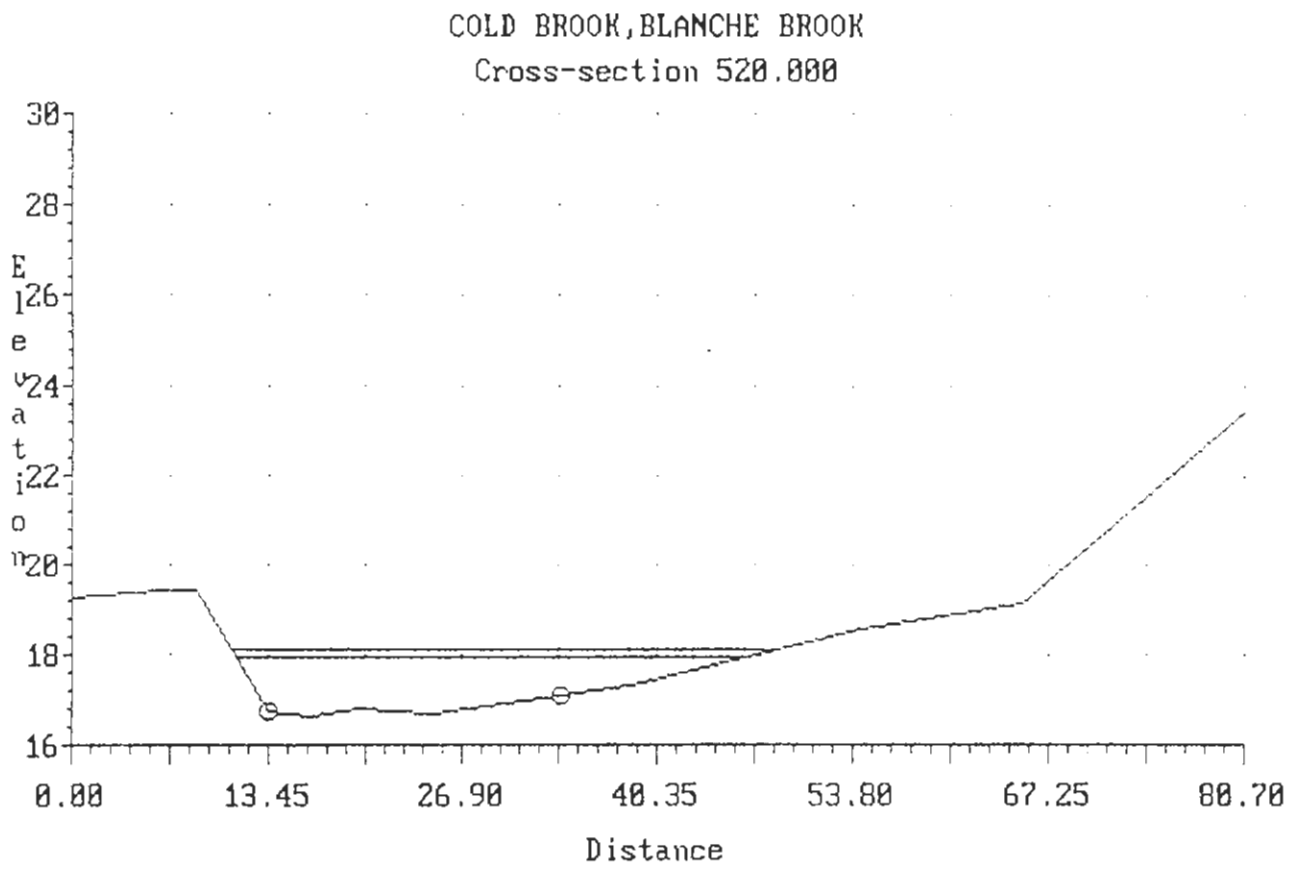

COLD BROOK,BLANCHE BROOK
Cross-section 515.000
13.00
12.50
12.00
11.50
11.00
10.50
10.00
9.50
Elevation
0.00
12.56
25.12
37.67
50.23
62.79
75.35
Distance

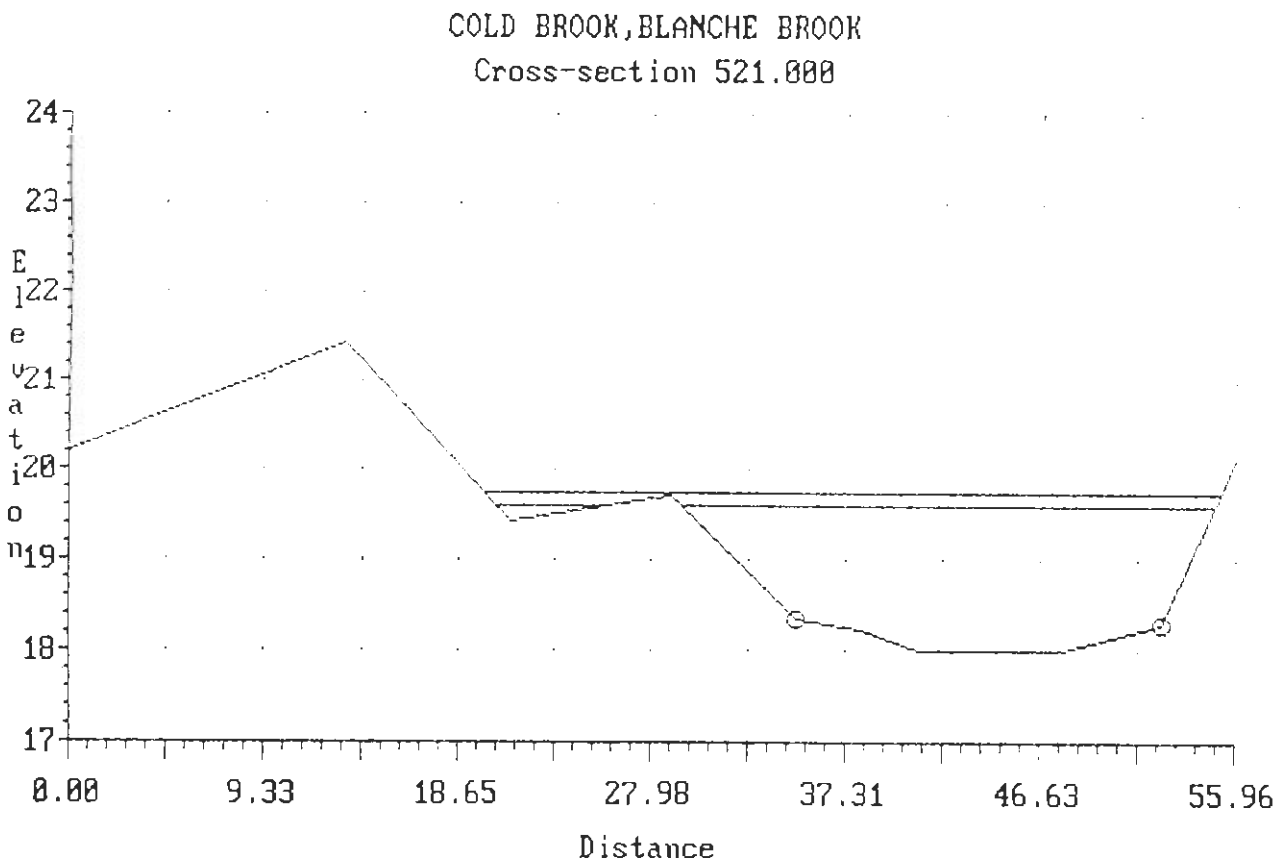

COLD BROOK,BLANCHE BROOK
Cross-section 516.000
Elevation
17
16
15
14
13
12
11
10
0.00
11.37
22.74
34.12
45.49
56.86
68.23
Distance

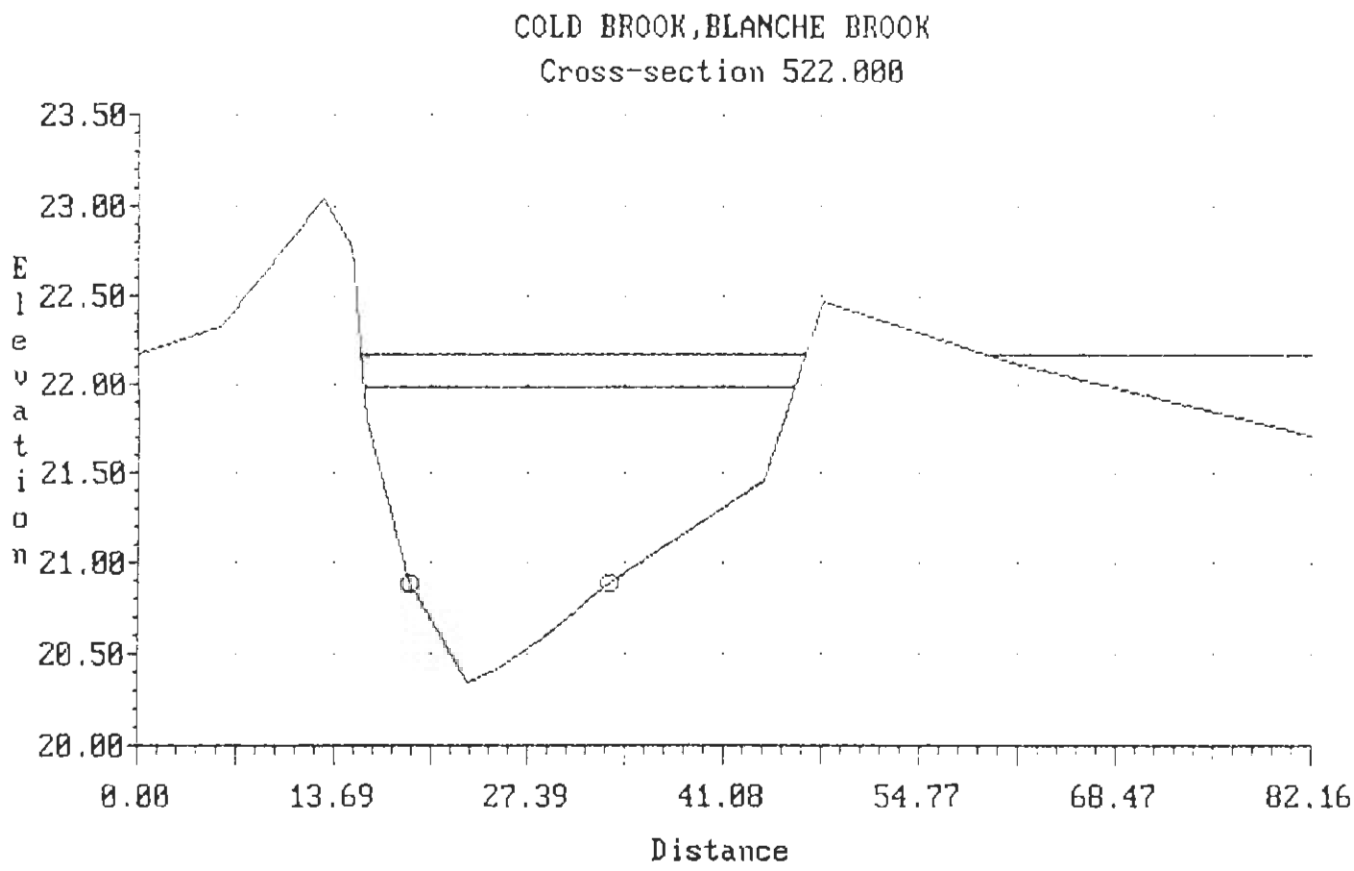

COLD BROOK,BLANCHE BROOK
Cross-section 517.000
Elevation
18
17
16
15
14
13
12
11
0.00
16.25
32.49
48.74
64.98
81.22
97.47
Distance

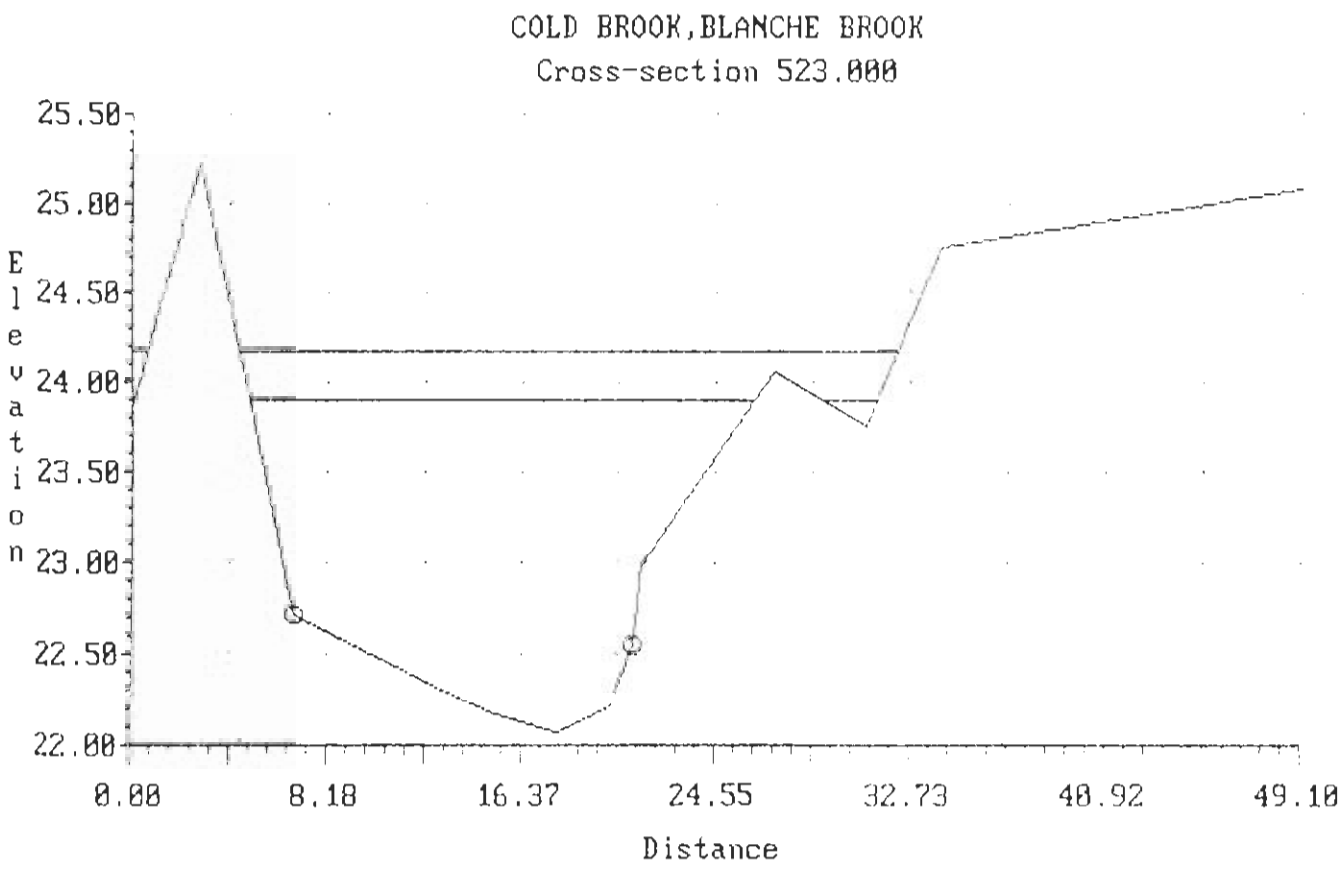

COLD BROOK,BLANCHE BROOK
Cross-section 518.000
Elevation
21
20
19
18
17
16
15
14
0.00
8.16
16.31
24.47
32.63
40.78
48.94
Distance

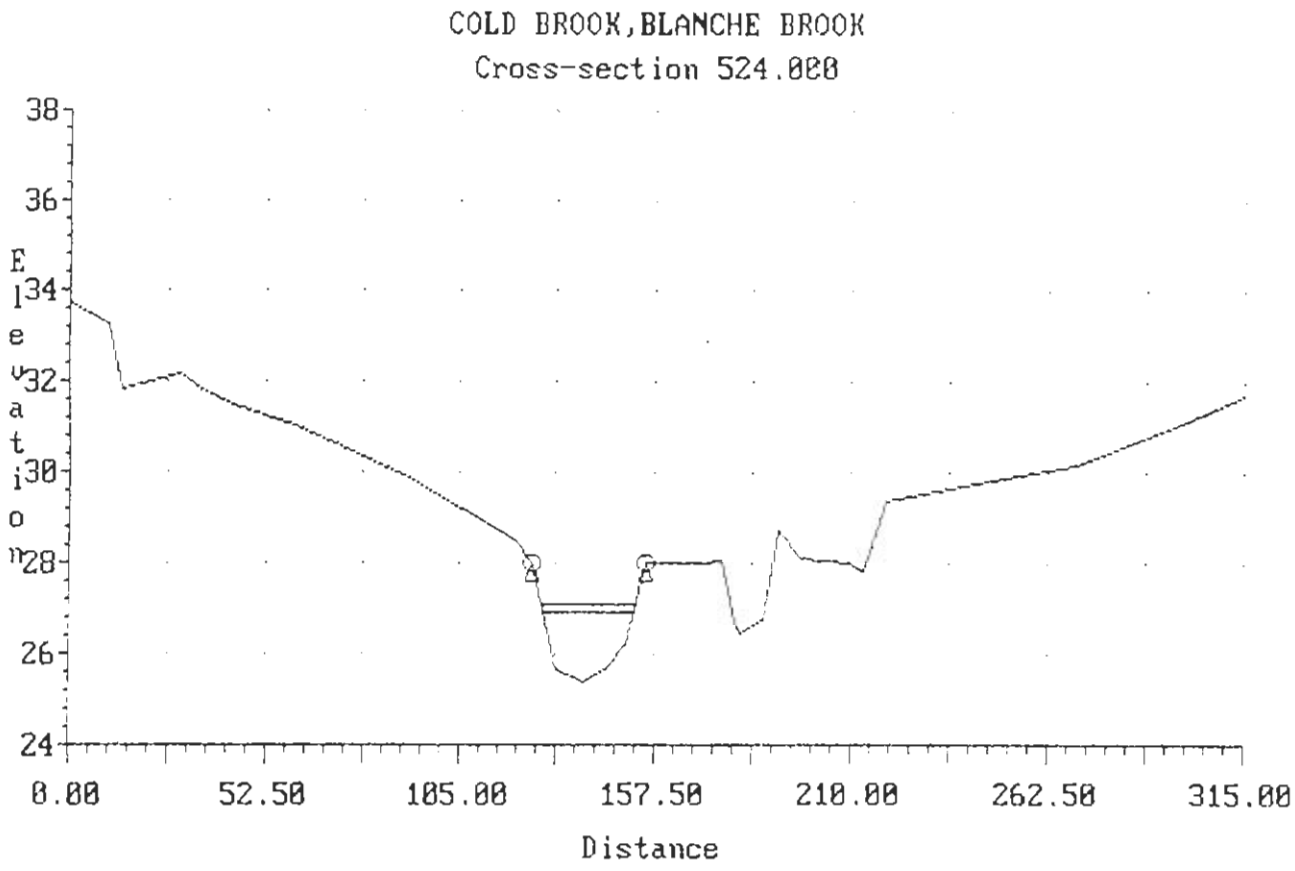

COLD BROOK,BLANCHE BROOK
Cross-section 519.000
Elevation
28
26
24
22
20
18
16
14
0.00
10.95
21.91
32.86
43.81
54.77
65.72
Distance

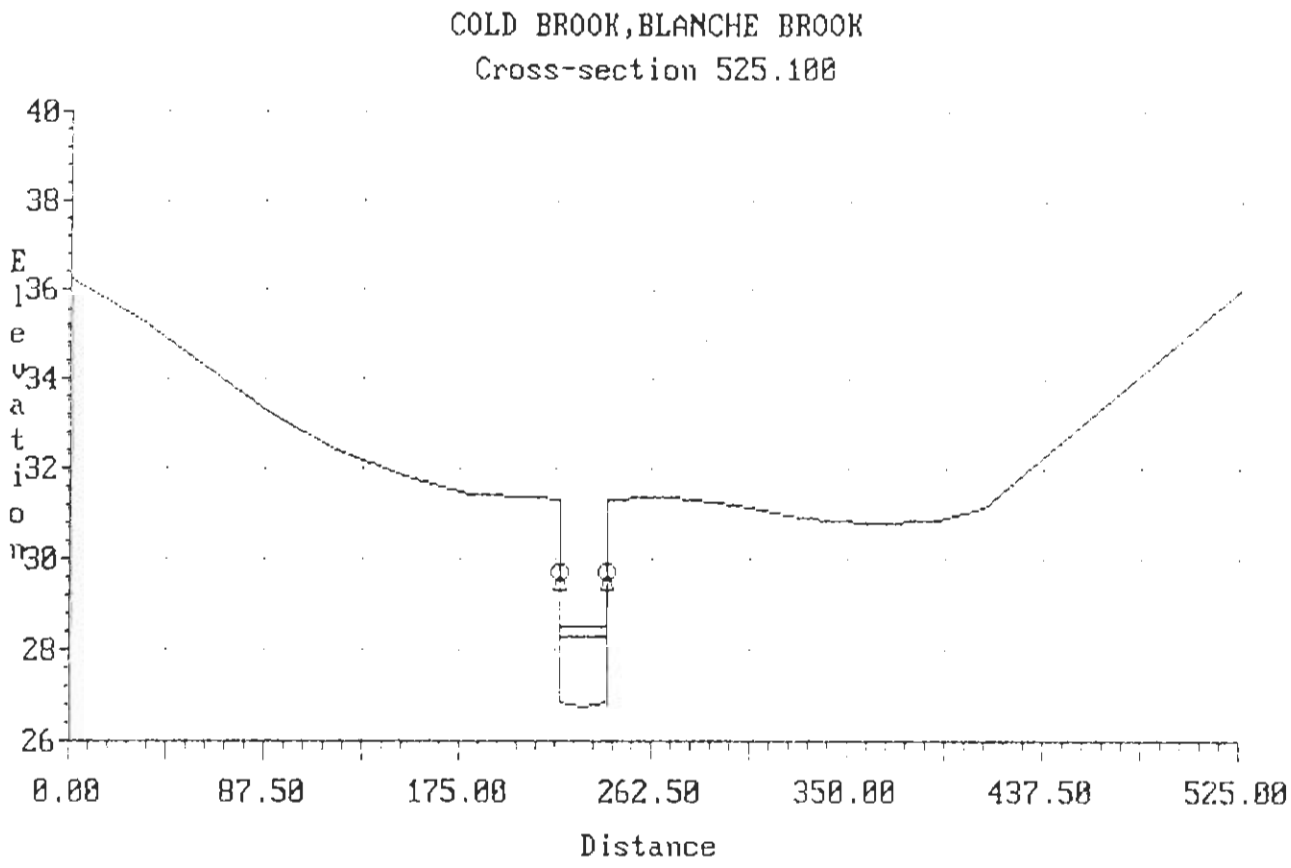

COLD BROOK,BLANCHE BROOK
Cross-section 520.000
Elevation
30
28
26
24
22
20
18
16
0.00
13.45
26.90
40.35
53.80
67.25
80.70
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 521.000
Elevation
24
23
22
21
20
19
18
17
0.00
9.33
18.65
27.98
37.31
46.63
55.96
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 522.000
23.50
23.00
22.50
22.00
21.50
21.00
20.50
20.00
Elevation
0.00
13.69
27.39
41.08
54.77
68.47
82.16
Distance

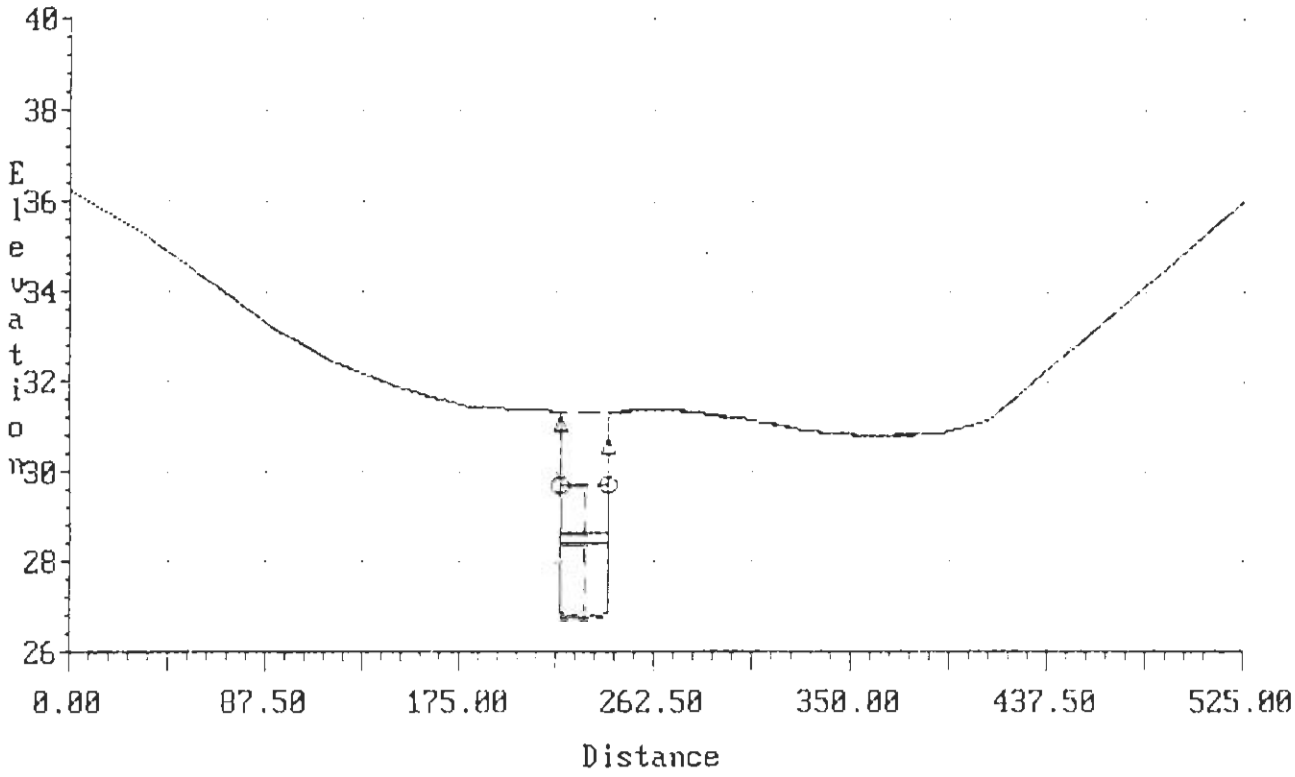

COLD BROOK,BLANCHE BROOK
Cross-section 523.000
25.50
25.00
24.50
24.00
23.50
23.00
22.50
22.00
Elevation
0.00
8.18
16.37
24.55
32.73
40.92
49.10
Distance

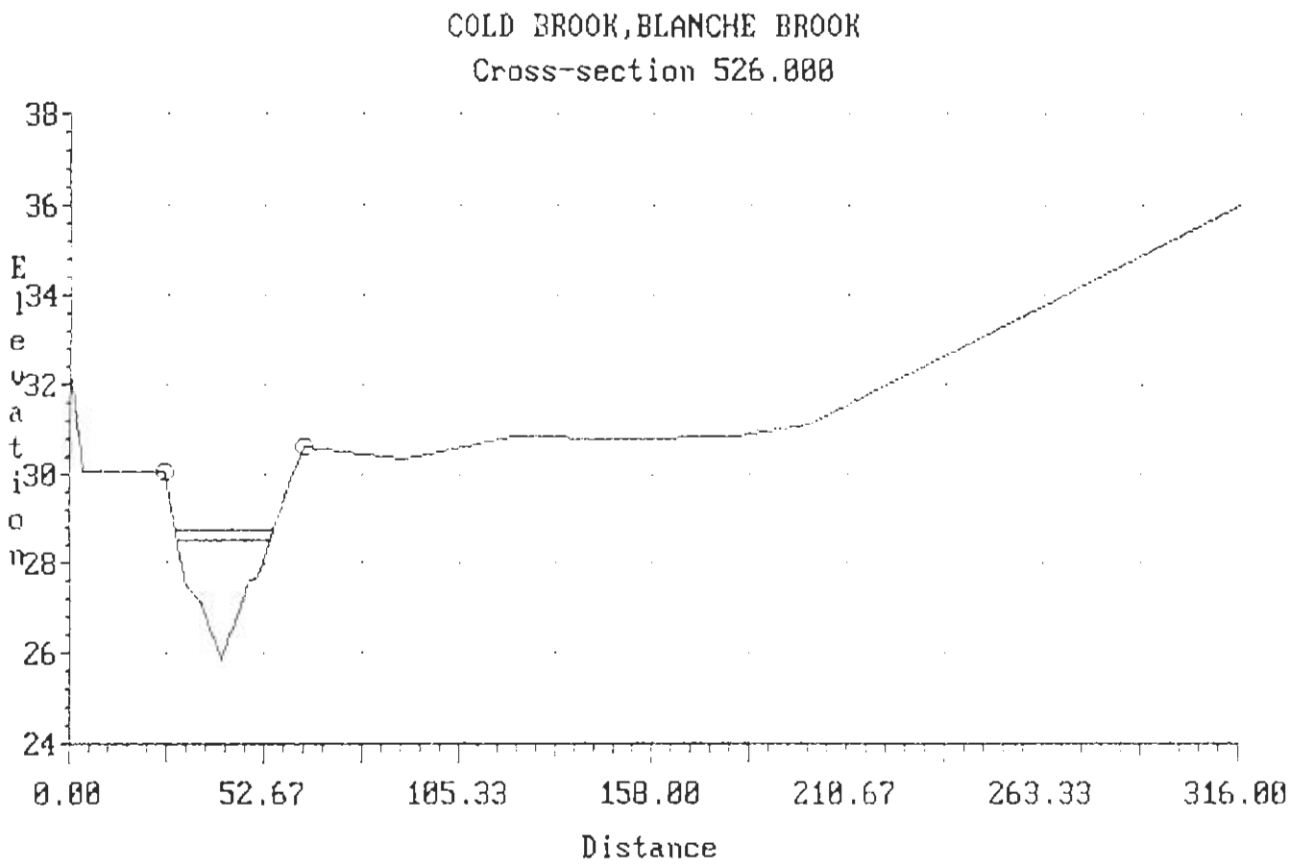

COLD BROOK,BLANCHE BROOK
Cross-section 524.000
Elevation
38
36
34
32
30
28
26
24
0.00
52.50
105.00
157.50
210.00
262.50
315.00
Distance

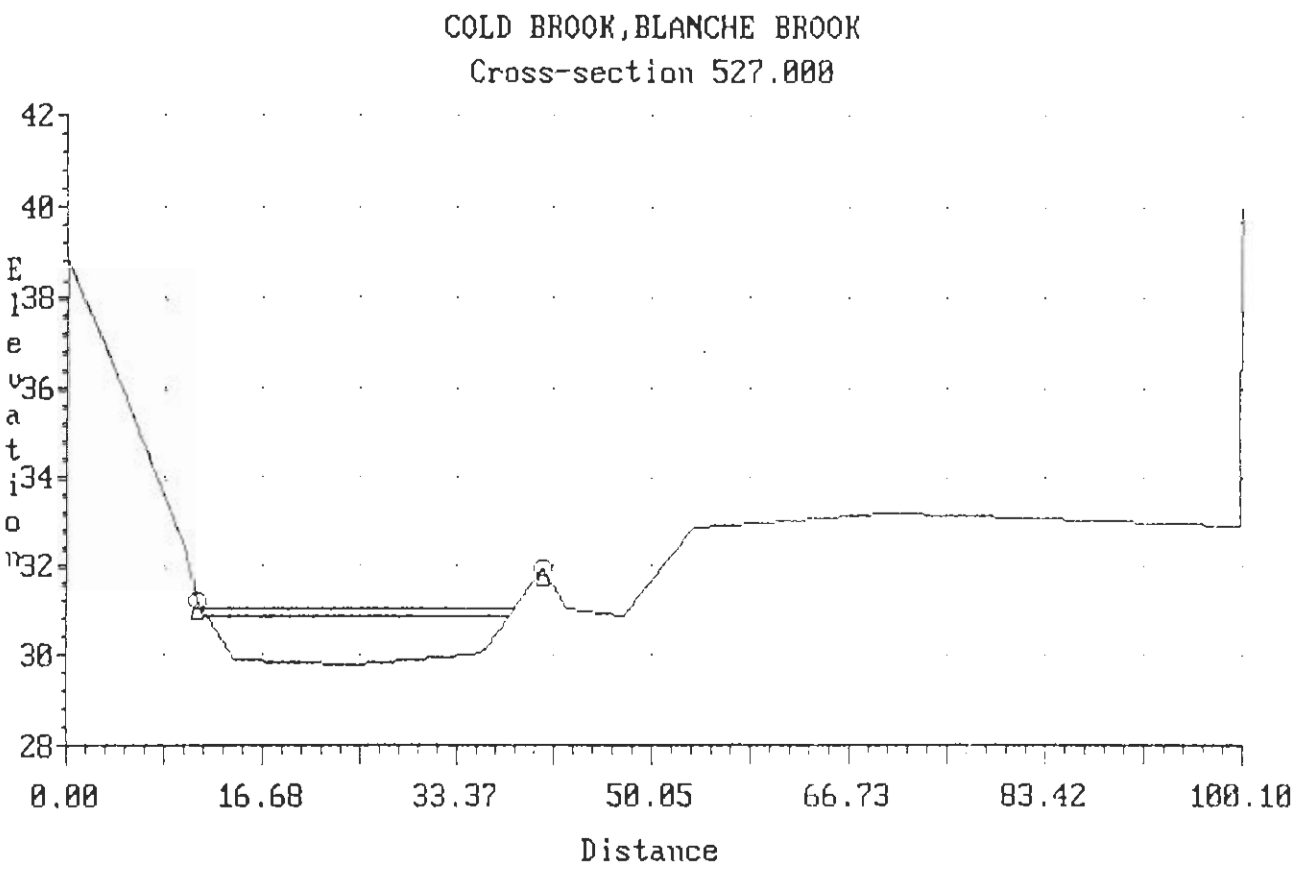

COLD BROOK,BLANCHE BROOK
Cross-section 525.100
Elevation
40
38
36
34
32
30
28
26
0.00
87.50
175.00
262.50
350.00
437.50
525.00
Distance

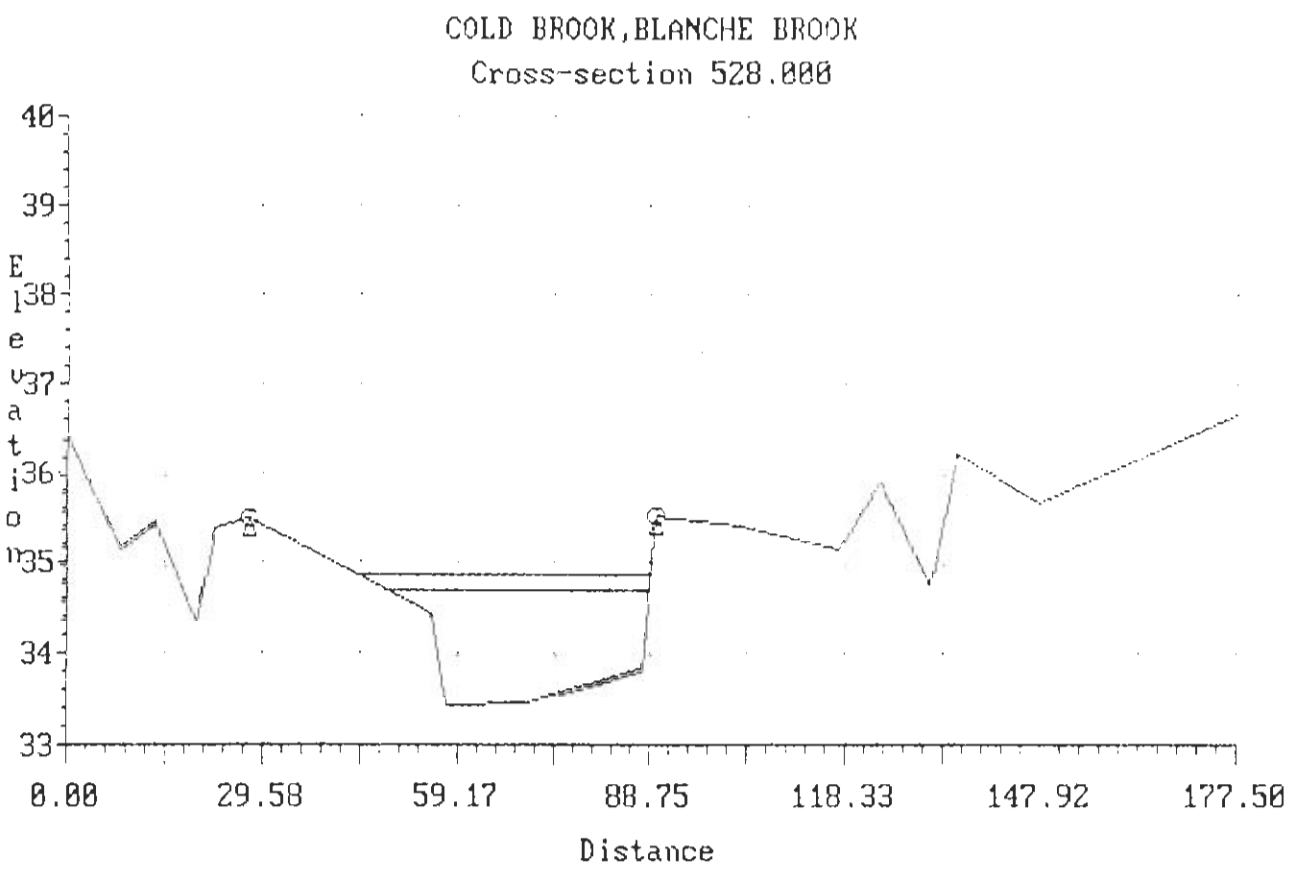
COLD BROOK,BLANCHE BROOK

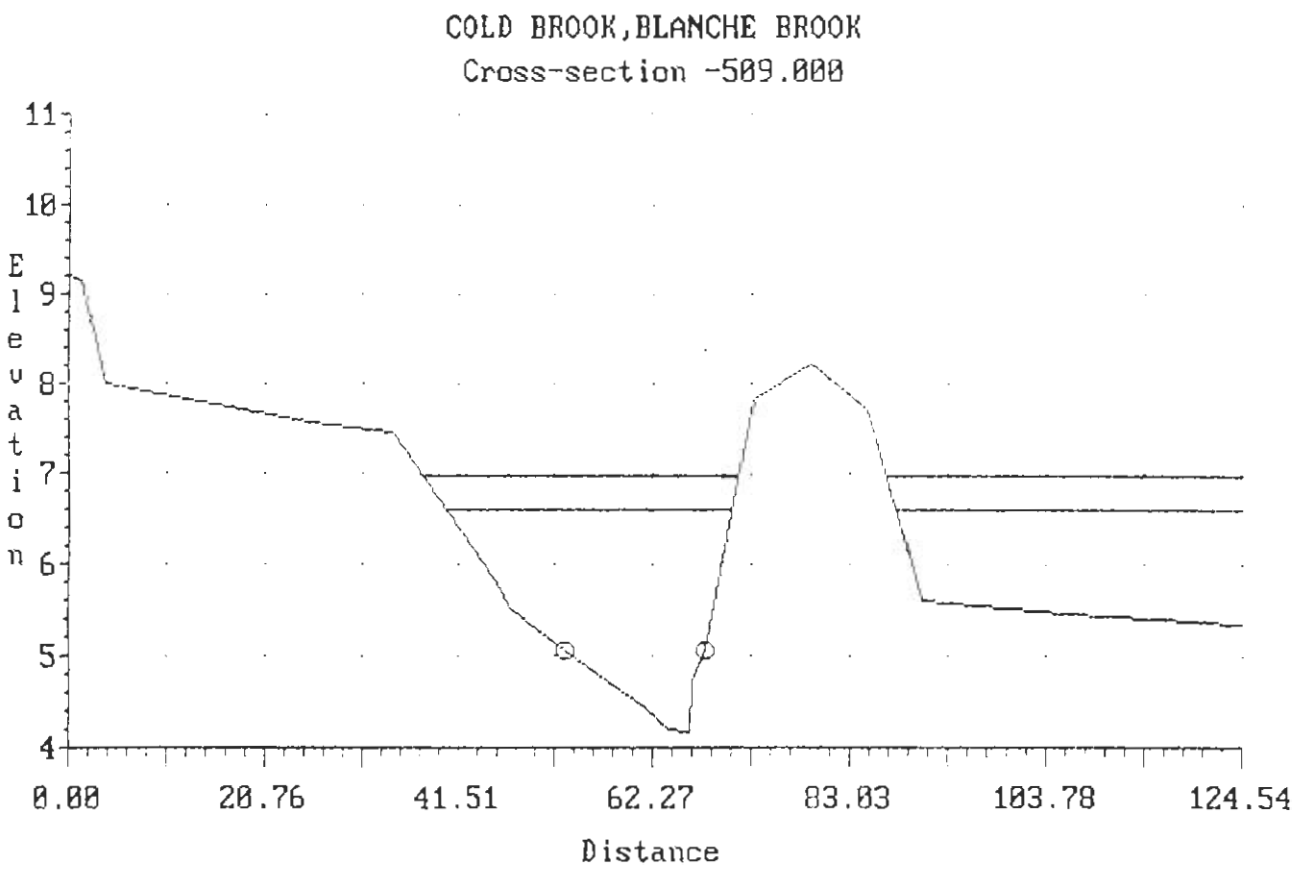
Cross-section 525.000




COLD BROOK,BLANCHE BROOK
Cross-section 526.000
38
36
34
32
30
28
26
24
Elevation
0.00
52.67
105.33
158.00
210.67
263.33
316.00
Distance

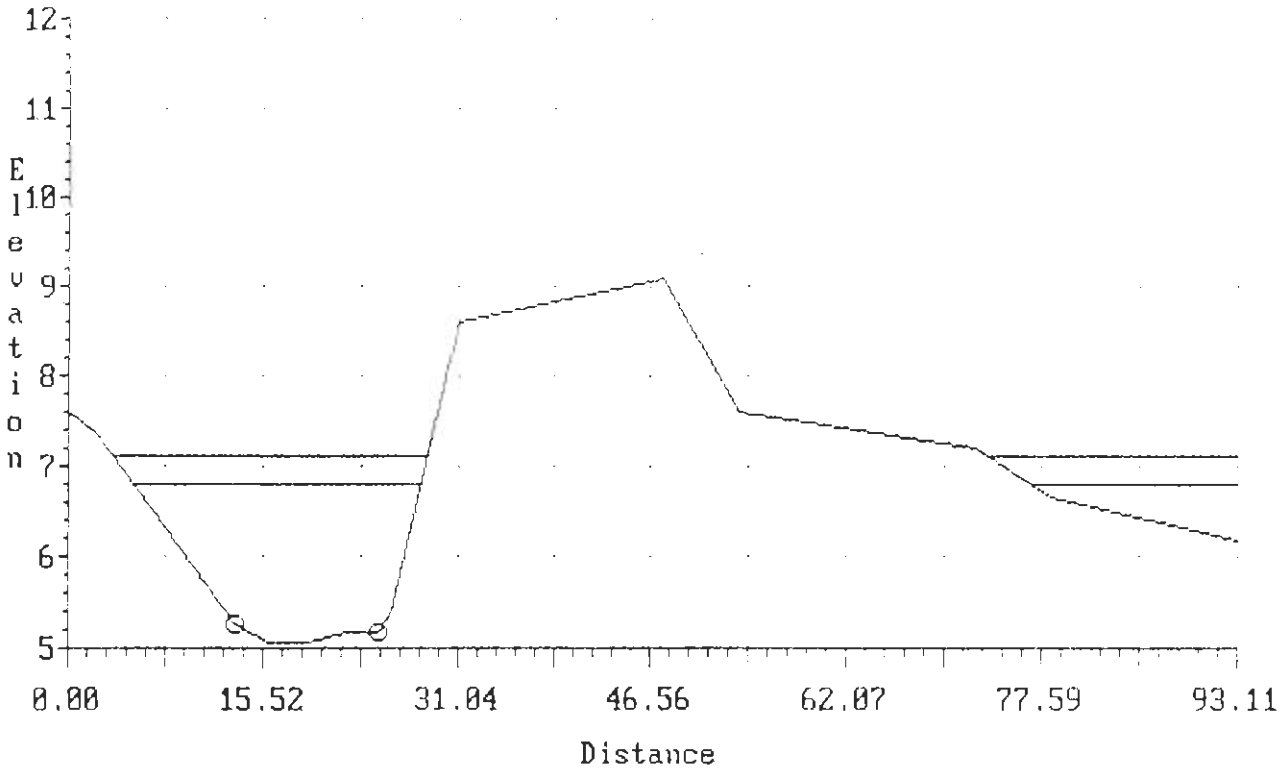

COLD BROOK,BLANCHE BROOK
Cross-section 527.000
42
40
38
36
34
32
30
28
Elevation
0.00
16.68
33.37
50.05
66.73
83.42
100.10
Distance

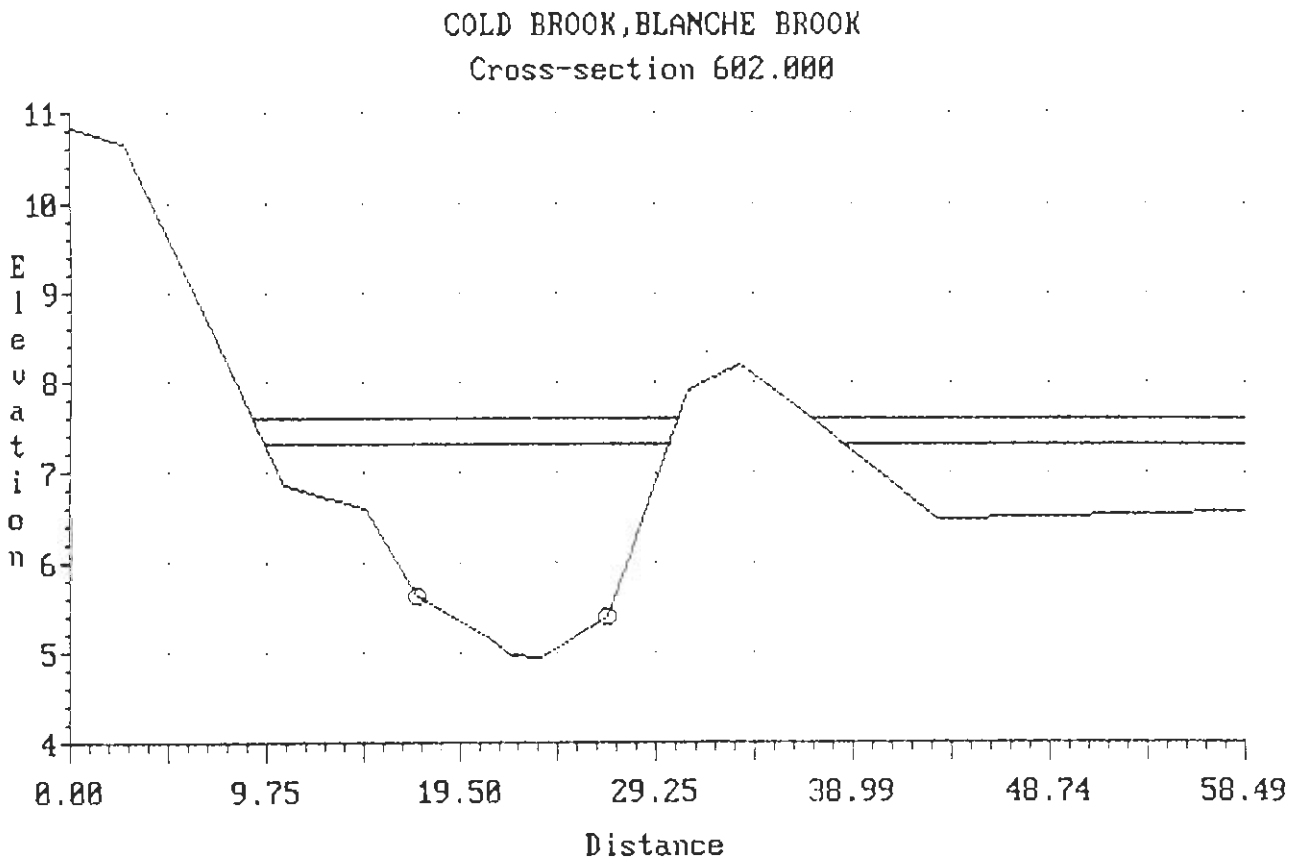

COLD BROOK,BLANCHE BROOK
Cross-section 528.000
Elevation
40
39
38
37
36
35
34
33
0.00
29.58
59.17
88.75
118.33
147.92
177.50
Distance

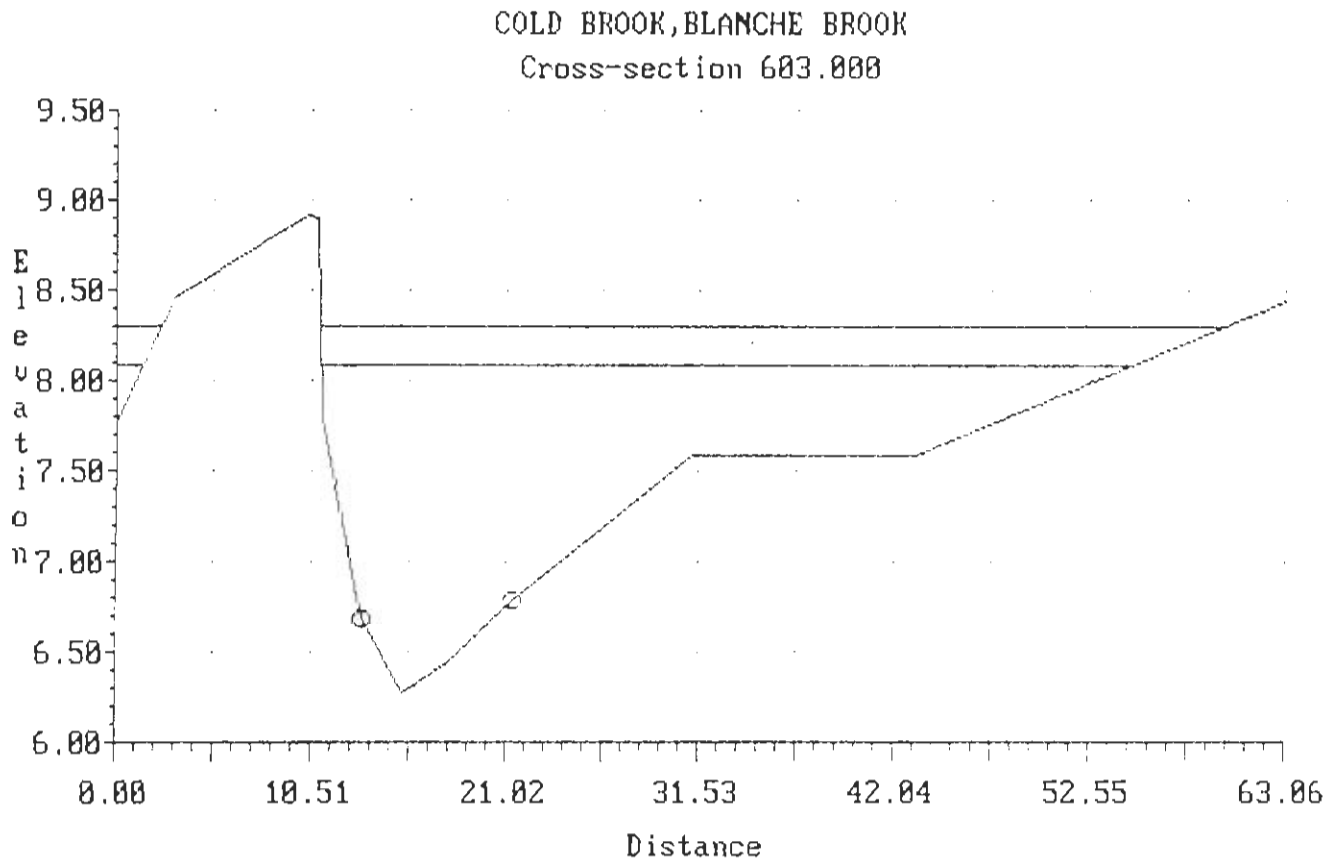

COLD BROOK,BLANCHE BROOK
Cross-section -509.000
Elevation
11
10
9
8
7
6
5
4
0.00
20.76
41.51
62.27
83.03
103.78
124.54
Distance

COLD BROOK,BLANCHE BROOK

Cross-section 601.000

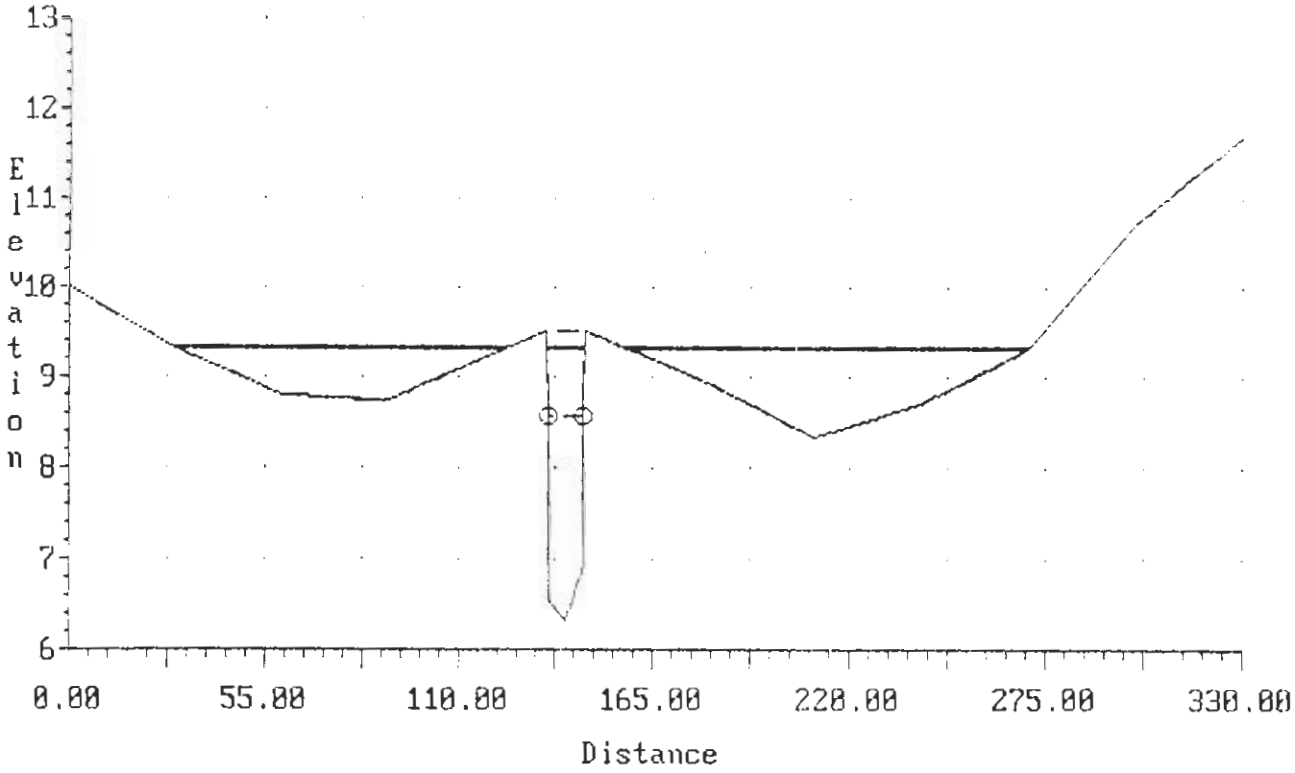


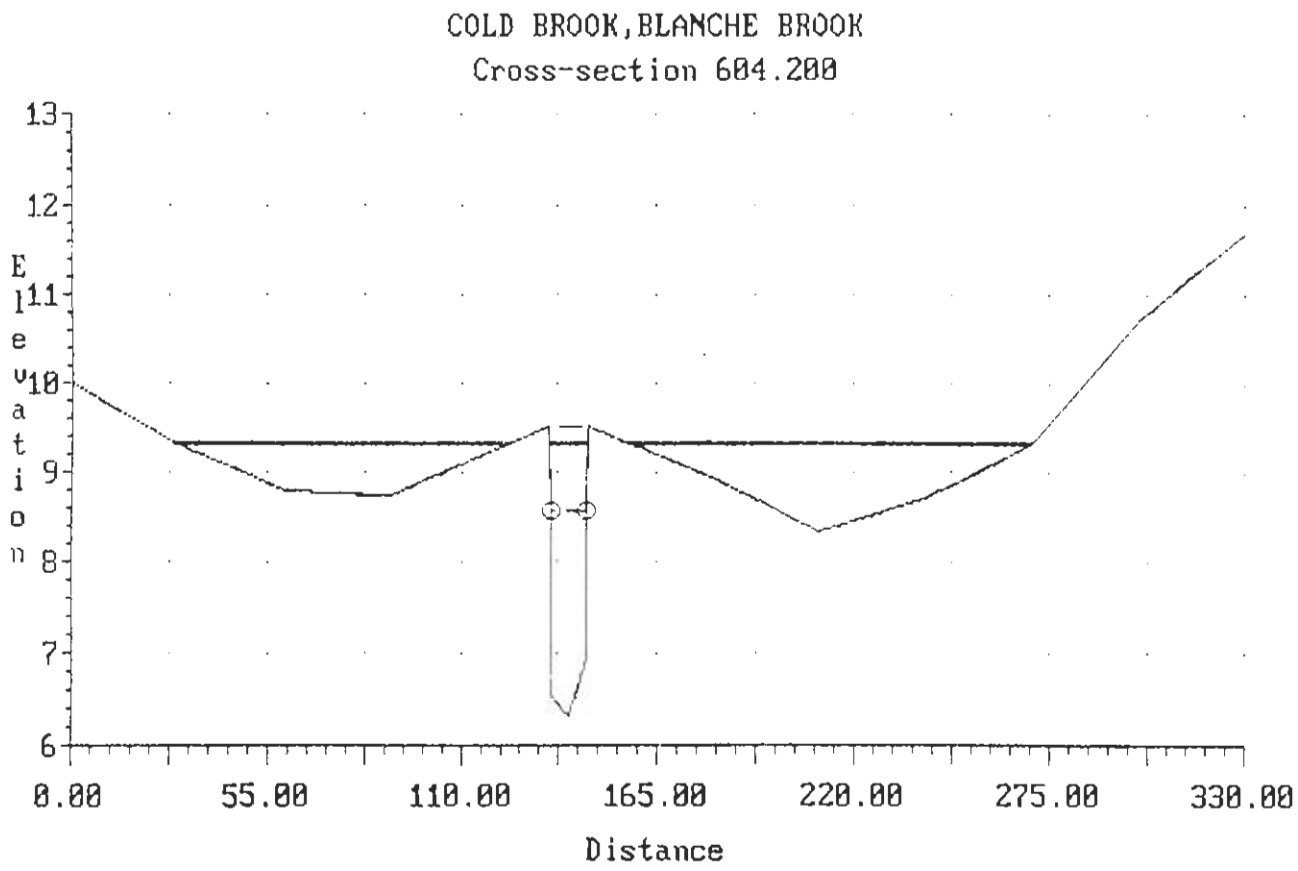

COLD BROOK,BLANCHE BROOK
Cross-section 602.000
Elevation
11
10
9
8
7
6
5
4
0.00
9.75
19.50
29.25
38.99
48.74
58.49
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 603.000
9.50
9.00
8.50
8.00
7.50
7.00
6.50
6.00
Elevation
0.00
10.51
21.02
31.53
42.04
52.55
63.06
Distance

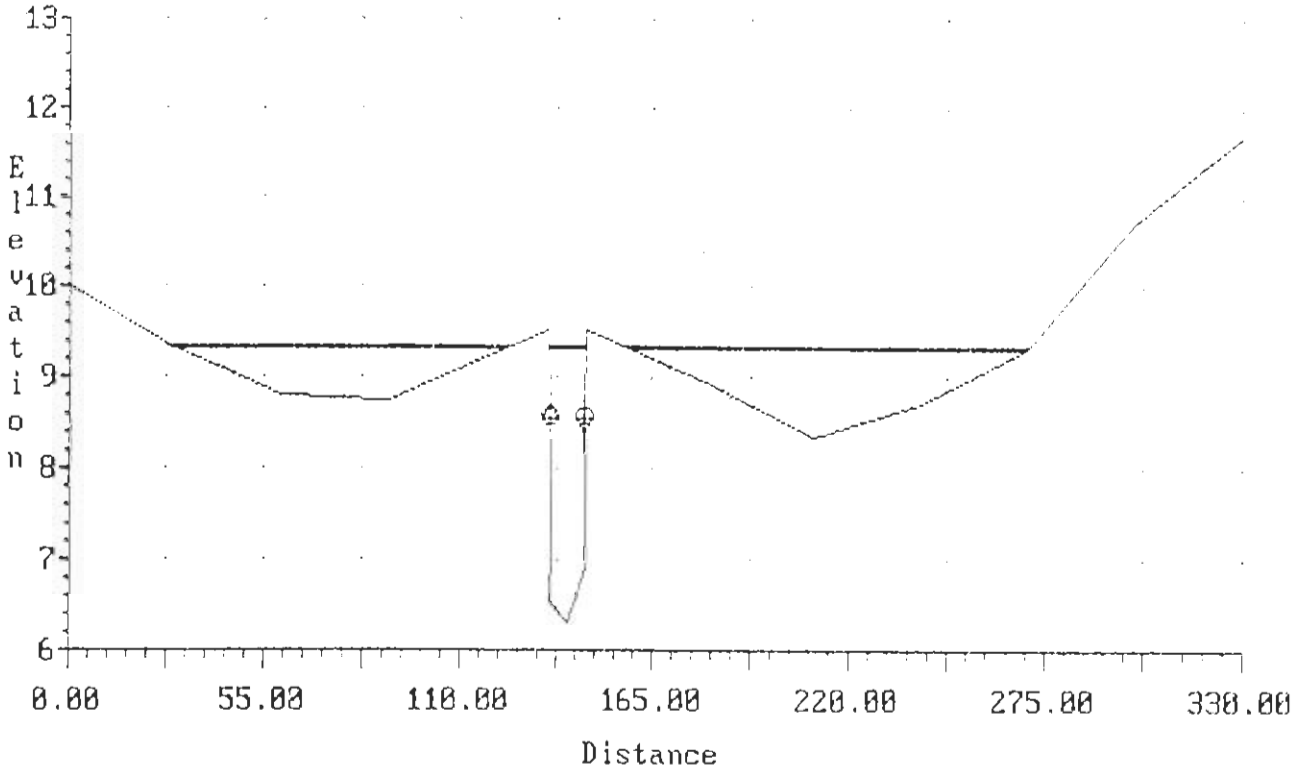
COLD BROOK,BLANCHE BROOK

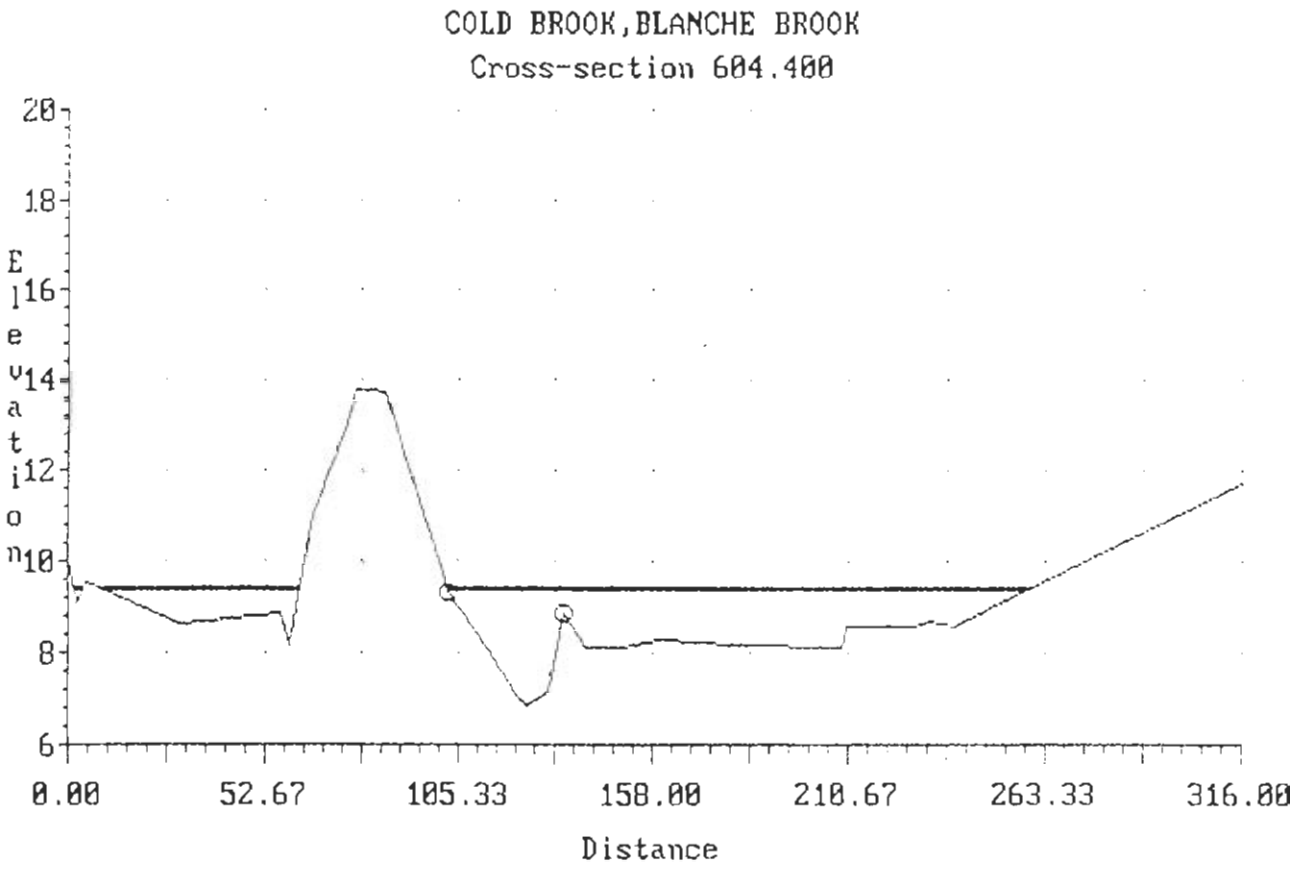
Cross-section 604.000

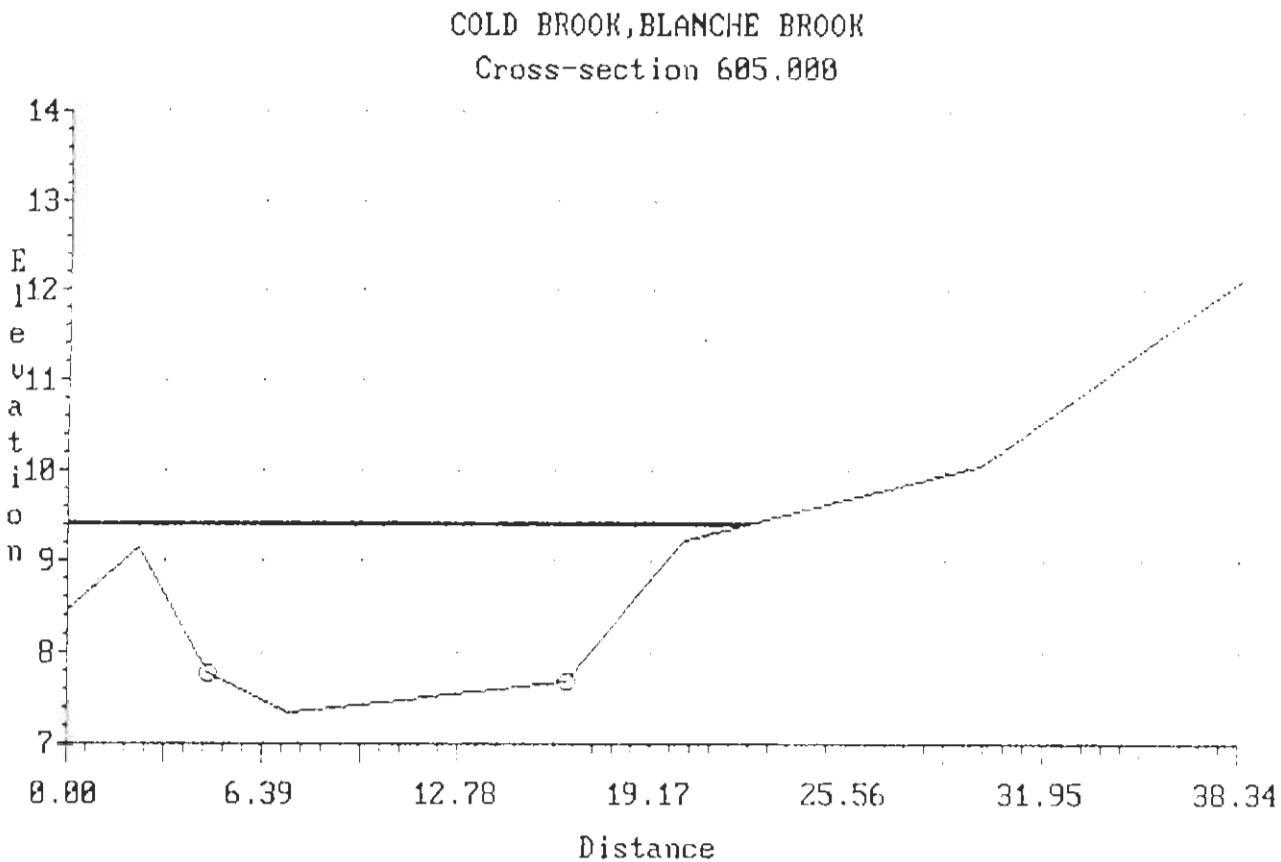


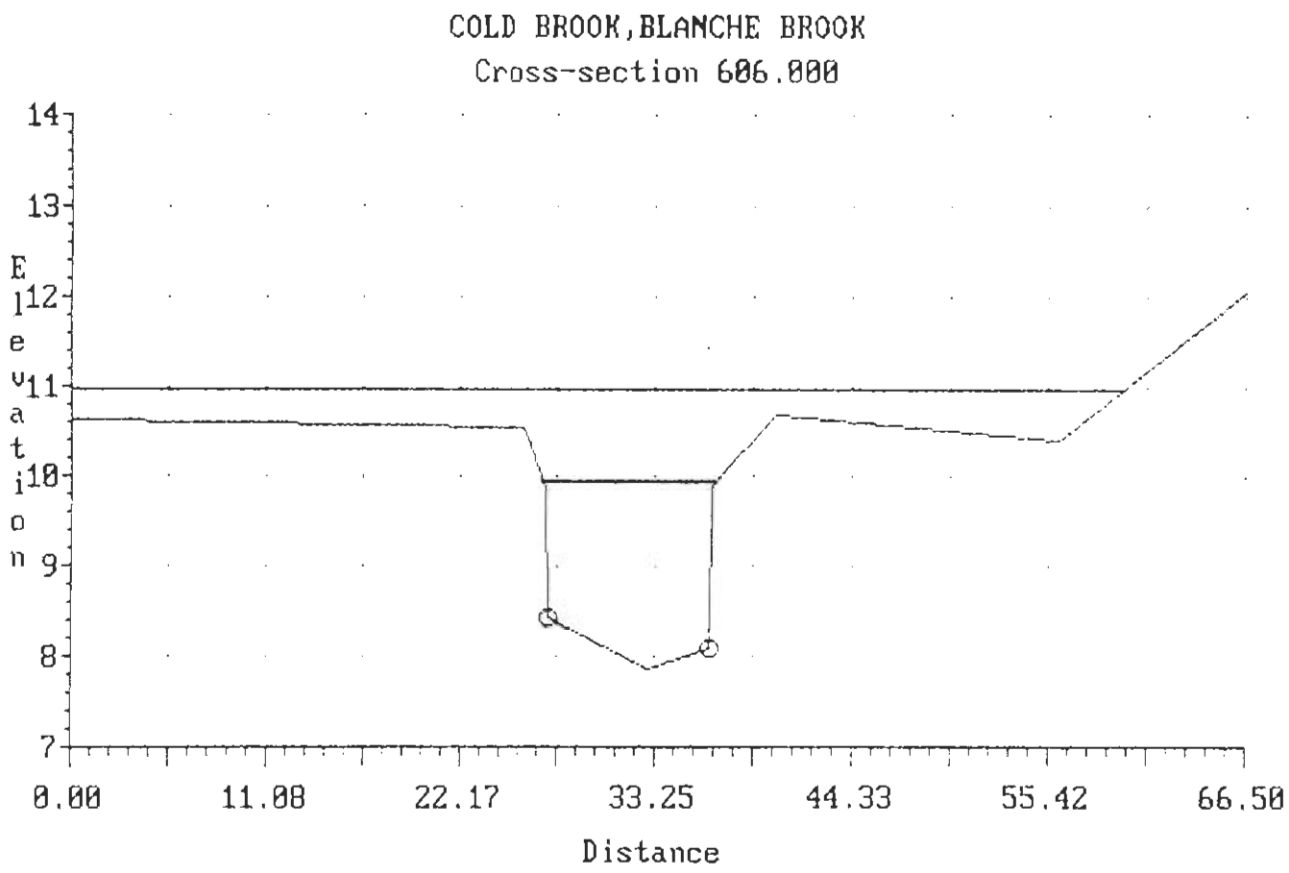

COLD BROOK,BLANCHE BROOK
Cross-section 604.200
Elevation
13
12
11
10
9
8
7
6
0.00
55.00
110.00
165.00
220.00
275.00
330.00
Distance

