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Cross section and scour chain data in the Ngarradj catchment for 2002 and 2003

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Contents

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1 Introduction

Initial field inspections were conducted in the Ngarradj catchment during the dry season of 1998 as initial work on the Jabiluka mine had commenced. Erskine et al (2001) proposed that a sediment budget framework should be adopted by ***eriss*** to assess the physical impacts, if any, of the Jabiluka mine on the Ngarradj catchment (fig 1). During these field observations, various fluvial erosion processes were identified (Erskine et al 2001) with two of these being bank erosion and scour and fill of the sandy creek beds. To measure the amount of large-scale bank erosion permanently marked channel cross sections on the mine site tributaries (Tributaries North and Central) and at the three ***eriss*** gauging stations (Moliere et al 2002) (fig 1) were installed. Scour chains were used at some of the above cross sections to measure scour and fill (Saynor 2000, Erskine et al 2001, Saynor et al 2002b). Saynor et al (2001) outline the complete ***eriss*** field program in the Ngarradj catchment to assess the physical impacts of the Jabiluka mine.

The data for the annual cross sections surveys in the Ngarradj catchment between 1998 and 2001 are presented in Saynor et al (2002a) and the data for the scour and fill determined by scour chains between 1998 and 2001 are presented in Saynor et al (2002b). This report contains the data for cross sections and scour chains for 2002 and 2003.

2 Methods

Fifty six permanently marked channel cross sections were installed along various reaches of Ngarradj. Multiple cross sections were installed at each ***eriss*** gauging station (upper Swift Creek, lower Swift Creek and East Tributary) as well as on the mine site tributaries, Tributary North and Tributary Central (fig 1). Site specific details are provided below. At some of these cross sections scour chains were also installed in the channel bed.

During each wet season, the various grain size fractions of the bed material of Ngarradj and its tributaries are reworked and transported downstream at various rates to a number of sediment storages. Although the bed-material fluxes have been measured during the wet season (Erskine et al 2001), it is also important to know the depth to which the bed is scoured and/or aggraded each wet season. Repeated surveys of permanently marked cross sections, as reported by Saynor et al (2002a), only measure the net change between successive wet seasons. The actual depths of scour and fill during the wet season are usually much greater. Furthermore, the channels will be one of the first temporary stores to receive sediment, if any is generated by mining activities (Erskine et al 2001). Therefore, scour chains were used at some of the above cross sections to determine scour and fill during each wet season.

2.1 Channel cross sections

A series of permanently marked cross sections were installed during the 1998 dry season and have been surveyed annually each dry season. The data obtained and plots of every survey for the years 1998 to 2001 inclusive have been documented in a previous Internal Report (Saynor

et al 2002a). The background information and the complete methodology are contained in Saynor et al (2001) and Erskine et al (2001).

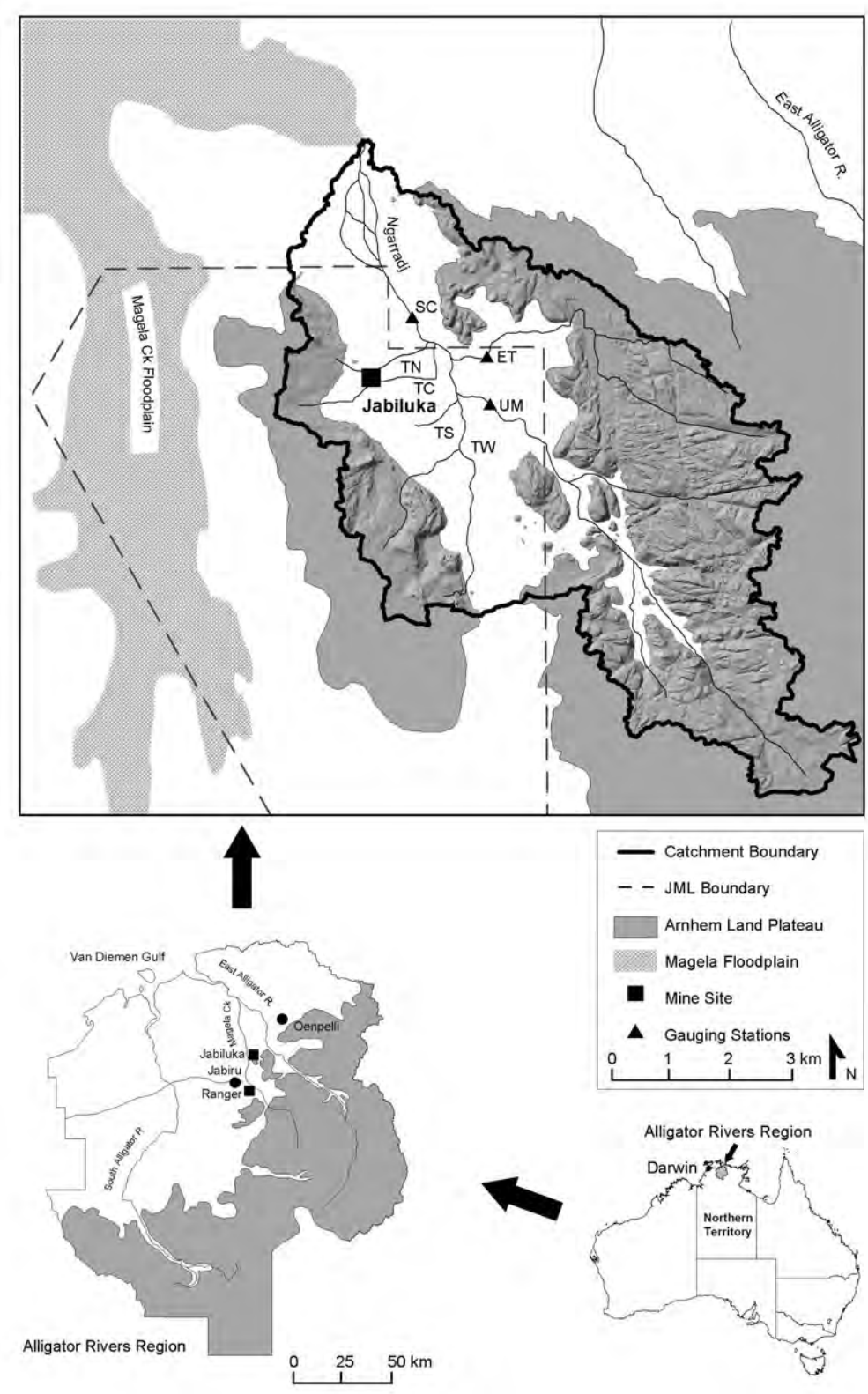

Figure 1 The Ngarradj catchment showing the Jabiluka Mineral Lease, ***eriss***'s gauging stations and local creek names. SC refers to Swift Creek gauging station, TN Tributary North, ET East Tributary gauging station, TC Tributary Central, TS Tributary South, TW Tributary West and UM upper Swift Creek gauging station.

The cross sections have been marked using a star picket driven into the ground with the top 0.3 m encased with a circular concrete collar (plinth) at each end of the cross section. A coach bolt has been set into the concrete (with a small drill hole in the top) to provide an accurate bench mark. At one end of the cross section a recovery star picket has been installed near the concrete plinth. These cross sections have been surveyed using a Topcon Total Station during each dry season between 1998 and 2003 to determine the net change in channel cross section during each intervening wet season. This approach follows the Vigil Network method of the US Geological Survey developed for the International Hydrological Decade (Leopold 1962, Emmett 1965, Leopold & Emmett 1965, Emmett & Hadley 19689). The cross section surveys have also been used to determine hydraulic geometry and changes in geometry during each wet season.

Table 1 Number of cross sections installed in the Ngarradj catchment

Location	Number of sections
Tributary North	17
Tributary Central	15
East Tributary Gauge	8
Upper Swift Creek Gauge	8
Swift Creek Gauge	8
Total	**56**

A plot of every survey for 1998 to 2003 at each cross section is shown in Appendices A to E of Saynor et al (2004). The survey data for each survey (2002 & 2003) of each cross section on each channel outlined in table 1 are contained in appendix 1.

2.2 Hydraulic geometry

The bankfull level (channel–floodplain junction) was initially determined at each cross section using Wolman's (1955) objective method of the point corresponding to the minimum width-depth ratio. This was done for any section where the bankfull level was difficult to determine visually. As more experience was gained with local conditions, it was possible to determine the bankfull level from field knowledge (Williams 1978). The lowest inflection point of the bank profile was adopted as bankfull stage. This leads, in some cases, to the adopted bankfull stage being lower than the apparent top of the bank.

Mean flow velocity at bankfull stage was calculated by Manning's equation:

$$u = n^{-1}.R^{0.67}.S^{0.5}. \quad (1)$$

where u is mean flow velocity (m/s), n is Manning's roughness coefficient, R is bankfull hydraulic radius (m) and S is energy slope (m/m). Water surface slope or bed slope was substituted for energy slope. A reach-averaged Manning's n value was determined by Cowan's (1956) method and by comparison of channel conditions with those for which roughness coefficients have been determined (Barnes 1967, Arcement & Schneider 1984). Hydraulic radius is calculated from the cross sections as:

$$R = A / P \quad (2)$$

where A is cross sectional area (m^2) and P is wetted perimeter (m). However, hydraulic mean depth (R_d) was substituted for hydraulic radius in Manning's equation and was calculated from the cross sections as:

$$R_d = A / W \quad (3)$$

where W is channel width (m). Bankfull discharge (Q in m^3/s) was calculated as:

$$Q = u.A \quad (4)$$

Specific stream power (ω in W/m^2) at bankfull stage was calculated by:

$$\omega = \rho.g.Q.S/W \quad (5)$$

where ρ is fluid density (g/cm^3) and g is the gravitational acceleration constant (9.8 m/s^2).

Tables listing the values of hydraulic geometry parameters are also included in each section. For comparative purposes, the values of hydraulic geometry parameters for all years are shown.

2.3 Scour chains

Depths of scour and fill can be measured by scour chains, as described by Emmett & Leopold (1963) and Emmett (1965). Scour chains were installed in various reaches of the Ngarradj catchment (Table 2). After each wet season, the elevation of the stream bed was resurveyed and the bed was excavated until the chain was exposed. If scour had occurred, a part of the chain was lying horizontally (fig 2). The difference between the existing bed elevation and the horizontal chain was the depth of fill (fig 2). If no scour had occurred, the amount of fill was the depth of sediment above the top of the buried chain. If the amount of fill equalled scour, there was no net change in bed level although scour and fill had occurred.

Scour chains were initially installed during the late dry seasons of 1998 & 1999. Table 2 contains information on the number and timing of scour chain installation in each reach. The scour chains were always located on a surveyed cross section. Only three scour chains were used on Tributary Central because bedrock, pebbles and/or clay prevented bed excavation for the installation of chains.

Table 2 Number of scour chains installed in each study reach in the Ngarradj catchment

Location	No. of cross sections with scour chains	Year of initial installation	Total number of scour chains in each reach
Swift Creek	3	1998 and 1999	15
East Tributary	4	1998	5
Upper Swift Creek	3	1998	6
Tributary North	5	1999	7
Tributary Central	3	1998 and 1999	3

Late in each dry season when the water table was at its lowest, the scour chains were relocated using the diagrams and measurements in Saynor et al (2001) and, more importantly, a metal detector. The metal detector was particularly effective in locating the chains. Measurements of the depth to the scour chain and the bed surface level were obtained. Figure 2 shows an example of an excavated scour chain.

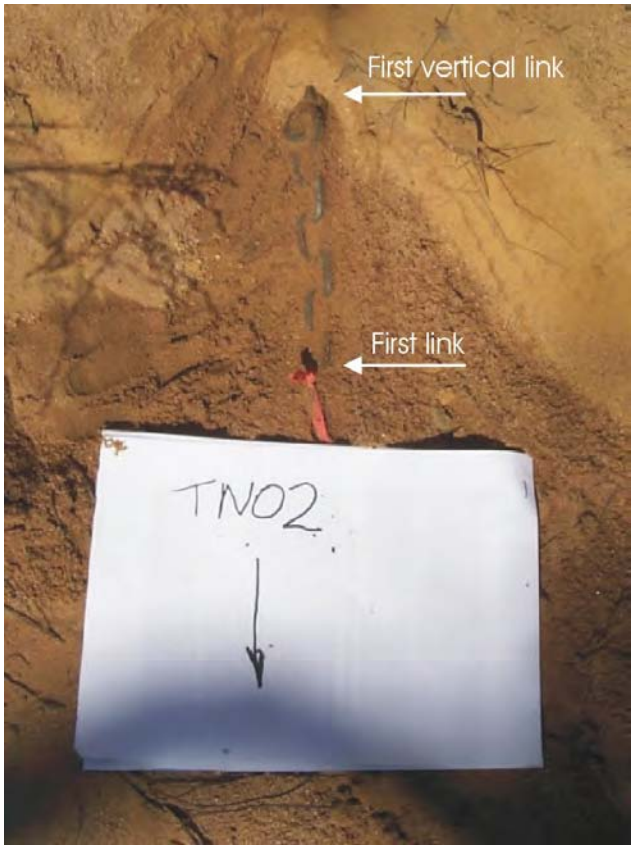

Figure 2 Scour chain at TN02 on 24 October 2000
orientated downstream. Arrow on paper shows flow direction.

A wooden board was positioned over the upstream face of the excavation and all measurements were taken to the bottom of this board which equated to the then bed level. A photograph was usually taken to show the position of the chain and an indication of the direction of flow was given by a trowel, arrow on paper, pen or ruler pointing downstream..As the scoured part of the chain was not always lying horizontal, two measurements were taken to determine the scour depth (fig 3). These were:

- Depth to top of first link (i.e. the link to which flagging tape had been tied) and
- Depth to the first vertical link.

After these measurements were made the chain was carefully straightened and then a further measurement made:

- Depth to straightened chain from the base of the wooden board.

All measurements were made as positive values except when the straightened chain was higher then the current bed level (wooden board) when the value was assigned a negative value. These measurements are used to determine scour and fill and are explained in the next section. Once all the measurements had been made, the chain was reset.

2.4 Scour and fill calculations

The top of the highest link of each chain is the zero datum for the next wet season. The values are all made to this datum even though some of the measurements are made to the bed level for year 2 (fig 4). Once the scour chains are reset the datum is then also reset and the bed level is called Year 1 for the following year (fig 4).

The maximum amount of fill (F_M) is the actual fill during the wet season. The depth to the straightened chain (DSC) is used in equation 6 to determine the maximum scour depth (S_M) and it is essential to keep the mathematical signs as shown in figure 4.

$$S_M = F_M - DSC \qquad \text{(Eq.6)}$$

The net change in bed level (BL_N) is determined by equation 7:

$$BL_N = F_M - S_M \qquad \text{(Eq.7)}$$

A positive value indicates net fill from year 1 to year 2 and a negative value, net scour. This convention of positive values for fill and negative values for scour has been used by, among others, Emmett (1965), Leopold et al (1966), Roberts (1991), Fowler & Wilson (1995) and Locher (1997). Figure 3 shows the three possible situations, net fill, net scour and no net change.

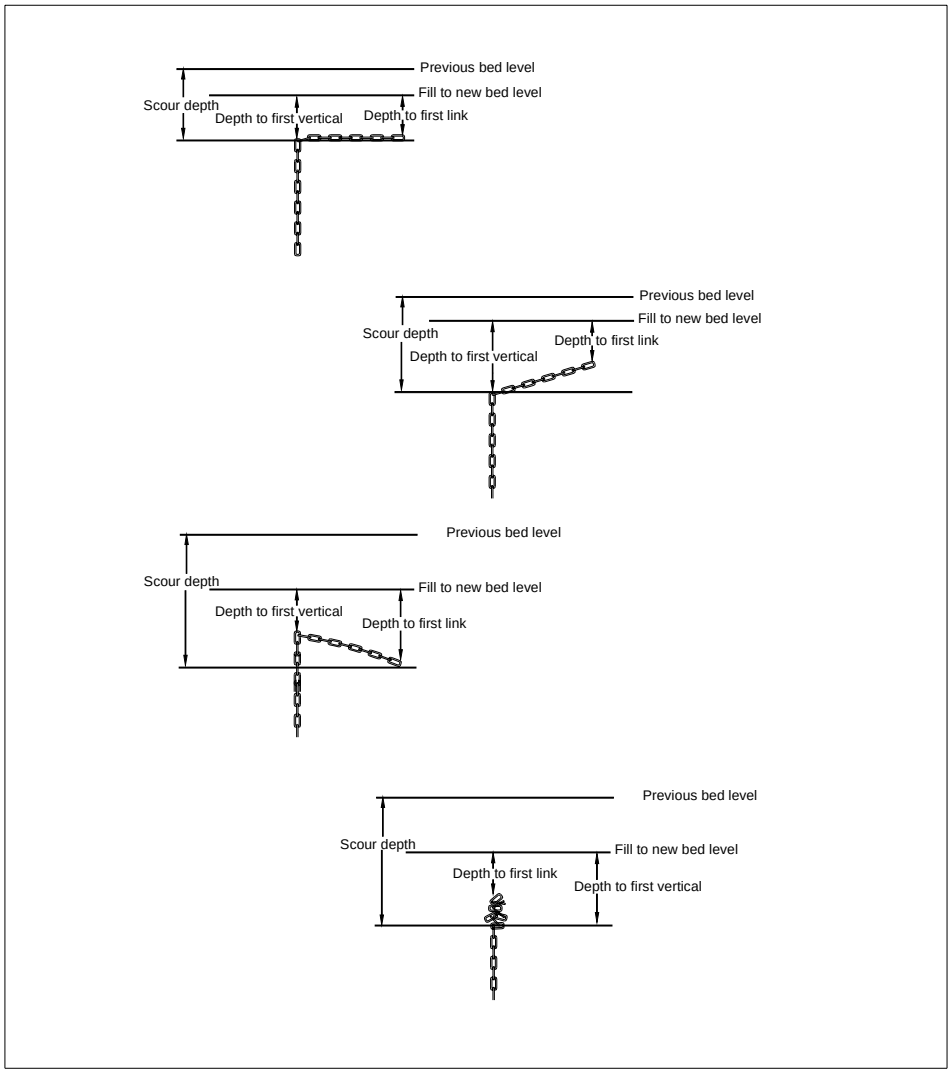

Figure 3 Diagrammatic representation of the full range of scour chain behaviour when there was net scour depicted by the middle option in figure 4. Net fill is shown by the top option in figure 4 and no change, by the lower option in figure 4.

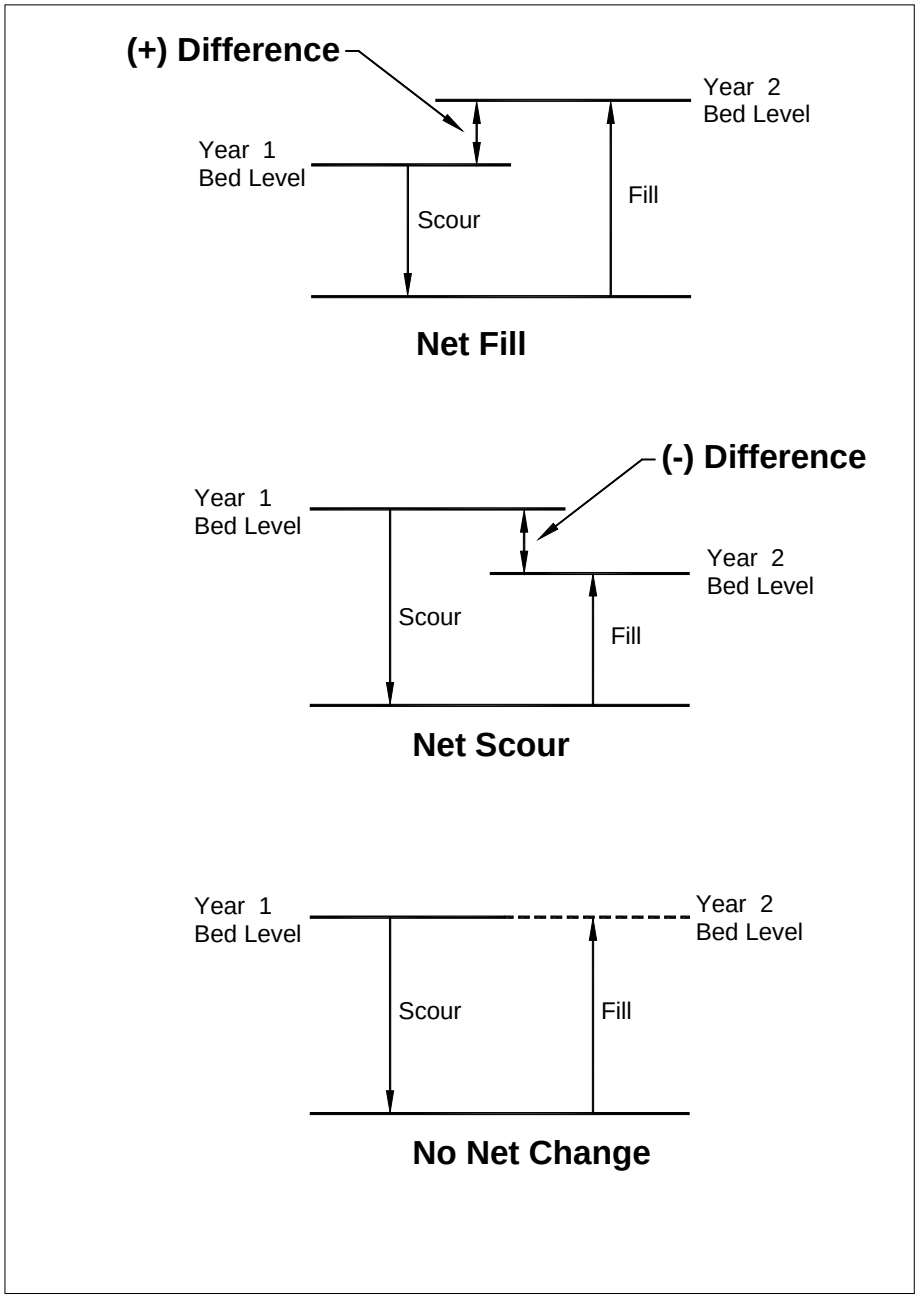

Figure 4 Three options of net channel bed change during the wet season detected by scour chains. Net fill occurs when the bed level for the 2nd year is higher than for the 1st (top). Net scour occurs when the bed level for the 2nd year is lower than for the 1st (middle). No net change occurs when the bed level for the 1st and 2nd years is the same (bottom).

3 Annual Cross section surveys – Results and discussion

The plots of the 56 cross sections for each year between 1998 and 2003 are shown in Appendices A to E of Saynor et al (2004). The cross section survey data for all of the sections for 1998 to 2001 are contained in Saynor et al (2002a) and the survey data for all sections for 2002 and 2003 are contained in Appendix 1. Values for various hydraulic geometry parameters have been also calculated (Tables 3, 4,5,6,7 & 8).

3.1 Tributary North Cross sections

A total of 13 cross sections were installed on this channel downstream of the Jabiluka mine site in the floodout and gullied reaches (Erskine et al 2001). A tributary joins Tributary North on the left bank approximately 30 m upstream of the confluence with Ngarradj. Several cross sections include both the main channel as well as the tributary (fig 5). Four cross sections (10, 11, 12 & 13) of an unchanneled section in the floodout were surveyed but no hydraulic geometry parameters have been calculated because either there was no channel present or it was impossible to identify the bankfull stage.

For the determination of the values of the hydraulic geometry parameters in tables 3 & 4, the slope used was 0.00412 m/m (4.12 m/km) which was determined from a longitudinal bed survey using differential GPS during the 1998 dry season. The Manning's n value used was 0.04. All comparisons for the survey data are made to the first survey which was completed in 1998. For further analysis Tributary North has been divided into Tributary North Main Gully and Tributary North Tributary Gully and are discussed in Saynor et al (2004). For compatibility with the initial discussions about the cross sections (Saynor et al 2002a) they have been left as the one reach for the discussion below.

The cross sectional area at cross section TN01, the closest section to the primary nickpoint at the upstream end of the gullied reach (Erskine et al 2001) increased in area by 18% from 1998 to 2001 due to gully erosion. The 2003 survey compared to the 1998 survey shows only a 16% increase in area indicating that there has been deposition at the cross section, as the nickpoint eroded further upstream. Of the remaining 12 cross sections for the 2001 comparison, six decreased in area, four increased in area and two were essentially constant. Interestingly for the 2003 survey the same values were obtained for changes in cross section area, however not necessarily for the same cross section.

Cross section TN01 was actively widening in 2001 and continued to do so for the 2003 survey. Of the remaining 12 cross sections for the 2001 survey, six had widened and six had contracted. For the 2003 survey, ten had widened, one had contracted and one was the same width as in 1998. For the 2001 survey the mean depth decreased at seven sections, increased at five and remained essentially constant at one. The 2003 survey showed that mean depth had decreased at ten sections and increased at three sections. For both the 2001 survey and the 2003 survey the maximum depth increased at nine sections and decreased at four.

In comparison to the incised channels discussed in Darby and Simon (1999), the gullied lower reach of Tributary North is slowly developing by the upstream migration of the primary nickpoint and subsequent channel widening and degradation. The nickpoint is surveyed each year and the upstream migration of the nickpoint is shown in figure 6. These geomorphic processes were occurring before the development of the Jabiluka mine and their rates of activity do not appear to have been accelerated.

