# RIVER DISCHARGES DERIVED FROM SINGLE VELOCITY MEASUREMENTS

By



Thesis presented in partial fulfilment of the requirements for the degree of Master of Science in Engineering at the University of Stellenbosch

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# DECLARATION

Hereby I, GC Cloete, declare that this thesis is my own original work and that all sources have been accurately reported and acknowledged. This document has not previously in its entirety or in part been submitted to any educational institution in order to obtain an academic qualification.

GC Cloete

# SYNOPSIS

This work investigates methods to theoretically determine the lateral velocity distribution across a river from which factors may be derived to translate a single point velocity into average velocity for the river as a whole.

A wide range of field data from various rivers was analysed. This produced over a hundred velocity distributions with which to compare theoretical distribution results. Four theoretical approaches were considered: the one-dimensional method (Manning's equation), a two-dimensional flow formula solved as an initial-value-problem, a two dimensional flow formula solved as a boundary-value-problem and an empirical method developed from energy principles.

The one-dimensional and initial-value-problem approaches were unsuccessful. The boundary-value and empirical approach did however produce promising results. Surprisingly the analysis of the field data revealed patterns of similarity which could produce accurate results without the need of a theoretical approach.

## SINOPSIS

Metodes word ondersoek om teoreties 'n laterale snelheidsverspreiding oor 'n rivier te bepaal en sodoende 'n faktor te vind waarmee 'n gemete enkelpuntsnelheid in die rivier omgeskakel kan word na 'n gemiddelde snelheid vir die rivier in geheel.

Vloeimeetdata van verskeie riviere is geanaliseer. Sodoende is meer as 100 snelheidsverspreidings gegenereer waarmee die teorie vergelyk kon word. Vier teoretiese benaderings is gevolg: Manning se een-dimensionele vloeivergelyking, 'n twee dimensionele vloei-vergelyking opgelos met behulp van 'n beginwaarde, 'n twee dimensionele vloei-vergelyking opgelos met behulp van randwaardes, en 'n empiriese metode ontwikkel vanuit energie beginsels.

Die een-dimensionele- en beginwaarde-benaderings was nie suksesvol nie. Die randwaarde- en empiriese benaderings het wel belowende resultate gelewer. Selfs verwerking van die gemete stroommetings het waardevolle inligting gelewer: daar bestaan duidelike ooreenkomste in die snelheidsverspreidings wat gebruik kan word om die verspreidingsfaktor mee te bereken sonder om teoretiese oplossings te soek.

## PREFACE

This work is a continuation of research previously undertaken by the author in the form of a final year thesis in 2000, named "Hoogvloeimeting in riviere met behulp van drukmeting by brugpylers: 'n Gids vir installasie en gebruik". Translated it means "High flow measurements in rivers using pressure measurements against bridge piers: A guide for installation and use".

The above fieldwork showed promising results and raised interest at the South African Department of Water Affairs and Forestry, Hydrology Division. Prompted by the interest and probable significance of this approach toward open channel flow measurement, further research seemed appropriate.

The method for measuring velocity using a bridge pier has been researched extensively, with good results, at the University of Stellenbosch (Meyer et al, 2000) (Cloete & Rooseboom, 2000) (Retief & Rooseboom, 1998). Translation of this point velocity into an average velocity for the river remained an uncertainty.

This work is an extensive though not exhaustive investigation into possible methods for determining a theoretical velocity distribution laterally across a river. From this a factor is determined with which to convert a single point velocity measurement into average velocity for the river as a whole.

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# LIST OF SYMBOLS

α	velocity coefficient
β	inverse of the velocity coefficient
Δ	delta factor – converts single point velocity to average river velocity
λ	lateral shear
vt	eddy viscosity
ρ	water density
LB	left bank of river
RB	right bank of river
Q	total discharge in a river
V	streamwise velocity associated with one-dimensional flow formula
Α	discharge area
$S_0$	bed slope of river
K	von Karman constant (0.4)
b	width of bridge pier
В	distance between adjacent bridge piers
L	length of bridge pier
d	depth of flood plain flow
D	depth of main channel flow
у	depth of flow at a local point
у	distance laterally across a river for 2 or 3 dimensional flow formulae
W	total surface width of river
U,V,W	velocity components in the (x) streamwise, (y) lateral and (z) vertical
	directions, associated with 3-dimensional flow formula
U <sub>d</sub>	depth averaged velocity, associated with 2-dimentional flow formula
h	depth of main channel below overbank level
f	D'arcy friction factor
g	gravitational acceleration
Н	maximum depth of flow

# LIST OF ABBREVIATIONS

СНОН	-	Coherence is the degree to which the different zones, in a river
		cross section, exhibit similarity (Ackers 1991)
DCM	-	Divided Channel Method: Dividing a compound river section
		into hydraulically homogeneous sub-divisions, calculating the
		discharge in each using one dimensional flow theory, and finally
		adding them to obtain overall discharge.
DELV	-	Dynamic Equation of Lateral Depth averaged Velocity
		(Wormleaton 1988)
DISADF	-	Discharge Adjustment Factor (Ackers 1992)
DWAF	-	The South African Department of Water Affairs and Forestry
FCF	-	Flood Channel Facility at Wallingford, UK, jointly sponsored by
		SERC and Hydraulics Research Ltd, UK
MS	-	MICRO SOFT <sup>™</sup> products
RSA	-	Republic of South Africa
SERC	-	Science and Engineering Research Council, UK
WRC	-	The Water Research Commission of South Africa

#### **1 INTRODUCTION**

Reliable prediction of the carrying capacity of rivers is of great significance to mitigate flood damage and prevent loss of life (Myers 1987). This statement emphasises the necessity to measure floods accurately.

Flow measurement in natural rivers is complicated in the case of high flood flows: gauging weirs become inundated, increased sediment loads hamper magnetic field measurements, and floating debris prohibits point velocity measurements using instruments suspended on a cable or rod. These are problems often encountered especially in arid regions with seasonal river flow.

There is a saying in Afrikaans, "om te meet is om te weet" which when translated would mean 'to measure is to know'. This is true, but accuracy of the measurement relies upon the calibration of the 'measuring stick'. Gauging weirs are theoretically calibrated for modular flow, and to some extent for non-modular flow. But when totally inundated, weir formula cannot estimate the flow rate. In these cases various measurement techniques, some mentioned above, are employed to fix a flow-rate to a flood peak measured at a weir. In so doing the calibration of a weir is raised above its theoretical limit.

Some reasons why the full spectrum of river flow data is necessary:

- South Africa, being a dry country, considers water to be a natural resource which must be controlled and managed. The more information known about this resource, the better it may be controlled.
- Catchment management, regarding water users in a river basin, is a new control
  mechanism enforced by DWAF in RSA. Agriculture requiring irrigation has
  increased in the drier regions of Southern Africa: grape farming has boomed
  along the banks of the lower Orange River in Namibia and South-Africa, as well
  as along the banks of the Berg River. On the other hand, the river eco-system is

• South Africa relies heavily upon its natural water resources for development and economic growth. Job creation, a present era buzzword, mainly takes place at major coastal centres where local and foreign investors build large production facilities and ship out the goods. An influx of job seekers from rural communities to these centres strain the available water sources as industries and informal settlements expand, and with them the demand on potable water.

From the above it can be seen that measurement of river run-off, over the whole spectrum of flow, is necessary for management and control. A multitude of river gauging stations accurately measure the lower part of the spectrum, but the upper part is still inaccurate, and often unmeasured due to lack of resources.

### 2 BACKGROUND

In Southern Africa most weirs are equipped with water level recorders, placed in a tower well above the maximum expected flood level. This allows for accurate recording of the water level even during floods, but this level can only be converted to flow rate by means of a calibration table: flow height above some relative zero datum versus flow rate. When several flood measurements correspond concerning relative height and flow rate, it is considered safe to extend the calibration table to this flow rate. A variance of 10% in measured flow rate for a given height is considered as accurate, but when the variance approaches 30- to 40%, further measurements are required before the calibration table is extended (van Heerden, DWAF).

A general explanation for the necessity of measuring flood peaks accurately may be summarised as follows:

- In any given year, for 90% of the time, a typical weir in a relatively dry region would measure 8% of the annual river run-off accurately (in the form of low flow). The remaining 92% of run-off comes in the form of floods during the rainy season over the remaining 10% of the time. During these flood peaks, large volumes of water are conveyed down the river, forming the bulk of the remaining annual run-off.
- If the weir is not calibrated accurately for the flood peaks, then a large part of the remaining 92% annual run-off is either underestimated due to the 'ceiling' in the weir discharge table, or unreliable due to assumptions made in extrapolating the discharge table to accommodate the higher flow levels.