COLD BROOK,BLANCHE BROOK
Cross-section 604.300



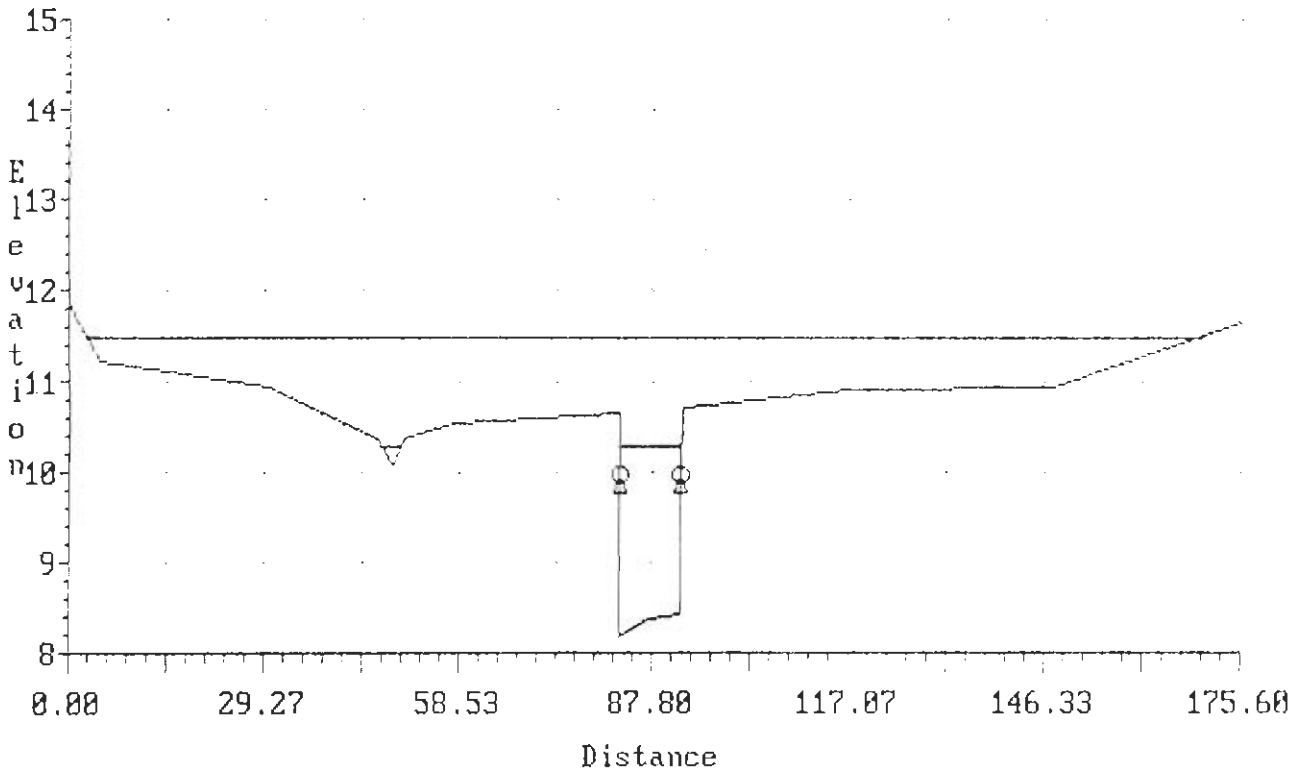

COLD BROOK,BLANCHE BROOK
Cross-section 604.400
Elevation
20
18
16
14
12
10
8
6
0.00
52.67
105.33
158.00
210.67
263.33
316.00
Distance

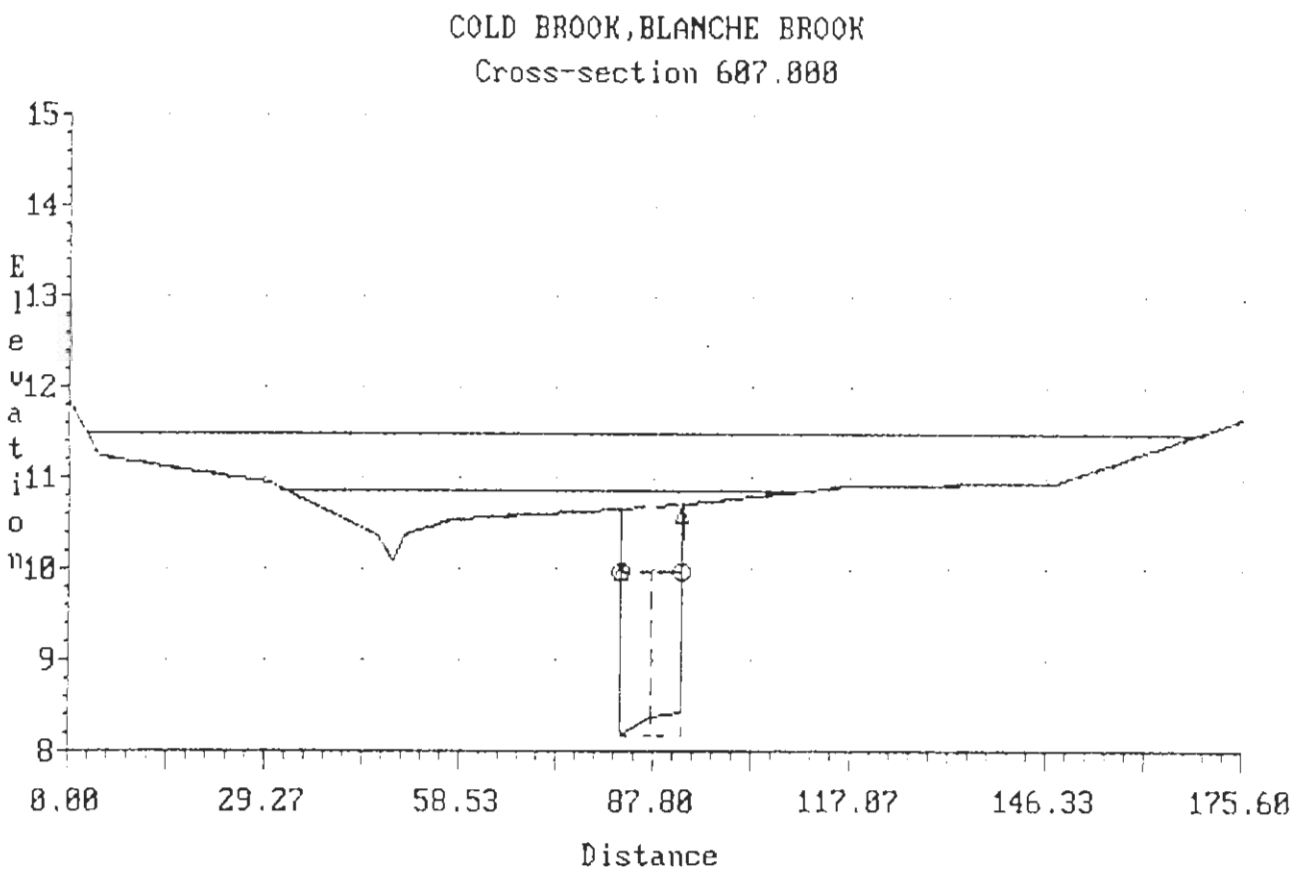

COLD BROOK,BLANCHE BROOK
Cross-section 605.000
Elevation
14
13
12
11
10
9
8
7
0.00
6.39
12.78
19.17
25.56
31.95
38.34
Distance

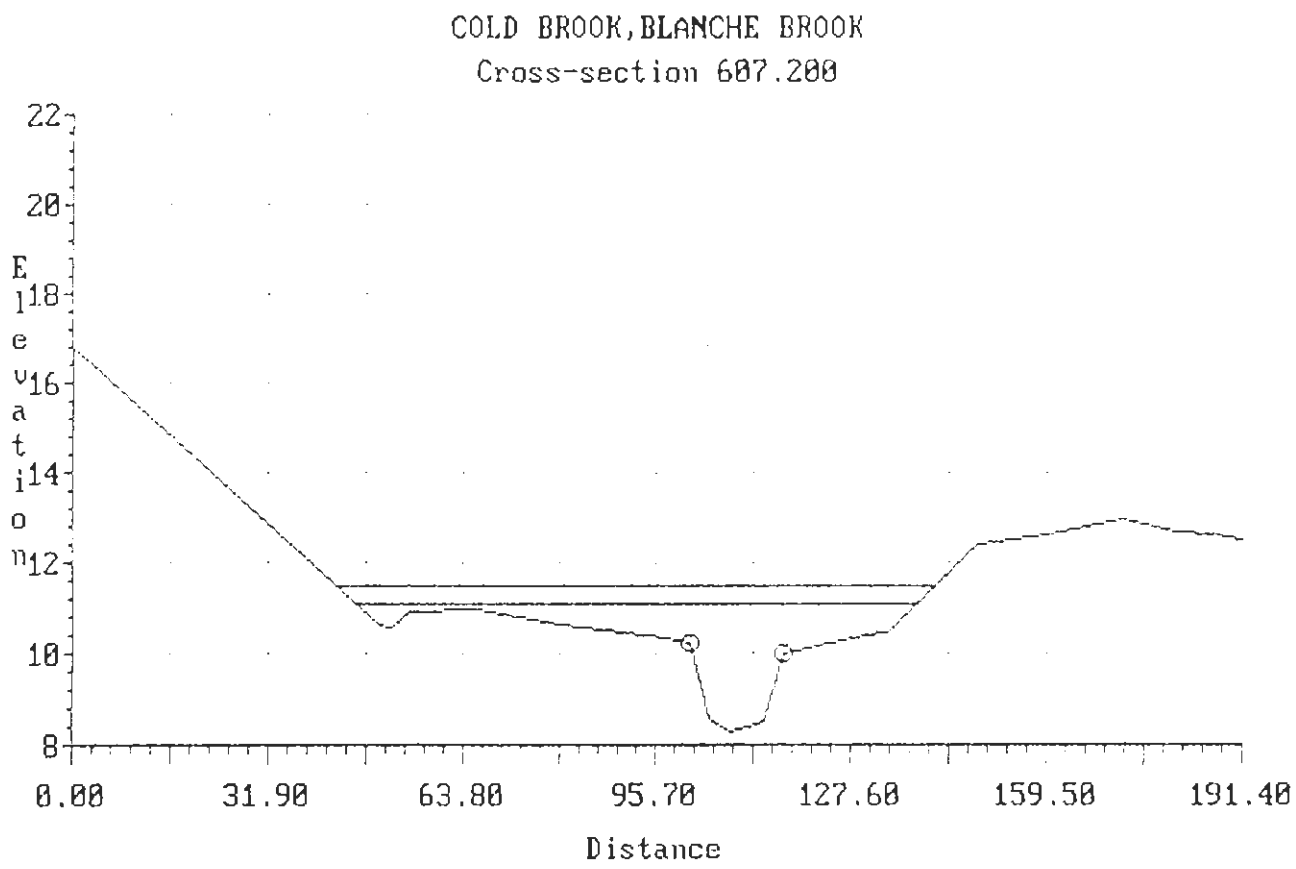

COLD BROOK,BLANCHE BROOK
Cross-section 606.000
Elevation
14
13
12
11
10
9
8
7
0.00
11.08
22.17
33.25
44.33
55.42
66.50
Distance

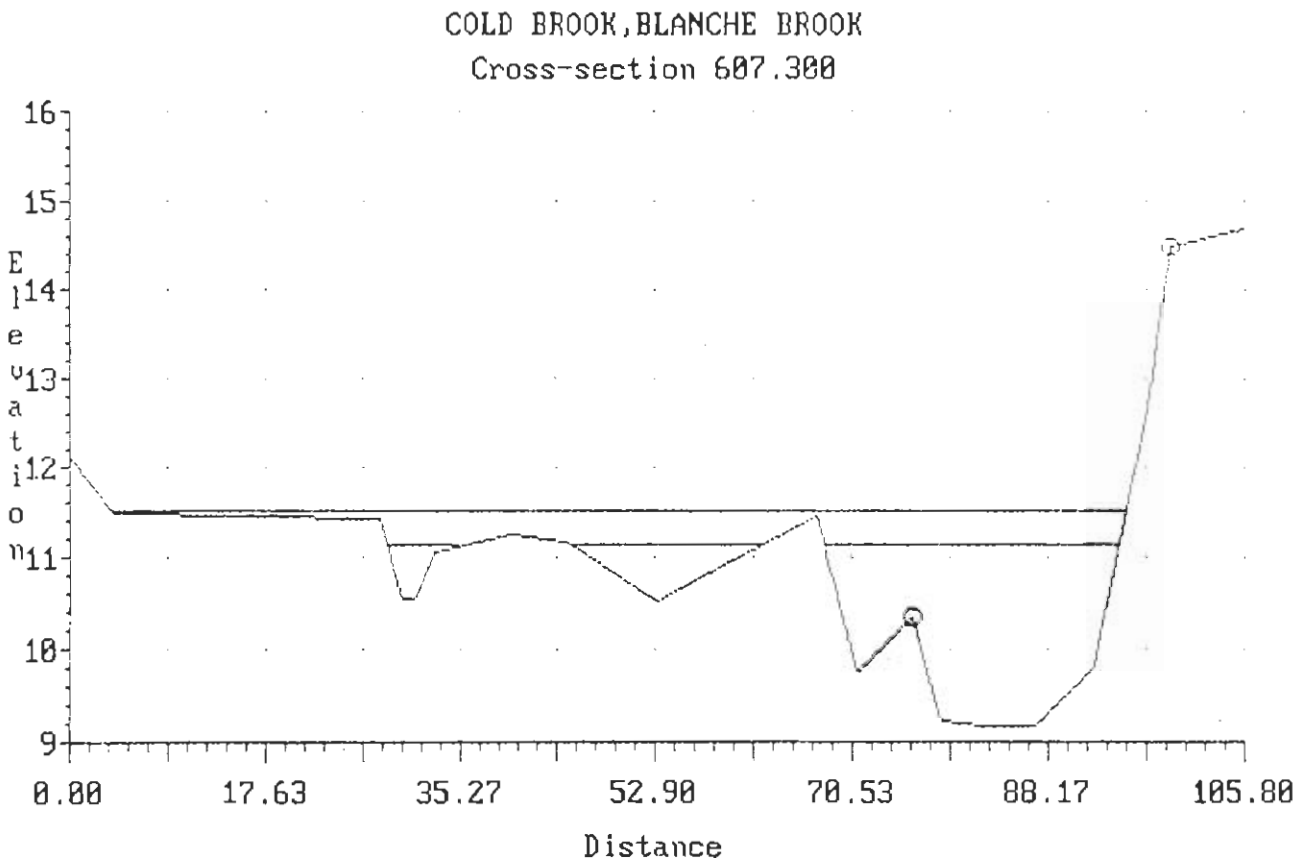
COLD BROOK,BLANCHE BROOK

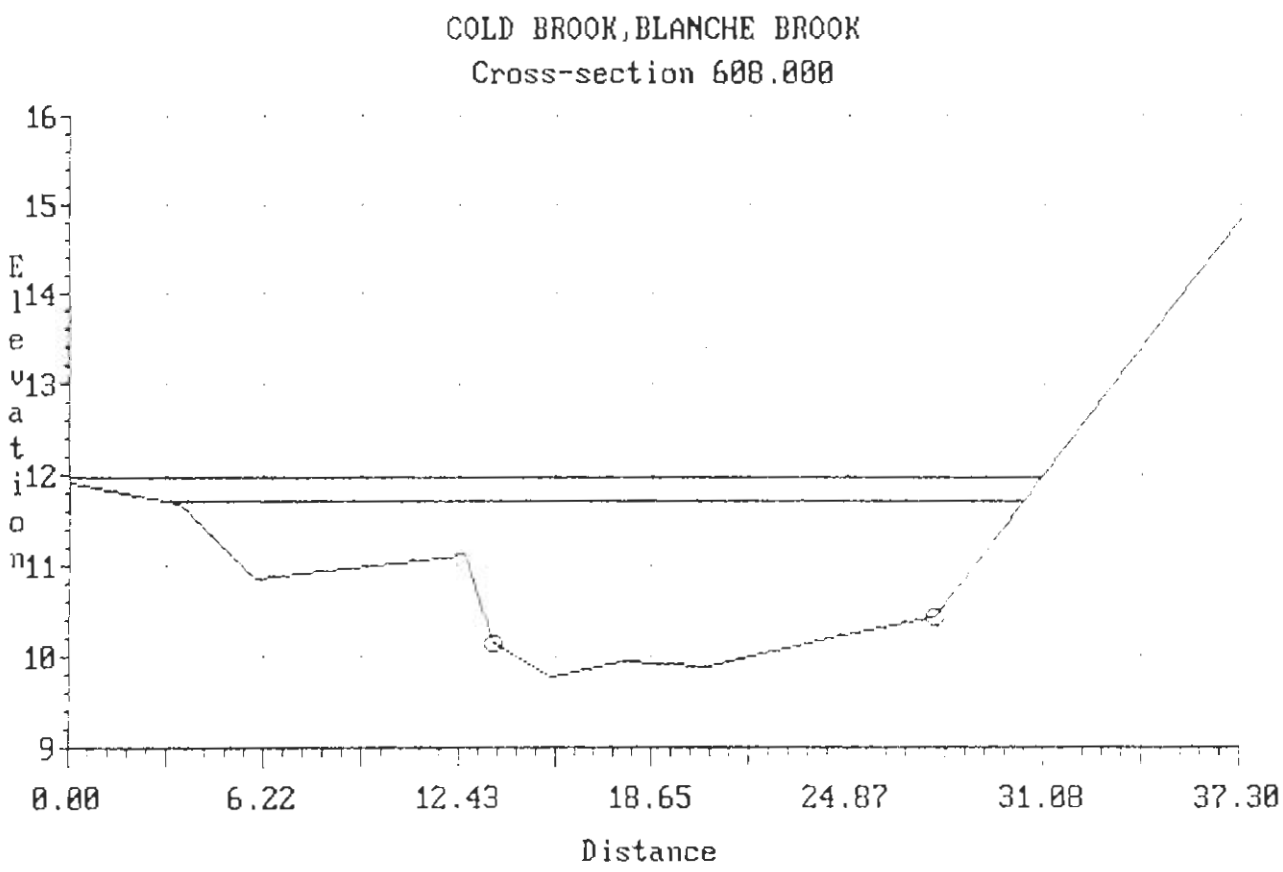
Cross-section 687.100

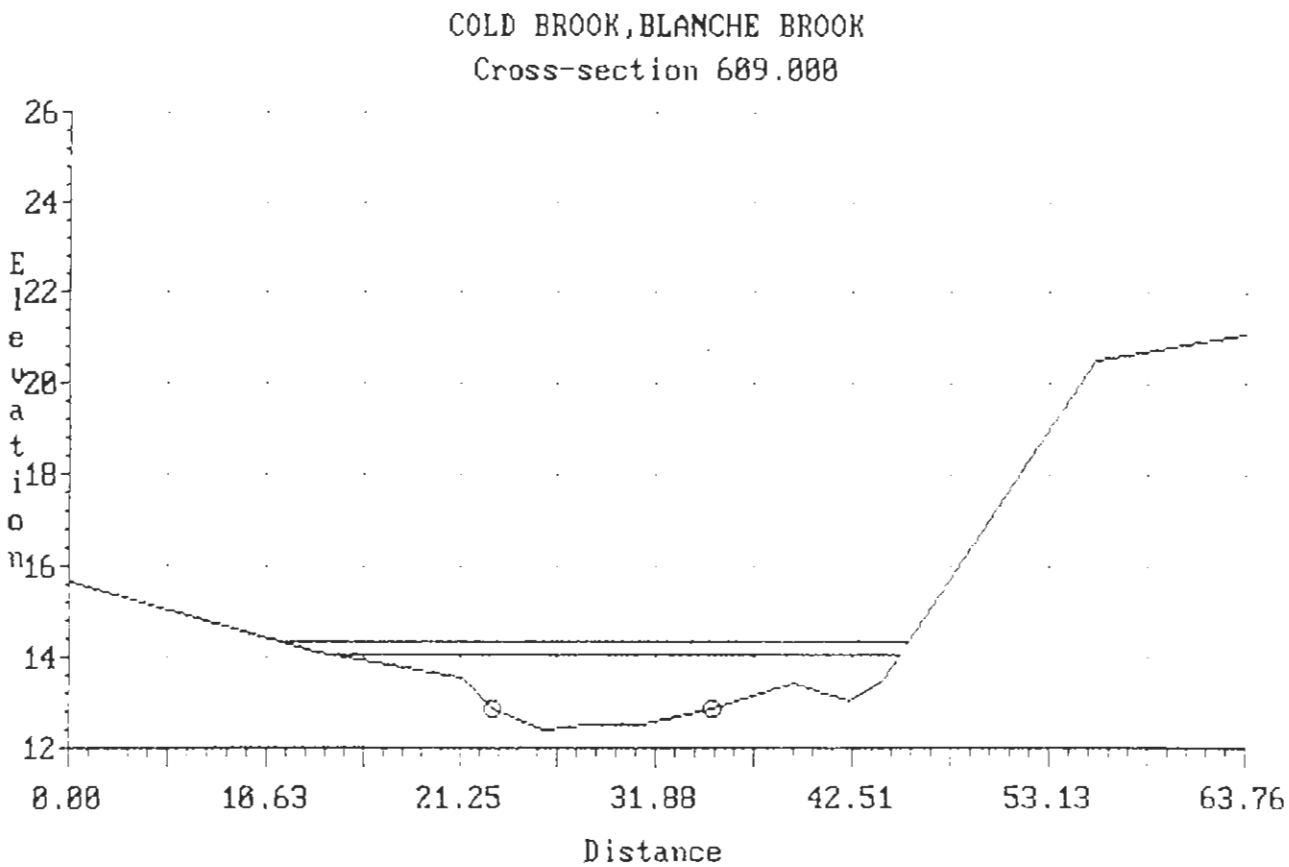


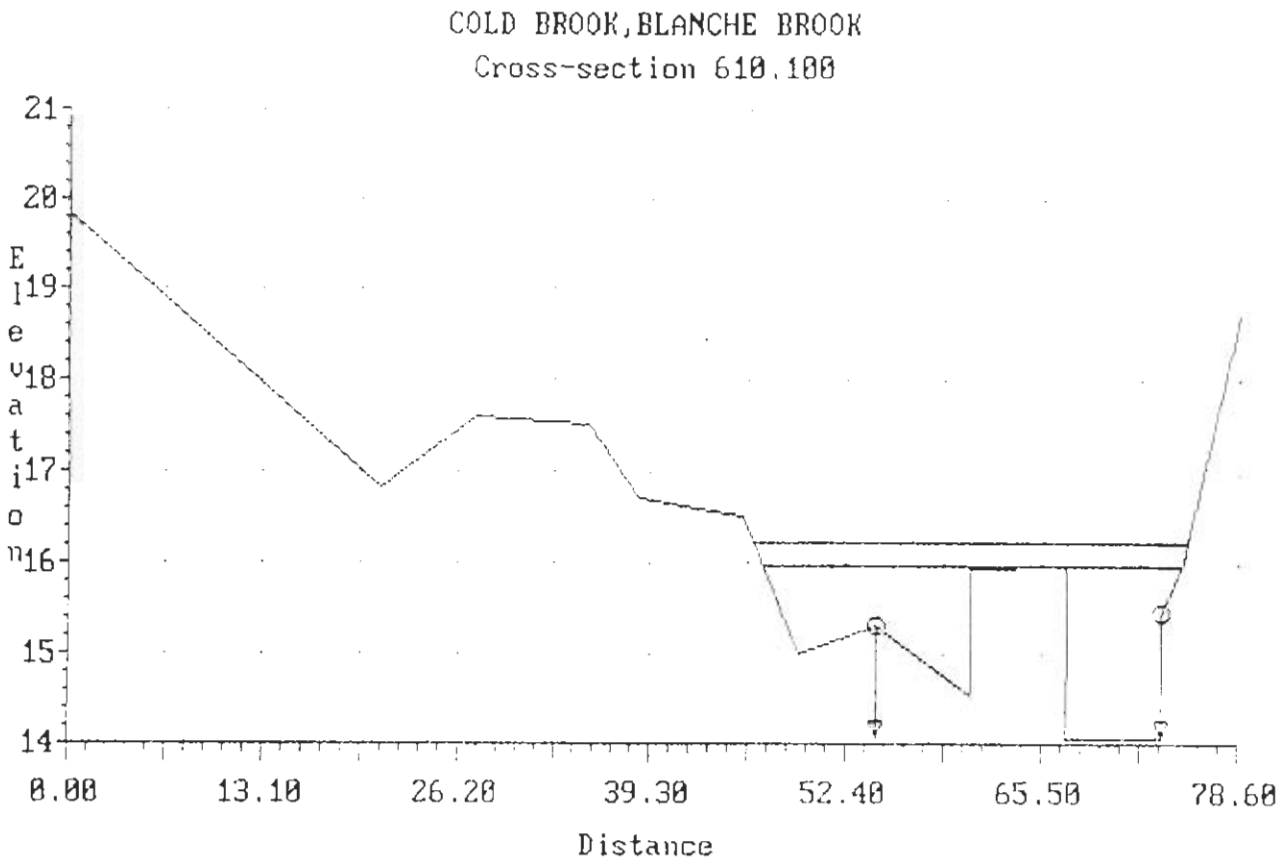

COLD BROOK,BLANCHE BROOK
Cross-section 607.000
Elevation
15
14
13
12
11
10
9
8
0.00
29.27
58.53
87.80
117.07
146.33
175.60
Distance

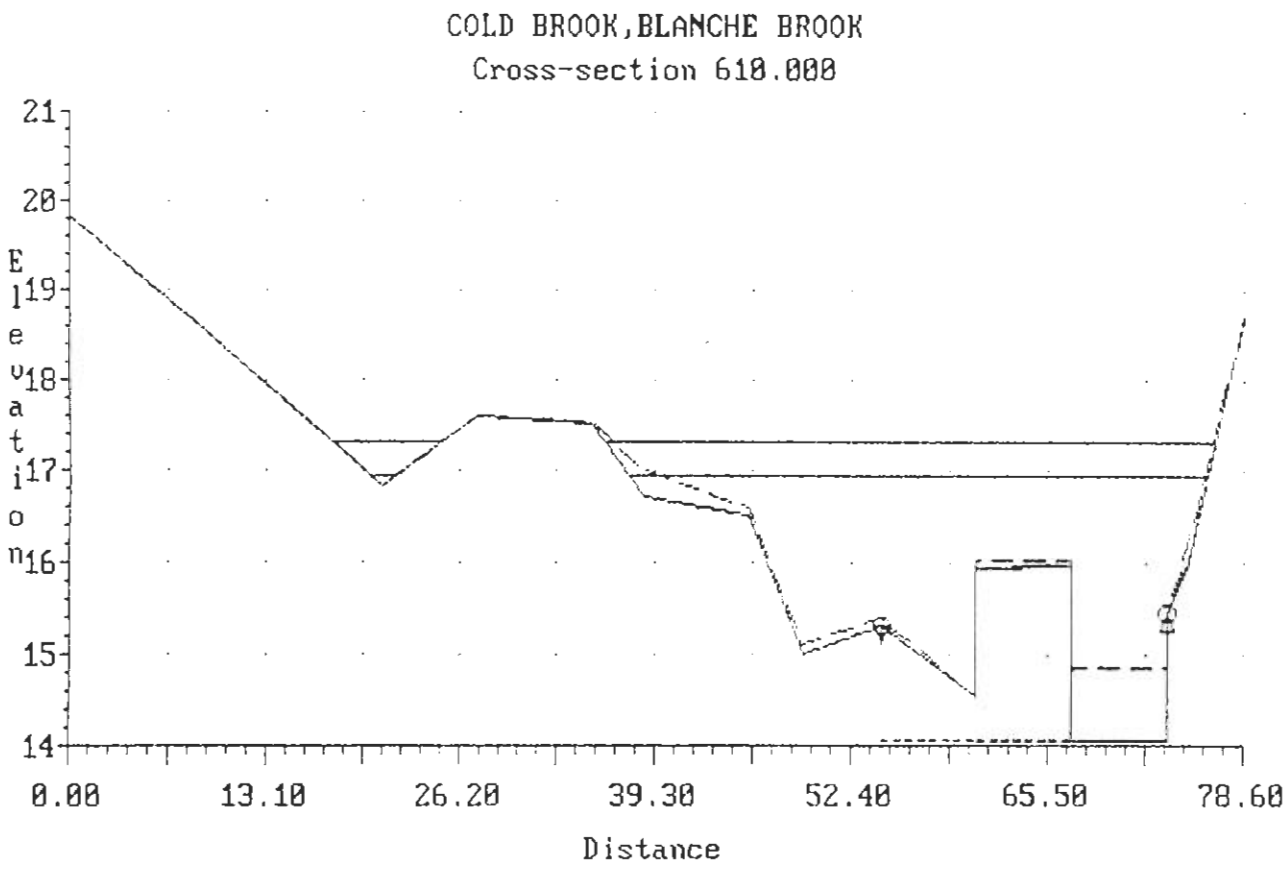

COLD BROOK,BLANCHE BROOK
Cross-section 607.200
Elevation
22
20
18
16
14
12
10
8
0.00
31.90
63.80
95.70
127.60
159.50
191.40
Distance

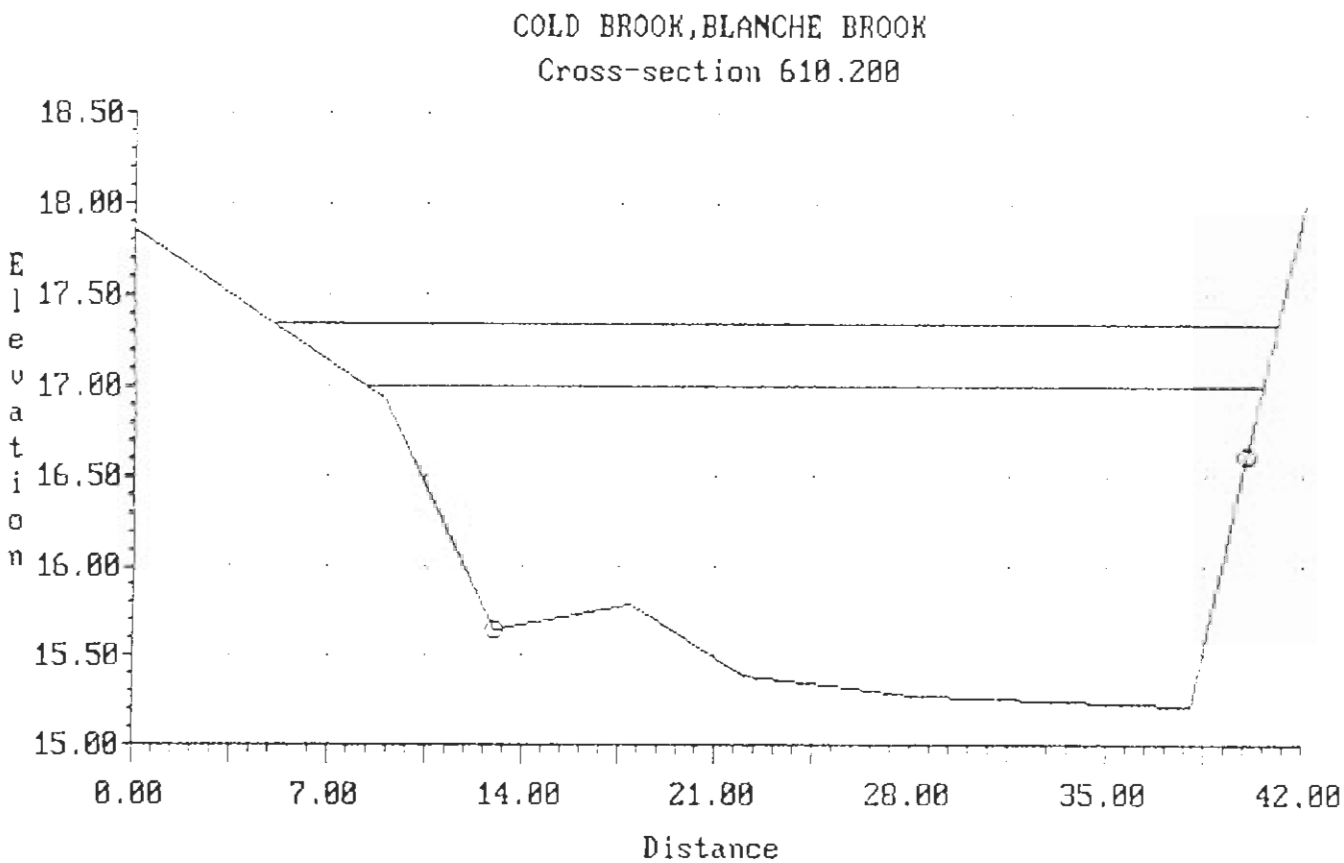

COLD BROOK,BLANCHE BROOK
Cross-section 607.300
Elevation
16
15
14
13
12
11
10
9
0.00
17.63
35.27
52.90
70.53
88.17
105.80
Distance

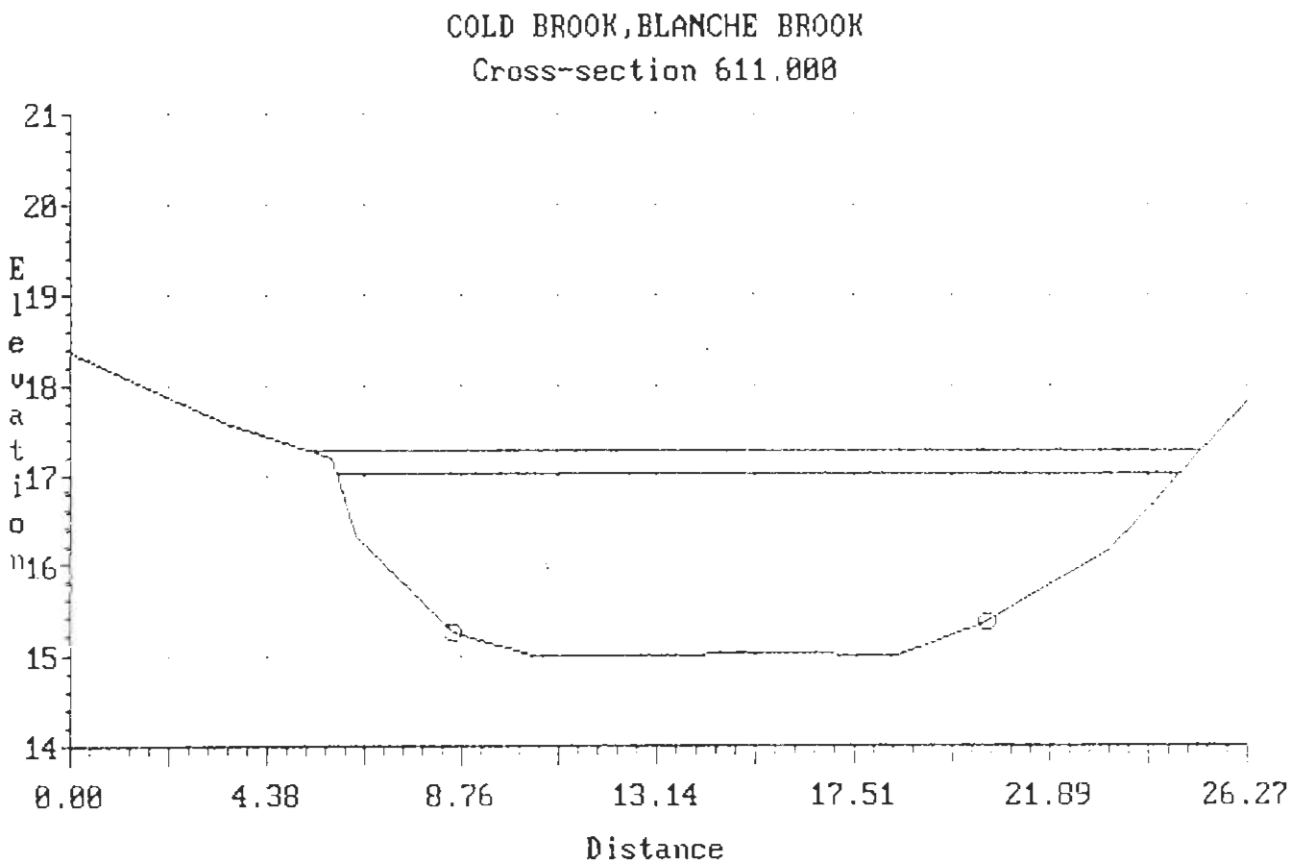

COLD BROOK,BLANCHE BROOK
Cross-section 608.000
Elevation
16
15
14
13
12
11
10
9
0.00
6.22
12.43
18.65
24.87
31.08
37.30
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 609.000
Elevation
26
24
22
20
18
16
14
12
0.00
10.63
21.25
31.88
42.51
53.13
63.76
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 610.100
21
20
19
18
17
16
15
14
Elevation
0.00
13.10
26.20
39.30
52.40
65.50
78.60
Distance

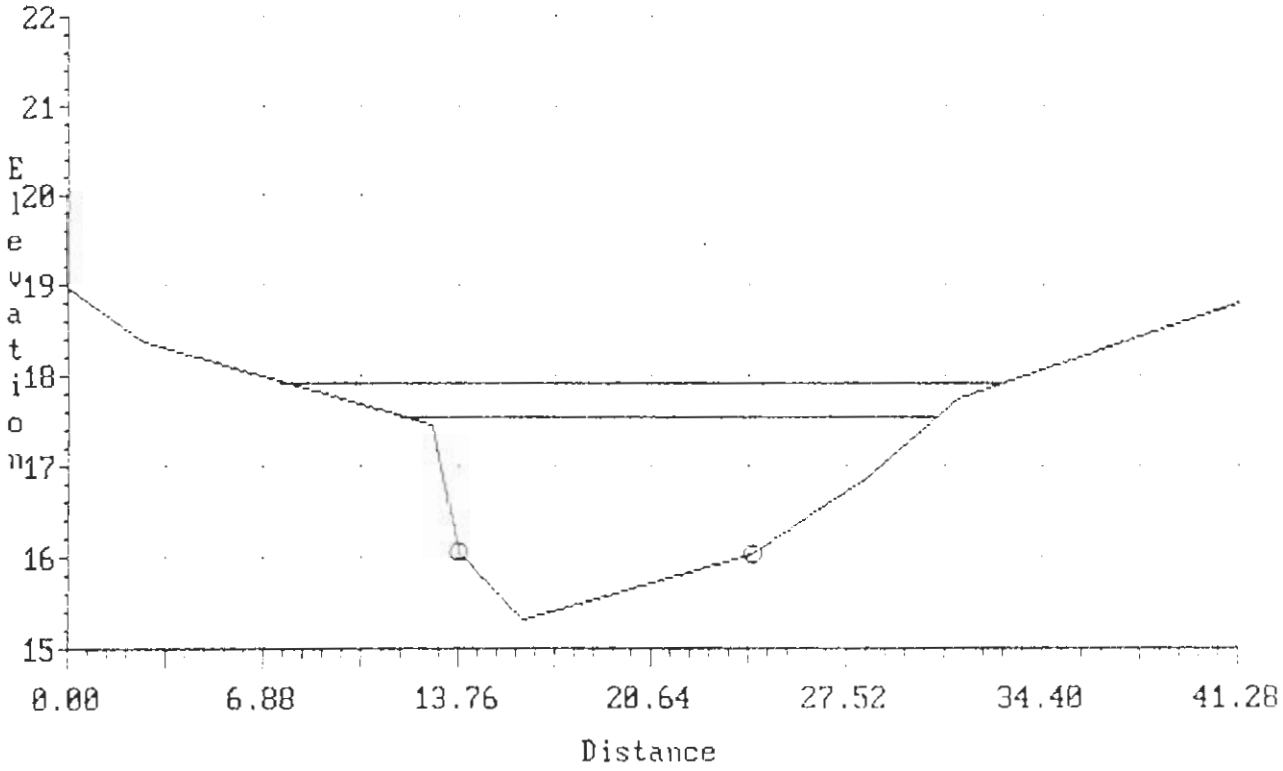

COLD BROOK,BLANCHE BROOK
Cross-section 610.000
Elevation
21
20
19
18
17
16
15
14
0.00
13.10
26.20
39.30
52.40
65.50
78.60
Distance

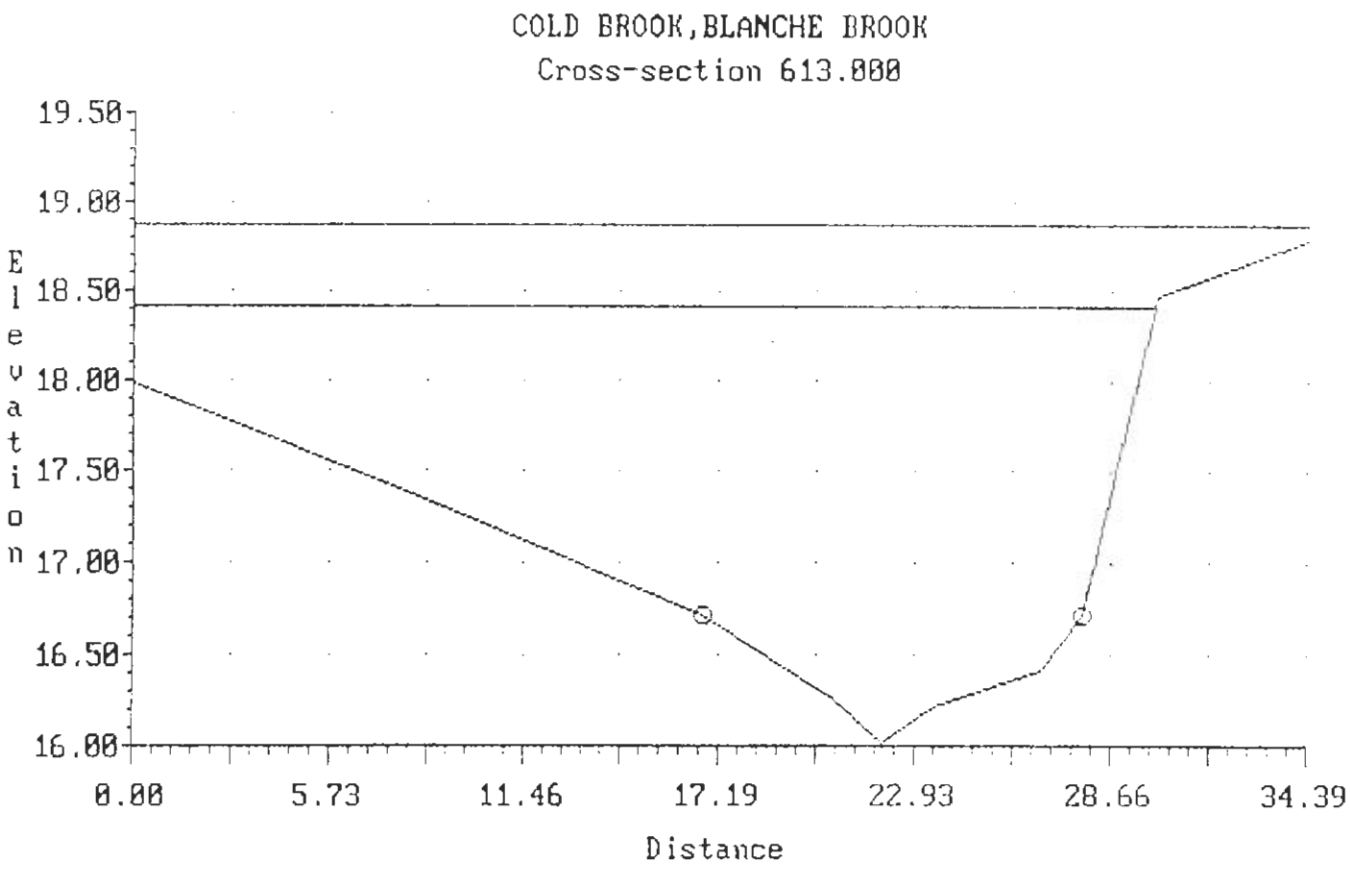

COLD BROOK,BLANCHE BROOK
Cross-section 610.200
18.50
18.00
17.50
17.00
16.50
16.00
15.50
15.00
Elevation
0.00
7.00
14.00
21.00
28.00
35.00
42.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 611.000
Elevation
21
20
19
18
17
16
15
14
0.00
4.38
8.76
13.14
17.51
21.89
26.27
Distance

COLD BROOK,BLANCHE BROOK

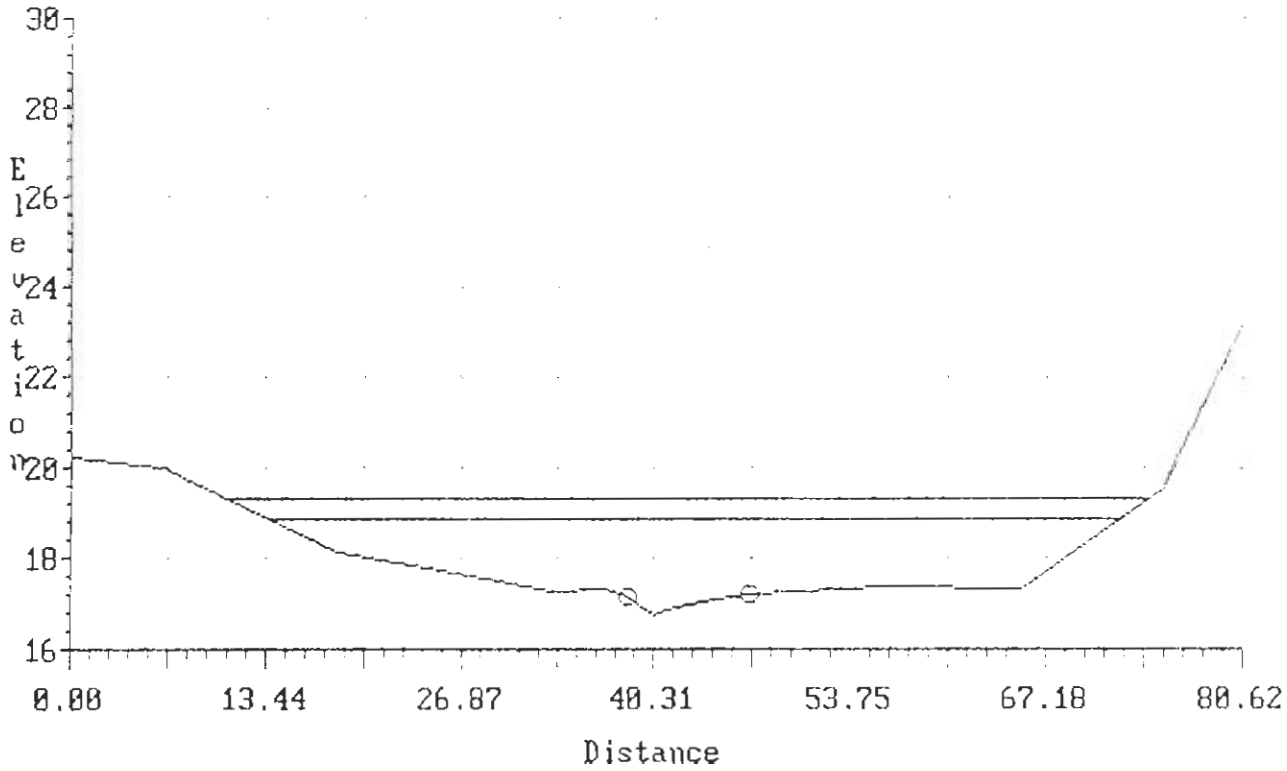
Cross-section 612.000

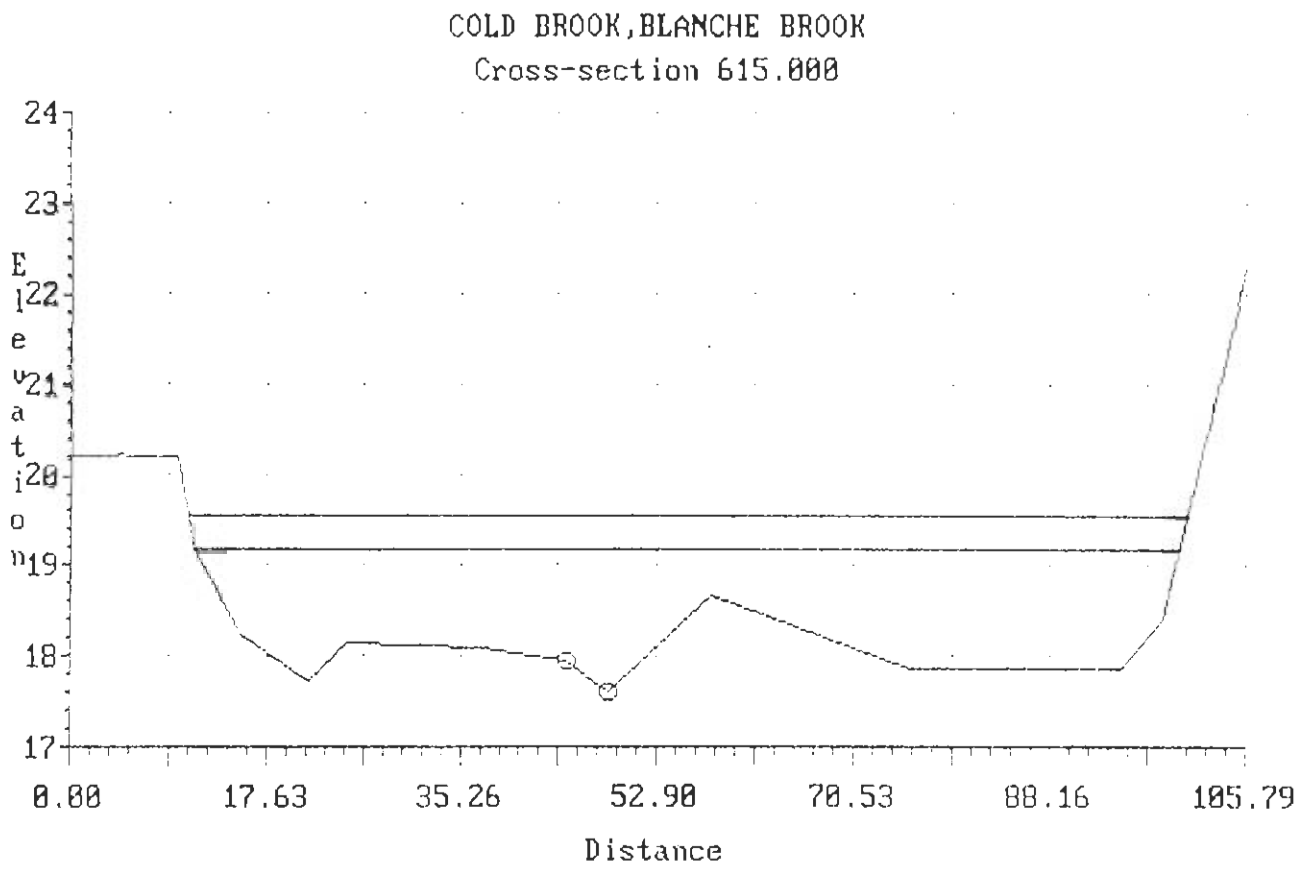


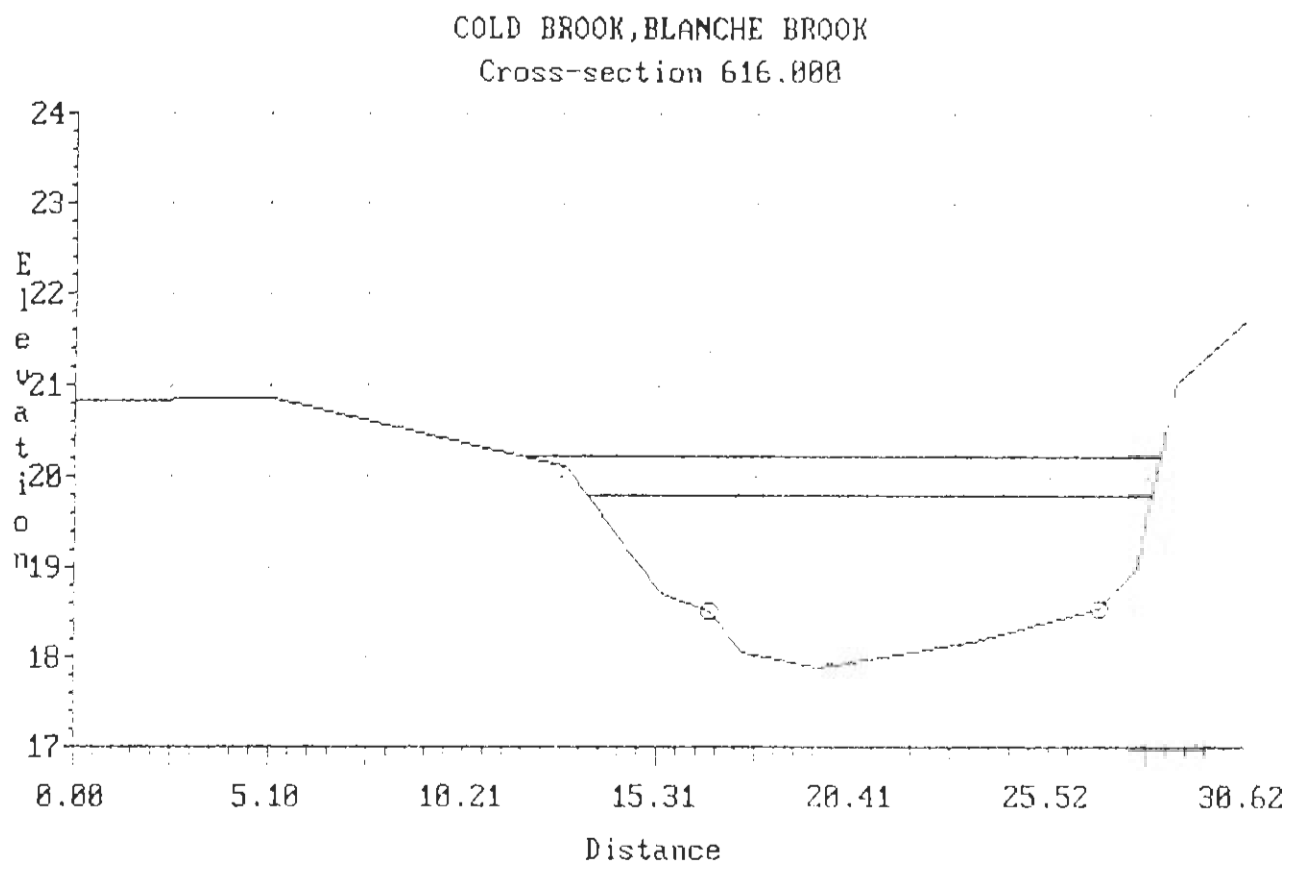

COLD BROOK,BLANCHE BROOK
Cross-section 613.000
19.50
19.00
18.50
18.00
17.50
17.00
16.50
16.00
Elevation
0.00
5.73
11.46
17.19
22.93
28.66
34.39
Distance

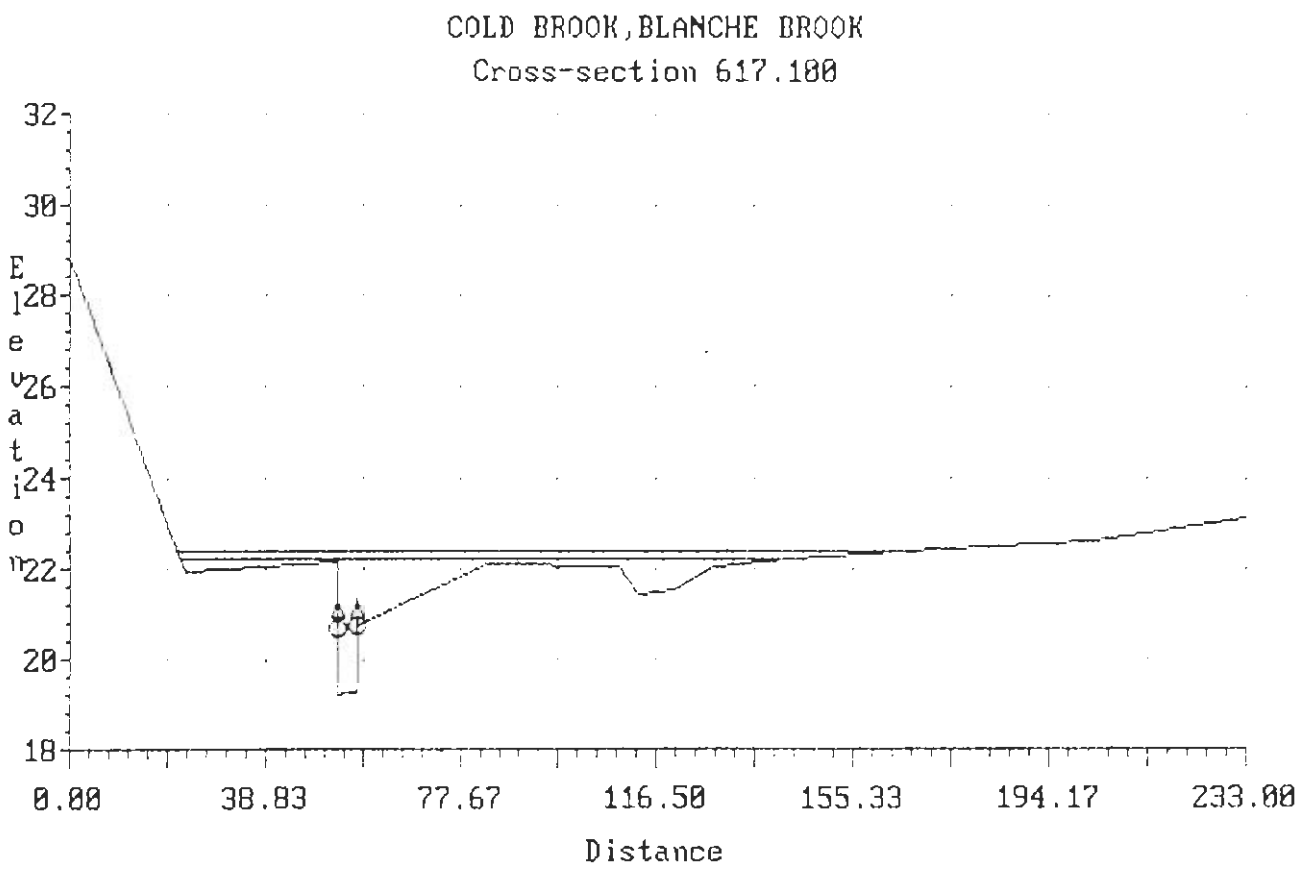
COLD BROOK,BLANCHE BROOK

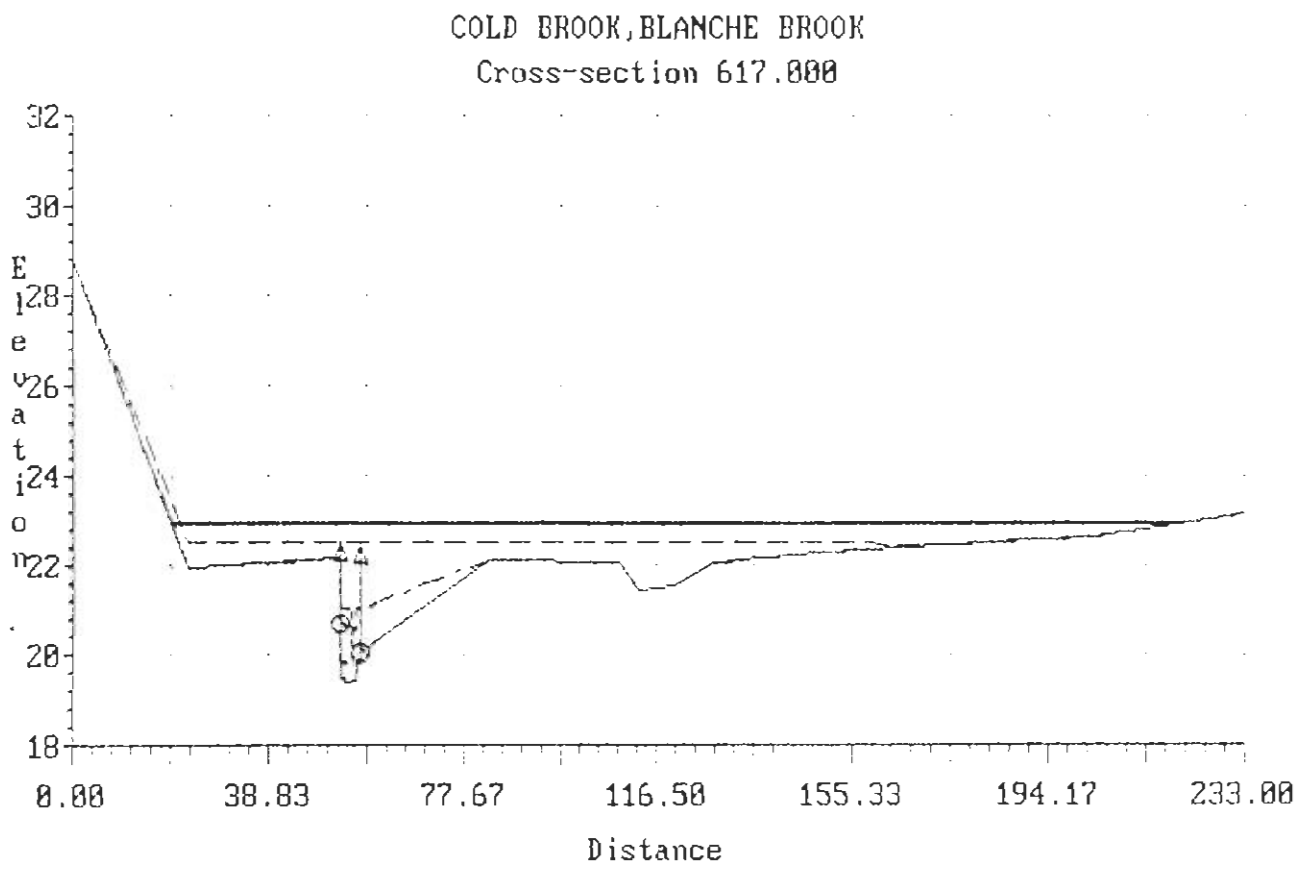
Cross-section 614.000

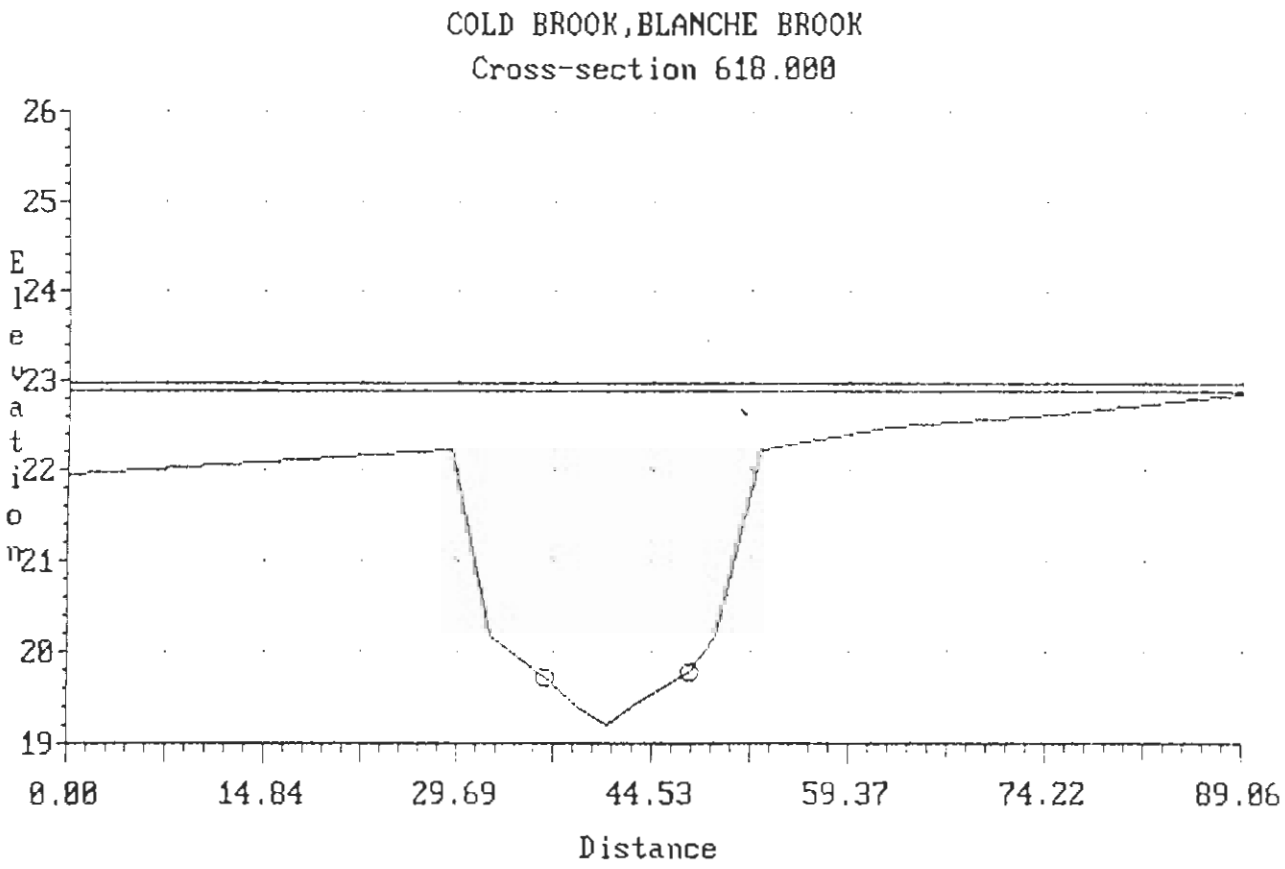



COLD BROOK,BLANCHE BROOK
Cross-section 615.000
Elevation
24
23
22
21
20
19
18
17
0.00
17.63
35.26
52.90
70.53
88.16
105.79
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 616.000
Elevation
24
23
22
21
20
19
18
17
0.00
5.10
10.21
15.31
20.41
25.52
30.62
Distance