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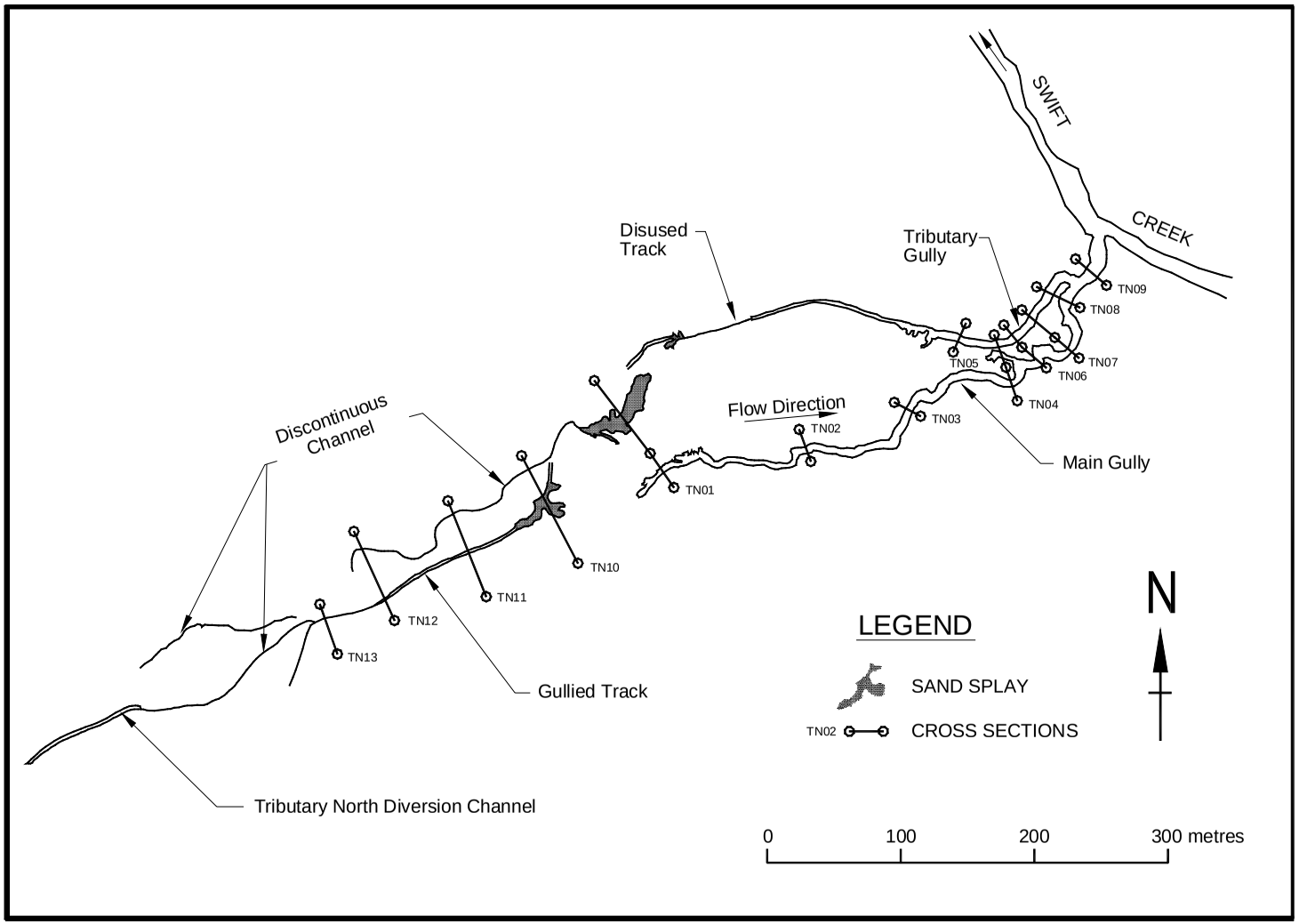

Figure 5 Location of the permanently monumented cross sections on Tributary North

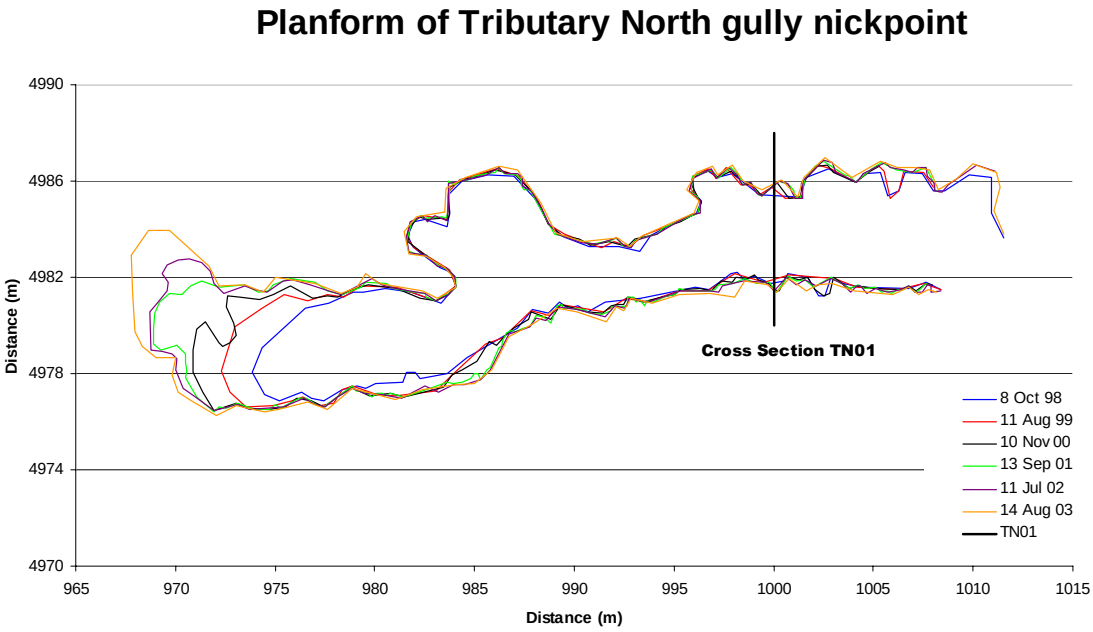

Figure 6 Annual surveys of the primary nickpoint at the head of Erskine et al's (2001) gullied reach on Tributary North. This refers to the main gully.

Table 3 Hydraulic geometry parameter values for Tributary North main gully 1998 - 2003

Bankfull Hydraulic Geometry Parameters	TN01						TN02					
	1998	1999	2000	2001	2002	2003	1988	1999	2000	2001	2002	2003
Area (m^2)	2.10	2.52	2.48	2.48	2.52	2.44	2.99	2.99	2.98	3.04	3.03	2.91
Width (m)	3.81	4.11	4.45	4.41	4.57	4.62	6.54	6.48	6.45	6.51	6.53	6.58
Hydraulic mean depth (m)	0.55	0.61	0.56	0.56	0.55	0.53	0.46	0.46	0.46	0.47	0.46	0.44
Maximum depth (m)	0.913	1.021	0.955	0.982	0.961	0.977	1.009	1.051	1.116	1.154	1.108	1.013
Mean velocity (ms^{-1})	1.08	1.16	1.09	1.09	1.08	1.05	0.95	0.96	0.96	0.96	0.96	0.93
Discharge Q (m^3s^{-1})	2.26	2.91	2.69	2.71	2.71	2.55	2.85	2.87	2.86	2.93	2.91	2.70
Specific Stream Power (Wm^{-2})	23.9	28.5	24.4	24.8	23.9	22.24	17.5	17.8	17.9	18.2	18.0	16.6
Bankfull Hydraulic Geometry Parameters	**TN03**						**TN04**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	3.14	3.13	3.01	3.20	3.05	3.13	1.25	1.39	1.33	1.35	1.43	1.43
Width (m)	5.00	4.99	5.05	5.11	5.06	5.16	4.01	3.64	3.51	3.63	4.26	4.47
Hydraulic mean depth (m)	0.63	0.63	0.60	0.63	0.60	0.61	0.31	0.38	0.38	0.37	0.34	0.32
Maximum depth (m)	1.095	1.216	1.111	1.257	1.190	1.202	0.644	0.774	0.723	0.750	0.867	0.832
Mean velocity (ms^{-1})	1.18	1.18	1.14	1.17	1.14	1.15	0.74	0.84	0.84	0.83	0.78	0.75
Discharge Q (m^3s^{-1})	3.70	3.68	3.43	3.76	3.49	3.60	0.92	1.17	1.12	1.12	1.11	1.07
Specific Stream Power (Wm^{-2})	29.8	29.7	27.4	29.7	27.8	28.2	9.2	13.0	12.9	12.4	10.6	9.7

Table 3 Cont. Hydraulic geometry parameter values for Tributary North main gully 1998- 2003

Bankfull Hydraulic Geometry Parameters	TN06						TN07					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	2.10	2.29	2.22	2.17	2.20	2.23	2.25	2.30	2.27	2.26	2.26	2.35
Width (m)	5.32	5.43	5.40	5.30	5.34	5.32	5.36	5.42	5.35	5.18	5.36	5.79
Hydraulic mean depth (m)	0.39	0.42	0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.44	0.42	0.41
Maximum depth (m)	0.661	0.750	0.761	0.729	0.905	0.866	0.776	0.798	0.862	0.852	0.872	0.829
Mean velocity (ms^{-1})	0.86	0.90	0.88	0.88	0.89	0.90	0.90	0.91	0.91	0.92	0.90	0.88
Discharge Q (m^3s^{-1})	1.81	2.07	1.96	1.92	1.95	2.00	2.03	2.08	2.06	2.08	2.04	2.07
Specific Stream Power (Wm^{-2})	13.7	15.4	14.6	14.6	14.7	15.2	15.3	15.5	15.5	16.2	15.3	14.4
Bankfull Hydraulic Geometry Parameters	**TN08**						**TN09**					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	5.28	5.12	5.10	4.98	5.01	5.16	6.98	7.04	6.96	6.91	6.96	6.92
Width (m)	9.85	9.72	9.80	9.74	9.60	10.03	9.86	9.78	9.96	9.95	10.00	9.91
Hydraulic mean depth (m)	0.54	0.53	0.52	0.51	0.52	0.51	0.71	0.72	0.70	0.69	0.70	0.70
Maximum depth (m)	0.965	1.053	1.022	1.011	1.020	0.998	1.069	1.097	1.097	1.095	1.083	1.094
Mean velocity (ms^{-1})	1.06	1.05	1.04	1.03	1.04	1.03	1.27	1.29	1.26	1.26	1.26	1.26
Discharge Q (m^3s^{-1})	5.59	5.36	5.30	5.10	5.20	5.31	8.90	9.06	8.80	8.68	8.76	8.73
Specific Stream Power (Wm^{-2})	22.9	22.3	21.8	21.1	21.8	21.4	36.4	37.4	35.6	35.2	35.3	35.5

Table 4. Hydraulic geometry parameter values for Tributary North Tributary Gully 1998- 2003

Bankfull Hydraulic Geometry Parameters	TN05						TN04					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	3.78	3.75	3.74	3.76	3.73	3.76	3.80	3.74	3.70	3.67	3.68	3.67
Width (m)	6.27	6.35	6.46	6.68	6.74	6.75	5.33	5.31	5.40	5.39	5.53	5.47
Hydraulic mean depth (m)	0.60	0.59	0.58	0.56	0.55	0.56	0.71	0.70	0.68	0.68	0.66	0.67
Maximum depth (m)	1.026	1.034	1.025	1.012	0.986	0.973	1.065	1.032	1.019	1.045	1.026	1.026
Mean velocity (ms^{-1})	1.14	1.13	1.11	1.09	1.08	1.09	1.28	1.27	1.25	1.24	1.22	1.23
Discharge Q (m^3s^{-1})	4.33	4.23	4.16	4.12	4.04	4.09	4.87	4.74	4.61	4.55	4.49	4.51
Specific Stream Power (Wm^{-2})	27.8	26.8	25.9	24.9	24.2	24.4	36.8	36.0	34.4	34.0	32.7	33.2
Bankfull Hydraulic Geometry Parameters	**TN06**						**TN07**					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	4.26	4.19	4.24	4.19	4.22	4.05	4.82	4.70	4.76	4.76	4.69	4.77
Width (m)	5.39	5.35	5.46	5.35	5.48	5.24	7.16	6.65	7.22	7.37	7.53	7.67
Hydraulic mean depth (m)	0.79	0.78	0.78	0.78	0.77	0.77	0.67	0.71	0.66	0.65	0.62	0.62
Maximum depth (m)	1.082	1.152	1.152	1.132	1.116	1.085	1.228	1.039	1.068	1.056	1.027	1.107
Mean velocity (ms^{-1})	1.37	1.36	1.36	1.36	1.35	1.35	1.23	1.27	1.21	1.20	1.17	1.17
Discharge Q (m^3s^{-1})	5.85	5.72	5.74	5.71	5.68	5.47	5.94	5.98	5.78	5.70	5.50	5.58
Specific Stream Power (Wm^{-2})	43.8	43.2	42.4	43.0	41.8	42.1	33.5	36.3	32.3	31.2	29.4	29.3

Table 4 Cont. Hydraulic geometry parameter values for Tributary North tributary gully 1998- 2003

Bankfull Hydraulic Geometry Parameters	TN08					
	1998	1999	2000	2001	2002	2003
Area (m^2)	4.30	4.24	4.22	4.26	4.25	4.33
Width (m)	6.59	7.05	7.16	7.16	7.43	7.88
Hydraulic mean depth (m)	0.65	0.60	0.59	0.59	0.57	0.55
Maximum depth (m)	1.280	1.162	1.148	1.152	1.155	1.149
Mean velocity (ms^{-1})	1.21	1.14	1.13	1.13	1.11	1.07
Discharge Q (m^3s^{-1})	5.20	4.84	4.75	4.83	4.70	4.65
Specific Stream Power (Wm^{-2})	31.8	27.7	26.8	27.2	25.5	23.8

3.2 Tributary Central Cross sections

The location of the 15 cross sections on Tributary Central downstream of the Jabiluka mine site is shown in figure 7. The most upstream sites, 6 and 7, comprise three cross sections (called A, B & C) on two abrupt angled bends in the sinuous reach of Erskine et al (2001). They were selected to determine the amount of bank erosion and lateral migration on meander loops. The remaining cross sections were located in the large and small capacity reaches of Erskine et al (2001) which extend from the sinuous reach to the anabranch of Ngarradj. Two cross sections (sites TC08 and TC09) were located in the large capacity reach and the remaining six sections were sited in the small capacity reach. Bank height and channel capacity decrease rapidly downstream so that the channel is poorly defined where Tributary Central joins the anabranch of Ngarradj.

For the determination of the values of the hydraulic geometry parameters in table 5, the slope used was 0.00226 m/m (2.26 m/km) which was measured from a longitudinal bed survey using differential GPS during the 1998 dry season. The Manning's n value used was 0.04. All comparisons for the survey data are made to the first survey which was completed in 1998. The cross sectional area for the 2001 survey increased at 12 of the 14 cross sections. For the 2003 survey, area increased at 12 of the sections, decreased at one section and was stable at the other section. For the 2001 survey five of the six cross sections on the abrupt angled bends (site TC06 & TC07) increased in area, with the largest increase being 45 % (TC07B) since 1998. For the 2003 survey all six cross sections increased in area with the largest being 75% (TC06C) since 1998

For the 2001 survey, width increased at 11 of the cross sections and decreased at the other three. The 2003 survey widths increased at 12 of the 14 sections and decreased at the other two. Mean depth in 2001 had increased at nine of the cross sections, decreased at three and was constant at two. In 2003 mean depth had increased at nine of the sections and decreased at five sections. Maximum depth for 2001 increased at 14 of the sections and decreased at one. The 2003 survey found increases in mean depth at 12 of the sections and decreases at the other two sections.

Channel erosion by lateral migration, bed degradation and channel widening is active on Tributary Central. Clearly, Tributary Central has been unstable during the life of the Jabiluka mine. However, significant overbank deposition has also occurred on the floodplain in the small capacity reach where crevasses and splays are common. Sand deposition has formed a low angle fan which is well vegetated. Anabranches are developing and avulsions seem likely. While sand has been supplied to the anabranch, it terminates further downstream in a well defined sand front and is not being transported through to Ngarradj. It is essential that all available vertical air photographs are obtained and interpreted to determine whether Tributary Central was unstable before any development of the Jabiluka mine.

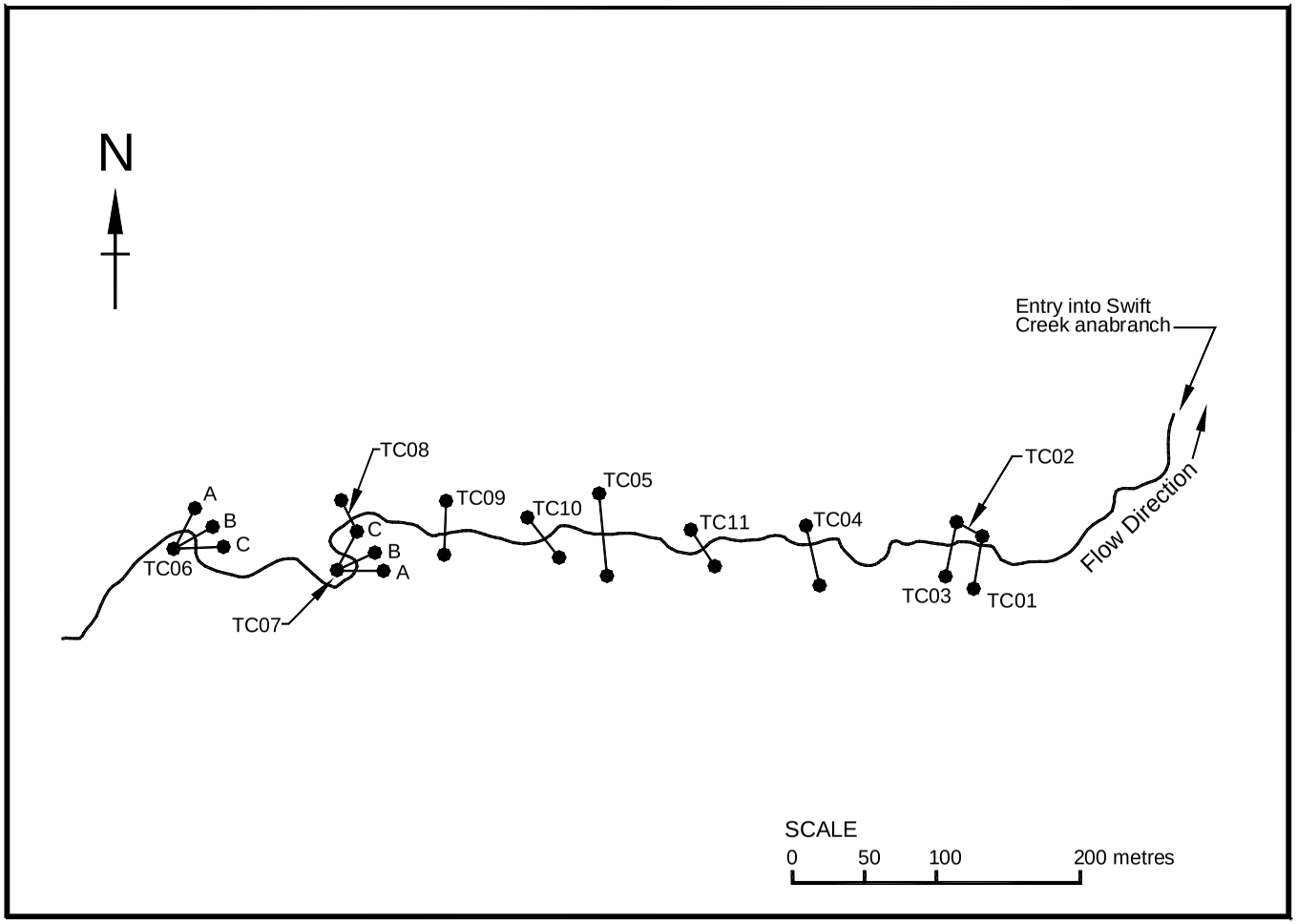

Figure 7 Location of the permanently monumented cross sections on Tributary Central

Table 5 Hydraulic geometry parameter values for Tributary Central 1998- 2003. All of the values for TC07B for each of the years have been recalculated (From those presented in IR 385 Saynor et al 2001) as the point of Inflexion has changed.

Bankfull Hydraulic Geometry Parameters	TC06A						TC06B					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	4.87	4.53	5.19	5.92	4.84	5.20	4.10	4.18	4.27	3.72	3.74	4.32
Width (m)	10.33	10.64	10.35	10.57	10.71	10.47	10.61	10.86	10.85	6.78	11.27	14.36
Hydraulic mean depth (m)	0.47	0.43	0.50	0.56	0.45	0.50	0.39	0.39	0.39	0.55	0.33	0.30
Maximum depth (m)	0.919	1.072	1.078	1.107	0.926	1.083	1.006	1.090	1.070	1.091	1.025	0.976
Mean velocity (ms^{-1})	0.72	0.67	0.75	0.81	0.81	0.81	0.63	0.63	0.64	0.80	0.57	0.53
Discharge Q (m^3s^{-1})	3.50	3.05	3.89	4.77	4.77	4.77	2.58	2.63	2.73	2.96	2.13	2.30
Specific Stream Power (Wm^{-2})	7.5	6.3	8.3	10.0	10.0	10.0	5.4	5.4	5.6	9.7	4.2	3.5
Bankfull Hydraulic Geometry Parameters	**TC06C**						**TC07A**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	4.55	4.32	4.60	4.63	5.54	3.19	7.39	7.97	10.55	10.01	10.75	10.81
Width (m)	8.70	7.76	7.84	8.49	11.62	7.98	11.83	12.43	14.77	15.37	16.66	17.13
Hydraulic mean depth (m)	0.52	0.56	0.59	0.55	0.48	0.40	0.62	0.64	0.71	0.65	0.64	0.63
Maximum depth (m)	0.982	0.912	0.962	1.177	1.059	1.010	1.169	1.150	1.258	1.220	1.285	1.140
Mean velocity (ms^{-1})	0.77	0.80	0.83	0.79	0.73	0.64	0.87	0.88	0.95	0.89	0.89	0.87
Discharge Q (m^3s^{-1})	3.51	3.47	3.83	3.67	4.02	2.06	6.42	7.04	10.01	8.93	9.53	9.45
Specific Stream Power (Wm^{-2})	8.9	9.9	10.8	9.6	7.7	5.7	12.0	12.5	15.0	12.9	12.7	12.2

Table 5 Cont. Hydraulic geometry parameter values for Tributary Central 1998- 2003

Bankfull Hydraulic Geometry Parameters	TC07B						TC07C					
	1998	1999	2000	2003	2002	2001	1998	1999	2000	2001	2002	2003
Area (m^2)	6.09	7.82	8.50	8.74	8.82	8.83	4.93	5.51	5.59	5.70	5.68	5.96
Width (m)	9.99	11.49	12.70	13.19	12.93	13.07	7.56	8.02	8.13	8.18	8.30	8.31
Hydraulic mean depth (m)	0.61	0.68	0.67	0.66	0.68	0.68	0.65	0.69	0.69	0.70	0.68	0.72
Maximum depth (m)	1.185	1.288	1.314	1.341	1.333	1.346	1.221	1.291	1.258	1.271	1.440	1.549
Mean velocity (ms^{-1})	0.85	0.92	0.91	0.90	0.92	0.91	0.89	0.93	0.93	0.93	0.92	0.95
Discharge Q (m^3s^{-1})	5.19	7.18	7.72	7.89	8.12	8.07	4.40	5.10	5.17	5.32	5.24	5.67
Specific Stream Power (Wm^{-2})	11.5	13.8	13.5	13.2	13.9	13.7	12.9	14.1	14.1	14.4	14.0	15.1
Bankfull Hydraulic Geometry Parameters	**TC08**						**TC09**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	6.76	7.47	7.33	7.45	7.52	7.46	6.94	7.16	7.31	**7.84**	8.19	8.26
Width (m)	8.38	8.37	8.51	8.63	8.83	8.88	7.55	7.76	7.70	9.21	9.04	8.86
Hydraulic mean depth (m)	0.81	0.89	0.86	0.86	0.85	0.84	0.92	0.92	0.95	0.85	0.91	0.93
Maximum depth (m)	1.524	1.613	1.632	1.644	1.648	1.658	1.421	1.393	1.411	1.499	1.474	1.478
Mean velocity (ms^{-1})	1.03	1.10	1.07	1.08	1.07	1.06	1.12	1.13	1.15	1.07	1.11	1.13
Discharge Q (m^3s^{-1})	6.95	8.22	7.88	8.03	8.02	7.89	7.80	8.07	8.38	8.37	9.11	9.37
Specific Stream Power (Wm^{-2})	18.4	21.7	20.5	20.6	20.1	19.7	22.9	23.0	24.1	20.1	22.3	23.4

Table 5 Cont. Hydraulic geometry parameter values for Tributary Central 1998- 2003

Bankfull Hydraulic Geometry Parameters	TC10						TC05					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	3.87	3.87	3.96	4.28	4.31	4.19	4.95	4.83	4.86	4.81	4.64	4.85
Width (m)	7.79	7.66	7.93	8.55	8.52	8.90	5.48	5.36	5.52	5.61	5.56	5.75
Hydraulic mean depth (m)	0.50	0.50	0.50	0.50	0.51	0.47	0.90	0.90	0.88	0.86	0.83	0.84
Maximum depth (m)	0.753	0.753	0.789	0.833	0.823	0.838	1.141	1.130	1.156	1.209	1.155	1.188
Mean velocity (ms^{-1})	0.75	0.75	0.75	0.75	0.75	0.72	1.11	1.11	1.09	1.07	1.05	1.06
Discharge Q (m^3s^{-1})	2.89	2.91	2.96	3.21	3.26	3.01	5.50	5.35	5.30	5.15	4.89	5.14
Specific Stream Power (Wm^{-2})	8.2	8.4	8.3	8.3	8.5	7.5	22.2	22.1	21.2	20.3	19.5	19.8
Bankfull Hydraulic Geometry Parameters	**TC11**						**TC04**					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	3.59	3.84	3.97	4.07	4.16	4.25	3.33	3.48	3.74	3.78	3.95	3.95
Width (m)	6.44	6.27	6.60	7.31	7.35	8.16	4.88	4.79	4.93	4.70	4.78	4.92
Hydraulic mean depth (m)	0.56	0.61	0.60	0.56	0.57	0.52	0.68	0.72	0.76	0.80	0.83	0.80
Maximum depth (m)	0.777	0.890	0.837	1.107	1.112	1.075	1.005	0.984	1.177	1.186	1.199	1.214
Mean velocity (ms^{-1})	0.80	0.86	0.85	0.80	0.81	0.77	0.92	0.96	0.99	1.03	1.05	1.03
Discharge Q (m^3s^{-1})	2.89	3.30	3.36	3.28	3.38	3.27	3.06	3.33	3.69	3.88	4.12	4.05
Specific Stream Power (Wm^{-2})	9.9	11.6	11.3	9.9	10.2	8.9	13.9	15.4	16.6	18.3	19.1	18.2

Table 5 Cont. Hydraulic geometry parameter values for Tributary Central 1998- 2003

Bankfull Hydraulic Geometry Parameters	TC03						TC01					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	2.10	2.28	2.28	2.24	2.25	2.10	1.66	1.52	1.74	1.81	1.89	1.81
Width (m)	4.84	5.15	5.45	4.59	4.60	4.36	3.93	4.01	4.29	4.47	5.43	3.94
Hydraulic mean depth (m)	0.44	0.44	0.42	0.49	0.49	0.48	0.42	0.38	0.40	0.41	0.35	0.46
Maximum depth (m)	0.588	0.658	0.707	0.703	0.689	0.656	0.620	0.606	0.653	0.649	0.640	0.595
Mean velocity (ms^{-1})	0.68	0.69	0.66	0.74	0.74	0.73	0.67	0.62	0.65	0.65	0.59	0.71
Discharge Q (m^3s^{-1})	1.44	1.58	1.51	1.65	1.66	1.54	1.11	0.94	1.13	1.18	1.11	1.28
Specific Stream Power (Wm^{-2})	6.6	6.8	6.1	7.9	8.0	7.8	6.3	5.2	5.8	5.8	4.5	7.2

3.3 East Tributary Cross sections

The gauging station is located in the forested meandering reach of Erskine et al (2001). Eight cross sections were installed near the gauge during the 1998 dry season They have been resurveyed during each subsequent dry season. The location of the cross sections is shown in figure 8. The values of the bankfull hydraulic geometry parameters for each survey at each cross section are listed in table 6.

A field surveyed flood (2000/2001 wet season) slope of 0.0015 m/m (1.5 m/km) was used to determine the values of the hydraulic geometry parameters in table 6. The Manning's n value used was 0.04. All comparisons for the survey data are made to the first survey which was completed in 1998.