This emphasises the saying "to measure is to know".

### 2.1 Flow measurement techniques in RSA

Several methods of measuring open channel stream-flow are used in RSA today, with varying degrees of accuracy and difficulty, especially during floods. Some of these are:

- Fixed calibrated measuring structures such as gauging weirs or dam walls. The theoretically calibrated weir becomes unusable when completely inundated; this however is unlikely to happen at the spillway of a dam wall, making this structure reliable even during maximum design flood flows.
- Current gaugings using flow meters suspended from a specially designed cableway or from a bridge structure. This method is relatively accurate but dangerous to use in flooded rivers with a high debris load.
- Slope-Area-Method which applies energy principles. This method determines only the flood-peak flow rate, as post-flood survey heights are taken of the debris levels in trees and bushes along a selected stretch of river. Often the energy slope is misinterpreted due to the high rotational energy content of water at the side of a river in the form of eddies and vortices, which may cause local interference with the water level. This leads to varying flow rate measurements for similar sized floods. This method is very popular in RSA for lack of better techniques.
- Float measurements are sometimes applied, but generally only to get a rough estimate of the flow rate: brightly painted wooden blocks, are thrown into the middle of a flooded river. The time it takes to travel a fixed distance is recorded. This velocity is factored by 0,8 to convert it to average velocity (this factor is an over-estimation of actual flow rate as proven by this research), an estimate is made of the discharge area, and the product of these gives discharge.

• Physical model study in a laboratory, accurate but expensive.

#### 2.2 Flow measurement techniques used abroad

Some of the measuring techniques which have been used with success abroad are mentioned below:

- Dilution methods
- Magnetic field measurements
- Acoustic Doppler Velocimetry (ADV) (Bradley et al, 2003). ADV has been used to measure two- and three dimensional flow fields in natural waterways. It's a direct measurement technique, and thus subject to the dangers of measurement during floods.
- Particle Image Velocimetry (PIV) (Bradley et al, 2003) : photographs are taken of surface flow in quick succession (30 frames per second). With the time frame known, the distance and direction of travel for certain pixel groups are measured and so surface flow vectors are determined, which can be translated into average velocity and flow rate.
- Bubbles released from a pipe at bottom. Suspended sediment load, often present during floods, however, increases the density of the water and thus reduces the escape velocity of the air bubbles. In this case the average velocity is overestimated.

#### 2.3 Proposed simplified measurement approach

The proposed simplified measurement approach requires only a single point-velocity, taken preferably in the middle of a river. By means of a factor, dubbed the Single Point Velocity Factor and denoted with the character delta ( $\Delta$ ), this single point velocity is converted into an average velocity for the river as a whole. With the section geometry known, the flow rate is determinable.

Point velocity may be determined by means of any direct measurement technique. The only requirement being that the point velocity must be converted into the average velocity for the vertical stream element. The depth averaged velocity is then converted to average velocity for the river as a whole, using the single point velocity factor, delta.

This method of discharge calculation, and its approach, are described fully in an earlier unpublished work by the author in 2000: "Hoogvloeimeting in riviere met behulp van drukmeting by brugpylers: 'n Gids vir installasie en gebruik".

**NB.** Please note that the velocity distribution factor in the former work was denoted by the Greek character alpha ( $\alpha$ ). In this work however the alpha character is applied in its more traditional form as a velocity coefficient, describing energy losses for the kinetic energy levels as discussed in chapter 7. For this reason delta ( $\Delta$ ) is used as the velocity distribution factor in this work.

## 2.4 Aim of this research

This research focuses on a theoretical approach to determine the lateral velocity distribution for single- or compound channels, from which the delta-factor is derived. This work mainly looks at compound channels, as a theory developed for compound channels should also be able to model single concave channels.

### **3 LITERATURE STUDY**

The essence of a number of major publications are reviewed here. These publications were chosen on the basis of velocity distributions, discharge, conveyance, turbulent structures and available energy in prismatic compound channels. A publication on a simple concave channel is also included which investigates the use of one-dimensional formulae when subdividing the channel into hydraulically homogeneous sections.

#### **3.1 Title: Flow distribution in compound channels**

Author:Wormleaton, R.R., Hadjipanos, P.Published:1985

In previous work the authors had determined that by subdividing a compound river section into hydraulically homogeneous areas, and summing the calculated flow through each, the resulting discharge overestimates the actual flow.

Previous work only considered the total discharge. This research investigated the overand underestimation of the main channel flow and the floodplain flow separately.

Three different interface planes were examined, namely Vertical (V), Diagonal (D) and Horizontal (H). Results for the horizontal and diagonal interface methods showed similar characteristics, thus reference is only made to the horizontal.

The interface was included (i) and excluded (e) in the main channel wetted perimeter. For the vertical interface, the main channel flow was grossly overestimated in both  $V_e$  and  $V_i$ . However in both cases the overbank flow was underestimated, correcting the total discharge to an extent. For  $V_e$ , the total flow was overestimated in all depth scenarios. For  $V_i$  the total flow was overestimated for depth ratios (H - h)/H = 0.2 or 0.3. But for depth ratios approaching 0.4, some measurements underestimated the flow. For both  $V_e$  and  $V_i$ , the total discharge was overestimated by 50% and 40% respectively.

# 3.2 Title: Velocity and discharge in compound channels Author: Myers, W.R. Published: 1987

The author states that if the compound channel is considered as a single entity, the carrying capacity is underestimated, while in applying the divided channel method (DCM) the resulting discharge is an overestimation.

The DCM overestimates the full cross sectional carrying capacity by up to 10% and hence underestimates the flood stage for given discharges. The value of 10% is a lower limit of overestimation.

An important observation is made: lateral depth-averaged velocity distributions are independent of channel bed slope.

# 3.3 Title: Determination of discharge in compound channels using the dynamic equation for lateral velocity distribution

Author:Wormleaton, R.R.Published:1988

Traditional discharge calculations (Chezy, Manning, Colebrook-White) lead to large inaccuracies in compound channels due to no provision for interference at the interface between main channel and floodplains.

The interaction between main channel and floodplain flow is a very complex threedimensional problem, and its complete solution would require correspondingly complex and sophisticated methods. However these may be very time-consuming and not at all suited to numerical river modelling. Moreover, the detailed description of the flow and the levels of accuracy produced by these methods are not always required in practice.

A method which is fast and gives a more realistic description of the discharge than Chezy et el. is the Dynamic Equation of Lateral depth averaged Velocity distribution (DELV):

$$gS_0 - \frac{fU|U|}{8h} + \frac{\partial}{\partial y} \left( v_t \frac{\partial U}{\partial y} \right) = 0$$

The equation is a non-linear second order partial differential equation which can be solved numerically by finite differences.

DELV was found not to be scale dependent, and gives improved values for total discharge for depth ratios  $\leq$  0.4. Above that flow becomes distinctly three dimensional in character.

3.4 Title: A comparison of velocity measurements in straight, single meander and multiple meander compound channels
 Author: McKoegh, E.J.; Kielly, G.K.
 Published: 1990

Mechanisms of main channel and floodplain interactions are typified by:

- The transfer of momentum from the main channel to the floodplain
- The transfer of turbulence from the floodplain to the main channel
- The creation of vortices with vertical axes at the interface

All these cause energy loss which is not included in the traditional treatment of compound channels.

A comparison of the lateral distribution of velocity indicates that a straight channel is more amenable to analytic treatment than either a single or a multiple meander. A simplified turbulence model predicting the lateral distribution of depth averaged velocity has been proposed by the authors (1989). This model is based on the simplified dynamic equation:

$$gS_0 - \frac{fU|U|}{8y} + \frac{\partial}{\partial z} \left( v_t \frac{\partial U}{\partial z} \right) = 0$$

Symbols: The 1989 publication of the authors work, which has not been located prior to binding this document, contains the symbols for the above equation. These symbols are therefore not disclosed in this work.

# 3.5 Title: Effects of momentum transfer in compound channels Authors: Stephenson, D., Kolovopoulos, P. Published: 1990

The difference in main channel and floodplain velocities results in a bank of vortices as demonstrated by Knight & Hamed in 1984, referred to as the "turbulence phenomenon". There is therefore a lateral transfer of momentum that results in apparent shear stress.