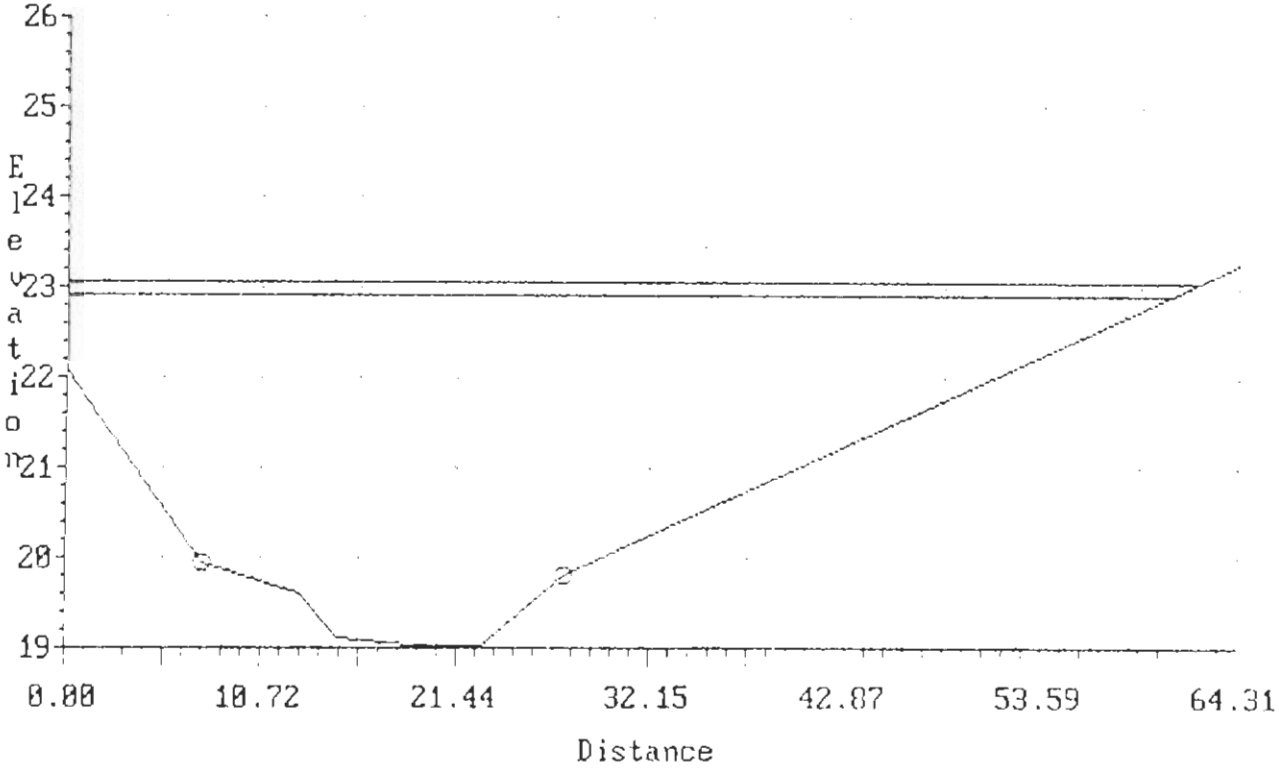

COLD BROOK,BLANCHE BROOK
Cross-section 617.100
Elevation
32
30
28
26
24
22
20
18
0.00
38.83
77.67
116.50
155.33
194.17
233.00
Distance

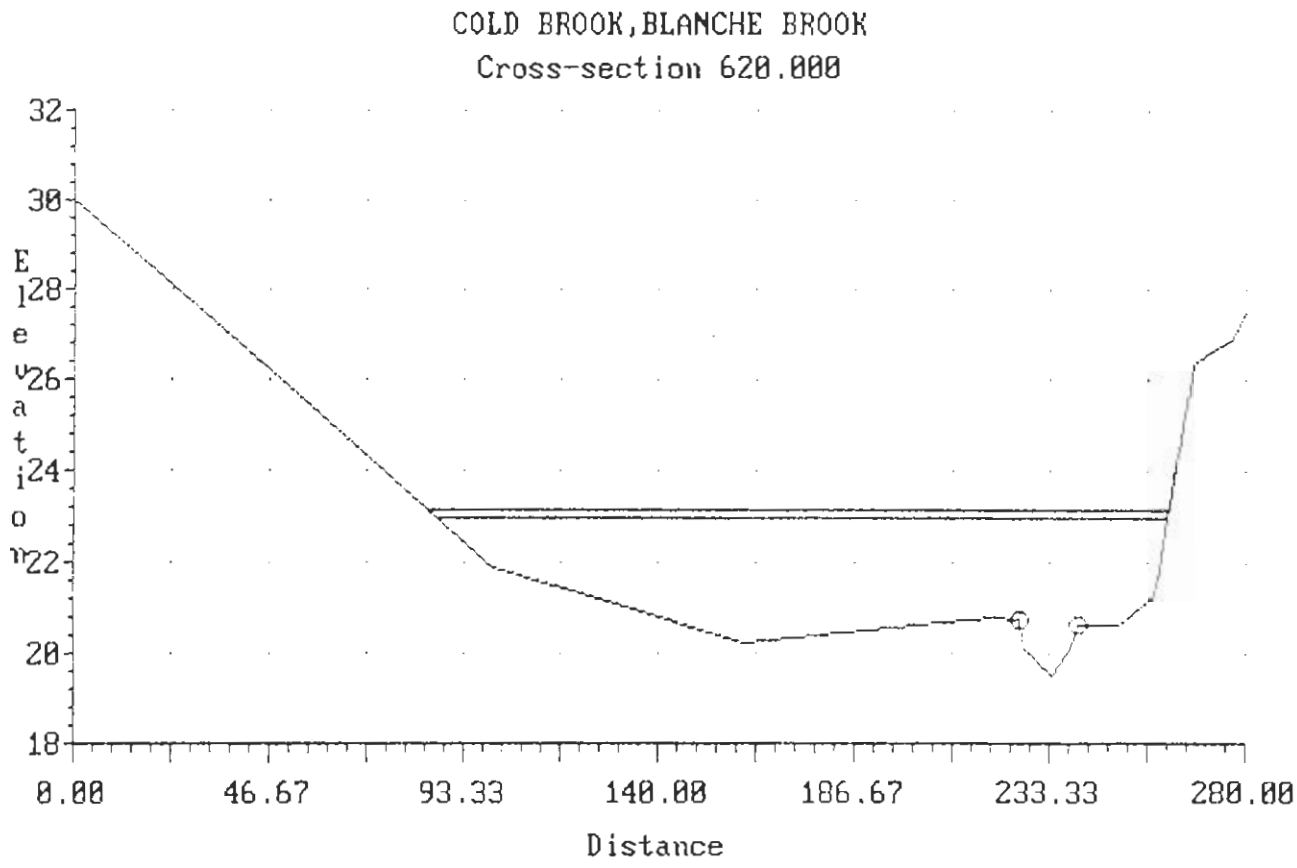

COLD BROOK,BLANCHE BROOK
Cross-section 617.000
Elevation
32
30
28
26
24
22
20
18
0.00
38.83
77.67
116.50
155.33
194.17
233.00
Distance

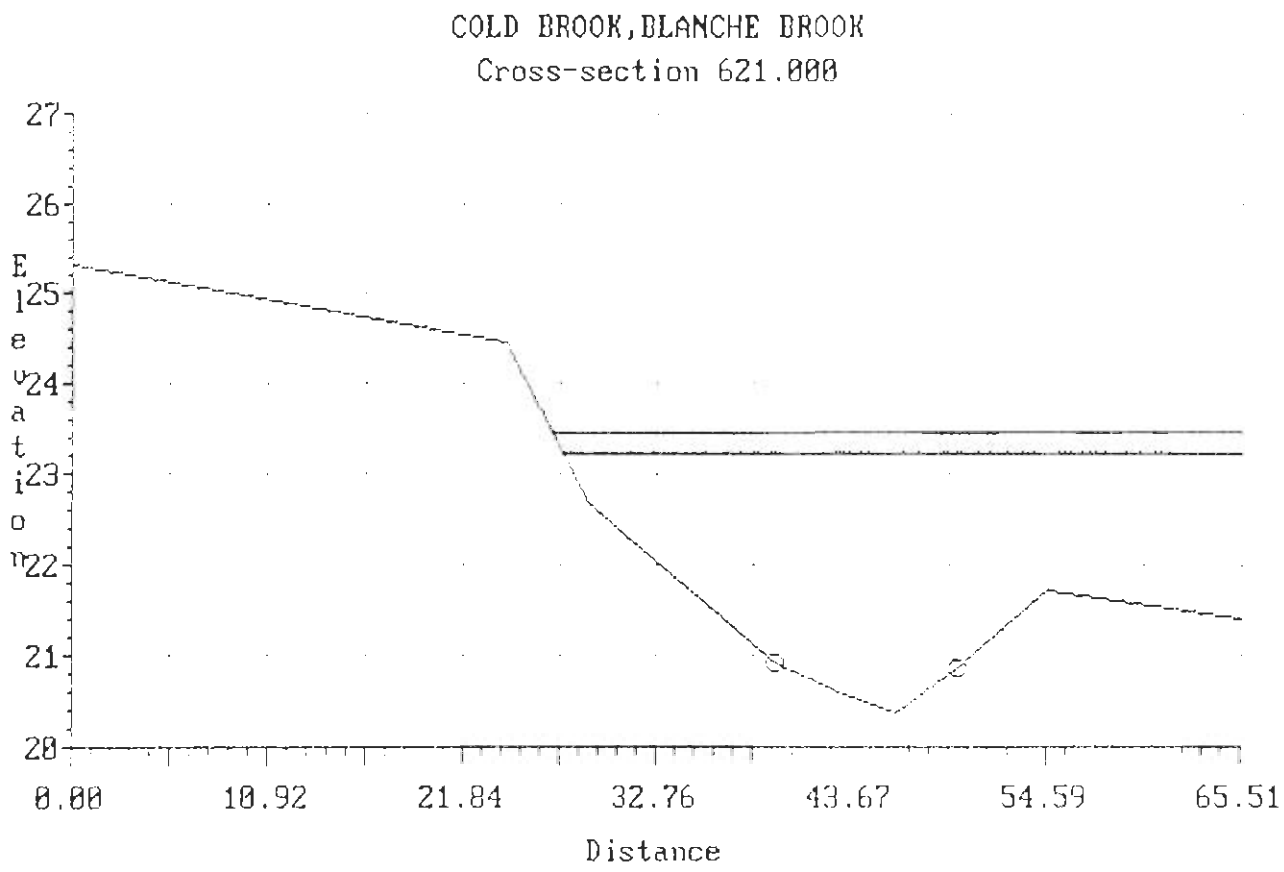

COLD BROOK,BLANCHE BROOK
Cross-section 618.000
26
25
24
23
22
21
20
19
Elevation
0.00
14.84
29.69
44.53
59.37
74.22
89.06
Distance

COLD BROOK,BLANCHE BROOK

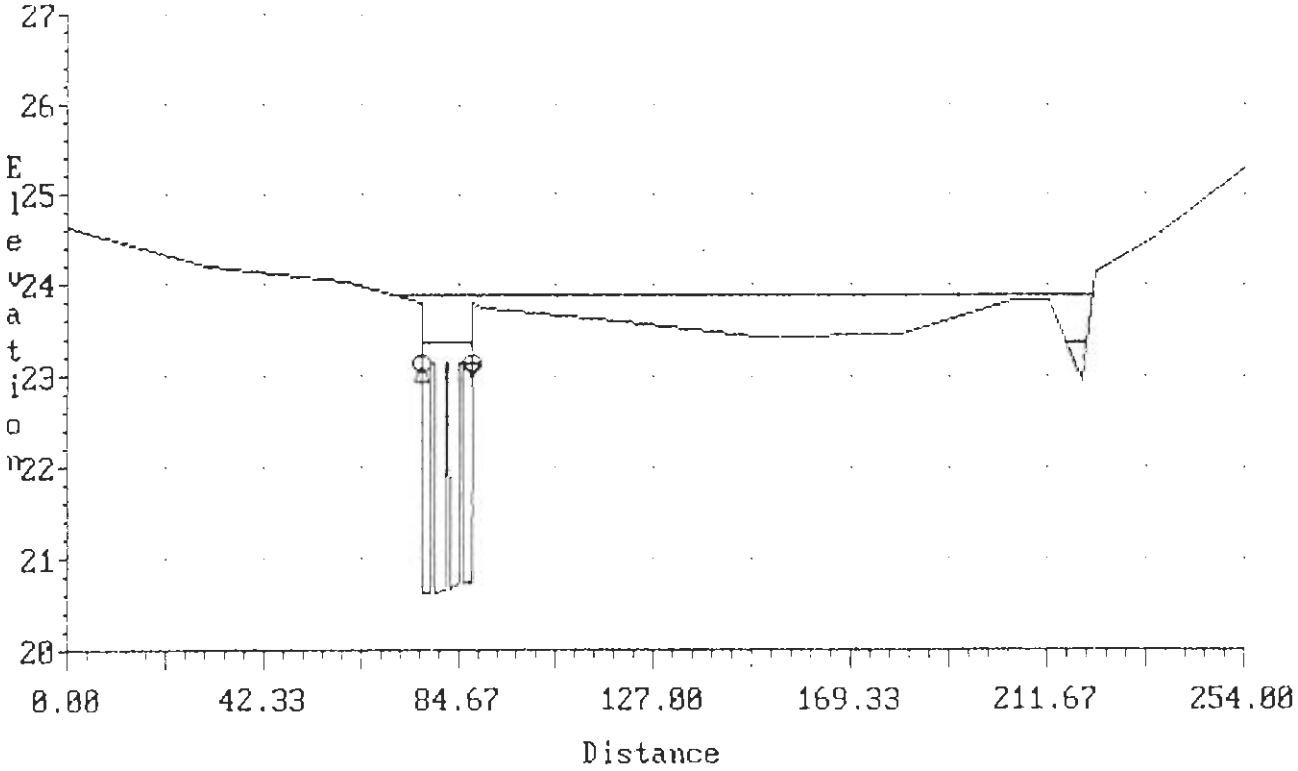
Cross-section 619.000




COLD BROOK,BLANCHE BROOK
Cross-section 620.000
Elevation
32
30
28
26
24
22
20
18
0.00
46.67
93.33
140.00
186.67
233.33
280.00
Distance

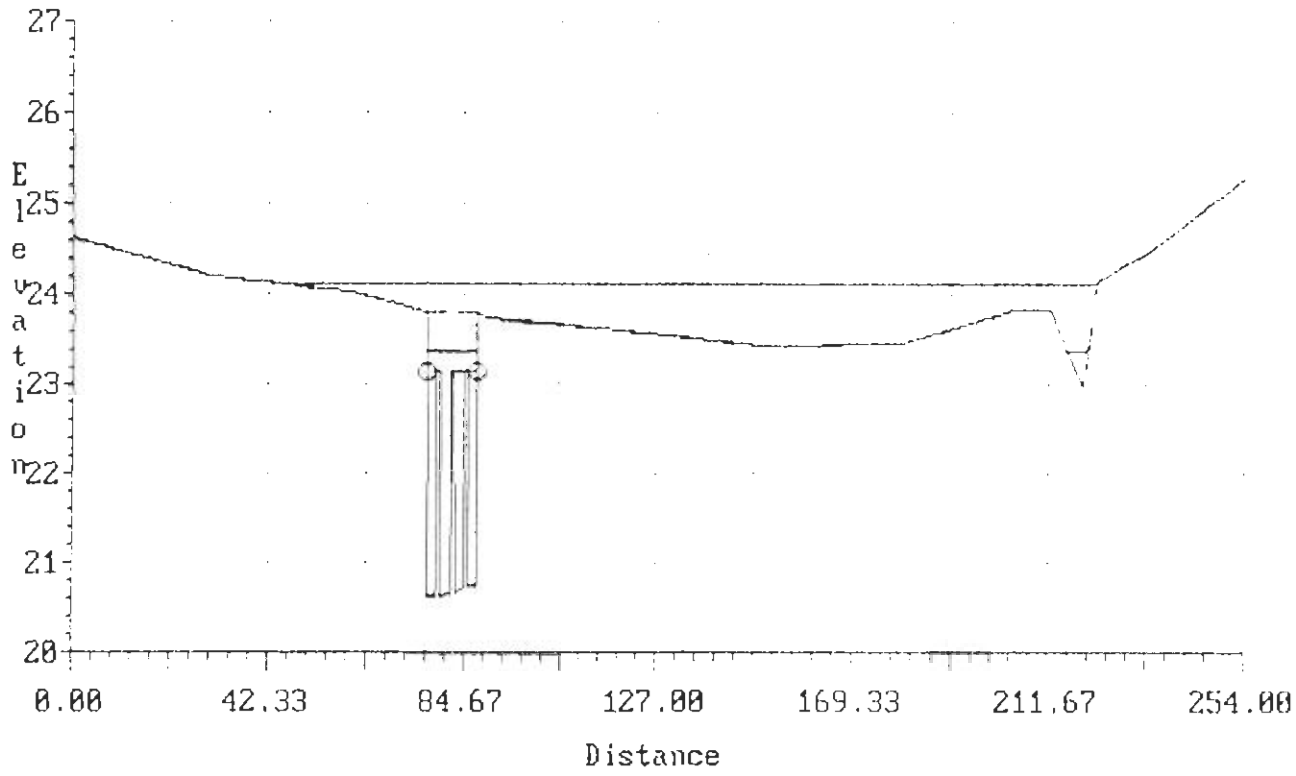

COLD BROOK,BLANCHE BROOK
Cross-section 621.000
Elevation
27
26
25
24
23
22
21
20
0.00
10.92
21.84
32.76
43.67
54.59
65.51
Distance

COLD BROOK,BLANCHE BROOK
Cross-section 622.100



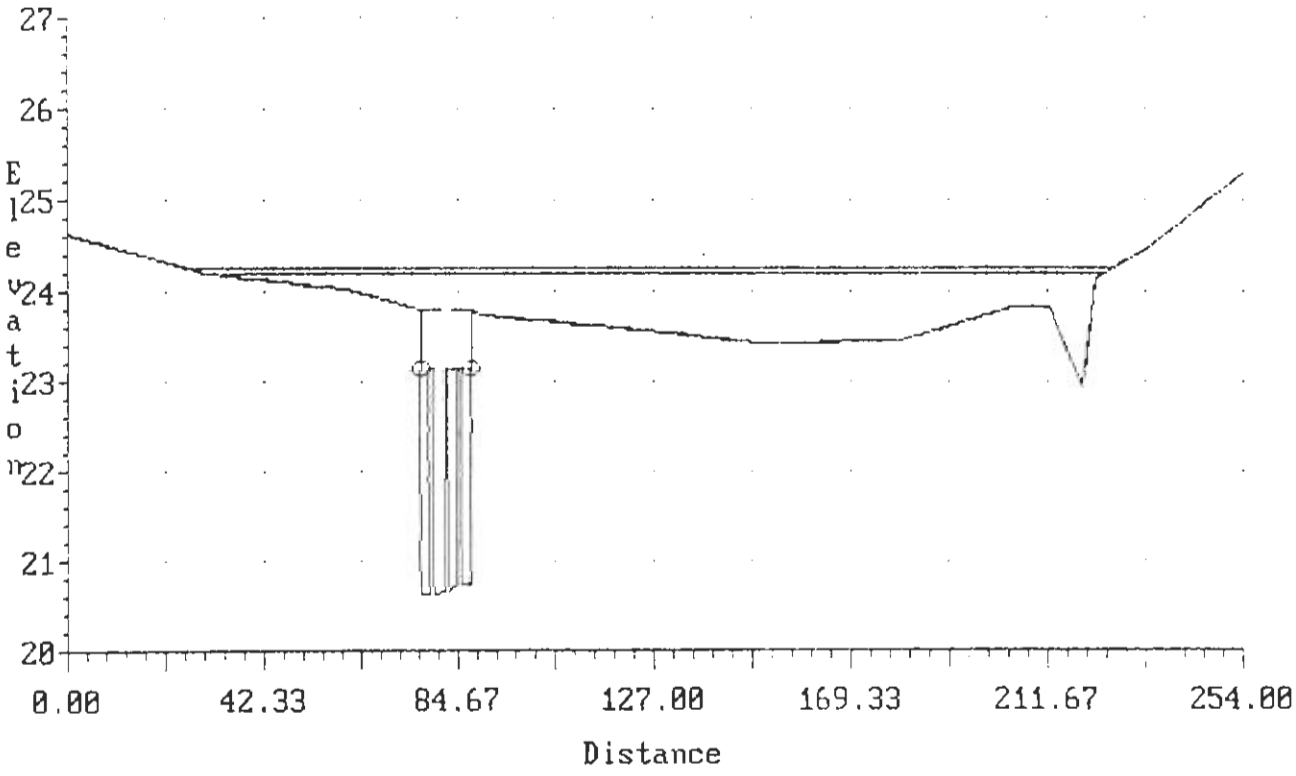
COLD BROOK,BLANCHE BROOK

Cross-section 622.000

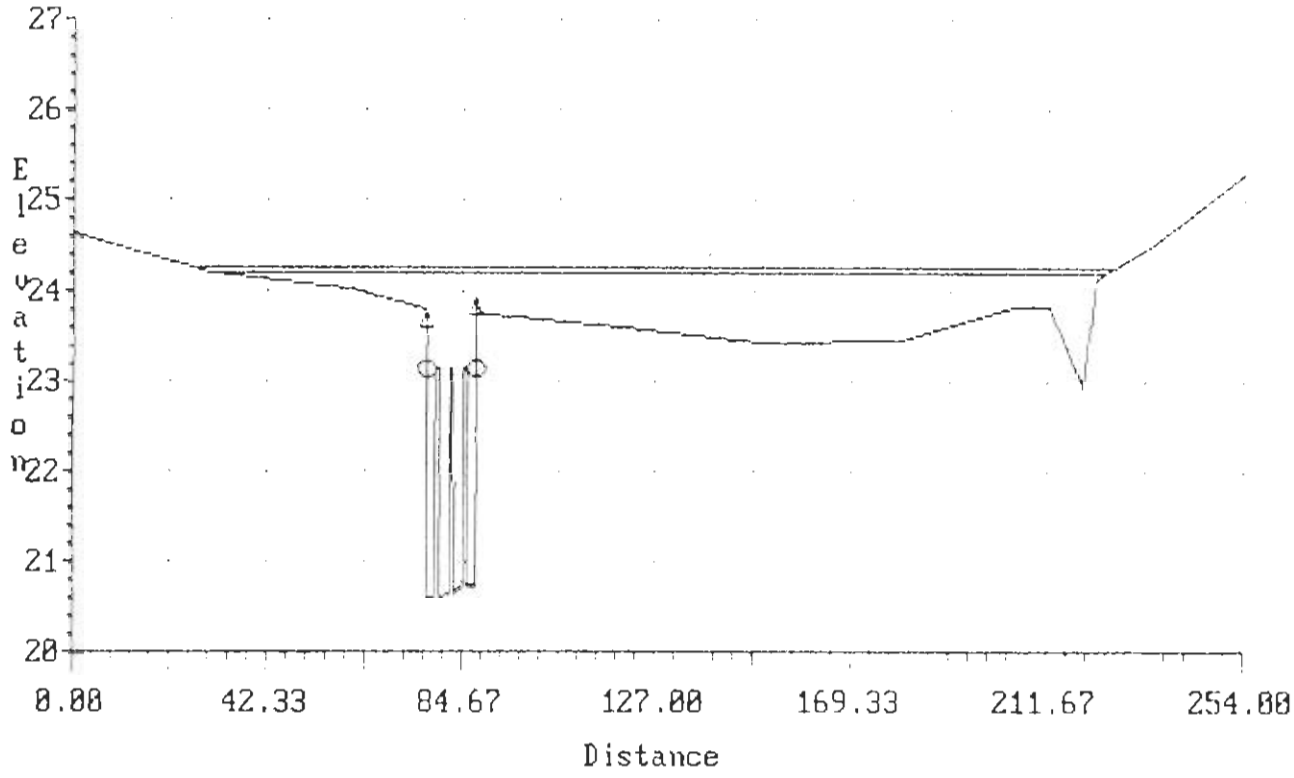


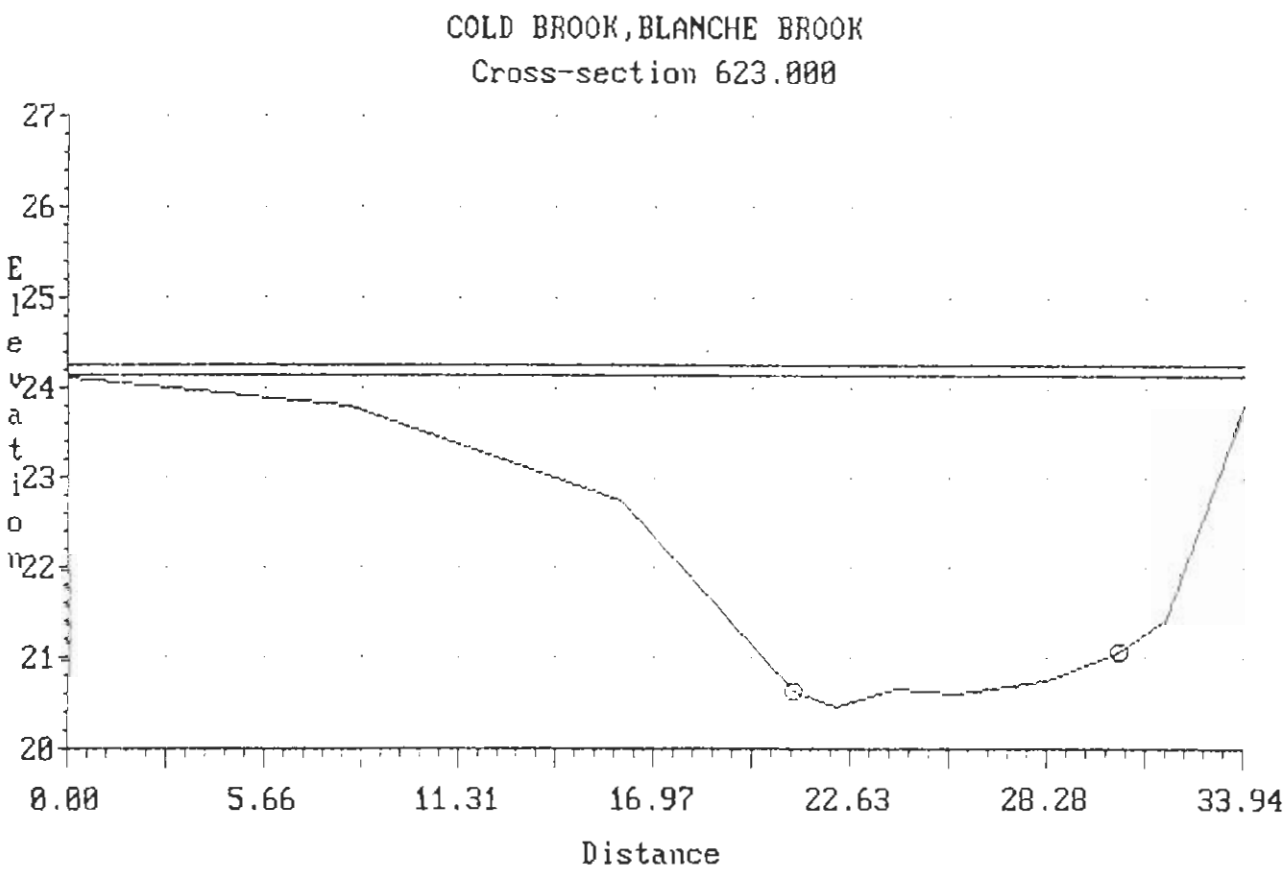
COLD BROOK,BLANCHE BROOK

Cross-section 622.200



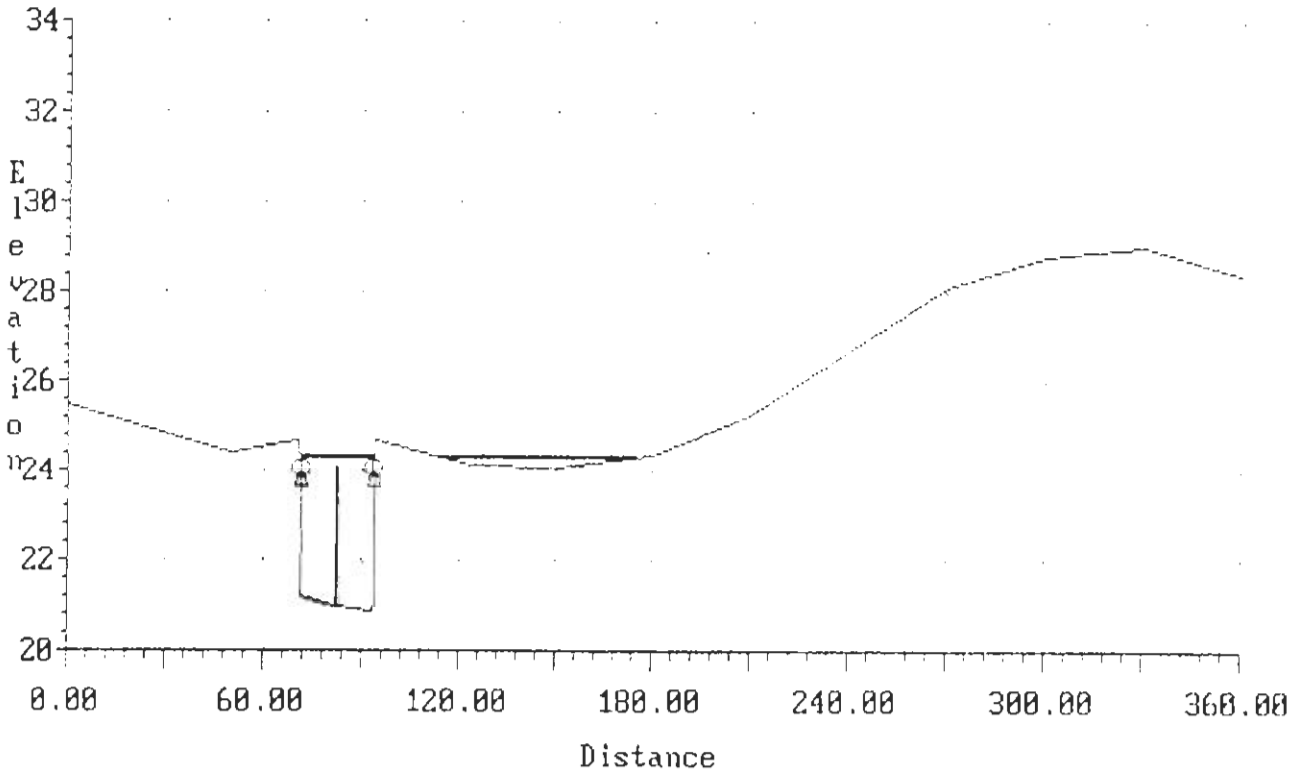
COLD BROOK,BLANCHE BROOK
Cross-section 622.300



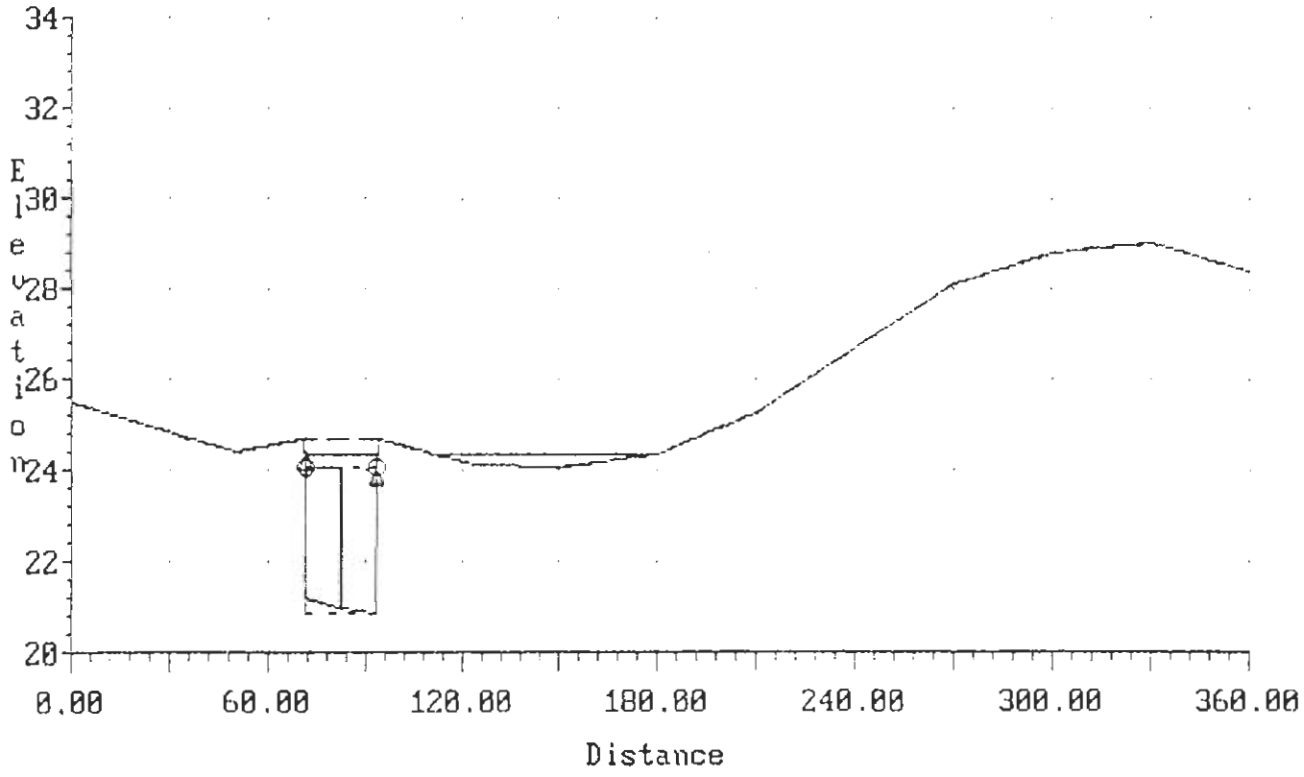

COLD BROOK,BLANCHE BROOK
Cross-section 623.000
Elevation
27
26
25
24
23
22
21
20
0.00
5.66
11.31
16.97
22.63
28.28
33.94
Distance

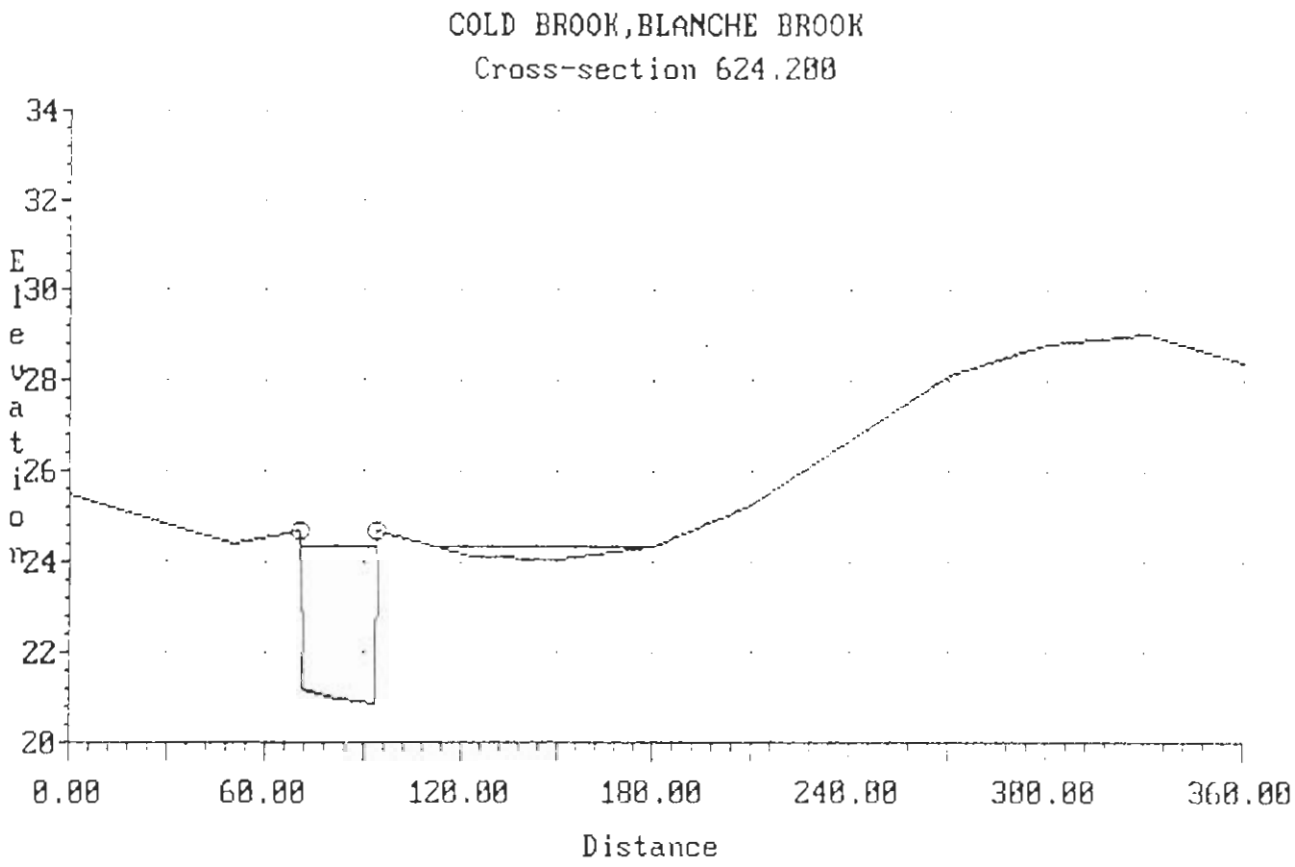
COLD BROOK,BLANCHE BROOK

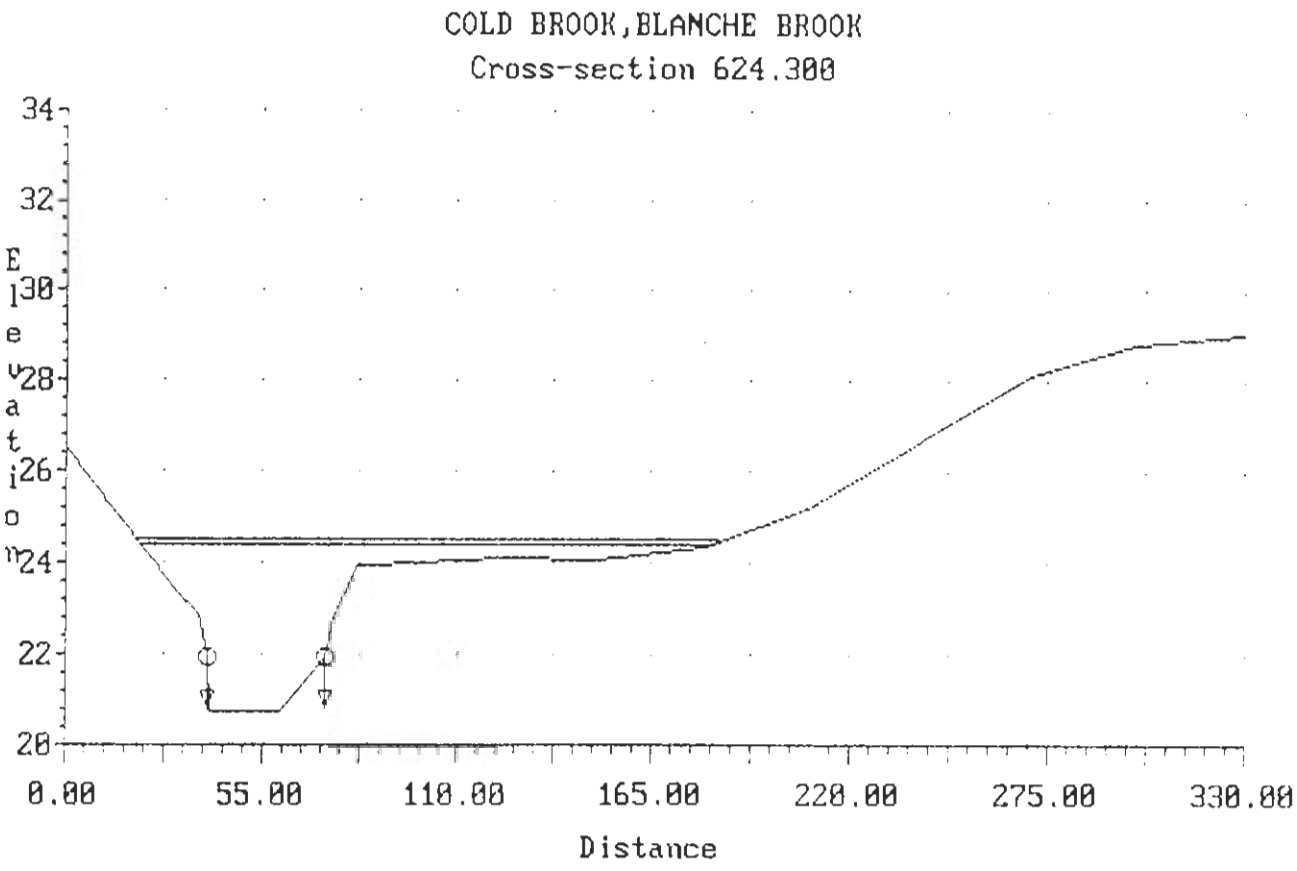
Cross-section 624.100



COLD BROOK,BLANCHE BROOK
Cross-section 624.000

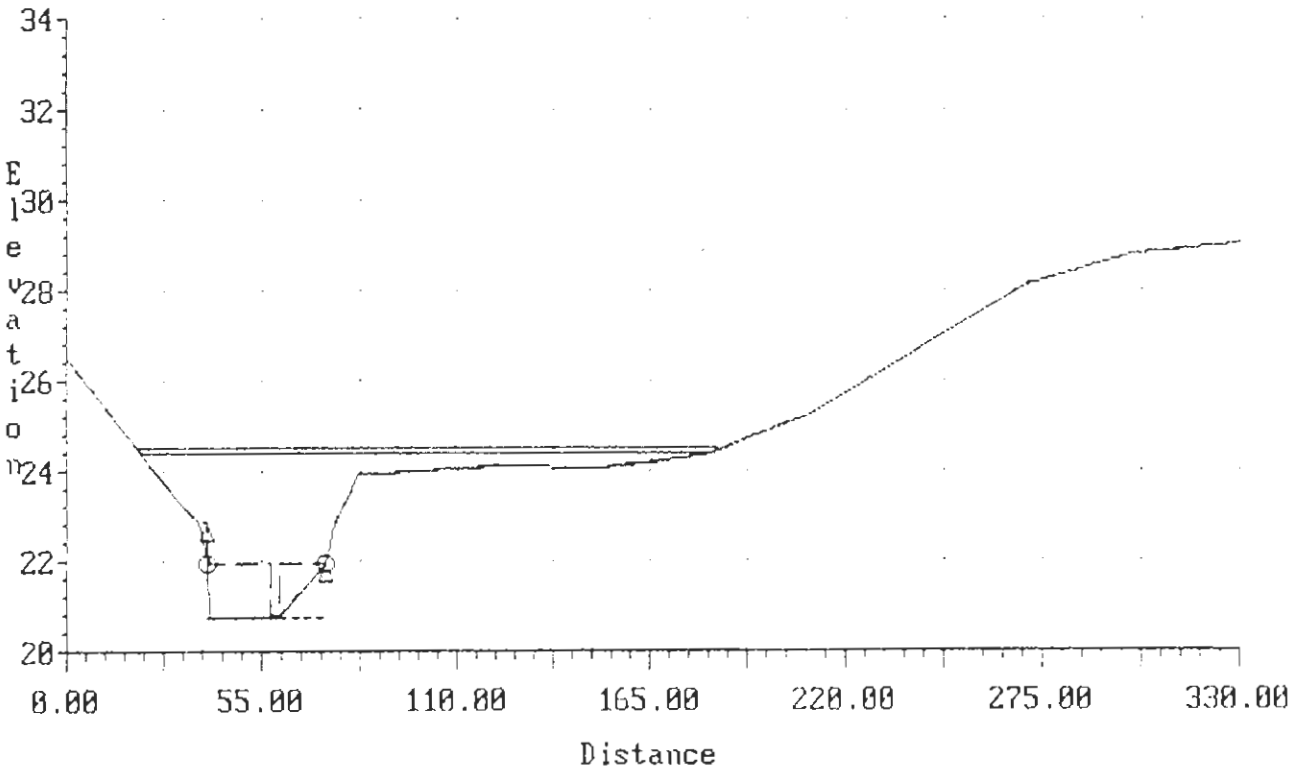



COLD BROOK,BLANCHE BROOK
Cross-section 624.200
Elevation
34
32
30
28
26
24
22
20
0.00
60.00
120.00
180.00
240.00
300.00
360.00
Distance

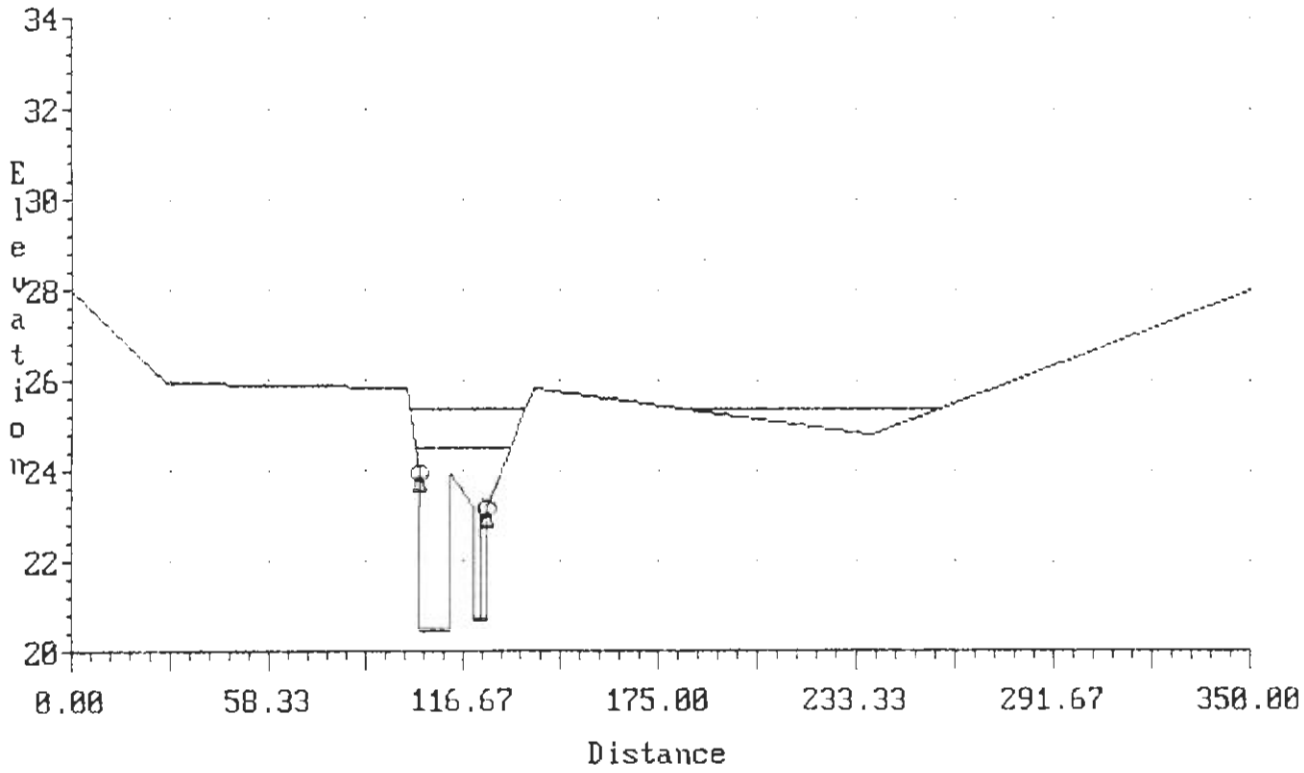

COLD BROOK,BLANCHE BROOK
Cross-section 624.300
Elevation
34
32
30
28
26
24
22
20
0.00
55.00
110.00
165.00
220.00
275.00
330.00
Distance

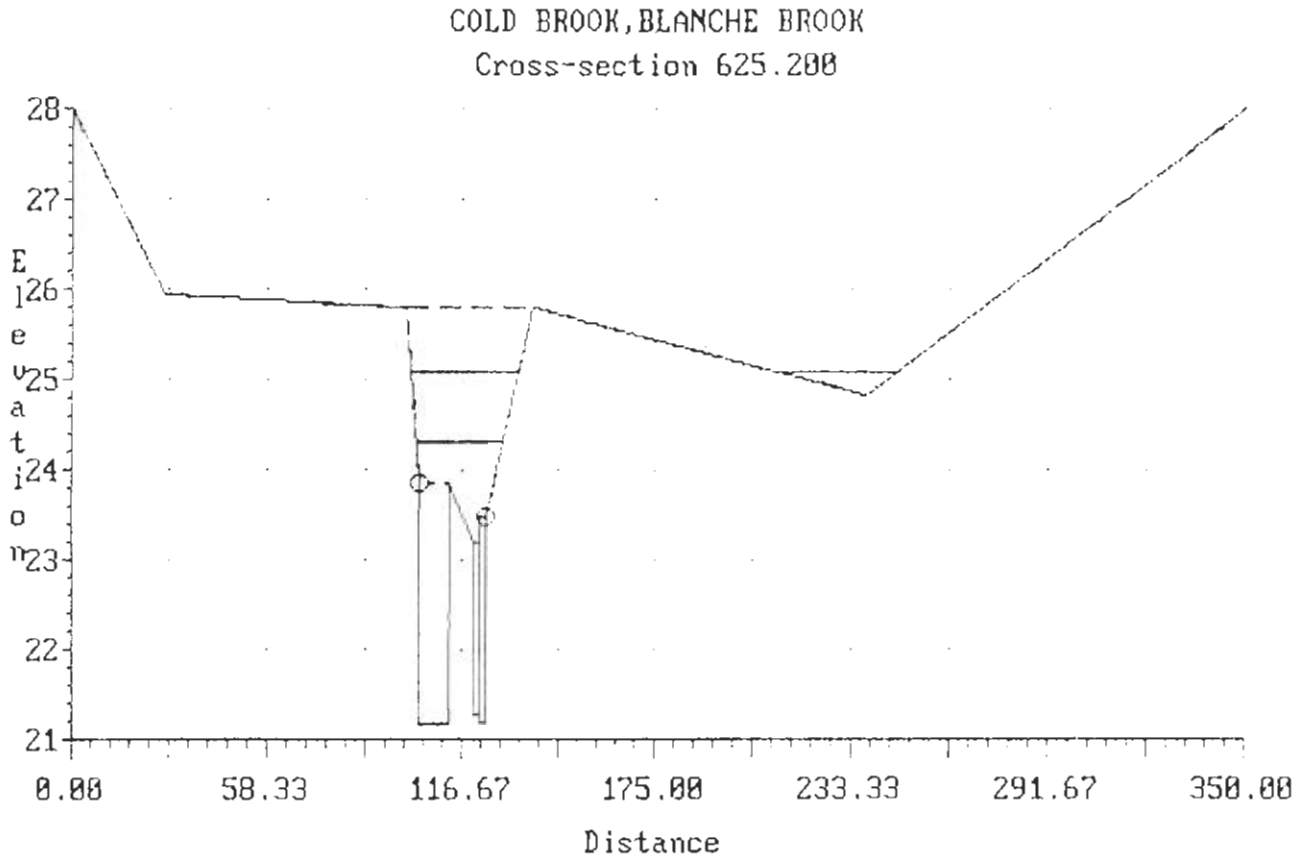
COLD BROOK,BLANCHE BROOK

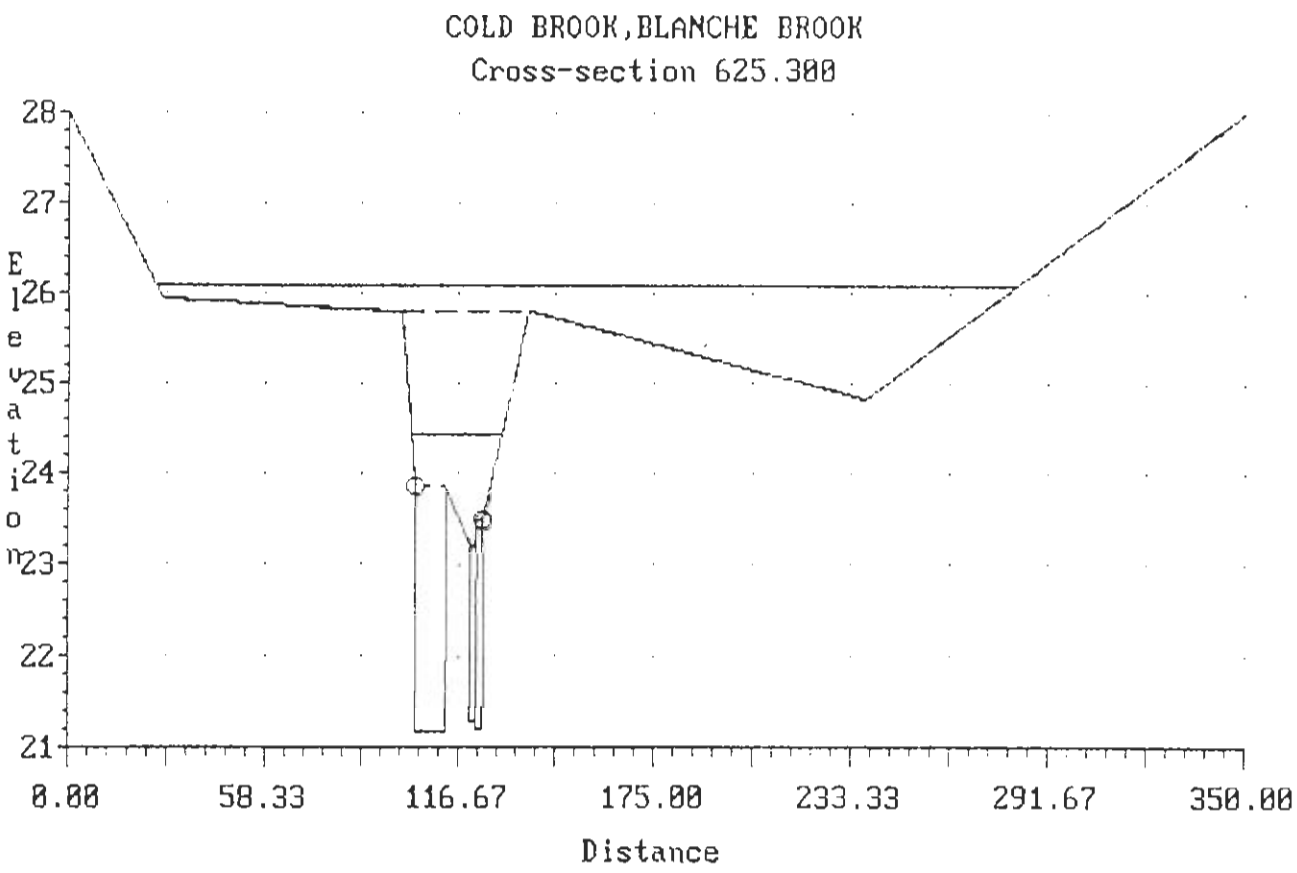
Cross-section 624.400

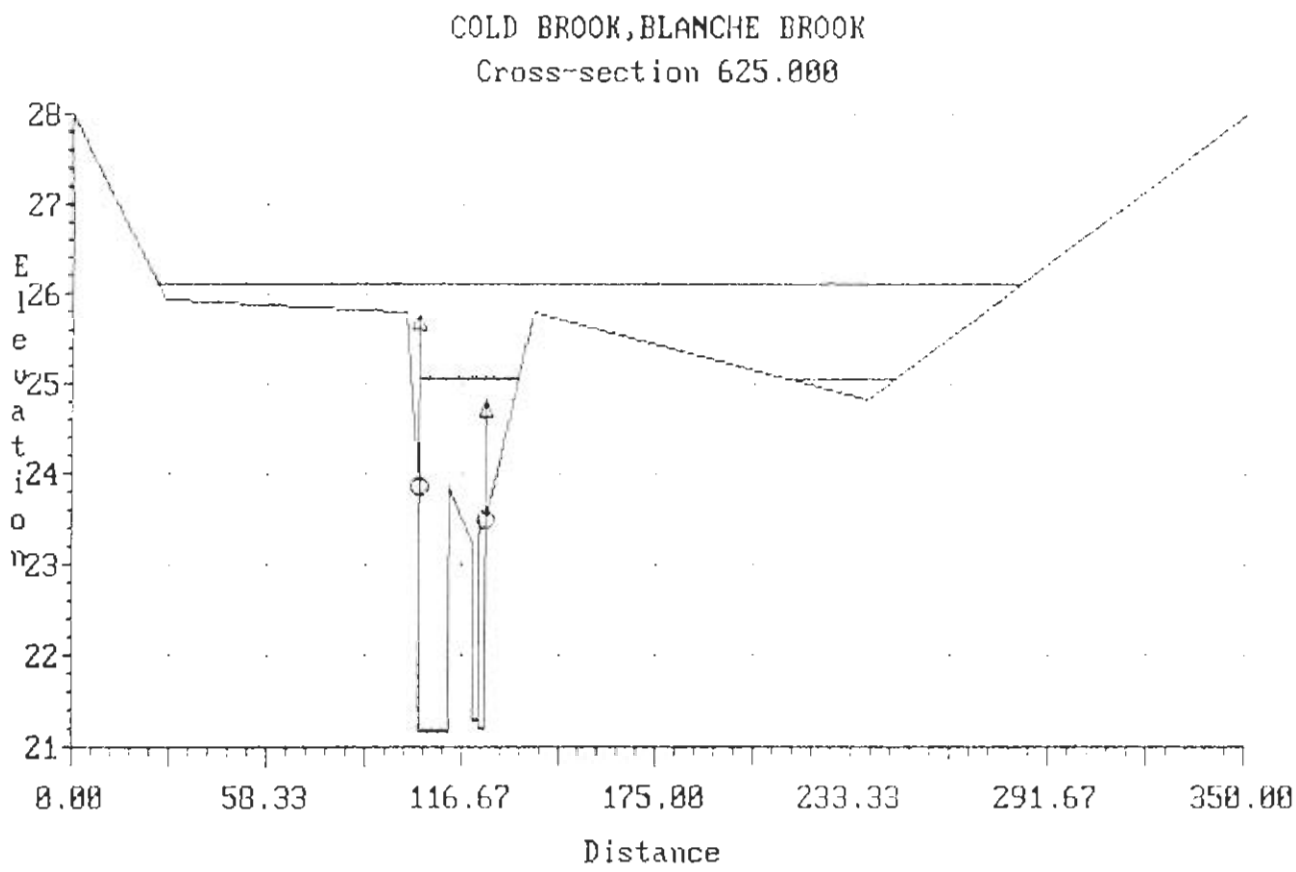


COLD BROOK,BLANCHE BROOK
Cross-section 625.100

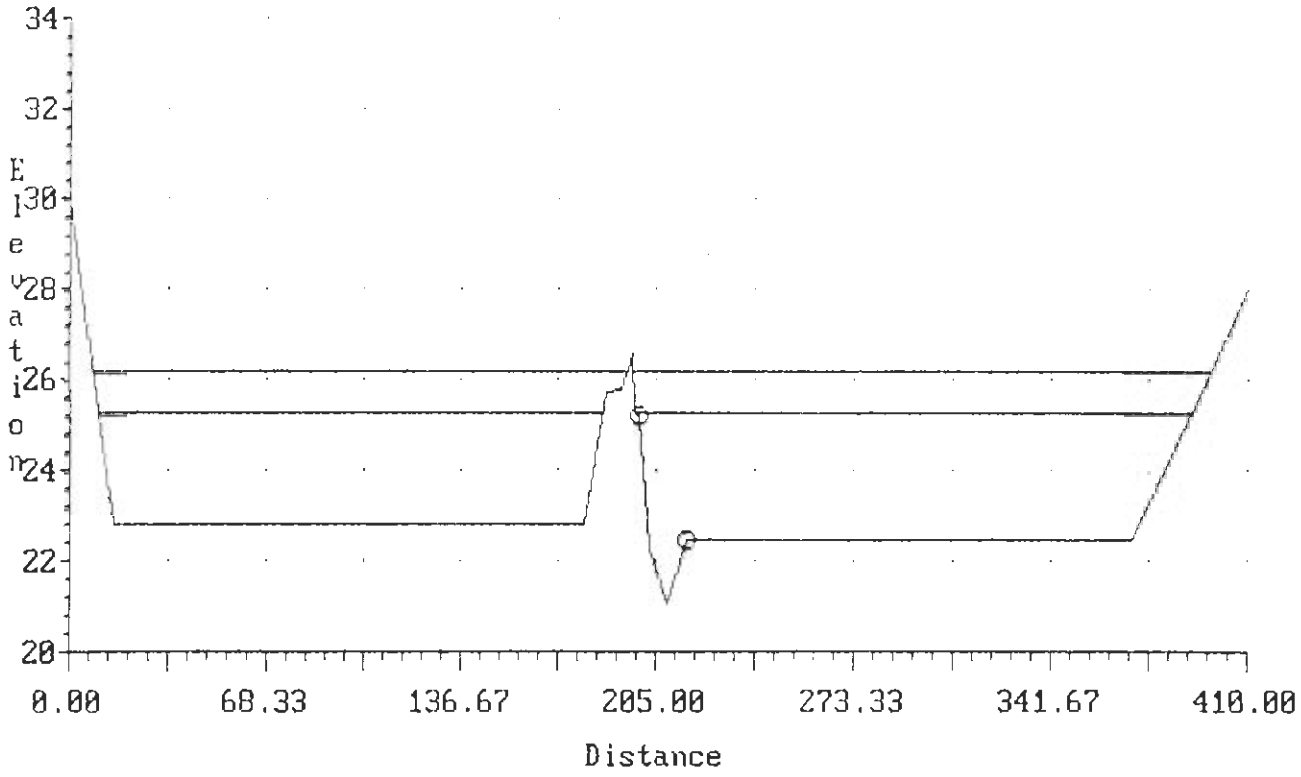


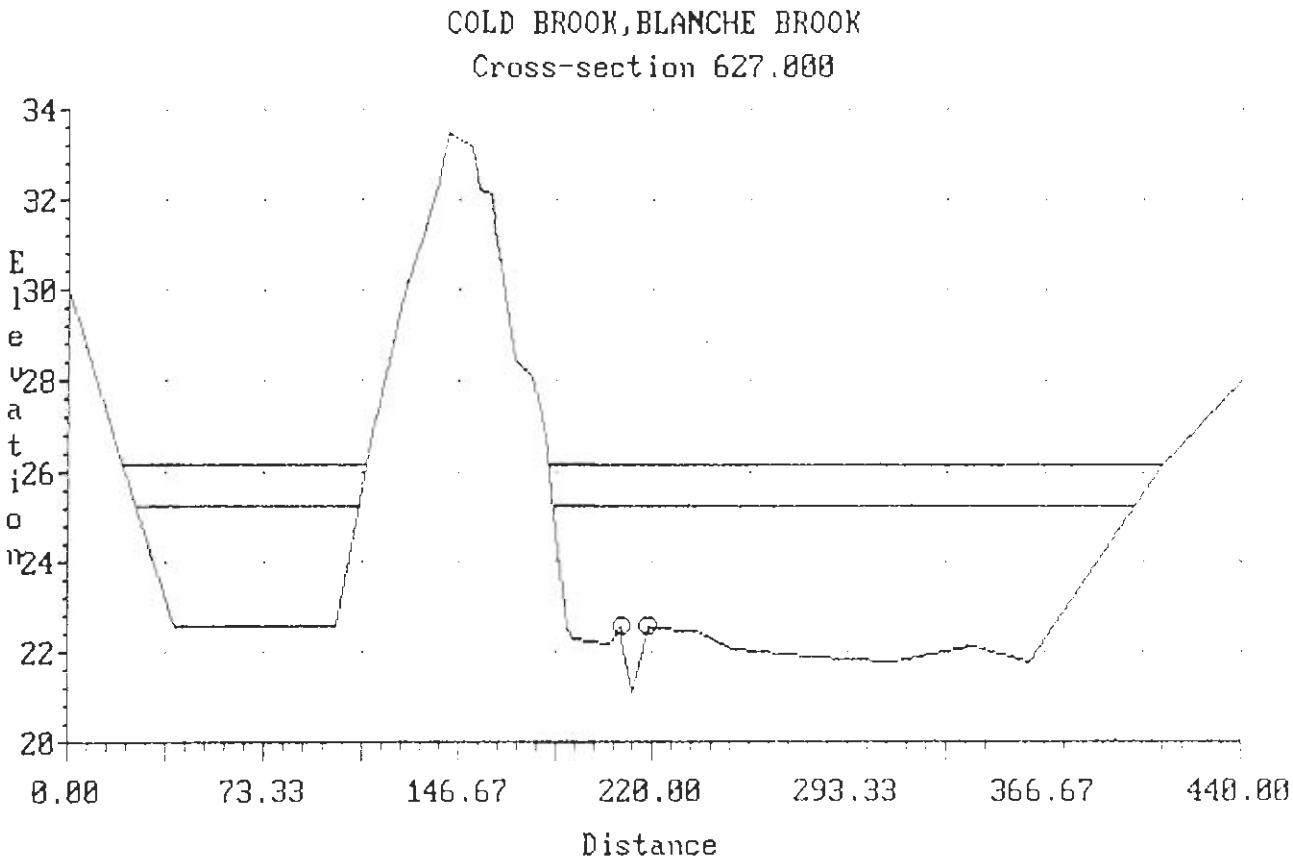

COLD BROOK,BLANCHE BROOK
Cross-section 625.200
Elevation
28
27
26
25
24
23
22
21
0.00
58.33
116.67
175.00
233.33
291.67
350.00
Distance

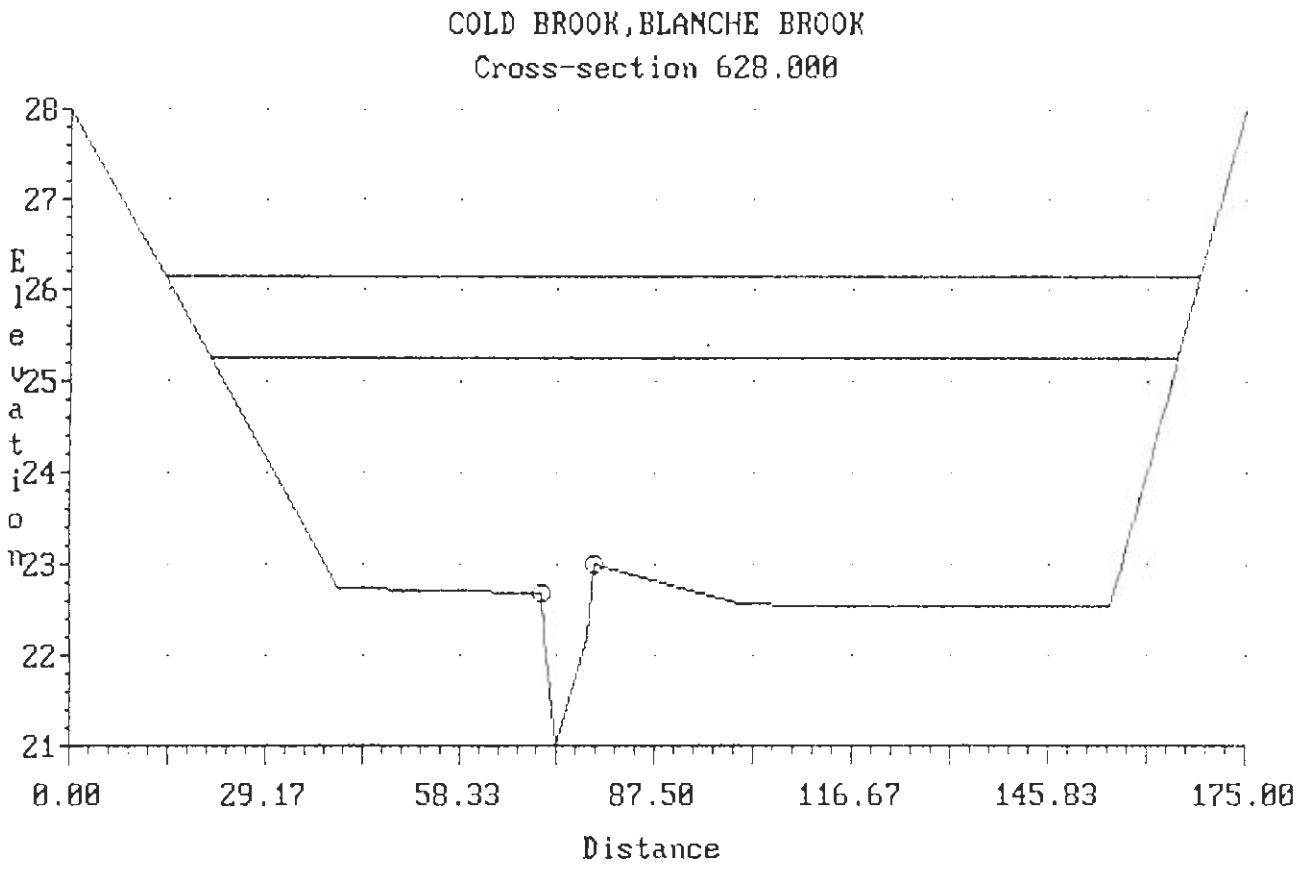

COLD BROOK,BLANCHE BROOK
Cross-section 625.300
Elevation
28
27
26
25
24
23
22
21
0.00
58.33
116.67
175.00
233.33
291.67
350.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 625.000
Elevation
28
27
26
25
24
23
22
21
0.00
58.33
116.67
175.00
233.33
291.67
350.00
Distance