There was an increase in cross sectional area at all cross sections between 1998 and 2001. However, the maximum percentage increase in cross sectional area since 1998 was only 8.6%. In 2003, the mean cross sectional area had increased at seven sections and decreased at one. The maximum percentage increase in cross sectional area for between 2003 and 1998 was 11.9%. For both 2001 and 2003 surveys compared to 1998, width had increased at seven of the eight sections with the other section decreasing (ET08 in both instances). Mean and maximum depth increased at all cross sections for 2001. In 2003, mean depth increased at six sections and decreased at two and maximum depth increased at seven sections and decreased at one.

East Tributary is not impacted by the Jabiluka mine and is flanked by a monsoonal vine forest at the gauging station (Erskine et al 2001). The forest stabilises the bank by a high density of tree trunks, roots and root mats.

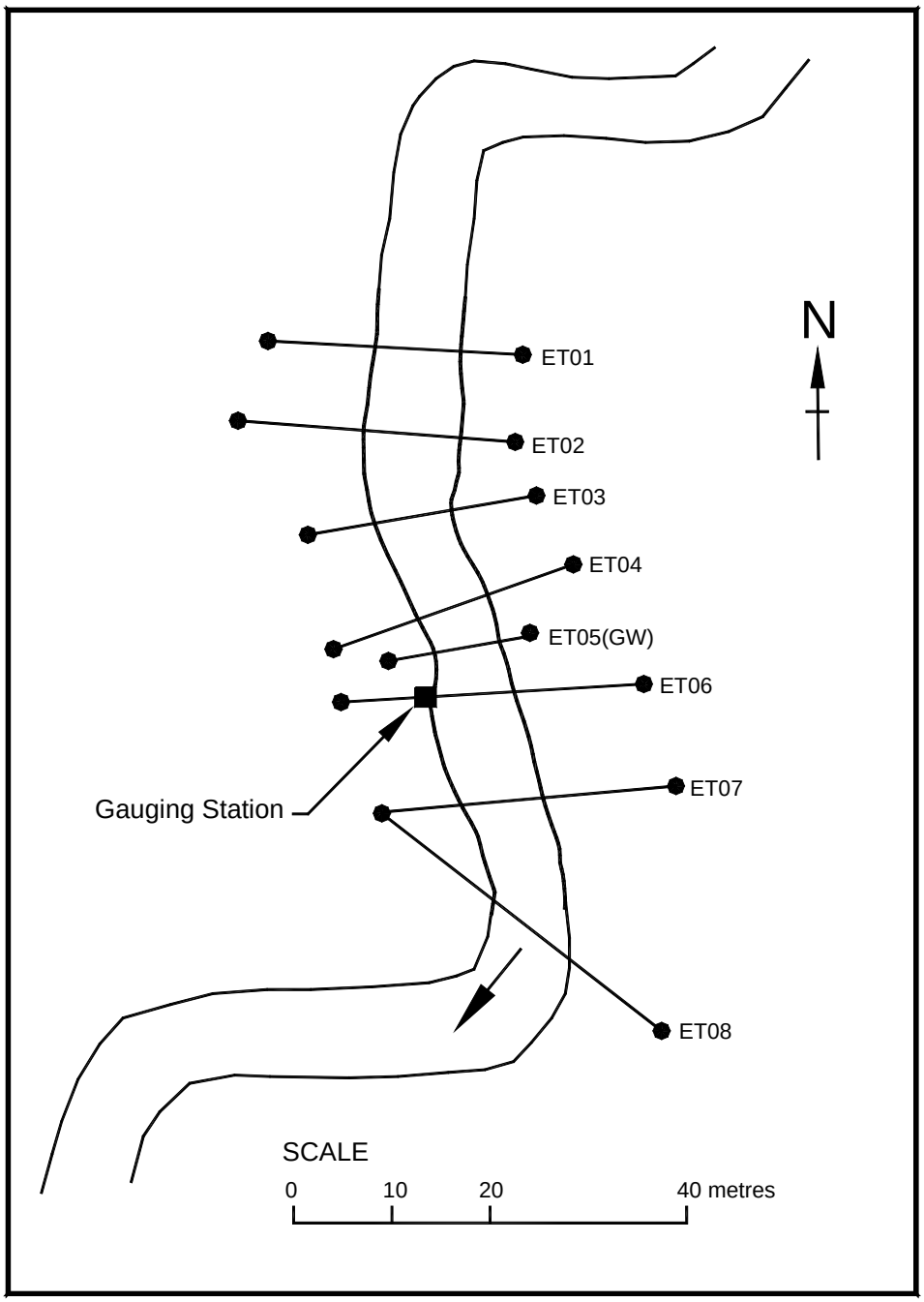

Figure 8 Location of the cross sections on East Tributary at the ***eriss*** gauging station

Table 6 Hydraulic geometry parameter values for East Tributary 1998- 2003.

Bankfull Hydraulic Geometry Parameters	ET01						ET02					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	8.30	8.33	9.14	8.83	8.90	8.75	12.93	13.53	13.74	13.88	12.87	12.61
Width (m)	8.07	8.13	8.17	8.29	8.46	8.56	10.01	9.88	9.86	10.03	10.08	10.20
Hydraulic mean depth (m)	1.03	1.02	1.12	1.07	1.05	1.02	1.29	1.37	1.39	1.38	1.28	1.24
Maximum depth (m)	1.510	1.459	1.759	1.671	1.749	1.552	2.193	2.181	2.328	2.251	2.03	1.831
Mean velocity (ms^{-1})	0.99	0.98	1.04	1.01	1.00	0.98	1.15	1.19	1.21	1.20	1.14	1.11
Discharge Q (m^3s^{-1})	8.19	8.20	9.54	8.92	8.92	8.59	14.84	16.16	16.59	16.70	14.67	14.06
Specific Stream Power (Wm^{-2})	14.9	14.8	17.2	15.8	15.5	14.8	21.8	24.0	24.7	24.5	21.4	20.2
Bankfull Hydraulic Geometry Parameters	**ET03**						**ET04**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	7.57	7.80	8.31	7.93	8.25	8.13	6.26	6.39	6.38	6.55	**6.53**	6.54
Width (m)	7.65	7.63	7.68	7.74	7.85	7.96	6.85	6.85	7.04	7.11	6.69	7.01
Hydraulic mean depth (m)	0.99	1.02	1.08	1.02	1.05	1.02	0.91	0.93	0.91	0.92	0.98	0.93
Maximum depth (m)	1.518	1.603	1.654	1.614	1.626	1.587	1.261	1.321	1.320	1.336	1.397	1.339
Mean velocity (ms^{-1})	0.96	0.98	1.02	0.98	1.00	0.98	0.91	0.92	0.91	0.92	0.95	0.92
Discharge Q (m^3s^{-1})	7.28	7.66	8.48	7.80	8.26	7.98	5.70	5.90	5.78	6.00	6.21	6.04
Specific Stream Power (Wm^{-2})	14.0	14.8	16.2	14.8	15.5	14.7	12.2	12.7	12.1	12.4	13.6	12.7

Table 6 Cont. Hydraulic geometry parameter values for East Tributary 1998- 2003

Bankfull Hydraulic Geometry Parameters	ET05						ET06					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	4.78	4.78	4.93	5.16	5.32	5.09	5.37	5.59	5.80	**5.80**	5.65	6.01
Width (m)	5.95	5.99	5.98	6.02	5.90	6.05	7.25	7.33	7.38	7.41	7.37	7.38
Hydraulic mean depth (m)	0.80	0.80	0.83	0.86	0.90	0.84	0.74	0.76	0.79	0.78	0.77	0.81
Maximum depth (m)	1.166	1.187	1.247	1.274	1.255	1.179	1.137	1.197	1.318	1.324	1.343	1.418
Mean velocity (ms^{-1})	0.84	0.83	0.85	0.87	0.90	0.86	0.79	0.81	0.82	0.82	0.81	0.84
Discharge Q (m^3s^{-1})	4.00	3.98	4.20	4.50	4.81	4.39	4.26	4.51	4.78	4.77	4.58	5.07
Specific Stream Power (Wm^{-2})	9.9	9.8	10.3	11.0	12.0	10.7	8.6	9.0	9.5	9.5	9.1	10.1
Bankfull Hydraulic Geometry Parameters	**ET07**						**ET08**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	8.40	8.64	8.85	9.12	8.94	8.62	12.14	12.60	13.30	13.04	12.96	12.73
Width (m)	8.81	9.39	9.30	9.44	9.52	9.13	13.64	13.45	13.58	13.48	13.84	13.39
Hydraulic mean depth (m)	0.95	0.92	0.95	0.97	0.94	0.94	0.89	0.94	0.98	0.97	0.94	0.95
Maximum depth (m)	1.377	1.418	1.547	1.548	1.388	1.388	1.553	1.840	1.761	1.897	1.690	1.587
Mean velocity (ms^{-1})	0.94	0.92	0.94	0.95	0.93	0.93	0.90	0.93	0.96	0.95	0.93	0.94
Discharge Q (m^3s^{-1})	7.87	7.91	8.30	8.63	8.30	8.03	10.88	11.68	12.70	12.35	12.00	11.92
Specific Stream Power (Wm^{-2})	13.1	12.4	13.1	13.4	12.8	12.9	11.7	12.8	13.8	13.5	12.7	13.1

3.4 Upper Swift Creek Cross sections

The gauging station is located on upper Ngarradj in the forested meandering reach of Erskine et al (2001). Seven cross sections were installed at the gauge during the 1998 dry season. They were resurveyed during each subsequent dry season. An additional cross section was added in 1999 (the gauging wire). The location of the cross sections is shown in figure 9. The values of the bankfull hydraulic geometry parameters for each survey at each cross section are listed in table 6.

A field-surveyed flood slope (2000/2001 wet season) of 0.00078 m/m (0.78 m/km) was used to determine the values of the hydraulic geometry parameters in table 7. The Manning's n value used was 0.035. Channel changes on upper Swift Creek are relatively minor in comparison to the previous sites. All comparisons for the survey data are made to the first survey which was completed in 1998, except for cross section UMGW (gauging wire) which was installed in 1999. At six cross sections in 2001, area decreased over the 4 years, with a reduction of - 8.2% being the maximum change. For 2003 compared to 1998, area had decreased at all eight of the cross sections with a reduction of -10.3% being the maximum change. Width in 2001 had decreased at four sections, increased at three and was stable at one. In 2003, width had increased at six of the sections and decreased at two.

Mean depth decreased slightly (maximum change -5.8 %) at six cross sections for the 2001 and decreased at all of the sections (maximum change -10.9) for the 2003 survey. The maximum depth decreased at five of the sections in 2001 and at all of the sections for the 2003 survey. It is recommended that monitoring should continue at this site while ever monitoring is continued on the mine site tributaries.

Upper Ngarradj is not impacted by the Jabiluka mine and is flanked by a monsoonal vine forest at the gauging station (Erskine et al 2001). Again this forest stabilises the banks

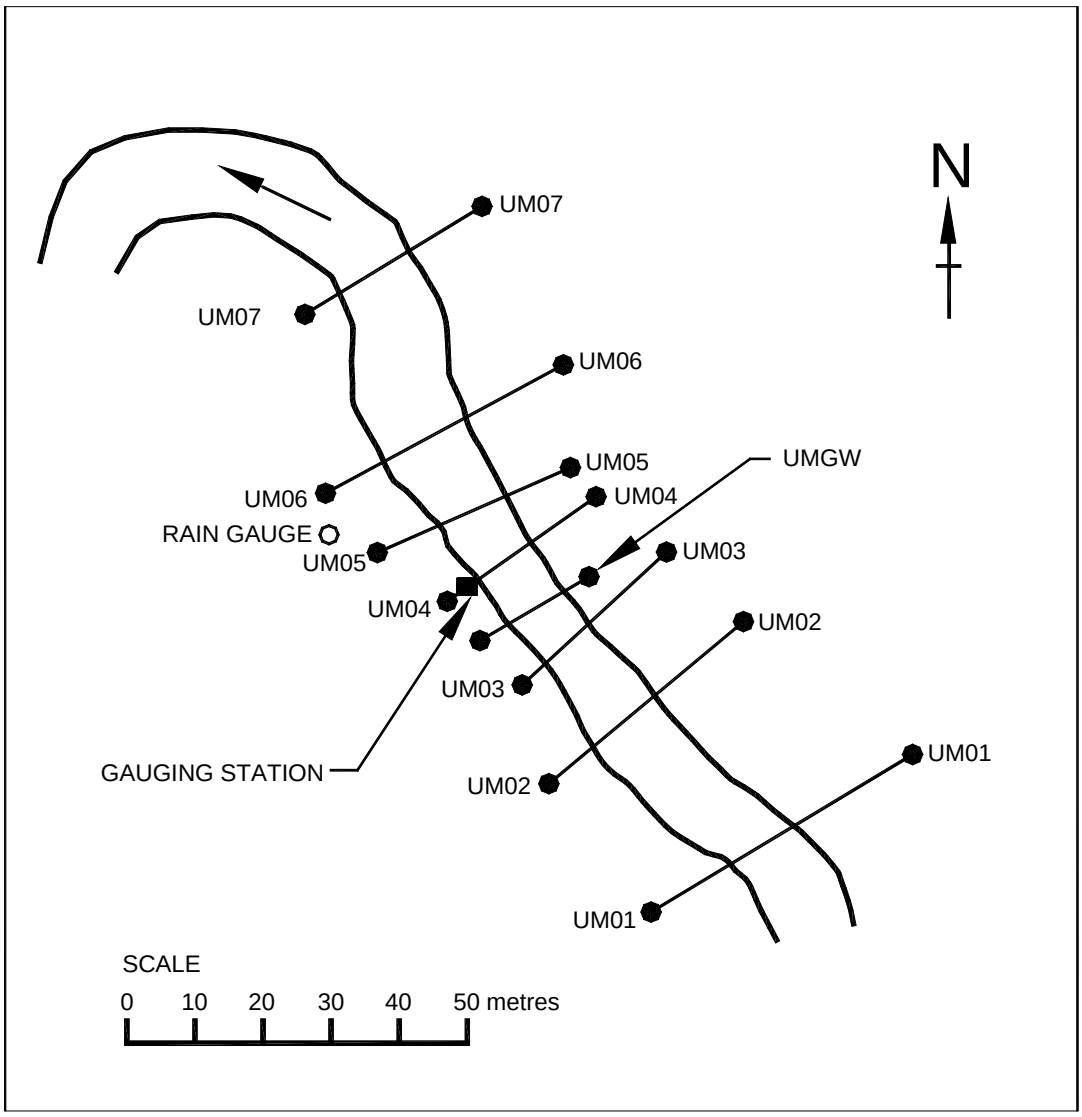

Figure 9 Location of the cross sections at the upper Swift Creek gauge

Table 7 Hydraulic geometry parameter values for Upper Swift Creek 1998- 2003. All of the values for UM01 for each of the years have been recalculated as the point of Inflexion has changed.

Bankfull Hydraulic Geometry Parameters	UM01						UM02					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	11.88	11.64	11.68	11.71	11.85	11.57	11.25	10.77	10.67	10.88	10.70	10.51
Width (m)	11.08	11.29	11.05	10.69	10.67	11.21	10.21	10.13	10.21	10.36	10.33	10.72
Hydraulic mean depth (m)	1.07	1.03	1.06	1.10	1.11	1.03	1.10	1.06	1.04	1.05	1.04	0.98
Maximum depth (m)	1.781	1.687	1.724	1.732	1.723	1.724	1.643	1.564	1.607	1.633	1.598	1.531
Mean velocity (ms^{-1})	0.46	0.45	0.45	0.46	0.47	0.45	0.47	0.45	0.45	0.45	0.45	0.43
Discharge Q (m^3s^{-1})	5.43	5.18	5.29	5.43	5.54	5.15	5.24	4.89	4.79	4.91	4.78	4.53
Specific Stream Power (Wm^{-2})	1.1	1.0	1.1	1.2	1.2	1.1	1.2	1.1	1.1	1.1	1.1	1.0
Bankfull Hydraulic Geometry Parameters	**UM03**						**UMGW**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	7.11	6.80	6.55	6.53	6.44	6.38	NA	9.46	9.51	9.63	9.42	9.31
Width (m)	7.25	7.20	7.06	6.73	6.72	7.02	NA	8.75	8.77	8.97	8.96	9.02
Hydraulic mean depth (m)	0.98	0.94	0.93	0.97	0.96	0.91	NA	1.08	1.09	1.07	1.05	1.03
Maximum depth (m)	1.277	1.202	1.241	1.303	1.188	1.131	NA	1.381	1.380	1.474	1.393	1.363
Mean velocity (ms^{-1})	0.43	0.42	0.41	0.43	0.42	0.41	NA	0.46	0.46	0.46	0.45	0.45
Discharge Q (m^3s^{-1})	3.06	2.86	2.72	2.79	2.73	2.61	NA	4.35	4.38	4.40	4.25	4.15
Specific Stream Power (Wm^{-2})	1.0	0.9	0.9	0.9	0.9	0.8	NA	1.1	1.1	1.1	1.1	1.1

Table 7 Cont. Hydraulic geometry parameter values for Upper Swift Creek 1998- 2003

Bankfull Hydraulic Geometry Parameters	UM04						UM05					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	10.66	10.35	10.66	10.69	10.84	10.55	11.53	11.25	11.27	11.23	11.28	11.22
Width (m)	9.36	9.35	9.41	9.36	9.48	9.55	9.97	9.94	10.09	10.03	10.03	10.12
Hydraulic mean depth (m)	1.14	1.11	1.13	1.14	1.14	1.11	1.16	1.13	1.12	1.12	1.12	1.11
Maximum depth (m)	1.574	1.471	1.471	1.574	1.556	1.469	1.551	1.483	1.479	1.490	1.466	1.447
Mean velocity (ms^{-1})	0.48	0.47	0.47	0.48	0.48	0.47	0.48	0.47	0.47	0.47	0.47	0.47
Discharge Q (m^3s^{-1})	5.07	4.83	5.05	5.09	5.17	4.92	5.54	5.33	5.29	5.28	5.32	5.24
Specific Stream Power (Wm^{-2})	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.2	1.2
Bankfull Hydraulic Geometry Parameters	**UM06**						**UM07**					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	14.24	14.09	14.06	14.01	13.95	13.84	15.96	15.36	15.49	14.97	15.26	14.77
Width (m)	12.26	12.14	12.83	12.32	12.27	12.18	11.60	11.60	11.54	11.54	11.60	11.65
Hydraulic mean depth (m)	1.16	1.16	1.10	1.14	1.14	1.14	1.38	1.32	1.34	1.30	1.32	1.27
Maximum depth (m)	1.545	1.535	1.504	1.504	1.499	1.490	1.927	1.797	1.923	1.74	1.831	1.656
Mean velocity (ms^{-1})	0.48	0.48	0.46	0.48	0.48	0.47	0.54	0.53	0.53	0.52	0.52	0.51
Discharge Q (m^3s^{-1})	6.86	6.79	6.52	6.66	6.63	6.57	8.61	8.08	8.22	7.77	7.99	7.54
Specific Stream Power (Wm^{-2})	1.3	1.3	1.2	1.2	1.2	1.2	1.7	1.6	1.6	1.5	1.6	1.5

3.5 Swift Creek Cross sections

The gauging station is located on Ngarradj in the sinuous reach of Erskine et al (2001). Eight cross sections were installed at the gauge during the 1998 dry season. They were resurveyed during each subsequent dry season. The location of the cross sections is shown in figure 10. The values of the bankfull hydraulic geometry parameters for each survey at each cross section are listed in table 8.

A field-surveyed bed slope of 0.00095 m/m (0.95 m/km) was used to determine the values of the hydraulic geometry parameters in table 8. The Manning's n value used was 0.035. All comparisons for the survey data are made to the first survey which was completed in 1998.

All of the cross sections experienced a decrease in cross sectional area up to both 2001 (maximum -8.2 %) and 2003 (maximum - 9.9). Width decreased at six sections in 2001 but increased at six in 2003. Mean depth decreased at seven cross sections in 2001 and at five sections in 2003. Maximum depth decreased at five of the sections in 2001 indicating that there has been general bed aggradation since 1998. The 2003 survey had bed levels increasing at seven of the cross sections, indicating that the bed has aggraded above the 1998 levels. This shows that sediment is being stored in the bed.

It is recommended that monitoring should continue at this site while ever monitoring is being conducted elsewhere in the Ngarradj catchment to provide a comprehensive baseline of information about sediment.

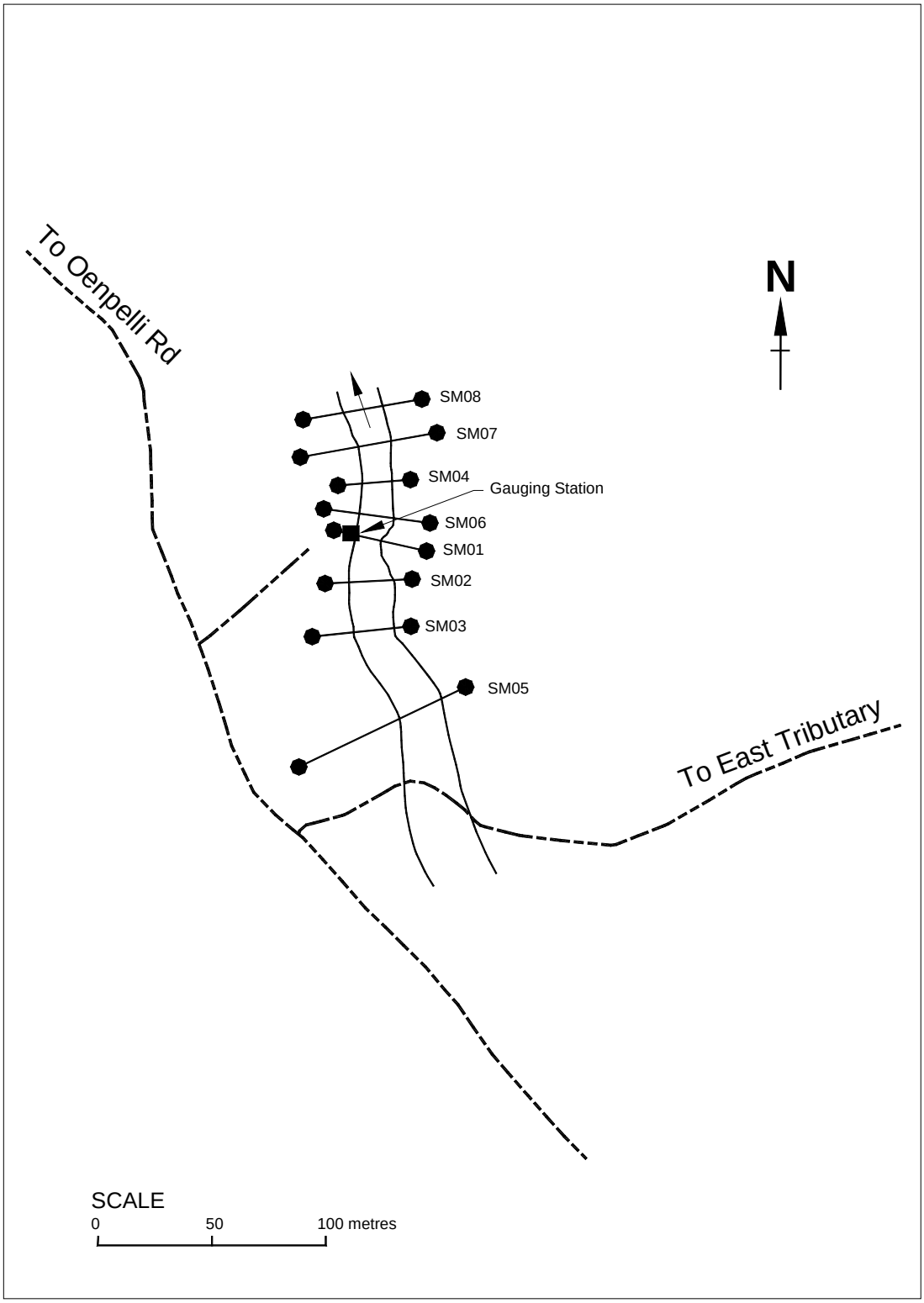

Figure 10 Location of cross sections at the lower Swift Creek gauge

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Table 8 Hydraulic geometry parameter values for lower Swift Creek 1998 - 2003

Bankfull Hydraulic Geometry Parameters	SM05						SM03					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	21.53	20.40	20.27	20.24	23.09	20.39	19.32	18.49	17.54	18.17	18.17	17.40
Width (m)	19.23	18.89	19.05	19.05	20.04	21.96	19.80	19.39	19.69	19.64	20.03	20.66
Hydraulic mean depth (m)	1.12	1.08	1.06	1.06	1.15	0.93	0.98	0.95	0.89	0.93	0.91	0.84
Maximum depth (m)	1.702	1.613	1.681	1.772	2.171	1.855	1.432	1.430	1.545	1.620	1.786	1.619
Mean velocity (ms^{-1})	0.95	0.93	0.92	0.92	0.97	0.84	0.87	0.85	0.82	0.84	0.83	0.79
Discharge Q (m^3s^{-1})	20.48	18.93	18.63	18.58	22.37	17.12	16.77	15.80	14.32	15.21	15.01	13.68
Specific Stream Power (Wm^{-2})	9.9	9.4	9.1	9.1	10.4	7.3	7.9	7.6	6.8	7.2	7.0	6.2
Bankfull Hydraulic Geometry Parameters	**SM02**						**SM01**					
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Area (m^2)	18.28	17.17	16.66	16.82	17.04	17.39	10.35	9.89	9.89	10.20	10.42	10.37
Width (m)	19.56	20.38	19.81	19.68	19.67	19.79	10.75	11.30	11.05	11.02	10.85	11.13
Hydraulic mean depth (m)	0.93	0.84	0.84	0.85	0.87	0.88	0.96	0.88	0.89	0.93	0.96	0.93
Maximum depth (m)	1.522	1.421	1.456	1.495	1.528	1.474	1.431	1.356	1.313	1.565	1.566	1.450
Mean velocity (ms^{-1})	0.84	0.79	0.79	0.79	0.80	0.81	0.86	0.81	0.82	0.84	0.86	0.84
Discharge Q (m^3s^{-1})	15.40	13.51	13.09	13.35	13.65	14.07	8.89	7.98	8.09	8.55	8.95	8.72
Specific Stream Power (Wm^{-2})	7.3	6.2	6.2	6.3	6.5	6.6	7.7	6.6	6.8	7.2	7.7	7.3

Table 8 Cont. Hydraulic geometry parameter values for lower Swift Creek 1998 – 2003

Bankfull Hydraulic Geometry Parameters	SM06						SM04					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	17.57	17.09	16.91	17.14	17.56	17.52	10.08	9.40	8.91	9.25	9.71	9.83
Width (m)	17.99	17.63	17.78	17.43	17.76	18.59	11.65	11.51	10.96	10.77	10.83	11.13
Hydraulic mean depth (m)	0.98	0.97	0.95	0.98	0.99	0.94	0.87	0.82	0.81	0.86	0.90	0.88
Maximum depth (m)	1.763	1.697	1.691	1.745	1.876	1.785	1.173	1.107	1.135	1.158	1.327	1.195
Mean velocity (ms^{-1})	0.87	0.86	0.85	0.87	0.87	0.85	0.80	0.77	0.77	0.80	0.82	0.81
Discharge Q (m^3s^{-1})	15.25	14.76	14.42	14.95	15.36	14.86	8.07	7.24	6.84	7.37	7.95	7.98
Specific Stream Power (Wm^{-2})	7.9	7.8	7.6	8.0	8.1	7.5	6.5	5.9	5.8	6.4	6.9	6.7
Bankfull Hydraulic Geometry Parameters	**SM07**						**SM08**					
	1998	1999	2000	2001	2002	2003	1998	1999	2000	2001	2002	2003
Area (m^2)	18.87	18.16	17.64	17.54	18.98	18.83	19.75	18.74	18.21	18.37	18.46	18.68
Width (m)	15.05	14.77	15.61	14.82	15.29	15.08	18.80	18.65	18.68	18.55	18.84	18.73
Hydraulic mean depth (m)	1.25	1.23	1.13	1.18	1.24	1.25	1.05	1.01	0.97	0.99	0.98	1.00
Maximum depth (m)	1.768	1.662	1.651	1.751	2.002	2.062	1.717	1.53	1.634	1.603	1.755	1.785
Mean velocity (ms^{-1})	1.03	1.01	0.96	0.99	1.02	1.02	0.91	0.88	0.87	0.88	0.87	0.88
Discharge Q (m^3s^{-1})	19.35	18.38	16.88	17.30	19.33	19.26	18.00	16.58	15.79	16.09	16.06	16.44
Specific Stream Power (Wm^{-2})	12.0	11.6	10.1	10.9	11.8	11.9	8.9	8.3	7.9	8.1	8.0	8.2

4 Scour Chain Results

Data for 1998/1999, 1999/2000 and 2000/2001 wet seasons are contained in Saynor et al (2002b) and those for 2001/2002 and 2002/2003 wet seasons are shown below. Analysis of the scour chain data is contained in Saynor et al (2004).