Apparent shear stress acting on the assumed interface, proposed by Prinos & Townsend (1984), is represented by:

$$\tau_{ai} = 0.874 (\Delta V)^{0.92} \left(\frac{d}{D}\right)^{-1.129} \left(\frac{W_f}{W_c}\right)^{-0.514}$$

 $\Delta V$  = difference in mean velocity of main channel and flood plain

d = depth of floodplain flow

D = depth of main channel flow

 $W_f = floodplain width$ 

 $W_c = channel width$ 

 $\tau_{ai}$  = apparent shear stress acting upon the assumed interface

To validate the equation the authors compared four existing steady state computation methods with laboratory data by Wormleaton (1982) and Knight and Dimetriou (1983), with good results. As quoted, these methods are (1) the Divided Channel Method (DCM), (2) the Inclined Interface Method by Yen and Overton (1973), (3) Area Method by Holden (1986) and (4) the K-method which, according to the authors, is an improvement on the vertical interface method.

# 3.6 Title: An improved method of calculation for steady uniform flow in prismatic main channel/flood plain sections Authors: Wormleaton, P.R.; Merrett, D.J. Published: 1990

Ø-Indices are brought into the DCM calculations to modify results, allowing for a degree of interaction and momentum transfer between the main channel and floodplain subsections.

Ø-Indices were first suggested by Radjovic (1985) to characterise momentum transfer between adjacent sub-areas in discharge calculation methods.

The authors have applied the Ø-Indices to several discharge calculation methods, and have found a way of calculating the Ø-Indices fairly accurately using channel geometry and roughness.

# 3.7 Title: Calculation of total conveyance in natural channels Authors: Garbrecht, J.; Brown, G.O. Published: 1991

For simple concave sections, subdivision of the section into elements, ignoring lateral velocity gradients as well as shear between elements, and computation of the non-linear conveyance as a summation of components leads to overestimation of total conveyance.

For a typical trapezoidal section:

 $\frac{W}{D} \approx 20$ gives 5% overestimation $\frac{W}{D} \approx 10$ gives 10% overestimation $\frac{W}{D} \approx 5$ gives 20% overestimation

For: W = top width

D = depth

The conveyance as a summation of elements can only be true when the hydraulic radius (R) is constant, or a linear function of area, e.g. an infinitely wide section of constant depth. As a rule of thumb, the channel should not be sub-divided when width/depth ratio  $\leq 10$ .

# 3.8 Title: Turbulent structure in Compound Open-channel flows Authors: Tominaga, A.; Nezu, I.

Published: 1991

Measurements were conducted on the turbulent structures in compound open channelflows, using a Fibre-optic Laser Doppler Anemometer (FLDA). The three-dimensional distribution of the mean velocity, and the associated turbulent characteristics, were revealed by the FLDA database.

Two types of vortices were identified: secondary currents, which are a strong pair of longitudinal vortices either side of the main channel, and vertical axis vortices at the interface of the main channel and floodplain.

The database of this experimental data is also valuable for examining the validity of numerical calculations for three-dimensional compound open channel flows, including the effect of the free surface.

A typical distribution of transverse velocity vectors, measured with the FDLA, is indicated in **Figure 3.1**. The diagram was obtained from the Journal of Hydraulic Engineering, Vol. 117, No. 1. **Figure 3.1** illustrates the large size of the vectors at the interface of the main channel and floodplain where large translational energy losses occur, as opposed to vectors with near zero length in the middle of the river where very small translational energy losses occur.



Figure 3.1: A compound cross section indicating velocity vectors perpendicular to streamwise flow direction.

### 3.9 Title: Hydraulic design of two-stage channels

Author:Ackers, P.Published:1992

The author provides a new hydraulic parameter, the section Coherence (COH), which describes the degree to which the different zones exhibit flow similarity.

 $COH = \frac{Calculated flow for whole section as a unit}{\Sigma separate calculated zonal flows}$ 

As COH approaches unity, the section hydraulics approaches that of a non-compound channel.

The ratio of the actual discharge to the nominal discharge, where the latter is derived as the sum of the flows estimated separately for the main channel on floodplain zones, is termed the Discharge Adjustment Factor (DISADF). Actual discharge is thus determined by multiplying the DCM with the DISADF. This however corrects the total discharge as a whole, and not the separate zone discharges. Over much of the range of flood flows, the DISADF is between 0,95 and 0,9.

# 3.10 Title: Flow formulae for straight two stage (compound) channels

Authors: Ackers, P Published: 1993

The author claims much work had been done to date on the complex flow patterns of compound channels. This work had however been academically oriented and has not provided practical design procedures.

The DCM, as most text books refer to it, is attractive due to its simplicity, but it disregards head loss at the channel floodplain interface, and thus overestimates discharge.

The author suggests that the DCM be used in accordance with correction factors to allow for inter-zone interactions: A ratio of the actual- to the calculated discharge (DCM) is determined. This ratio is referred to as the Discharge Adjustment Factor (DISADF), as mentioned in section 3.9.

The author identifies four regions of flow: from only main channel flow (overbank-flow = 0) to overbank flow so deep that COH  $\Rightarrow$  unity (the section hydraulics approaches that of a non-compound channel; Ackers 1992).

Formulae are presented for these four flow regions to determine the DISADF applicable to each.

# 3.11 Title: Refined calibration of a depth-averaged model for turbulent flow in a compound channel

Author:Knight, D.W.; Abril, J.B.Published:1996

The Navier-Stokes equation for streamwise motion of a small element, within the cross section of an open channel with bed inclined streamwise is:

$$\rho \left[ V \frac{\partial U}{\partial y} + W \frac{\partial U}{\partial z} \right] = \rho g \sin \theta + \frac{\partial \tau_{yx}}{\partial y} + \frac{\partial \tau_{zx}}{\partial z}$$

Where [UVW] = velocity components in the xyz directions; x streamwise, y lateral and z normal to bed,  $\rho$  = water density,  $\theta$  = channel bed slope,  $\tau_{yx}$  = Reynolds shear stress on a plane perpendicular to y direction. Gravity force is not only expended on vertical and lateral shear during streamwise flow (U), but also to maintain secondary flows transverse to the streamwise direction with velocity components in the y & z direction.

Navier-Stokes must be integrated over depth to be of practical use:

$$\rho g HS_0 - \rho \frac{f}{8} U_d^2 \left( 1 + \frac{1}{s^2} \right)^{0.5} + \frac{\partial}{\partial y} \left\{ \rho \lambda H^2 \left( \frac{f}{8} \right)^{0.5} U_d \frac{\partial U_d}{\partial y} \right\} = \frac{\partial}{\partial y} \left[ H(\rho UV)_d \right]$$

With

 $U_{d} = depth average velocity$  H = local water depth s = channel side slope (1: s)  $\lambda = lateral shear (via depth averaged eddy viscosity)$   $\Gamma = \frac{\partial}{\partial y} [H(\rho UV)_{d}] = secondary flow$ 

$S_0$	=	channel streamwise slope
f	=	local bed friction
ρ	=	water density
g	=	gravitational acceleration

Starting values are needed for f,  $\lambda$ ,  $\Gamma$  in the river channel, (f) is known and ( $\lambda$ ,  $\Gamma$ ) must be estimated. A depth averaged finite element model is applied to simulate turbulent flow. Results show the model accurately predicts the lateral distribution of depth mean velocity.

# 3.12 Title: Estimating the discharge capacity in straight compound channels

Authors:Lambert, M.F.; Myers, W.R.Published:1998

This research presents a method for predicting the stage discharge relationship in a straight compound channel, more accurately than the traditional method termed the Divided Channel Method (DCM). The DCM refers to dividing a compound channel into relatively large homogenous sub-areas, analysing each separately and summing the results.

However turbulent momentum interaction between the main channel and floodplain extends the influence of the floodplain wetted perimeter into the main channel, past the point defined by the vertical division line. In so doing the floodplain area is increased and the main channel area decreased.

The authors propose a weighting factor ( $\xi$ ) to be applied to the different average velocities calculated for the main channel and flood plain. This method is termed the Weighted Divided Channel Method (WDCM).

Using experimental results from the UK Flood Channel Facility (FCF), the WDCM produces results which more closely represent observed velocity in both the main channel and flood plain than the traditional DCM.

#### 3.13 Title: Total energy levels in rivers

Author:Rooseboom, APublished:1988

In typical flow sections, the velocity gradients and therefore rotational energy content, is high where translational energy content is lowest and vice versa: right against boundaries, the velocity equals zero while the rotational energy content is very high.