COLD BROOK,BLANCHE BROOK
Cross-section 626.000

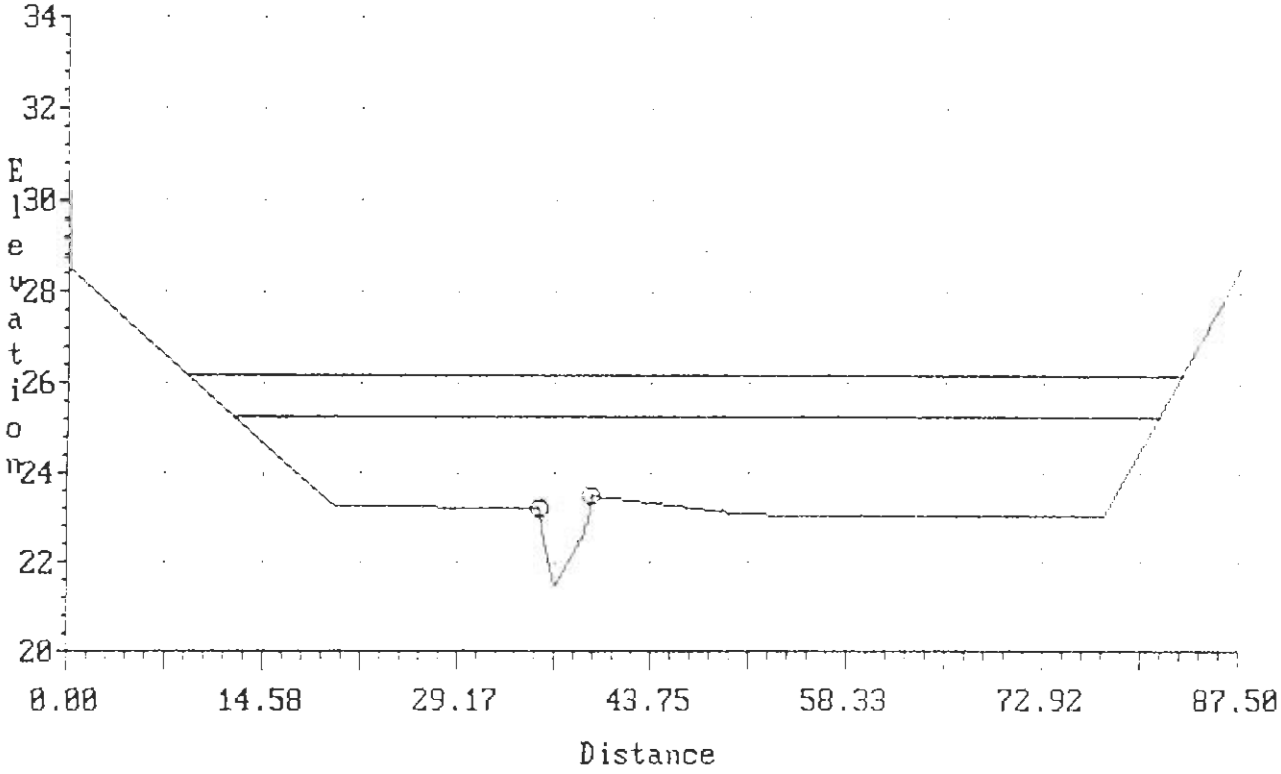


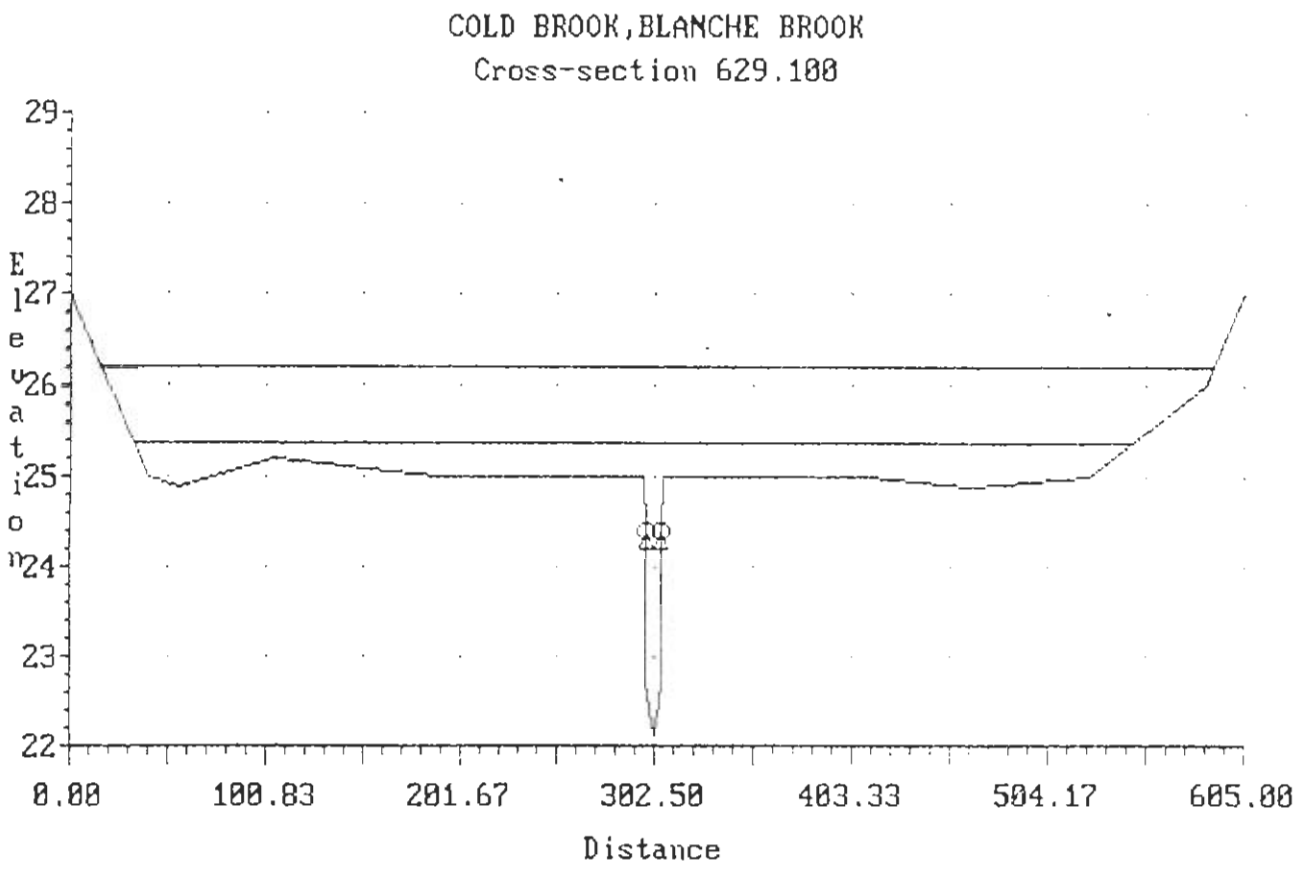

COLD BROOK,BLANCHE BROOK
Cross-section 627.000
34
32
30
28
26
24
22
20
Elevation
0.00
73.33
146.67
220.00
293.33
366.67
440.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 628.000
Elevation
28
27
26
25
24
23
22
21
0.00
29.17
58.33
87.50
116.67
145.83
175.00
Distance

COLD BROOK,BLANCHE BROOK

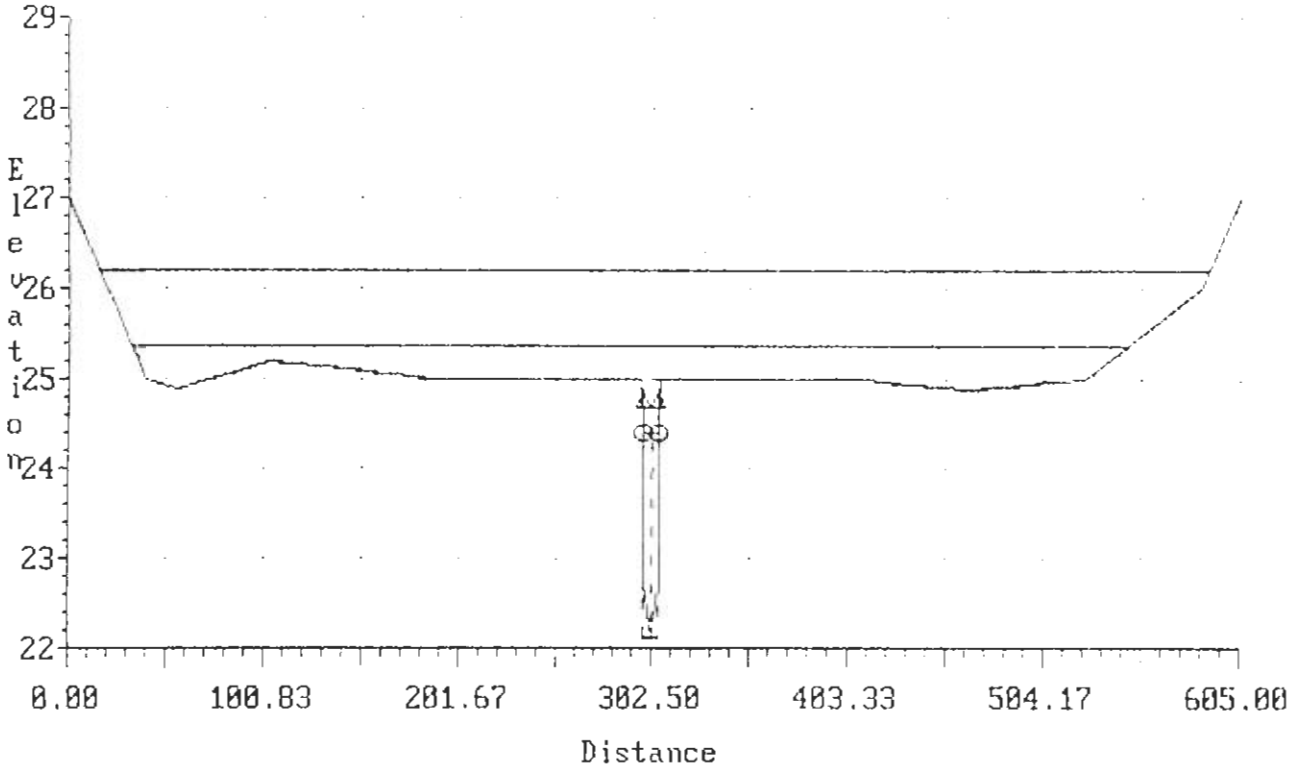
Cross-section 628.100

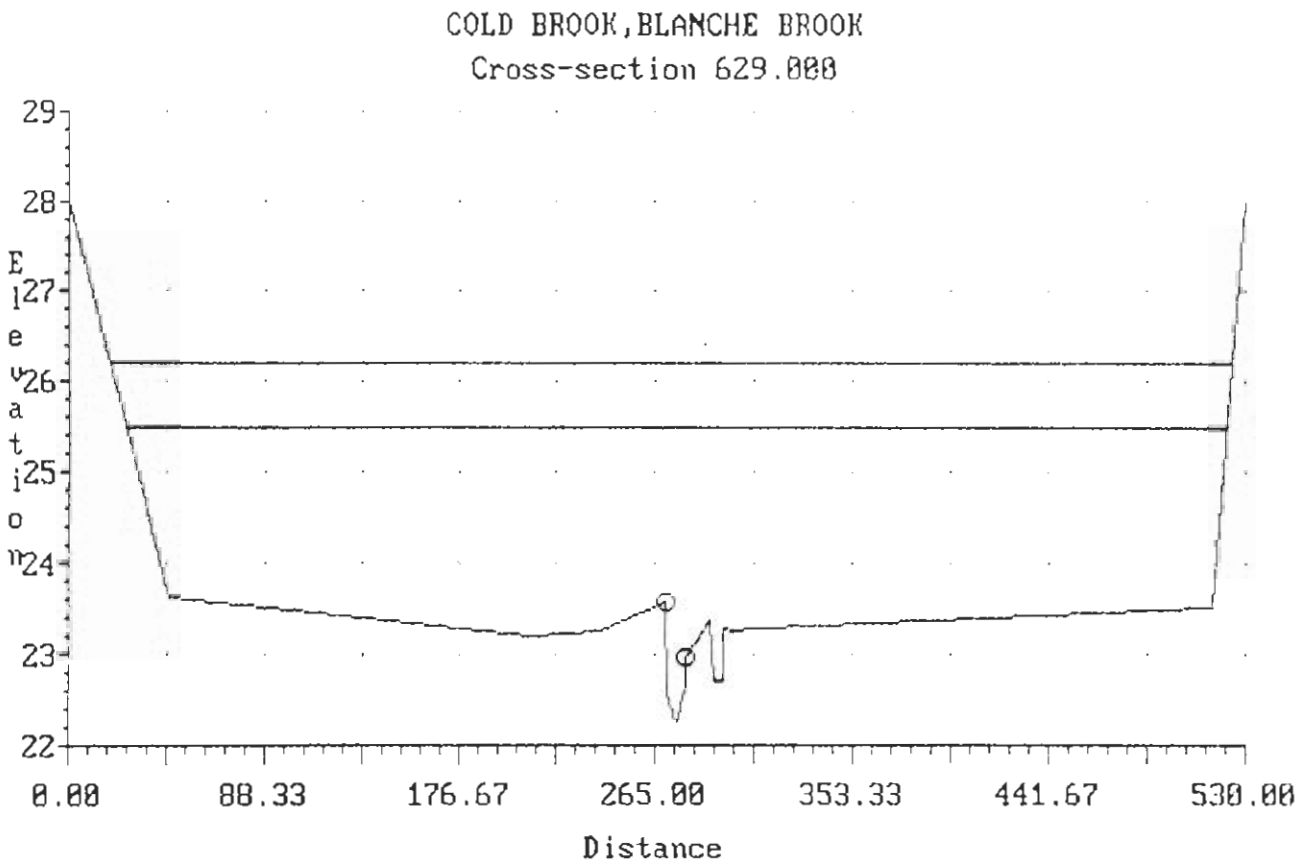


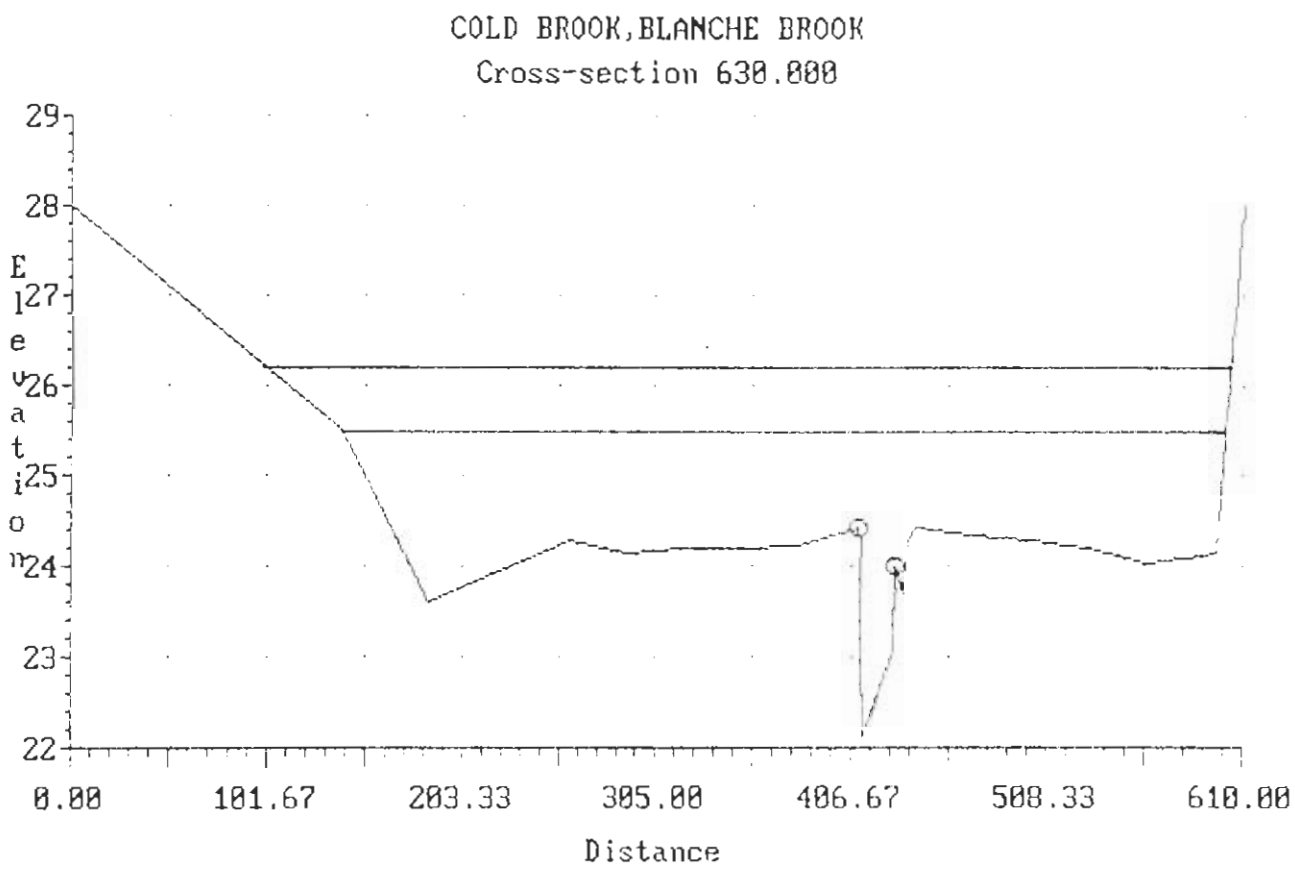

COLD BROOK,BLANCHE BROOK
Cross-section 629.100
Elevation
29
28
27
26
25
24
23
22
0.00
100.83
201.67
302.50
403.33
504.17
605.00
Distance

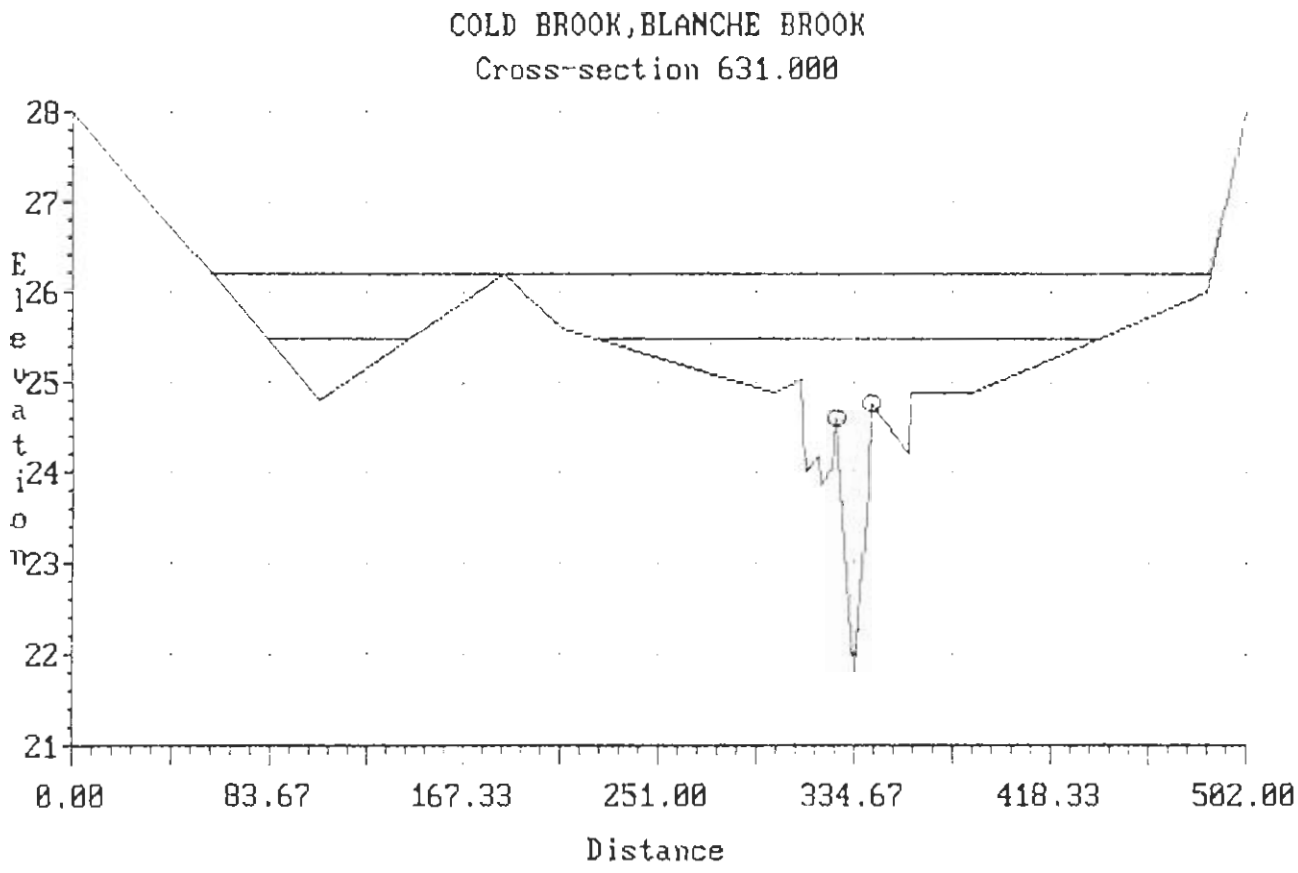
COLD BROOK,BLANCHE BROOK

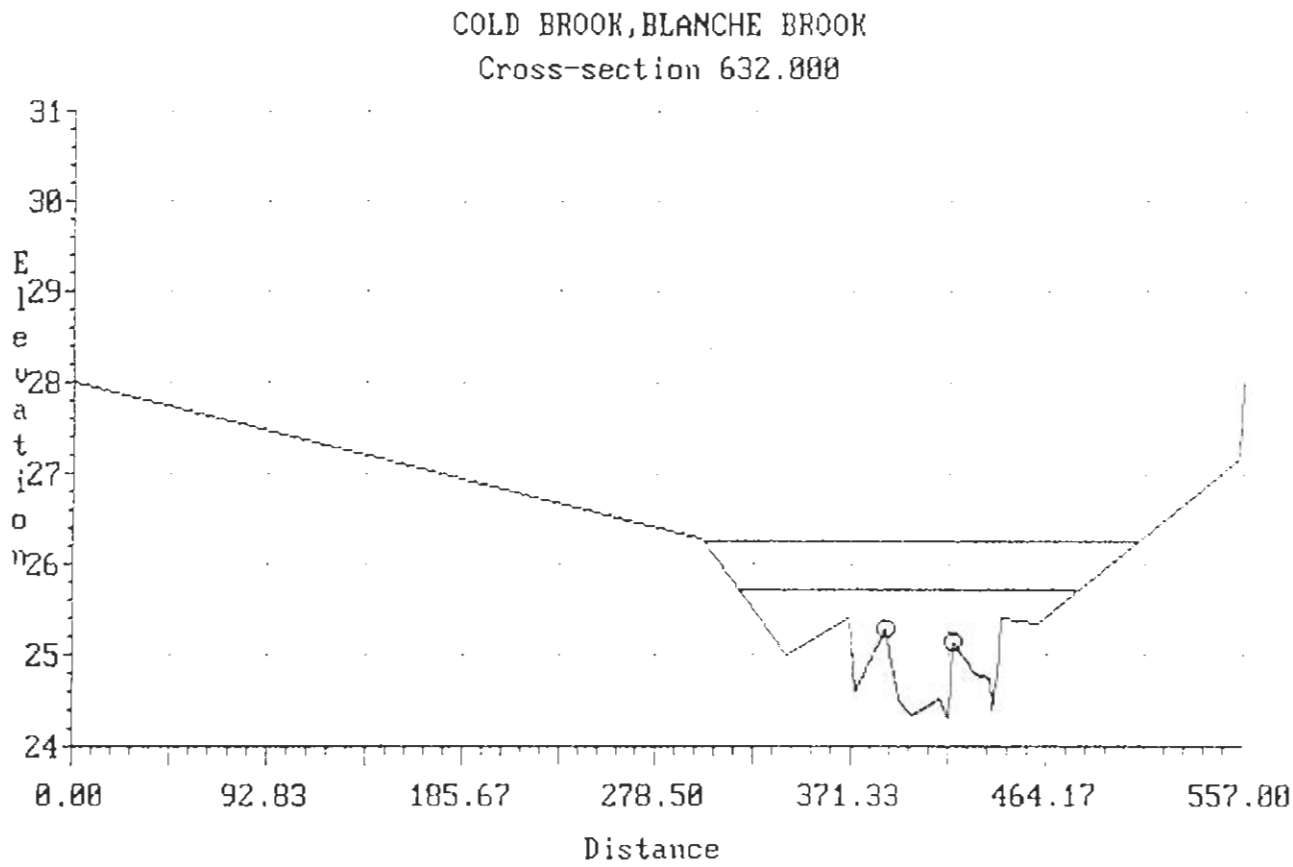
Cross-section 629.200

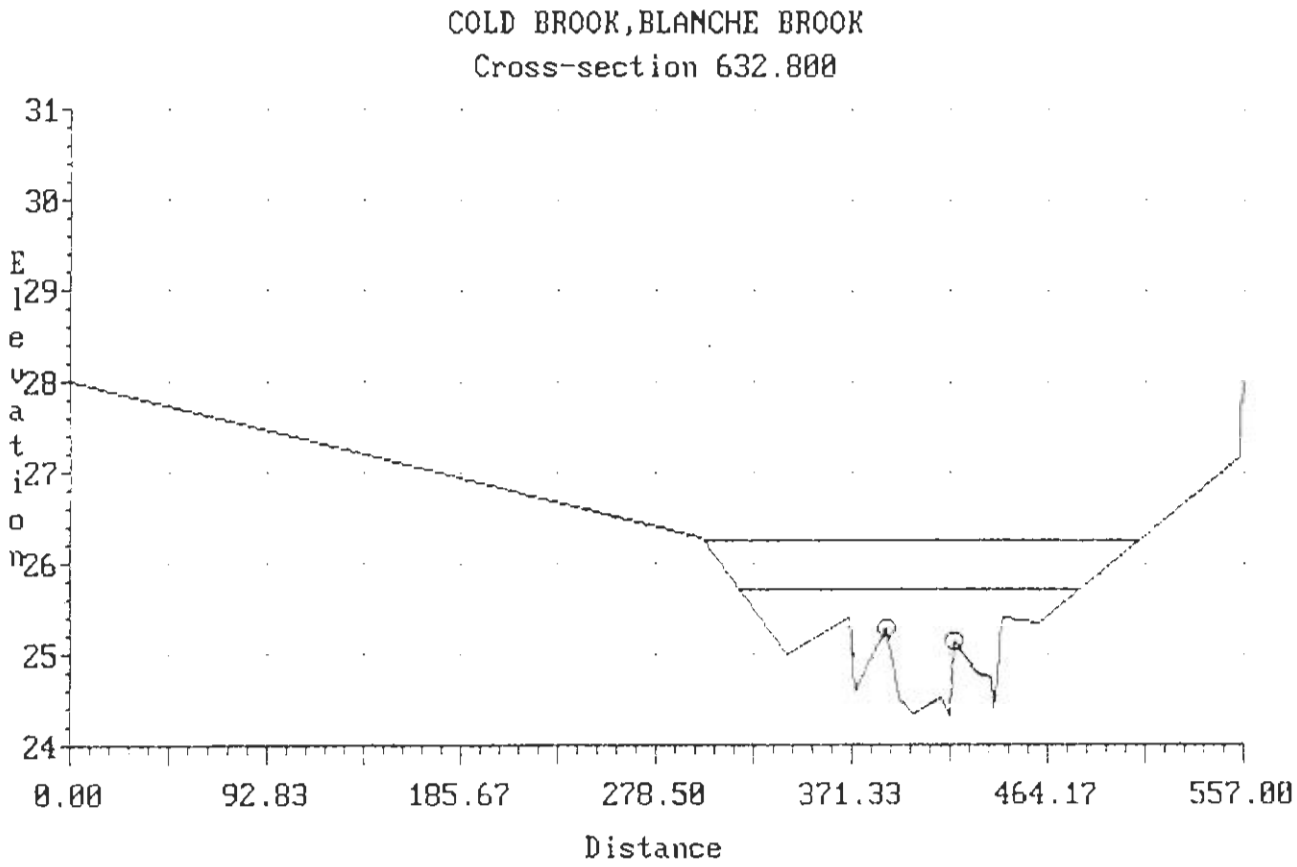



COLD BROOK,BLANCHE BROOK
Cross-section 629.000
Elevation
29
28
27
26
25
24
23
22
0.00
88.33
176.67
265.00
353.33
441.67
530.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 630.000
Elevation
29
28
27
26
25
24
23
22
0.00
101.67
203.33
305.00
406.67
508.33
610.00
Distance

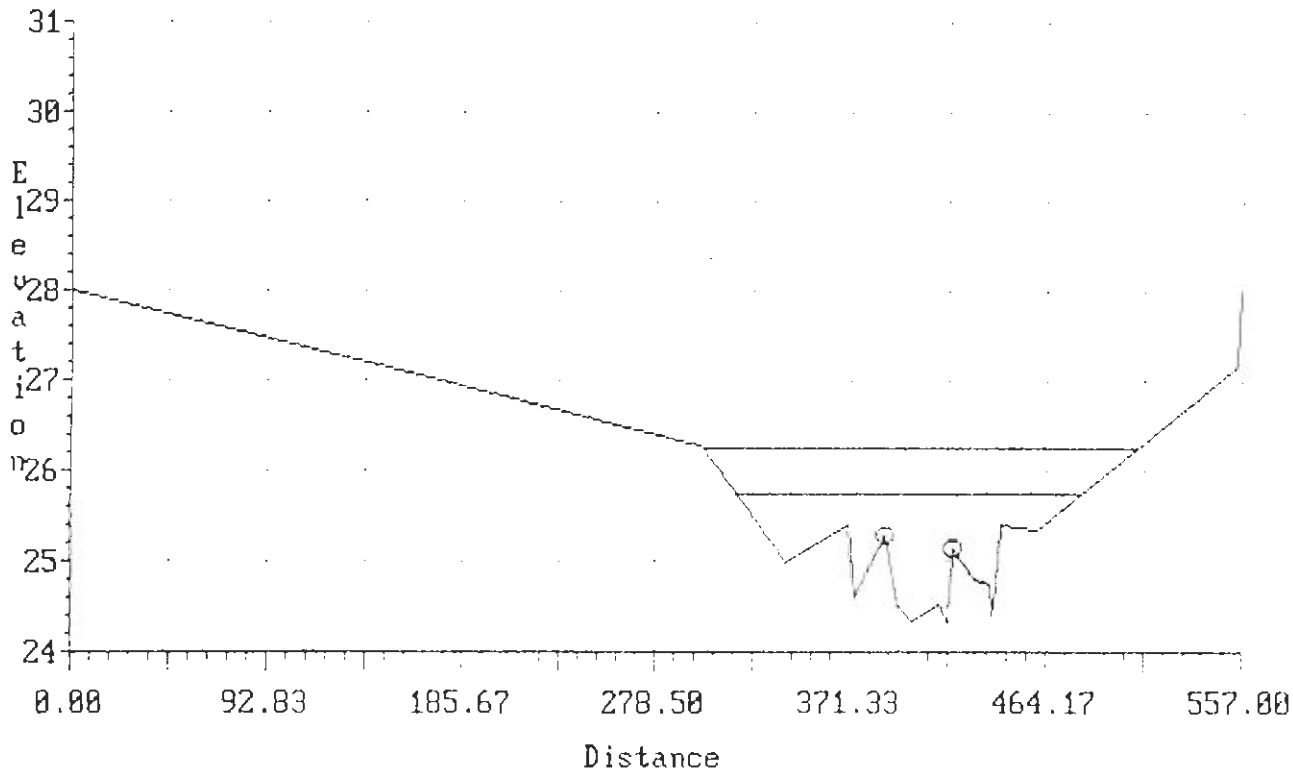

COLD BROOK,BLANCHE BROOK
Cross-section 631.000
Elevation
28
27
26
25
24
23
22
21
0.00
83.67
167.33
251.00
334.67
418.33
502.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 632.000
Elevation
31
30
29
28
27
26
25
24
0.00
92.83
185.67
278.50
371.33
464.17
557.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 632.800
Elevation
31
30
29
28
27
26
25
24
0.00
92.83
185.67
278.50
371.33
464.17
557.00
Distance

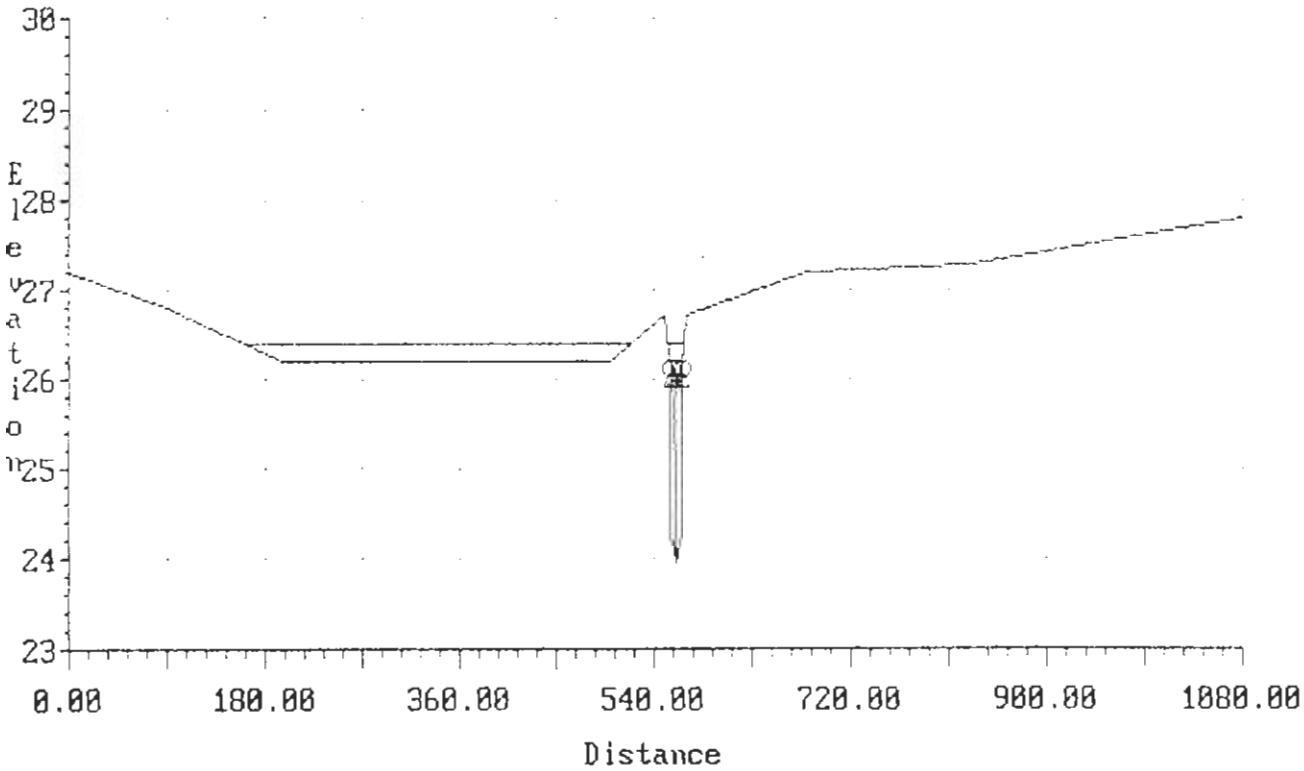
COLD BROOK,BLANCHE BROOK

Cross-section 632.900



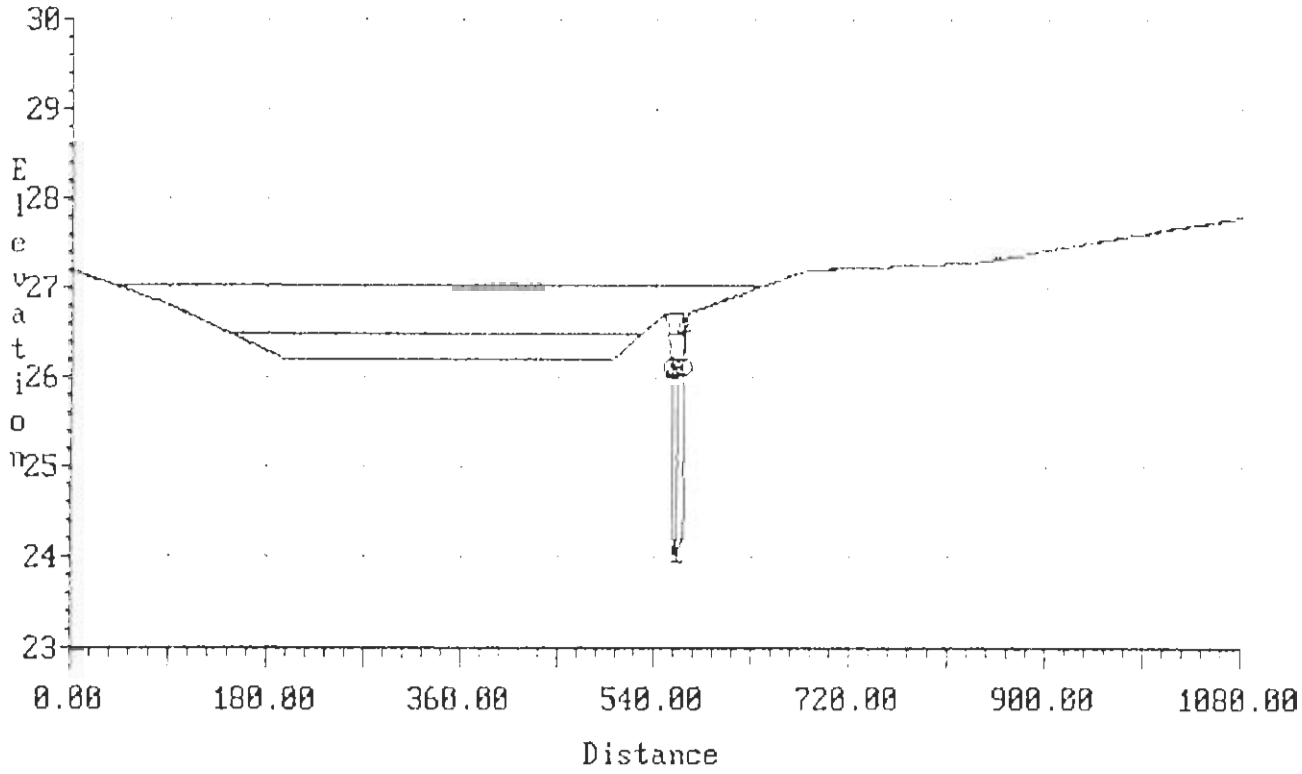
COLD BROOK,BLANCHE BROOK

Cross-section 632.100



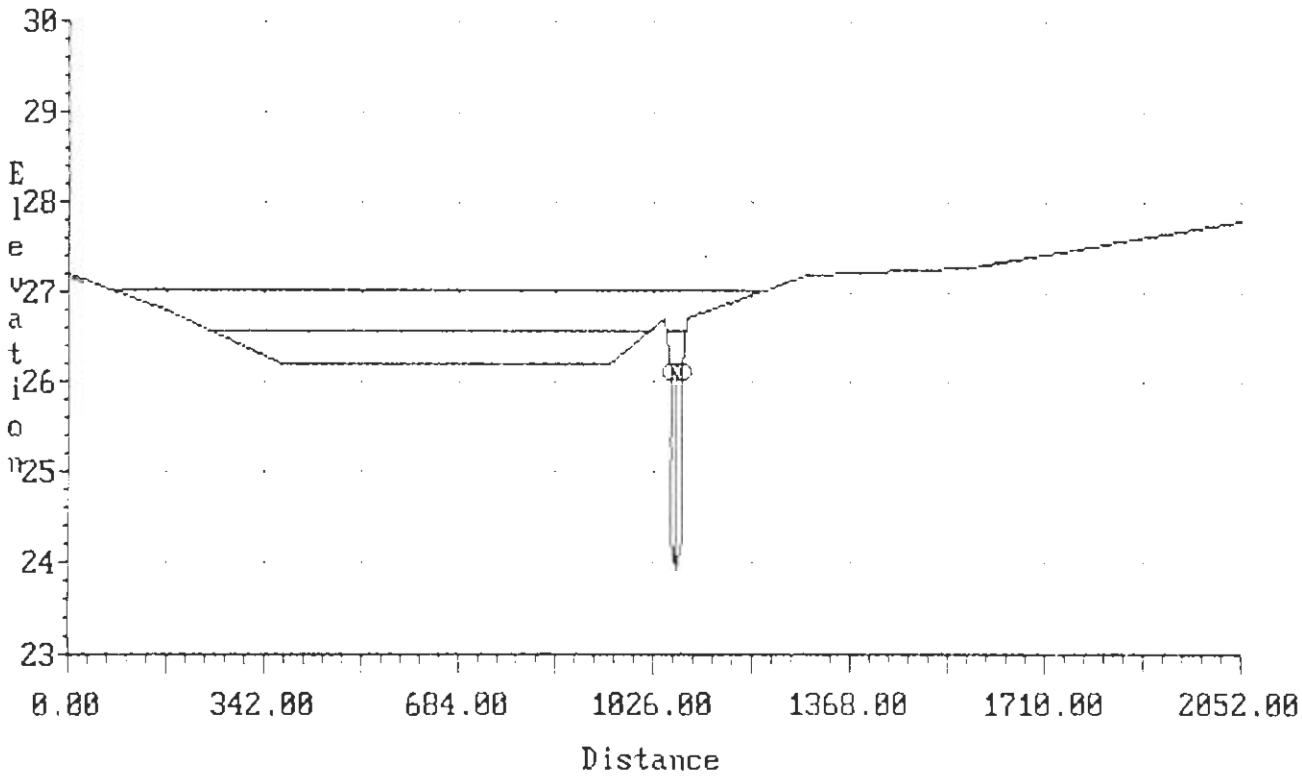
COLD BROOK,BLANCHE BROOK

Cross-section 632.200



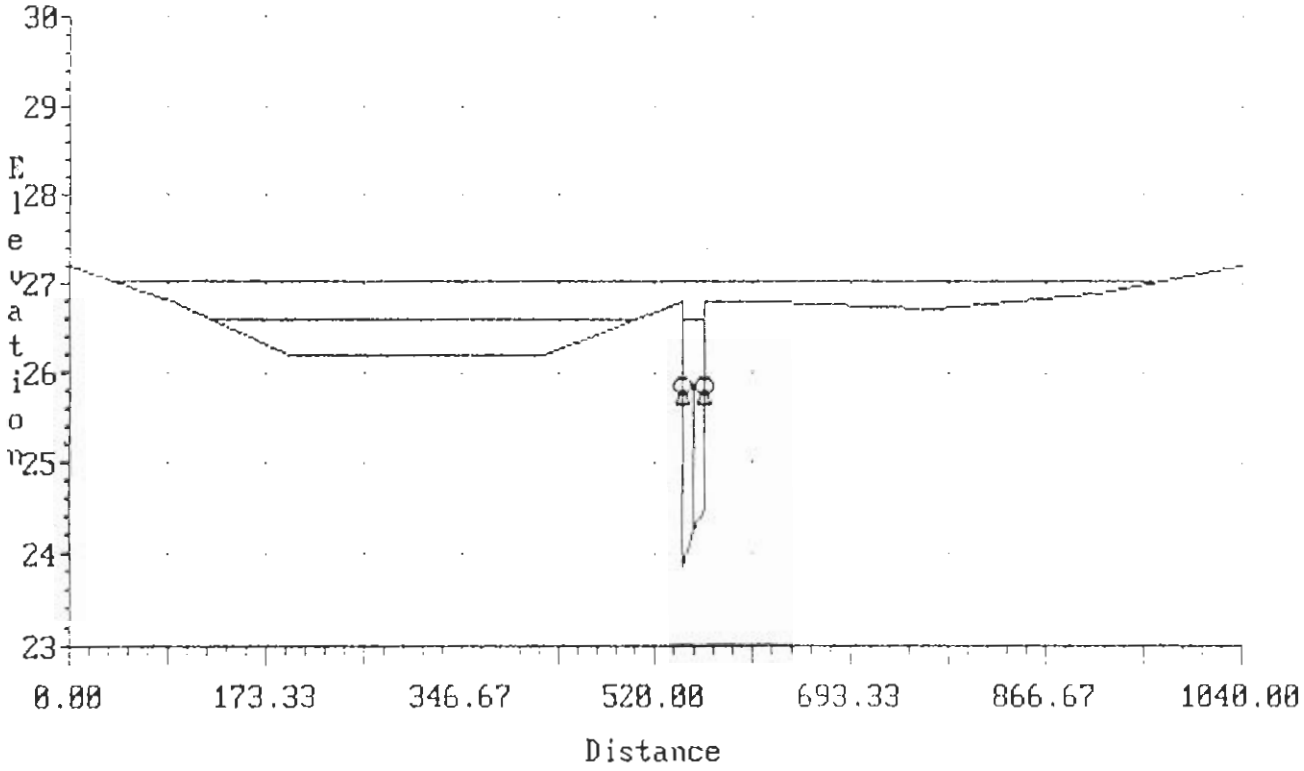
COLD BROOK,BLANCHE BROOK

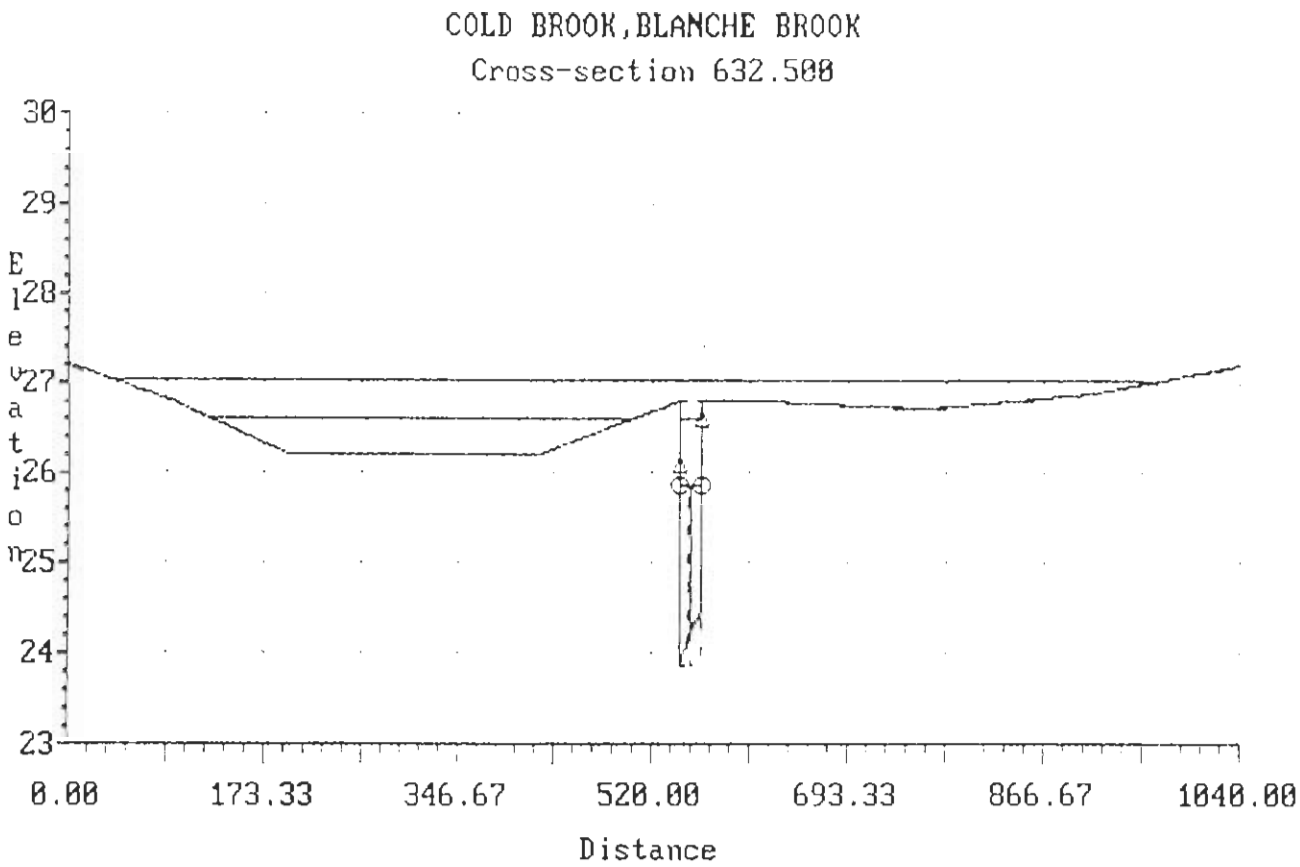
Cross-section 632.300

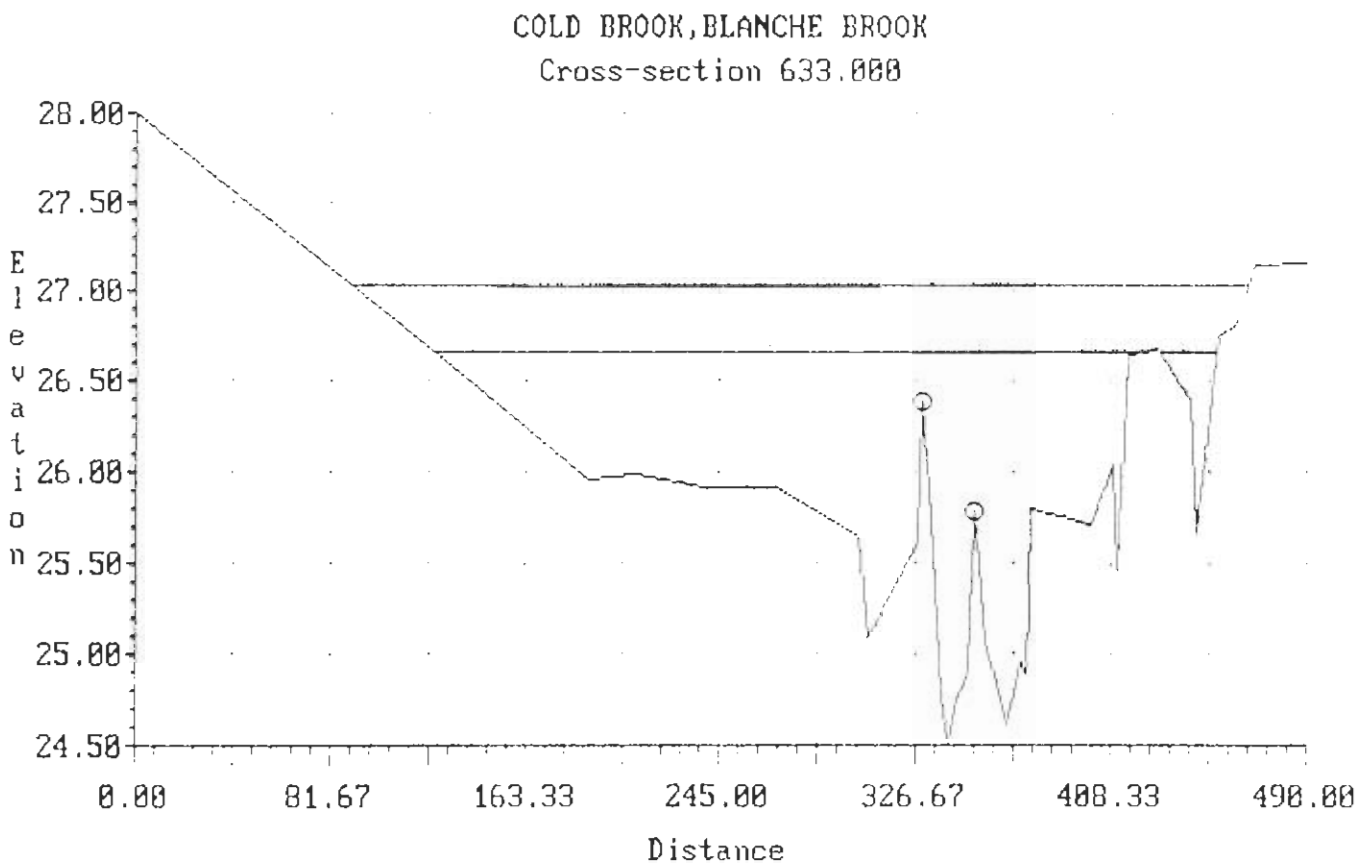


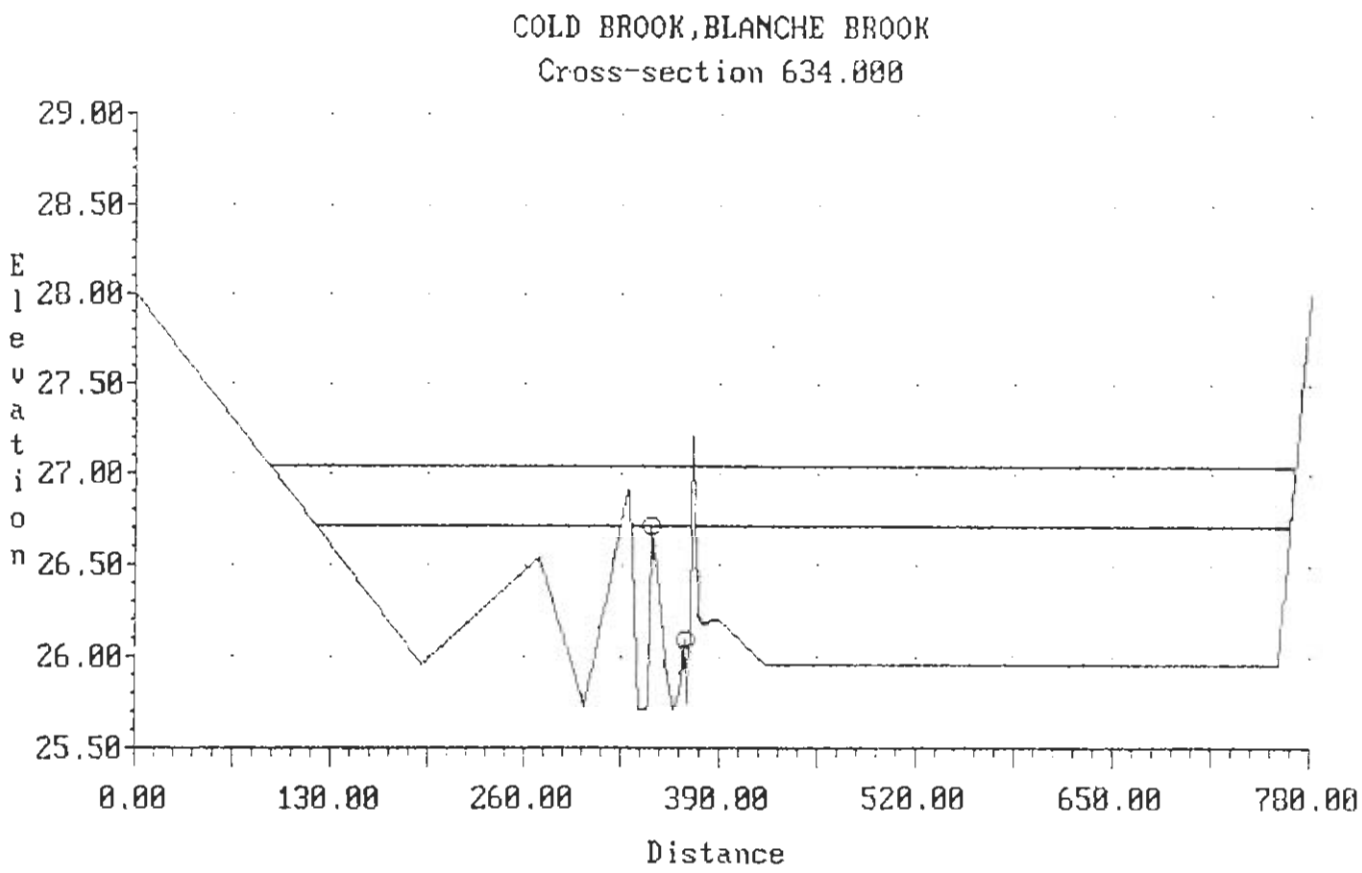
COLD BROOK,BLANCHE BROOK

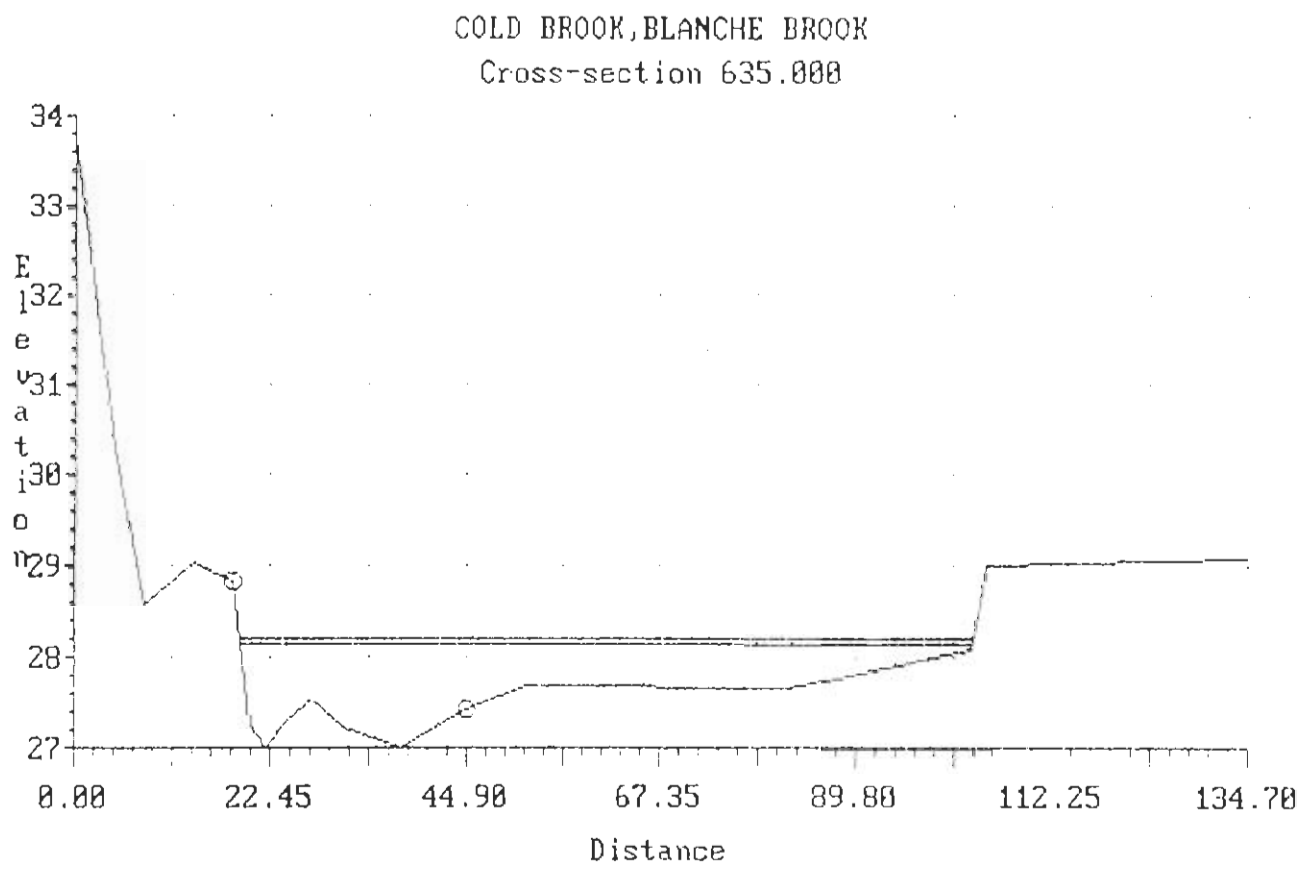
Cross-section 632.400

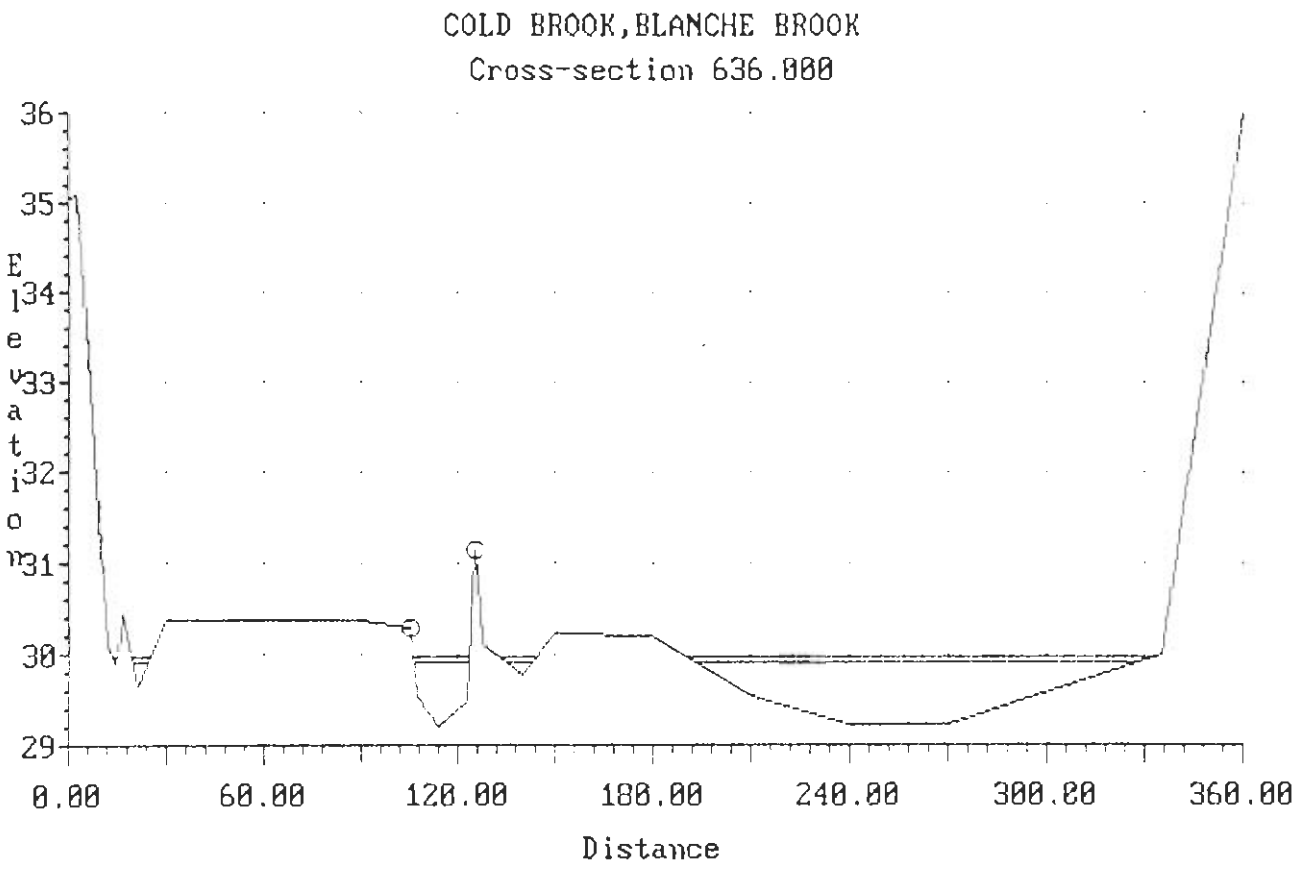



COLD BROOK,BLANCHE BROOK
Cross-section 632.500
Elevation
30
29
28
27
26
25
24
23
0.00
173.33
346.67
520.00
693.33
866.67
1040.00
Distance


COLD BROOK,BLANCHE BROOK
Cross-section 633.000
28.00
27.50
27.00
26.50
26.00
25.50
25.00
24.50
Elevation
0.00
81.67
163.33
245.00
326.67
408.33
490.00
Distance

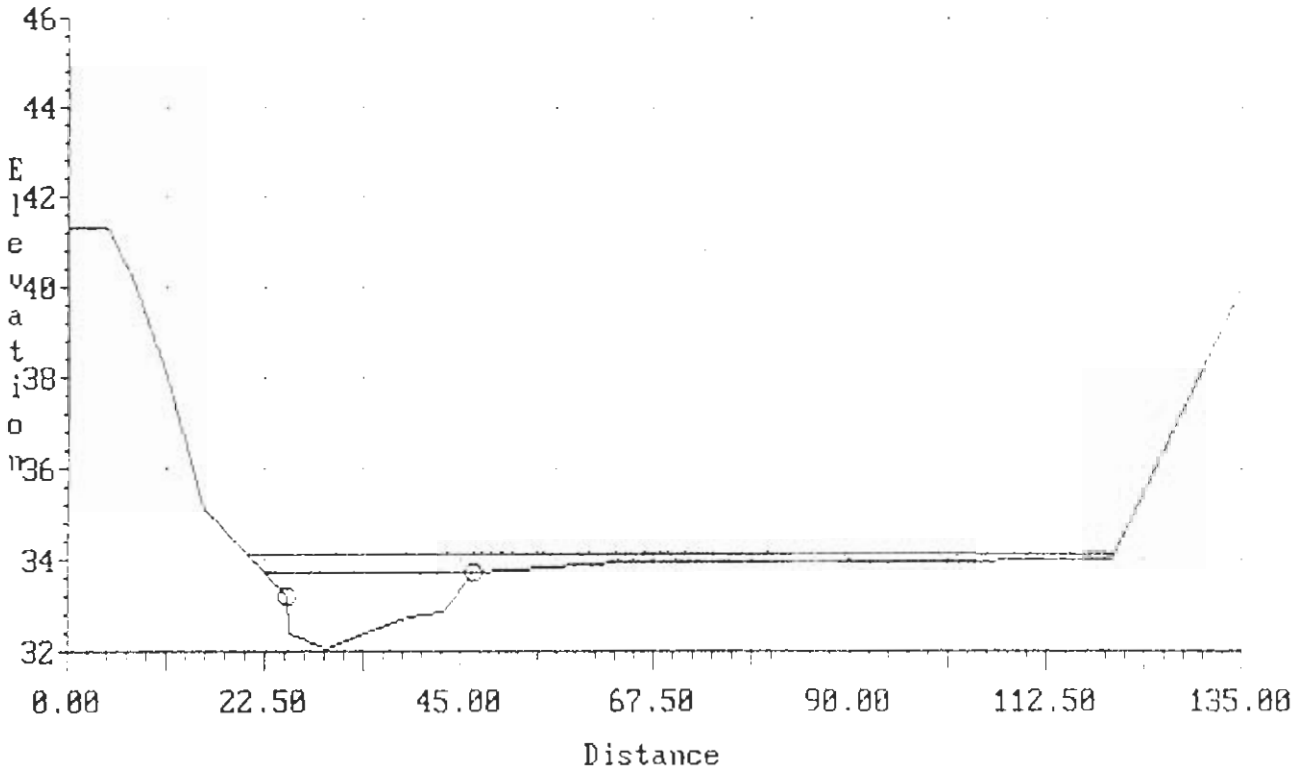

COLD BROOK,BLANCHE BROOK
Cross-section 634.000
29.00
28.50
28.00
27.50
27.00
26.50
26.00
25.50
Elevation
0.00
130.00
260.00
390.00
520.00
650.00
780.00
Distance

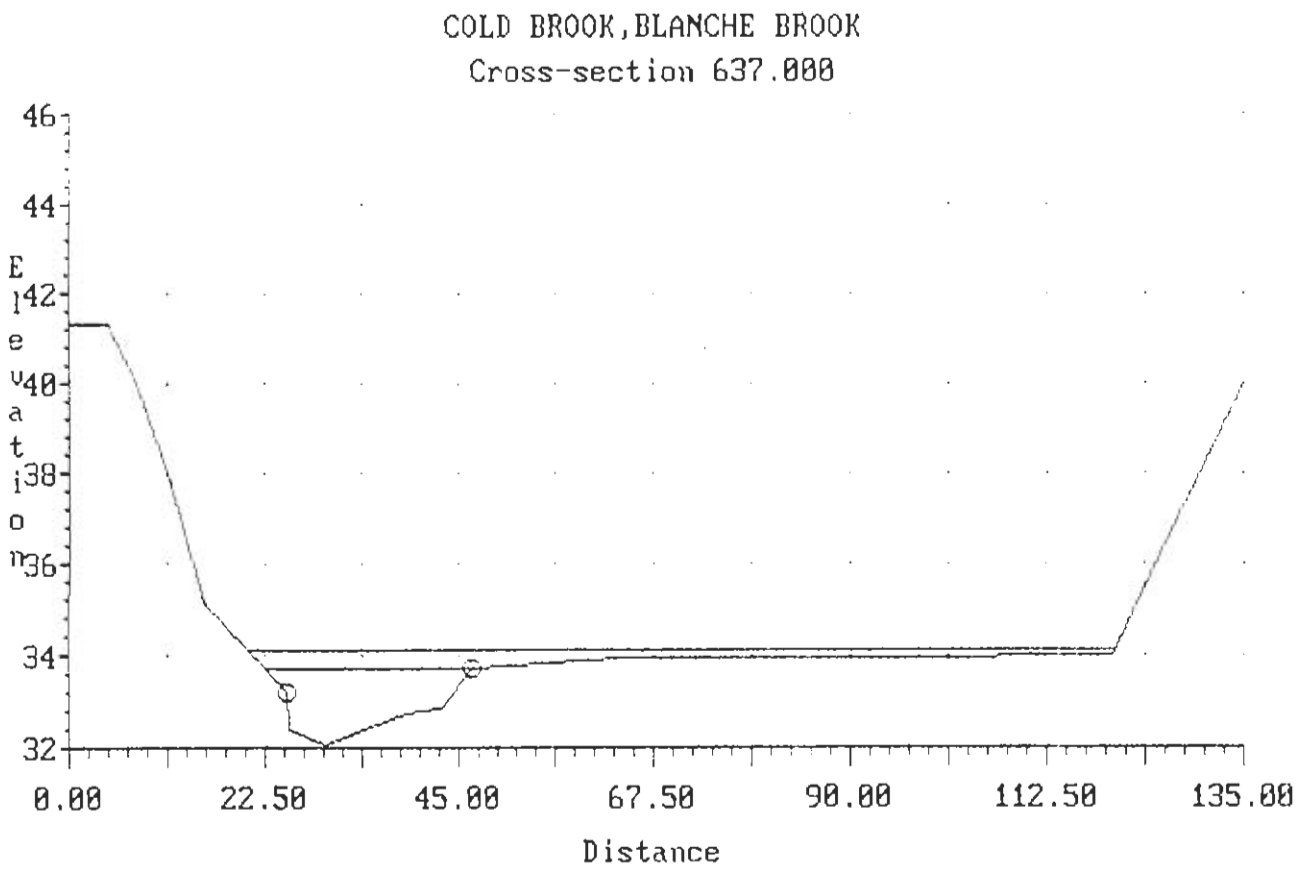

COLD BROOK,BLANCHE BROOK
Cross-section 635.000
34
33
32
31
30
29
28
27
Elevation
0.00
22.45
44.90
67.35
89.80
112.25
134.70
Distance