4.1 Tributary North

Chains were installed during the late dry season of 1999 at five cross sections. The following cross sections had a single chain installed in the middle of the main gully: TN02, TN04, and TN07. The most downstream cross section on the main gully, TN09, had two chains installed in the bed. The tributary gully had a single chain installed in the middle of the gully on cross sections TN05 and TN07. The location of the cross sections is shown in figure 5. The scour chain results are combined for both the main and tributary gullies due to the small sample size.

4.1.1 Tributary North cross section 2 (TN02)

There is one chain located in the middle of the gully which was found on 17 September 2002. The chain was buried and was orientated downstream.

- Depth to first link……..95 mm
- Depth to first vertical link…….82 mm
- Depth to straightened chain……..27 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 68 mm below the 2001 bed level, and then there was subsequent fill of 95 mm which aggraded the bed to its 2002 level. The bed level in 2002 was 27 mm higher than it was in 2001.

The chain was found on 11 November 2003. It was still orientated vertically and was covered by sediment, indicating that only fill had occurred during the 2002/2003 wet season.

- Depth to first link……..180 mm
- Depth to first vertical link…….180 mm
- Depth to straightened chain……..180 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was not scoured, however, there was fill to a maximum depth of 180 mm above the 2002 bed level. The bed level in 2003 was 180 mm higher than it was in 2002.

4.1.2 Tributary North cross section 4 (TN04)

There was one chain in the middle of the main gully which was found on 17 September 2002. The chain was located with the three top links visible on the surface facing downstream. This indicates that only scour occurred during the 2001/2002 wet season.

- Depth to first link…… 0 mm
- Depth to first vertical link……0 mm
- Depth to straightened chain…….-90 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a depth of 90 mm. There was no fill and the 2002 bed level was 90 mm below the 2001 level.

The chain was found on 11 November 2003. It was orientated vertically and was covered by sediment, indicating that only fill had occurred during the 2002/2003 wet season.

- Depth to first link…… 75 mm
- Depth to first vertical link……75 mm
- Depth to straightened chain…… 75 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was not scoured, however, there was fill to a maximum depth of 75 mm above the 2002 bed level. The bed level in 2003 was 75 mm higher than it was in 2002.

4.1.3 Tributary North cross section 5 (TN05)

Tributary North cross section 5 (TN05) is located on the tributary gully channel and has one chain located in the middle of the gully. This chain was located on 17 September 2002. All links were vertical.

- Depth to first link……..20 mm
- Depth to first vertical link…….20 mm
- Depth to straightened chain……..20 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed aggraded by 20 mm and that there was no scour. The bed level in 2002 was 20 mm higher than in 2001, indicating that only fill had occurred during the 2001/2002 wet season.

The chain was found on 11 November 2003. It was orientated vertically and was covered by sediment, indicating that only fill had occurred during the 2002/2003 wet season.

- Depth to first link…… 36 mm
- Depth to first vertical link……36 mm
- Depth to straightened chain…… 36 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was not scoured, however, there was fill to a maximum depth of 36 mm above the 2002 bed level. The bed level in 2003 was 36 mm higher than it was in 2002.

4.1.4 Tributary North cross section 7 (TN07)

Cross section 7 is located across both the main channel and the tributary gully (fig 5). A single scour chain was installed in each gully.

4.1.4.1 Tributary North Cross Section 7, (TN07- main gully)

This chain was located in the middle of the bed and was found on 17 September 2002. The top of the chain was visible on the bed and was orientated downstream.

- Depth to first link…….0 mm
- Depth to first vertical link……0 mm
- Depth to straightened chain…….-75 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a depth of 75 mm below the 2001 bed level, and then there was no subsequent fill. The bed level in 2002 was 75 mm lower than the 2001 bed level.

The chain was found on 11 November 2003. It was orientated vertically and covered by sediment, indicating that only fill had occurred during the 2002/2003 wet season.

- Depth to first link…… 76 mm
- Depth to first vertical link……76 mm
- Depth to straightened chain…… 76 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was not scoured, however, there was fill to a maximum depth of 76 mm above the 2002 bed level. The bed level in 2003 was 76 mm higher than it was in 2002.

4.1.4.2 Tributary North Cross Section 7, (TN07- tributary)

This chain was located in the middle of the tributary gully and was found on 17 September 2002. The top link of the chain was orientated vertically indicating that there had been no scour.

- Depth to first link……60 mm

- Depth to first vertical link……...60 mm
- Depth to straightened chain……60 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was not scoured but that there had been 60 mm of fill, which aggraded the bed to 60 mm above the 2001 level.

The chain was found on 11 November 2003. It was orientated slightly towards the left bank and downstream.

- Depth to first link……130 mm
- Depth to first vertical link……...110 mm
- Depth to straightened chain……0 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 130 mm and then filled by 130 mm. The 2003 bed level was the same as the 2002 bed level.

4.1.5 Tributary North cross section 9 (TN09)

This cross section is located on the main gully downstream of the confluence with the left bank tributary gully but upstream of the junction with Ngarradj (fig 5).

4.1.5.1 Scour Chain 1, (TN09-1)

Scour Chain 1 is located towards the left bank and was found on 17 September 2002. The chain was orientated downstream.

- Depth to first link……50 mm
- Depth to first vertical link……...70 mm
- Depth to straightened chain……48 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a depth of 22 mm and then filled by 70 mm. The 2002 bed level was 48 mm higher than the 2001 bed level.

The chain was found on 11 November 2003. It was orientated vertically and covered by sediment, indicating that only fill had occurred during the 2002/2003 wet season.

- Depth to first link…… 26 mm
- Depth to first vertical link……26 mm
- Depth to straightened chain…… 26 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was not scoured, however, there was fill to a maximum depth of 26 mm above the 2002 bed level. The bed level in 2003 was 26 mm higher than it was in 2002.

4.1.5.2 Scour Chain 2, (TN09-2)

Scour Chain 2 is located towards the right bank of cross section 9 and was found on 17 September 2002. The chain was orientated towards the left bank and slightly downstream.

- Depth to first link…….22 mm
- Depth to first vertical link……32 mm
- Depth to straightened chain…….0 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a depth of 32 mm below the 2001 bed level, and then there was subsequent fill of 32 mm. The 2002 bed level was the same as the 2001 bed level.

At TN09 the average scour for the 2001/2002 wet season was 27 mm and the average fill was 51 mm. There was no scour for the 2002/2003 wet season and the average fill was 13 mm. These results suggest that there was not much activity at this section because the cross section was backwater affected at high flows.

4.2 Tributary Central

A single chain was located on each of three cross sections, TC09, TC11 and TC03 before the 1988/1999 wet season (fig 7). The scour chain results are presented below

4.2.1 Tributary Central cross section 9 (TC09)

There is one chain located in the middle of the channel which was found on 18 September 2002. The top link was visible on the bed surface and was orientated downstream.

- Depth to first link…….5 mm
- Depth to first vertical link……20 mm
- Depth to straightened chain……0mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 20 mm below the 2001 bed level, and then there was fill of 20 mm. The bed level in 2002 was the same as in 2001.

The chain was found on 11 November 2003. The top one half of the first link was exposed and was orientated vertically.

- Depth to first link……..0 mm
- Depth to first vertical link…….0 mm
- Depth to straightened chain……-15 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 15 mm below the 2002 bed level, and then there was no fill. The bed level in 2003 was 15 mm below the 2002 bed level.

4.2.2 Tributary Central cross section 11 (TC11)

There is one chain located in the middle of the channel which was found on 18 September 2002. There is a gravel armoured sand bar at this location. There were two links on the surface orientated downstream.

- Depth to first link……..0 mm
- Depth to first vertical link…….0 mm
- Depth to straightened chain…….-60 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 60 mm below the 2001 bed level, and then there was no fill. The bed level in 2002 was 60 mm below the 2001 bed level.

The chain was found on 11 November 2003. The chain was orientated vertically. The channel at this cross section is shifting laterally and the chain was no longer in the middle of the channel.

- Depth to first link…….0 mm
- Depth to first vertical link……0 mm
- Depth to straightened chain…….0 mm (2002 bed level)

These measurements show that during the 2001/2002 wet season the bed remained stable with no scour or fill. The 2003 bed level was the same as the 2002 bed level.

4.2.3 Tributary Central cross section 3 (TC03)

There is one chain located in the middle of the channel which was found on 18 September 2002. The links were lying in a pile orientated to the left bank.

- Depth to first link…….96 mm
- Depth to first vertical link……130 mm
- Depth to straightened chain…….40mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 90 mm below the 2001 bed level, and then there was subsequent fill of 130 mm. The 2002 bed level was 40 mm higher than the 2001 bed level.

The chain was found on 11 November 2003. The top two links were orientated downstream.

- Depth to first link…….110 mm
- Depth to first vertical link……120 mm
- Depth to straightened chain…….50mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 120mm below the 2002 bed level, and then there was subsequent fill of 50 mm. The 2003 bed level was 70 mm lower than the 2002 bed level.

4.3 East Tributary scour chains

Scour chains were installed at four cross sections at the East Tributary gauging station before the 1998/99 wet season. Two chains were located on cross section ET01 and one chain was located on ET04, ET07 and ET08 (fig 8).

4.3.1 East Tributary cross section 1 (ET01)

4.3.1.1 Chain 1 (ET01-1)

Scour chain 1 is located towards the left bank and was found on 17 September 2002. The chain was orientated diagonally upstream and towards the right bank.

- Depth to first link …….…...125 mm
- Depth to first vertical link……115 mm
- Depth to straightened chain…….30 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 95 mm below the 2001 bed level, and then there was subsequent fill of 125 mm. The 2002 bed level was 30 mm higher than the 2001 bed level.

Scour chain 1 was found on 12 November 2003. The chain was orientated downstream and slightly towards the right bank.

- Depth to first link …….…...170 mm
- Depth to first vertical link……150 mm
- Depth to straightened chain…….25 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 145 mm below the 2002 bed level, and then there was subsequent fill of 170 mm. The 2003 bed level was 25 mm higher than the 2002 bed level.

4.3.1.2 Chain 2 (ET01-2)

This chain was found on 17 September 2002. The chain was buried and was orientated downstream.

- Depth to first link …….…..135mm
- Depth to first vertical link……170 mm
- Depth to straightened chain……-30 mm (2001 bed level)

The measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 200 mm and then there was subsequent fill of 170 mm. The bed level is 2002 was 30 mm lower than the 2001 bed level.

This chain was found on 12 November 2003 and was located towards the right bank. The chain was buried and was orientated downstream and slightly towards the left bank.

- Depth to first link …….……360mm
- Depth to first vertical link…….365 mm
- Depth to straightened chain……..240 mm (2002 bed level)

The measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 125 mm and then there was subsequent fill of 365 mm. The bed level in 2003 was 240 mm higher than the 2002 bed level.

For East Tributary Cross Section 1, the 2001/2002 wet season average scour was 148 mm and the average fill was 148 mm. For the 2002/2003 wet season, the average scour was 135 mm and the average fill was 268 mm.

4.3.2 East Tributary cross section 4 (ET04)

There is one chain in the middle of the channel which was located on 17 September 2002. The chain was orientated in a downstream direction.

- Depth to first link …….…….120 mm
- Depth to first vertical link.…….135 mm
- Depth to straightened chain……...95 mm (2001 bed level)

The measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 40 mm and then there was subsequent fill of 135 mm. The bed level in 2002 was 95 mm higher than the 2001 bed level.

The chain was found on 12 November 2003. The chain was orientated in a downstream direction.

- Depth to first link …….…….70 mm
- Depth to first vertical link.…….85 mm
- Depth to straightened chain……..-55 mm (2002 bed level)

The measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 140 mm and then there was subsequent fill of 85 mm. The bed level in 2003 was 55 mm lower than the 2002 bed level.

4.3.3 East Tributary cross section 7 (ET07)

There is one chain located in the middle of the channel which was located on 17 September 2002. It was orientated towards the right bank but angled downstream

- Depth to first link …….……200 mm
- Depth to first vertical link…….215 mm
- Depth to straightened chain……..23 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 192 mm below the 2001 bed level, and then there was subsequent fill of 215 mm. The 2002 bed level was 23 mm higher than the 2001 bed level.

The chain was located on 12 November 2003 and was orientated downstream

- Depth to first link …….……290 mm
- Depth to first vertical link…….280 mm
- Depth to straightened chain……..10 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 280 mm below the 2002 bed level, and then there was subsequent fill of 290 mm. The 2003 bed level was 10 mm higher than the 2002 bed level.

4.3.4 East Tributary cross section 8 (ET08)

There is one chain located near the thalweg on the outside of the point bar towards the left bank. The chain was located on 17 September 2002 and was orientated downstream.

- Depth to first link …….……50 mm
- Depth to first vertical link…….95 mm
- Depth to straightened chain…….-12 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 107 mm below the 2001 bed level, and then there was subsequent fill of 95 mm. The bed level in 2002 was 12 mm lower than the 2001 bed level.

The chain was located on 12 November 2003 and was orientated downstream.

- Depth to first link …….……175 mm
- Depth to first vertical link…….175 mm
- Depth to straightened chain……..120 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 55 mm below the 2002 bed level, and then there was subsequent fill of 175 mm. The bed level in 2003 was 120 mm higher than the 2002 bed level.

4.4 Upper Swift Creek scour chains

Scour chains were installed at three cross sections at the Upper Swift Creek gauging station before the 1998/99 wet season. Two chains were located at cross sections UM02, UM05 and UM07. The location of the cross sections is shown in figure 9.

4.4.1 Upper Swift Creek cross section 2 (UM02)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.1.1 Chain 1 (UM02-1)

This chain was located on 18 September 2002 and was orientated downstream.

- Depth to first link…….340 mm
- Depth to first vertical link……350 mm
- Depth to straightened chain…….15 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 335 mm and then there was subsequent fill of 350 mm. The 2002 bed level was 15 mm above the 2001 level.

The chain was located on 12 November 2003 and was orientated mainly downstream and slightly towards the left bank.

- Depth to first link…….360 mm
- Depth to first vertical link……380 mm
- Depth to straightened chain…….60 mm (2002 bed level)

These measurements show that during the 2002/2002 wet season the bed was scoured to a maximum depth of 320 mm and then there was subsequent fill of 380 mm. The 2003 bed level was 60 mm above the 2002 level.

4.4.1.2 Chain 2 (UM02-2)

This chain was located on 18 September 2002 and was lying in a circular pattern across the bed and orientated downstream.

- Depth to first link……..…340 mm
- Depth to first vertical link……360 mm
- Depth to straightened chain……..…30 mm (2001 bed level)

These measurements indicate that during the 2001/2002 wet season the bed was scoured to a depth 330 mm and then there was subsequent fill of 360 mm. The 2002 bed level was 30 mm above the 2001 level.

This chain was located on 12 November 2003 and was lying in a circular pattern towards the left bank but orientated downstream.

- Depth to first link……..…440 mm
- Depth to first vertical link……430 mm

- Depth to straightened chain…….…20 mm (2002 bed level)

These measurements indicate that during the 2002/2003 wet season the bed was scoured to a maximum depth 420 mm and then there was subsequent fill of 440 mm. The 2003 bed level was 20 mm above the 2002 level.

For the 2001/2002 wet season at Upper Swift Creek cross section 2, the average scour was 333 mm and the average fill was 355 mm. For the 2002/2003 wet season the average scour was 370 mm and the average fill was 410 mm.

4.4.2 Upper Swift Creek cross section 5 (UM05)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.2.1 Chain 1 (UM05-1)

This chain was located on 18 September 2002 and was orientated diagonally upstream towards the right bank.

- Depth to first link…….160 mm
- Depth to first vertical link……220 mm
- Depth to straightened chain……0 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 220 mm below the 2001 bed level and then there was subsequent fill of 220 mm. The 2002 bed level was the same as the 2001 bed level.

This chain was located on 12 November 2003 and was orientated diagonally downstream towards the right bank.

- Depth to first link…….135 mm
- Depth to first vertical link……160 mm
- Depth to straightened chain…… 15mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 145 mm below the 2002 bed level and then there was subsequent fill of 160 mm. The 2003 bed level was 15 mm above the 2002 level.

4.4.2.2 Chain 2 (UM05-2)

This chain was located on 18 September 2002 orientated at right angles to the bed towards the left bank.

- Depth to first link…….180 mm
- Depth to first vertical link……200 mm
- Depth to straightened chain…….0 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 200 mm below the 2001 bed level and then there was subsequent fill of 200 mm. The 2002 bed level was the same as the 2001 bed level.

This chain was located on 12 November 2003 and was orientated diagonally downstream towards the left bank.

- Depth to first link…….65 mm
- Depth to first vertical link……140 mm
- Depth to straightened chain…….0 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 140 mm below the 2002 bed level and then there was subsequent fill of 140 mm. The 2003 bed level was the same as the 2002 bed level.

For Upper Swift Creek cross section 5, the 2001/2002 wet season average scour was 210 mm and the average fill was 210 mm. For the 2002/2003 wet season, the average scour was 143 mm and the average fill was 150 mm.

4.4.3 Upper Swift Creek cross section 7 (UM07)

Chain 1 was located closer to the left bank and chain 2, closer to the right bank.

4.4.3.1 Chain 1 (UM07-1)

This chain was located on 18 September 2002 and was orientated towards the right bank and slightly upstream.

- Depth to first link…….170 mm
- Depth to first vertical link……190 mm
- Depth to straightened chain…….5 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 185 mm below the 2001 bed level and then there was fill of 190 mm. The 2002 bed level was 5 mm above the 2001 bed level.

This chain was located on 12 November 2003 and was orientated towards the right bank.

- Depth to first link…….225 mm
- Depth to first vertical link……223 mm
- Depth to straightened chain…….50 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 175 mm below the 2002 bed level and then there was fill of 225 mm. The 2003 bed level was 50 mm above the 2002 bed level.

4.4.3.2 Chain 2 (UM07-2)

This chain was located on 18 September 2002, and was orientated diagonally upstream towards the left bank.

- Depth to first link……..320 mm
- Depth to first vertical link…….290 mm
- Depth to straightened chain…….0 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 320 mm below the 2001 bed level and then there was subsequent fill of 320 mm. The 2002 bed level was the same as the 2001 bed.

This chain was located on 12 November 2003, and was found in a circular pattern towards the left bank but then orientated downstream.

- Depth to first link……..330 mm
- Depth to first vertical link…….340 mm
- Depth to straightened chain…….20 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 320 mm below the 2002 bed level and then there was subsequent fill of 340 mm. The 2003 bed level was 40 mm above the 2002 bed level.

For Upper Swift Creek cross section 7, the 2001/2002 wet season average scour was 253 mm and the average fill was 255 mm. For the 2002/2003 wet season, the average scour was 248 mm and the average fill was 283 mm.

4.5 Swift Creek scour chains

Scour chains were installed at two cross sections at the Swift Creek gauging station before the 1998/99 wet season. Three chains were located at cross sections SM05 and SM08. Additional chains were installed at cross section SM02 before the 1999/2000 wet season. The location of the cross sections is shown in figure 10.

4.5.1 Swift Creek cross section 5 (SM05)

The three chains at cross section 5 were searched for on 18 September 2002. The water table was reached at a depth of 200 mm below the surface and one of the chains (SM05-1) could be felt by hand at a depth of approximately 500 mm. It was not possible to make any measurements at any of the scour chains. The chains were not reset and thus there were similar problems when the chains were searched for on 12 November 2003. Therefore, no scour and fill data were obtained at this section for the 2001/2002 and 2002/2003 wet seasons.

4.5.2 Swift Creek cross section 2 (SM02)

4.5.2.1 Chain 1 SM02-1

This chain was located on 18 September 2002 and was above the current ground surface. This was caused by pig damage and no measurements were possible. The chain was reset.

This chain was located on 11 November 2003 and was orientated downstream.

- Depth to first link…….58 mm
- Depth to first vertical link……65 mm
- Depth to straightened chain……15 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 50 mm below the 2002 level, and then there was subsequent fill of 65 mm. The 2003 bed level was 15 mm above the 2003 bed level.

4.5.2.2 Chain 2 (SM02-2)

This chain was located on 18 September 2002. The upper 200 mm of bed had been greatly disturbed by pigs and hence no measurements were possible. The chain was reset.

This chain was located on 11 November 2003 and was orientated downstream. There were several spirals in the chain

- Depth to first link……63 mm
- Depth to first vertical link……..140 mm
- Depth to straightened chain……4 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 136 mm below the 2002 level, and then there was subsequent fill of 140 mm. The 2003 bed level was 4 mm higher than the 2002 bed level.

4.5.2.3 Chain 3 (SM02-3)

This chain was located on 18 September 2002 and was orientated diagonally upstream towards the left bank. There was some pig damage to the bed but some measurements were possible.

- Depth to first link…….….Unknown
- Depth to first vertical link…….95 mm
- Depth to straightened chain……..40 mm (2001 bed level).

These measurements suggest that during the 2001/2002 wet season the bed may have been scoured to a depth of 55 mm below the 2001 level with subsequent fill of 95 mm. The 2002 bed

level was 40 mm higher than the 2001 bed level. Due to the pig damage there is uncertainty in these measurements and these values were not used in the net scour and fill calculations.

This chain was located on 11 November 2003 and was orientated towards the left bank. The chain was lying on the surface.

- Depth to first link…….….0 mm
- Depth to first vertical link…….0 mm
- Depth to straightened chain……-190 mm (2002 bed level).

These measurements show that during the 2002/2003 wet season the bed was scoured to a depth of 190 mm below the 2002 level, and then there was no subsequent fill. The 2003 bed level was 190 mm lower than the 2002 bed level.

For Swift Creek Cross Section 2, there was no average scour or fill calculations because the pig damage had been too extensive. For the 2002/2003 wet season, the average scour was 125 mm and the average fill was 68 mm.

4.5.3 Swift Creek cross section 8 (SM08)

4.5.3.1 Chain 1 (SM08-1)

This chain was located on 18 September 2002 and was orientated upstream and towards the right bank.

- Depth to first link……...250 mm
- Depth to first vertical link……..260 mm
- Depth to straightened chain……...85 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 175 mm below the 2001 bed level, and then there was subsequent fill of 260 mm. The 2002 bed level was 85 mm higher than the 2001 bed level.

This chain was located on 11 November 2003 and was orientated towards the right bank.

- Depth to first link……...415 mm
- Depth to first vertical link……..385 mm
- Depth to straightened chain……...0 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 415 mm below the 2002 bed level, and then there was subsequent fill of 415 mm. The 2003 bed level was the same as the 2002 bed level.

4.5.3.2 Chain 2 (SM08-2)

This chain was located on 18 September 2002 and was orientated diagonally downstream and towards the right bank.

- Depth to first link…….115 mm
- Depth to first vertical link……195 mm
- Depth to straightened chain…….0 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 195 mm and then there was fill of 195 mm. The 2002 bed level was the same as the 2001 bed level.

This chain was located on 11 November 2003 and was orientated towards the left bank.

- Depth to first link…….295 mm
- Depth to first vertical link……325 mm
- Depth to straightened chain…….0 mm (bed level not changed)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 325 mm below the 2002 bed level, and then there was subsequent fill of 325 mm. The 2003 bed level was the same as the 2002 bed level.

4.5.3.3 Chain 3 (SM08-3)

This chain was located on 18 September 2002 and was orientated towards the left bank.

- Depth to first link……..75 mm
- Depth to first vertical link…….142 mm
- Depth to straightened chain……..35 mm (2001 bed level)

These measurements show that during the 2001/2002 wet season the bed was scoured to a maximum depth of 107 mm and then there was subsequent fill of 142 mm. The 2002 bed level was 35 mm higher than the 2001 bed level.

This chain was located on 11 November 2003 and was orientated towards the left bank and slightly upstream.

- Depth to first link……..247 mm
- Depth to first vertical link…….230 mm
- Depth to straightened chain……..-25 mm (2002 bed level)

These measurements show that during the 2002/2003 wet season the bed was scoured to a maximum depth of 272 mm and then there was subsequent fill of 247 mm. The 2003 bed level was 25 mm lower than the 2002 bed level.

For Swift Creek Cross Section 8, the 2001/2002 average scour was 159 mm and the average fill was 199 mm. For the 2002/2003 wet season there was 337 mm of scour and 329 mm of fill.

5 Conclusions and recommendations

The channel cross sectional data collected by ***eriss*** on Tributary North, Tributary Central, East Tributary and Swift Creek have been presented in this report as survey data (appendix 1). There are now 56 permanently monumented cross sections installed in the Ngarradj catchment following the Vigil Network method of the US Geological Survey developed for the International Hydrological Decade. These cross sections have been surveyed each dry season between 1998 and 2003 to determine the impact, if any, of the Jabiluka mine on channel changes and sediment storage in the Ngarradj catchment. Scour chains have been installed at some of the cross section and provide information about the scour and fill that occurs during each wet season.

The program includes two monitoring reaches (East Tributary and upper Swift Creek) on channels not impacted by the mine, two tributaries draining the mine site (Tributaries North and Central) and Swift Creek downstream of the two mine site tributaries and the two sites not impacted by the mine.

Continued monitoring of the cross sections and scour chains is recommended while the mine is in a care and maintenance phase. This will provide an excellent baseline data set against which the impacts of the mine can be evaluated should the Jabiluka mine proceed in the future.

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Appendix 1

This appendix contains the survey data for each cross section for the 2002 and 2003 dry seasons. The sections are listed in increasing numerical order which does not always correspond to their location in downstream sequence. Refer to the relevant diagrams in Section 3 to determine where they are located.