In a compound river section, along the flood plains, the translational energy content will be low while rotational energy content is high and the total Kinetic Energy could be higher than in the main channel, where translational energy content is high and rotational energy content low.

It is doubtful whether the cumbersome standard methods for calculating  $\alpha$ -coefficients produce a truly representative kinetic energy height, as the kinetic energy content of flows along the flood plains is under-estimated in such calculations.

#### 3.14 Title: Numerical Analysis, third edition

Authors:Burdow, R.O.; Faires, J.E.Published:1985

(10.4) Finite-Difference Methods for Nonlinear Problems: for general non-linear boundary value problems, the difference method is similar to the method applied to

linear problems. Here, however, the system of equations that is derived will not be linear, so an iterative process is required to solve it.

### 3.15 Title: Advanced Engineering Mathematics

Authors:	Zill, D.G.; Cullen, M.R.
Published:	1992

(15.9) Second order boundary value problems: The simplified equation reads as follows:

$$\left(1+\frac{h}{2}P_{i}\right)y_{i+1}+\left(-2+h^{2}Q_{i}\right)y_{i}+\left(1-\frac{h}{2}P_{i}\right)y_{i-1}=h^{2}f_{i}$$

This equation is known as a finite difference equation, and is an approximation of the differential equation. It enables one to approximate a solution at the interior mesh points  $(x_1, x_2, x_3, x_4, \dots, x_n)$  of an interval [a;b]. The boundary conditions must be known.

Definition of parameters are as follows:

$$h = \frac{(a-b)}{n} = \text{interval size}$$
$$y_i = y(x_i) \qquad x_i \in [a,b]$$
$$P_i = P(x_i) \qquad x_i \in [a,b]$$
$$Q_i = Q(x_i) \qquad x_i \in [a,b]$$
$$f_i = f(x_i) \qquad x_i \in [a,b]$$

# 4 PROPOSED SIMPLIFIED FLOOD MEASUREMENT APPROACH

The simplified measurement approach to flood estimation, proposed and investigated in this study, relies upon a single velocity measurement taken somewhere around the centre of a river. Using the typical vertical velocity distribution curve for open channel flow (See Figure 4.2), this point velocity is translated to a depth averaged velocity. Then using the newly derived delta-factor, as presented by this work, the translated point velocity is converted into an average velocity for the entire cross-section. The product of area and average velocity then gives the discharge.

The proposed simplified flood measurement approach requires firstly determining the delta-factor for a section in a river, secondly measuring a point velocity in a river, thirdly converting the point velocity to a depth averaged velocity (standard procedure), the fourth step is to convert the depth averaged velocity into an average velocity for the whole river cross-section by applying the delta-factor. The last step is to calculate discharge as mentioned above. These steps are discussed in detail in the rest of this chapter.

#### 4.1 Determining the Delta-factor

Delta as defined in this investigation is the ratio of the average velocity to point velocity. The average velocity being the average for the whole river cross section, and the point velocity is defined as the depth averaged velocity for any point laterally across the river. The formula for the delta-factor is as follows:

 $Delta(\Delta) = \frac{Average \ river \ velocity}{Depth \ averaged \ velocity \ at \ any \ point \ in \ the \ river}$ (Equation 4.1)

The process of determining delta ( $\Delta$ ) actually requires knowing what the lateral velocity profile looks like beforehand to calculate delta, and then using delta again to determine the average velocity in a river from a single point velocity. It may seem that one is defying the very purpose for determining delta, but fortunately once delta has been fixed for a section in a river, all future measurements require only a single point velocity which then can be converted to average river velocity by means of the delta factor.

If current gaugings are available for a specific section in a river, they may be used to determine delta. If not, then a theoretical velocity distribution is required which would closely simulate the actual distribution. This is the main objective of this work. Chapter 5 deals with methods of determining a lateral velocity distribution in a river.

In the middle of a river the point velocity is higher than the average velocity. In this case delta( $\Delta$ ) will be smaller than unity, in the region of 0.7 to 0.8. At the side of the river the average velocity is higher than the point velocity. This leads to delta( $\Delta$ ) being larger than unity and highly erratic: values range from 1 and can tend to infinity, depending on how close one gets to a point of zero velocity near the side of the river.

It thus becomes clear why the delta-factor must be determined near the centre of the river: adjustment to a measured point velocity will be at the most 30% in the centre of the river whereas it becomes 200-, 300- or 400 % as one moves closer to the side of the river. The margin of error with 30% adjustment is much smaller than on a 400% adjustment. The single point velocity method thus is "safer" and of more practical use when delta is determined at the centre of the river. Obviously future single point velocity measurements must be taken at the centre of the river as well.

See Figure 4.1 for a typical delta calculation. Here delta is determined at chainage 91m, approximately the centre of the river, and at chainage 155m near the rivers edge. This distribution was generated from velocities measured in the Orange river at Irene in February 1989, when the discharge was  $2411 \text{m}^3/\text{s}$ .

#### 4.2 Single point velocity measurements in rivers.

Several methods exist which could be employed to measure a single point velocity in the main stream of a river. Discussed under the following chapters are three methods: two tried and tested and one new approach which has recently been developed and tested at the University of Stellenbosch.



Figure 4.1: A typical velocity distribution used to determine the delta factor at the centre and near the side of a river.

#### 4.2.1 Pressure differences at bridge piers (the new approach):

A method first investigated in the late 1990's (Retief, Rooseboom 1998) and improved on in 2000 (Meyer, Rooseboom 2000) (Cloete, Rooseboom 2000), has proven itself reliable through extensive laboratory testing and trial tests in a river.

This technique of velocity measurement has been used in the aviation industry for decades, namely the pitot tube. Here it is applied to measure water velocity in a river,

and instead of using a fixed wing as a supporting structure for the pressure meters, a bridge pier in the main stream is used. The method of application relies on energy principles: Bernoulli's equation.

This technique involves measuring dynamic pressure against the upstream face of a bridge pier and static pressure against the downstream side of the pier. Given the difference in pressure, one can determine the velocity at the pier using Bernoulli's total energy equation. Through the laboratory tests, a discharge coefficient has been determined to translate the measured velocity into a true velocity, since the pier width and length influence the normal stream flow.

**Table 4.1** shows results from Meyer and Rooseboom for a typical bridge pier under drowned flow conditions downstream. Note that the table makes allowance for different widths and lengths of the pier, with  $b_p$  being the width of the pier and B being the influential width of the pier: a distance equal to the centreline distance between two adjacent piers. The letter L denotes the length of the pier, upstream to downstream side.

Table 4.1: Meyer and Rooseboom (2000) discharge coefficients for different size bridge piers tested in a laboratory.

*Discharge coefficier Parallel approachin Drowned conditions	n <b>ts for different size brid</b> ng flow <sub>p</sub> s prevail downstream of th	<b>ge piers</b> ne bridge pier	
	$L/b_{p} = 6.9$	$L/b_{p} = 5.6$	L/b <sub>p</sub> = 4.2
	(Long)	(Medium)	(Short)
B/b <sub>p</sub> = 19.0	0.98	0.97	0.98
3/b <sub>p</sub> = 15.2	0.99	0.99	1.00
3/b <sub>p</sub> = 12.2	0.98	0.97	0.98
3/b <sub>p</sub> = 9.7	0.96	0.97	0.97
\* The pressure gauges in this case were mounted close to the base of the pier. Different values may be expected if the pressure gauges are mounted higher up against the pier. Refer to Cloete and Rooseboom (2000) where one set of pressure gauges was mounted near the water surface. The discharge coefficient in this case was in the vicinity of 0.8.

For the purpose of this exercise the Velocity coefficient  $(C_v)$  may be assumed equal to the Discharge coefficient  $(C_d)$  obtained through laboratory testing by Meyer & Rooseboom (2000). The formulae for determining the point velocity using this method is as follows:

Theoretical velocity  $V_t = \sqrt{2gh}$  as derived from Bernoulli's equation h = height difference between static and dynamic pressure

To translate this value to a real point velocity, it must be factorised with an appropriate value from Meyers' table.

Real velocity  $V_r = Cv \times V_r$ 

This represents real velocity at the base of the pier, and must be converted into depth averaged velocity for the vertical stream element.

#### 4.2.2 Surface velocity measurements

There are several methods for determining surface velocity. Some are mentioned below:

• Surface velocity determined using float gaugings: Bright coloured floats are dropped into the main stream, upstream of a selected reach in the river. Using a stopwatch the time is taken for the float to travel a fixed distance.