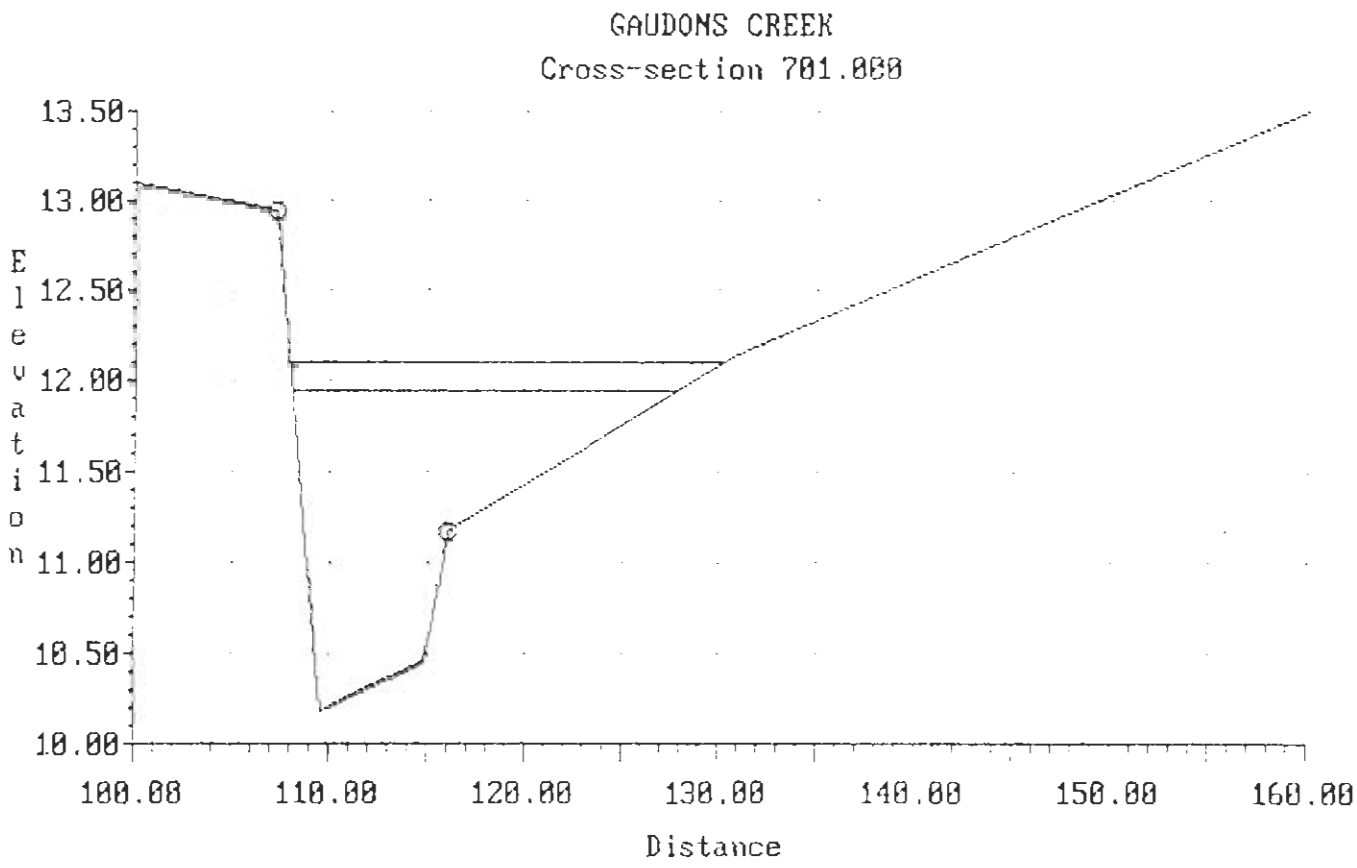

COLD BROOK,BLANCHE BROOK
Cross-section 636.000
Elevation
36
35
34
33
32
31
30
29
0.00
60.00
120.00
180.00
240.00
300.00
360.00
Distance

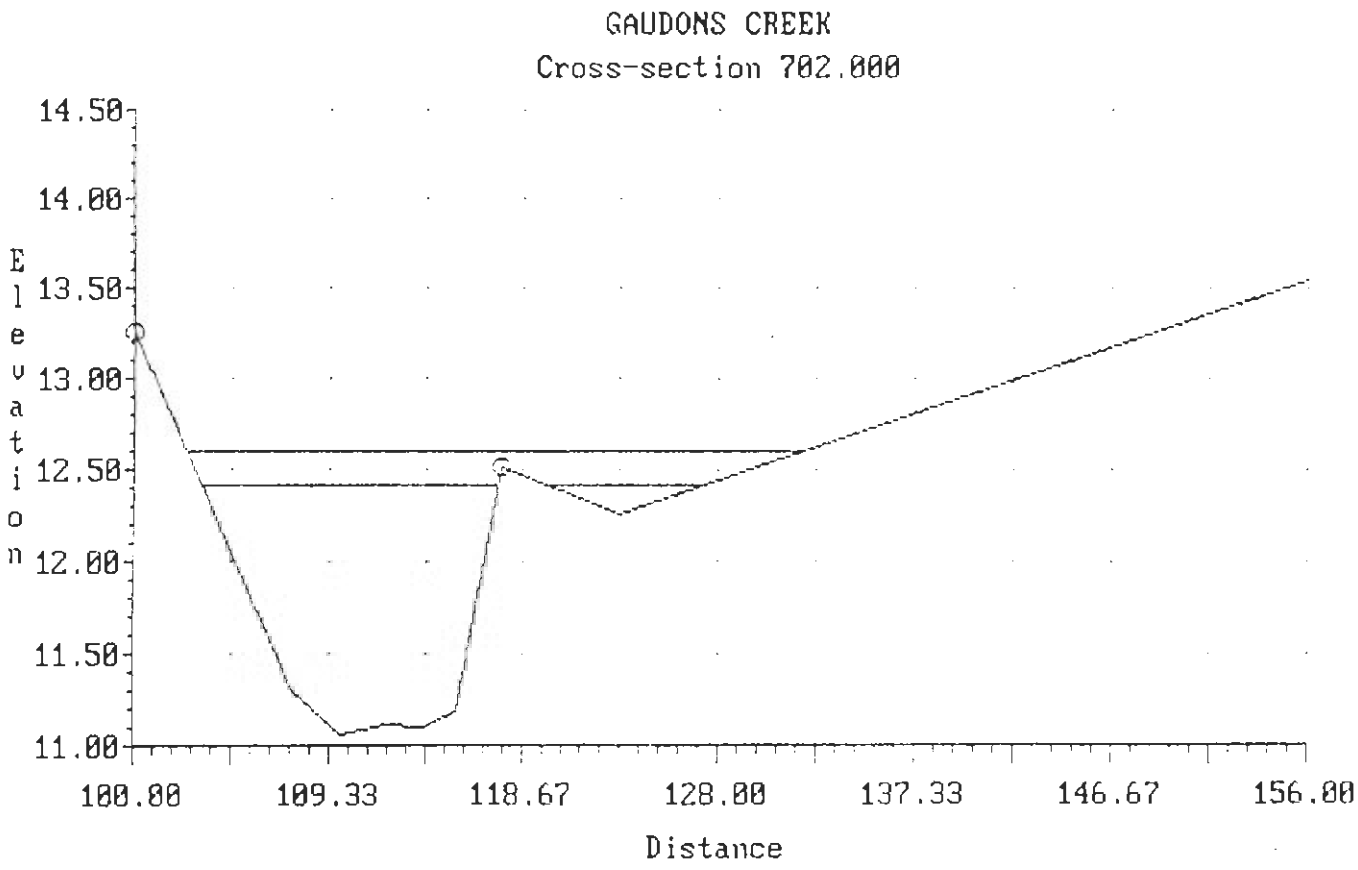
COLD BROOK,BLANCHE BROOK

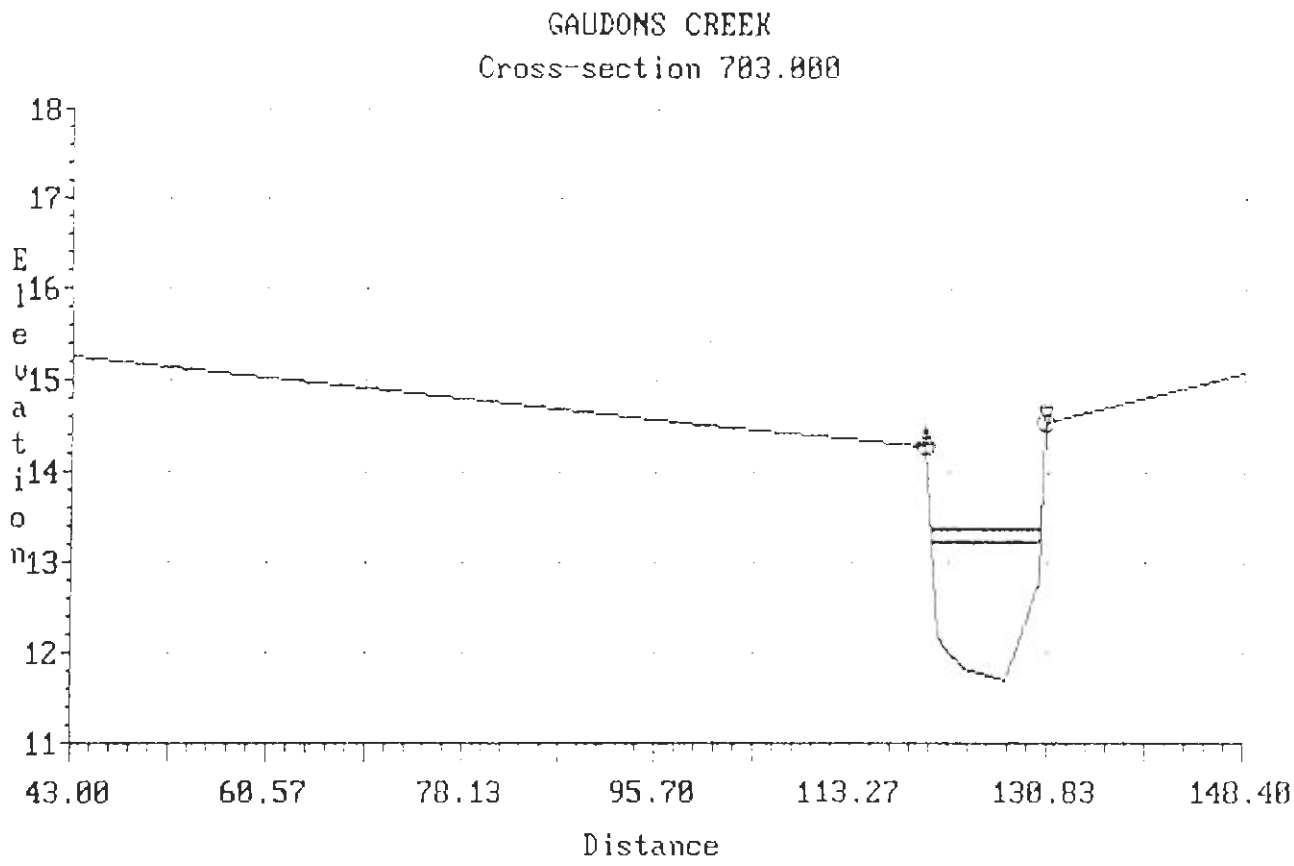
Cross-section 637.000




COLD BROOK,BLANCHE BROOK
Cross-section 637.000
Elevation
46
44
42
40
38
36
34
32
0.00
22.50
45.00
67.50
90.00
112.50
135.00
Distance

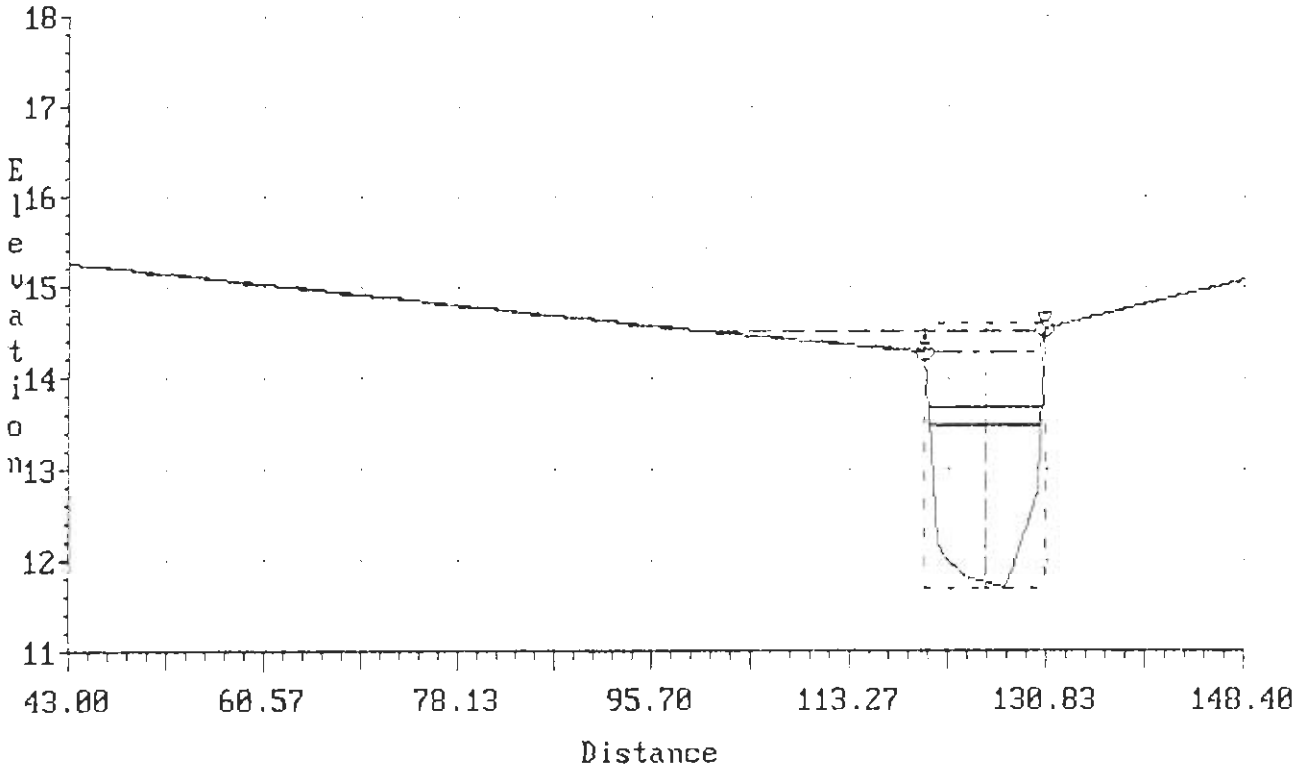

GAUDONS CREEK
Cross-section 701.000
13.50
13.00
12.50
12.00
11.50
11.00
10.50
10.00
Elevation
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance


GAUDONS CREEK
Cross-section 702.000
14.50
14.00
13.50
13.00
12.50
12.00
11.50
11.00
Elevation
100.00
109.33
118.67
128.00
137.33
146.67
156.00
Distance


GAUDONS CREEK
Cross-section 703.000
Elevation
18
17
16
15
14
13
12
11
43.00
60.57
78.13
95.70
113.27
130.83
148.40
Distance

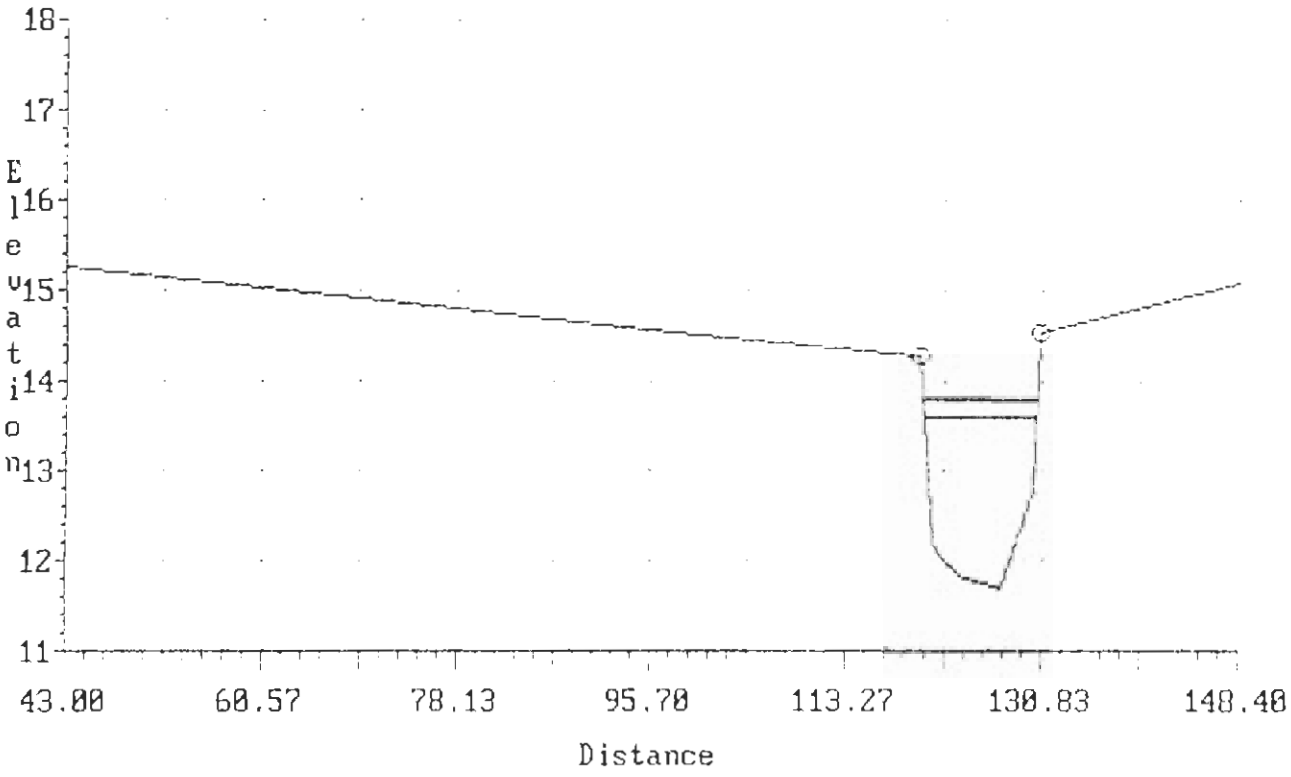
GAUDONS CREEK

Cross-section 702.100



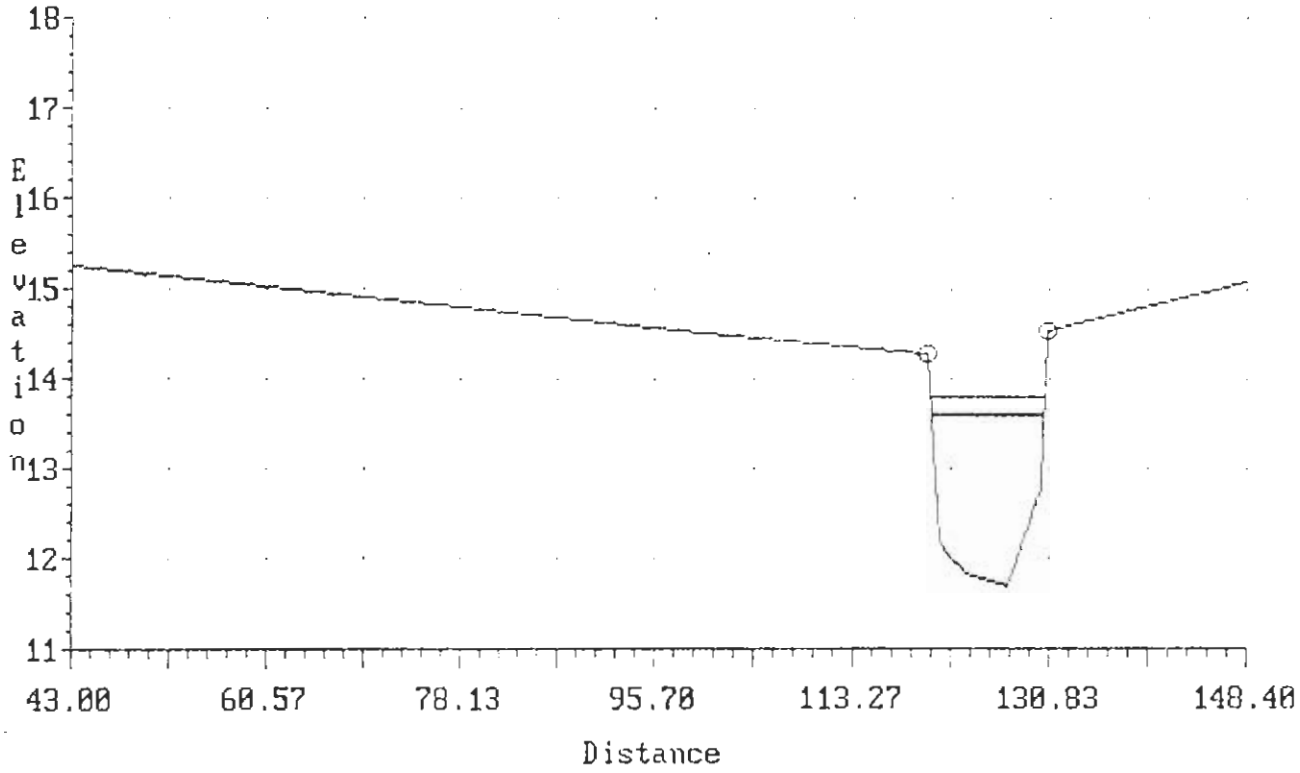
GAUDONS CREEK

Cross-section 703.200



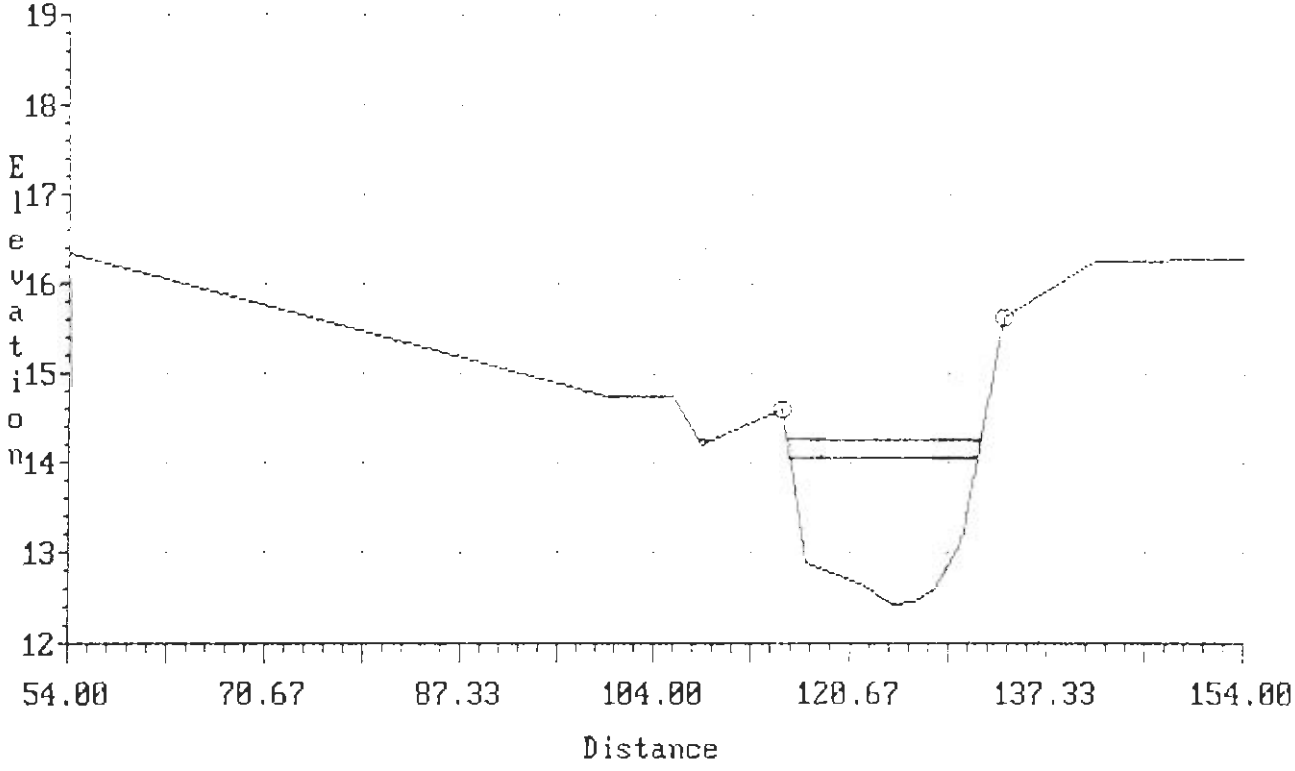
GAUDONS CREEK

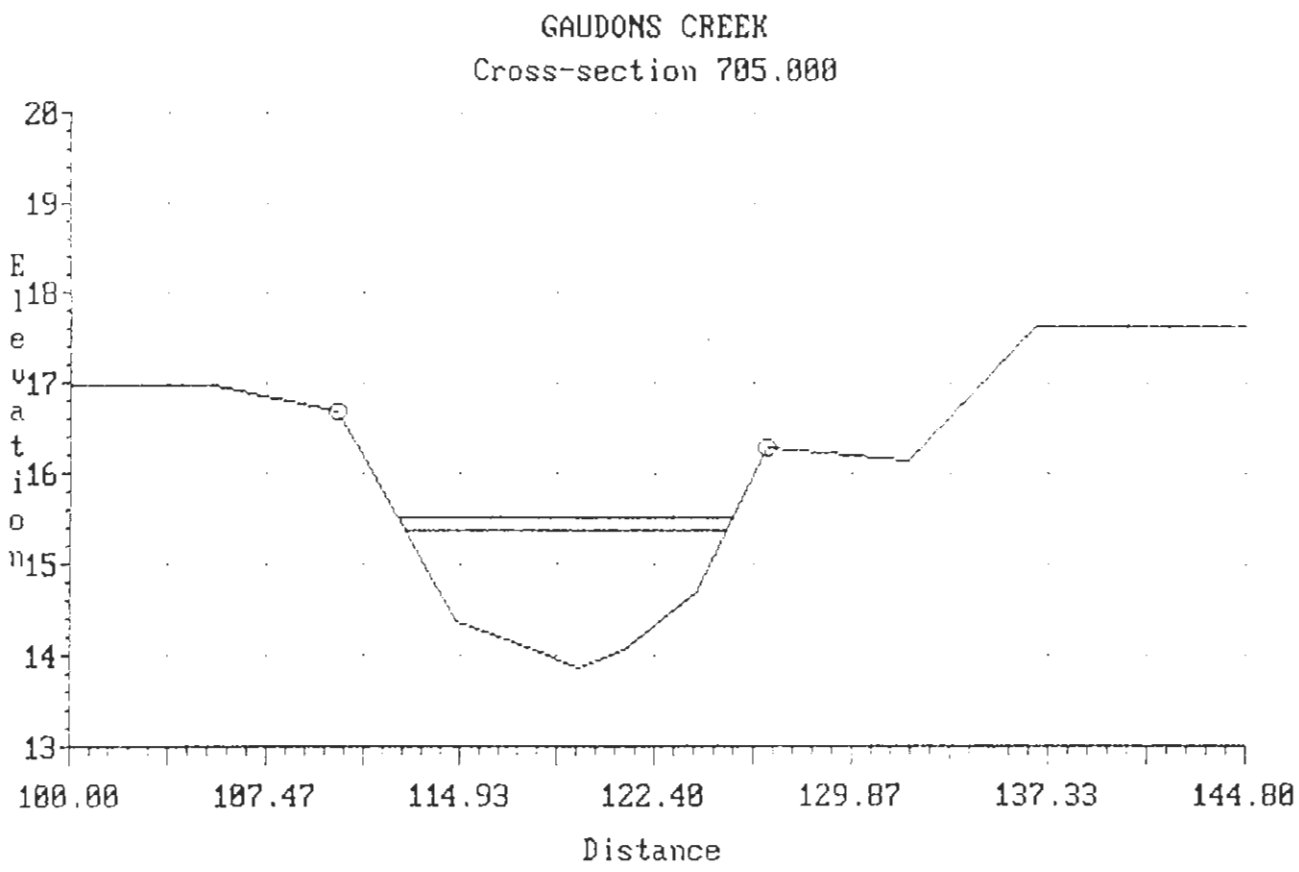
Cross-section 703.300

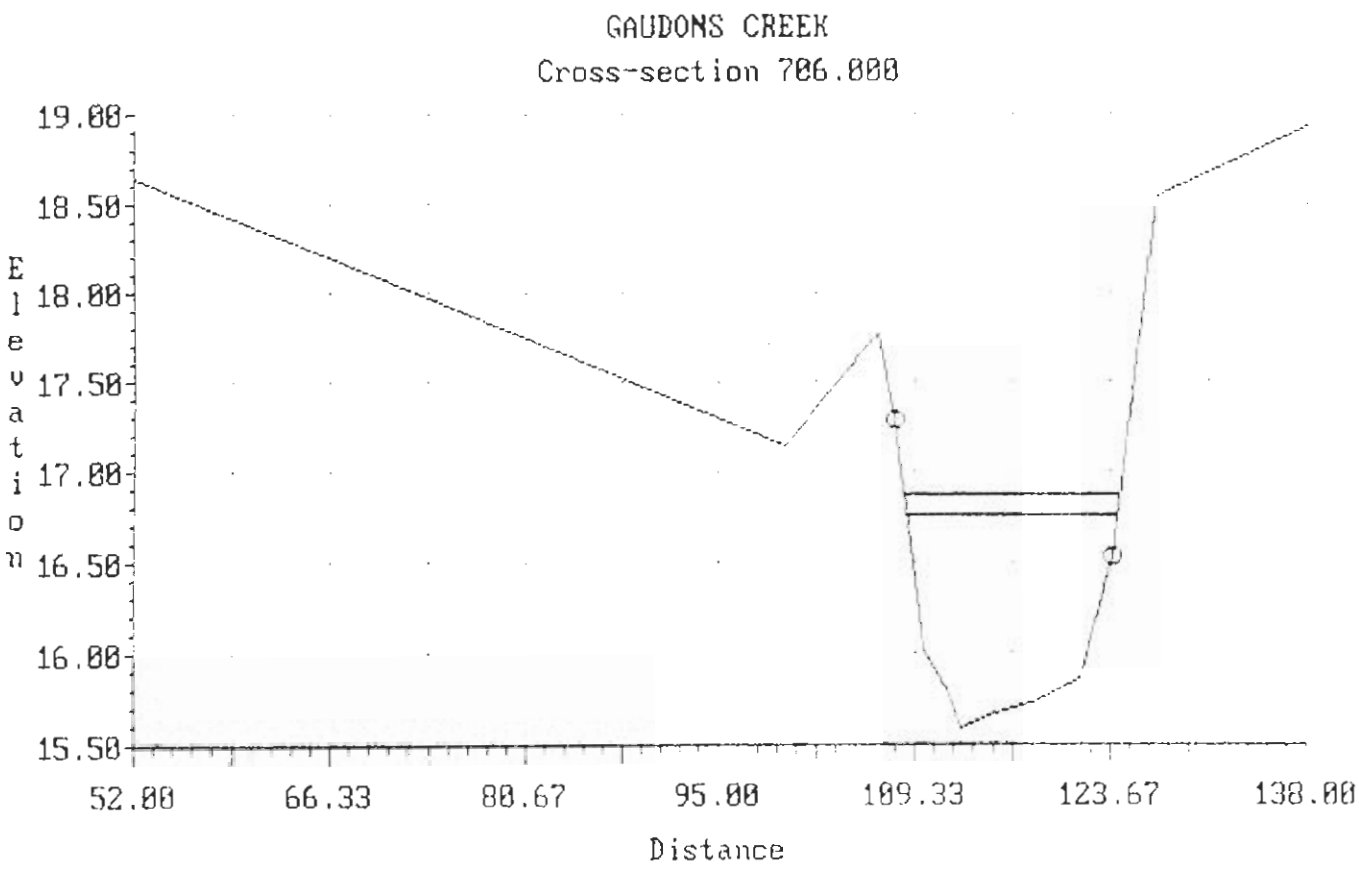


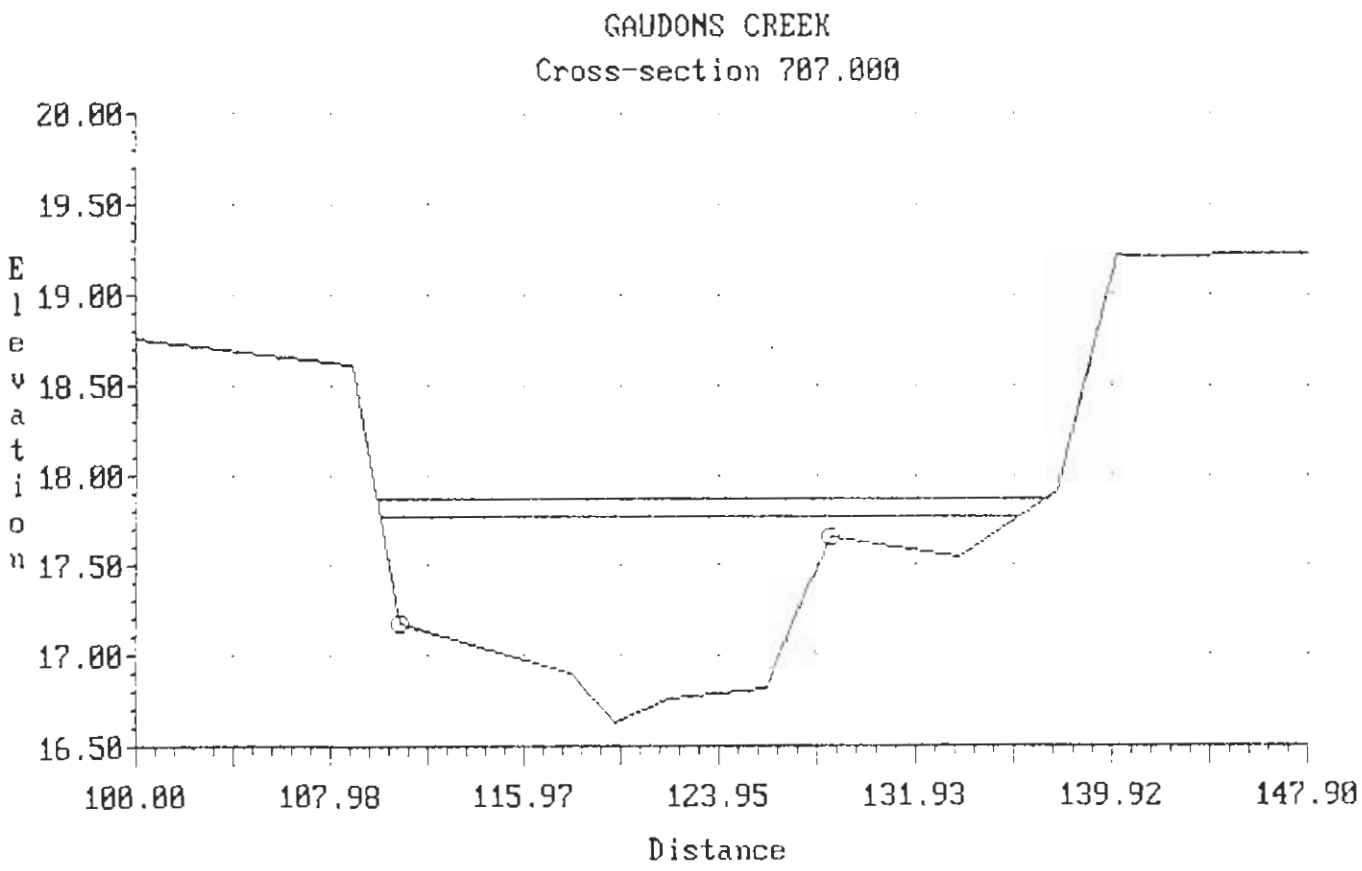
GAUDONS CREEK

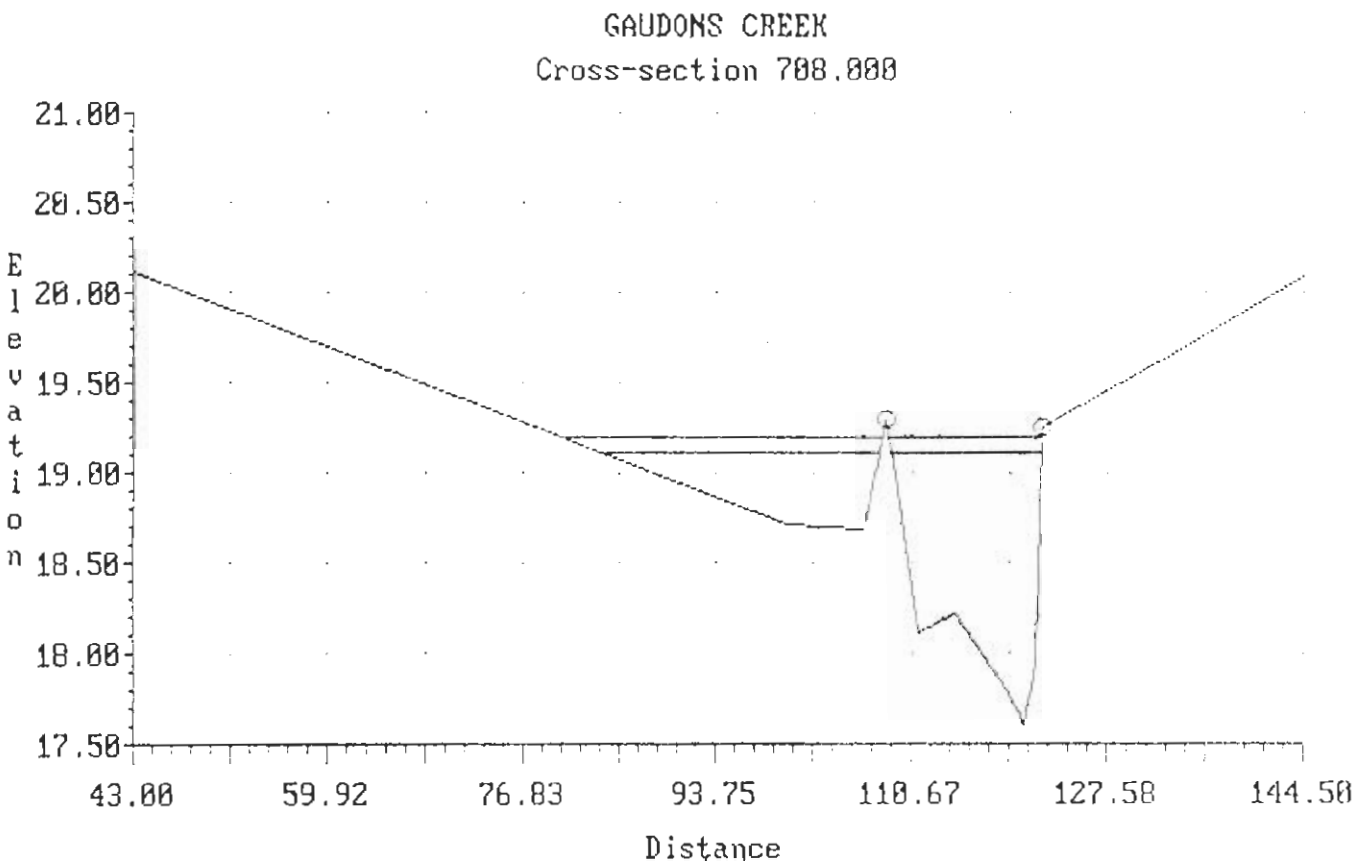
Cross-section 704.000

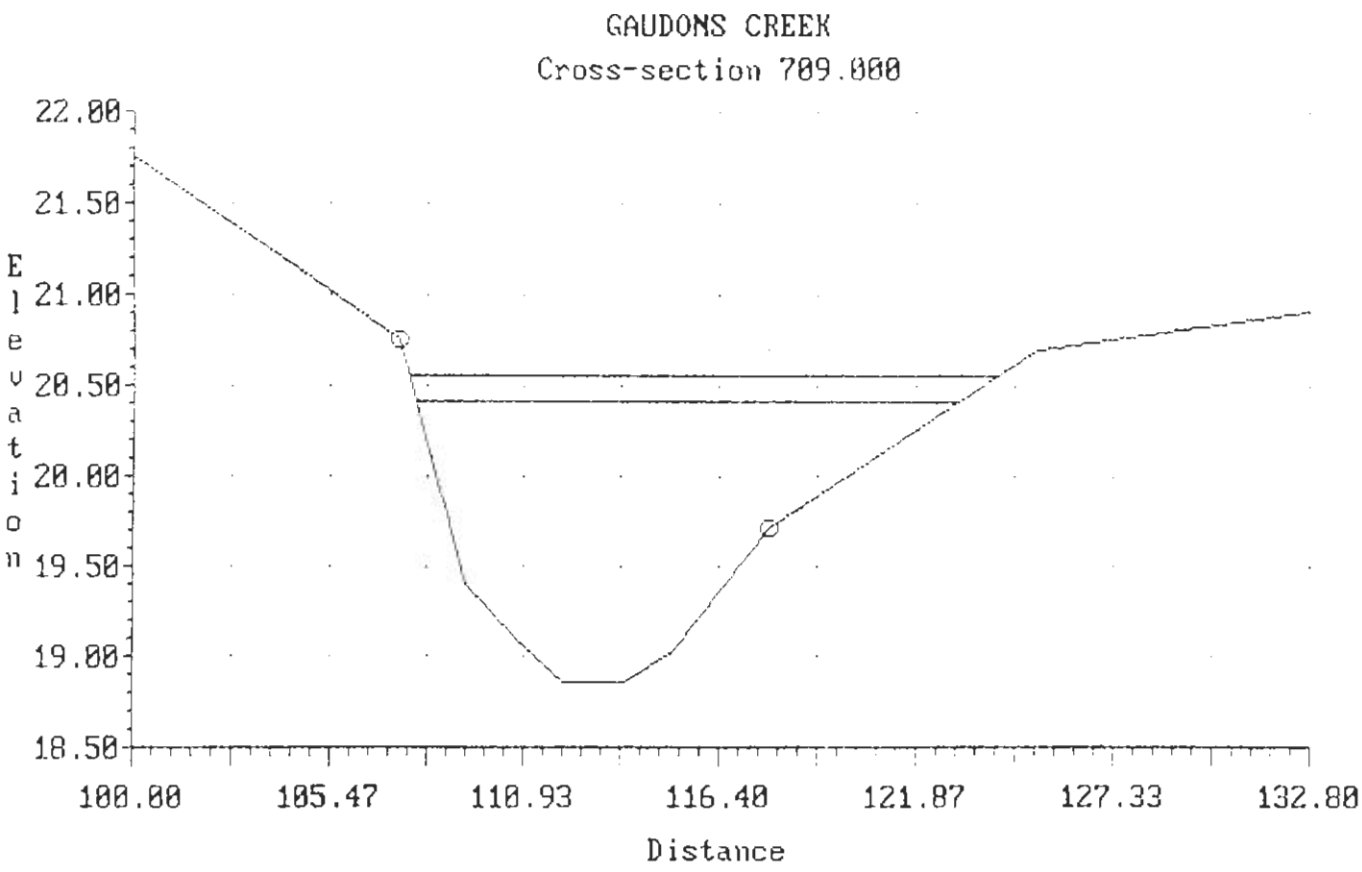


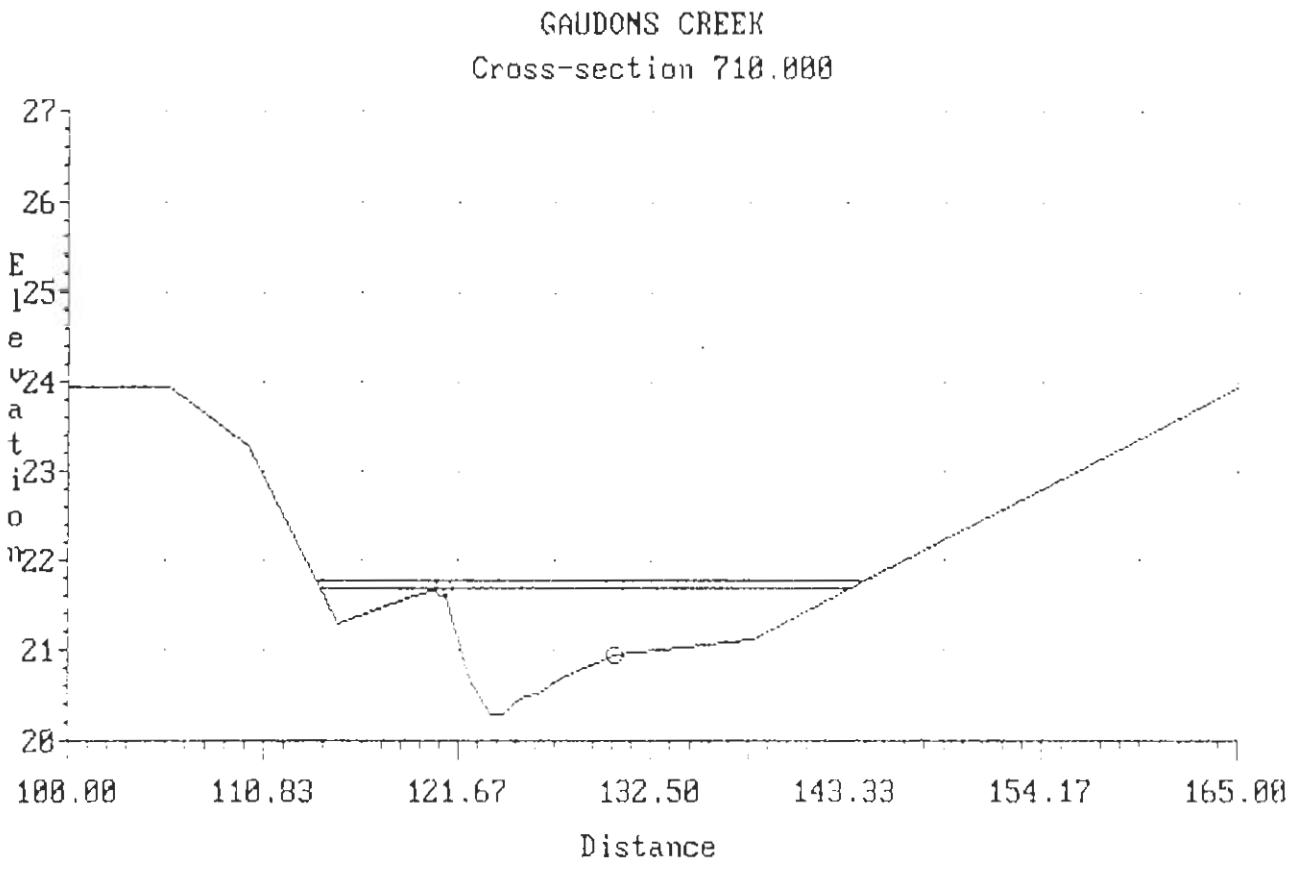

GAUDONS CREEK
Cross-section 705.000
20
19
18
17
16
15
14
13
Elevation
100.00
107.47
114.93
122.40
129.87
137.33
144.80
Distance

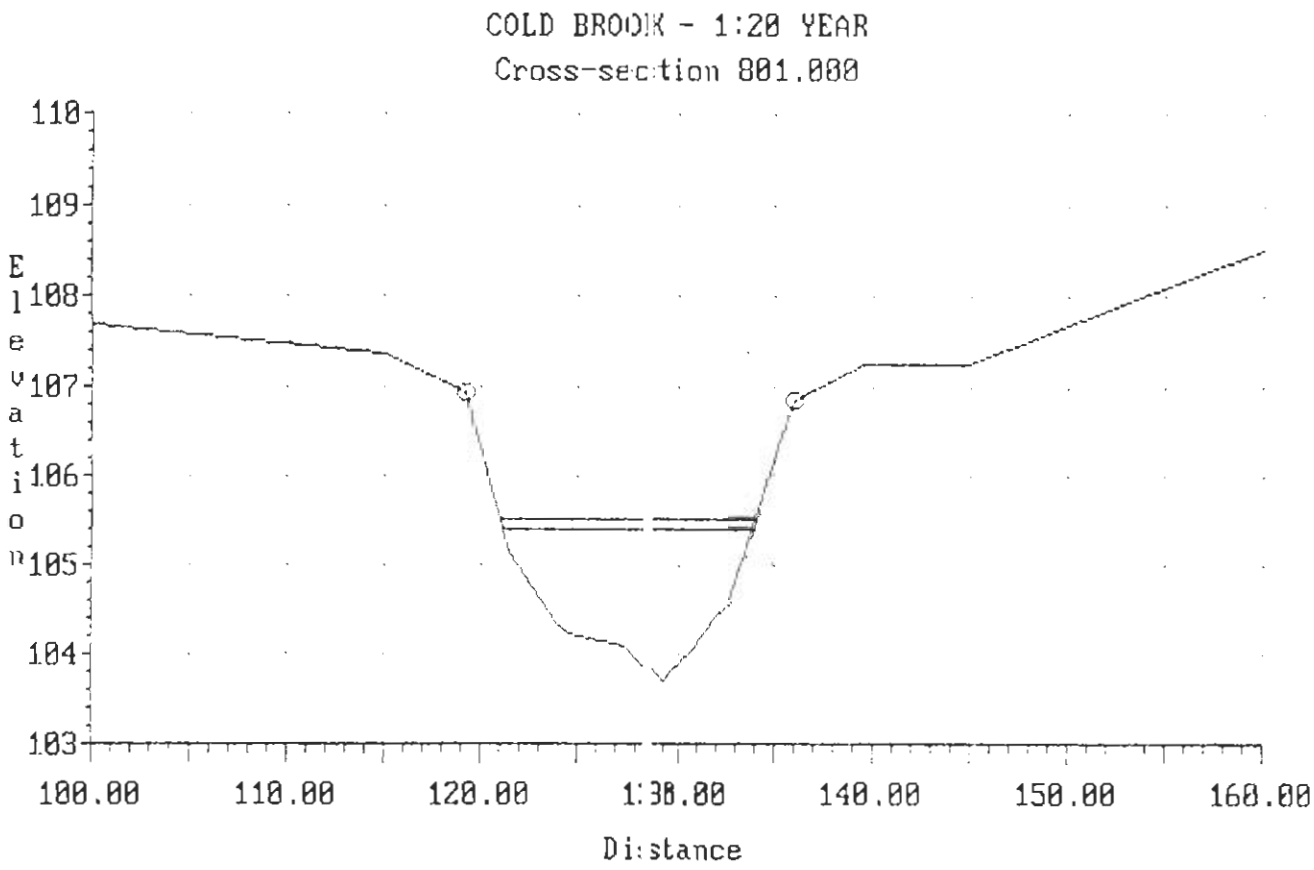

GAUDONS CREEK
Cross-section 706.000
19.00
18.50
18.00
17.50
17.00
16.50
16.00
15.50
Elevation
52.00
66.33
80.67
95.00
109.33
123.67
138.00
Distance

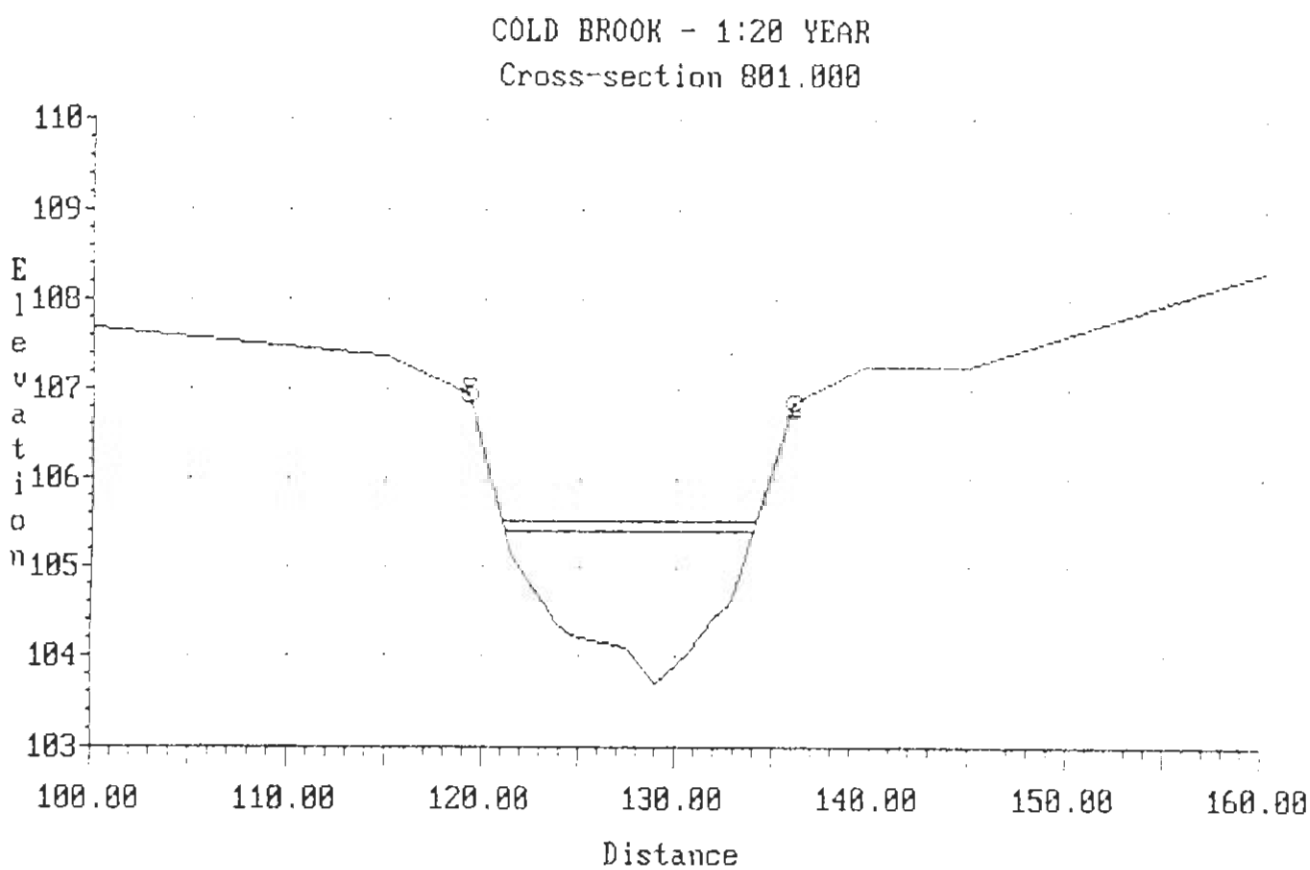

GAUDONS CREEK
Cross-section 707.000
20.00
19.50
19.00
18.50
18.00
17.50
17.00
16.50
Elevation
100.00
107.98
115.97
123.95
131.93
139.92
147.90
Distance

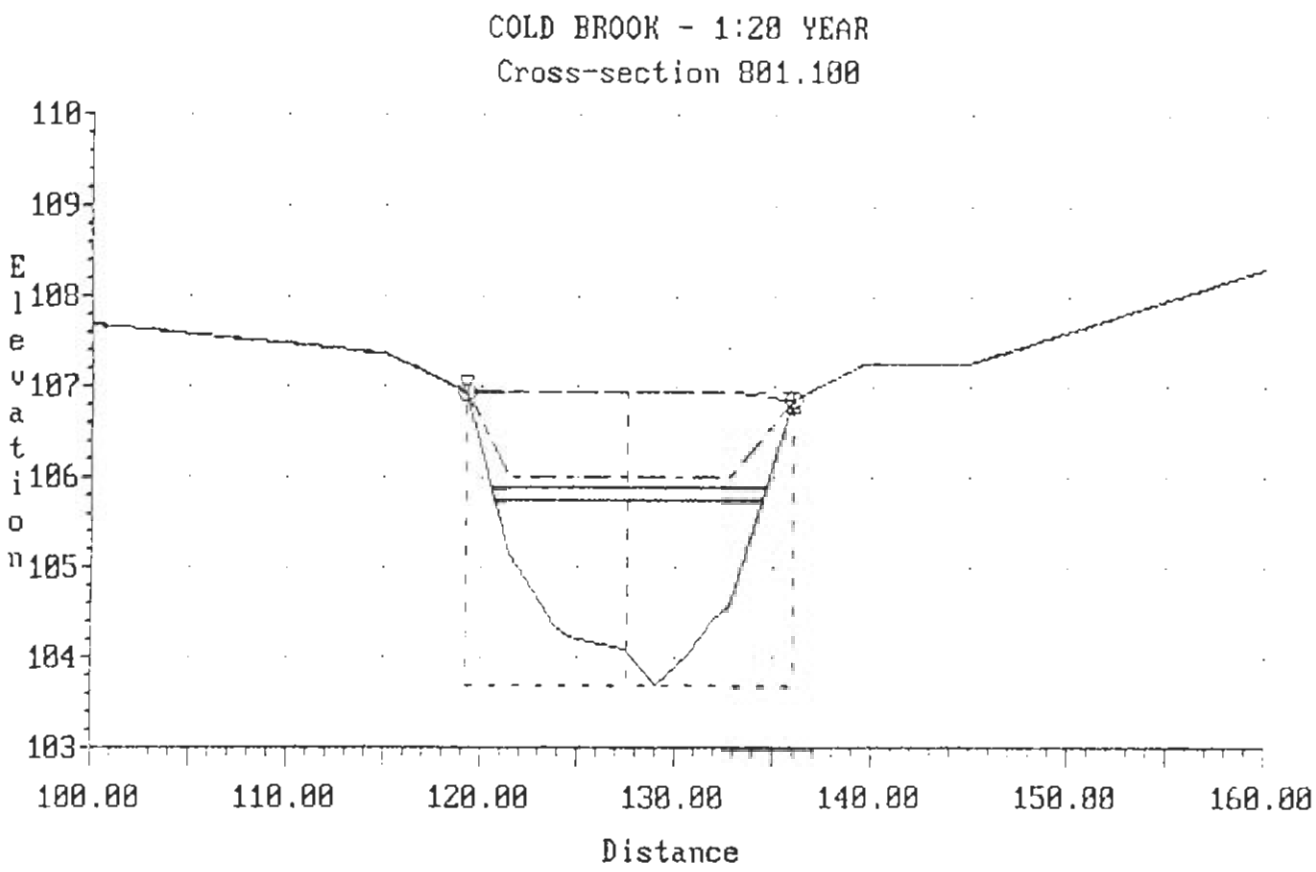

GAUDONS CREEK
Cross-section 708.000
21.00
20.50
20.00
19.50
19.00
18.50
18.00
17.50
Elevation
43.00
59.92
76.83
93.75
110.67
127.58
144.50
Distance

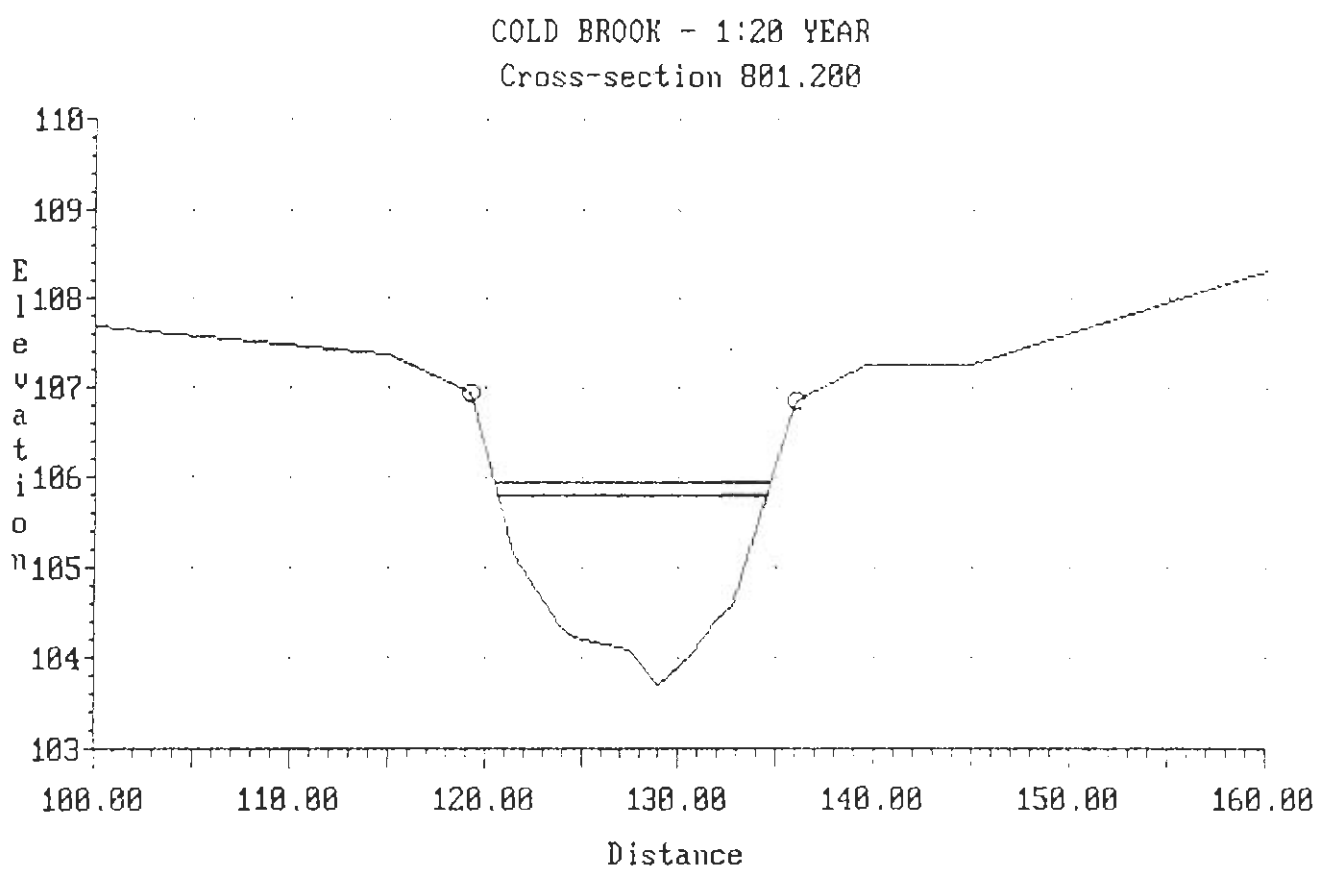

GAUDONS CREEK
Cross-section 709.000
22.00
21.50
21.00
20.50
20.00
19.50
19.00
18.50
Elevation
100.00
105.47
110.93
116.40
121.87
127.33
132.80
Distance

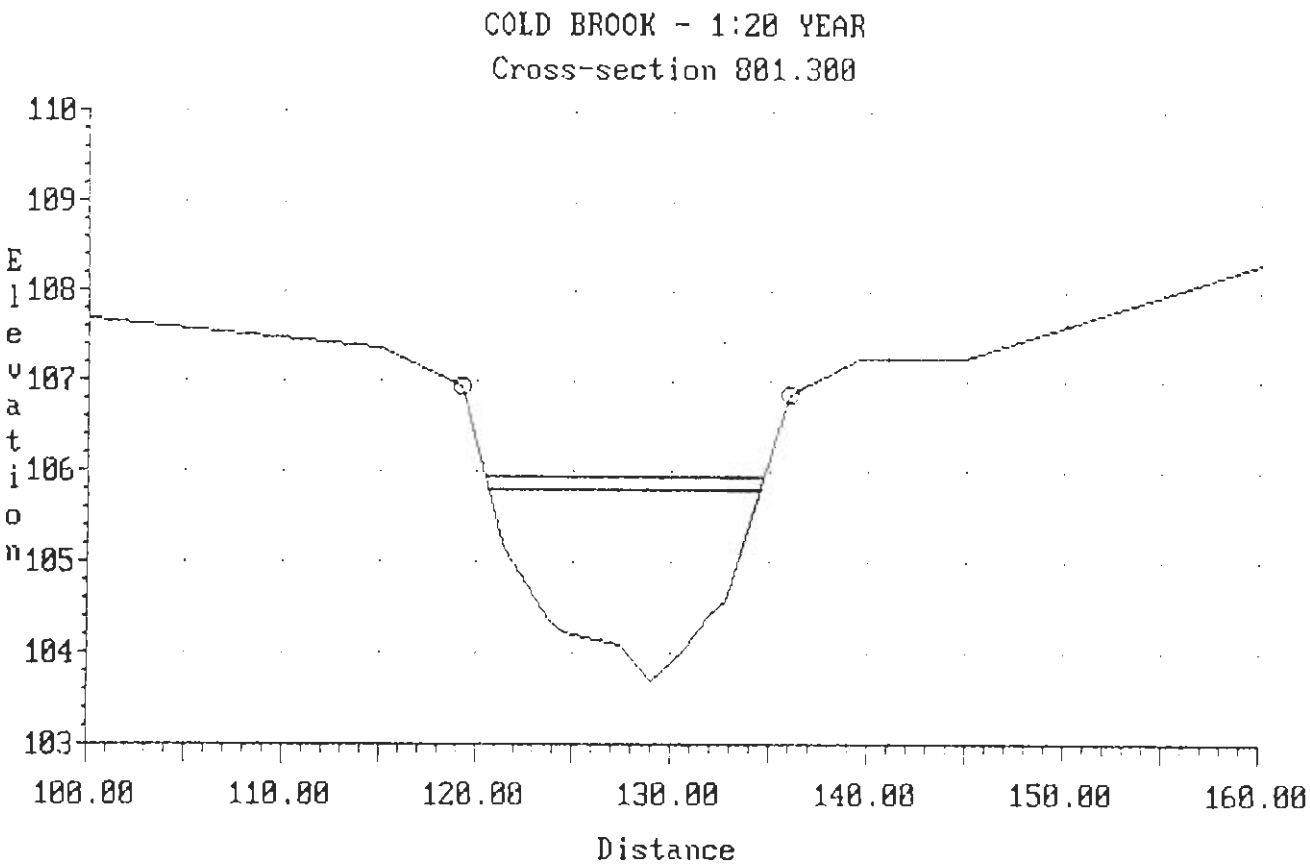

GAUDONS CREEK
Cross-section 710.000
Elevation
27
26
25
24
23
22
21
20
100.00
110.83
121.67
132.50
143.33
154.17
165.00
Distance

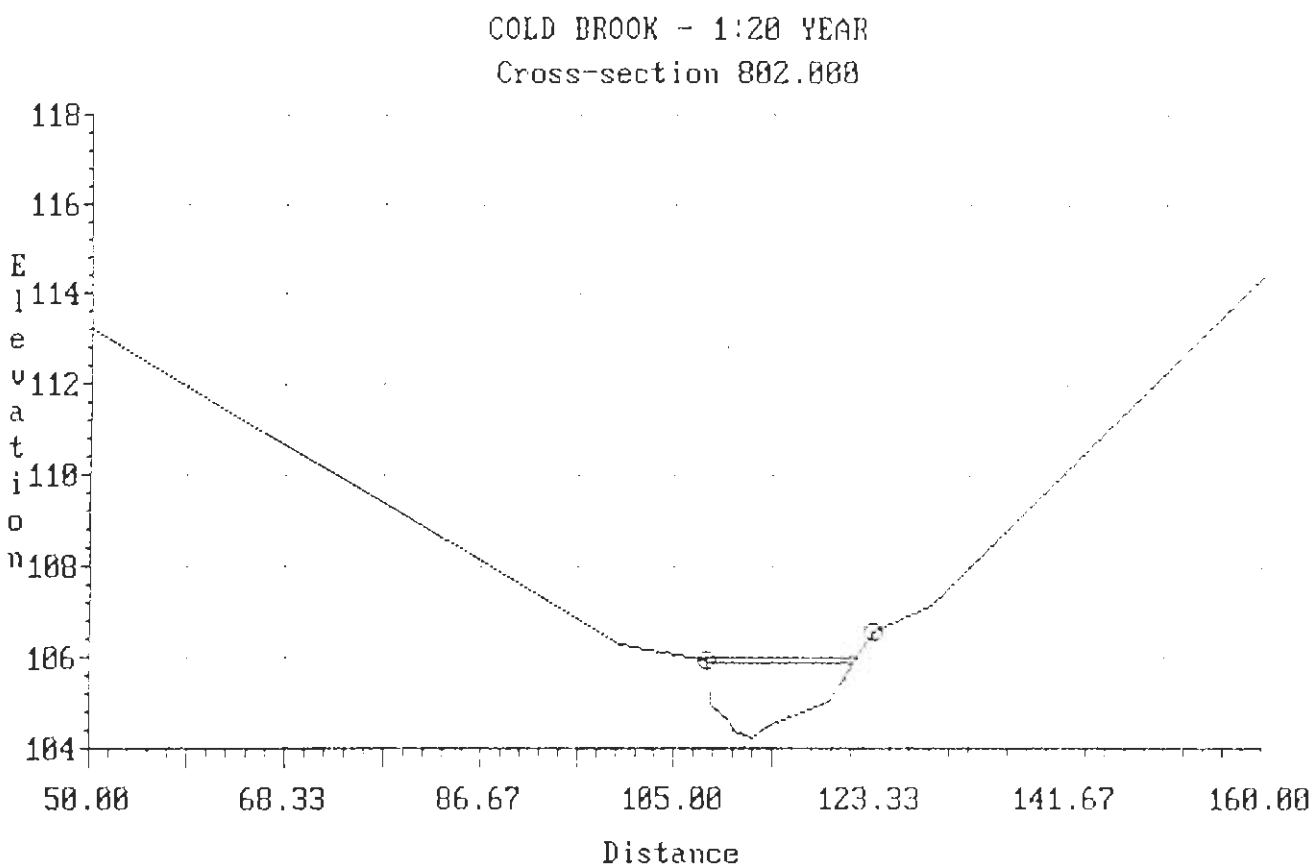

COLD BROOK - 1:20 YEAR
Cross-section 801.000
Elevation
110
109
108
107
106
105
104
103
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance


COLD BROOK - 1:20 YEAR
Cross-section 801.000
Elevation
110
109
108
107
106
105
104
103
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance


COLD BROOK - 1:20 YEAR
Cross-section 801.100
110
109
108
107
106
105
104
103
Elevation
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance

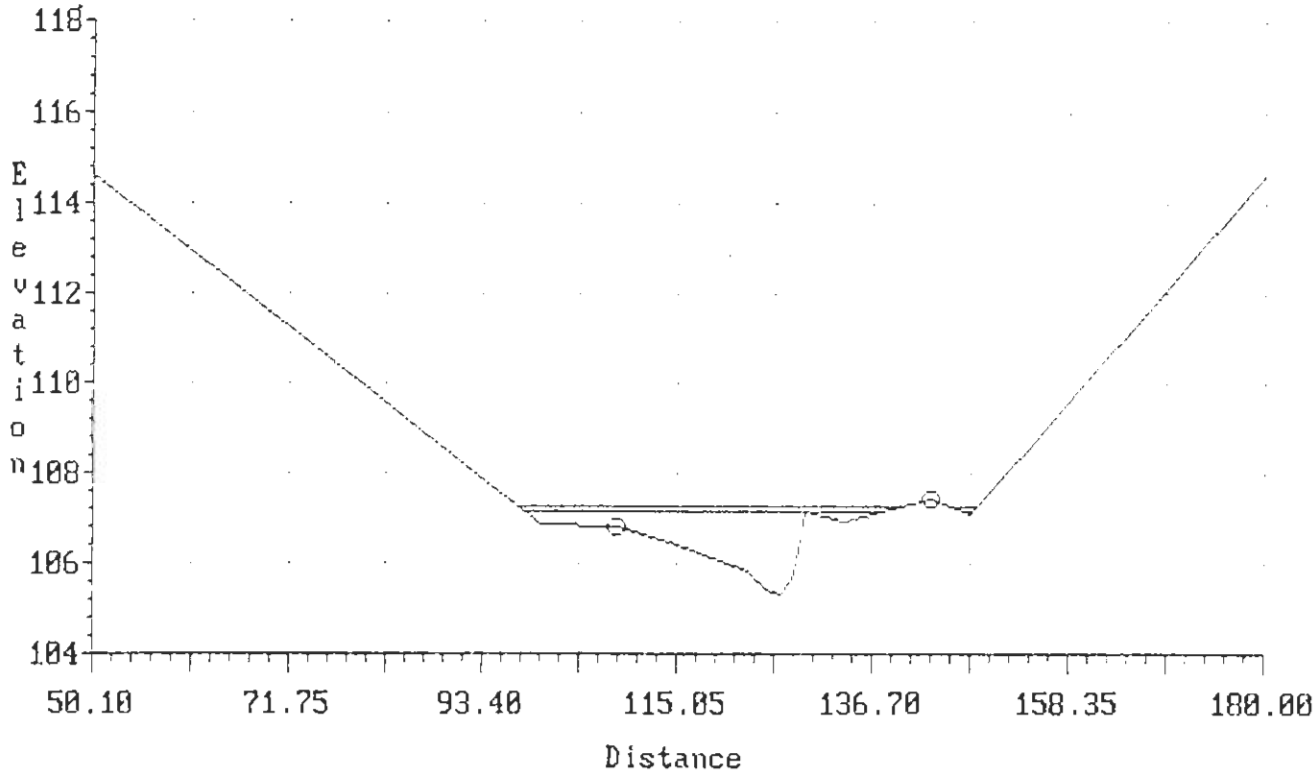

COLD BROOK - 1:20 YEAR
Cross-section 801.200
Elevation
110
109
108
107
106
105
104
103
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance


COLD BROOK - 1:20 YEAR
Cross-section 801.300
Elevation
110
109
108
107
106
105
104
103
100.00
110.00
120.00
130.00
140.00
150.00
160.00
Distance

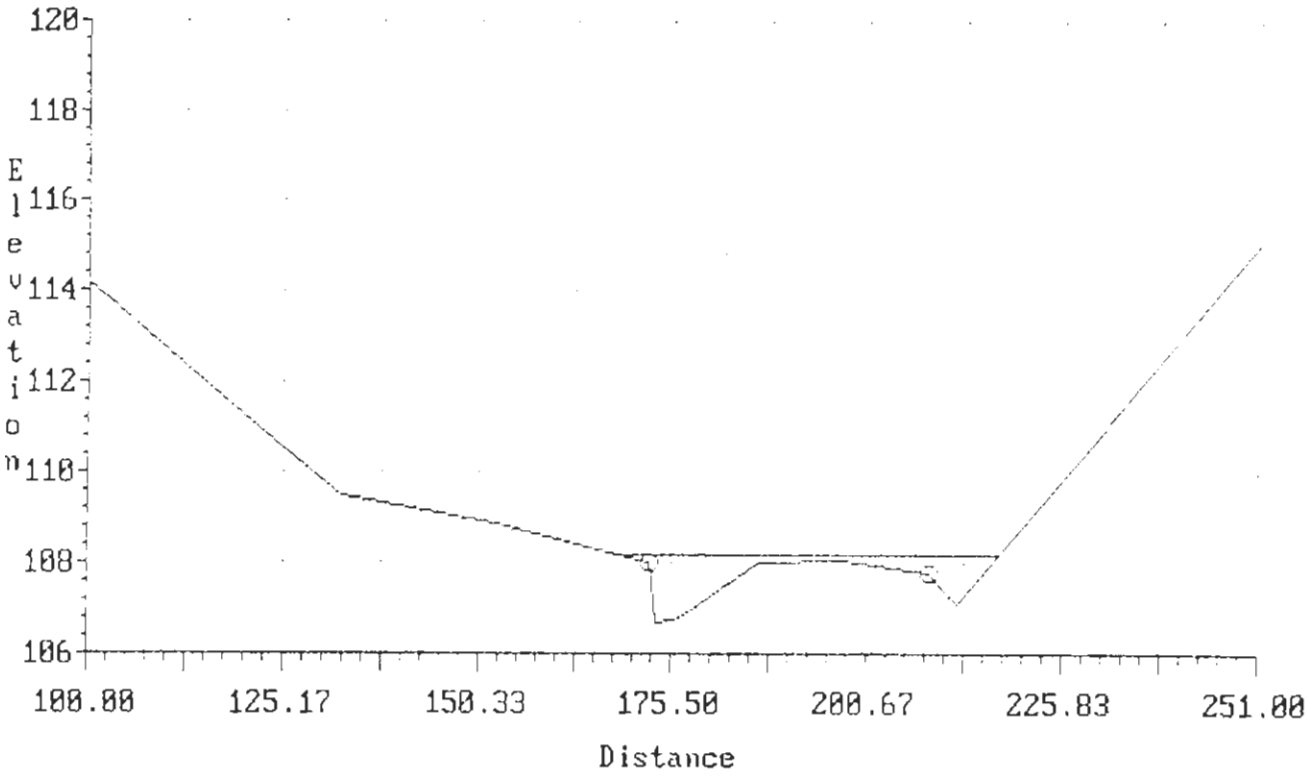

COLD BROOK - 1:20 YEAR
Cross-section 802.000
118
116
114
112
110
108
106
104
Elevation
50.00
68.33
86.67
105.00
123.33
141.67
160.00
Distance

COLD BROOK - 1:20 YEAR

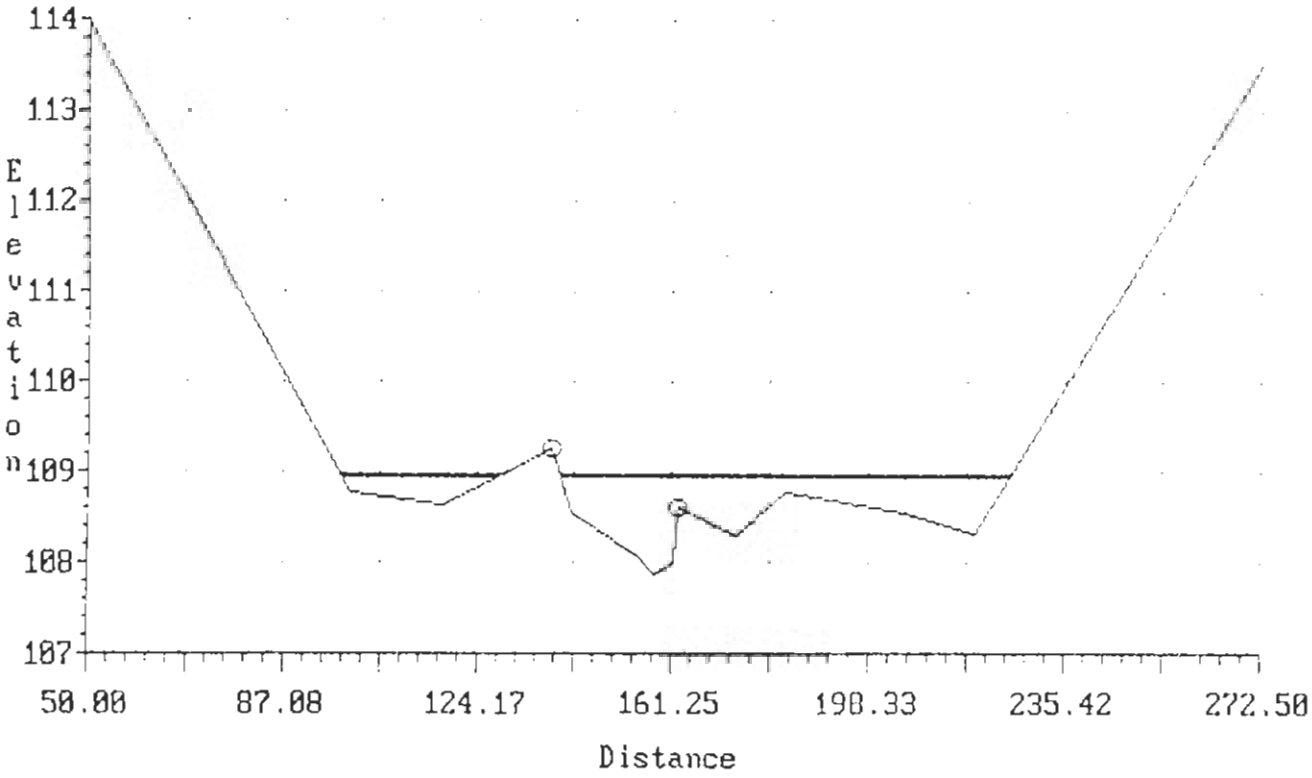
Cross-section 803.000

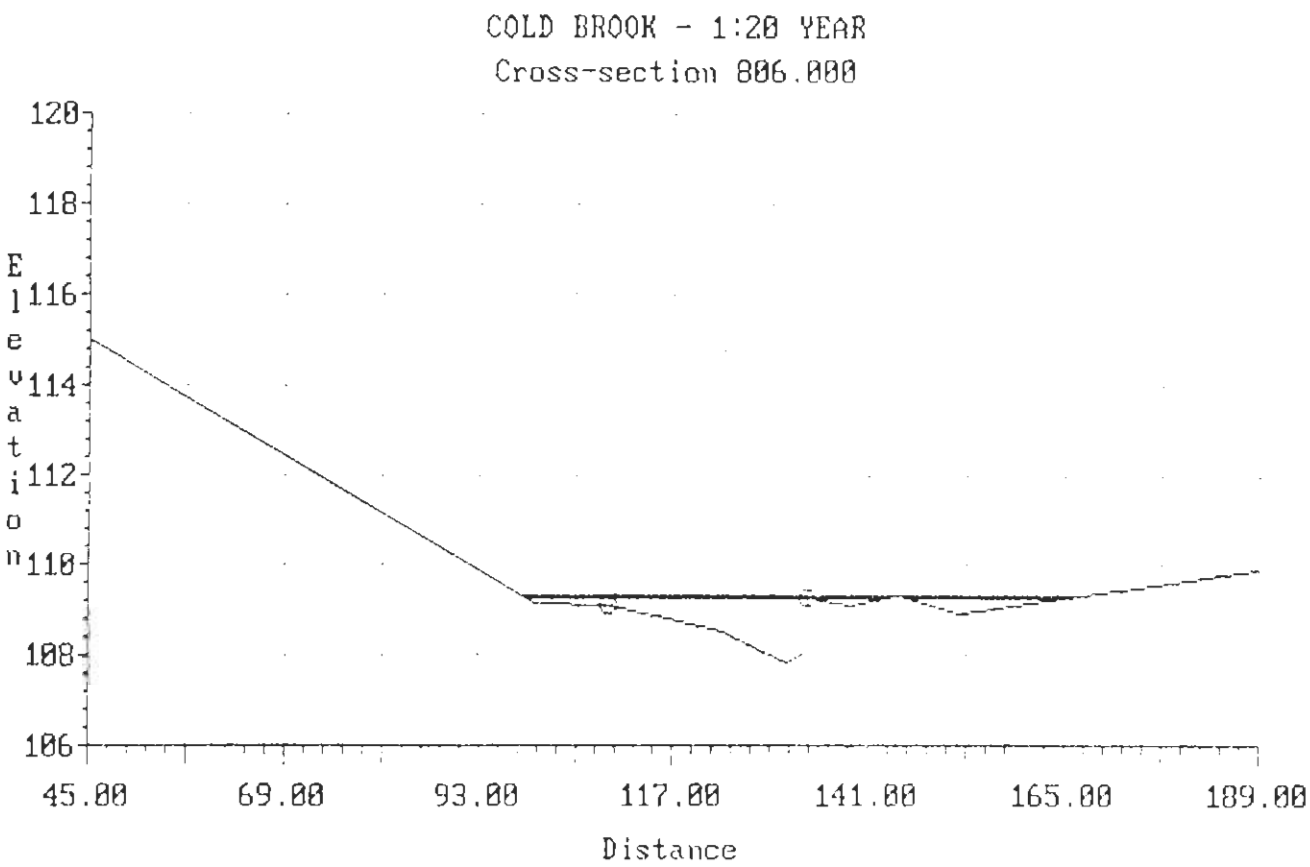


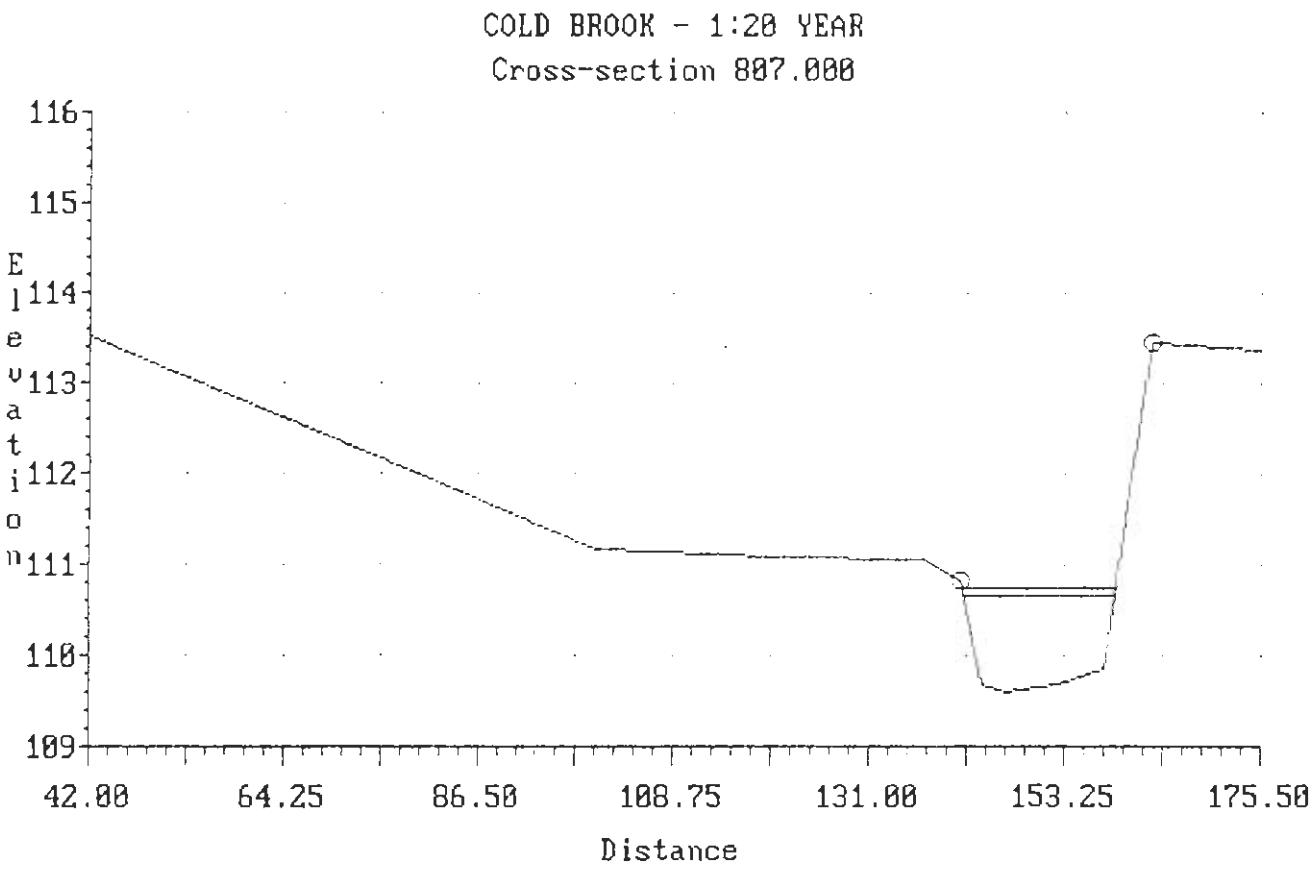
COLD BROOK - 1:20 YEAR
Cross-section 804.000



COLD BROOK - 1:20 YEAR
Cross-section 805.000

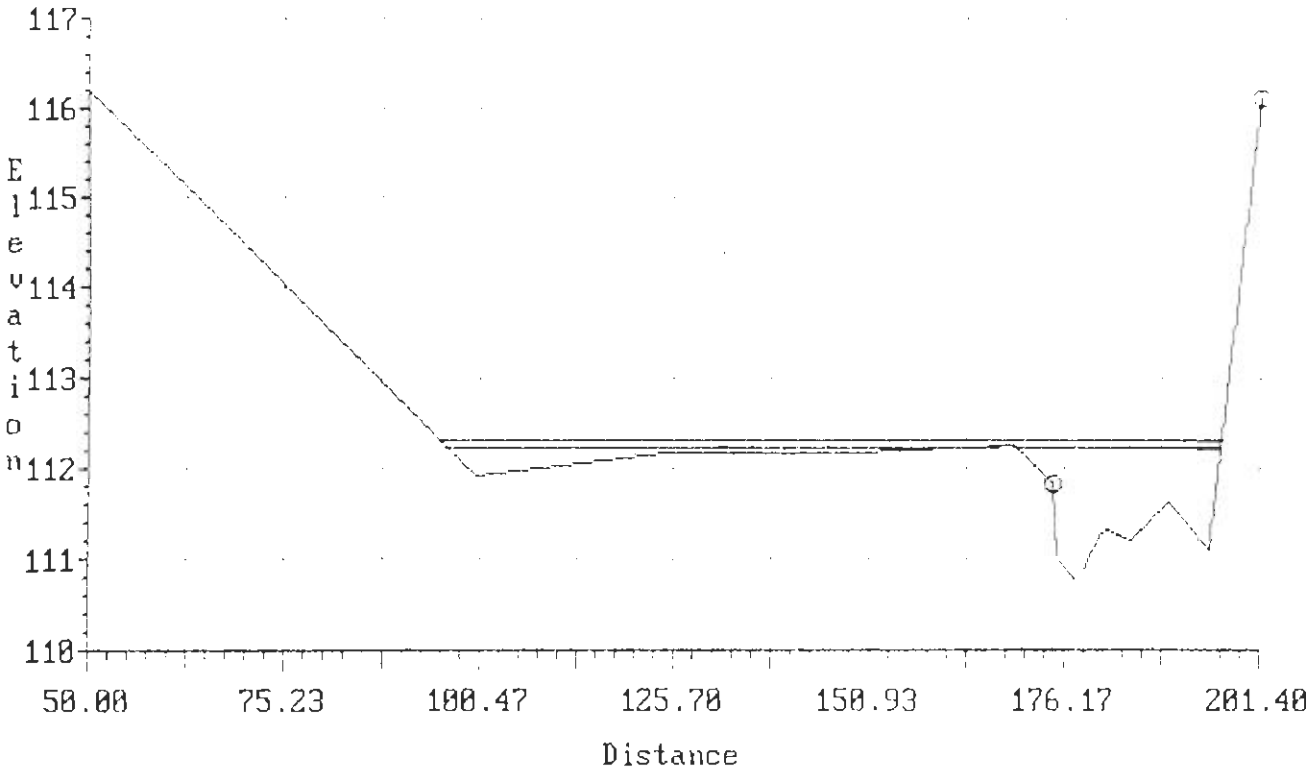


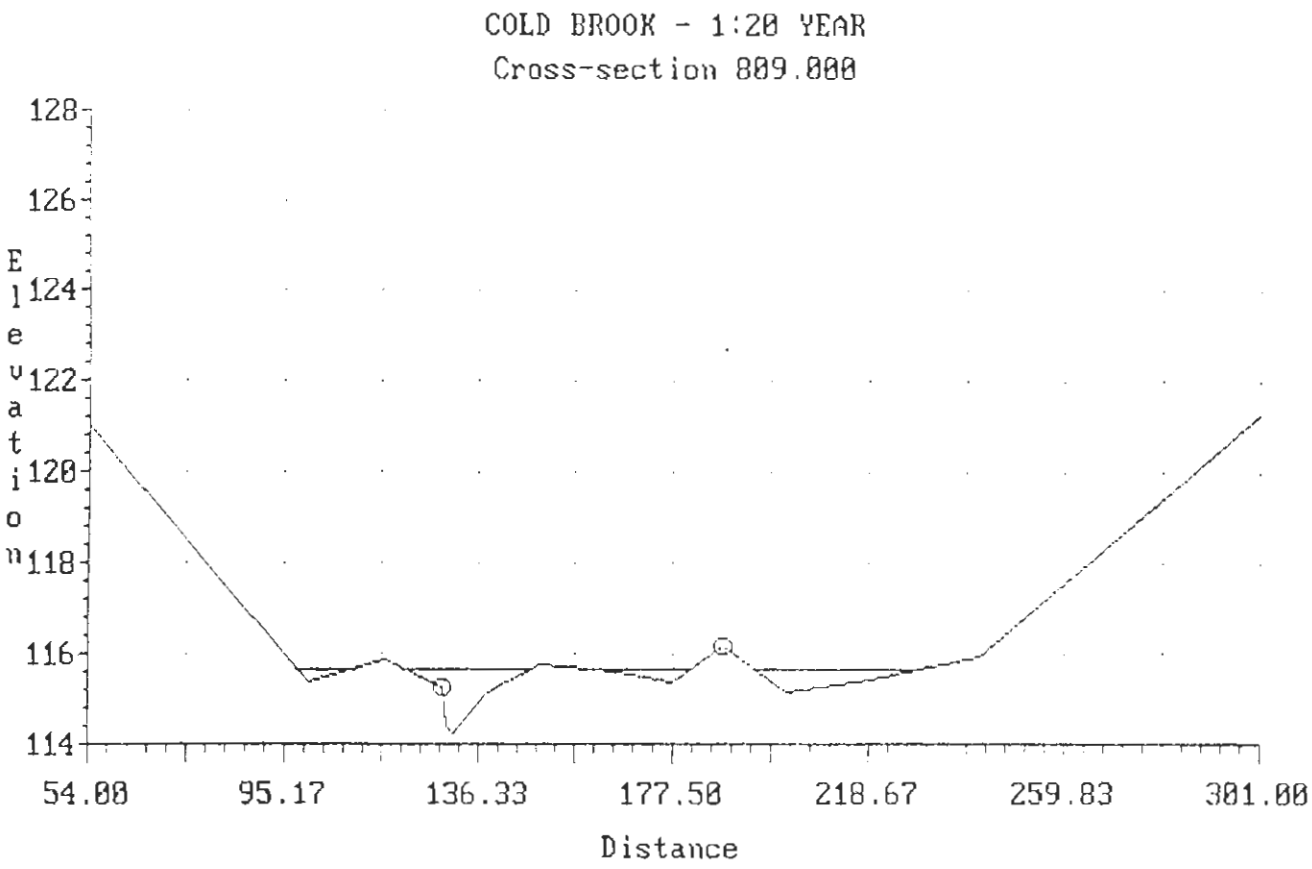

COLD BROOK - 1:20 YEAR
Cross-section 806.000
Elevation
120
118
116
114
112
110
108
106
45.00
69.00
93.00
117.00
141.00
165.00
189.00
Distance


COLD BROOK - 1:20 YEAR
Cross-section 807.000
116
115
114
113
112
111
110
109
Elevation
42.00
64.25
86.50
108.75
131.00
153.25
175.50
Distance

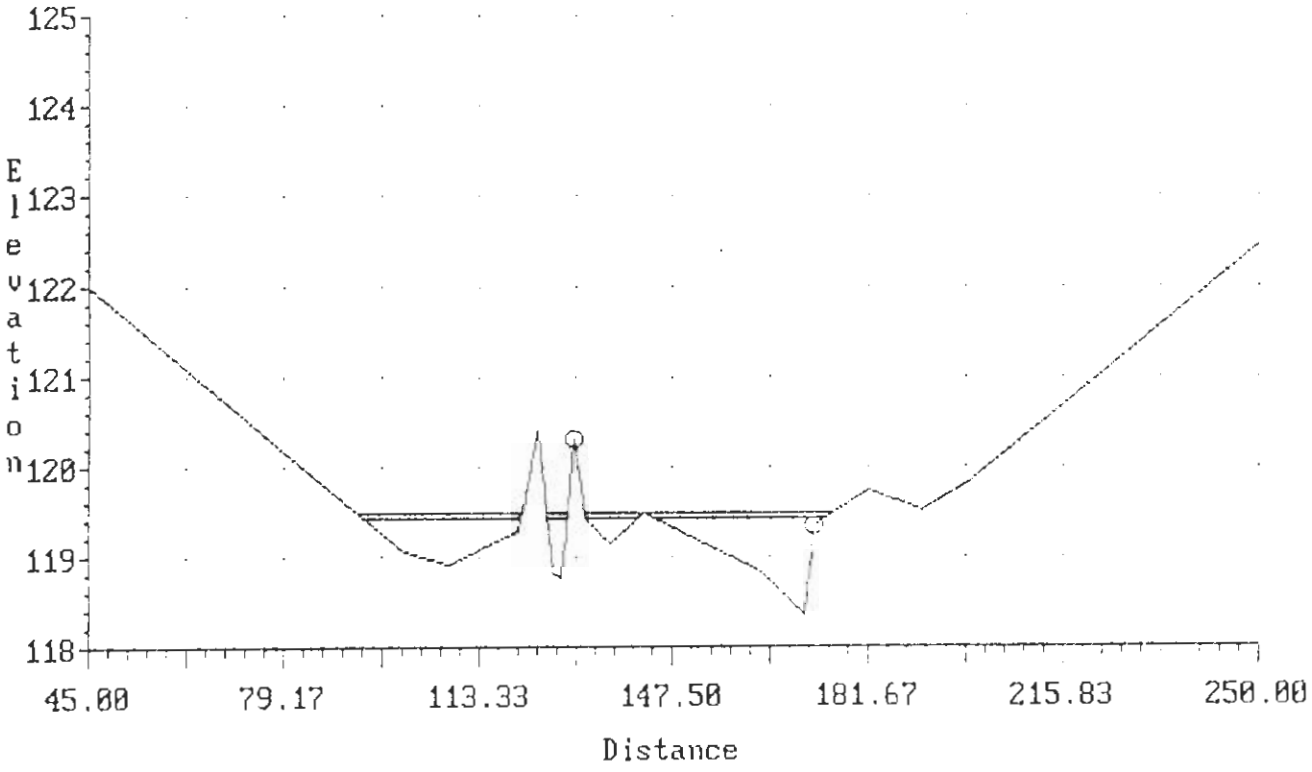
COLD BROOK - 1:20 YEAR

Cross-section 808.000




COLD BROOK - 1:20 YEAR
Cross-section 809.000
Elevation
128
126
124
122
120
118
116
114
54.00
95.17
136.33
177.50
218.67
259.83
301.00
Distance

COLD BROOK - 1:20 YEAR
Cross-section 810.000



# Appendix E

# Photographs

Photo No. 1

Looking upstream from Kin Place Bridge (B1).

Photo No. 2

Lower reaches of Blanche Brook.

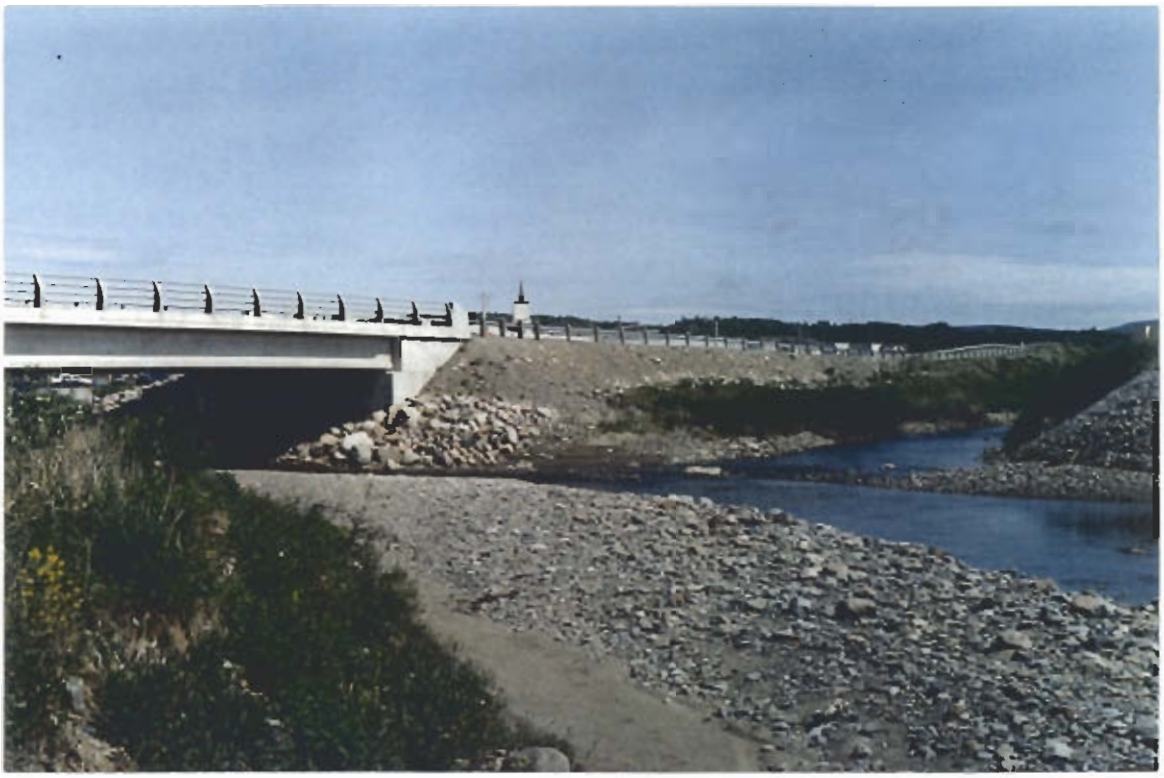


Photo No. 3

Confluence of Blanche Brook and Warm Creek downstream of bridge on Minnesota Drive (B2).

Photo No. 4

Blanche Brook between Minnesota Drive and Main Street.

Photo No. 5

Looking upstream on Blanche Brook from Main Street.

Photo No. 6

Typical channel section b/w Main Street and Hansen Highway (Route 460).

Photo No. 7

Blanche Brook looking downstream from Mill Place.

Note collapsed gabions.

Photo No. 8

Collapsed gabion structure near Valley Road.

Photo No. 9

Looking downstream on Blanche Brook from Hansen Highway bridge (B4).

Photo No. 10

Looking upstream on Blanche Brook from bridge (B4.)

Photo No. 11

Looking upstream on Warm Creek from confluence with Blanche Brook.

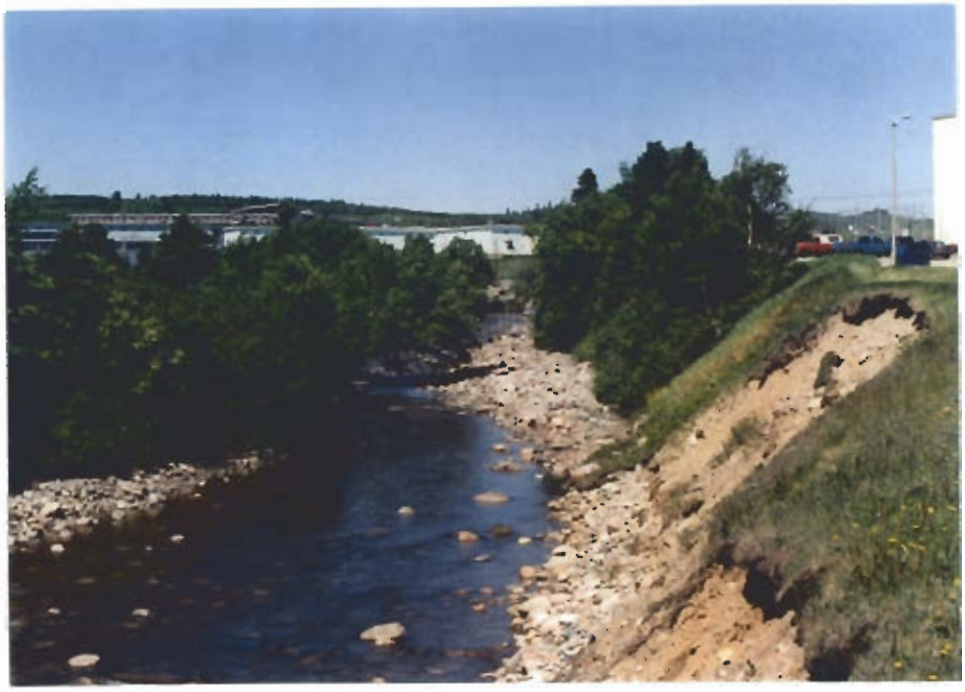


Photo No. 12

Looking upstream on Warm Creek from bridge on Mississauga Drive.

Photo No. 13

Warm Creek downstream of train trestle near Connecticut Drive.

Photo No. 14

Control structure (W2) and concrete bridge at outlet of Noels Pond (B7).

Photo No. 15

Looking downstream to Noels Pond from Route 460.

Photo No. 16

Flood plain downstream of train trestle (B8A) in Community of Noels Pond.

Photo No. 17

Looking upstream from bridge (B8) on Route 460.

Photo No. 18

Flood upstream of concrete bridge on Gaudons Brook.

Photo No. 19

Looking downstream from bridge on Gaudons Brook.

Photo No. 20

Partially collapsed gabion structure downstream of bridge on Gaudons Brook.

Photo No. 21

Looking upstream from concrete bridge on Cold Brook access road.

Photo No. 22

Looking upstream on Cold Brook.

Photo No. 23

Concrete bridge (B8) on Route 460.

Photo No. 24

Recent channel bank stabilization on Blanche Brook near New Mexico Drive.

Photo No. 25

Recent channel bank stabilization on Blanche Brook upstream of Mill Place.

Photo No. 26

New concrete bridge on Gaudons Brook.

Photo No. 27

New gabion protection downstream of new bridge on Gaudons Brook.

Photo No.

# Appendix F

# Structural Data Sheets

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Blanche Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: B1 – Kin Place |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 9.43 m | Low Chord (Soffit) Elevation: 3.70 m |
| Length of Structure: 9.32 m | Upstream Invert Elevation: –0.64 m |
| Top of Road Elevation: 3.54 m | Effective Flow Area: 39.16 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Blanche Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: B2 – Minesota Drive |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 26.76 m | Low Chord (Soffit) Elevation: 9.283 m |
| Length of Structure: 11.36 m | Upstream Invert Elevation: 5.38 m |
| Top of Road Elevation: 11.00 m | Effective Flow Area: 86.18 m2 |

**NOTES:**

**PHOTOGRAPHIC PRESENTATION**

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Blanche Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: B3 – Main Street |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 24.40 m | Low Chord (Soffit) Elevation: 11.723 m |
| Length of Structure: 16.70 m | Upstream Invert Elevation: 8.11 m |
| Top of Road Elevation: 13.49 m | Effective Flow Area: 84.90 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Blanche Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: B4 – Hansen Highway |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 21.10 m | Low Chord (Soffit) Elevation: 29.51 m |
| Length of Structure: 20.0 m | Upstream Invert Elevation: 25.94 m |
| Top of Road Elevation: 31.26 m | Effective Flow Area: 72.18 m2 |

**NOTES:**

**PHOTOGRAPHIC PRESENTATION**

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Warm Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: B5 – Carolina Ave |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 10.12 m | Low Chord (Soffit) Elevation: 8.49 m |
| Length of Structure: 7.72 m | Upstream Invert Elevation: 7.10 m |
| Top of Road Elevation: 9.603 m | Effective Flow Area: 14.07 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Noels Pond Community | Map Sheet No.: 1N14 – 111 |
| Location: Warm Brook | Structure: B7 – Connecticut Drive |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 17.09 m | Low Chord (Soffit) Elevation: 25.81 m |
| Length of Structure: 8.58 m | Upstream Invert Elevation: 23.61 m |
| Top of Road Elevation: 26.80 m | Effective Flow Area: 27.89 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Warm Brook | Map Sheet No.: 1N14 – 111 |
| Location: Noels Pond Community | Structure: B7A–Conn. Dr. – Railway Trestle |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 10.69 m | Low Chord (Soffit) Elevation: 26.35 m |
| Length of Structure: 7.35 m | Upstream Invert Elevation: 23.76 m |
| Top of Road Elevation: N\A m | Effective Flow Area: 25.19 m2 |

**NOTES:**

**PHOTOGRAPHIC PRESENTATION**

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Warm Brook | Map Sheet No.: 1N14 – 111 |
| Location: Noels Pond Inlet | Structure: B7B – Route 490 |

## A. SPECIFICATIONS

| | |
|---|---|
| Type: (CSP 6200 x 3900 Arch) m | Low Chord (Soffit) Elevation: N\A m |
| Length of Structure: 28.63 m | Upstream Invert Elevation: 19.56 m |
| Top of Road Elevation: 25.22 m | Effective Flow Area: 18.4 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Warm Brook | Map Sheet No.: 1N14 – 111 |
| Location: Noels Pond Inlet | Structure: B7B – Route 490 |

## A. SPECIFICATIONS

| | |
|---|---|
| Type: CSP#2 (CSP#3) 2400 mm Dia. | Low Chord (Soffit) Elevation: N\A m |
| Length of Structure: 30.02 (30.34) m | U/S Invert Elev.: 20.64 (20.23) m |
| Top of Road Elevation: 25.22 (25.22) m | Effective Flow Area: 4.52 (4.52) m2 |

**NOTES:**
CSP#2 & CSP#3 are in Background. CSP#1 is in Foreground.

**PHOTOGRAPHIC PRESENTATION**

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Noels Pond Community | Map Sheet No.: 1N14 – 111 |
| Location: B8 – Route 460 | Structure: Concrete Box Culvert |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 22.75 m | Low Chord (Soffit) Elevation: 25.81 m |
| Length of Structure: 8.5 m | Upstream Invert Elevation: 23.65 m |
| Top of Road Elevation: 26.81 m | Effective Flow Area: 45.05 m2 |

NOTES:

PHOTOGRAPHIC PRESENTATION

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Cold Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville (Cold Brook) | Structure: Concrete Bridge |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 11.41 m | Low Chord (Soffit) Elevation: 106.40 m |
| Length of Structure: 9.74 m | Upstream Invert Elevation: 104.02 m |
| Top of Road Elevation: 107.46 m | Effective Flow Area: 25.84 m2 |

**NOTES:**

**PHOTOGRAPHIC PRESENTATION**

# STRUCTURAL DATA SHEET

| | |
|---|---|
| Water Course: Gaudons Brook | Map Sheet No.: 1N14 – 111 |
| Location: Stephenville | Structure: Concrete Bridge (Damaged) |

## A. SPECIFICATIONS

| | |
|---|---|
| Span: 9.81 m | Low Chord (Soffit) Elevation: 14.05 m |
| Length of Structure: 10.13 m | Upstream Invert Elevation: m |
| Top of Road Elevation: 14.63 m | Effective Flow Area: m2 |

**NOTES:**

**PHOTOGRAPHIC PRESENTATION**

# Appendix G

# Velocity Measurement Data Sheets

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Kippens | Meter Setting: 5 Revelutions/Beep |
| River: Gaudons Brook | Channel Width: 5.0 m |
| Date: July 17/95 | Number of Subareas: 5 |
| Meter: Price 622 A | NOTES: |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m ^ 2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m ^ 3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.24 | 1 | 0.24 | 0.017 | 0.016 | 0.004 |
| 2 | 0.44 | 1 | 0.44 | 0.367 | 0.252 | 0.111 |
| 3 | 0.3 | 1 | 0.3 | 0.258 | 0.179 | 0.054 |
| 4 | 0.17 | 1 | 0.17 | 0.283 | 0.196 | 0.033 |
| 5 | 0.1 | 1 | 0.1 | 0.150 | 0.106 | 0.011 |
| | | | | Total Flow(m ^ 3/sec): | | 0.212 |

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Kippens | Meter Setting: 5 Revelutions/Beep |
| River: Gaudons Brook | Channel Width: 5.0 m |
| Date: July 25/95 | Number of Subareas: 5 |
| Meter: Price 622 A | NOTES: |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m^2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m^3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.3 | 1 | 0.3 | 0.150 | 0.106 | 0.032 |
| 2 | 0.5 | 1 | 0.5 | 1.000 | 0.680 | 0.340 |
| 3 | 0.4 | 1 | 0.4 | 0.717 | 0.488 | 0.195 |
| 4 | 0.3 | 1 | 0.3 | 0.417 | 0.286 | 0.086 |
| 5 | 0.3 | 1 | 0.3 | 0.533 | 0.365 | 0.109 |
| | | | | Total Flow(m^3/sec): | | 0.762 |

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Kippens | Meter Setting: 5 Revelutions/Beep |
| River: Gaudons Brook | Channel Width: 5.0 m |
| Date: Sept 20/95 | Number of Subareas: 5 |
| Meter: Price 622 A | NOTES: |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m ^ 2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m ^ 3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.3 | 1 | 0.3 | 0.050 | 0.038 | 0.011 |
| 2 | 0.4 | 1 | 0.4 | 0.667 | 0.455 | 0.182 |
| 3 | 0.35 | 1 | 0.35 | 0.500 | 0.342 | 0.120 |
| 4 | 0.25 | 1 | 0.25 | 0.467 | 0.319 | 0.080 |
| 5 | 0.15 | 1 | 0.15 | 0.200 | 0.139 | 0.021 |
| | | | | Total Flow(m ^ 3/sec): | | 0.414 |

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Cold Brook | Meter Setting: 5 Revelutions/Beep |
| River: Cold Brook | Channel Width: 4.4 |
| Date: July 16/95 | Number of Subareas: 5 |
| Meter: Price 622 A | NOTES: |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m ^ 2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m ^ 3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.21 | 1.1 | 0.231 | 0.125 | 0.089 | 0.020 |
| 2 | 0.3 | 1.1 | 0.33 | 0.200 | 0.139 | 0.046 |
| 3 | 0.29 | 1.1 | 0.319 | 0.300 | 0.207 | 0.066 |
| 4 | 0.11 | 1.1 | 0.121 | 0.033 | 0.027 | 0.003 |
| | | | | Total Flow(m ^ 3/sec): | | 0.136 |

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Cold Brook | Meter Setting: 5 Revelutions/Beep |
| River: Cold Brook | Channel Width: 9.0 |
| Date: July 25/95 | Number of Subareas: 8 |
| Meter: Price 622 A | NOTES:<br>1. 50 mm of rain (approx) fell previous day |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m ^ 2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m ^ 3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.35 | 1 | 0.35 | 0.483 | 0.331 | 0.116 |
| 2 | 0.65 | 1.1 | 0.715 | 0.920 | 0.626 | 0.447 |
| 3 | 0.6 | 1.1 | 0.66 | 1.085 | 0.737 | 0.486 |
| 4 | 0.45 | 1 | 0.45 | 1.333 | 0.905 | 0.407 |
| 5 | 0.2 | 1 | 0.2 | 1.000 | 0.680 | 0.136 |
| 6 | 0.2 | 1 | 0.2 | 0.833 | 0.567 | 0.113 |
| 7 | 0.15 | 1 | 0.15 | 0.467 | 0.319 | 0.048 |
| 8 | 0.05 | 1 | 0.05 | 0.333 | 0.229 | 0.011 |
| | | | | Total Flow(m ^ 3/sec): | | 1.766 |

# VELOCITY MEASUREMENT DATA SHEET

| | |
|---|---|
| Community: Cold Brook | Meter Setting: 5 Revelutions/Beep |
| River: Cold Brook | Channel Width: 8.0 |
| Date: Sept 20/95 | Number of Subareas: 8 |
| Meter: Price 622 A | NOTES:<br>1. 50 mm of rain (approx) fell previous day |

| Subarea No. | Average Depth(m) | Width (m) | Subarea (m^2) | Meter Reading (rev/sec) | Velocity (m/s) | Subarea Flow (m^3/sec) |
|---|---|---|---|---|---|---|
| 1 | 0.38 | 1.14 | 0.43 | 0.433 | 0.297 | 0.129 |
| 2 | 0.45 | 1.14 | 0.51 | 0.467 | 0.319 | 0.164 |
| 3 | 0.48 | 1.14 | 0.55 | 0.867 | 0.590 | 0.323 |
| 4 | 0.3 | 1.14 | 0.34 | 0.593 | 0.405 | 0.139 |
| 5 | 0.12 | 1.14 | 0.14 | 0.317 | 0.218 | 0.030 |
| 6 | 0.08 | 1.14 | 0.09 | 0.250 | 0.173 | 0.016 |
| 7 | 0.04 | 1.14 | 0.05 | 0.250 | 0.173 | 0.008 |
| | | | | Total Flow(m^3/sec): | | 0.809 |

# Appendix H

# Crest Gauge Data Sheets

# CREST GAUGE DATA SHEET

| | |
|---|---|
| Community: Kippens | Geoditic Ref. #: CLM 938019 |
| River: Gaudons Brook | Base Elevation(m): 20.29 |
| Location: X–Section 710 | NOTES: |

| Measurment # | Water Depth @ Crest Gauge (m) | Elevation (m) | Date |
|---|---|---|---|
| 1 | 0.355 | 20.645 | July 17, 1995 |
| 2 | 0.5 | 20.79 | July 25, 1995 |
| 3 | 0.45 | 20.74 | Sept. 20, 1995 |

# CREST GAUGE DATA SHEET

| | |
|---|---|
| Community: Cold Brook | Geoditic Ref. #: CLM 938064 |
| River: Cold Brook | Base Elevation(m): 104.26 |
| Location: X–Section 802 | NOTES: |

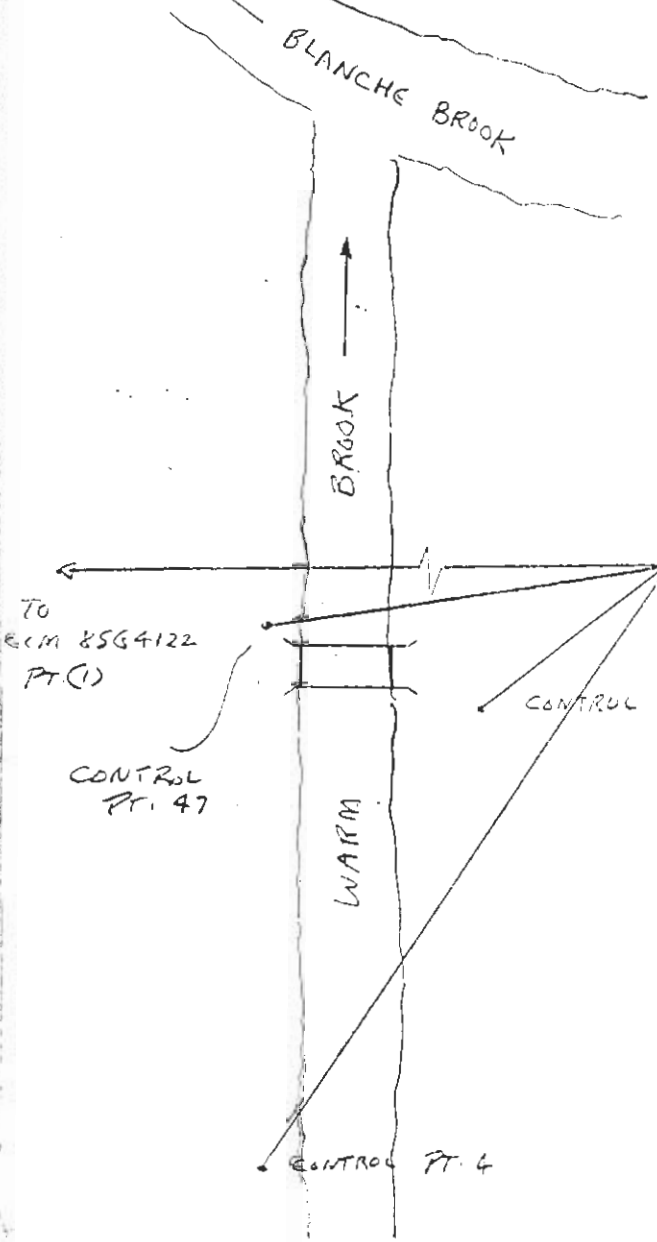
| Measurment # | Water Depth @ Crest Gauge (m) | Elevation (m) | Date |
|---|---|---|---|
| 1 | 0.35 | 104.61 | July 17, 1995 |
| 2 | 0.6 | 104.86 | July 25, 1995 |
| 3 | 0.5 | 104.76 | Sept. 20, 1995 |

# Appendix I

# Detailed Survey Information

FIELD SURVEY
WARM BROOK
STEPHENVILLE, NF
JUNE /95

CONTROL NETWORK
JUNE 26/95



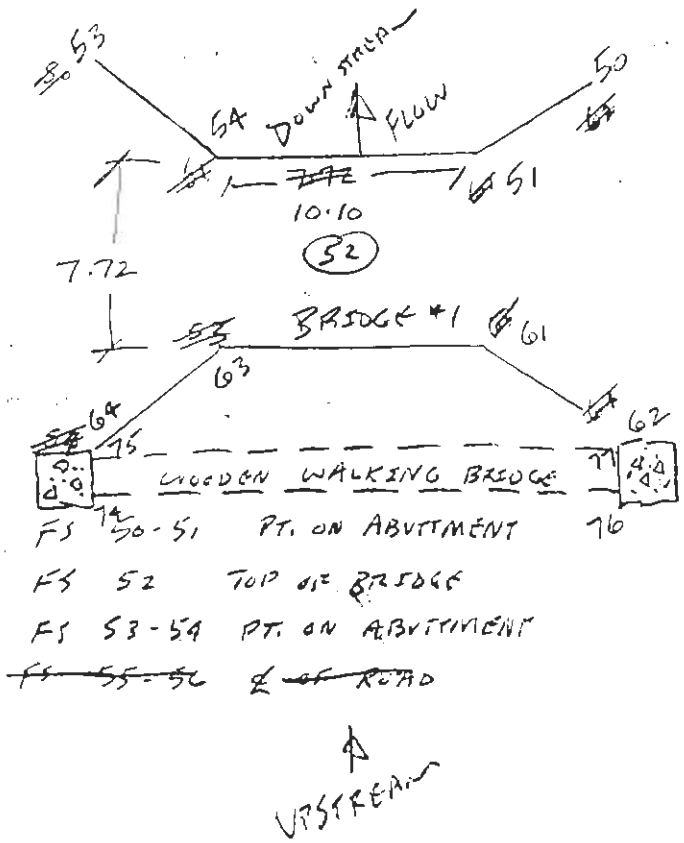

⊼ @ PT 2 ; BS PT. 1

| | | |
|---|---|---|
| FS | CONTROL PT. 3 | LOOKING |
| | " " 4 | UPSTREAM |
| FS | PT 5 - 18 | TRANSECT # 21 LEFT → RT |
| FS | PT 19 - 30 | TRANSECT # 22 RT → LEFT |
| | NOTE: PT. 23 = EROSSION LIMITS | |
| FS | 31 - 40 | DOWNSTREAM SECTION @ BRIDGE LEFT → RT |
| FS | 41 - | APPURTENANCES |
| FS | 42 - 46 | TOPO - LOW LYING AREA |
| FS | 47 | CONTROL PT. |
| FS | 48 - 49 | APPURTENANCES |
| FS | 50 - | TOPO SHOTS |

CHURCH STEEPLE ∠ RT = 235° ~~24~~ 28' 30"
CENTER
(PENTECOSTAL CHURCH)

JUNE 26/95
WARM BROOK

⊼ @ CONTROL PT 47 ; BS CONTROL PT. 2



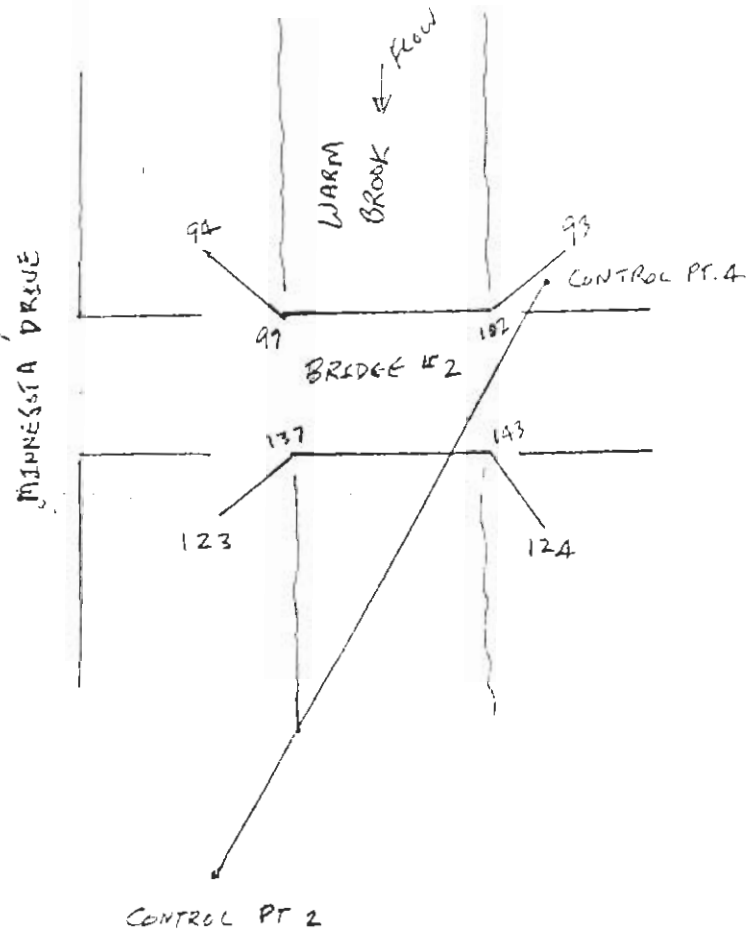

FS 50 - 51 PT. ON ABUTMENT
FS 52 TOP OF BRIDGE
FS 53 - 54 PT. ON ABUTMENT
~~FS 55 - 56 ℄ OF ROAD~~

⊼ @ CONTROL PT. 3 ; BS CONTROL PT 2

| | |
|---|---|
| FS 55 - 56 | ℄ OF ROAD |
| FS 57 - 60 | UPSTREAM TRANSECT BRIDGE #1 |
| 67 - 72 | LEFT → RT |
| FS PT. 61 - 64 | EDGE OF ABUTMENTS |
| FS PT. 65 | BOTTOM CHORD OF CONCRETE BRIDGE |
| FS PT. 66 | BOTTOM CHORD WOODEN BRIDGE |
| FS 73 | HP # 7358674 |
| FS 74 - 77 | CORNER OF CONCRETE FOR WOODEN BRIDGE |
| FS 78 | HP # 7165400 |
| FS 79 - 83 | TOPO ON CANADIAN TIRE PARKING LOT |
| FS 84 - 92 | TRANSECT 23 RT → LEFT |

JUNE 26/95

WARM BROOK




⊼ @ CONTROL PT. 4; CONTROL PT. 2

| | |
|---|---|
| FS 93-94 | END OF WING WALL |
| FS 95-106 | TRANSECT 24 LEFT→RT UPSTREAM @ BRIDGE #2 |
| 95 | TOP OF WINGWALL |
| 102 | " " " |
| 100-103 | ℄ RD |
| 107 | ℄ ROAD TOP OF BRIDGE |
| 109 | BOTTOM CHORD UPSTREAM |
| 110-121 | TRANSECT 25 RT→LEFT |
| 112 | EDGE OF BROOK |
| [illegible] | " " " |
| 122 | CONTROL PT. 122 |

→ NEXT PAGE

JUNE 26/95
WARM BROOK

TT @ CONTROL PT. 122; BS CONTROL PT. 4

| | |
|---|---|
| FS 123 - 124 | TOP OF WINGWALLS |
| 125 | BOTTOM CHORD DOWNSTREAM |
| 126 - 127 | TOP OF STEEL RETAINING WALL |
| 128 | INVERT OUTLET 300mmφ CONCRETE CULVERT |
| 129 - 134 | TOPO ON PARKING LOT (PAVED) |
| 135 - 145 | TRANSECT DOWNSTREAM @ BRIDGE #2 LEFT → RT. |

CLM 938083
CONTROL PT. #2

CONTROL PT. 4

CONTROL PT. 158

⊼ @ PT 4 ; BS CONTROL PT 2

| | |
|---|---|
| FS PTS. 146-156 | TRANSECT ACROSS BROOK @ UPSTREAM @ WOODEN BRIDGE NEAR BRIDGE #1 LEFT → RT. |
| 149 | EDGE OF BROOK LEFT |
| 152 | EDGE OF BROOK RT |
| FS PT 157 | TOP OF WOODEN BRIDGE |
| FS PT 158 | CONTROL PT. 158 |

6

CONTROL PT. 4

CONTROL PT. 158

CONTROL PT. 159

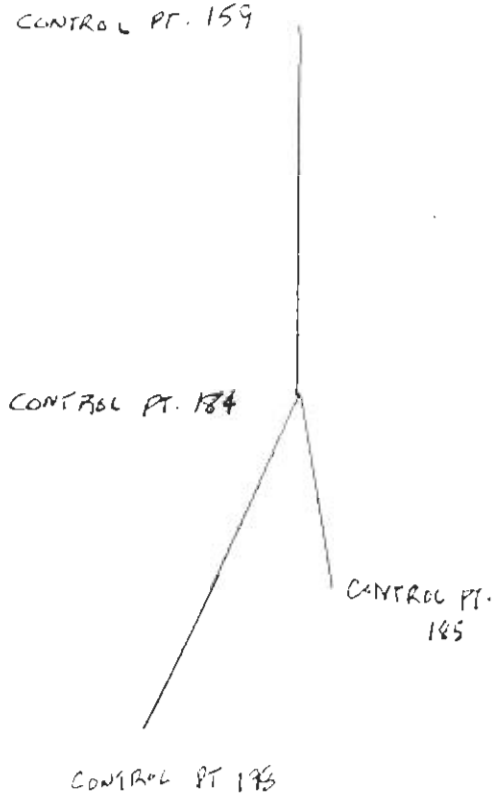
CONTROL PT. 184

⊼ @ CONTROL PT. 158; BS CONTROL PT 4

| | |
|---|---|
| FS 159 | CONTROL PT. 159 |
| FS PT 160-170 | TRANSECT # 26 LEFT → RT |
| FS 164 | EDGE OF BROOK LEFT |
| FS PT 169 | EDGE OF BROOK RT |

⊼ @ CONTROL PT 159; BS CONTROL PT 158

| | |
|---|---|
| FS [illegible] - 183 | TRANSECT # 27 LEFT → RT. |
| PT 174 | EDGE OF BROOK (LEFT) |
| PT 174 | EDGE OF BROOK (RT) |
| FS 184 | CONTROL PT. 184 |




TA @ CONTROL PT. 184; BS CONTROL PT. 159

| | | |
|---|---|---|
| FS | PT. 185 | CONTROL PT. 185 |
| BS | PT. 186 - 197 | TRANSECT 28 LEFT → RT. |
| | 196 | EDGE OF BROOK (LEFT) |
| | 195 | EDGE OF BROOK (RT) |
| FS | PT. 198 | CONTROL PT. 198 |

TA @ CONTROL PT 185, BS CONTROL PT 184

| | | |
|---|---|---|
| FS | 199 - 208 | TRANSECT 29 LEFT → RT |
| | PT - 202 | EDGE OF BROOK (LEFT) |
| | PT - 205 | EDGE OF BROOK (RT) |

CONTROL PT
184

CONTROL PT. 198

CONTROL PT. 209

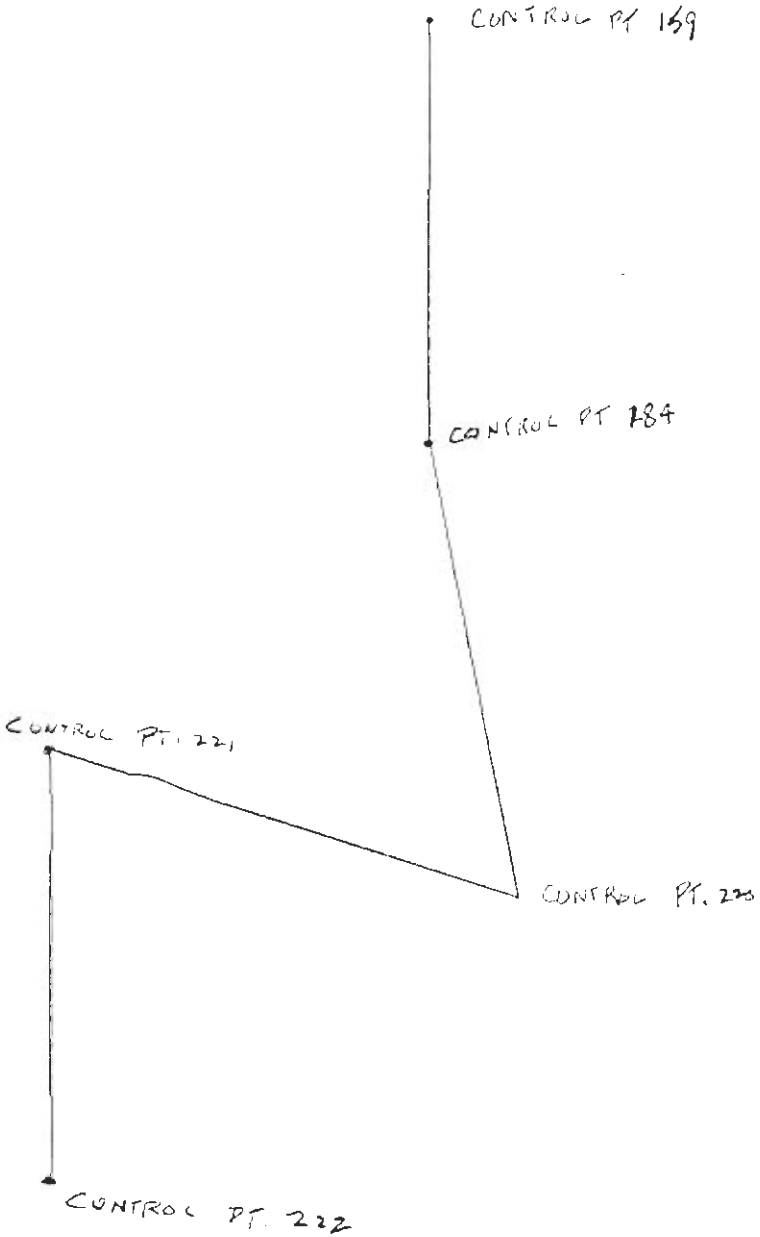
TE @ CONTROL PT. 198; BS CONTROL PT 184

FS PT. 209 — CONTROL PT 209

FS 210 - 219 — TRANSECT 30
RT → LEFT

PT. 212 — EDGE OF BROOK (RT)

PT. 217 — EDGE OF BROOK (LF)




INC @ PT 184; BS PT. 159

FS PT. 220 CONTROL PT 220

INC @ PT 220, BS PT. 184

FS PT 221 CONTROL PT 221

INC @ PT 221; BS PT. 220

FS PT. 222 CONTROL PT. 222

FS 223 - 237 TRANSECT 31 (LF → RT)

PT 229 EDGE OF BROOK (LEFT)

PT 233 EDGE OF BROOK (RT)

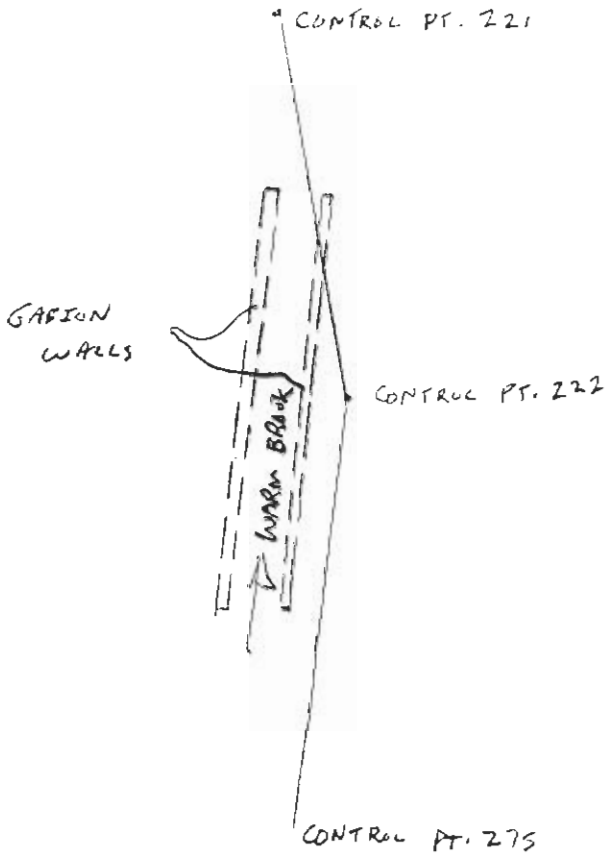
FS 238 - 252 TRANSECT 32 (LF → RT)

PT 241 EDGE OF SMALL BROOK (LEFT)

PT 243 EDGE OF SMALL BROOK (RT.)