The datum used for each section is an assumed datum with a horizontal angle of either 0°, 90°, 180°, 270° so that there is a distance (chainage) and a height for each survey point. All measurements are in metres and each cross section is independent of each other cross section. The assumed datum is often different between cross sections.

The location of the data files on the ***eriss*** network is in the following directories:

\\Landscape Characterisation and Monitoring\Jabiluka\(Dry) Channel stability in the Ngarradj catchment\Data\Survey xsections*location*

where *location* refers to one of the five sites at which the cross sections are located, namely Tributary North, Tributary Central, East Tributary, Upper Swift Creek and Swift Creek.

Tributary North Cross sections 1 to 4 2002							
TN01 Distance (m)	20-Jun-02 Assumed Height (m)	TN02 Distance (m)	20-Jun-02 Assumed Height (m)	TN03 Distance (m)	20-Jun-02 Assumed Height (m)	TN04 Distance (m)	18-Jun-02 Assumed Height (m)
4968.956	11.005	3974.715	9.868	2977.928	10.012	1973.514	10.264
4969.088	10.790	3974.828	9.693	2978.054	9.818	1973.622	10.054
4970.888	10.753	3976.586	9.638	2979.197	9.791	1975.110	10.023
4973.521	10.717	3978.400	9.628	2981.190	9.727	1976.444	10.026
4975.100	10.676	3980.336	9.582	2983.230	9.673	1978.673	10.006
4976.566	10.623	3981.246	9.486	2984.146	9.658	1980.517	9.979
4978.256	10.574	3981.588	9.374	2984.855	9.534	1982.097	9.967
4979.859	10.523	3981.891	9.323	2985.065	9.396	1984.015	9.901
4981.115	10.469	3981.968	9.233	2985.412	9.236	1984.996	9.825
4981.419	10.414	3982.482	8.986	2985.717	9.111	1985.548	9.592
4981.721	10.278	3983.240	8.839	2986.040	9.009	1985.770	9.503
4982.018	10.104	3983.447	8.630	2986.309	8.929	1986.034	9.295
4982.173	9.966	3983.571	8.498	2986.582	8.849	1986.572	9.045
4982.447	9.916	3983.766	8.338	2986.760	8.683	1986.738	8.876
4982.623	9.703	3984.063	8.338	2986.871	8.568	1986.942	8.752
4982.909	9.665	3984.429	8.439	2987.039	8.454	1987.265	8.595
4983.091	9.564	3984.764	8.508	2987.189	8.365	1987.387	8.489
4983.240	9.472	3984.921	8.809	2987.560	8.369	1987.564	8.504
4983.470	9.472	3985.271	8.933	2988.001	8.480	1987.784	8.616
4983.728	9.589	3985.527	9.052	2988.266	8.826	1988.225	8.819
4984.009	9.624	3985.861	9.120	2988.707	8.964	1988.408	9.072
4984.302	9.730	3986.003	9.185	2988.868	9.136	1988.767	9.203
4984.767	9.778	3986.927	9.264	2989.064	9.260	1989.495	9.331
4985.022	9.981	3987.535	9.352	2989.437	9.386	1990.586	9.369
4985.498	10.206	3988.006	9.473	2990.065	9.686	1991.680	9.411
4985.811	10.194	3989.743	9.572	2990.724	9.721	1992.351	9.498
4985.884	10.435	3991.768	9.631	2992.048	9.705	1993.126	9.437
4987.070	10.505	3993.844	9.688	2993.716	9.717	1994.073	9.442
4988.152	10.538	3995.519	9.760	2995.647	9.744	1995.658	9.445
4990.076	10.587	3997.674	9.800	2997.030	9.776	1996.896	9.499
4992.005	10.664			2998.375	9.815	1997.861	9.617
4993.946	10.696					2001.685	9.827
4997.943	10.795					2002.874	9.832
5002.742	10.827					2004.377	9.814
5006.666	10.761					2005.851	9.823
5009.300	10.728					2006.927	9.778
5011.951	10.677					2007.438	9.681
5013.284	10.673					2007.983	9.508
5013.704	10.635					2008.242	9.393

Tributary North Cross sections 1 to 4 2002							
TN01 Distance (m)	20-Jun-02 Assumed Height (m)	TN02 Distance (m)	20-Jun-02 Assumed Height (m)	TN03 Distance (m)	20-Jun-02 Assumed Height (m)	TN04 Distance (m)	18-Jun-02 Assumed Height (m)
5013.992	10.639					2008.719	9.313
5015.098	10.662					2009.279	9.291
5017.995	10.637					2010.042	9.363
5021.383	10.653					2010.651	9.439
5024.599	10.688					2011.248	9.592
5027.118	10.732					2012.154	9.786
5029.723	10.845					2013.230	9.909
5032.774	10.934					2014.267	9.925
5035.951	10.907					2014.877	9.886
5039.484	10.820					2015.427	9.762
5043.253	10.763					2015.639	9.625
5046.923	10.724					2015.961	9.494
5050.786	10.730					2016.320	9.429
5054.201	10.743					2016.546	9.253
5058.331	10.726					2016.742	9.140
5061.852	10.731					2017.064	9.016
5065.306	10.742					2017.630	8.884
5068.388	10.747					2017.976	8.829
5068.511	10.927					2018.399	8.865
						2019.309	8.919
						2019.586	8.979
						2019.725	9.181
						2020.008	9.273
						2020.301	9.517
						2020.554	9.864
						2021.284	9.928
						2022.866	9.956
						2024.356	9.973
						2026.122	9.959

Tributary North Cross sections 5 to 8 2002							
TN05 Distance (m)	18-Jun-02 Assumed Height (m)	TN06 Distance (m)	18-Jun-02 Assumed Height (m)	TN07 Distance (m)	18-Jun-02 Assumed Height (m)	TN08 Distance (m)	18-Jun-02 Assumed Height (m)
3523.957	9.881	2021.024	9.066	1976.162	8.886	4963.987	7.784
3523.853	9.711	1972.659	8.628	1976.274	8.720	4964.146	7.582
3523.851	9.717	1974.495	8.592	1978.146	8.672	4965.271	7.534
3523.847	9.716	1976.576	8.565	1979.867	8.652	4966.973	7.511
3521.972	9.719	1978.536	8.552	1981.122	8.620	4968.476	7.478
3519.993	9.716	1979.655	8.433	1981.830	8.615	4969.638	7.438
3518.394	9.719	1980.233	8.247	1982.560	8.561	4970.247	7.410
3516.539	9.708	1980.752	8.091	1982.836	8.419	4970.334	7.367
3515.090	9.713	1981.285	7.904	1983.237	8.305	4970.880	7.343
3514.479	9.683	1981.590	7.746	1983.647	8.129	4971.207	7.181
3513.989	9.532	1982.213	7.653	1984.235	7.954	4971.483	7.138
3513.894	9.454	1982.737	7.581	1984.871	7.853	4971.797	7.061
3513.494	9.319	1983.076	7.535	1985.140	7.773	4972.536	6.987
3513.166	9.236	1983.228	7.310	1985.412	7.695	4973.061	6.927
3512.880	9.127	1983.405	7.346	1985.788	7.588	4973.680	6.873
3512.565	9.050	1983.981	7.618	1986.016	7.499	4974.316	6.831
3512.413	8.905	1984.484	7.905	1986.476	7.569	4975.005	6.886
3511.855	8.830	1984.898	8.069	1986.665	7.682	4975.653	6.849
3511.464	8.737	1985.411	8.163	1986.944	7.957	4976.100	6.695
3511.171	8.704	1985.779	8.235	1987.336	8.168	4976.657	6.690
3510.586	8.764	1986.345	8.256	1987.748	8.236	4976.974	6.641
3510.069	8.819	1987.073	8.205	1988.144	8.320	4977.365	6.528
3509.705	8.935	1987.725	8.180	1988.611	8.426	4977.463	6.534
3509.382	9.167	1988.282	8.206	1989.497	8.501	4977.706	6.380
3508.992	9.334	1988.578	8.289	1990.393	8.585	4978.236	6.345
3508.647	9.441	1988.816	8.436	1991.733	8.700	4978.594	6.311
3508.273	9.614	1988.985	8.472	1993.310	8.687	4978.796	6.325
3507.822	9.701	1989.914	8.535	1994.407	8.704	4979.104	6.539
3506.827	9.722	1991.744	8.548	1996.024	8.721	4979.454	6.797
3505.173	9.744	1993.336	8.593	1998.513	8.779	4979.737	6.968
3503.377	9.759	1995.800	8.663	2001.645	8.840	4980.013	7.120
3501.556	9.787	1997.359	8.727	2003.386	8.889	4980.520	7.337
		1999.012	8.778	2004.858	8.893	4981.201	7.703
		2001.354	8.829	2007.137	8.946	4982.236	7.706
		2003.454	8.853	2009.574	8.992	4983.908	7.776
		2005.038	8.851	2012.062	8.991	4985.313	7.805
		2005.555	8.785	2013.819	9.010	4986.292	7.806
		2005.828	8.556	2015.771	9.028	4986.934	7.677

Tributary North Cross sections 5 to 8 2002							
TN05 Distance (m)	18-Jun-02 Assumed Height (m)	TN06 Distance (m)	18-Jun-02 Assumed Height (m)	TN07 Distance (m)	18-Jun-02 Assumed Height (m)	TN08 Distance (m)	18-Jun-02 Assumed Height (m)
		2006.032	8.370	2017.420	9.052	4987.416	7.405
		2006.483	8.134	2018.223	9.032	4988.078	7.097
		2006.648	7.979	2018.484	8.897	4988.552	6.928
		2007.098	7.884	2018.889	8.753	4988.901	6.791
		2007.549	7.704	2019.385	8.597	4989.414	6.684
		2007.895	7.656	2019.634	8.502	4989.723	6.631
		2008.148	7.658	2020.015	8.311	4989.789	6.697
		2008.427	7.700	2020.452	8.123	4990.179	6.739
		2008.698	7.792	2020.891	7.954	4990.456	6.833
		2009.249	7.825	2021.312	7.912	4990.670	6.962
		2009.781	7.877	2021.706	7.886	4990.817	7.100
		2009.881	7.955	2022.284	7.930	4991.040	7.149
		2010.099	7.978	2022.873	8.038	4991.824	7.307
		2010.591	8.311	2023.354	8.121	4992.533	7.438
		2010.933	8.578	2023.949	8.228	4992.985	7.510
		2011.093	8.833	2024.525	8.347	4993.478	7.746
		2011.941	8.876	2024.887	8.503	4994.148	7.825
		2013.038	8.870	2025.303	8.604	4995.607	7.828
		2015.641	8.867	2025.796	8.836	4996.811	7.825
		2017.816	8.879	2026.066	8.949	4998.485	7.814
		2020.905	8.867	2026.609	8.989		
				2027.495	8.983		
				2028.791	8.992		
				2029.995	9.013		
				2031.689	8.972		

Tributary North Cross sections 9 to 12 2002							
TN09 Distance (m)	18-Jun-02 Assumed Height (m)	TN10 Distance (m)	20-Jun-02 Assumed Height (m)	TN11 Distance (m)	20-Jun-02 Assumed Height (m)	TN12 Distance (m)	18-Jun-02 Assumed Height (m)
3969.693	8.164	5090.488	12.274	7077.004	13.160	7927.322	13.160
3969.817	7.964	5090.367	12.055	7076.889	12.981	7927.467	12.979
3971.990	7.969	5087.495	12.032	7074.373	12.859	7930.371	12.951
3974.332	7.946	5085.173	11.960	7072.170	12.735	7933.253	12.945
3976.247	7.915	5083.406	11.884	7070.057	12.577	7936.511	13.021
3977.327	7.907	5082.039	11.826	7069.356	12.502	7938.948	12.979
3978.434	7.838	5080.878	11.783	7068.642	12.404	7940.095	12.891
3978.917	7.746	5080.230	11.683	7068.245	12.426	7941.741	12.862
3979.245	7.647	5080.051	11.440	7068.015	12.273	7942.719	12.731
3979.567	7.479	5079.725	11.368	7067.556	12.311	7943.178	12.653
3979.988	7.330	5079.259	11.323	7067.261	12.207	7943.969	12.634
3980.337	7.194	5078.684	11.372	7066.713	12.167	7944.174	12.578
3980.679	6.941	5078.108	11.519	7066.118	12.209	7944.349	12.435
3981.045	6.776	5077.892	11.691	7065.702	12.261	7944.509	12.401
3981.317	6.726	5076.769	11.739	7064.610	12.449	7944.807	12.441
3981.833	6.763	5074.045	11.828	7063.709	12.540	7945.126	12.345
3982.513	6.738	5070.723	11.827	7061.608	12.590	7945.417	12.331
3982.985	6.669	5068.215	11.814	7059.417	12.621	7945.471	12.480
3983.490	6.591	5065.272	11.800	7057.231	12.661	7945.948	12.743
3983.750	6.568	5061.879	11.773	7055.303	12.640	7946.637	12.914
3984.062	6.476	5058.590	11.742	7051.953	12.591	7948.120	12.957
3984.549	6.482	5055.082	11.873	7049.013	12.554	7950.026	12.902
3985.036	6.551	5051.803	11.891	7046.184	12.569	7953.194	12.850
3985.658	6.568	5048.525	11.810	7042.842	12.586	7955.610	12.835
3986.075	6.619	5045.336	11.809	7040.268	12.563	7958.786	12.807
3986.397	6.711	5042.688	11.785	7038.009	12.633	7961.928	12.775
3986.619	6.787	5039.265	11.683	7036.920	12.567	7965.403	12.705
3987.259	6.797	5036.153	11.627	7036.499	12.579	7968.270	12.685
3987.501	6.934	5034.518	11.576	7036.202	12.606	7971.793	12.628
3987.982	7.168	5032.742	11.549	7035.854	12.573	7973.879	12.625
3988.669	7.352	5029.970	11.547	7035.586	12.409	7976.812	12.643
3989.028	7.433	5027.017	11.570	7035.412	12.336	7979.664	12.585
3989.479	7.581	5023.845	11.559	7034.991	12.321	7981.277	12.497
3990.443	7.604	5021.354	11.551	7034.449	12.385	7983.132	12.491
3991.560	7.633	5018.059	11.559	7034.167	12.462	7983.731	12.442
3992.676	7.669	5014.556	11.576	7033.878	12.669	7984.225	12.349
3994.334	7.687	5011.575	11.597	7032.824	12.673	7984.714	12.280
3995.857	7.729	5008.113	11.640	7029.543	12.594	7985.264	12.266
3997.282	7.755	5005.321	11.717	7026.646	12.616	7985.875	12.239

Tributary North Cross sections 9 to 12 2002							
TN09 Distance (m)	18-Jun-02 Assumed Height (m)	TN10 Distance (m)	20-Jun-02 Assumed Height (m)	TN11 Distance (m)	20-Jun-02 Assumed Height (m)	TN12 Distance (m)	18-Jun-02 Assumed Height (m)
3999.051	7.791	5002.912	11.758	7023.864	12.637	7986.188	12.244
				7021.070	12.670	7986.383	12.229
				7018.353	12.660	7986.639	12.276
				7014.979	12.677	7986.801	12.373
				7011.846	12.692	7987.095	12.423
				7008.533	12.726	7988.105	12.457
				7005.485	12.759	7990.148	12.536
				7002.279	12.791	7992.178	12.607
						7994.826	12.738
						7997.760	12.788

Tributary North Cross section 13 2002			
TN13 Distance (m)	18-Jun-02 Assumed Height (m)	TN13 Cont. Distance (m)	18-Jun-02 Assumed Height (m)
8960.518	14.267	8989.389	13.547
8960.653	14.074	8989.537	13.544
8962.911	14.039	8989.779	13.436
8964.897	14.025	8990.006	13.392
8966.724	13.947	8990.295	13.447
8969.328	13.884	8990.459	13.586
8971.755	13.854	8991.538	13.642
8974.220	13.796	8993.023	13.711
8976.838	13.719	8994.485	13.685
8979.513	13.686	8996.223	13.749
8981.442	13.618	8997.252	13.822
8981.762	13.558		
8982.204	13.542		
8982.895	13.526		
8983.898	13.502		
8985.007	13.511		
8986.255	13.490		
8988.076	13.527		
8988.970	13.574		

Tributary Central Cross sections 1-4 2002							
TC01 Distance (m)	10-Jul-02 Assumed Height (m)	TC02 Distance (m)	10-Jul-02 Assumed Height (m)	TC03 Distance (m)	10-Jul-02 Assumed Height (m)	TC04 Distance (m)	10-Jul-02 Assumed Height (m)
4962.688	11.063	1980.564	11.081	5962.270	12.288	6956.905	12.221
4964.242	11.109	1980.568	11.081	5962.422	12.111	6957.069	12.061
4966.130	11.067	1980.695	10.916	5965.458	12.104	6959.959	12.005
4967.432	10.968	1981.931	10.930	5968.949	11.977	6963.464	11.983
4969.317	10.881	1983.173	10.983	5972.156	11.904	6966.542	11.924
4971.783	10.817	1984.351	10.892	5974.757	11.931	6969.867	11.883
4974.114	10.793	1985.479	10.937	5978.537	12.020	6973.420	11.829
4975.851	10.820	1986.824	11.039	5980.389	12.009	6976.917	11.817
4976.500	10.755	1988.568	11.066	5981.348	12.110	6979.351	11.887
4977.726	10.768	1989.605	11.066	5982.170	12.152	6980.816	11.971
4978.410	10.913	1990.884	11.013	5982.480	12.035	6982.127	12.044
4978.679	10.982	1991.994	11.041	5982.619	11.886	6982.983	12.071
4980.278	11.074	1993.888	10.985	5983.057	11.761	6983.659	12.090
4982.447	11.044	1995.245	10.957	5983.264	11.627	6983.874	12.006
4984.220	11.015	1996.437	10.933	5983.556	11.555	6984.168	11.707
4985.842	11.059	1998.316	10.904	5983.946	11.424	6984.468	11.565
4986.151	11.012			5984.840	11.446	6984.667	11.386
4986.603	10.854			5985.645	11.440	6984.795	11.306
4986.907	10.820			5986.009	11.524	6985.030	11.109
4987.324	11.022			5986.305	11.731	6985.283	10.988
4988.342	11.091			5986.464	11.862	6985.574	10.924
4989.198	11.083			5986.661	12.026	6986.180	10.883
4989.899	11.158			5986.933	12.139	6986.814	10.858
4990.831	11.198			5987.282	12.163	6987.142	10.996
4991.116	11.200			5987.761	12.150	6987.408	11.076
4991.333	11.124			5988.875	12.113	6987.634	11.121
4991.420	10.988			5989.791	12.042	6987.944	11.318
4991.452	10.634			5991.335	11.975	6988.221	11.652
4991.536	10.562			5993.847	11.907	6988.325	11.821
4991.984	10.508			5996.185	11.905	6988.375	11.983
4992.536	10.454			5998.266	11.833	6988.546	12.069
4993.089	10.532					6988.985	12.108
4993.358	10.543					6989.534	12.058
4993.597	10.552					6991.444	11.969
4993.783	10.526					6993.601	11.937
4993.924	10.494					6995.738	11.893
4994.143	10.566					6997.883	11.831
4994.420	10.818						

Tributary Central Cross sections 1-4 2002							
TC01 Distance (m)	**10-Jul-02 Assumed Height (m)**	**TC02 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**TC03 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**TC04 Distance (m)**	**10-Jul-02 Assumed Height (m)**
4995.002	10.943						
4995.514	11.048						
4996.079	11.048						
4996.832	11.097						
4998.140	10.947						

Tributary Central Cross sections 5-6C 2002							
TC05 Distance (m)	27-Jun-02 Assumed Height (m)	TC06A Distance (m)	27-Jun-02 Assumed Height (m)	TC06B Distance (m)	27-Jun-02 Assumed Height (m)	TC06C Distance (m)	27-Jun-02 Assumed Height (m)
7942.512	12.589	9031.201	14.265	0.139	13.995	0.150	13.427
7942.629	12.380	9028.668	14.260	2.258	13.977	1.340	13.461
7945.007	12.358	9024.951	14.271	3.675	14.015	2.966	13.524
7948.399	12.278	9021.438	14.242	5.305	14.032	4.589	13.593
7951.378	12.230	9019.517	14.232	6.852	14.052	6.205	13.663
7953.470	12.198	9018.073	14.227	8.153	14.069	7.867	13.751
7956.299	12.148	9017.414	14.185	9.305	14.071	9.445	13.820
7958.116	12.102	9017.130	14.129	9.892	14.063	10.791	13.856
7960.944	12.029	9017.041	14.055	10.274	14.058	11.461	13.919
7962.275	11.973	9017.068	13.460	10.488	13.986	11.737	13.917
7963.358	11.920	9016.844	13.344	10.725	12.855	12.048	13.864
7964.280	11.902	9016.501	13.223	10.855	12.785	12.226	13.674
7965.232	11.937	9016.392	12.803	11.340	12.570	12.440	13.481
7966.044	11.983	9016.238	12.707	11.518	12.559	12.774	13.320
7967.240	12.045	9016.150	12.720	11.992	12.730	12.899	13.170
7967.958	12.061	9015.856	12.823	12.590	12.936	13.341	12.930
7968.325	12.018	9015.750	12.839	13.180	12.967	13.576	12.616
7968.372	11.622	9015.241	12.725	13.773	13.046	14.046	12.353
7968.679	11.474	9014.939	12.714	14.233	13.107	14.268	12.359
7968.913	11.455	9014.746	12.724	14.809	13.131	14.995	12.482
7969.119	11.267	9014.000	12.869	15.307	13.263	15.955	12.520
7969.292	11.041	9012.875	12.970	16.335	13.387	16.487	12.657
7969.628	10.851	9012.288	13.020	17.339	13.479	16.716	12.623
7970.258	10.891	9011.782	13.111	17.971	13.576	17.024	12.673
7971.175	10.942	9011.374	13.207	18.827	13.560	17.194	12.652
7972.045	10.942	9010.601	13.247	19.623	13.550	17.620	12.751
7972.258	10.935	9010.156	13.257	19.888	13.467	18.058	12.856
7972.568	11.168	9009.661	13.478	20.158	13.437	18.400	12.832
7972.960	11.247	9009.199	13.529	20.598	13.487	18.998	13.016
7973.108	11.461	9008.699	13.513	21.569	13.569	19.335	12.948
7973.544	11.907	9007.735	13.544	22.233	13.605	19.947	13.033
7974.196	12.095	9007.443	13.584	23.232	13.564	20.410	13.105
7975.208	12.125	9006.932	13.598	24.179	13.568	20.696	13.159
7977.354	12.057	9006.320	13.635	24.848	13.567	21.064	13.341
7979.223	12.003	9005.577	13.529	25.656	13.596	21.943	13.372
7981.067	11.978	9005.257	13.524	26.788	13.687	22.881	13.327
7981.901	11.905	9004.784	13.579	28.396	13.733	23.367	13.291
7982.503	11.830	9003.545	13.676			23.899	13.391

Tributary Central Cross sections 5-6C 2002							
TC05 Distance (m)	**27-Jun-02 Assumed Height (m)**	**TC06A Distance (m)**	**27-Jun-02 Assumed Height (m)**	**TC06B Distance (m)**	**27-Jun-02 Assumed Height (m)**	**TC06C Distance (m)**	**27-Jun-02 Assumed Height (m)**
7983.211	11.786	9001.945	13.733			24.717	13.448
7984.248	11.741					25.110	13.472
7984.776	11.780					26.382	13.460
7985.462	11.866					27.106	13.470
7986.041	11.996					28.217	13.551
7986.805	12.022					29.269	13.585
7988.419	11.976					29.514	13.671
7990.856	11.939					31.566	13.756
7992.921	11.908						
7994.645	11.877						
7997.410	11.859						

Tributary Central Cross sections 7A-8 2002							
TC07A Distance (m)	27-Jun-02 Assumed Height (m)	TC07B Distance (m)	27-Jun-02 Assumed Height (m)	TC07C Distance (m)	27-Jun-02 Assumed Height (m)	TC08 Distance (m)	27-Jun-02 Assumed Height (m)
1032.984	13.263	0.126	12.778	0.149	12.821	5976.113	12.758
1032.878	13.090	1.816	12.859	1.729	12.818	5976.267	12.558
1030.884	13.132	3.499	12.960	3.235	12.840	5977.616	12.535
1029.130	13.184	5.246	12.975	5.208	12.833	5979.264	12.585
1027.320	13.225	6.557	12.988	6.718	12.852	5980.905	12.463
1025.730	13.234	7.710	13.016	8.644	12.861	5981.707	12.341
1024.579	13.256	8.411	13.005	10.125	12.885	5982.179	12.139
1023.642	13.265	8.501	12.570	12.122	12.890	5982.788	11.956
1023.552	12.219	8.772	12.359	14.177	12.921	5983.072	11.784
1023.227	12.020	8.910	12.207	15.546	12.912	5983.463	11.673
1022.611	11.677	9.378	11.971	16.400	12.855	5983.920	11.504
1022.387	11.640	9.766	11.575	16.572	12.133	5984.015	11.391
1022.159	11.514	10.089	11.199	16.836	11.911	5984.246	11.282
1022.029	11.546	10.435	11.224	16.954	11.752	5984.333	11.182
1022.031	11.546	10.809	11.315	17.347	11.396	5984.519	11.056
1021.715	11.489	11.037	11.316	17.556	11.401	5984.809	10.892
1021.471	11.502	11.386	11.291	17.740	11.270	5985.013	10.891
1021.222	11.588	12.019	11.324	18.164	11.179	5985.235	10.898
1020.616	11.588	12.471	11.357	18.837	11.037	5985.728	10.810
1020.278	11.624	13.124	11.429	19.207	11.037	5986.032	10.846
1019.967	11.694	13.582	11.462	19.447	11.196	5986.408	10.843
1019.467	11.528	13.965	11.543	19.773	11.542	5986.883	11.091
1018.919	11.473	14.244	11.622	20.422	11.792	5987.474	11.361
1018.757	11.344	14.733	11.653	21.279	11.916	5987.752	11.533
1018.318	11.217	15.156	11.654	22.012	11.979	5988.050	11.698
1017.944	11.257	15.518	11.743	22.504	12.135	5988.388	11.777
1017.487	11.427	15.747	11.799	23.582	12.348	5988.690	12.031
1017.082	11.421	16.025	11.896	24.293	12.386	5989.223	12.317
1016.525	11.545	16.985	12.101	25.065	12.527	5989.790	12.465
1015.895	11.718	17.913	12.230	26.181	12.489	5990.676	12.621
1015.484	11.780	18.367	12.267	26.998	12.557	5991.382	12.694
1014.888	11.713	18.592	12.327	28.377	12.650	5993.135	12.761
1014.073	11.926	18.795	12.236	29.363	12.652	5994.764	12.783
1013.622	11.861	19.220	12.228			5996.771	12.810
1013.053	12.032	19.816	12.324			5998.255	12.813
1012.847	12.024	20.287	12.363				
1012.557	12.100	20.739	12.398				
1012.218	12.103	21.439	12.532				