 Another approach is Particle Image Velocimitry (PIV). A sequence of digital photographs of the water surface, 30 frames per second, allows one to follow the path of a most likely group of pixels (Bradley et el, 2003). The pixel-group movement may be converted into surface velocity.

#### 4.2.3 Sub surface velocity measurements:

Velocity measurements, using a velocity meter suspended on a rod or cable beneath the water surface, gives accurate readings. Several types of velocity meters are available on the market, for example the propeller type, an electromagnetic type or an acoustic Doppler meter.

## 4.3 Depth Averaged Velocity for a vertical stream element:

The average velocity of a vertical stream element can be either measured with a current meter, measuring velocity at several different intervals from the top to the bottom of a vertical stream element and drawing the profile, or by applying the well known Vanoni equation (1941) and calculating the average velocity from a measured point at the surface for example.

Using a current meter: As previously mentioned the current meter is an accurate measuring instrument, and there are various types available on the market. It can be lowered to the bottom of the stream, and measure velocity at different depths. Report no. 13 of the World Meteorological Organization (WMO) (1980) on Operational Hydrology describes several methods of measuring depth average velocity. Two methods commonly used in the RSA by DWAF are the six-tenths method and the three-point method. These types of measurement are only possible in favourable conditions.

• Applying Vanoni's equation: The depth averaged velocity (V) of a vertical stream element is obtained by applying an equation derived by Vanoni (1941), to any measured point velocity, if the depth of measurement relative to the total stream depth is known.

$$u = V + \frac{1}{K} \sqrt{gy_0 S} \left( 1 + 2.3 \log \frac{y}{y_0} \right)$$
 (Equation 4.2)

Where	<b>y</b> 0	=	water depth at point of measurement
	u	=	velocity at distance y from channel bed
	K	=	von Kármán constant, having a value of about 0,4 for
			clear water
	V	=	mean velocity
	S	=	bed slope

A typical velocity curve was also obtained through intensive investigation of vertical velocity curves by Hulsing, Smith and Cobb (1966). The following graph, **Figure 4.2**, gives the average ordinates of the vertical velocity curve.



Figure 4.2: The typical vertical velocity curve by Hulsing, Smith and Cobb (1966)

\* Depth ratio is the ratio of observation depth to depth of water, Velocity ratio is the ratio of point velocity to mean velocity in the vertical.

The average velocity may be determined from any single point velocity measured at a known depth ratio.

## 4.4 Calculation of total discharge

Having determined the depth averaged velocity for a vertical stream element, one may calculate the average velocity for the river by applying the delta-factor. Hence total discharge is determined as the area of discharge should be available.

$$Q = \Delta \times V_{da} \times A \tag{Equation 4.3}$$

Where

- Q = total discharge
- $\Delta$  = delta-factor which converts depth averaged point velocity (V<sub>da</sub>) to average river velocity
- $V_{da}$  = depth averaged velocity for a vertical stream element at an appropriate location within the section

A = discharge area

Chapters 5, 6 and 7 deals with methods of determining the velocity distributions in rivers to enable deriving of accurate delta-factors, resulting in reliable total discharge.

## 5 METHODS OF DETERMINING LATERAL VELOCITY DISTRIBUTIONS

The focus of this research is to find a theoretical approach for determining the lateral velocity distribution for single- or compound river sections, "physical measurement of the velocity distribution is subject to typical measurement problems, which is why a theoretical velocity distribution is necessary for the Single Point Velocity method to be of practical use" (van Heerden 2001). It is emphasized that a theoretical approach should closely simulate a measured velocity distribution, bringing into account the energy losses encountered at the sides of the cross section. This work mainly looks at compound channels, as a theory developed for compound channels should also model single concave channels.

This work does however investigate over 100 physical gaugings done in 13 different rivers, with an average of 20 point velocities measured per gauging. This is to analyse velocity profiles for different discharge rates in typical rivers. (Chapter 6.)

Accurate prediction of the lateral velocity profile is the key to the success of the Single Point Velocity measurement method: an accurate prediction of the lateral velocity distribution is necessary for the calculation of the delta-factor which is used to convert the depth averaged velocity into an average velocity for the river cross section as a whole.

The lateral velocity profile is determinable either through direct measurements, or by means of a mathematical model, predicting the profile by taking into account energy losses due to vortices and secondary currents in the stream.

#### 5.1 Physical Measurements:

Using a current meter to determine velocities at several chainages across a river will produce an accurate lateral velocity distribution. Unfortunately some river sections are inaccessible during floods, or conditions in flooded rivers (such as high debris load) do not permit instruments to be lowered into the water. Often in arid regions high intensity rainfall leads to flash floods in several rivers simultaneously, with limited resources one is not always able to measure all the streams at once.

## 5.2 Theoretical approach to lateral depth-averaged velocity distributions

A reliable mathematical model would allow for a large number of lateral velocity distributions for different stage heights. Only a few are required to determine the single point velocity factor, delta, for a point in the middle of the river. Generally delta will stay the same for the different stage heights. The only variation of this rule is in the case of a compound channel, when flood water spills over the flood plain and changes the shape of the lateral velocity profile. This has been witnessed in the analysis of the field data which is discussed in chapter 6.

It is important to note that the lateral velocity distribution profile, and the resulting single point velocity factor, delta ( $\Delta$ ), are not dependent on the river bed-slope: for a given cross section, a change in bed slope would not change the profile of the lateral velocity distribution but only its magnitude. Subsequently the average velocity will also change; therefore the delta-factor will stay the same. A supporting statement by Myers (1987) reads as follows, "Lateral depth-averaged velocity distributions for one cross section are independent of channel bed slope, as predicted by theory."

#### 5.2.1 One dimensional flow theory

Most commonly the Manning or Chezy formula is used to calculate the average velocity in the vertical for any given point laterally across a river. In so doing a distribution may be determined, but this may grossly overestimate velocities near the river edge or close to the interface between a main channel and flood plain. See **Figure 5.1**.



Figure 5.1: Comparison of a measured velocity distribution and a calculated velocity distribution using Manning's one-dimensional equation.

Garbrecht & Brown (1991) state that Manning's uniform flow formula has been empirically developed from undivided cross-section data with a single mean flow velocity. It's application to each section element of a cross-section divided into several elements, creates a lateral velocity gradient: each element is considered an independent channel with frictionless walls and no lateral momentum exchange, which is incorrect. This approach would however be correct for an infinitely wide channel with uniform depth and roughness. This method however is very attractive due to its simplicity. Suitable correction factors, such as the Ø-indices by Wormleaton and Merrit (1990), the Weighted Divided Channel Method using the single parameter,  $\xi$ , by Lambert and Myers (1998) or the DISADF by Ackers (1993) help to solve the problem of energy losses when using one dimensional flow formula. However they only make adjustments for the average velocity of the whole cross section, or for the main channel and flood plain separately in the case of compound channels. They do not produce an accurate lateral velocity distribution, which is essential for determining the delta-factor.

#### 5.2.2 Two- and Three-dimensional flow theory

Flow structures in compound rivers are complex and require a 3-dimensional analysis for correct interpretation. Tominagu & Nezu (1991) measured the 3-D turbulent structure of a model compound section, using a Fibre-Optic Laser Doppler Anemometer (FLDA). Longitudinal and vertical axis vortices were encountered. In **Figure 5.2** velocity vectors are plotted on a plane normal to the streamwise direction.



Figure 5.2: Vectors indicating velocity components normal to the flow direction in a compound channel cross section.

#### 5.2.2.1 The Three-dimensional theory:

The well-known Navier-Stokes partial differential equation for three-dimensional flow has no analytical solution, and must therefore be solved numerically. The Navier-Stokes equation reads as follows:

$$\rho \left[ \overline{V} \frac{\partial \overline{U}}{\partial y} + \overline{W} \frac{\partial \overline{U}}{\partial z} \right] = \rho g \sin \theta + \frac{\partial \tau_{yx}}{\partial y} + \frac{\partial \tau_{zx}}{\partial z}$$
 (Equation 5.1)

where

 $\{\overline{U}, \overline{V}, \overline{W}\}$  are local mean velocities in the x (streamwise), y (lateral) and z (normal to bed) directions

 $\rho = \text{density of water}$ 

g = gravitational acceleration

 $\theta$  = the bed slope (S<sub>0</sub> = sin  $\theta$ )

 $\tau_{ij}$  = shear in the j-direction perpendicular to the i-direction

There are computer packages available which apply the Navier-Stokes equation to calculate discharge or stage height for given data, such as Delft 3D or FAST3D, but these programs are expensive to purchase and not a feasible option for all river engineers. "Solution of three dimensional flow formulae for compound channels produce high levels of accuracy, but are very complex and time consuming. The detailed description of flow and the levels of accuracy produced by these methods are not always required in practice" (Wormleaton, 1988).