FS PT 245 — EDGE OF ~~SMALL~~ LARGE BROOK (LEFT)

FS PT 247 — EDGE OF LARGE BROOK (RT)




FS CONTROL PT 222; BS CONTROL PT. 221

FS 253 - 266 — TRANSECT 33 (LF → RT)

PT. 257 — EDGE OF BROOK (LEFT)

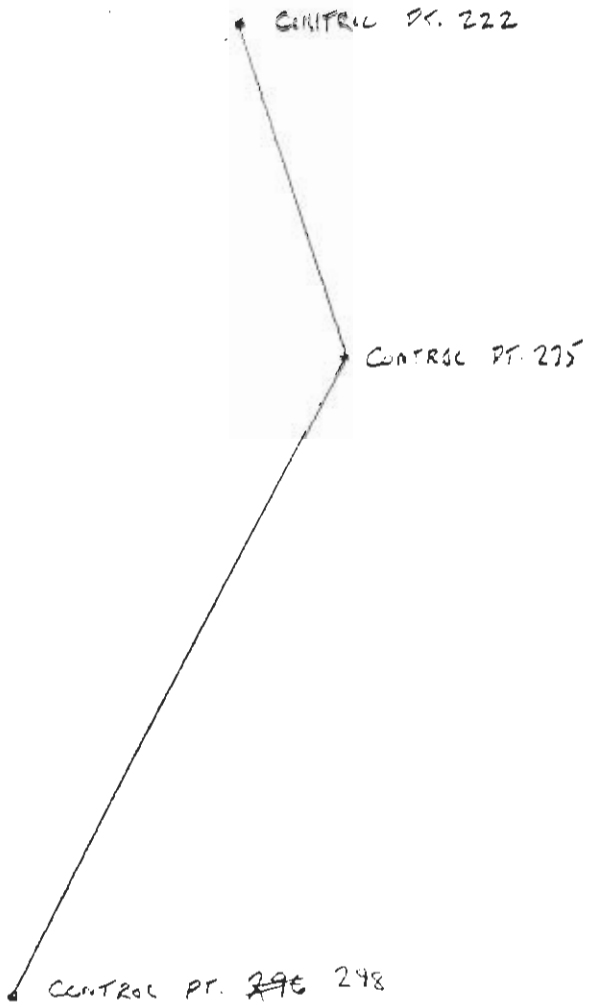
PT. 262 — EDGE OF BROOK (RT)

FS 266 - 269 — OUTSIDE TOP GABION WALL (RT SIDE)

FS 270 - 274 — OUTSIDE TOP GABION WALL (LEFT SIDE)

FS 275 — CONTROL PT. 275

JUNE 28/95
WARM BROOK




⊼ @ CONTROL PT. 275, BS PT 222

| | |
|---|---|
| FS 276 - 288 | TRANSECT 34 (LF → RT) |
| PT. 279 | EDGE OF BROOK (LEFT) |
| PT. 283 | EDGE OF BROOK (RT) |
| FS 289 - | TRANSECT 35 (LF → RT) |
| PT 290 | EDGE OF BROOK (LEFT) |
| PT. 295 | EDGE OF BROOK (RT) |
| PT ~~296~~ 298 | CONTROL PT. ~~296~~ 298 |

CONTROL PT. 275

CONTROL PT. ~~296~~ 298

CONTROL PT. ~~297~~ 299

⊼ @ PT. ~~296~~ 298; BS PT. 275

FS CONTROL PT. ~~297~~ 299

PT. 297 (TDS)

SPK CONTROL PT. 298

SPK CONTROL PT. 299

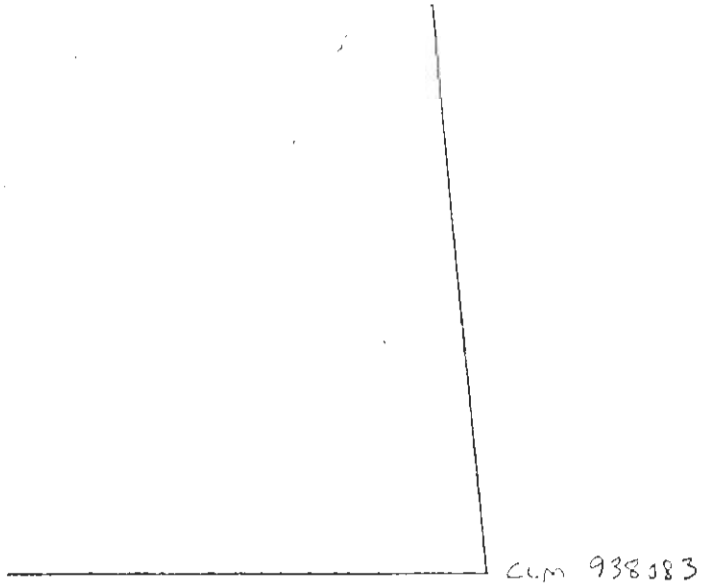
CONTROL PT 300

CONCRETE NAIL IN ASPHALT NORTH SIDE OF ROAD NEAR

CONTROL PT 301 CONCRETE NAIL IN ASPHALT WEST OF BRIDGE @ OUTLET OF NOEL'S POND

WARM BROOK
JUNE 28/95

CONTROL PT 317

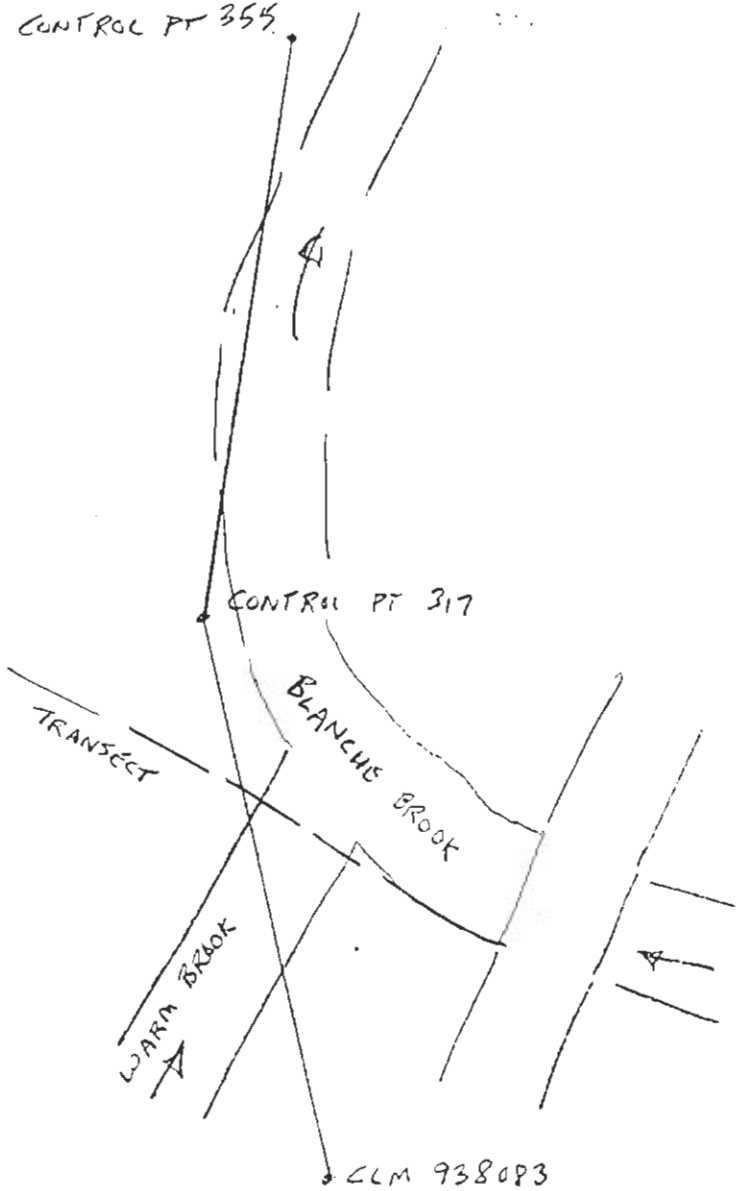



BS 2 (CLM 938083) ; BS PT. 1 (CLM 85G4122)

| | |
|---|---|
| PT 302 | TRANSECT @ CONFLUENCE OF WARM BROOK & BLANCHE BROOK |
| PT 305 | EDGE OF WARM BROOK (LEFT) |
| PT. 309 | EDGE OF WARM BROOK (RT) |
| PT. 309 | INSIDE EDGE OF GABION MAT |
| PT. 311 | CONTROL PT 317 |

Same pt.

BLANCHE BROOK
JUNE 28/95




⊼ @ CONTROL PT. 317; BS PT 2 (CLM 938083)

| | |
|---|---|
| FS 318 - 337 | TRANSECT #5 (LEFT → RT) BLANCHE BR. |
| PT. 325 | EDGE OF BROOK (LEFT) |
| PT. 331 | EDGE OF BROOK (RT) |
| FS 338 | TRANSECT 4A (LF - RT) |
| PT. 344 | EDGE OF BROOK (LEFT) |
| PT. 349 | EDGE OF BROOK (RIGHT) |
| PT. 355 | CONTROL PT 355 |

CONTROL PT. 398

CONTROL PT. 378

CONTROL PT. 355

CONTROL PT. 317

⊼ @ CONTROL PT. 355; BS CONTROL PT. 317

FS PT. 356 - 374 TRANSECT # 4 (LF → RT)

FS PT. 362 EDGE OF BROOK (LEFT)

FS PT. 368 EDGE OF BROOK (RIGHT)

PT 378 CONTROL PT. # 378

PT 375 - 377 ℄ TOP OF 400 min φ INSIDE CONCRETE WALL. POSSIBLY RETAINING WALL FOR RIVER

PT 378 CONTROL PT 378

⊼ @ CONTROL PT 378; BS CONTROL PT. 355

FS 379 TRANSECT 3 (LF → RT)

FS 386 EDGE OF BROOK (LEFT)

FS 392 EDGE OF BROOK (RT)

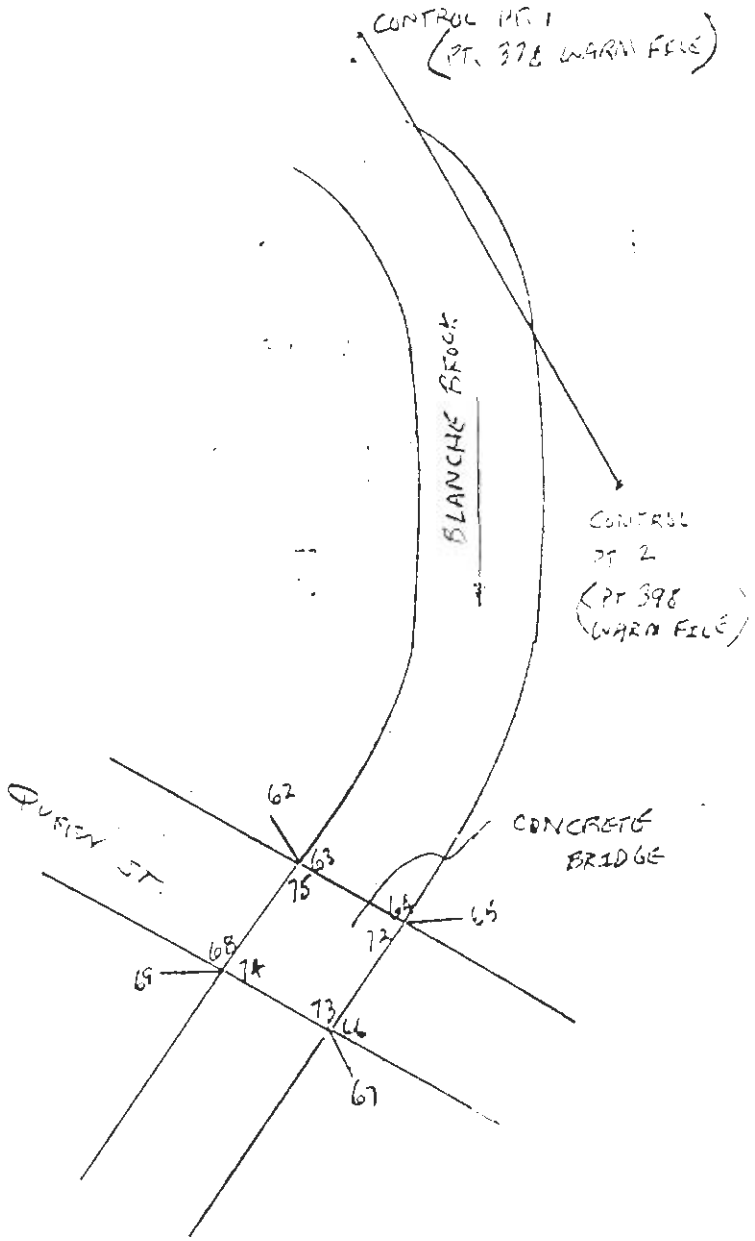
FS 395 CONTROL PT. 398

TT @ 378; BS 355

FS 399 - 409 TOP OF GABION SLOPED SECTION

JULY 13/95

BLANCHE BRIDGE



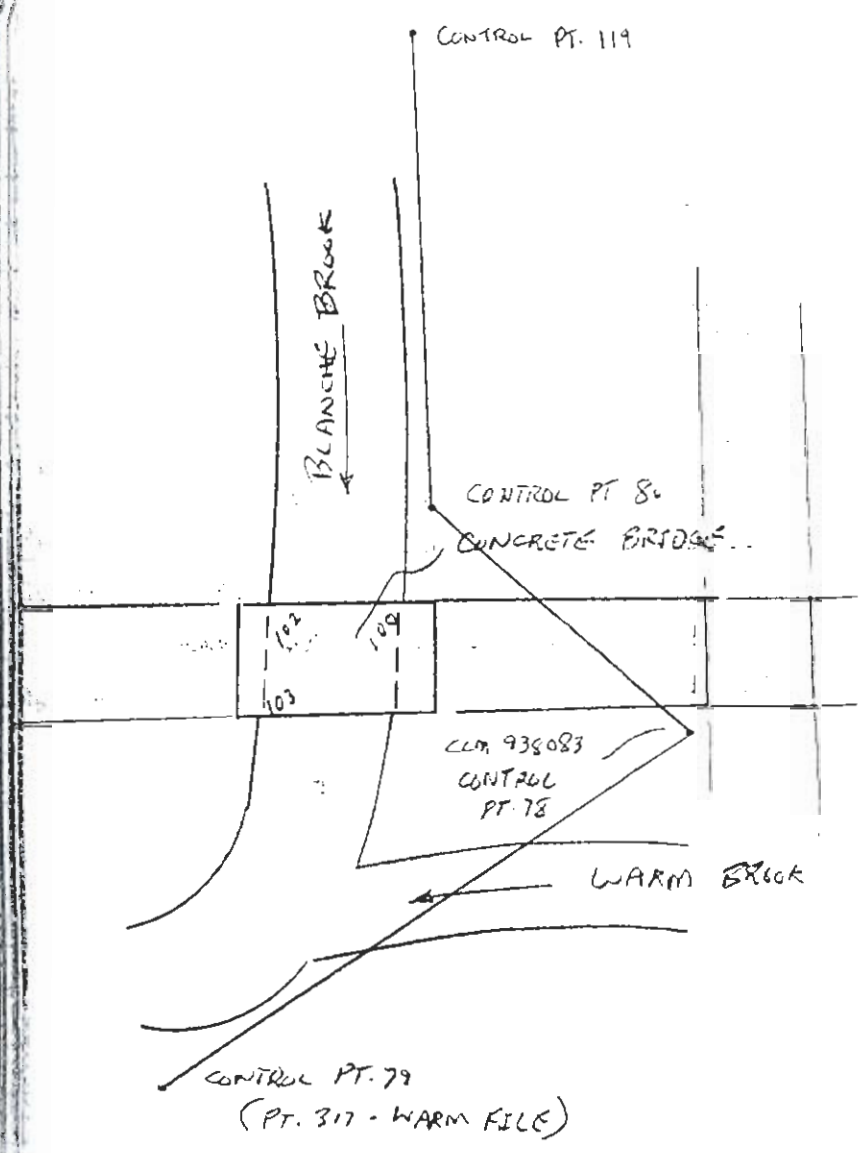

TK @ PT 2 ; BS PT 1

| | | | |
|---|---|---|---|
| FS | PT 3-23 | TRANS | 3 - INFO |
| FS | PT 24-45 | TRANS | 2 - INFO |
| FS | PT 46-56 | TRANS | 1 |

TRANS 1 IS @ UPSTREAM EDGE OF BRIDGE

TRANS LEFT + RIGHT LOOKING UP

| | | |
|---|---|---|
| FS | 57-61 | ℄ ROAD |
| FS | 62-69 | PT. ON WINGWALLS |
| FS | 70-71 | TOP END OF GABION |
| FS | 72-75 | BRIDGE CORNER |
| FS | 76 | OUTLET 700 mm ϕ SEWER OUTFALL (PVC) |
| FS | 77-[illegible] | OUTLET 900 mm ϕ CSP |



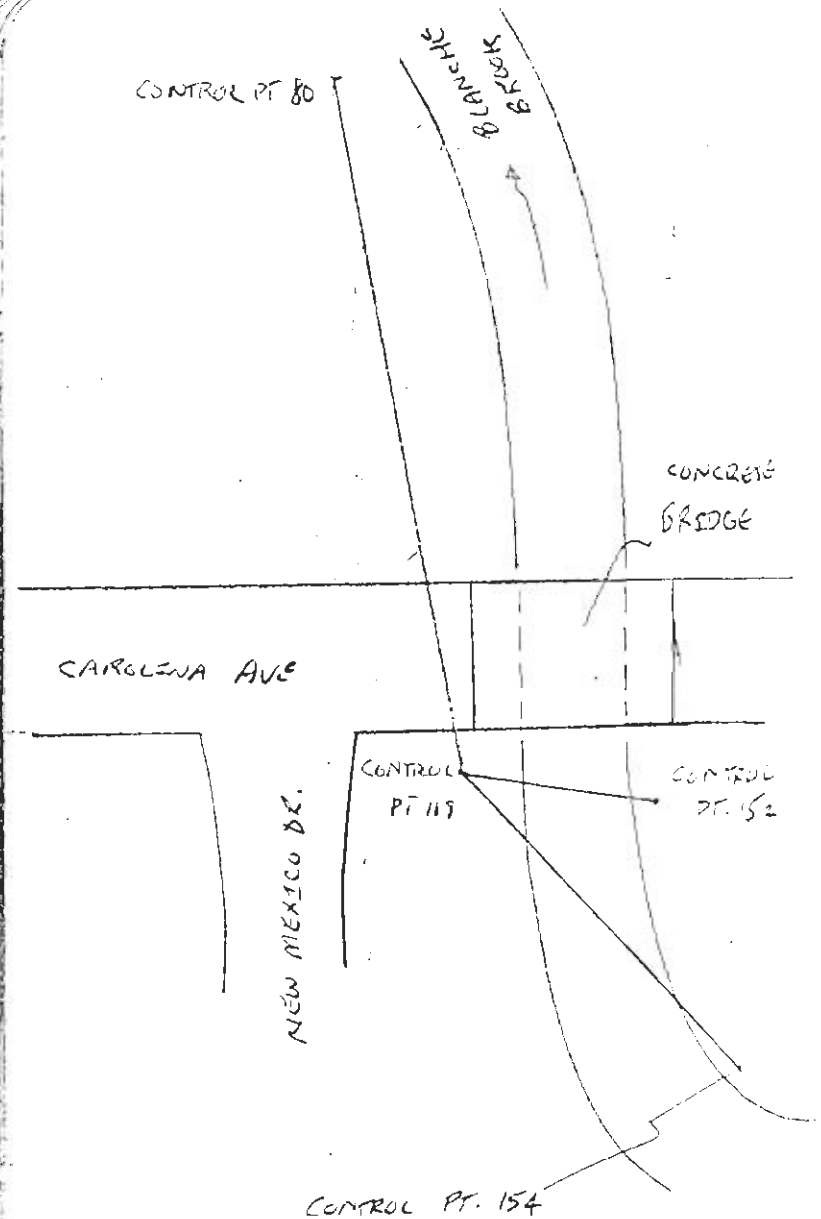

NOTE: CONTROL PT 78 IS PT. # 2 IN WARM FILE
" " 79 IS PT # 317 " " "

TT @ CONTROL PT. 78; BS CONTROL PT. 79

FS CONTROL PT. 80

TT @ CONTROL PT. 80; BS PT. 78

| | | |
|---|---|---|
| FS 81-84 | | TOP CORNERS OF BRIDGE |
| FS 85-87 | | ℄ ROAD |
| FS 88-99 | LEFT → RT | TRANS 6 @ BRIDGE (UPSTREAM) |
| FS 100- | | BOTTOM CORNER OF BRIDGE |
| FS 101 | | BOTTOM CHORD |
| FS 102-103 | | BOTTOM CORNER OF BRIDGE |
| FS 104-118 | LEFT → RT. | TRANS - 7 |
| FS - 119 | | CONTROL PT. 119 |

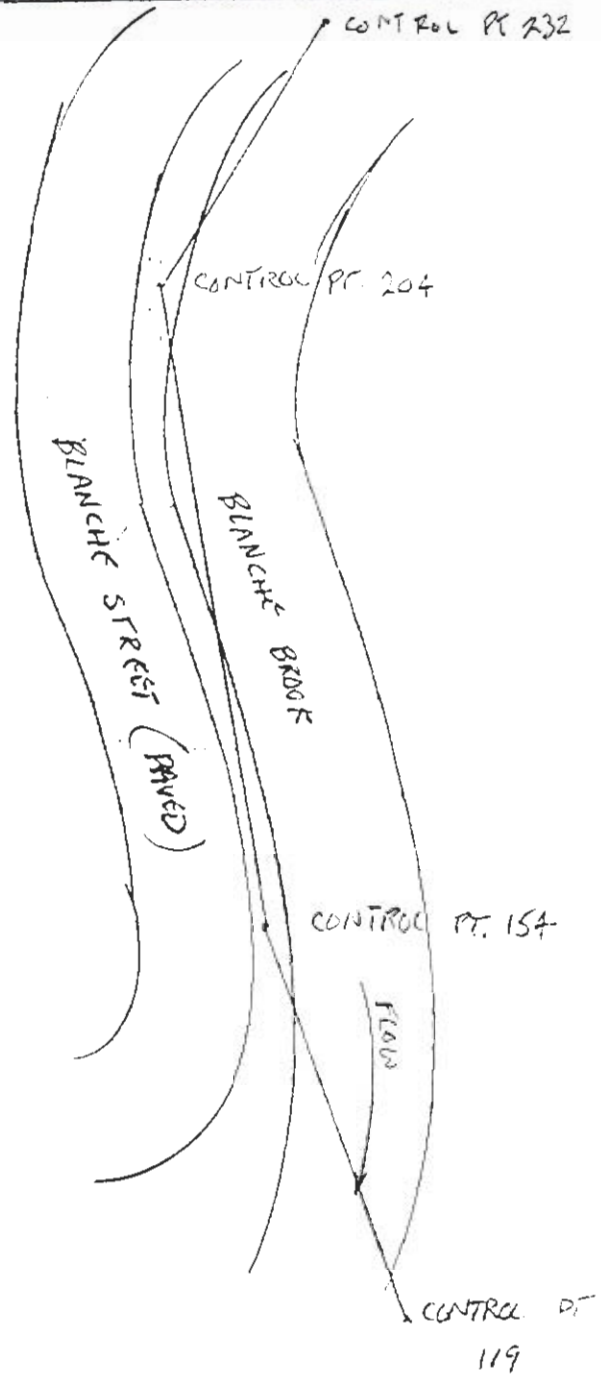



FS @ CONTROL PT. 119, BS CONTROL PT 80

| | |
|---|---|
| FS 120 - 133 | TRANS - 8 (LEFT + RT) |
| FS 134 - 137 | CORNERS OF BRIDGE (TOP) |
| FS 138 - 143 | EDGE OF ROAD |
| FS 144 - 147 | EDGE OF ABUTTMENT (OLD) |
| FS 148 - 151 | " " " |
| FS 152 | CONTROL PT. 152 |
| FS 153 | OUTLET 1200 MM CSP |
| FS 154 | CONTROL PT. 154 |

FS @ CONTROL PT. 152 ; BS CONTROL PT. 119

| | |
|---|---|
| FS 155 - 162 ; 164 - 165 | TRANS 9 (LEFT + RT) @ BRIDGE UPSTREAM |
| FS 157 & 166 | BOTTOM BRIDGE CORNERS |
| FS 163 | BOTTOM CHORD OF BRIDGE |
| FS 169 | FF OF HOUSE |
| FS 170 | CATCH BASIN |
| FS 171 - 174 | CORNER CONCRETE TANK |

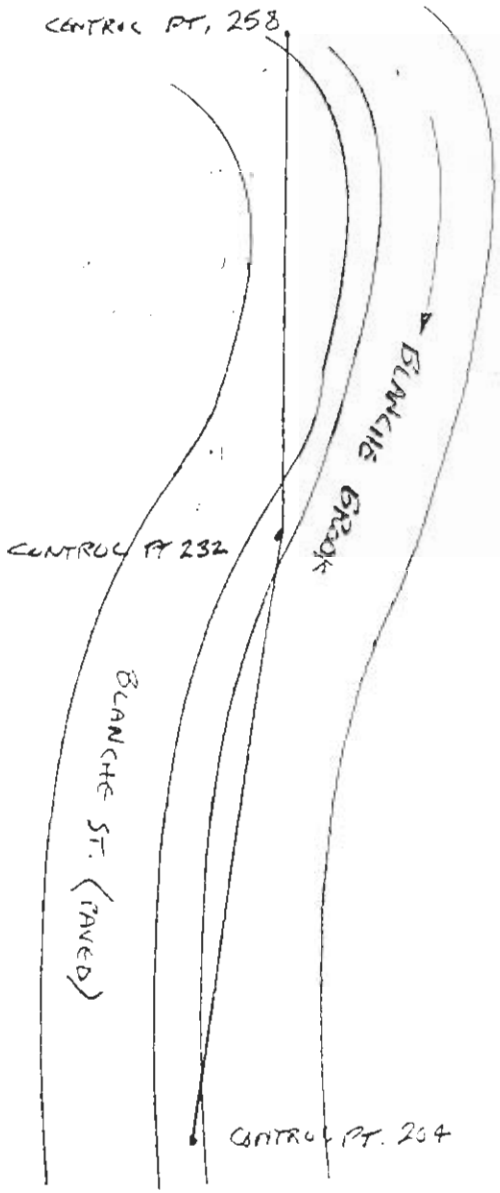



TE CONTROL PT. 154; BS CONTROL PT. 119

| | |
|---|---|
| FS 175 - 187 | TRANS 10 |
| FS 188 | HP # 7139819 |
| FS 189 | HP # 3253833 |
| FS 190 | FF BLDG. KINGDOM HALL (CRAWL SPACE) |
| FS 191 - 203 | TRANS - 11 |
| FS 204 | CONTROL PT. 204 |

TE CONTROL PT. 204; BS CONTROL PT. 154

| | |
|---|---|
| FS 205 - 219 | TRANS 12 |
| FS 220 - | GABION END TOP |
| FS 221 - 229 | FT. ON GABIONS |
| FS 230 | GABION END - TOP |
| FS 231 | 900 mm ϕ CSP OUTLET |
| FS 232 | CONTROL PT 232 |



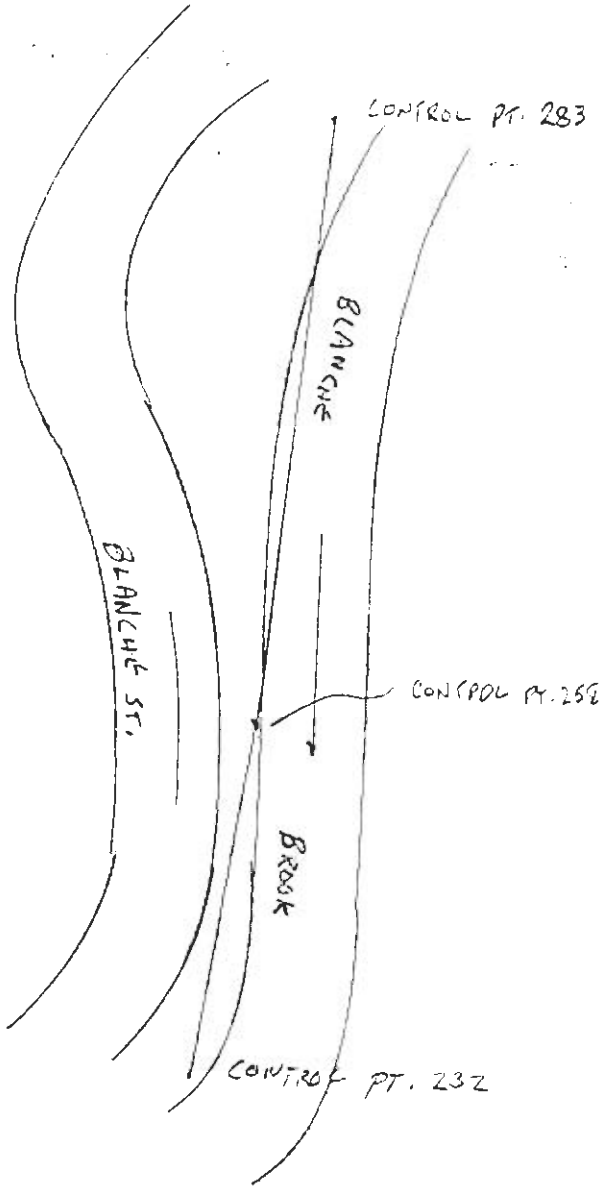

TR @ CONTROL PT. 232; BS CONTROL PT. 204

FS PT 233 - 244 TRANS 13

NOTE: BANK ON RT SIDE OF STREAM HAS INCURRED WASH-OUT ON LAST RAIN STORM.

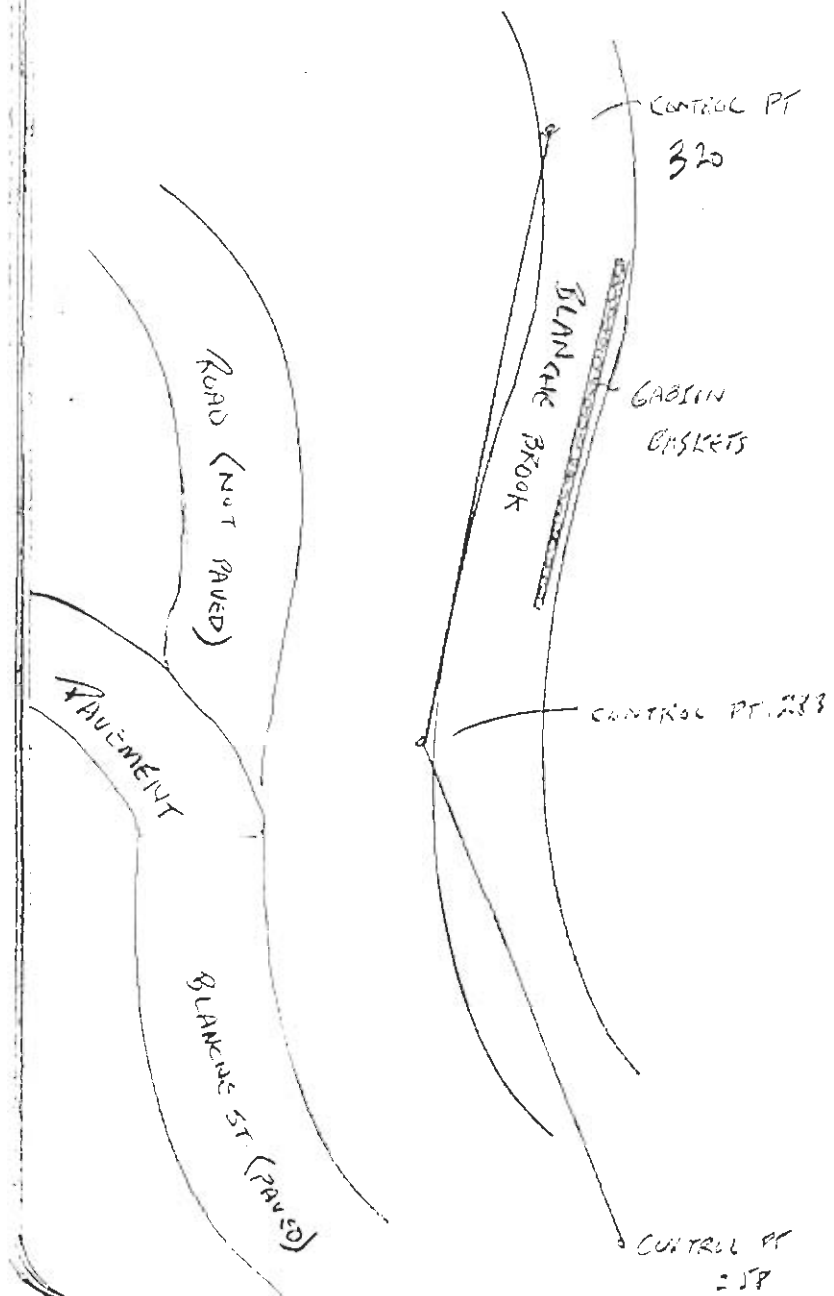
FS PT 245 - 257 TRANS 14

FS PT 258 CONTROL PT. 258



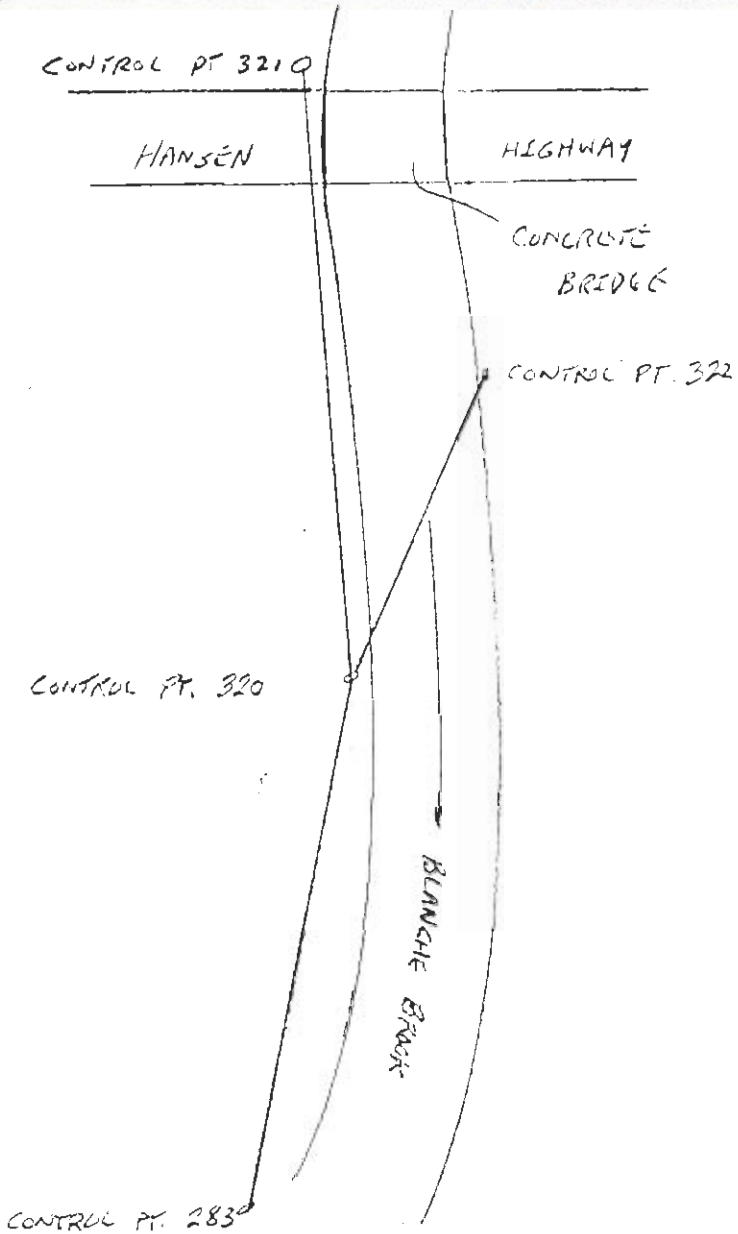

TA @ CONTROL PT. 258; BS CONTROL PT. 232

| | | | |
|---|---|---|---|
| FS | 259 - 270 | | TRANS - 15 |
| FS | 271 - 281 | | TRANS - 16 |
| ~~FS~~ | ~~282~~ | DOSD POINT | ~~CONTROL PT. 282~~ |
| FS | 283 | | CONTROL PT. 283 |




TN @ CONTROL PT. 283; BS CONTROL PT 258

| | | |
|---|---|---|
| FS | PT. 284 - 286 | TRANS 16 |
| FS | PT. 286 - 299 | TRANS 17 |
| FS | PT. 300 - 304 | DAMAGED GABION - TOP |
| FS | PT. 305 - 310 | GABION WALL (INTACT) TOP |
| FS | PT. 311 - 316 | DAMAGED GABION TOP |
| FS | PT. 317 - 319 | GABION WALL (INTACT) TOP |
| FS | PT. 320 | CONTROL PT. 320 |




FS CONTROL PT. 320; BS CONTROL PT. 320

| | | |
|---|---|---|
| FS | 321 - | CONTROL PT. 321 |
| FS | 322 - | CONTROL PT. 322 |
| FS | 323 - 335 | TRANS - 18 |

NOTE PT 320 IS ON TRANS 18 @ EDGE OF BK.

| | | |
|---|---|---|
| FS | 336 | FF HOUSE |
| FS | 337 | FF SHED |

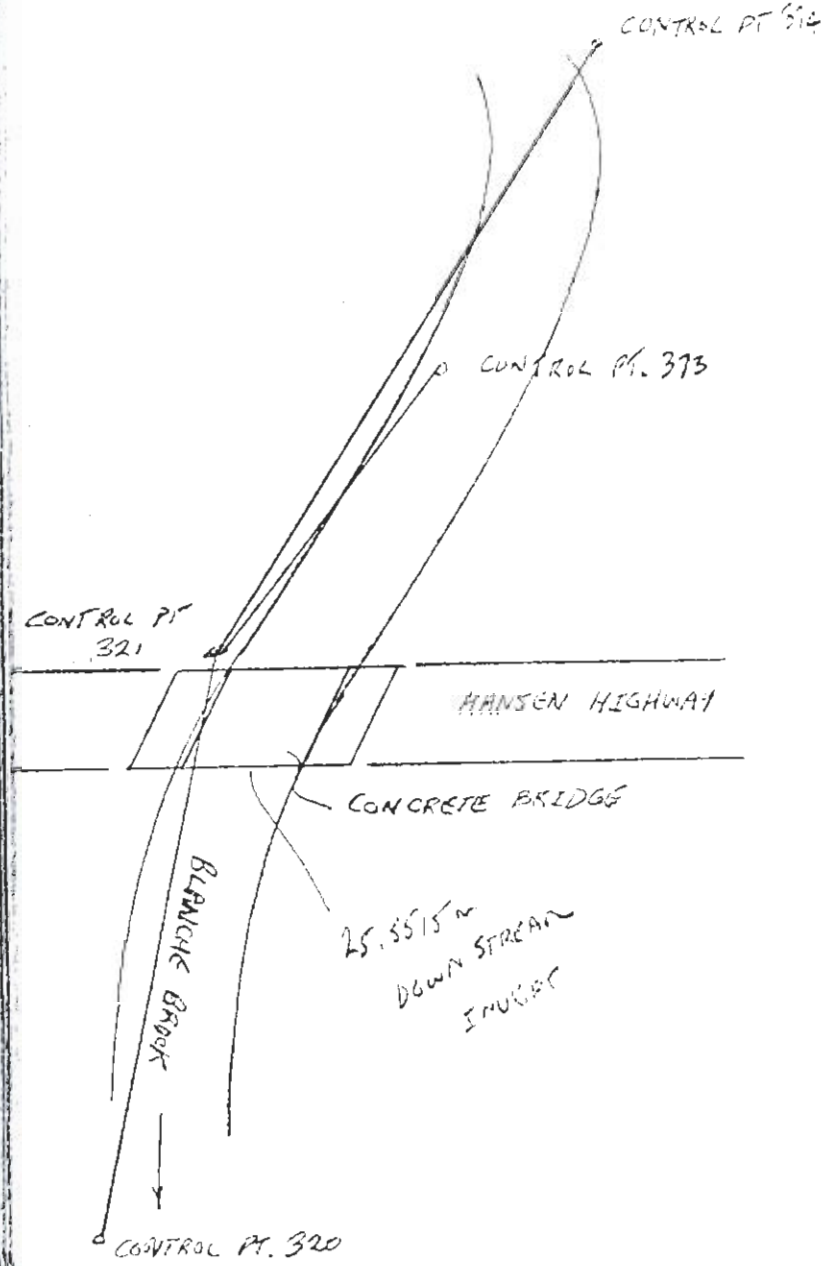
FS @ 322, BS CONTROL PT 322

| | | |
|---|---|---|
| FS | 338 - 348 | TRANS 19 |

NOTE: PT. 322 IS ON TRANS - 19 @ RT EDGE OF BK.

MR. AUCOIN 9 RIVERSIDE DRIVE

HAS CONCERNS ABOUT RIVER OVERRUNNING ITS BANKS ON SHARP BEND ≈ 120 m UPSTREAM AND FLOODING OCCURRING HOUSE @ THE FRONT OF THE PROPERTY. RIVER COURSE IS CHANGING AWAY FROM HIS PROPERTY.




TR @ CONTROL PT. 321 ; BS CONTROL PT. 320

| | |
|---|---|
| FS PT. 349 - | O.L.M. BSG 4113 |
| FS PT 350 - 353 | BRIDGE CORNERS TOP |
| FS PT 354 - 356 | ℄ ROAD |
| FS PT 357 | HP # 6055099 |
| FS PT 358 | HP # 17 |
| FS PT 359 - 371 | TRANS 20 |

NOTE PT. 361 IS @ BOTTOM LEFT CORNER OF BRIDGE ON UPSTREAM END

PT. 369 IS @ BOTTOM RT CORNER OF BRIDGE

| | |
|---|---|
| FS PT. 372 | BOTTOM CHORD OF BRIDGE |
| FS PT 373 | CONTROL PT. 373 |
| FS PT 374 | CONTROL PT. 374 |

BLANCHE BROOK
JULY 15/95

FS @ CONTROL PT. 373; BS CONTROL PT 321

FS PT. 375 - 385 TRANS 21

FS @ CONTROL PT 374; BS CONTROL 373

FS 386 - 401 TRANS 22
FS 402 - 419 TRANS 23
FS 420 CONTROL PT. 420

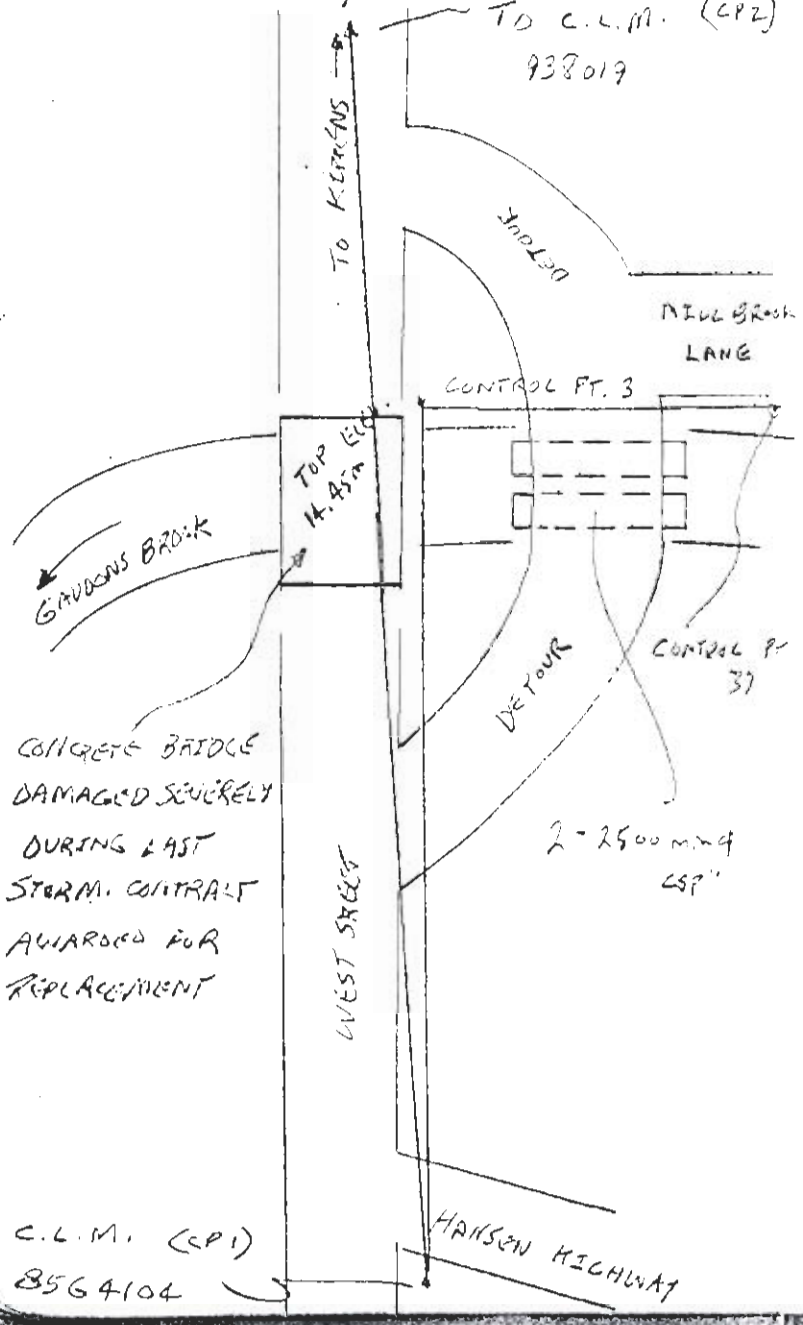
FS @ CONTROL PT. 420; BS CONTROL PT. 374

FS 421 - 431 TRANS 24
FS PT 432 FF HOUSE RT REAR CORN.
FS PT 433 CONTROL PT. 433

FS CONTROL PT. 433; BS CONTROL PT. 420

FS 434 - 447 TRANS 25

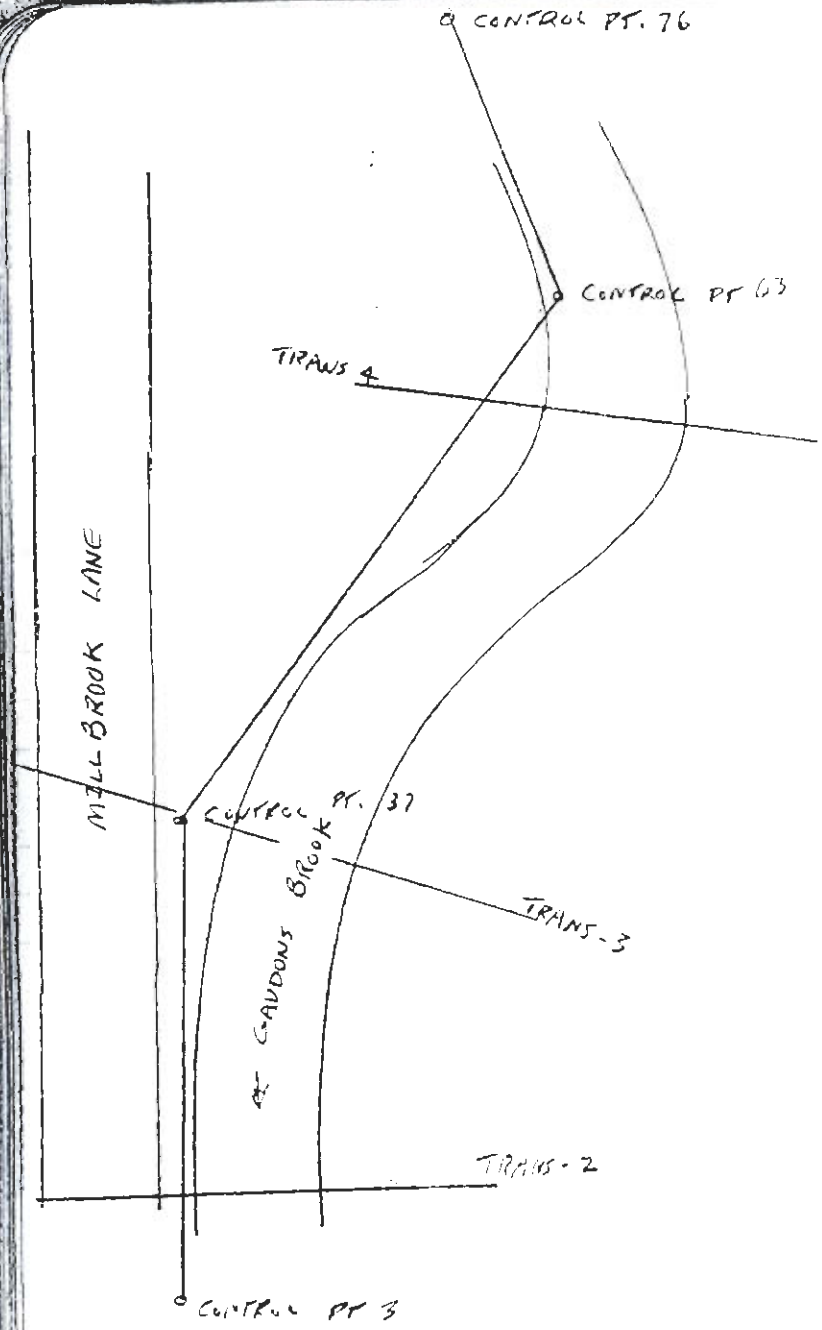
GAUDONS BROOK
JULY 16/95




TL @ CONTROL PT. 3 ; BS CONTROL PT. 1

| | |
|---|---|
| FS 4 - 7 | EDGE OF WEST STREET |
| FS 8 - 11 | EDGE OF MILLBROOK LN |
| FS 12 - 21 | EDGE OF DETOUR |
| FS 22 | FF OF HOUSE (CRAWL SPACE) |
| FS 23 - 24 | OUTLET 2500 mm ϕ CSP |
| FS 25 - 26 | INLET " " |
| FS 27 - 36 | TRANS 1 @ BRIDGE ↑ |
| FS 37 | CONTROL PT 37 |
| FS 38 - 50 | TRANS 2 |

DOWNSTREAM INVERT @ 11.48 m

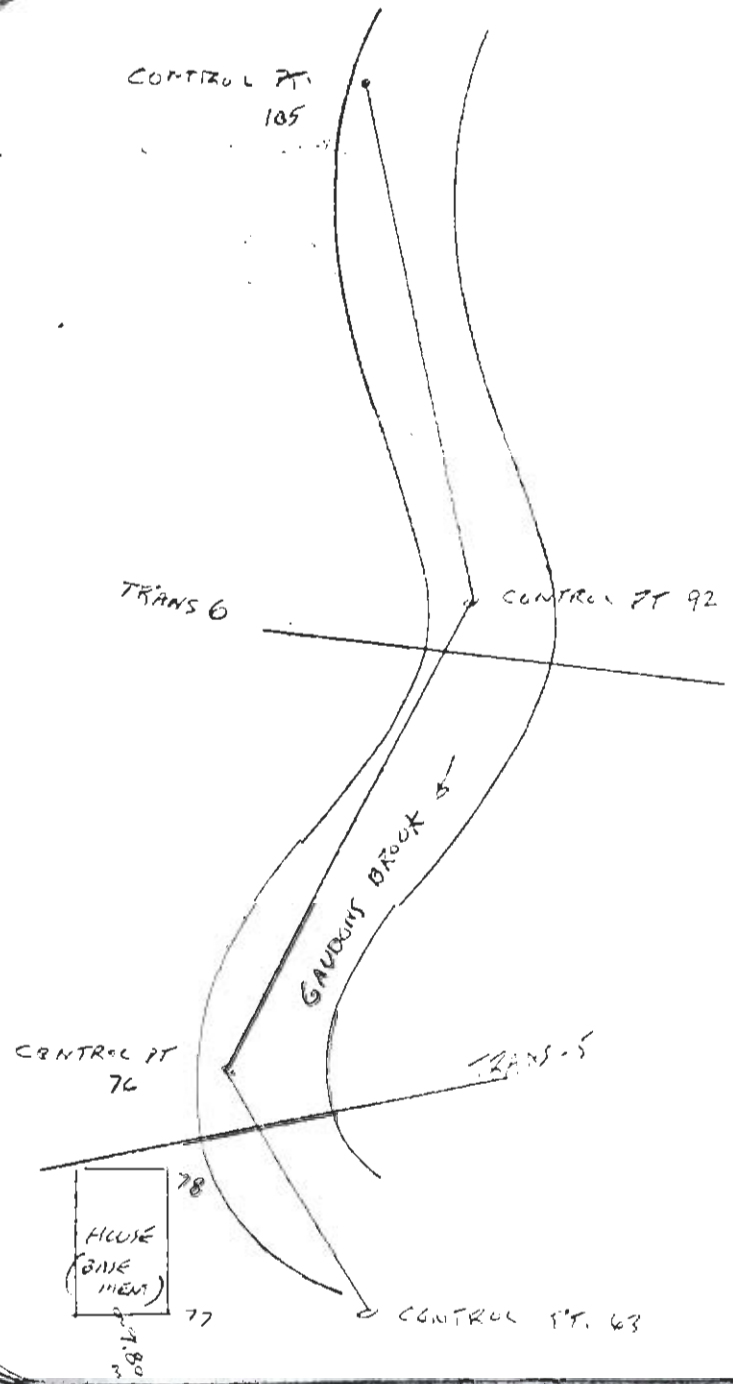



Q CONTROL PT. 37; @ CONTROL 3

| | |
|---|---|
| FS 51 – 62 | TRANS 3 |
| FS 63 | CONTROL PT. 63 |

@ CONTROL PT 63; BS CONTROL PT. 37

| | |
|---|---|
| FS 76 – 75 | TRANS 4 |
| FS 76 | CONTROL PT. 76 |

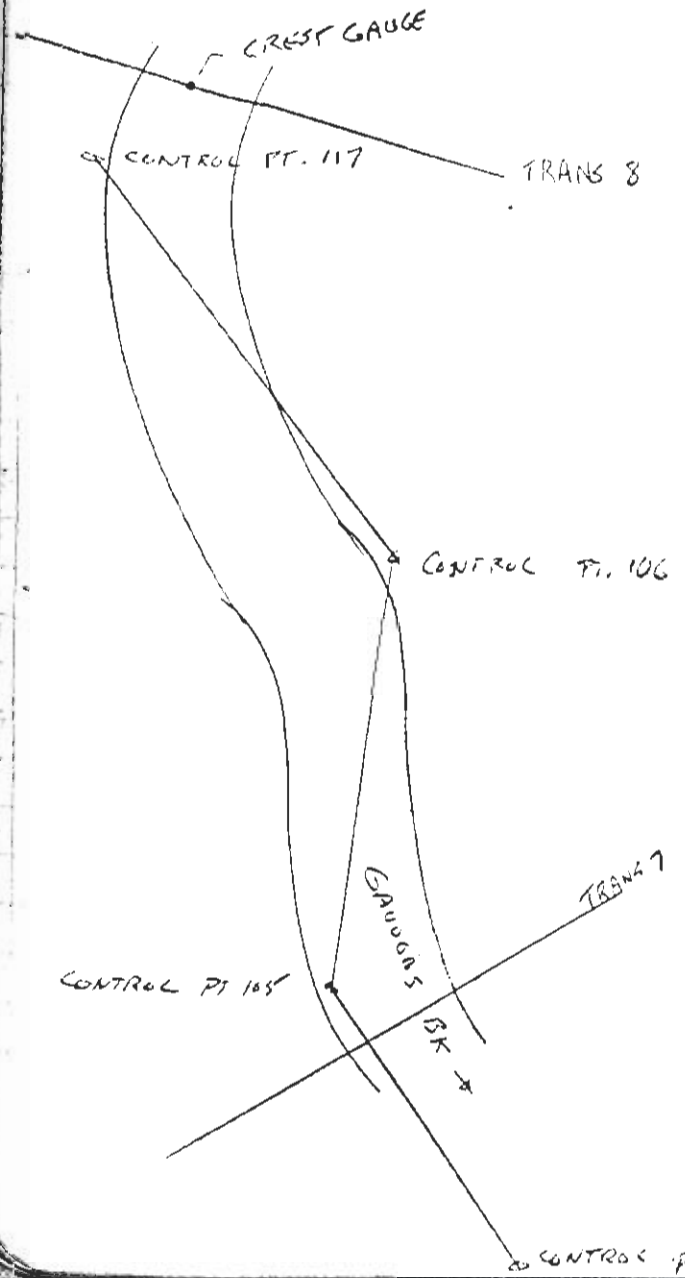



TL CONTROL PT 76; BS CONTROL PT 63

| | |
|---|---|
| FS 77-78 | HOUSE CORNERS |
| FS 79 | FF HOUSE |
| FS 80-91 | TRANS-5 |
| FS 92 | CONTROL PT. 92 |

TL CONTROL PT. 92; BS CONTROL PT 76

| | |
|---|---|
| FS 93-104 | TRANS 6 |
| FS 105 | CONTROL PT. 105 |




⊼ @ CONTROL PT. 105 ; ⊼S CONTROL PT 92

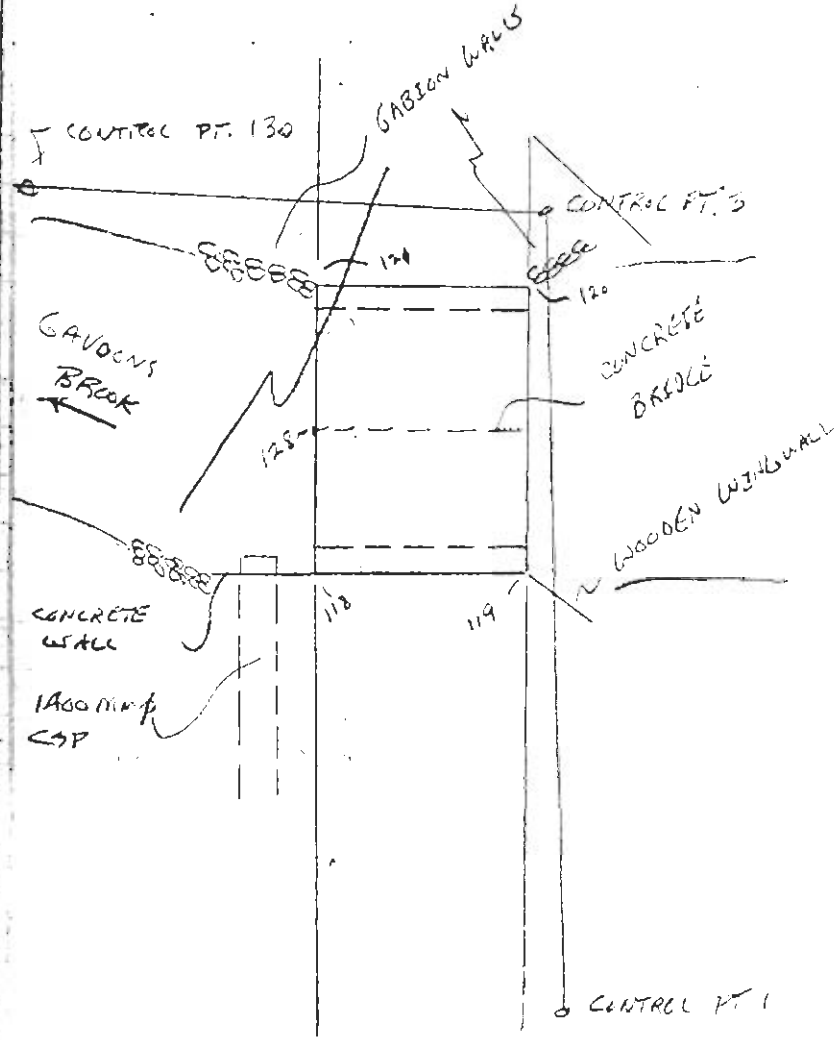
| | |
|---|---|
| FS 106 | CONTROL PT. 106 |
| FS 107 - 116 | TRANS 7 |

⊼ @ 106 , ⊼S CONTROL PT. 105

| | |
|---|---|
| FS 117 | CONTROL PT. 117 |

⊼ @ CONTROL PT. 117 ; ⊼S CONTROL PT. 106

| | |
|---|---|
| FS 168 - 181 | TRANSECT 8 CREST GAUGE TRANSECT |
| NOTE PT. 176 | CREST GAUGE LOCATION |



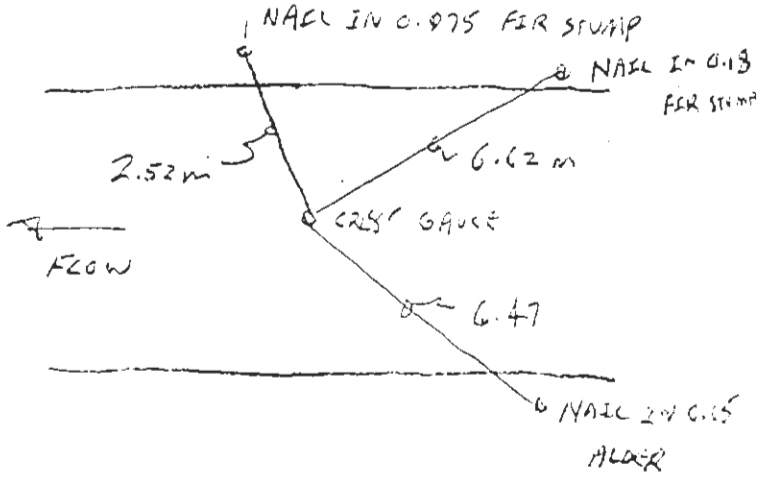

TS @ CONTROL PT. 3; BS CONTROL PT. 1

| | |
|---|---|
| FS 118 - 121 | CORNER OF BRIDGE (TOP) |
| FS 122 - 123 | ON GABION WALL |
| FS 124 - 126 | ON " " |
| FS 125 - 127 | ON WOODEN WINGWALL |
| FS 128 | TOP OF CONCRETE SUPPORT 0.60 THICK |
| FS 129 | BOTTOM CHORD OF CONCRETE BRIDGE |
| FS 130 | CONTROL PT. 130 |

TS @ CONTROL PT. 130, BS CONTROL PT. 3

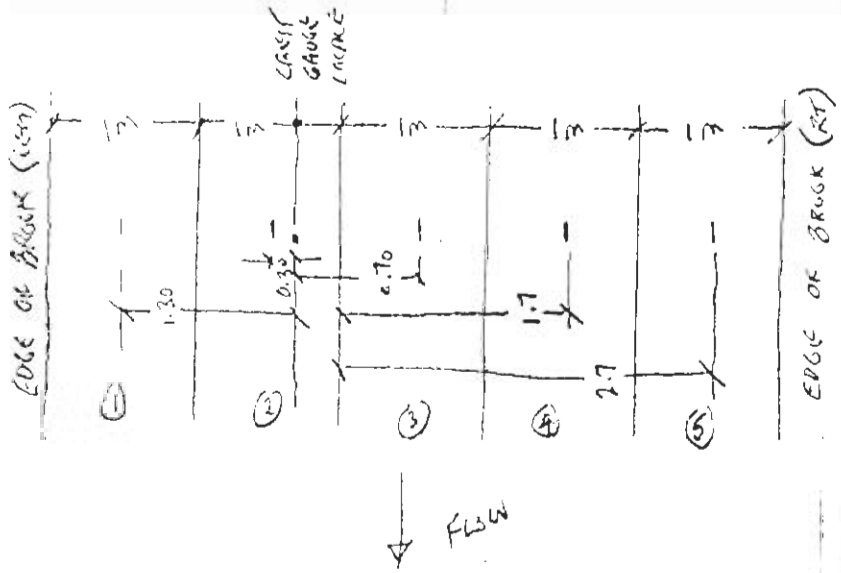
| | |
|---|---|
| FS 132 - 133 | TOP OF CONCRETE WALL 0.30m |
| FS 134 - 137 | GABION WALL (TOP) |
| FS 151 | OUTLET OF 1400 mm ϕ CSP |
| FS 138 - 143 | GRAVEL DRIVEWAY - EDGE |
| FS 144 - 151 | TRANS 1A |
| FS 152 - 158 | " 1B |
| FS 159 - 162 | BOTTOM OF GABION |
| FS 163 - 166 | TOP OF GABION |
| FS 167 | CONTROL PT. 167 |

CREST GAUGE REFERENCE
GAUDONS BROOK
STEPHENVILLE
JULY 17/95



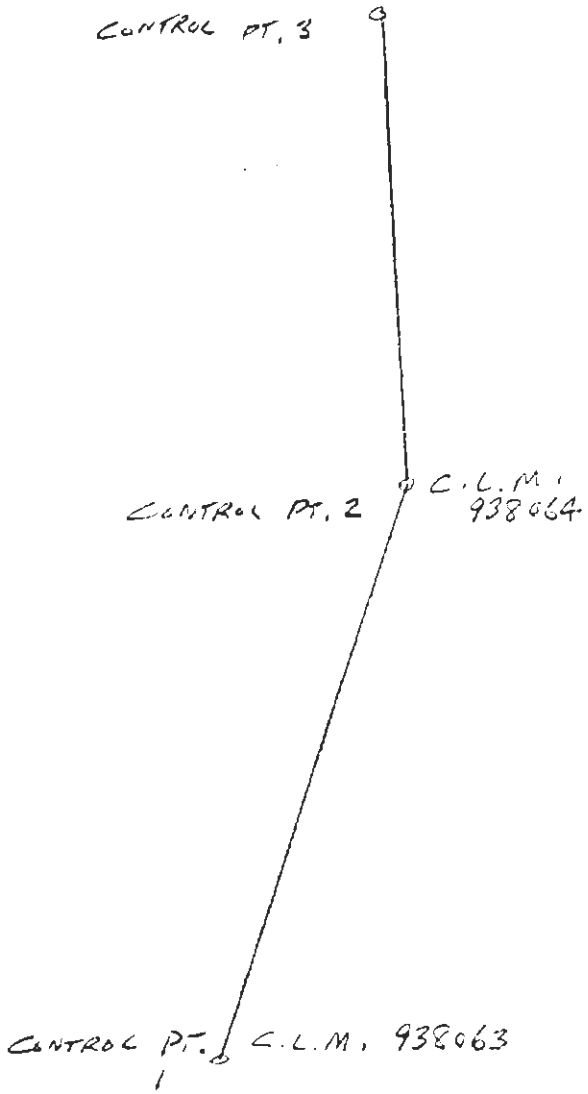

DEPTH @ GAUGE = 0.355 m
HT OF GAUGE = 1.830 M

BROOK IS 5.0 M WIDE
EDGE OF BROOK RT IS 3.20 FROM GAUGE
" " " LEFT " 1.80 " "



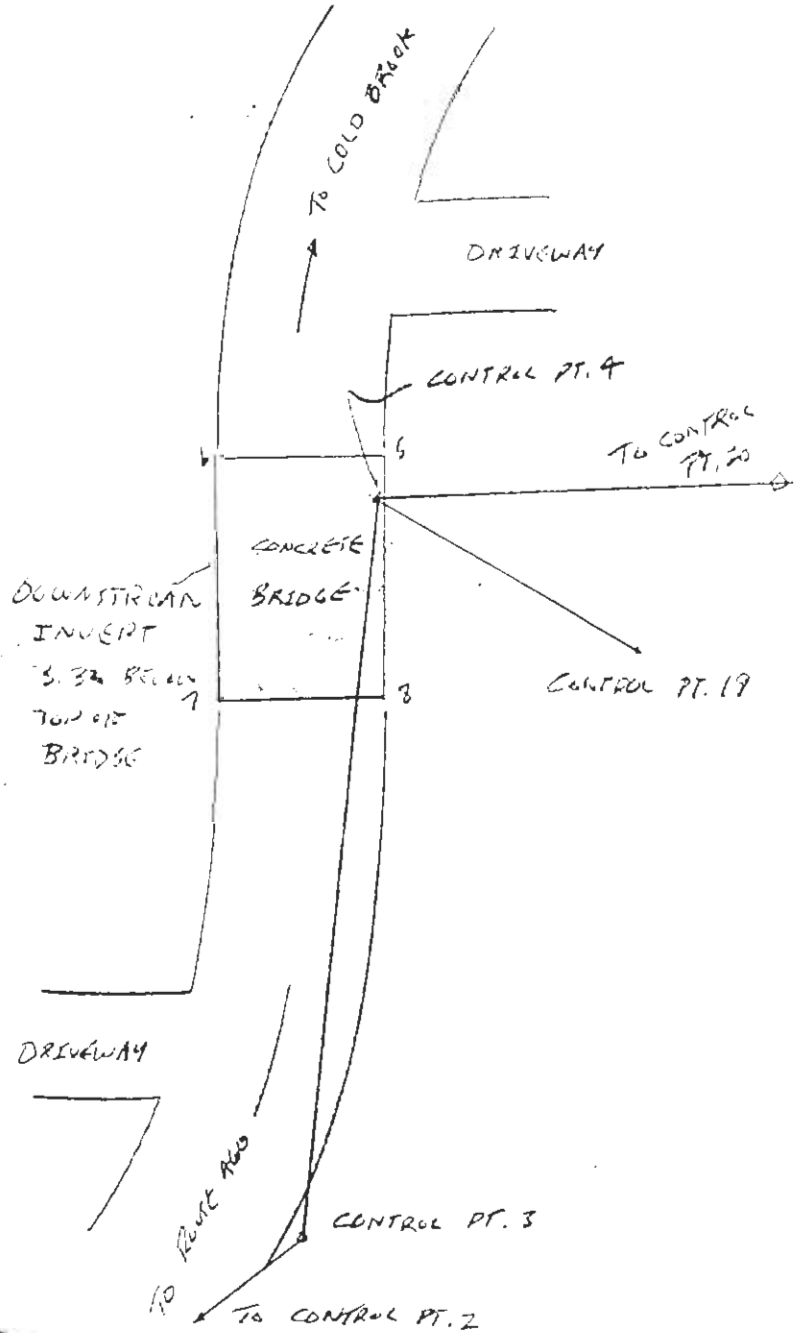

| CENTROID # | TIME INT | # REVOLUTIONS | # BEEPS | DEPTH |
|---|---|---|---|---|
| 1 | 1 MIN | 1 | 0.20 | 0.24 m |
| 2 | " | 22 | 4.4 | 0.44 m |
| 3 | " | 15.5 | 3.1 | 0.30 m |
| 4 | " | 17 | 3.4 | 0.17 m |
| 5 | " | 9 | 1.8 | 0.10 m |

COLD BROOK FLOOD RISK MAPPING
JULY 17/95




TO CONTROL PT. 2, BY CONTROL PT. 1

FS 3 CONTROL PT. 3




TS @ CONTROL PT. 3; BS CONTROL PT. 2

| | | |
|---|---|---|
| FS | 4 | CONTROL PT. 4 |
| FS | 5-8 | BRIDGE CORNERS TOP |
| FS | 9-18 | EDGE OF ROAD |

NOTES: ROBERT JESSO - MRS. JESSO ADVISED ME THAT DURING THE LAST STORM IN JUNE WATER FROM COLD BROOK OVERFLOWED UP TO THEIR HOME. MR. JESSO HAD TO BARRICADE HIS WOODSHED TO STOP HIS WOOD FROM FLOATING AWAY. WATER RAN IN UNDER THE PORCH ON THE HOUSE - THE WHOLE BACKYARD AREA WAS FLOOD AND THIS IS A REGULAR OCCURRENCE DURING THE SPRING OF THE YEAR.