Tributary Central Cross sections 7A-8 2002							
TC07A Distance (m)	27-Jun-02 Assumed Height (m)	TC07B Distance (m)	27-Jun-02 Assumed Height (m)	TC07C Distance (m)	27-Jun-02 Assumed Height (m)	TC08 Distance (m)	27-Jun-02 Assumed Height (m)
1011.933	12.205	22.432	12.550				
1011.481	12.179	23.322	12.456				
1011.306	12.250	23.631	12.523				
1010.438	12.163	24.690	12.509				
1009.361	12.217	25.741	12.572				
1008.570	12.261	26.574	12.609				
1008.166	12.284	27.487	12.640				
1007.786	12.468						
1006.864	12.504						
1005.662	12.536						
1005.284	12.543						
1004.723	12.479						
1003.577	12.529						
1002.477	12.625						

Tributary Central Cross sections 9-11 2002						
TC09 Distance (m)	27-Jun-02 Assumed Height (m)	TC10 Distance (m)	27-Jun-02 Assumed Height (m)	TC11 Distance (m)	27-Jun-02 Assumed Height (m)	
8962.482	13.113	7965.297	12.871	6969.909	13.066	
8962.615	12.927	7965.438	12.689	6970.041	12.860	
8964.215	12.858	7967.470	12.678	6972.743	12.827	
8966.553	12.834	7970.147	12.688	6975.627	12.797	
8968.635	12.856	7972.591	12.725	6978.138	12.764	
8970.658	12.896	7974.083	12.774	6979.207	12.786	
8972.375	12.890	7975.381	12.806	6979.526	12.785	
8973.125	12.870	7976.109	12.801	6979.712	12.744	
8973.648	12.802	7976.978	12.709	6979.774	12.678	
8973.682	12.437	7977.094	12.324	6979.840	12.389	
8974.008	12.265	7977.304	12.154	6979.976	12.362	
8974.180	12.209	7977.531	12.037	6980.364	11.926	
8974.461	11.746	7977.775	11.854	6980.645	11.725	
8974.826	11.646	7978.257	11.770	6980.772	11.662	
8974.905	11.526	7978.612	11.729	6980.912	11.330	
8975.115	11.393	7978.815	11.649	6981.009	11.302	
8975.457	11.495	7979.517	11.550	6981.294	11.329	
8976.030	11.405	7980.761	11.593	6981.584	11.450	
8976.376	11.425	7981.229	11.601	6981.902	11.560	
8977.194	11.472	7981.801	11.689	6982.487	11.629	
8977.675	11.535	7982.288	11.768	6983.181	11.711	
8978.057	11.529	7982.783	12.034	6983.716	11.845	
8978.477	11.591	7983.507	12.046	6984.183	11.912	
8978.820	11.714	7984.047	12.074	6984.448	12.012	
8979.130	11.753	7984.908	12.267	6984.726	12.063	
8979.327	11.925	7985.727	12.392	6984.966	12.073	
8979.654	12.178	7986.798	12.434	6985.158	12.006	
8980.101	12.224	7987.987	12.467	6985.548	11.945	
8980.638	12.348	7988.907	12.505	6986.144	11.999	
8981.106	12.613	7989.691	12.574	6986.714	12.122	
8981.490	12.752	7990.399	12.671	6986.967	12.338	
8982.347	12.894	7992.173	12.838	6987.186	12.415	
8983.807	12.984	7994.571	12.801	6987.597	12.399	
8985.596	12.967	7997.514	12.749	6988.645	12.427	
8987.254	12.946			6989.792	12.413	
8988.901	12.926			6990.641	12.382	
8991.238	12.860			6991.535	12.451	
8992.803	12.826			6992.607	12.645	

Tributary Central Cross sections 9-11 2002						
TC09 Distance (m)	**27-Jun-02 Assumed Height (m)**	**TC10 Distance (m)**	**27-Jun-02 Assumed Height (m)**	**TC11 Distance (m)**	**27-Jun-02 Assumed Height (m)**	
8994.620	12.815			6993.901	12.741	
8996.186	12.806			6995.309	12.773	
8997.910	12.796			6996.950	12.809	
				6998.547	12.818	

East Tributary Cross sections 1 to 4- 2002							
ET01 Distance (m)	7-Jun-02 Assumed Height (m)	ET02 Distance (m)	10-Jul-02 Assumed Height (m)	ET03 Distance (m)	10-Jul-02 Assumed Height (m)	ET04 Distance (m)	10-Jul-02 Assumed Height (m)
975.717	14.879	1971.698	14.903	2976.631	14.956	3974.118	14.900
925.528	14.122	1971.819	14.704	2976.761	14.768	3974.255	14.709
927.980	14.118	1973.131	14.713	2978.288	14.769	3975.261	14.725
930.813	14.139	1974.480	14.739	2979.741	14.789	3976.780	14.745
934.020	14.155	1976.327	14.727	2980.492	14.797	3978.251	14.781
936.428	14.197	1976.842	14.721	2981.710	14.820	3979.898	14.842
939.688	14.240	1977.220	14.577	2983.323	14.864	3981.459	14.886
942.371	14.368	1977.430	14.315	2984.400	14.875	3983.054	14.914
945.403	14.477	1978.188	14.091	2985.156	14.791	3983.606	14.776
948.562	14.545	1978.473	13.809	2985.782	14.671	3984.096	14.495
951.424	14.624	1978.785	13.662	2986.043	14.549	3984.310	14.365
954.220	14.680	1979.092	13.574	2986.235	14.283	3984.510	14.329
957.232	14.694	1979.240	13.516	2986.413	14.228	3984.824	14.264
960.073	14.689	1979.710	13.499	2986.546	14.372	3984.832	13.649
963.030	14.734	1981.084	13.421	2986.864	14.238	3985.127	13.508
966.258	14.691	1981.710	13.374	2986.954	14.105	3985.796	13.384
969.365	14.731	1982.080	13.196	2987.076	13.981	3986.394	13.349
972.117	14.753	1982.286	13.113	2987.385	13.620	3987.131	13.365
975.045	14.679	1982.409	13.132	2988.112	13.176	3987.876	13.352
975.677	14.876	1982.852	13.055	2988.363	13.169	3988.304	13.327
975.827	14.692	1983.655	12.992	2988.757	13.206	3988.648	13.230
977.304	14.698	1983.938	12.827	2989.181	13.242	3988.962	13.303
978.510	14.691	1984.503	12.654	2989.752	13.205	3989.377	13.617
979.522	14.733	1985.094	12.702	2990.048	13.103	3989.777	13.907
980.229	14.801	1985.313	12.748	2990.751	13.111	3990.197	14.301
981.316	14.841	1985.695	12.834	2991.082	13.128	3990.560	14.519
982.046	14.833	1985.971	13.012	2991.342	13.429	3990.928	14.668
982.578	14.650	1986.036	13.445	2992.099	13.661	3991.567	14.726
982.921	14.576	1986.393	13.566	2992.513	14.100	3992.087	14.766
983.186	14.410	1986.541	13.707	2992.814	14.397	3992.548	14.918
983.385	14.038	1986.777	14.081	2993.273	14.709	3992.838	14.925
983.552	13.865	1986.889	14.499	2993.748	14.882	3994.102	14.881
983.841	13.593	1987.065	14.755	2994.461	14.919	3995.495	14.873
984.279	13.423	1987.395	14.856	2995.622	14.873	3996.459	14.824
984.557	13.279	1988.588	14.836	2996.719	14.872	3997.507	14.822
985.186	13.228	1990.055	14.803	2998.357	14.826	3998.752	14.847
985.824	13.199	1991.591	14.831				
986.310	13.044	1994.204	14.809				

East Tributary Cross sections 1 to 4- 2002							
ET01 Distance (m)	**7-Jun-02 Assumed Height (m)**	**ET02 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**ET03 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**ET04 Distance (m)**	**10-Jul-02 Assumed Height (m)**
986.924	12.955	1996.156	14.831				
987.760	13.069	1998.532	14.804				
988.370	13.200						
988.425	13.489						
988.717	13.557						
988.914	13.850						
989.303	14.040						
989.655	14.205						
990.105	14.456						
990.394	14.611						
990.601	14.657						
991.110	14.743						
992.292	14.732						
994.412	14.761						
996.637	14.807						
998.934	14.826						
1001.522	14.841						
1003.268	14.829						
1005.400	14.835						
1008.888	14.839						
1012.355	14.885						

East Tributary Cross sections 5 to 8 2002							
ET05 Distance (m)	7-Jun-02 Assumed Height (m)	ET06 Distance (m)	10-Jul-02 Assumed Height (m)	ET07 Distance (m)	10-Jul-02 Assumed Height (m)	ET08 Distance (m)	10-Jul-02 Assumed Height (m)
1985.021	9.935	5968.555	14.852	7470.723	14.891	0.079	14.384
1985.135	9.689	5968.674	14.688	7470.854	14.717	2.146	14.451
1986.404	9.732	5969.967	14.727	7472.435	14.715	4.057	14.542
1987.383	9.741	5971.788	14.776	7474.191	14.776	5.659	14.659
1987.928	9.677	5972.919	14.769	7476.314	14.763	7.098	14.675
1988.196	9.586	5974.157	14.779	7478.592	14.768	7.903	14.721
1988.504	9.399	5975.645	14.783	7480.153	14.798	10.229	14.792
1988.836	9.321	5977.024	14.815	7481.450	14.847	12.104	14.876
1988.977	9.129	5978.356	14.844	7483.217	14.912	13.744	14.904
1989.332	8.977	5979.662	14.876	7483.197	14.921	15.343	14.893
1989.548	8.787	5981.139	14.870	7483.798	14.902	16.365	14.845
1989.653	8.673	5981.827	14.801	7484.140	14.829	16.901	14.682
1989.839	8.381	5982.120	14.661	7484.433	14.674	17.195	14.512
1990.163	8.138	5982.239	14.572	7484.595	14.350	17.344	14.416
1990.443	8.005	5982.432	14.585	7484.851	14.093	17.651	14.255
1990.882	8.013	5982.515	14.455	7485.018	13.887	17.987	13.961
1991.400	8.149	5982.874	14.433	7485.499	13.639	18.216	13.873
1992.071	8.172	5983.103	14.251	7486.229	13.414	18.502	13.832
1992.865	8.210	5983.422	14.261	7486.835	13.467	18.654	13.464
1993.352	8.189	5983.630	14.552	7487.280	13.401	18.960	13.349
1993.615	8.243	5983.813	14.106	7488.334	13.417	19.185	13.377
1993.772	8.309	5984.142	14.057	7488.996	13.401	19.389	13.371
1994.217	8.540	5984.233	13.757	7489.612	13.466	19.790	13.117
1994.578	8.817	5984.533	13.619	7490.085	13.389	20.299	13.168
1994.730	9.216	5984.840	13.250	7490.396	13.519	21.138	13.253
1994.881	9.355	5985.233	13.282	7490.594	14.042	21.887	13.374
1995.335	9.449	5985.470	13.186	7490.761	14.139	22.011	13.527
1995.700	9.575	5986.447	13.414	7491.318	14.086	22.370	13.327
1996.746	9.671	5987.497	13.524	7491.705	14.235	23.041	13.453
1997.742	9.720	5988.062	13.617	7492.273	14.333	23.650	13.460
1998.988	9.723	5988.647	13.683	7493.205	14.553	24.720	13.670
		5988.918	13.835	7493.639	14.703	25.773	13.878
		5989.057	14.086	7493.858	14.842	26.257	14.039
		5989.278	14.216	7494.008	14.872	26.974	14.261
		5989.563	14.380	7494.983	14.908	27.858	14.378
		5989.986	14.606	7496.370	14.859	28.403	14.381
		5990.821	14.783	7498.599	14.826	29.152	14.552
		5991.641	14.873			29.827	14.694
		5993.229	14.858			30.612	14.870

East Tributary Cross sections 5 to 8 2002							
ET05 Distance (m)	**7-Jun-02 Assumed Height (m)**	**ET06 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**ET07 Distance (m)**	**10-Jul-02 Assumed Height (m)**	**ET08 Distance (m)**	**10-Jul-02 Assumed Height (m)**
		5994.723	14.881			31.647	14.889
		5995.819	14.863			33.007	14.844
		5996.714	14.848			34.585	14.835
		5998.528	14.825				

Upper Swift Creek cross sections 1 to GW 2002							
UM01 Distance (m)	31-May-02 Assumed Height (m)	UM02 Distance (m)	31-May-02 Assumed Height (m)	UM03 Distance (m)	31-May-02 Assumed Height (m)	UMGW Distance (m)	31-May-02 Assumed Height (m)
2042.907	9.994	2038.574	9.888	2029.556	9.730	13.213	9.644
2042.907	9.994	2038.575	9.888	2029.556	9.730	13.123	9.472
2042.829	9.784	2038.453	9.705	2029.423	9.576	12.272	9.476
2041.856	9.753	2037.396	9.698	2028.135	9.572	11.657	9.422
2041.279	9.681	2036.119	9.583	2026.861	9.583	11.101	9.362
2038.844	9.610	2034.783	9.572	2025.580	9.546	10.524	9.364
2036.639	9.565	2032.649	9.519	2024.395	9.514	10.038	9.420
2034.349	9.552	2031.070	9.551	2023.556	9.507	9.668	9.401
2032.067	9.524	2028.892	9.515	2023.302	9.550	9.220	9.329
2030.928	9.505	2028.117	9.556	2022.743	9.577	8.916	9.228
2029.732	9.555	2027.336	9.600	2022.296	9.529	8.631	9.121
2029.097	9.488	2026.440	9.583	2021.367	9.511	8.491	9.024
2027.954	9.470	2025.196	9.518	2020.346	9.479	8.406	8.895
2026.699	9.516	2024.486	9.482	2019.855	9.444	8.225	8.794
2025.922	9.520	2023.677	9.513	2019.201	9.478	8.073	8.120
2025.458	9.416	2022.973	9.523	2018.388	9.462	7.867	8.086
2024.270	9.373	2022.038	9.521	2017.914	9.490	7.635	8.034
2023.516	9.399	2021.483	9.424	2017.020	9.420	7.276	7.995
2022.947	9.469	2021.123	9.280	2016.102	9.356	6.189	7.957
2022.331	9.506	2020.664	9.046	2015.431	9.393	5.157	7.951
2021.888	9.395	2020.362	8.944	2014.911	9.313	4.056	7.941
2021.527	9.196	2020.177	8.895	2014.776	9.195	3.747	7.909
2021.363	9.079	2019.915	8.727	2014.048	9.132	3.390	7.932
2020.840	8.958	2019.706	8.685	2013.870	9.170	3.084	8.002
2020.475	8.861	2019.666	8.127	2013.802	9.051	2.344	7.985
2020.331	8.686	2019.395	8.015	2013.616	9.060	1.909	8.120
2019.995	8.446	2018.947	7.981	2013.496	9.103	1.814	8.174
2019.741	8.309	2018.299	7.955	2013.227	8.982	1.504	8.331
2019.126	8.137	2017.830	8.004	2013.185	8.692	1.432	8.584
2018.188	7.972	2016.966	8.005	2013.114	8.579	1.227	8.728
2018.123	7.991	2016.154	8.027	2012.867	8.580	0.993	8.824
2017.887	7.785	2015.695	8.033	2012.694	8.486	0.666	9.009
2017.608	7.783	2015.281	8.006	2012.654	8.022	0.569	9.105
2017.138	7.837	2014.935	7.877	2012.403	7.905	0.129	9.327
2016.543	7.843	2014.681	7.958	2012.121	7.868	-0.279	9.472
2015.928	7.849	2014.153	8.218	2011.852	7.881	-1.027	9.569
2015.034	7.828	2013.761	8.398	2011.442	7.989	-2.218	9.687
2014.744	7.809	2013.408	8.521	2010.319	7.927	-3.539	9.783
2014.411	7.910	2012.920	8.722	2009.346	7.949	-5.308	9.794

Upper Swift Creek cross sections 1 to GW 2002							
UM01 Distance (m)	**31-May-02 Assumed Height (m)**	**UM02 Distance (m)**	**31-May-02 Assumed Height (m)**	**UM03 Distance (m)**	**31-May-02 Assumed Height (m)**	**UMGW Distance (m)**	**31-May-02 Assumed Height (m)**
2014.252	7.985	2012.756	8.828	2008.257	7.897		
2013.986	7.966	2011.995	9.174	2008.095	8.184		
2013.782	8.022	2011.565	9.440	2007.897	8.146		
2013.436	8.325	2011.022	9.599	2007.813	8.091		
2013.187	8.840	2010.874	9.639	2007.455	8.071		
2012.820	9.138	2010.426	9.716	2007.227	8.186		
2012.225	9.327	2009.610	9.799	2007.035	8.380		
2011.009	9.529	2008.402	9.749	2006.797	9.019		
2009.907	9.667	2007.811	9.783	2006.462	9.115		
2009.070	9.764	2007.550	9.854	2006.278	9.270		
2008.404	9.770	2006.490	9.814	2005.805	9.453		
2007.988	9.756	2004.555	9.806	2005.359	9.593		
2006.947	9.822	2001.872	9.812	2004.909	9.585		
2005.683	9.818			2004.182	9.566		
2003.937	9.804			2003.292	9.691		
2001.939	9.781			2003.078	9.949		
				2002.901	9.768		
				2002.137	9.822		
				2001.193	9.839		

Upper Swift Creek cross sections 4 to 7 2002							
UM04 Distance (m)	31-May-02 Assumed Height (m)	UM05 Distance (m)	31-May-02 Assumed Height (m)	UM06 Distance (m)	31-May-02 Assumed Height (m)	UM07 Distance (m)	31-May-02 Assumed Height (m)
528.027	9.731	2033.043	9.870	2040.685	9.981	2032.089	9.816
528.017	9.731	2033.043	9.870	2040.687	9.981	2058.145	9.600
527.884	9.518	2032.888	9.689	2040.559	9.794	2054.348	9.613
525.336	9.511	2030.733	9.660	2037.726	9.797	2050.775	9.574
523.810	9.485	2028.880	9.620	2034.740	9.739	2046.948	9.572
522.038	9.443	2028.287	9.655	2031.942	9.669	2042.941	9.590
520.332	9.459	2027.618	9.572	2028.801	9.596	2038.907	9.598
519.825	9.399	2025.878	9.543	2027.162	9.557	2035.469	9.614
518.471	9.404	2024.658	9.555	2026.624	9.609	2032.083	9.816
517.345	9.374	2024.335	9.504	2025.792	9.666	2031.934	9.634
516.269	9.376	2024.057	9.436	2025.066	9.695	2028.764	9.640
515.729	9.122	2023.487	9.429	2024.608	9.642	2025.142	9.601
514.941	8.789	2022.877	9.489	2024.017	9.458	2022.046	9.683
514.780	8.733	2022.595	9.552	2023.657	9.234	2020.461	9.706
514.550	8.363	2022.370	9.460	2023.097	8.766	2019.257	9.779
514.477	8.000	2021.988	9.112	2022.417	8.459	2018.993	9.744
514.263	7.889	2021.865	8.761	2021.903	8.300	2018.967	9.744
513.487	7.883	2021.757	8.696	2021.238	8.200	2018.675	9.640
512.168	7.905	2021.694	8.446	2020.786	8.205	2018.218	9.210
511.033	7.895	2021.572	8.396	2019.741	8.214	2017.783	8.843
509.873	7.866	2021.426	8.281	2018.580	8.115	2017.600	8.611
509.116	7.838	2021.002	8.228	2017.278	8.094	2017.365	8.416
508.986	7.777	2019.268	8.128	2016.261	8.029	2016.764	8.192
508.693	7.794	2017.255	8.059	2015.029	8.029	2016.140	7.954
508.492	7.878	2015.494	8.056	2014.459	8.043	2015.634	7.833
508.152	8.033	2014.980	8.043	2013.636	8.414	2015.419	7.854
507.863	8.282	2014.584	8.180	2013.301	8.601	2014.896	8.047
507.557	8.593	2014.353	8.327	2013.121	8.758	2014.288	8.027
507.265	8.782	2014.108	8.556	2012.896	9.124	2013.404	7.950
506.779	9.224	2013.993	8.774	2012.466	9.264	2012.184	8.009
506.723	9.326	2013.835	8.864	2012.119	9.404	2011.013	8.088
506.314	9.449	2013.626	8.958	2011.953	9.544	2009.895	8.136
506.141	9.564	2013.480	9.116	2011.117	9.820	2009.274	8.147
505.909	9.617	2013.183	9.297	2010.664	9.908	2008.821	8.349
505.301	9.659	2012.639	9.445	2008.616	9.905	2008.660	8.464
504.145	9.655	2012.353	9.546	2006.283	9.863	2008.566	8.780
502.380	9.686	2011.914	9.736	2003.771	9.839	2008.362	9.009
501.204	9.732	2011.498	9.836	2001.708	9.817	2008.217	9.220
528.027	9.731	2010.254	9.833			2008.130	9.271

Upper Swift Creek cross sections 4 to 7 2002							
UM04 Distance (m)	**31-May-02 Assumed Height (m)**	**UM05 Distance (m)**	**31-May-02 Assumed Height (m)**	**UM06 Distance (m)**	**31-May-02 Assumed Height (m)**	**UM07 Distance (m)**	**31-May-02 Assumed Height (m)**
528.017	9.731	2008.670	9.811			2008.031	9.315
527.884	9.518	2006.792	9.828			2007.927	9.405
525.336	9.511	2004.384	9.811			2007.674	9.593
523.810	9.485	2001.608	9.812			2007.180	9.662
522.038	9.443					2005.996	9.721
520.332	9.459					2003.870	9.779
519.825	9.399					2001.720	9.792
518.471	9.404					1998.514	9.793
517.345	9.374					1996.363	9.778
516.269	9.376					1992.547	9.710
515.729	9.122					1989.633	9.674
514.941	8.789					1986.400	9.692
514.780	8.733					1983.185	9.714
514.550	8.363					1979.890	9.669
514.477	8.000					1976.315	9.632
514.263	7.889					1972.843	9.573
513.487	7.883					1968.474	9.555
512.168	7.905					1964.525	9.549
511.033	7.895					1961.466	9.534
509.873	7.866					1957.781	9.484
509.116	7.838						
508.986	7.777						
508.693	7.794						

Swift Creek Cross sections 1 to 4 2002							
SM01 Distance (m)	**10-Jul-02 Assumed Height (m)**	**SM02 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM03 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM04 Distance (m)**	**11-Jul-02 Assumed Height (m)**
462.588	9.053	2037.794	7.992	2040.639	8.044	2033.234	7.968
462.721	8.846	2037.654	7.818	2040.522	7.919	2033.066	7.778
466.033	8.782	2035.319	7.885	2037.589	7.925	2030.789	7.780
467.707	8.770	2033.124	7.923	2035.092	7.879	2029.004	7.841
468.263	8.738	2030.873	7.948	2033.175	7.843	2027.323	7.903
469.009	8.664	2029.658	7.905	2032.408	7.776	2025.982	7.919
469.417	8.608	2028.785	7.802	2031.410	7.563	2025.263	7.965
469.955	8.595	2028.133	7.650	2030.624	7.403	2025.005	7.974
470.619	8.597	2027.464	7.525	2029.999	7.127	2024.584	7.817
471.460	8.610	2026.787	7.496	2029.387	6.931	2024.460	7.600
471.732	8.582	2026.529	7.411	2028.838	6.903	2024.110	7.552
472.175	8.438	2025.816	7.112	2028.218	6.841	2023.685	7.293
472.484	8.310	2025.271	6.921	2027.202	6.788	2023.107	7.127
473.187	8.202	2024.947	6.781	2025.836	6.626	2022.968	6.824
473.649	7.997	2024.109	6.638	2024.526	6.454	2022.761	6.518
474.167	7.759	2023.116	6.576	2023.687	6.339	2022.440	5.943
474.603	7.559	2022.048	6.527	2022.596	6.271	2022.255	5.931
474.741	7.404	2021.126	6.493	2021.929	6.230	2021.614	6.099
475.158	7.274	2020.396	6.325	2020.919	6.127	2020.024	6.121
476.157	7.266	2019.723	6.222	2019.998	5.938	2018.803	6.182
476.887	7.241	2019.026	6.211	2019.131	5.814	2017.515	6.260
477.693	7.169	2018.607	6.253	2018.782	5.825	2016.402	6.386
478.188	7.135	2018.351	6.339	2018.615	5.952	2015.386	6.454
478.627	7.073	2017.857	6.366	2018.364	6.018	2014.562	6.425
479.055	7.061	2017.472	6.278	2018.247	6.091	2013.827	6.418
479.359	7.078	2017.057	6.145	2017.899	6.432	2013.378	6.728
479.571	6.990	2016.588	5.971	2017.458	6.627	2012.930	7.182
479.797	6.975	2016.026	5.936	2016.751	6.754	2012.714	7.265
480.083	7.132	2015.381	6.027	2016.187	6.854	2011.923	7.402
480.199	7.219	2014.812	6.078	2015.791	6.962	2011.500	7.444
480.520	7.507	2014.437	6.172	2015.457	6.936	2010.503	7.535
481.140	7.665	2014.297	6.207	2014.898	6.754	2009.366	7.629
481.340	7.773	2014.123	6.228	2014.539	6.787	2007.762	7.722
481.543	7.925	2013.923	6.365	2014.194	6.847	2005.595	7.802
482.051	8.159	2013.630	6.458	2013.878	7.106	2002.269	7.796
482.400	8.425	2013.387	6.643	2013.310	7.344		
483.031	8.664	2013.246	6.671	2012.399	7.536		
483.320	8.809	2012.428	6.633	2011.527	7.602		

Swift Creek Cross sections 1 to 4 2002							
SM01 Distance (m)	**10-Jul-02 Assumed Height (m)**	**SM02 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM03 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM04 Distance (m)**	**11-Jul-02 Assumed Height (m)**
483.864	9.000	2011.701	6.607	2010.559	7.601		
485.629	9.024	2011.181	6.669	2010.026	7.520		
488.030	8.976	2010.249	6.826	2008.896	7.496		
490.290	8.918	2009.432	7.001	2007.748	7.482		
492.339	8.899	2008.755	7.202	2006.403	7.510		
494.552	8.881	2007.680	7.357	2004.489	7.601		
496.727	8.867	2006.656	7.523	2002.920	7.687		
498.489	8.843	2005.293	7.666				
		2004.076	7.721				
		2001.834	7.792				