#### 5.2.2.2 The Two-dimensional theory:

Three two-dimensional equations were considered, of which two were used in the theoretical approach described in detail in chapter 7. Here follows the three equations:

1) Shiono and Knight (1991) integrated the Navier-Stokes equation over depth. This produced a depth averaged-velocity equation, simpler in solution than the Navier-Stokes equation (refer to chapter 3.11):

$$\rho g H S_0 - \rho \frac{f}{8} U_d^2 \sqrt{1 + \frac{1}{s^2}} + \frac{\partial}{\partial y} \left\{ \rho \lambda H^2 \left( \frac{f}{8} \right)^{\frac{1}{2}} U_d \frac{\partial U_d}{\partial y} \right\} = \frac{\partial}{\partial y} \left[ H \left( \rho \overline{U} \overline{V} \right)_d \right] \quad (Equation 5.2)$$

where f is Darcy-Weisbach friction factor:  $f = 8 \frac{\tau_b}{\left(\rho U_d^2\right)}$ 

- $U_d$  = depth averaged streamwise velocity
- $\tau_b$  = the local bed shear
- s = the channel side slope (1 : s, vertical : horizontal) and

- $S_0 =$  channel bed slope
- H = flow depth
- $\lambda$  = the dimensionless eddy viscosity coefficient given by

$$\bar{\varepsilon}_{yx} = \lambda H \left(\frac{f}{8}\right)^{\frac{1}{2}} U_d$$

where  $\varepsilon_{yx}$  is the depth averaged eddy viscosity

$$\tau_{yx} = \rho \varepsilon_{yx} \frac{\partial U_d}{\partial y}$$

2) Wark, Irvine and Samuels (1990) also integrated the Navier-Stokes equation over depth to produce a two-dimensional equation for steady turbulent flow which allows for lateral shear.

$$gDS_{xf} - \frac{Bf|U|U}{8} + \frac{\partial}{\partial y} \left[ v_t D \frac{\partial U}{\partial y} \right] = 0 \qquad (Equation 5.3)$$

Where

 $B = (1 + S_x^2 + S_y^2)^{\frac{1}{2}}$ : a factor relating to stress on an inclined surface to stress in the horizontal plane

D = flow depth

$$f = \frac{8gn^2}{D^{\frac{1}{3}}}$$
 (The Darcy friction factor)

- g = gravitational acceleration
- Sx = Longitudinal slope of channel bed
- Sy = Lateral slope of channel bed
- x = Longitudinal coordinate direction

y = Lateral coordinate direction

- U = longitudinal depth averaged velocity
- $v_t = Lateral eddy viscosity$

**3) Wormleaton (1988)** derived a differential equation from first principles, the DELV equation, which corresponds with the Wark, Irvine and Samuels version of the Navier-Stokes equation:

$$gS_0 - \frac{fU|U|}{8h} + \frac{\partial}{\partial y} \left( v_t \frac{\partial U}{\partial y} \right) = 0$$
 (Equation 5.4)

Where:

- U = Local depth averaged velocity
- f = Darcy-Weisbach friction factor.
- $v_t$  = Depth averaged kenematic eddy viscosity

$$h =$$
 Flow depth

$$t_t = \lambda U_* h$$

$$U_* = \sqrt{\frac{\tau_b}{\rho}}$$

 $\tau_b = \rho g R S$  with R = hydraulic radius and S = bed slope

In Chapter 7, the Wark, Irvine and Samuels (1990) and the Wormleaton (1988) equations are used to determine lateral velocity distributions, and the resulting data are analysed.

## 6 FIELD DATA

The field data is analysed to provide a benchmark with which to compare the theoretical distributions, but also to see whether in practice fixed patterns exist in the velocity distributions for different discharges at the same river section.

Field data, in the form of flow measurements done by DWAF over an extended period of time, has been used: DWAF have collected several hundred, even thousands of flow measurements over the past 40 years. These vary from relatively low flow- to flood measurements in small and large rivers, and in canals. Nearly all the measured data have been gathered for the purpose of extending the calibration of gauging weirs.

In collaboration with DWAF, 13 relatively large rivers were selected for analysis. Criteria for selection were availability of flood measurement data, single-channel cross section and straight river sections upstream from the point of measurement. Approximately 8 gaugings per river were selected, all taken at the same place. The data was processed and is attached as **Appendix H**.

All these measurements were done with either a propeller or electromagnetic type flow meter, and according to the methods as described in the World Meteorological Organization report no. 13 on operational hydrology of 1980: Manual on stream gauging, volume 2, fieldwork. The six-tenths, 2-point and 3-point methods were mostly used.

### 6.1 Selection of appropriate river flow-data

For the purpose of this research, the appropriate river sections where velocity measurements had been taken should be prismatic, with well defined banks, of relatively large capacity and with a single cross section where all the data had been measured, i.e. a fixed cableway or a bridge.

Concerning discharge rates for the selected measurements, only high flows were considered. Flood measurements with over-bank flow, when encountered, were selected. It is assumed that during floods or relatively high discharges, all water can be considered to move in a stream-wise direction given a well-defined prismatic stretch of river.

These requirements were discussed and agreed upon in a meeting between the author and several DWAF officials of the Hydrology Division in Pretoria, August 2001. See **Appendix A** for minutes of the meeting.

## 6.2 Preparation of field data for use

For each individual river, the field data had to be aligned to be of practical use: in practice, DWAF officials usually take the waters edge as the zero for the cross section chainages when doing flow measurement laterally across in a river. So when plotting the cross sectional data for different magnitude floods at the same river section on a depth to width axes (water surface is zero for depth), the cross sections for different size flow measurements are not aligned around some common centre point.

See Figure 6.1. For each measurement the left bank water edge is taken as zero. The legend block XS (Q298), denotes the cross section for the discharge of 298  $m^3/s$ . The DWAF number for the station is C8H030.

To align the cross sections, the largest magnitude flood was selected as datum for width and depth. Common features on the cross sections were identified and used to make horizontal shifts in the lower magnitude flow data. Thus the common features are aligned and the centre of the river is the same for lower and higher magnitude floods. (See Figure 6.2 below).



Figure 6.1: Unaligned cross section data for the Wilge river near Kimberley.



Figure 6.2: Aligned cross section data for the Wilge river near Kimberley.

#### 6.3 Lateral velocity distribution

With the cross sections aligned for each selected river, the distribution of measured mean velocity could be plotted. These plots fitted quite well for fixed bed river sections and different size discharges. See **Figure 6.3**.The Klip river at De Langes Drift, DWAF no. C1h015. The legend block, V (Q113) and XS (Q113), denotes velocity distribution and cross section profile for the discharge of 113 m<sup>3</sup>/s. Note that the depth scale is factored by 0.1.

Exceptions were two cross sections where erodeable bed material was present. The erodable bed channels varied in cross section profile and also in velocity distribution. This can be attributed to seasonal meandering taking place within the confines of the main river channel. See **Figure 6.4** which shows non-uniformity for velocity profiles of different size floods. The legend block, V (Q403) and XS (Q403), denotes velocity distribution and cross section profile for the discharge of 403 m<sup>3</sup>/s. Note that the depth scale is factored by 0.5.



Figure 6.3: The fixed river bed produces a relatively fixed velocity profile for different discharges in the Klip river at De Langes drift.



Figure 6.4: An erodable river bed influences the velocity profile for different size discharges in the Orange river at Oranjedraai, DWAF no. D1H009.

In other cases where compound channel flows occurred, a definite reduction in velocity is observed at the interface of the main channel and floodplain. This phenomenon is a result of momentum transfer between the main channel and flood plain (Lambert & Myers, 1998; Wormleaton & Merrit, 1990) and secondary currents (Tominaga & Nezu, 1991).

Another phenomenon is noticed in the velocity distribution of the compound river channel. This is when coherence (COH) approaches unity, as described by Ackers (1991): "the instance where section hydraulics for a compound channel approaches that of a non-compound channel". The turbulence caused by momentum transfer between a main channel and floodplain disappears and the channel exhibits the characteristic flow distribution of a single concave channel.