3RD HOUSE ON LEFT HEADING TOWARDS STEPHENVILLE

BARBARA WHITE & DOREEN PERRIER WATER EXTENDED UP TO THESE HOUSES ALSO DURING THE JUNE STORM AND SPRING TIME FLOODING IS ALSO EXPERIENCED.

1ST & 2ND HOUSE ON LEFT HEADING TOWARDS STEPHENVILLE

NOTES : ROBERT RUSSELL - MR RUSSELL ADVISED THAT DURING LAST STORM WATER ROSE TO COVER THE DRIVEWAY AND SURROUNDING DITCHES BY ABOUT 0.30M. DOES NOT HAVE TO OVER TROUBLE IN THE SPRING BUT HE REFERRED MR JESSP'S PROBLEMS. MR. RUSSELL FEELS THAT A SHARP RIGHT HAND TURN IN 500-600 FEET UPSTREAM IS THE PROBLEM AT THIS LOCATION THE LEFT BANK IS LOW AND THE RT. BANK IS HIGH.

INVESTIGATED AREA OF CONCERN AND IT APPEARS TO ME THAT THERE ARE SEVERAL SMALL DEVIATIONS IN THE STREAM BED ON THE LEFT SIDE OF THE RIVER, IT APPEARS THAT DURING HEAVY FLOW PERIODS THIS AREA WILL FLOOD AND EMPTY INTO THE LOW LYING AREAS PREVIOUSLY MENTIONED, A BERM (LEFT) MAY CURE THIS PROBLEM IN THIS AREA.

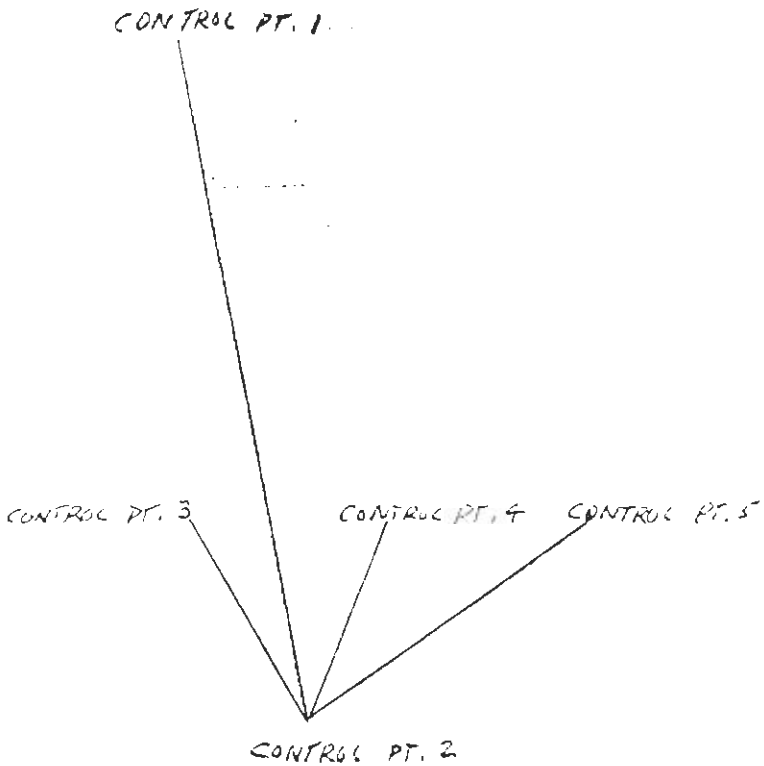
OUTLET TO NIELS POND
JULY 16/93

SETUP ; BS BM 76F-886

ELEV. @ BM 76F-886 = 24.642m
HT. = 1.48m
VD (BS) @ BM 76F-886 = +0.409
HI. = 25.713
VD (FS) @ CONTROL PT. 2 = +0.369
ELEV. @ CONTROL PT. 2 = 24.642

OUTLET TO NOEL'S POND

JULY 16/95

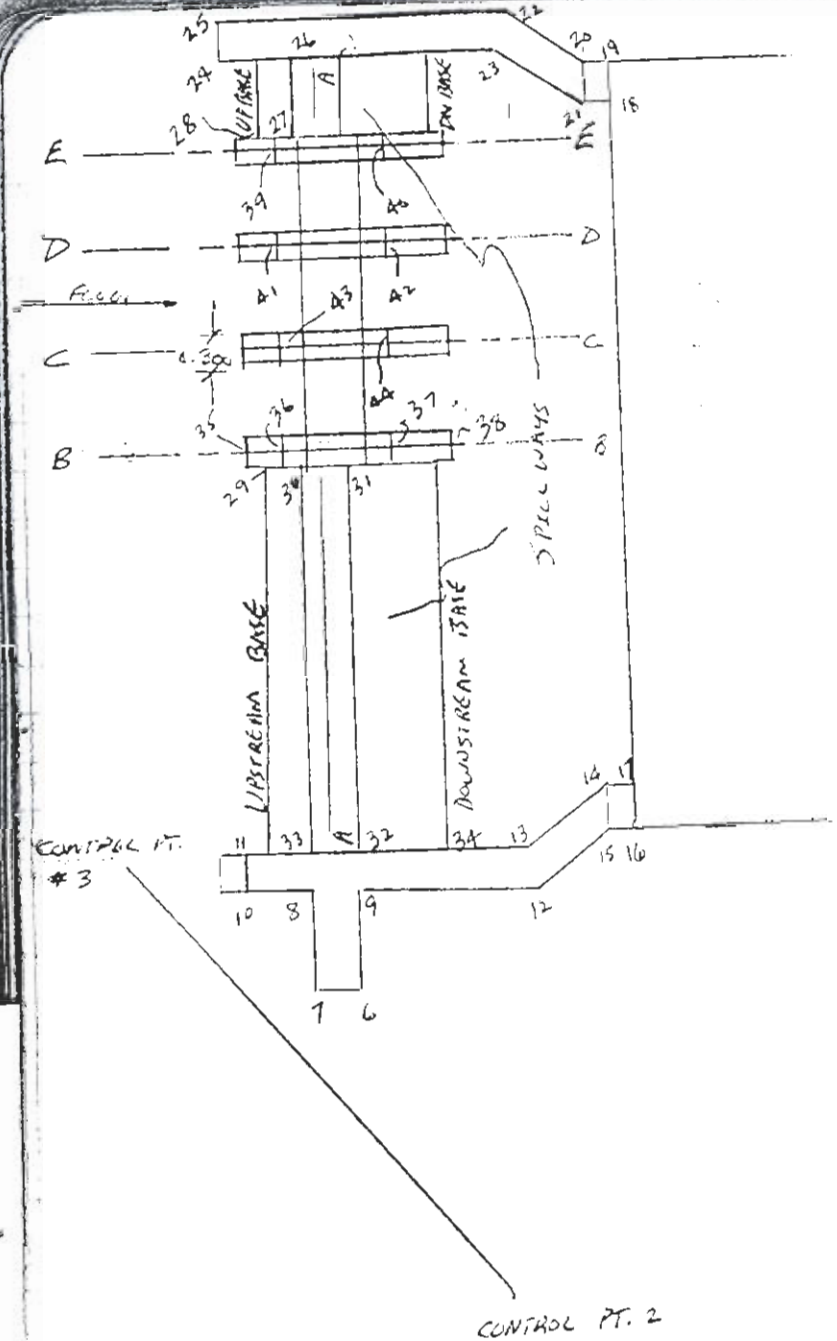



→ @ CONTROL PT. 2; BS CONTROL PT. 1

FS 3 CONTROL PT 3

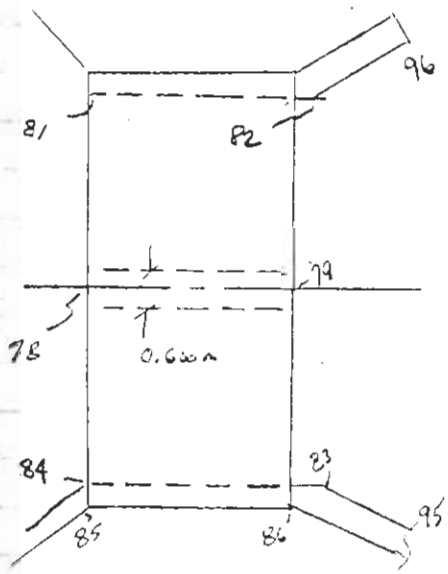
FS 4 CONTROL PT. 4

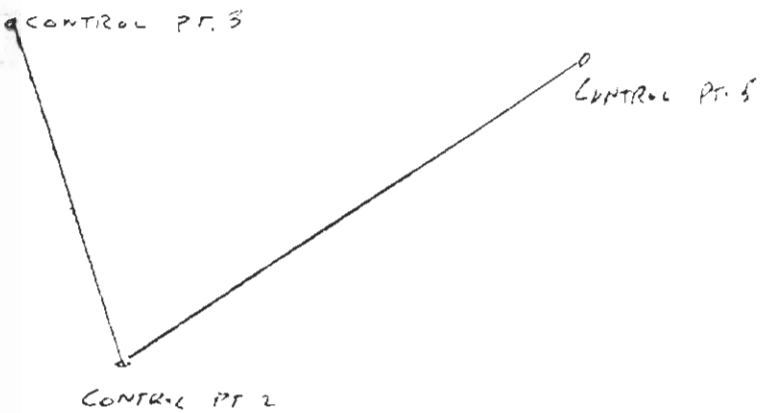
FS 5 CONTROL PT. 5




TT @ CONTROL PT. 3; BS CONTROL PT. 2

| | |
|---|---|
| FS 6 - 14 | SPILLWAY & LADDER DETAIL |
| FS 15 - 26 | CORNERS OF WALKWAY |
| FS 49 - 57 | TRANS-1 @ OUTLET OF MOELS POND |
| FS 58 - 67 | TRANS 2 @ UPSTREAM EDGE OF SPILLWAY |
| FS 68 - 77 | TRANS 3 @ " " " BRIDGE |



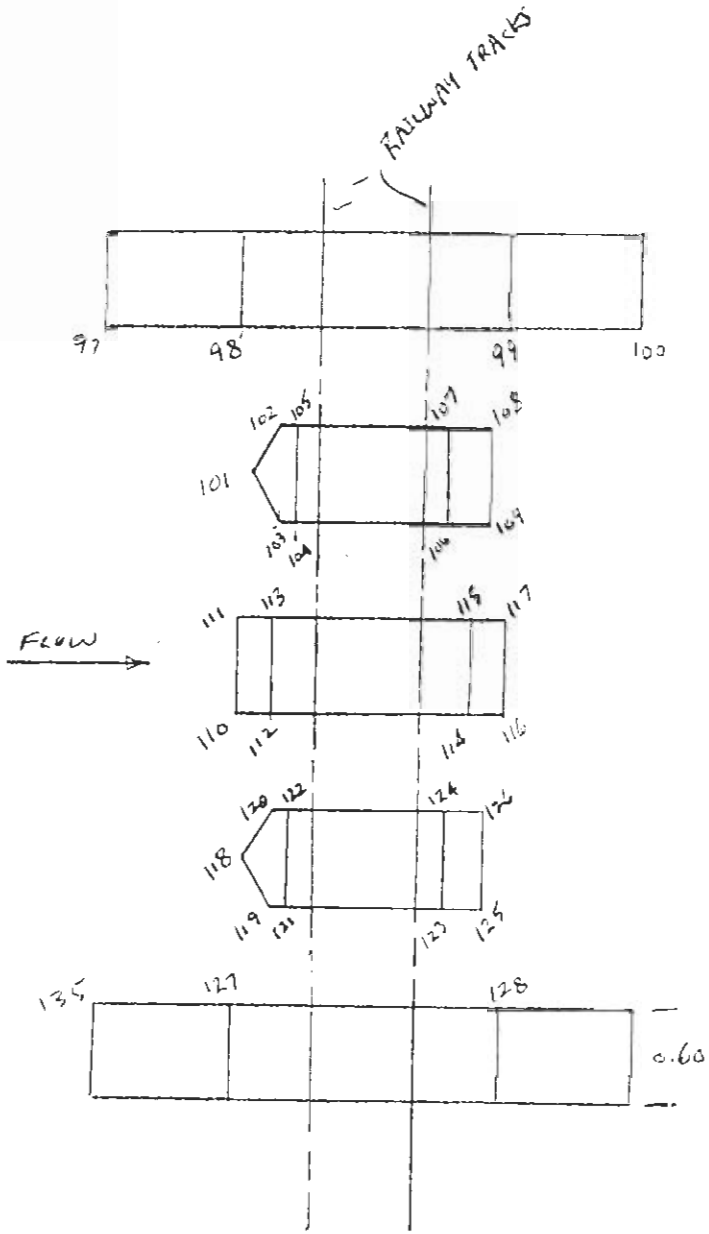




FS CONTROL PT 3 ; BS CONTROL PT. 2

| | |
|---|---|
| FS 78-79 | ℄ OF 600mm THICK CONCRETE SUPPORT |
| FS 80 | LOW CHORD ELEV. |
| FS 81 - 84 | INSIDE CORNERS OF BRIDGE |
| FS 85-88 | EXTERIOR CORNERS OF " |
| FS 89 - 94 | EDGE OF PAVED ROAD |

FS CONTROL PT. 5 ; BS CONTROL PT. 2

| | |
|---|---|
| FS 95 - 96 | WINGWALL END |




TR @ CONTROL PT. 6 ; BS CONTROL PT. 2

| | |
|---|---|
| FS 97 - 128 | TRESTLE DETAIL |
| FS 129 | LOW CHORD |
| FS 130 - 131 | ℄ RAILWAY BED |

TR @ CONTROL PT. 4 , BS CONTROL PT. 2

| | |
|---|---|
| FS 132 - 142 | TRANS 4 |

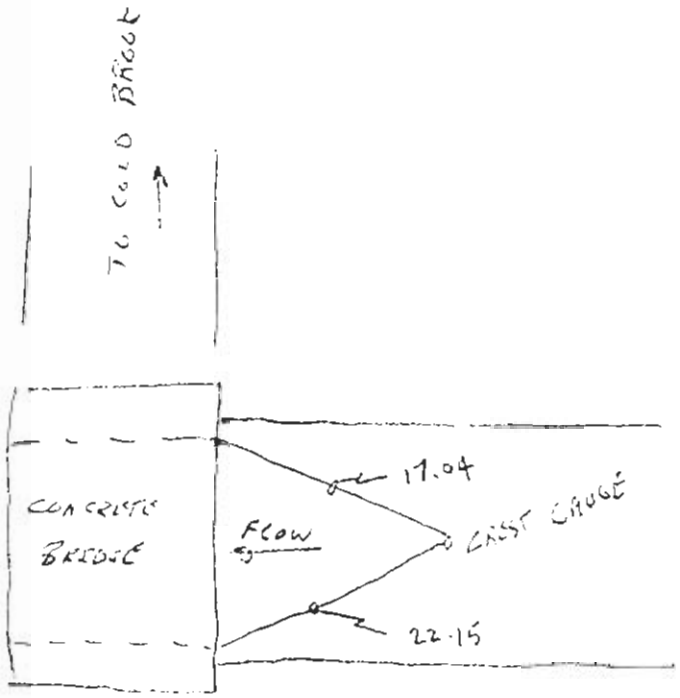
NOTE: PT. 135 IS EDGE OF BROOK @ INT ABUTT (LEFT)
NOTE: PT. 141 IS @ INTERIOR OF ABUTMENT (RIGHT)

| | |
|---|---|
| FS 143 | HP & ANGL |
| FS 144 | GUYWIRE |
| FS 149 | CONTROL PT. 149 |
| FS 145 - 148 | CORNER OF FENCE SUBSTATION |

TR @ CONTROL PT. 149 , BS CONTROL PT. 4

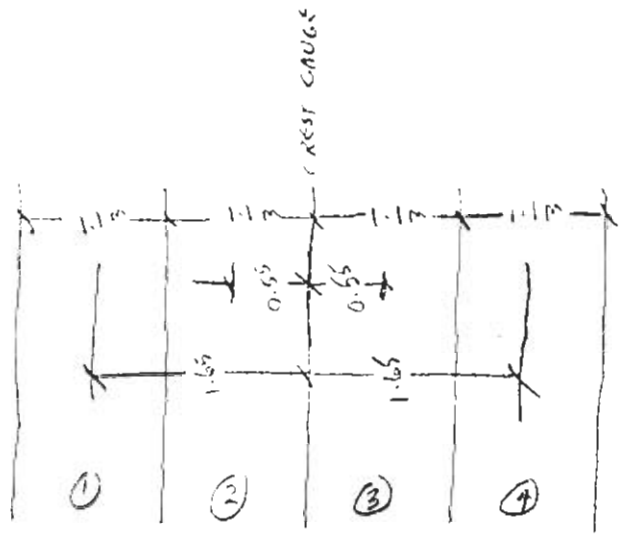
| | |
|---|---|
| FS 150 - 158 | TRANS 5 |

CREST GAUGE TIE-IN
COLD BROOK, STEPHENVILLE JULY 17/95

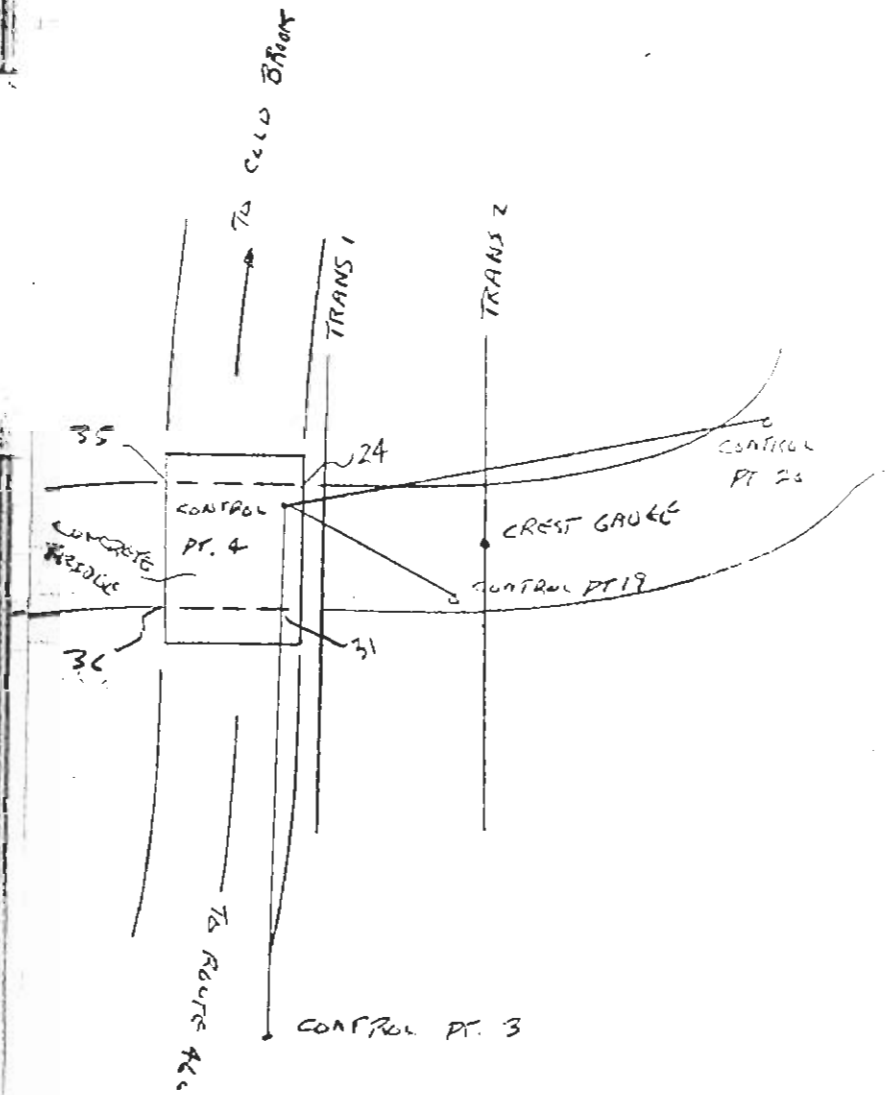



DEPTH @ GAUGE = .350 m
HT @ GAUGE = 1.835 m.
Width of brook 4.40

Edge of brook 2.20 Rt. of Crest Gauge
" " 2.20 Lt of Crest Gauge




| CENTRELINE # | TIME INT | # REVOLUTIONS | # BEEPS | DEPTH |
|---|---|---|---|---|
| 1 | 1 MIN | 7.5 | 1.5 | 0.21 m |
| 2 | " | 12 | 24 | 0.30 m |
| 3 | " | 18 | 3.6 | 0.29 m |
| 4 | " | 2 | .4 | 0.11 m |




⊼ @ CONTROL PT. 4; BS CONTROL PT. 3

| | |
|---|---|
| FS 19 | CONTROL PT. 19 |
| FS 20 | CONTROL PT. 20 |
| FS 21 - 23 | TRANS 1 |

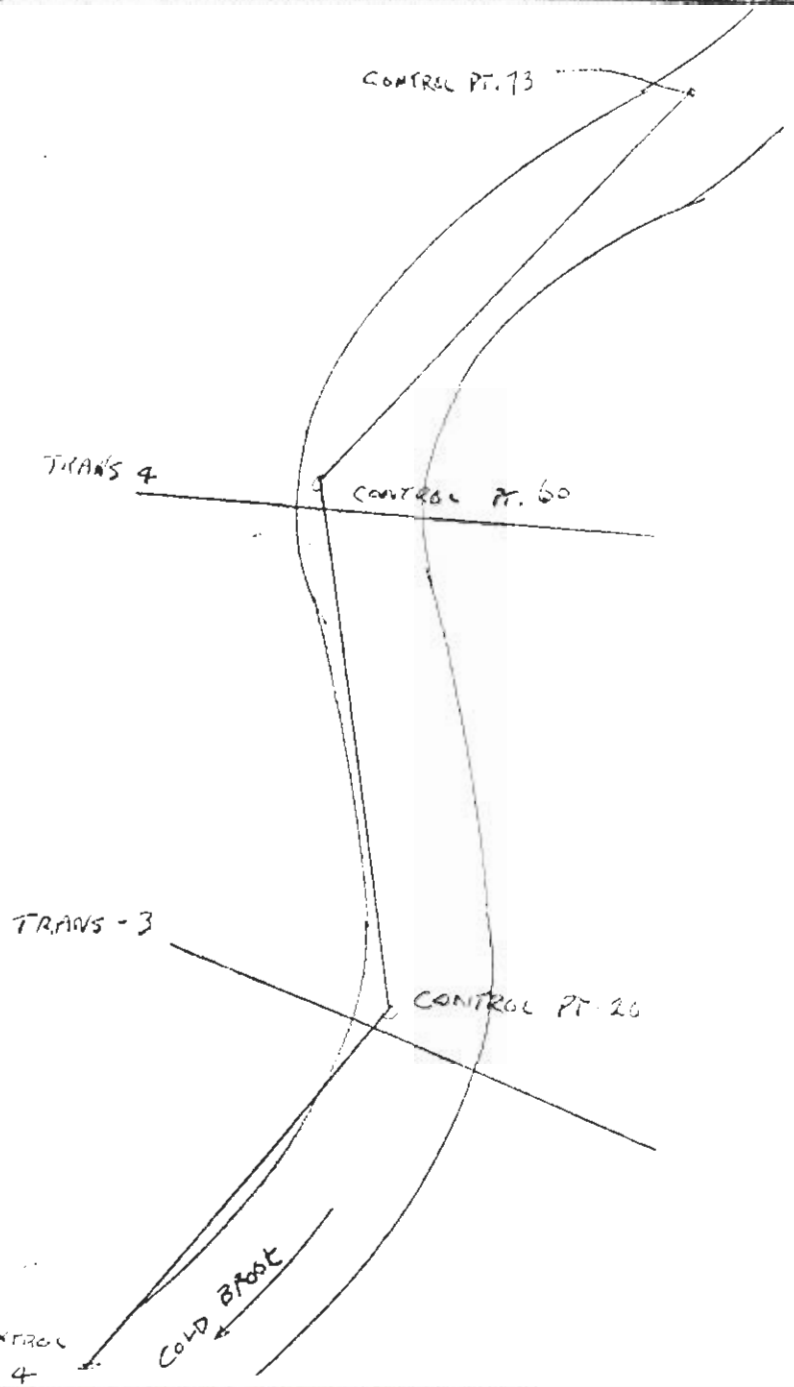
⊼ @ CONTROL PT. 19; BS CONTROL PT. 4

| | |
|---|---|
| FS 24 - 34 | TRANS - 1 |

NOTE: PT 24 IS BOTTOM LEFT CORNER OF BRIDGE
PT 31 " " RT. " " "

| | |
|---|---|
| FS 35 - 36 | BOTTOM CORNERS OF BRIDGE |
| FS 37 | LOW CHORD OF BRIDGE |
| FS 38 - 48 | TRANS-2 @ CREST GAUGE |

NOTE PT 43 @ CREST GAUGE LOCATION




TO CONTROL PT 20 ; BS CONTROL PT. 4

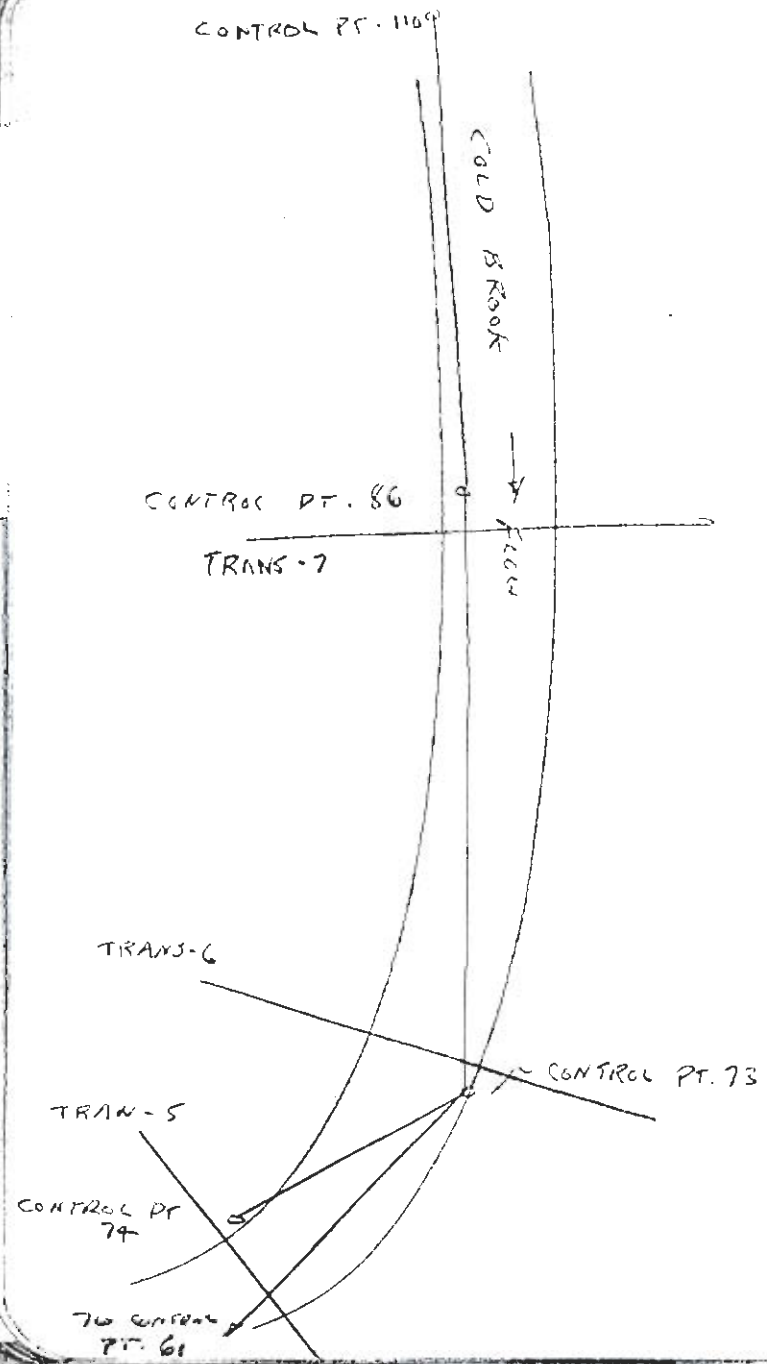
FS 49 - 59 TRANS - 5
FS 60 CONTROL PT. 60

TO CONTROL PT. 60 ; BS CONTROL 20

FS 61 - 72 TRANS 4
FS 73 CONTROL PT 73

FAN WHITE GARDEN FLOODING
1 KINGS ST.
STEPHENVILLE

TRANSECT 5 SHOWS GRADES ON A VEGETABLE GARDEN OWNED BY MR. WHITE. HE SAID DURING THE LAST FLOOD IN JUNE THAT HIS GARDEN FLOODED. THE PROPERTY IS ON THE RT SIDE OF THE STREAM LOOKING UPSTREAM AND THE RIVER TAKES A LEFT HAND BEND IN THIS AREA. MR WHITE FEELS A BERM ON THE RIGHT RIVER BANK WOULD PROTECT THIS AREA. HE WANTED TO RENT A TRACTOR AND DO THE WORK HIMSELF BUT ENVIRONMENT STOPPED HIM.

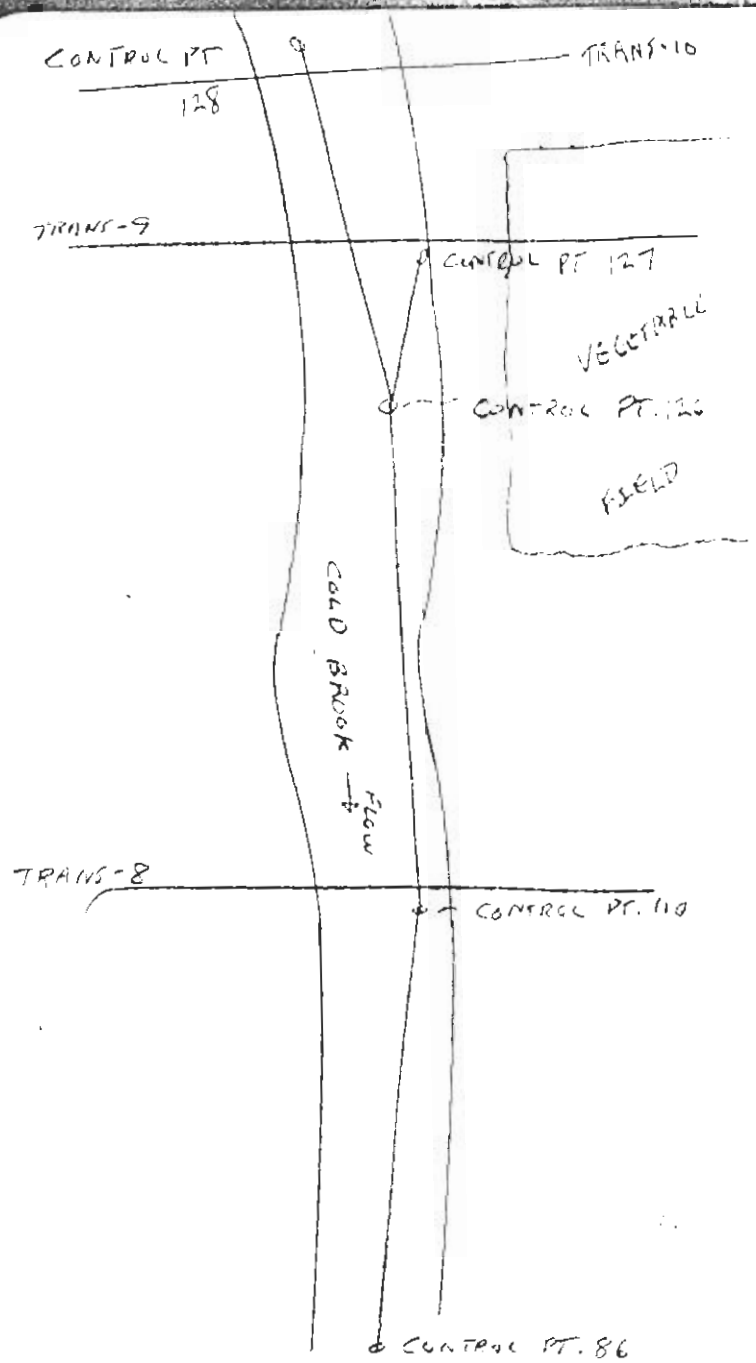



⊼ @ CONTROL PT 73; BS CONTROL 60

| | |
|---|---|
| FS 74 | CONTROL PT. 74 |
| FS 75 - 85 | TRANS 6 |
| FS 86 | CONTROL PT. 86 |
| FS 87 - 99 | TRANS 5 |

⊼ @ CONTROL PT. 86; BS CONTROL PT. 73

| | |
|---|---|
| FS 100 - 109 | TRANS - 7 |
| FS 110 | CONTROL PT. 110 |




@ CONTROL PT. 110; BS CONTROL PT 86

FS 111-125 TRANS-8
FS 126 CONTROL PT. 126

@ CONTROL PT. 126; BS CONTROL PT. 110

FS 127 CONTROL PT. 127
FS 128 CONTROL PT. 128
~~FS 129-142~~ ~~TRANS-9~~

@ CONTROL PT. 127; BS CONTROL PT. 126

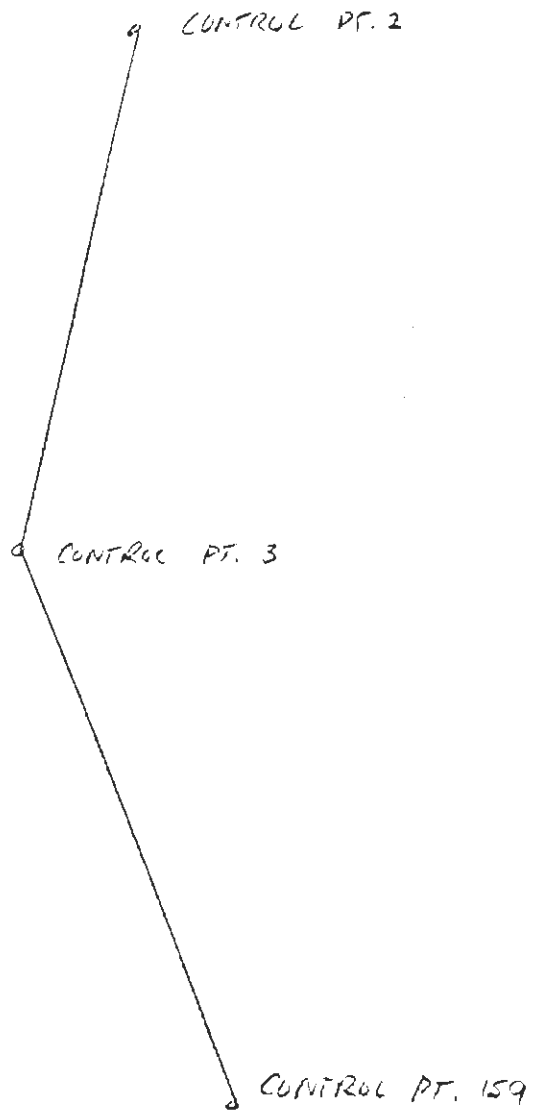
FS 129-142 TRANS-9

@ CONTROL PT. 128; BS CONTROL PT. 126

FS 43-158 TRANS-10

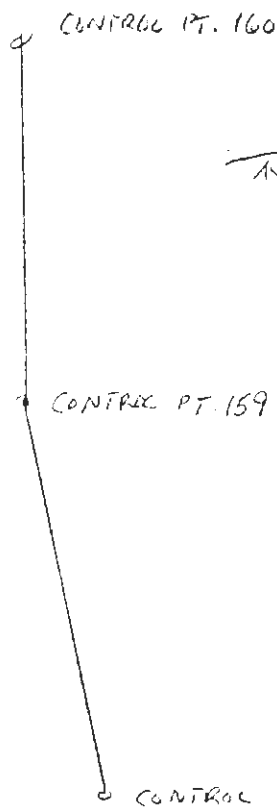
NOTE @ TRANSECT 10 THE BROOK APPEARS TO HAVE GONE UNDERGROUND

COLD BROOK
HOUSES & SELECTED TOPO SHOTS
JULY 18/95

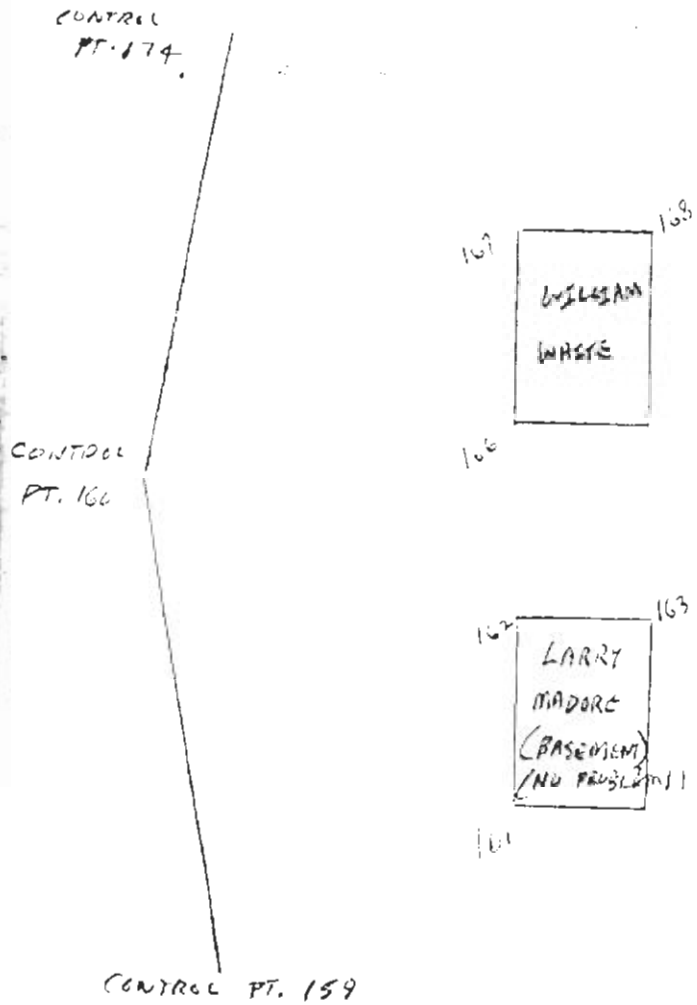



TC CONTROL PT. 3, BS CONTROL PT. 2

FS 159 CONTROL PT 159

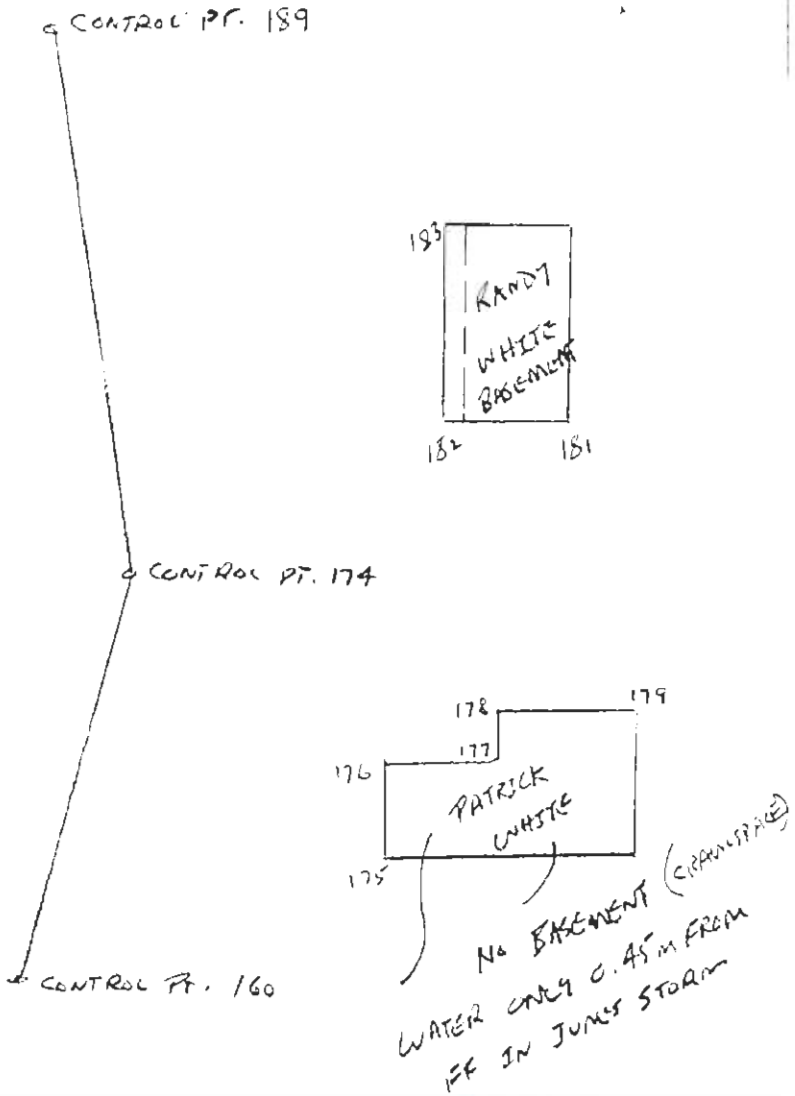



TC CONTROL PT. 159
BS CONTROL PT. 3
FS CONTROL PT. 160



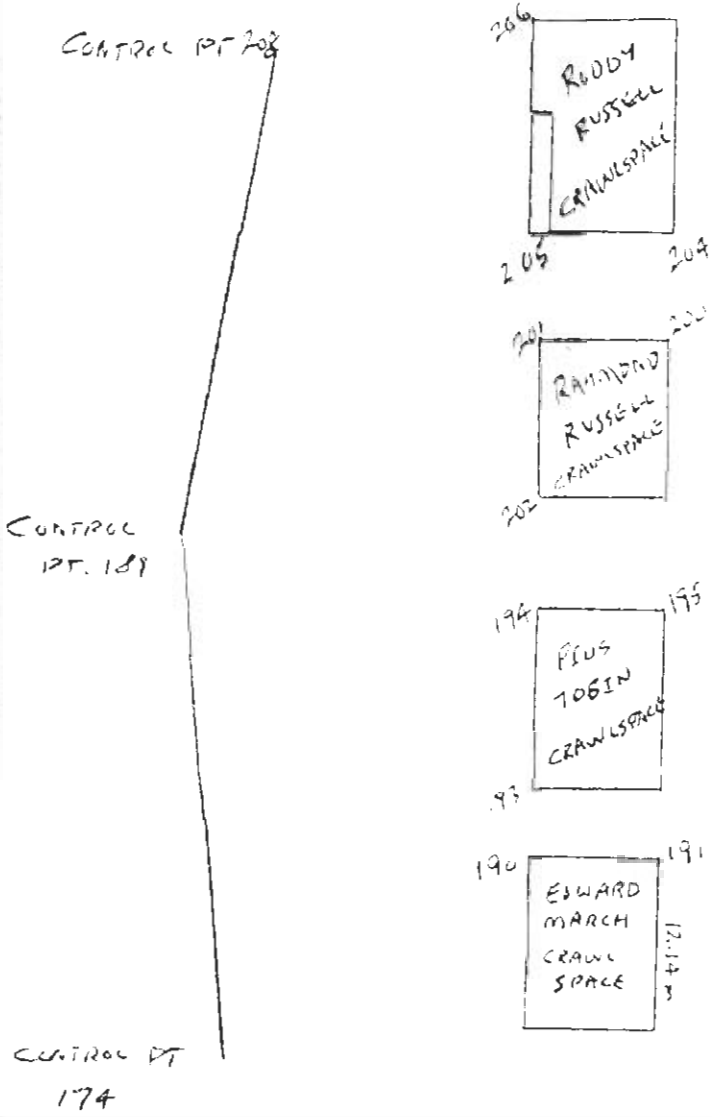

TRE CONTROL PT. 163; BS CONTROL PT. 159

| | | |
|---|---|---|
| FS | 161 - 163 | HOUSE CORNER |
| FS | 164 | FF LARRY MADORE |
| FS | 165 | TOPO |
| FS | 166 - 168 | HOUSE CORNER |
| FS | 169 | FF WILLIAM WHITE |
| FS | 170 - 173 | TOPO |
| FS | 174 | CONTROL PT. 174 |



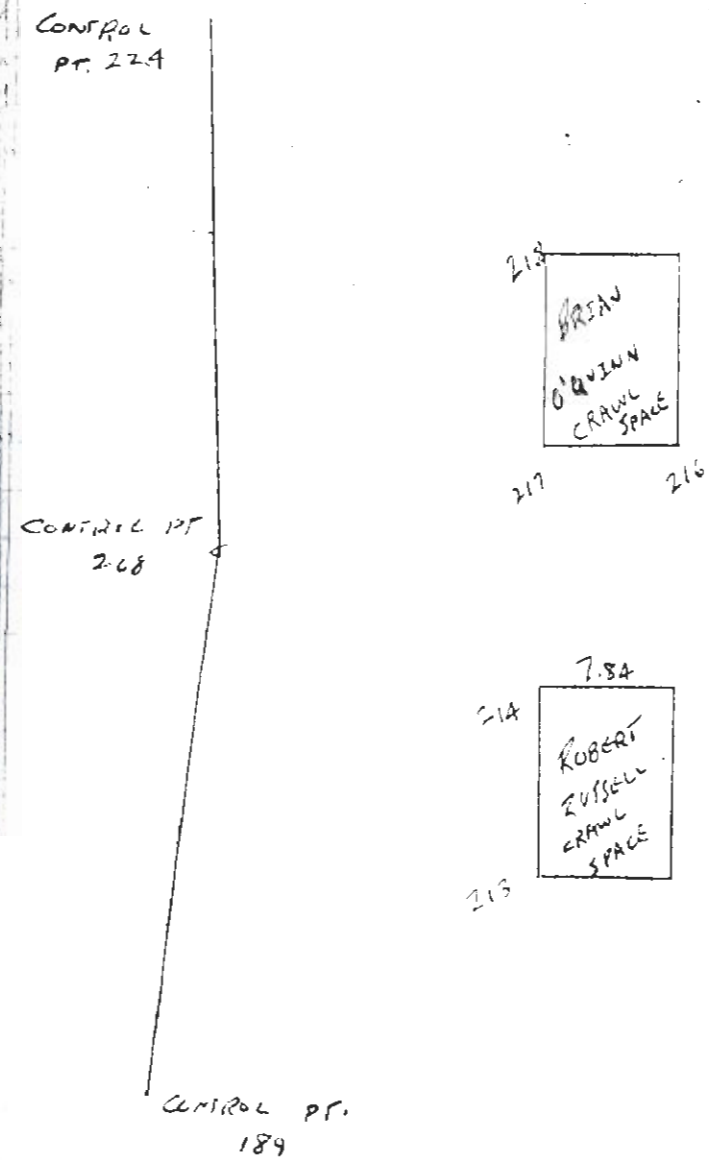

TP @ CONTROL PT. 174 ; BS CONTROL PT. 160

| | | |
|---|---|---|
| FS | 175 - 179 | HOUSE CORNER |
| FS | 180 | FF |
| FS | 181 - 183 | HOUSE CORNER |
| FS | 184 | FF RANDY WHITE |
| FS | 185 - 188 | TOPO |
| FS | 189 | CONTROL PT. 189 |



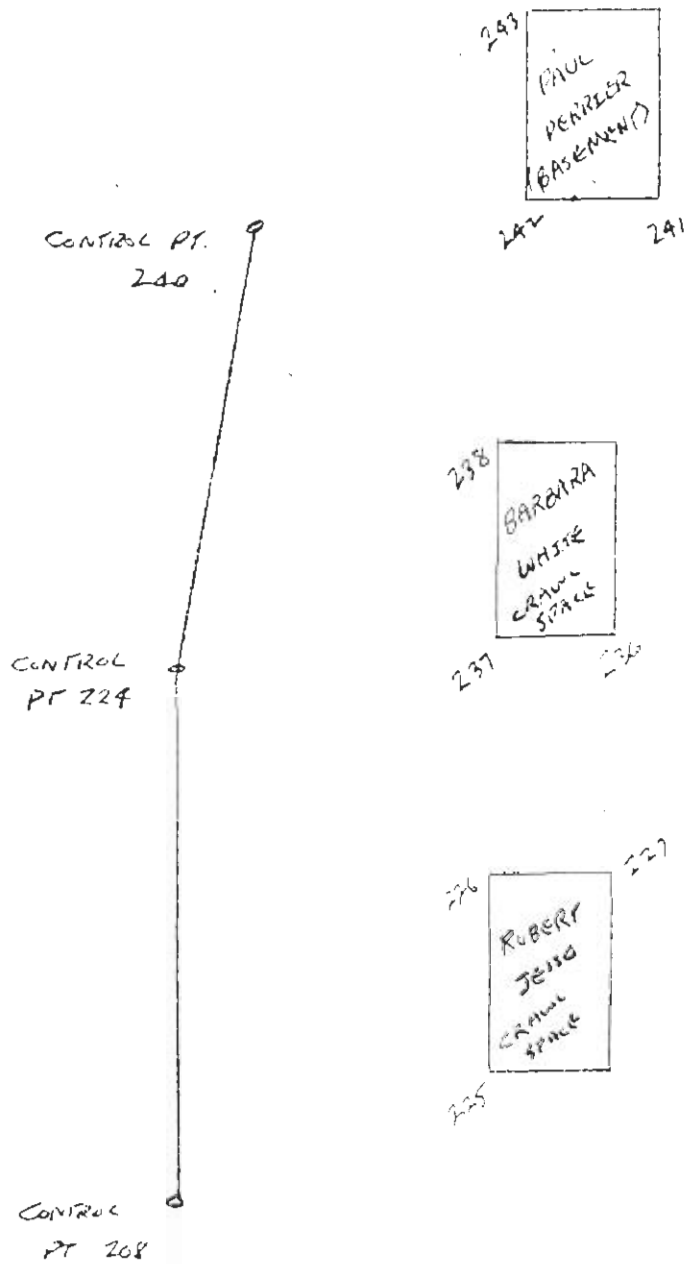

K @ CONTROL PT. 189 ; BS CONTROL PT. 174

| | | |
|---|---|---|
| FS | 190 - 191 | HOUSE CORNER |
| FS | 192 | FF EDWARD MARCH |
| FS | 193 - 195 | HOUSE CORNER |
| FS | 196 | FF PIUS TOBIN |
| FS | 197 - 199 | TOPO |
| FS | 200 - 202 | HOUSE CORNER |
| FS | 203 | FF RAYMOND RUSSELL |
| FS | 204 - 206 | HOUSE CORNER |
| FS | 207 | FF RUDDY RUSSELL |
| FS | 208 | CONTROL PT. 208 |




TI @ CONTROL PT. 208; BS CONTROL PT. 189

| | | |
|---|---|---|
| FS | 209 - 212 | TOPO |
| FS | 213 - 214 | HOUSE CORNER |
| FS | 215 | FF ROBERT RUSSELL |
| FS | 216 - 218 | HOUSE CORNERS |
| FS | 219 | FF BRIAN O'QUINN |
| FS | 224 | CONTROL PT. # 224 |
| FS | 220 - 223 | TOPO |




→ @ CONTROL PT 224, BS CONTROL PT 208

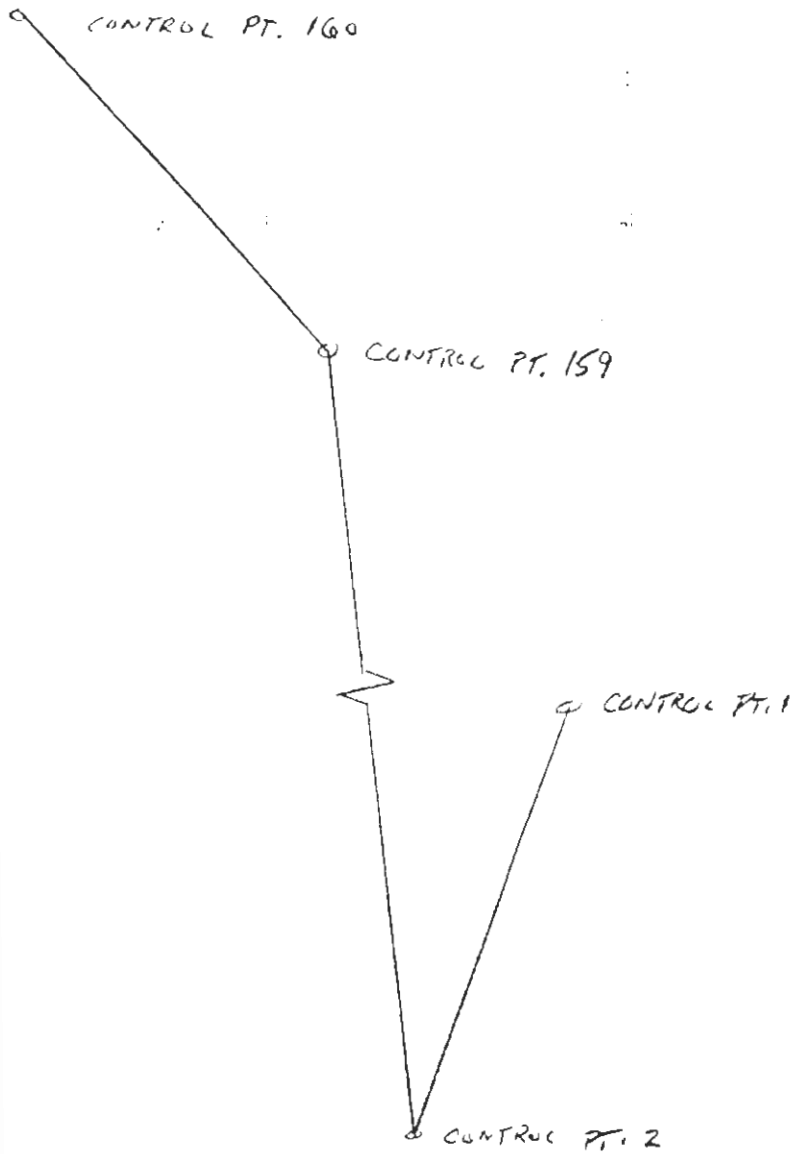
| | | |
|---|---|---|
| FS | 225 - 227 | HOUSE CORNERS |
| FS | 228 | FF ROBERT JESSO |
| FS | 229 - 235 | TOPO |
| FS | 236 - 238 | HOUSE CORNERS |
| FS | 239 | FF BARBARA WHITE |
| FS | 240 | CONTROL PT 240 |

→ @ CONTROL PT. 240; BS CONTROL PT. 224

| | | |
|---|---|---|
| FS | 241 - 243 | HOUSE CORNERS |
| FS | 244 | FF PAUL PERRIER |
| FS | 245 - | TOPO |

NOELS' POND INLET
JULY 19/95

CONTROL TRANSFER.




TT @ CONTROL PT. 2; BS CONTROL PT. 1

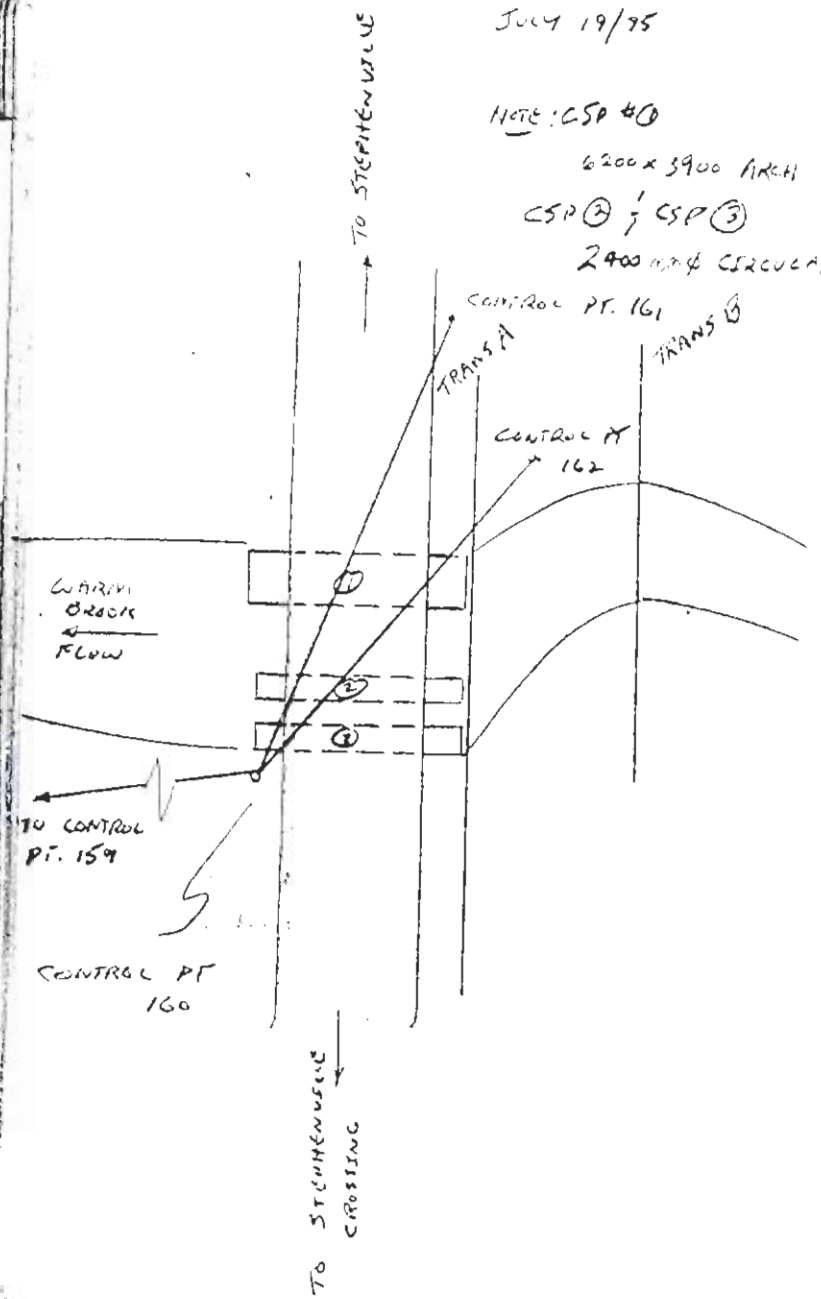
FS 159 CONTROL PT. 159

TT @ CONTROL PT. 159; BS CONTROL PT. 2

FS 160 CONTROL PT. 160

NIELS' POND INLET
JULY 19/95

NOTE: CSP #1
6200 x 3900 ARCH
CSP 2 & CSP 3
2400 mm ϕ CIRCULAR




TK @ CONTROL PT. 160; BS CONTROL PT. 159

| | | |
|---|---|---|
| FS | 161 | CONTROL PT 161 |
| FS | 162 | CONTROL PT. 162 |
| FS | 163 | OUTLET CSP #1 |
| FS | 164 | " CSP #2 |
| FS | 165 | " CSP #3 |
| FS | 166 - 168 | ℄ OF ROAD 8.0 m WIDE |
| FS | 169 | SHOT ON NIELS' POND WATER LEVEL. |

TK @ CONTROL PT. 162; BS CONTROL PT. 160

| | | |
|---|---|---|
| FS | 170 | INLET CSP #1 |
| FS | 171 | " CSP #2 |
| FS | 172 | " CSP #3 |
| FS | 173 - 191 | TRANS 1 (@ CSP INLETS) |

NOTE: PT 171 SHOULD BE USED AS PART OF IN BROOK SHOT FOR TRANS #1

TK @ CONTROL PT. 161; BS CONTROL PT. 160

FS 192 - 203 TRANS - 2

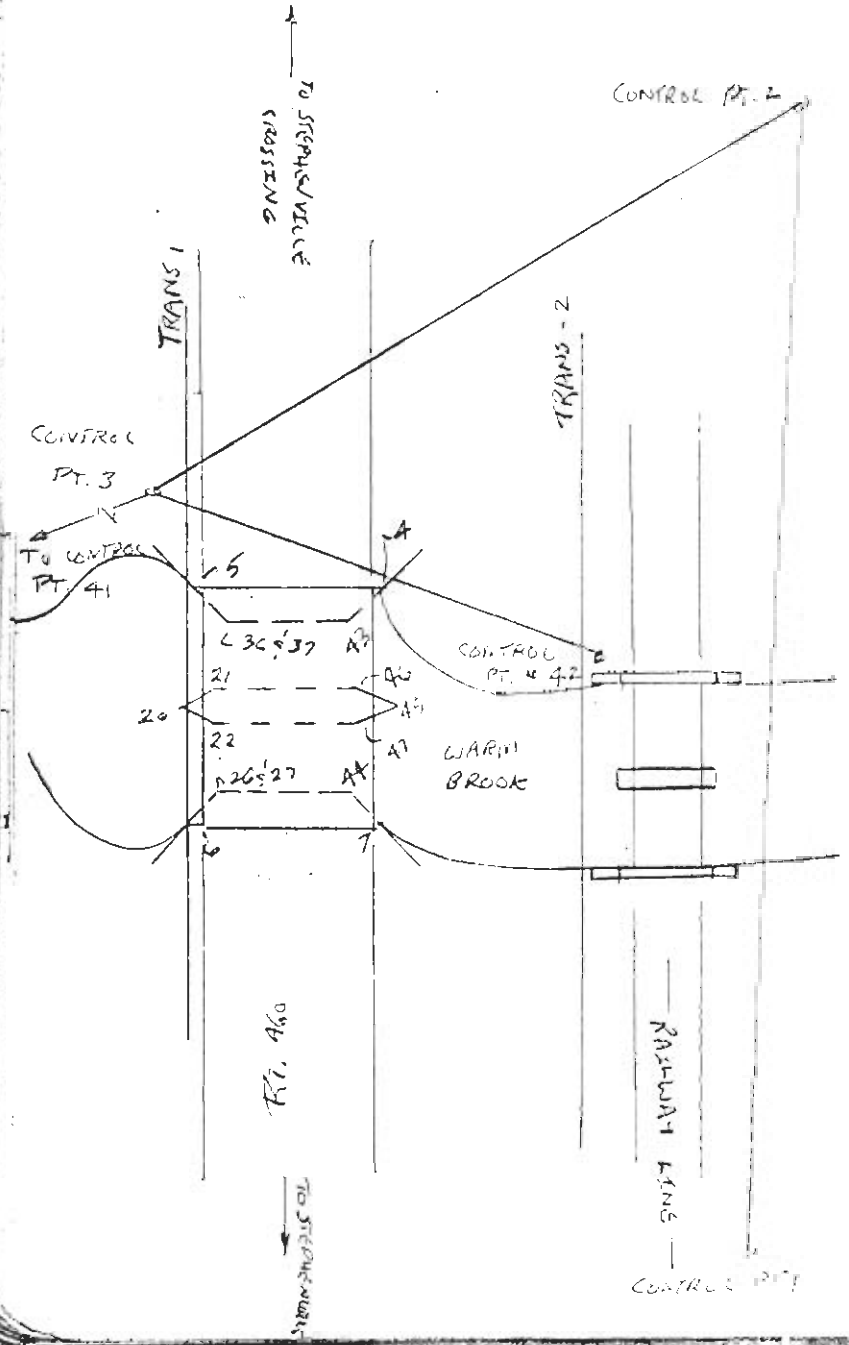
NOELS POND COMMUNITY
JULY 19/95

CONTROL PT. 2
C.L.M. 856 4134

CONTROL PT 3

TT @ PT. #3
BS BM 76F 885
ELEV. @ BM = 26.646
HT. = 1.78
VD (BS) = + 0.346
HI = 28.086
I.H. = 1.443
ELEV. @ CONTROL PT. 3 = 26.643

C.L.M. 938043
CONTROL PT 1




FS CONTROL PT. 3 ; BS CONTROL PT. 2

| | | |
|---|---|---|
| FS | 4 - 7 | TOP OF BRIDGE CORNERS |
| FS | 8 - 10 | ℄ ROAD |
| FS | 11 - 12 | PT. ON WINGWALL |
| FS | 13 - 14 | " " " |
| FS | 15 | LOW CHORD OF CONCRETE BRIDGE |
| FS | 16 - 17 | PT. ON WINGWALL |
| FS | 18 - 19 | " " " |
| FS | 20 - 22 | ℄ CENTER SUPPORT (BRIDGE) |
| FS | 23 - 40 | TRANS - 1 |
| FS | 41 | CONTROL PT. 41 |
| FS | 42 | CONTROL PT. 42 |
| ~~FS~~ | ~~43 - 44~~ | ~~BOTTOM CORNERS OF BRIDGE~~ |
| ~~FS~~ | ~~45 - 47~~ | ~~℄ CENTER SUPPORT~~ |

~~NOTE 45 IS DOWNSTREAM INVERT ALSO~~

FS CONTROL PT. 42 ; BS CONTROL PT. 3

| | | |
|---|---|---|
| FS | 43 - 44 | BOTTOM CORNERS OF BRIDGE |
| FS | 45 - 47 | ℄ CENTER SUPPORT |

NOTE PT. 45 IS ALSO DOWNSTREAM INVERT OF STREAM @ BRIDGE

TR @ CONTROL PT. 42; BS CONTROL PT. 3

| | |
|---|---|
| FS 48 - 51 | TOP OF CONCRETE ABUTT. |
| FS 52 - 55 | TOP OF " SUPPORT |
| FS 56 - 59 | " " " ABUTT |
| FS 74 | BOTTOM CHORD |
| FS 60 - 70 | TRANS - 2 |
| FS 71 - 73 | ℄ RAIL BED |

NOTE DOWNSTREAM INVERT OF TRESTLE @ CENTER IS 23.5526 m

| | |
|---|---|
| FS 75 | FF ALBERT WHITE |
| FS 76 | FF GERALD RYAN |

NOTE; ALBERT WHITE & GERALD RYAN ONLY HAVE CRAWLSPACES IN THEIR SUMMER HOME AND THEY HAVE ONLY EXPERIENCED MINOR FLOODING.

TR @ CONTROL PT. 41; BS CONTROL PT. 3

| | |
|---|---|
| FS 17 - 96 | TRANS - 3 |
| FS 97 | CONTROL PT. 97 |

TR @ CONTROL PT. 97; BS CONTROL PT. 41

| | |
|---|---|
| FS 99 - 124 | TRANS - 4 |
| FS 92 | FF SUMMER HOME |

VERTICAL CONTROL TIE-IN FOR
C.L.M. 938083
BLANCHE & WARM BROOK

TT @ SETUP ; BS BM 76F893

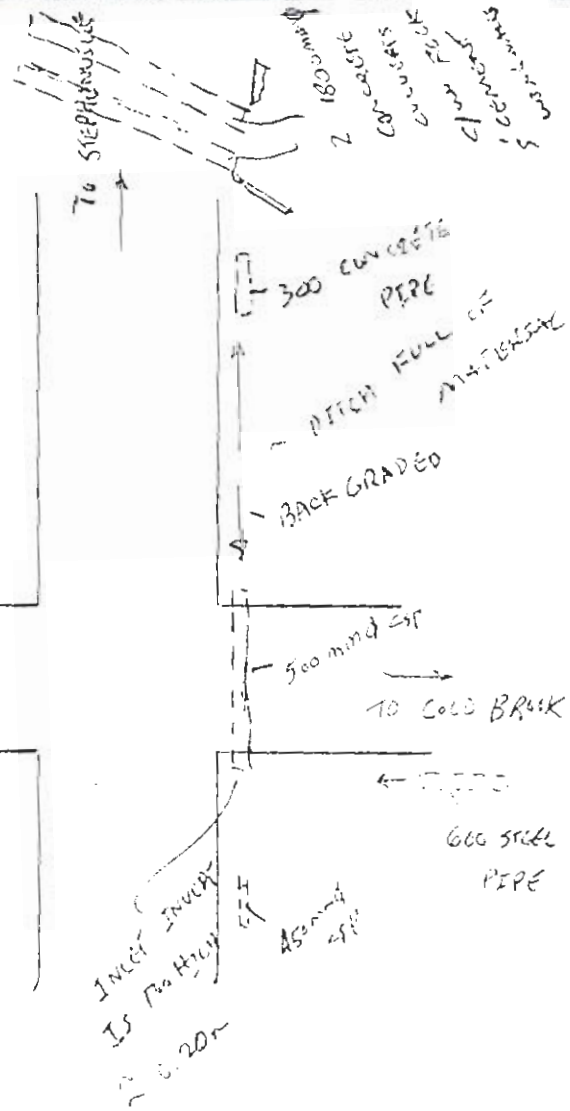
ELEV. @ 76F 893 = 8.148
HT = 1.48
VO (BS) = -0.137
HI = 9.765
VO (FS) = +5.392
HT = 1.48
ELEV. @ 938083 = 13.677

VERTICAL CONTROL TIE-IN FOR
85G4104 GAUDONS' BROOK

TT @ SETUP ; BS 76F897

ELEV. @ 76F897 = 16.672
HT. = 1.48
VO (BS) = +0.352
HI = 7.800
VO (FS) = 1.332
HT = 1.48
ELEV. @ 85G4104 = 17.652

65


TO STEPHENSVILLE
300 CONCRETE PIPE
PITCH FULL OF MATERIAL
BACK GRADED
500 mm CSP
TO COLD BROOK
600 STEEL PIPE

# Appendix J

# Cross Sections and Flood Risk Maps

CANADA-NEWFOUNDLAND
AGREEMENT RESPECTING
WATER RESOURCE MANAGEMENT

**TECHNICAL APPENDICES**

# FLOOD RISK MAPPING STUDY

# OF

# STEPHENVILLE, KIPPENS, AND COLD BROOK

**Prepared For: -**

**Government of Newfoundland and Labrador**
**Department of Environment**
**Water Resources Division**

**Prepared By: -**

**Sheppard Green Engineering and Associates Limited**

**In Association With: -**

**Cumming Cockburn Limited**

**May, 1996**

GOVERNMENT OF
NEWFOUNDLAND
AND LABRADOR

**Department of**
**Environment**

Environment Canada
Environnement Canada