Swift Creek Cross sections 5 to 8 2002							
SM05 Distance (m)	11-Jul-02 Assumed Height (m)	SM06 Distance (m)	11-Jul-02 Assumed Height (m)	SM07 Distance (m)	11-Jul-02 Assumed Height (m)	SM08 Distance (m)	11-Jul-02 Assumed Height (m)
2082.672	7.999	2047.863	7.788	2060.659	7.714	2052.934	7.853
2082.528	7.801	2047.708	7.609	2060.518	7.510	2052.794	7.678
2079.815	7.775	2044.543	7.615	2056.861	7.618	2049.618	7.677
2077.734	7.795	2040.711	7.659	2053.678	7.671	2045.557	7.688
2075.572	7.884	2037.511	7.693	2050.167	7.695	2041.959	7.686
2073.714	7.946	2035.100	7.721	2046.466	7.752	2040.023	7.770
2071.806	7.953	2033.140	7.766	2043.988	7.864	2038.257	7.765
2070.511	7.969	2031.612	7.671	2041.791	7.907	2037.090	7.607
2070.537	7.969	2030.670	7.516	2040.970	7.902	2036.178	7.608
2069.970	7.905	2029.490	7.158	2040.541	7.843	2035.646	7.608
2069.544	7.735	2028.706	6.858	2040.183	7.675	2035.295	7.492
2068.989	7.487	2028.086	6.503	2040.009	7.470	2034.816	7.332
2068.460	7.179	2027.688	6.349	2039.851	7.086	2034.203	6.972
2068.185	6.972	2027.055	5.924	2039.736	6.919	2033.512	6.577
2068.138	6.972	2025.858	5.960	2039.489	6.859	2032.645	6.397
2067.679	6.779	2024.327	6.010	2039.289	6.733	2031.872	6.280
2067.483	6.340	2023.214	6.031	2038.894	6.536	2030.750	6.262
2067.252	6.220	2022.704	6.036	2038.454	6.174	2029.967	6.300
2067.105	5.760	2022.149	5.997	2038.246	5.791	2028.674	6.258
2066.339	5.584	2021.977	5.939	2037.882	5.817	2027.505	6.157
2065.533	5.533	2021.834	5.855	2036.528	5.931	2026.203	6.115
2064.495	5.701	2021.563	5.877	2035.767	6.001	2025.470	6.086
2063.827	5.820	2021.196	6.043	2035.210	5.923	2024.493	5.920
2062.885	5.844	2020.951	6.100	2034.225	6.111	2024.075	6.026
2062.203	5.969	2020.488	6.487	2033.308	6.194	2023.632	6.187
2061.484	5.953	2019.826	6.732	2032.869	6.221	2023.404	6.366
2060.691	6.040	2019.556	6.858	2031.706	6.385	2023.023	6.460
2060.137	5.999	2018.767	6.944	2030.498	6.498	2022.691	6.759
2059.531	5.990	2018.124	7.113	2029.119	6.517	2022.456	6.961
2059.061	6.082	2017.881	7.180	2028.415	6.566	2022.005	7.119
2058.496	6.222	2017.531	7.353	2028.161	6.781	2021.438	7.238
2058.224	6.358	2016.250	7.570	2027.872	6.951	2020.184	7.239
2057.558	6.501	2015.239	7.693	2027.656	7.255	2019.613	7.384
2056.723	6.697	2014.309	7.776	2027.246	7.492	2019.119	7.566
2055.800	6.836	2013.963	7.711	2026.314	7.617	2018.395	7.784
2054.753	6.994	2013.037	7.751	2025.878	7.734	2017.596	7.901
2054.046	7.079	2011.392	7.737	2025.539	7.765	2015.635	7.901
2053.440	7.182	2009.454	7.728	2024.675	7.826	2014.315	7.871
2052.730	7.332	2007.392	7.707	2023.228	7.815	2012.598	7.759

Swift Creek Cross sections 5 to 8 2002							
SM05 Distance (m)	**11-Jul-02 Assumed Height (m)**	**SM06 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM07 Distance (m)**	**11-Jul-02 Assumed Height (m)**	**SM08 Distance (m)**	**11-Jul-02 Assumed Height (m)**
2052.377	7.409	2005.054	7.743	2021.417	7.732	2010.950	7.724
2051.818	7.411	2002.003	7.827	2019.290	7.699	2008.702	7.711
2051.004	7.613			2016.483	7.699	2006.375	7.722
2050.114	7.695			2012.942	7.743	2002.098	7.786
2048.978	7.710			2010.257	7.814		
2047.709	7.716			2006.539	7.847		
2045.350	7.734			2002.034	7.827		
2042.444	7.729						
2039.783	7.713						
2036.192	7.712						
2032.995	7.612						
2030.457	7.588						
2028.497	7.517						
2026.400	7.420						
2024.822	7.314						
2024.164	7.094						
2023.455	6.814						
2022.642	6.709						
2021.484	6.670						
2020.177	6.743						
2018.998	6.870						
2017.411	7.016						
2015.564	7.274						
2013.626	7.477						
2011.467	7.585						
2008.840	7.615						
2006.421	7.656						
2004.578	7.784						
2001.992	7.810						

Tributary North Cross sections 1 to 4 2003							
TN01 Distance (m)	14-Aug-03 Assumed Height (m)	TN02 Distance (m)	14-Aug-03 Assumed Height (m)	TN03 Distance (m)	14-Aug-03 Assumed Height (m)	TN04 Distance (m)	14-Aug-03 Assumed Height (m)
4968.948	10.996	3974.702	9.862	2977.927	9.983	1973.514	10.262
4969.095	10.784	3974.821	9.668	2977.921	9.983	1973.517	10.263
4972.166	10.733	3977.178	9.639	2978.048	9.795	1973.642	10.058
4974.978	10.684	3979.496	9.591	2980.276	9.735	1973.654	10.058
4978.045	10.575	3980.796	9.557	2982.497	9.673	1973.66	10.058
4979.918	10.539	3981.347	9.454	2984.205	9.623	1976.139	10.02
4980.653	10.519	3981.986	9.249	2984.707	9.582	1978.786	9.997
4981.28	10.454	3982.22	9.088	2985.249	9.314	1980.881	9.979
4981.621	10.338	3982.68	8.954	2985.515	9.186	1983.566	9.919
4981.93	10.182	3983.22	8.909	2985.939	9.047	1984.532	9.871
4982.097	10.029	3983.439	8.62	2986.171	8.92	1984.901	9.794
4982.263	9.964	3983.628	8.536	2986.486	8.861	1985.324	9.661
4982.501	9.928	3983.716	8.433	2987.137	8.415	1985.818	9.478
4982.607	9.766	3984.127	8.497	2987.35	8.353	1985.975	9.344
4982.942	9.695	3984.494	8.498	2987.727	8.481	1986.486	9.105
4983.242	9.456	3984.733	8.507	2988.09	8.456	1986.718	8.829
4983.488	9.475	3984.791	8.726	2988.233	8.67	1987.097	8.713
4983.79	9.67	3984.892	8.796	2988.441	8.853	1987.22	8.555
4984.07	9.663	3985.169	8.935	2988.705	8.952	1987.358	8.572
4984.166	9.739	3986.04	9.166	2989.079	9.217	1987.645	8.524
4984.778	9.768	3987.029	9.273	2989.665	9.457	1987.854	8.682
4984.893	9.936	3987.577	9.362	2990.185	9.656	1988.17	8.831
4985.271	10.083	3988.206	9.503	2990.889	9.682	1988.426	9.123
4985.409	10.186	3990.994	9.608	2993.105	9.673	1988.682	9.2
4985.812	10.199	3991.025	9.609	2995.688	9.713	1989.349	9.27
4985.879	10.422	3993.172	9.686	2998.464	9.791	1990.353	9.352
4986.277	10.473	3995.696	9.767			1991.693	9.424
4988.363	10.551	3998.163	9.808			1992.53	9.5
4990.822	10.62					1993.367	9.433
4993.655	10.702					1995.195	9.457
4998.22	10.781					1996.127	9.438
5002.587	10.813					1997.199	9.542
5007.857	10.74					1998.763	9.726
5011.447	10.694					2001.769	9.82
5012.557	10.654					2003.539	9.824
5013.291	10.683					2005.24	9.828
5013.869	10.641					2006.75	9.781
5014.431	10.663					2007.483	9.665
5016.802	10.644					2007.829	9.504

Tributary North Cross sections 1 to 4 2003							
TN01 Distance (m)	14-Aug-03 Assumed Height (m)	TN02 Distance (m)	14-Aug-03 Assumed Height (m)	TN03 Distance (m)	14-Aug-03 Assumed Height (m)	TN04 Distance (m)	14-Aug-03 Assumed Height (m)
5021.018	10.657					2008.125	9.38
5025.826	10.703					2008.691	9.282
5029.186	10.832					2009.404	9.294
5033.22	10.944					2010.025	9.37
5035.015	10.953					2010.841	9.55
5036.677	10.879					2011.707	9.732
5039.294	10.832					2012.435	9.846
5042.365	10.776					2013.136	9.895
5048.523	10.734					2014.113	9.938
5053.315	10.729					2014.842	9.886
5058.73	10.724					2015.224	9.796
5063.3	10.751					2015.454	9.726
5068.382	10.75					2015.644	9.577
5068.511	10.942					2016.031	9.491
						2016.292	9.351
						2016.64	9.213
						2016.942	9.097
						2017.67	8.892
						2018.274	8.843
						2019.253	8.924
						2019.624	9.032
						2019.819	9.185
						2020.236	9.49
						2020.356	9.775
						2020.759	9.88
						2021.961	9.957
						2023.864	9.969
						2026.086	9.963

Tributary North Cross sections 5 to 8 2003							
TN05 Distance (m)	14-Aug-03 Assumed Height (m)	TN06 Distance (m)	14-Aug-03 Assumed Height (m)	TN07 Distance (m)	14-Aug-03 Assumed Height (m)	TN08 Distance (m)	14-Aug-03 Assumed Height (m)
3523.974	9.876	1972.699	8.613	1976.162	8.881	4964.005	7.782
3523.966	9.877	1975.117	8.593	1976.164	8.881	4963.986	7.781
3523.833	9.706	1976.788	8.552	1976.338	8.729	4964.124	7.572
3521.139	9.717	1978.594	8.552	1979.136	8.656	4966.726	7.505
3518.137	9.718	1979.353	8.498	1981.301	8.613	4969.082	7.469
3515.426	9.714	1979.911	8.349	1982.028	8.606	4970.034	7.432
3514.781	9.718	1980.686	8.11	1982.547	8.562	4970.774	7.32
3514.405	9.646	1981.31	7.877	1983.542	8.156	4971.264	7.175
3514.265	9.576	1981.46	7.758	1984.223	7.96	4971.708	7.075
3514.013	9.54	1982.069	7.693	1984.872	7.84	4972.868	6.935
3513.943	9.452	1982.424	7.617	1985.324	7.745	4973.928	6.844
3513.211	9.243	1983.006	7.576	1985.624	7.618	4974.511	6.828
3513.105	9.219	1983.229	7.349	1985.859	7.614	4974.962	6.897
3512.606	9.032	1983.574	7.41	1986.209	7.542	4975.803	6.832
3512.398	8.92	1984.025	7.609	1986.487	7.593	4976.181	6.722
3511.84	8.822	1984.598	7.932	1986.718	7.692	4976.781	6.666
3511.375	8.717	1985.126	8.112	1986.966	7.982	4977.593	6.432
3510.775	8.743	1985.746	8.23	1987.145	8.04	4977.856	6.422
3510.104	8.809	1986.413	8.27	1987.625	8.127	4978	6.36
3509.711	8.917	1987.522	8.221	1988.438	8.322	4978.316	6.333
3509.576	9.009	1988.309	8.27	1989.689	8.488	4978.841	6.367
3509.453	9.148	1988.565	8.339	1991.053	8.634	4979.182	6.491
3509.017	9.289	1988.659	8.426	1993.256	8.682	4979.288	6.664
3508.667	9.433	1989.395	8.527	1995.932	8.726	4979.754	6.897
3508.144	9.66	1990.857	8.56	1998.482	8.772	4980.272	7.12
3507.502	9.734	1993.334	8.607	2001.587	8.83	4980.681	7.287
3505.772	9.744	1995.85	8.678	2007.605	8.956	4981.142	7.663
3503.447	9.764	1998.346	8.749	2010.218	8.994	4983.417	7.724
3501.644	9.789	2001.89	8.829	2013.058	9.005	4985.626	7.794
		2004.342	8.841	2015.357	9.023	4986.831	7.761
		2005.562	8.844	2017.227	9.047	4987.167	7.492
		2006.06	8.721	2018.342	9.018	4987.316	7.423
		2006.118	8.46	2018.69	8.819	4988.059	7.091
		2006.276	8.233	2019.113	8.687	4988.99	6.815
		2006.863	7.948	2020.03	8.345	4989.369	6.659
		2007.37	7.788	2020.7	8.012	4989.703	6.637
		2008.101	7.688	2021.55	7.862	4990.075	6.695
		2008.392	7.687	2021.865	7.806	4990.516	6.841

Tributary North Cross sections 5 to 8 2003							
TN05 Distance (m)	**14-Aug-03 Assumed Height (m)**	**TN06 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TN07 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TN08 Distance (m)**	**14-Aug-03 Assumed Height (m)**
		2008.558	7.773	2022.187	7.9	4990.78	6.997
		2009.072	7.826	2022.776	8.007	4991.113	7.17
		2009.728	7.88	2023.554	8.133	4991.599	7.248
		2009.987	7.97	2024.453	8.328	4992.817	7.487
		2010.569	8.239	2024.741	8.471	4993.205	7.588
		2010.882	8.505	2025.372	8.606	4993.655	7.761
		2011.147	8.838	2025.914	8.844	4994.004	7.821
		2012.221	8.901	2026.559	9.003	4996.431	7.845
		2014.753	8.869	2027.8	9.011	4998.49	7.794
		2017.762	8.871	2029.993	9.007		
		2020.887	8.862	2031.695	8.98		
		2021.035	9.064				
		2021.038	9.065				

Tributary North Cross sections 9 to 12 2003							
TN09 Distance (m)	14-Aug-03 Assumed Height (m)	TN10 Distance (m)	14-Aug-03 Assumed Height (m)	TN11 Distance (m)	14-Aug-03 Assumed Height (m)	TN12 Distance (m)	14-Aug-03 Assumed Height (m)
3969.697	8.162	5090.489	12.276	7077.02	13.175	7927.324	13.15
3969.695	8.162	5090.484	12.275	7077.018	13.176	7927.305	13.151
3969.823	7.964	5090.357	12.045	7076.883	12.977	7927.447	12.969
3972.018	7.955	5087.151	12.037	7073.567	12.796	7930.21	12.954
3974.721	7.939	5084.49	11.926	7071.09	12.665	7934.258	12.933
3976.953	7.899	5081.469	11.777	7069.397	12.511	7935.726	12.964
3978.34	7.868	5080.253	11.674	7068.527	12.411	7937.018	13.053
3978.726	7.799	5080.104	11.477	7067.551	12.298	7938.072	13.036
3979.199	7.642	5079.761	11.346	7066.803	12.173	7939.696	12.916
3979.993	7.32	5079.161	11.311	7066.153	12.206	7941.321	12.858
3980.727	6.911	5078.434	11.392	7065.616	12.294	7942.211	12.845
3980.969	6.8	5078.191	11.471	7064.917	12.423	7942.592	12.778
3981.285	6.743	5077.986	11.562	7063.902	12.516	7943.023	12.667
3981.873	6.764	5077.813	11.716	7061.312	12.585	7943.983	12.623
3982.745	6.704	5076.25	11.743	7057.247	12.64	7944.177	12.545
3983.372	6.605	5073.192	11.834	7052.856	12.593	7944.34	12.459
3984.188	6.465	5069.961	11.833	7049.022	12.55	7944.643	12.446
3985.071	6.567	5066.102	11.795	7046.374	12.537	7944.888	12.465
3985.93	6.594	5062.569	11.761	7044.027	12.554	7945.407	12.383
3986.346	6.665	5058.469	11.739	7043.585	12.546	7945.458	12.477
3986.627	6.768	5057.49	11.74	7042.635	12.554	7945.674	12.577
3987.281	6.844	5055.615	11.852	7041.247	12.563	7945.91	12.75
3987.402	6.875	5053.442	11.888	7039.052	12.588	7946.451	12.894
3987.945	7.161	5051.055	11.896	7037.678	12.659	7947.359	12.98
3988.479	7.328	5050.275	11.818	7037.376	12.573	7948.33	12.96
3988.749	7.434	5049.319	11.848	7036.989	12.537	7950.649	12.872
3989.371	7.571	5048.762	11.812	7036.366	12.572	7954.258	12.828
3990.982	7.619	5048.039	11.835	7035.988	12.593	7957.599	12.798
3992.993	7.67	5044.076	11.786	7035.777	12.543	7959.481	12.782
3995.093	7.707	5039.972	11.702	7035.581	12.4	7959.808	12.772
3998.025	7.759	5036.702	11.635	7035.3	12.331	7960.275	12.796
		5034.207	11.576	7034.96	12.319	7961.092	12.741
		5032.351	11.54	7034.453	12.385	7961.723	12.754
		5028.663	11.57	7034.199	12.44	7962.513	12.779
		5025.291	11.567	7034.03	12.529	7964.341	12.718
		5021.886	11.579	7033.898	12.625	7967.64	12.697
		5016.432	11.578	7032.902	12.665	7971.483	12.649
		5011.676	11.608	7030.623	12.59	7974.89	12.622

Tributary North Cross sections 9 to 12 2003							
TN09 Distance (m)	14-Aug-03 Assumed Height (m)	TN10 Distance (m)	14-Aug-03 Assumed Height (m)	TN11 Distance (m)	14-Aug-03 Assumed Height (m)	TN12 Distance (m)	14-Aug-03 Assumed Height (m)
		5006.905	11.715	7025.721	12.598	7977.853	12.606
		5002.443	11.771	7021.478	12.613	7980.255	12.549
				7017.198	12.659	7982.918	12.481
				7012.572	12.675	7983.825	12.421
				7007.846	12.74	7984.584	12.305
				7001.856	12.787	7985.625	12.233
						7986.49	12.246
						7986.827	12.304
						7987.056	12.389
						7987.74	12.461
						7990.415	12.535
						7992.961	12.659
						7997.631	12.809

Tributary North Cross section 13 2003			
TN13 Distance (m)	14-Aug-03 Assumed Height (m)	TN13 Cont. Distance (m)	14-Aug-03 Assumed Height (m)
8960.528	14.267	8989.741	13.398
8960.659	14.067	8990.082	13.401
8963.852	14.039	8990.382	13.453
8966.174	14.018	8990.493	13.546
8966.708	13.958	8990.942	13.637
8967.167	13.995	8991.866	13.666
8967.654	13.929	8994.45	13.684
8968.289	13.927	8997.845	13.828
8971.203	13.853		
8974.534	13.804		
8977.253	13.711		
8979.3	13.702		
8980.947	13.678		
8981.874	13.549		
8983.525	13.48		
8986.155	13.498		
8988.367	13.545		
8989.421	13.56		
8989.628	13.463		

Tributary Central Cross sections 1-4 2003							
TC01 Distance (m)	**14-Aug-03 Assumed Height (m)**	**TC02 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TC03 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TC04 Distance (m)**	**14-Aug-03 Assumed Height (m)**
4962.502	11.239	1980.551	11.08	5962.26	12.281	6956.901	12.217
4962.687	11.06	1980.685	10.946	5962.409	12.109	6957.072	12.056
4964.058	11.085	1982.442	10.954	5965.358	12.106	6960.852	11.994
4965.082	11.224	1983.711	10.929	5968.103	11.991	6965.25	11.947
4965.841	11.085	1985.061	10.999	5970.959	11.906	6969.63	11.86
4967.894	10.948	1986.326	10.997	5973.716	11.927	6973.771	11.817
4970.671	10.85	1987.686	10.988	5976.536	12.015	6977.402	11.818
4973.586	10.802	1988.261	11.048	5979.273	12.074	6978.652	11.831
4975.524	10.839	1989.568	11.106	5980.72	12.109	6979.879	11.97
4976.797	10.754	1990.861	11.029	5981.469	12.187	6981.499	11.964
4978.082	10.839	1991.749	11.073	5982.046	12.167	6982.817	12.067
4978.773	10.985	1994.148	10.996	5982.33	12.149	6983.618	12.078
4979.72	11.02	1996.221	10.933	5982.467	11.94	6983.925	12.02
4981.183	11.012	1998.417	10.897	5982.603	11.851	6984.319	11.828
4983.754	11.018			5983.405	11.604	6984.554	11.492
4985.515	11.067			5983.81	11.457	6985.003	11.119
4986.007	11.027			5984.619	11.512	6985.296	10.956
4986.498	10.887			5985.495	11.509	6985.591	10.965
4986.886	10.804			5985.954	11.56	6985.839	10.903
4987.262	10.996			5986.455	11.909	6986.833	10.843
4987.772	11.071			5986.753	12.143	6987.243	10.978
4989.265	11.11			5987.362	12.179	6987.735	11.135
4989.973	11.157			5988.872	12.125	6988.015	11.421
4990.681	11.199			5990.988	12.025	6988.292	11.62
4991.154	11.18			5993.167	11.963	6988.44	11.938
4991.306	11.067			5994.764	11.972	6988.655	12.059
4991.333	10.686			5996.51	11.927	6988.98	12.091
4991.505	10.564			5998.246	11.9	6990.623	11.989
4991.933	10.655					6991.532	11.954
4992.381	10.514	**TC01 Cont. Distance (m)**	**14-Aug-03 Assumed Height (m)**			6994.241	11.926
4992.865	10.533					6998.135	11.822
4993.304	10.566						
4993.546	10.547	4995.014	10.962				
4993.67	10.501	4995.311	11.162				
4993.951	10.499	4995.45	11.163				
4994.257	10.579	4995.761	10.999				
4994.507	10.736	4996.832	11.067				
4994.677	10.871	4997.99	10.982				

Tributary Central Cross sections 5-6C 2003							
TC05 Distance (m)	**14-Aug-03 Assumed Height (m)**	**TC06A Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TC06B Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TC06C Distance (m)**	**14-Aug-03 Assumed Height (m)**
7942.494	12.589	9031.362	14.453	0.000	14.189	0.000	13.648
7942.491	12.59	9031.36	14.452	0.145	13.993	0.134	13.442
7942.623	12.401	9031.218	14.262	2.759	14.022	2.456	13.495
7948.381	12.298	9027.072	14.265	5.367	14.027	4.745	13.609
7953.031	12.209	9023.188	14.26	8.202	14.069	7.093	13.694
7957.862	12.121	9019.76	14.23	9.751	14.056	9.512	13.819
7961.882	11.99	9017.404	14.175	10.259	14.056	10.833	13.854
7963.379	11.912	9017.079	14.08	10.571	13.887	11.822	13.895
7964.155	11.911	9017.012	13.457	10.643	13	12.060	13.821
7965.465	11.948	9016.511	13.205	10.873	12.759	12.249	13.52
7967.214	12.037	9016.374	12.832	11.233	12.608	12.579	13.274
7968.044	12.051	9016.219	12.773	11.736	12.733	12.760	13.195
7968.297	11.965	9015.868	12.55	12.179	12.877	13.072	13.083
7968.354	11.692	9015.37	12.567	12.484	12.916	13.653	12.485
7968.502	11.541	9014.321	12.756	13.585	12.911	13.920	12.402
7968.827	11.492	9013.59	12.846	14.233	12.941	14.238	12.499
7969.049	11.313	9012.288	13.027	14.786	13.005	15.040	12.836
7969.224	11.091	9011.717	13.13	15.254	13.146	15.317	12.897
7969.611	10.854	9011.052	13.255	16.049	13.19	16.589	13.03
7969.907	10.818	9010.448	13.287	17.582	13.458	17.182	13.133
7970.834	10.859	9009.886	13.274	18.384	13.578	18.686	13.175
7971.937	10.853	9009.522	13.424	19.575	13.549	19.540	13.238
7972.267	10.892	9009.028	13.504	19.984	13.466	19.908	13.361
7972.409	10.992	9007.594	13.535	20.512	13.447	20.562	13.433
7972.464	11.189	9006.717	13.618	21.626	13.546	20.791	13.428
7972.883	11.247	9005.876	13.606	23.076	13.577	21.110	13.36
7973.136	11.48	9005.374	13.528	24.346	13.562	22.664	13.389
7973.4	11.608	9003.997	13.646	26.064	13.624	23.744	13.355
7973.523	11.874	9001.856	13.753	28.287	13.727	24.283	13.437
7973.99	12.026					25.287	13.469
7974.52	12.135	**TC05 Cont. Distance (m)**	**14-Aug-03 Assumed Height (m)**			27.606	13.5
7976.724	12.111					28.882	13.587
7979.033	12.006					30.926	13.716
7981.034	11.975	7986.245	11.99			32.445	13.759
7982.218	11.868	7987.528	11.999				
7983.015	11.79	7991.197	11.938				
7984.332	11.762	7994.42	11.881				
7984.956	11.783	7998.096	11.821				

Tributary Central Cross sections 7A-8 2003							
TC07A Distance (m)	14-Aug-03 Assumed Height (m)	TC07B Distance (m)	14-Aug-03 Assumed Height (m)	TC07C Distance (m)	14-Aug-03 Assumed Height (m)	TC08 Distance (m)	14-Aug-03 Assumed Height (m)
1032.999	13.268	0.000	12.965	0.000	13.002	5976.094	12.76
1032.86	13.084	0.139	12.785	0.131	12.814	5976.247	12.559
1030.74	13.143	2.313	12.894	3.336	12.827	5977.667	12.537
1029.512	13.182	3.923	12.959	6.834	12.843	5978.931	12.593
1027.453	13.224	5.698	12.996	9.981	12.87	5979.853	12.568
1025.26	13.265	7.126	13.013	12.690	12.891	5981.278	12.418
1023.687	13.254	7.938	13.044	15.269	12.908	5981.573	12.356
1023.649	12.359	8.312	12.996	16.188	12.891	5981.93	12.248
1023.493	12.132	8.378	12.155	16.479	12.836	5982.508	12.012
1022.676	11.611	8.576	11.985	16.577	12.292	5983.495	11.68
1022.467	11.594	8.966	11.589	16.720	12.036	5984.019	11.434
1022.399	11.5	9.464	11.386	17.177	11.612	5984.259	11.28
1021.312	11.441	9.781	11.406	17.560	11.424	5984.678	10.967
1020.903	11.478	10.005	11.332	18.102	11.209	5984.836	10.866
1020.282	11.478	10.361	11.191	18.478	10.977	5985.205	10.8
1019.127	11.362	10.795	11.296	18.918	10.989	5985.555	10.807
1018.335	11.365	11.409	11.404	19.485	10.928	5986.148	10.912
1017.619	11.457	12.431	11.463	19.921	11.083	5986.456	10.937
1017.148	11.556	13.842	11.669	20.183	11.485	5986.887	11.114
1016.268	11.695	14.108	11.783	20.346	11.855	5987.484	11.379
1015.939	11.798	14.852	11.863	21.222	11.951	5987.971	11.705
1015.547	11.757	15.465	11.872	21.962	12.004	5988.484	11.909
1015.178	11.787	16.381	12.045	22.896	12.191	5989.06	12.153
1014.912	11.759	17.618	12.216	24.145	12.39	5989.33	12.366
1013.89	11.904	18.830	12.284	25.171	12.516	5990.441	12.594
1013.543	11.964	20.624	12.349	26.155	12.507	5991.573	12.711
1013.207	12.124	21.209	12.457	27.572	12.595	5993.812	12.756
1012.295	12.208	21.610	12.548	29.850	12.655	5995.958	12.844
1010.544	12.148	22.195	12.582			5998.291	12.821
1009.513	12.202	22.743	12.568				
1008.29	12.291	23.101	12.451				
1007.714	12.471	24.922	12.508				
1005.6	12.526	25.984	12.582				
1004.992	12.491	28.157	12.657				
1004.424	12.477						
1003.304	12.557						
1001.479	12.663						