An example of this was found in a compound river section in the Wilge river near Kimberley (See Figure 6.5): for a discharge of 298 m<sup>3</sup>/s, all flow was confined to the

main channel resulting in a simple convex-curve velocity distribution. At a higher discharge of 1251 m<sup>3</sup>/s a typical double curve distribution, as associated with energy losses at the main channel-floodplain interface, is noticed, then for a discharge of 1876 m<sup>3</sup>/s the distribution takes on a single convex shape again as associated with a simple concave channel. The legend block, V (Q298) and XS (Q298), denotes velocity distribution and cross section profile for the discharge of 298 m<sup>3</sup>/s. Note that the depth scale is factored by 0.2.



Figure 6.5: Velocity distributions go through 3 distinctive phases for different discharges in a compound river section at the Wilge river near Kimberley.

## 6.4 Determine the Delta-factor from field data

The delta-factor was determined at several points laterally across the main channel of each river: Consider the main channel left bank as 0% and the right bank as 100% of the channel width, then the delta-factor was determined at 20-, 30-, 40-, 50-, 60-, 70- and 80% of the distance laterally across the main channel. This was a suggestion made

by Dr. Pieter Wessels during a meeting with DWAF officials specializing in open channel flow measurement in RSA (see **Appendix A** for minutes of the meeting). In so doing one may notice the effect on the delta-factor as one moves away from the centre of the river towards the side.

The approach followed above proved quite useful: Performing a statistical analysis on the delta-factors at these points, a central zone in the river was identified in which one may safely apply the single point velocity method to determine discharge within a reasonable margin of error. The nearer one moves to the side, the larger the probable error becomes. Refer to the results in section 6.5.1.

One may assume that the highest velocities occur in the centre of the river, where the lowest energy losses occur: Translational energy losses are greatest at the side of a river (Tominaga & Nezu, 1991)

#### 6.4.1 Calculating delta ( $\Delta$ )

With the field data prepared, as described in 6.2, the next step in determining the deltafactor was to identify fixed boundaries for the main channel, which would apply to the lower and the higher discharges. This was done visually. Stage-heights far below the banks of the river were not included in this study as a velocity measurement at say 20% or 80% of channel width might be near zero or worse even on dry ground, since the top of the main channel banks represented 0% and 100% of the width.

See **Figure 6.6** for a typical representation of the main channel boundaries. For calculation of delta( $\Delta$ ), the centre of the main channel remains fixed at 50% main channel width, irrespective of flow depth.



Figure 6.6: Choosing the left bank and right bank of the main channel for a typical compound river section.

With the banks fixed, a simple calculation produced chainage distances (laterally across the river) for 20% to 80% in 10% increments. The result was several distances in meters measured from some distant zero point on the left bank of the river.

Since physical measurements across a river are taken at intervals varying between 2 and 10 meters, depending on the width of the river and available time to do the measurements, it so happens that the calculated distance to determine delta( $\Delta$ ) does not coincide with an actual point of measured velocity. In these cases the velocity was interpolated.

**Table 6.1** presents a typical table layout used in MS Excel to calculate the measured velocity distribution and the delta-factors.

**Methodology**: In a typical DWAF current gauging (refer **Table 6.1**), velocity (Column 4, 5 & 6) is measured at several chainage distances laterally across a river (Column 2). The area (Column 8) for each depth averaged velocity measurement (Column 7) is determined and hence discharge through that area is calculated (Column 9). Summation of all these component discharges produces a total discharge.

At some fixed points across the river, delta is determined by dividing each point velocity by the total average velocity. See **Table 6.1**. For this field data, the 3-point method of measurement was applied, which is considered very accurate.

Table 6.1: This table represents a typical current gauging by DWAF. The smaller table at the bottom indicates percentages and the actual chainages at which  $delta(\Delta)$ , in the last column, was calculated..

STA	TION No. :	D1H003			STAR	TTIME :	09h10				
RIVE	R NAME :	Oranje	****	Average	Gaugeplat	te reading :	1.881	m			
PLAC	E NAME :	Aliwal Noor	d								
	DATE :	1994/02/12			Main Channel LEFT : Main Channel RIGHT :		50 160				
1	2	3	4	5	6	7	8	9			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q			
number	(m)	or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)			
		depth (m)	(m/s)	(m/s)	(m/s)	2.102	433.4	911.08			
1	31	0	0	0	0	0.000	0.0	0.00			
2	36	0.195	0	-0.404	0	-0.404	1.0	-0.39			
3	41	0.38	0	-0.222	0	-0.222	1.9	-0.42			
4	46	1.39	0	0.324	0	0.324	7.0	2.25			
5	51	2.17	0.391	0.902	1.349	0.886	10.9	9.61			
6	56	1.52	1.176	1.437	1.842	1.473	7.6	11.19			
7	61	2.08	1.015	1.277	1.665	1.309	10.4	13.61			
8	66	2.87	1.243	1.382	1.716	1.431	14.4	20.53			
9	71	3.7	1.441	1.745	1.669	1.650	18.5	30.53			
10	76	4.277	2.23	2.104	1.56	2.000	21.4	42.76			
11	81	5.367	2.205	2.458	2.015	2.284	26.8	61.29			
12	86	4.577	2.618	2.564	2.256	2.501	22.9	57.22			
13	91	4.696	2.407	2.72	2.433	2.570	23.5	60.34			
14	96	4.746	2.407	2.884	2.572	2.687	23.7	63.76			
15	101	5.182	2.294	2.741	2.897	2.668	25.9	69.13			
16	106	5.081	2.197	2.745	2.985	2.668	25.4	67.78			
17	111	5.313	0	2.576	0	2.576	26.6	68.43			
18	116	5.307	0	2.31	0	2.310	26.5	61.30			
19	121	5.24	0	1.893	0	1.893	26.2	49.60			
20	126	5.402	0	2.201	0	2.201	27.0	59.45			
21	131	3.929	0	2.559	0	2.559	19.6	50.27			
22	136	3.889	0	2.618	0	2.618	19.4	50.91			
23	141	3.441	1.838	2.18	2.294	2.123	17.2	36.53			
24	146	3.167	1.475	1.361	1.205	1.351	15.8	21.39			
25	151	1.29	0	0.294	0	0.294	6.5	1.90			
26	156	1.55	0	0.29	0	0.290	7.3	2.13			
27	160.46	0	0	0	0	0.000	0.0	0.00			
50											
						2.102	433.4	911.08			
	Delta value calculations										
	Percntge	Act. Chn.	Ch-Low er	Ch-Upper	V-low er	V-Upper	V-Int	Delta			
	30%	83.0	81.00	86.00	2.28	2.50	2.37	0.89			
	40%	94.0	91.00	96.00	2.57	2.69	2.64	0.80			
	50%	105.0	101.00	106.00	2.67	2.67	2.67	0.79			
	60%	116.0	116.00	121.00	2.31	1.89	2.31	0.91			
	70%	127.0	126.00	131.00	2.20	2.56	2.27	0.93			

The measured data and calculated delta-factors of which a typical example is presented in **Table 6.1** above, are shown in **Appendix H** for all the river gaugings (approximately 90). A graphical representation of the cross section profile, velocity profile and delta factors are also shown in **Appendix H**.

# 6.5 Statistical analysis of the delta-factor determined from the field data.

A statistical analysis of the delta-factors derived from measured data was done to ascertain whether these observations were substantial enough to produce delta-factors which could be applied to any river cross-section in general, or to specific profile sections, e.g. parabolic, trapezoidal, compound, and still maintain an acceptable level of accuracy.

The criteria for analysis was the average delta-factor at 20%, 30%, 40% up to 80% of the main channel width, and secondly the standard deviation of delta at each of the above intervals.

Firstly all data was used disregarding section geometry; secondly the data was grouped according to similar section profiles and re-analysed. See **Appendix B**. The geometry specific section profiles investigated were:

- Rectangular width over depth ratio approximately 20
- Trapezoidal width over depth ratio approximately 20
- Parabolic width over depth ratio approximately 10

#### 6.5.1 Results

From the results it can be seen that for all river cross sections an approximate delta value of 0.8 applied in the centre of the river will produce an average velocity with a

standard deviation of 12 % from the actual velocity. When considering profile-specific cross sections, such as rectangular or trapezoidal, the standard deviation reduces to 3- or 5%, which is quite promising. Refer to **Table 6.2** which contains results for the delta values at the centre of each river.