Tributary Central Cross sections 9-11 2002						
TC09 Distance (m)	**14-Aug-03 Assumed Height (m)**	**TC10 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**TC11 Distance (m)**	**14-Aug-03 Assumed Height (m)**	
8962.472	13.115	7965.292	12.866	6969.91	13.061	
8962.6	12.92	7965.438	12.675	6970.04	12.875	
8965.265	12.852	7968.435	12.676	6972.938	12.831	
8968.079	12.857	7971.535	12.7	6975.73	12.796	
8970.225	12.903	7973.827	12.751	6978.016	12.783	
8972.565	12.907	7976.257	12.8	6979.325	12.803	
8973.235	12.876	7976.939	12.715	6979.66	12.69	
8973.538	12.757	7976.999	12.417	6979.848	12.271	
8973.604	12.44	7977.295	12.305	6980.248	11.846	
8973.984	12.253	7977.53	12.091	6980.439	11.777	
8974.199	11.946	7977.7	11.964	6980.531	11.385	
8974.417	11.838	7977.966	11.925	6980.631	11.339	
8974.506	11.705	7978.797	11.735	6981.405	11.479	
8974.884	11.544	7978.975	11.621	6981.795	11.553	
8975.327	11.554	7979.457	11.559	6982.362	11.589	
8975.63	11.432	7980.195	11.59	6983.256	11.71	
8975.986	11.389	7980.757	11.535	6983.56	11.799	
8977.047	11.435	7981.144	11.57	6983.946	11.98	
8977.46	11.499	7981.773	11.669	6984.727	12.116	
8977.691	11.534	7982.169	11.755	6985.007	12.105	
8977.99	11.526	7982.743	12.044	6985.268	12.002	
8978.46	11.584	7983.046	12.082	6985.525	11.972	
8979.195	11.838	7984.181	12.099	6986.016	11.976	
8979.722	12.223	7985.092	12.256	6986.686	12.129	
8980.31	12.28	7986.074	12.38	6987.153	12.401	
8980.76	12.425	7987.488	12.439	6987.702	12.4	
8981.316	12.699	7988.382	12.473	6988.616	12.453	
8981.853	12.824	7989.599	12.562	6989.716	12.438	
8982.634	12.952	7990.347	12.64	6990.396	12.399	
8983.566	12.998	7991.781	12.818	6991.053	12.402	
8986.489	12.966	7993.613	12.816	6991.609	12.478	
8989.067	12.927	7995.583	12.75	6992.961	12.651	
8992.15	12.83	7997.897	12.768	6994.378	12.775	
8995.257	12.801			6996.273	12.785	
8998.296	12.803			6998.362	12.821	

East Tributary Cross sections 1 to 4- 2003							
ET01 Distance (m)	14-Aug-03 Assumed Height (m)	ET02 Distance (m)	14-Aug-03 Assumed Height (m)	ET03 Distance (m)	14-Aug-03 Assumed Height (m)	ET04 Distance (m)	14-Aug-03 Assumed Height (m)
975.705	14.89	1971.688	14.905	2976.624	14.954	3974.118	14.901
975.709	14.89	1971.848	14.7	2976.755	14.954	3974.258	14.701
975.841	14.686	1974.098	14.726	2979.234	14.772	3976.671	14.738
977.456	14.697	1975.869	14.731	2981.484	14.791	3978.973	14.803
978.593	14.686	1976.774	14.716	2983.776	14.847	3980.697	14.841
979.199	14.691	1977.251	14.511	2984.637	14.885	3982.058	14.913
980.114	14.776	1977.346	14.371	2985.219	14.894	3983.22	14.907
980.95	14.853	1977.835	14.151	2985.657	14.761	3983.473	14.845
981.861	14.84	1978.227	14.075	2985.955	14.703	3984.078	14.445
982.145	14.802	1978.323	13.828	2986.127	14.54	3984.292	14.36
982.406	14.69	1978.538	13.773	2986.309	14.307	3984.453	14.343
982.943	14.525	1978.846	13.775	2986.419	14.279	3984.572	14.354
983.292	14.131	1979.255	13.609	2986.662	14.398	3984.722	14.275
983.633	13.64	1979.703	13.562	2986.673	14.323	3984.781	13.673
984.193	13.411	1980.369	13.43	2986.909	14.118	3985.118	13.509
984.428	13.26	1980.878	13.197	2987.061	14.052	3985.594	13.414
984.954	13.225	1980.944	13.127	2987.215	13.934	3985.832	13.379
985.637	13.265	1981.221	13.082	2987.495	13.699	3986.236	13.355
986.482	13.209	1981.476	12.939	2987.723	13.549	3986.79	13.288
987.153	13.152	1981.661	12.978	2987.899	13.51	3987.472	13.373
987.884	13.253	1982.307	13.217	2988.39	13.403	3988.051	13.462
988.231	13.285	1982.65	13.173	2989.114	13.236	3988.497	13.388
988.381	13.252	1982.875	13.224	2989.503	13.142	3988.679	13.393
988.557	13.5	1983.259	13.211	2989.859	13.228	3988.903	13.315
988.821	13.558	1983.631	13.117	2990.294	13.265	3989.453	13.633
988.961	13.875	1984.001	13.085	2990.731	13.346	3989.617	13.726
989.471	14.056	1984.411	12.935	2991.44	13.39	3989.727	13.891
989.937	14.28	1984.875	12.853	2991.557	13.373	3989.958	14.051
990.341	14.542	1985.376	12.891	2991.98	13.48	3990.503	14.497
990.73	14.683	1985.701	13.097	2992.342	13.617	3990.765	14.62
991.398	14.752	1986.041	13.148	2992.589	13.74	3991.391	14.721
993.017	14.735	1986.114	13.425	2992.854	14.091	3991.99	14.777
995.524	14.785	1986.384	13.553	2993.412	14.274	3992.488	14.909
998.202	14.833	1986.784	14.101	2993.874	14.725	3993.45	14.91
		1986.901	14.552	2994.651	14.903	3995.357	14.891
		1987.188	14.801	2996.158	14.932	3996.449	14.845
		1987.542	14.858	2998.447	14.884	3998.667	14.864
		1989.115	14.859				

East Tributary Cross sections 1 to 4- 2003							
ET01 Distance (m)	**14-Aug-03 Assumed Height (m)**	**ET02 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**ET03 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**ET04 Distance (m)**	**14-Aug-03 Assumed Height (m)**
		1990.073	14.826				
		1991.64	14.842				
		1993.692	14.815				
		1996.327	14.84				
		1998.161	14.824				

East Tributary Cross sections 5 to 8 2003							
ET05 Distance (m)	14-Aug-03 Assumed Height (m)	ET06 Distance (m)	14-Aug-03 Assumed Height (m)	ET07 Distance (m)	14-Aug-03 Assumed Height (m)	ET08 Distance (m)	14-Aug-03 Assumed Height (m)
1984.997	9.937	5968.559	14.871	7471.183	14.885	0.117184	14.372
1985.125	9.717	5968.687	14.696	7471.313	14.729	2.746834	14.503
1986.417	9.746	5970.921	14.761	7474.166	14.742	4.378736	14.564
1987.403	9.774	5973.106	14.806	7475.706	14.763	5.712472	14.664
1987.782	9.74	5975.072	14.782	7477.574	14.765	7.978096	14.713
1988.208	9.589	5977.638	14.829	7479.681	14.781	9.531745	14.785
1988.405	9.41	5979.865	14.869	7481.632	14.859	11.50584	14.871
1988.771	9.28	5981.21	14.869	7483.342	14.89	13.6243	14.904
1988.98	9.09	5981.799	14.803	7484.266	14.897	15.14305	14.915
1989.263	9.003	5981.903	14.761	7484.524	14.586	15.98296	14.895
1989.46	8.793	5982.053	14.644	7484.631	14.219	16.50308	14.828
1989.649	8.665	5982.344	14.584	7484.832	13.972	16.83856	14.712
1989.766	8.382	5982.539	14.375	7485.297	13.679	17.18264	14.51
1990.022	8.251	5982.824	14.291	7485.823	13.487	17.50023	14.315
1990.28	8.081	5983.342	14.253	7486.636	13.5	17.72644	14.179
1990.834	8.18	5983.493	14.351	7486.936	13.502	17.95414	13.928
1991.605	8.258	5983.688	14.039	7487.679	13.41	18.30254	13.802
1992.624	8.306	5983.805	13.976	7488.237	13.389	18.41417	13.495
1993.23	8.285	5984.097	13.976	7488.934	13.48	18.77083	13.338
1993.335	8.238	5984.176	13.987	7489.609	13.541	19.04331	13.22
1993.599	8.264	5984.393	13.544	7489.921	13.484	19.62111	13.224
1993.999	8.368	5984.529	13.382	7490.25	13.556	20.25355	13.306
1994.401	8.58	5984.863	13.276	7490.335	14.027	21.31305	13.421
1994.585	8.795	5985.126	13.262	7490.51	14.068	21.9823	13.477
1994.776	9.208	5985.418	13.111	7490.57	13.956	22.41033	13.392
1994.949	9.337	5985.656	13.125	7490.913	13.91	22.81853	13.463
1995.449	9.505	5986.1	13.317	7491.089	14.214	23.38631	13.486
1995.694	9.592	5986.715	13.482	7491.366	14.199	23.83921	13.566
1996.87	9.694	5986.934	13.518	7491.766	14.22	24.52132	13.671
1998.567	9.74	5987.917	13.51	7492.339	14.393	25.26962	13.754
		5988.322	13.605	7492.983	14.555	25.67617	13.802
		5988.646	13.67	7493.355	14.705	26.03519	13.943
		5988.943	13.831	7493.642	14.853	26.26023	14.043
		5989.186	14.043	7494.845	14.907	26.61083	14.128
		5989.375	14.295	7497.697	14.858	27.28089	14.323
		5989.757	14.52			27.74826	14.394
		5990.019	14.647			28.24797	14.378
		5990.797	14.789			28.72519	14.45
		5991.05	14.836			29.08266	14.578

East Tributary Cross sections 5 to 8 2003							
ET05 Distance (m)	**14-Aug-03 Assumed Height (m)**	**ET06 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**ET07 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**ET08 Distance (m)**	**14-Aug-03 Assumed Height (m)**
		5992.63	14.869			29.75841	14.71
		5993.903	14.862			29.99871	14.831
		5994.915	14.895			31.16328	14.87
		5996.268	14.866			33.7794	14.833
		5998.088	14.877				

Upper Swift Creek cross sections 1 to GW 2003							
UM01 Distance (m)	14-Aug-03 Assumed Height (m)	UM02 Distance (m)	14-Aug-03 Assumed Height (m)	UM03 Distance (m)	14-Aug-03 Assumed Height (m)	UMGW Distance (m)	14-Aug-03 Assumed Height (m)
2042.9	9.987	2038.574	9.884	2029.567	9.722	2020.153	9.644
2042.903	9.987	2038.427	9.689	2029.566	9.722	2020.151	9.644
2042.813	9.784	2035.862	9.588	2029.405	9.543	2020.047	9.463
2042.566	9.833	2035.011	9.562	2028.952	9.527	2019.209	9.456
2042.023	9.75	2034.431	9.604	2028.028	9.579	2018.428	9.404
2041.124	9.662	2033.696	9.508	2026.643	9.565	2017.623	9.42
2038.218	9.593	2032.531	9.51	2025.939	9.571	2017.414	9.373
2036.548	9.559	2031.746	9.581	2025.74	9.526	2016.829	9.43
2035.823	9.578	2031.073	9.552	2025.452	9.567	2016.329	9.373
2035.57	9.619	2030.485	9.529	2024.576	9.523	2016.016	9.276
2035.255	9.554	2029.542	9.566	2024.292	9.549	2015.824	9.159
2034.749	9.546	2028.551	9.5	2023.789	9.507	2015.672	9.113
2034.518	9.56	2028.274	9.524	2023.402	9.553	2015.421	8.91
2034.072	9.533	2027.747	9.63	2022.714	9.609	2015.223	8.795
2033.013	9.535	2026.715	9.587	2022.389	9.533	2015.162	8.529
2032.618	9.505	2026.385	9.58	2020.942	9.456	2015.057	8.441
2032.234	9.51	2026.228	9.665	2020.361	9.494	2015.018	8.117
2031.879	9.569	2026.078	9.558	2020.041	9.44	2014.722	8.092
2031.149	9.489	2024.646	9.485	2019.119	9.47	2014.503	8.105
2030.521	9.553	2023.979	9.509	2018.72	9.428	2014.113	8.053
2030.005	9.535	2023.296	9.486	2018.009	9.482	2012.57	7.983
2029.721	9.57	2022.334	9.486	2016.219	9.362	2011.533	7.945
2029.324	9.498	2021.538	9.447	2015.351	9.374	2010.893	7.965
2028.159	9.468	2021.216	9.353	2014.939	9.294	2010.394	7.939
2026.71	9.516	2020.993	9.181	2014.816	9.189	2009.615	8.006
2025.396	9.404	2020.607	9.006	2014.621	9.132	2009.101	8.055
2024.227	9.367	2020.282	8.922	2014.133	9.123	2008.813	8.085
2023.371	9.403	2019.837	8.695	2013.984	9.184	2008.687	8.369
2022.365	9.517	2019.69	8.668	2013.855	9.074	2008.626	8.334
2022.096	9.458	2019.668	8.143	2013.626	9.073	2008.472	8.327
2021.54	9.205	2019.376	7.991	2013.506	9.105	2008.356	8.633
2021.362	9.079	2017.963	7.998	2013.237	8.999	2008.068	8.733
2020.499	8.853	2016.675	8.065	2013.198	8.697	2007.88	8.823
2020.391	8.872	2015.862	8.084	2013.127	8.578	2007.601	8.953
2020.287	8.65	2015.357	8.129	2012.887	8.567	2007.512	9.093
2020.091	8.485	2014.893	7.944	2012.691	8.465	2007.211	9.252
2019.789	8.432	2014.724	7.955	2012.672	8.033	2006.885	9.379
2019.703	8.31	2014.447	8.096	2012.327	7.962	2006.365	9.517
2019.132	8.149	2013.955	8.385	2011.723	7.993	2005.349	9.616

Upper Swift Creek cross sections 1 to GW 2003							
UM01 Distance (m)	14-Aug-03 Assumed Height (m)	UM02 Distance (m)	14-Aug-03 Assumed Height (m)	UM03 Distance (m)	14-Aug-03 Assumed Height (m)	UMGW Distance (m)	14-Aug-03 Assumed Height (m)
2018.152	7.991	2013.501	8.475	2011.374	8.018	2004.269	9.721
2017.85	7.782	2013.121	8.622	2009.995	7.959	2002.358	9.787
2017.369	7.813	2012.349	9.01	2009.398	7.969		
2017.007	7.844	2012.074	9.113	2008.711	7.984		
2016.676	7.857	2011.569	9.42	2008.263	7.925		
2016.023	7.958	2011.02	9.592	2008.201	8.094		
2015.588	7.985	2010.478	9.7	2007.99	8.164		
2015.126	7.938	2010.067	9.761	2007.873	7.986		
2014.729	7.886	2009.476	9.823	2007.514	8.055		
2014.444	7.958	2008.613	9.756	2007.216	8.201		
2014.016	8.103	2007.865	9.78	2006.965	8.395		
2013.448	8.306	2007.252	9.843	2006.762	8.793		
2013.413	8.5	2005.586	9.815	2006.559	8.955		
2013.323	8.661	2003.333	9.825	2006.397	9.009		
2013.097	8.907	2001.469	9.811	2006.217	9.219		
2012.884	9.082			2006.046	9.267		
2012.51	9.226			2005.747	9.403		
2012.132	9.319			2005.292	9.567		
2011.152	9.501			2004.643	9.551		
2009.974	9.631			2004.123	9.578		
2009.261	9.766			2003.156	9.707		
2008.673	9.783			2003.056	9.946		
2008.143	9.757			2002.846	9.764		
2007.612	9.767			2001.467	9.811		
2006.905	9.821						
2005.071	9.77						
2004.306	9.776						
2003.669	9.832						
2003.281	9.79						
2001.721	9.781						

Upper Swift Creek cross sections 4 to 7 2003							
UM04 Distance (m)	**14-Aug-03 Assumed Height (m)**	**UM05 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**UM06 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**UM07 Distance (m)**	**14-Aug-03 Assumed Height (m)**
528.021	9.728	2033.048	9.873	2040.691	9.981	2032.084	9.819
528.029	9.728	2033.043	9.873	2040.686	9.981	2032.08	9.819
527.89	9.506	2032.878	9.679	2040.547	9.795	2032.083	9.82
526.108	9.506	2032.195	9.682	2037.776	9.792	2031.926	9.625
525.577	9.538	2030.456	9.64	2035.191	9.721	2028.901	9.632
525.221	9.492	2028.955	9.621	2031.9	9.671	2026.203	9.62
524.32	9.475	2028.245	9.678	2029.249	9.593	2024.181	9.629
523.565	9.524	2027.655	9.566	2028.652	9.577	2023.168	9.718
523.143	9.461	2026.843	9.573	2028.263	9.629	2022.577	9.709
522.049	9.439	2025.977	9.572	2027.711	9.578	2020.957	9.739
521.721	9.499	2025.39	9.577	2027.157	9.54	2019.65	9.777
520.638	9.489	2024.078	9.442	2026.657	9.6	2019.033	9.796
519.917	9.412	2023.491	9.422	2025.612	9.705	2018.66	9.644
518.361	9.38	2022.928	9.484	2024.799	9.703	2018.396	9.462
516.987	9.388	2022.566	9.532	2024.405	9.637	2018.321	9.215
516.219	9.361	2022.304	9.373	2023.938	9.369	2017.837	8.91
515.572	9.063	2021.994	9.1	2023.454	9.015	2017.71	8.855
514.981	8.799	2021.869	8.747	2022.761	8.597	2017.606	8.604
514.81	8.766	2021.777	8.689	2022.182	8.357	2016.744	8.14
514.566	8.369	2021.689	8.427	2021.593	8.259	2016.402	8.107
514.455	7.978	2021.545	8.38	2021.12	8.216	2015.887	8.173
514.201	7.932	2021.44	8.294	2019.365	8.153	2015.286	8.118
513.956	7.984	2021.011	8.251	2018.153	8.056	2014.88	8.041
512.219	7.937	2020.228	8.172	2017.307	8.038	2013.94	8.045
511.028	7.883	2019.905	8.167	2016.74	8.085	2013.161	8.008
509.772	7.919	2019.664	8.112	2016.092	8.152	2012.241	8.085
509.216	7.94	2018.241	8.124	2015.4	8.173	2010.805	8.121
508.801	7.864	2017.076	8.062	2014.317	8.129	2009.486	8.171
508.555	7.942	2015.379	8.091	2014.083	8.197	2009.073	8.243
508.2	8.043	2014.836	8.094	2013.289	8.598	2008.694	8.453
507.87	8.276	2014.365	8.297	2013.117	8.751	2008.587	8.766
507.782	8.396	2014.306	8.395	2012.944	9.054	2008.455	8.834
507.409	8.588	2013.924	8.847	2012.398	9.32	2008.363	8.983
507.065	8.962	2013.659	8.902	2011.965	9.565	2008.023	9.264
506.822	9.174	2013.551	9.049	2011.413	9.724	2007.653	9.547
506.549	9.378	2013.212	9.27	2010.72	9.877	2006.961	9.683
506.313	9.409	2012.941	9.38	2010.184	9.919	2004.949	9.76
506.198	9.516	2012.677	9.4	2009.353	9.909	2001.996	9.792
505.979	9.601	2012.412	9.507	2007.033	9.877		

Upper Swift Creek cross sections 4 to 7 2003							
UM04 Distance (m)	**14-Aug-03 Assumed Height (m)**	**UM05 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**UM06 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**UM07 Distance (m)**	**14-Aug-03 Assumed Height (m)**
505.68	9.629	2012.069	9.689	2004.693	9.853		
505.22	9.637	2011.786	9.817	2002.146	9.82		
503.739	9.651	2010.986	9.846				
502.397	9.678	2009.056	9.807				
501.245	9.752	2006.716	9.824				
		2004.443	9.814				
		2001.676	9.807				

Swift Creek Cross sections 1 to 4 2003							
SM01 Distance (m)	14-Aug-03 Assumed Height (m)	SM02 Distance (m)	14-Aug-03 Assumed Height (m)	SM03 Distance (m)	14-Aug-03 Assumed Height (m)	SM04 Distance (m)	14-Aug-03 Assumed Height (m)
462.587	9.051	2037.797	7.992	2040.628	8.042	2033.244	7.958
462.588	9.051	2037.805	7.994	2040.632	8.042	2033.067	7.77
462.723	8.85	2037.668	7.854	2040.492	7.911	2030.428	7.801
464.475	8.802	2034.742	7.878	2037.255	7.902	2027.48	7.908
466.337	8.768	2032.076	7.932	2034.454	7.857	2026.078	7.933
467.784	8.794	2029.664	7.913	2032.928	7.822	2025.003	7.958
468.868	8.665	2029.189	7.847	2031.292	7.543	2024.663	7.864
469.792	8.576	2028.192	7.662	2030.423	7.36	2024.46	7.634
471.039	8.573	2027.123	7.516	2029.722	7.049	2024.162	7.52
471.545	8.588	2026.666	7.425	2027.762	6.893	2023.996	7.294
472.197	8.425	2025.8	7.159	2026.243	6.784	2023.671	7.063
472.553	8.309	2024.988	6.833	2025.418	6.583	2023.265	6.965
473.48	8.133	2024.807	6.69	2023.448	6.315	2023.031	6.973
473.928	7.933	2023.283	6.512	2021.166	6.202	2022.815	6.525
474.611	7.537	2022.245	6.443	2019.744	6.096	2022.69	6.44
474.826	7.368	2021.67	6.312	2018.619	5.981	2022.463	6.063
475.321	7.248	2020.687	6.263	2018.213	6.124	2022.092	6.127
476.128	7.28	2019.526	6.191	2017.89	6.429	2021.849	6.108
476.555	7.189	2018.881	6.278	2017.256	6.67	2019.925	6.175
478.117	7.162	2017.745	6.353	2016.566	6.787	2018.673	6.186
479.903	7.091	2017.226	6.2	2015.406	6.842	2018.377	6.249
480.165	7.206	2016.422	5.99	2014.829	6.756	2017.103	6.356
480.578	7.515	2015.624	6.001	2014.367	6.872	2015.884	6.364
481.269	7.734	2014.743	6.093	2013.958	7.191	2014.798	6.287
482.085	8.17	2014.137	6.247	2012.787	7.494	2014.27	6.281
483.041	8.627	2013.62	6.487	2010.824	7.608	2014.004	6.328
483.941	9.003	2013.409	6.663	2009.143	7.49	2013.691	6.518
486.435	9.006	2012.923	6.626	2006.634	7.51	2013.41	6.695
488.871	8.966	2011.612	6.625	2004.364	7.605	2013.321	6.849
491.691	8.9	2010.617	6.822	2001.593	7.734	2013.195	6.905
494.448	8.878	2009.456	6.985			2013.006	7.076
495.644	8.87	2007.704	7.385			2012.923	7.22
497.828	8.829	2006.172	7.577			2012.438	7.392
		2005.028	7.691			2011.442	7.489
		2001.736	7.78			2009.793	7.613
						2007.434	7.753
						2004.678	7.802
						2001.741	7.799

Swift Creek Cross sections 5 to 8 2003							
SM05 Distance (m)	14-Aug-03 Assumed Height (m)	SM06 Distance (m)	14-Aug-03 Assumed Height (m)	SM07 Distance (m)	14-Aug-03 Assumed Height (m)	SM08 Distance (m)	14-Aug-03 Assumed Height (m)
2082.678	7.995	2047.848	7.767	2060.654	7.725	2052.945	7.849
2082.672	7.995	2047.723	7.593	2060.65	7.725	2052.944	7.851
2082.532	7.82	2044.867	7.606	2060.514	7.526	2052.803	7.663
2079.674	7.773	2041.118	7.636	2057.432	7.582	2048.84	7.681
2076.994	7.822	2039.042	7.664	2054.276	7.681	2044.849	7.694
2074.608	7.908	2036.46	7.703	2051.089	7.68	2041.867	7.702
2071.589	7.952	2033.699	7.738	2048.238	7.719	2040.802	7.743
2070.398	7.949	2031.859	7.701	2046.115	7.774	2039.157	7.778
2069.761	7.835	2030.913	7.599	2044.214	7.842	2037.935	7.739
2069.112	7.517	2030.145	7.349	2042.034	7.898	2037.152	7.618
2068.142	6.942	2029.231	7.03	2040.616	7.856	2036.267	7.625
2067.71	6.66	2028.118	6.454	2040.237	7.698	2035.836	7.671
2067.482	6.244	2027.349	6.032	2040.004	7.5	2035.314	7.568
2067.251	6.199	2027.084	5.987	2039.735	6.958	2034.883	7.365
2067.183	5.849	2026.486	5.946	2039.417	6.878	2034.133	6.93
2066.78	5.945	2025.055	5.997	2039.238	6.703	2033.327	6.401
2066.563	6.033	2023.731	6.066	2038.889	6.56	2032.744	6.308
2065.737	6.186	2022.604	6.077	2038.438	6.189	2031.944	6.256
2064.781	6.196	2021.704	6.146	2038.271	5.862	2030.848	6.222
2063.793	6.139	2020.859	6.153	2037.969	5.731	2029.096	6.255
2062.159	6.162	2020.627	6.364	2036.103	5.956	2027.732	6.231
2059.876	6.197	2020.044	6.612	2035.191	6.091	2026.31	6.084
2058.427	6.188	2019.71	6.78	2033.685	6.245	2024.726	5.89
2058.206	6.267	2018.594	6.978	2032.4	6.266	2023.934	6.029
2057.944	6.478	2017.873	7.173	2031.986	6.326	2023.279	6.351
2055.893	6.865	2017.601	7.272	2031.428	6.218	2022.789	6.633
2054.286	7.146	2017.5	7.34	2030.831	6.225	2022.517	6.888
2052.979	7.253	2015.667	7.608	2030.279	6.43	2021.989	7.165
2052.466	7.425	2014.411	7.779	2029.276	6.515	2021.441	7.269
2052.087	7.367	2013.842	7.689	2028.61	6.697	2020.109	7.308
2050.441	7.696	2011.052	7.732	2028.333	6.738	2019.495	7.456
2047.534	7.704	2008.135	7.707	2027.934	6.979	2018.674	7.71
2044.176	7.748	2005.248	7.729	2027.653	7.348	2018.112	7.866
2039.309	7.708	2001.832	7.799	2027.39	7.486	2016.701	7.9
2035.832	7.682			2026.873	7.596	2014.668	7.872
2032.041	7.601			2026.066	7.693	2012.532	7.751
2028.311	7.502			2025.708	7.782	2010.05	7.722
2026.033	7.375			2024.337	7.829	2006.564	7.725
2025.022	7.326			2022.476	7.783	2003.923	7.753

Swift Creek Cross sections 5 to 8 2003							
SM05 Distance (m)	**14-Aug-03 Assumed Height (m)**	**SM06 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**SM07 Distance (m)**	**14-Aug-03 Assumed Height (m)**	**SM08 Distance (m)**	**14-Aug-03 Assumed Height (m)**
2024.287	7.19			2019.949	7.7	2001.698	7.777
2023.072	6.748			2017.074	7.685		
2021.879	6.654			2013.037	7.74		
2020.179	6.745			2009.049	7.825		
2017.002	7.074			2005.798	7.845		
2013.841	7.443			2001.997	7.831		
2010.242	7.598						
2007.023	7.644						
2004.593	7.761						
2001.722	7.804						