Table 6.2: This table represents a summary of results in Appendix B

Chainage as a percentage of channel	All meas comb 14 river	ured data bined: sections	Rectangular fixed bed sections: 3 river sections		Trapezium sections: 3 river sections		Parabolic section: 1 river section	
width	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard
	average	deviation	average	deviation	average	deviation	average	deviation
40%	0.81	0.10	0.77	0.05	0.83	0.03	0.68	0.06
50%	0.81	0.12	0.78	0.05	0.81	0.05	0.66	0.04
60%	0.84	0.12	0.82	0.07	0.82	0.10	0.75	0.05

Statistical analysis of Delta-factors for combinations of measured data

The standard deviation around the centre of the main channel is relatively low opposed to the deviations closer to the rivers edge. For this reason application of this method must be as close to the centre of the main channel as possible. The results for the different analyses are discussed below.

#### Results of all data combined.

The entire population of data, 79 river gaugings with 7 delta-factors calculated for each gauging (from 20% to 80% main channel width), was used for this analysis. Despite the wide variety of section geometries the data compared fairly well: the average delta-factor for the centre of the river is 0.81 with a standard deviation of 0.12. The two adjacent delta factors, at 40% and 60% channel width, are 0.81 and 0.84 with standard deviations of 0.1 and 0.12 respectively.

Further away from the channel centre, 30% and 70% and beyond, the delta-factor becomes 0.9 and higher, with standard deviations of 0.18 up to 2.11.

#### **Results for similar geometry sections**

When considering sections of similar geometry, the delta factor becomes geometryspecific: for deep parabolic sections the delta–factor in the river centre is around 0.67 and for trapezium- or rectangular cross sections the delta factor is around 0.77. In all these cases the standard deviation is less than 0.05....which is very good.

Therefore determining the geometry-specific velocity profile, via direct measurement or an accurate theoretical model, would produce river discharges well within the 10% level of accuracy required by DWAF (See **Appendix A**).

**Table 6.2** indicates a summary of the most important results, **Appendix B** contains the complete set of statistical results and indicates the river sections associated with the geometry specific results.

## 7 THEORETICAL VELOCITY DISTRIBUTION

Three approaches were considered in order to find a method which closely represents the measured field data distribution, namely one-dimensional and two-dimensional theory, and an empirical approach.

#### 7.1 One-dimensional theoretical approach

For the one-dimensional theory on flow velocities, Manning's formula was used due to its simplicity. In MS-excel a spreadsheet was set up, using the chainages and depths measured during the field measurements. Assumptions were made for three parameters used in Manning's formula. These were:

*First assumption:* Manning's n-values for the main channel and river banks were not included in the available field data and are therefore taken from a general table (Road drainage manual, RSA) and applied to all cross sections.

<u>Second assumption</u>: Bedslope - The assumption is that the maximum calculated velocity is equal to the maximum measured velocity in the centre of the river: at the centre of a river where velocities are expected to be the highest, energy losses are low as it is assumed that no vertical or lateral velocities are present. Therefore all available energy produces streamwise motion. Using this as a guideline, the river bed slope is adjusted until the maximum calculated velocity equals maximum measured velocity.

**Third assumption:** The hydraulic radius (R) for Manning's formula is taken as equal to depth for each point velocity calculated:  $R \approx y$ . This would only apply to very wide sections with a constant depth.

Manning's formula reads as follows:

$$V = \frac{1}{n} R^{\frac{2}{3}} S_0^{\frac{1}{2}}$$
 (Equation 7.1)

with V = velocity

n = Mannings roughness coefficient R = hydraulic radius  $S_0 = bed$  slope

It must be kept in mind that the use of Manning's formula in this case is not to determine discharge, but only the lateral velocity profile and average velocity to enable the calculation of the delta-factor.

For each measured velocity profile, a one-dimensional velocity profile and a range of Delta-factors were determined. This produced a large population of data for statistical analysis and comparing with the measured velocity data.

#### 7.1.1 Results for one-dimentional theoretical approach

In all cases the one-dimentional approach (Manning's formula) overestimated the average velocity, resulting in a total over-estimation of discharge by about 10% when compared to the measured data.

See Appendix H for the Manning-calculated delta-factors. Table 7.1 indicates a summary of the most important statistical results. Appendix B contains the complete set of statistical results and indicates the river sections associated with the geometry specific results.

Table 7.1: This table represents a summary of results in Appendix C



#### 7.2 Two-dimensional theoretical approach

Two attempts were made to numerically solve the partial differential equations as presented by Wormleaton (1988) and by Wark, Irvine and Samuels (1990). The first attempt was to solve the Wormleaton equation as an initial value problem using the Fourth-Order Runga-Kutta Formula (Advanced Engineering Mathematics; Zill & Cullen; 1992). The second attempt was to solve the Wark, Irvine and Samuels equation as a boundary value problem using Finite-Difference Methods for Nonlinear Problems (Numerical Analysis, Third Edition; Burdon & Faires; 1985).

#### 7.2.1 Initial value problem:

For this approach, only half of the river width is considered. The motivation for this is that the lateral velocity-gradient in the middle of the river equals zero, therefore no transverse velocities occur at this point. This gives reason to believe that conditions either side of the centre do not influence each other. Using Mannings 1-dimentional formula, an initial value is calculated for the centre of the river in order to apply the Fourth-Order Runga-Kutta method. The Wormleaton equation as described in section 5.2.2 is presented below:

$$gS_0 - \frac{fU|U|}{8h} + \frac{\partial}{\partial y} \left( v_t \frac{\partial U}{\partial y} \right) = 0$$

(Equation 7.2)

is solved as follows:

$$gS_0 - \frac{fU|U|}{8h} + v_t \frac{\delta^2 U}{\delta y^2} = 0$$

It can now be written in a form suitable for solving using Runga-Kutta:

$$\frac{\delta^2 U}{\delta y^2} = \frac{fU^2}{8hv_t} - \frac{gS_0}{v_t}$$

Which is similar to:

$$\frac{\delta^2 U}{\delta y^2} = C_1 U^2 - C_2$$
  
Let  $\frac{\delta U}{\delta y} = V$  then  $\frac{\delta V}{\delta y} = C_1 U^2 - C_2$ 

after substitution of related formulae described in chapter 5, the constants C1 and C2 are as follows:

$$C_{1} = \frac{f}{8hv_{t}} = \frac{8gn^{2}h^{\frac{-1}{3}}}{8h(\lambda h\sqrt{gRS_{0}})}$$
$$C_{2} = \frac{gS_{0}}{v_{t}} = \frac{gS_{0}}{\lambda h\sqrt{RS_{0}}}$$

The fourth-order Runga-Kutta method is as follows:

$$U_{n+1} = U_n + \frac{1}{6} (m_1 + 2m_2 + 2m_3 + m_4)$$
 (Translational velocity)  
$$V_{n+1} = V_n + \frac{1}{6} (k_1 + 2k_2 + 2k_3 + k_4)$$
 (Lateral velocity)

where

$$m_{1} = hf(y_{n}, U_{n}, V_{n}) \qquad k_{1} = hg(y_{n}, U_{n}, V_{n})$$

$$m_{2} = hf\left(y_{n} + \frac{1}{2}h, U_{n} + \frac{1}{2}m_{1}, V_{n} + \frac{1}{2}k_{1}\right) \qquad k_{2} = hg\left(y_{n} + \frac{1}{2}h, U_{n} + \frac{1}{2}m_{1}, V_{n} + \frac{1}{2}k_{1}\right)$$

$$m_{3} = hf\left(y_{n} + \frac{1}{2}h, U_{n} + \frac{1}{2}m_{2}, V_{n} + \frac{1}{2}k_{2}\right) \qquad k_{3} = hg\left(y_{n} + \frac{1}{2}h, U_{n} + \frac{1}{2}m_{2}, V_{n} + \frac{1}{2}k_{2}\right)$$

$$m_{4} = hf(y_{n} + h, U_{n} + m_{3}, V_{n} + k_{3}) \qquad k_{4} = hg(y_{n} + h, U_{n} + m_{3}, V_{n} + k_{3})$$

## Sample calculation:

For a sample calculation, data was used from an actual flow measurement so that results could be compared. The river section is De Langes drift in the Klip river, DWAF station number C1H015. This is a compound river section. The flow rate was  $113 \text{ m}^3$ /s. See **Appendix D** for the sample calculation.

#### 7.2.2 Boundary value problem

The other approach was to solve the Wark, Irvine and Samuels formula as a boundaryvalue problem. This formula is similar to the Wormleaton formula, except for a factor (B) relating stress on an inclined surface to stress in the horizontal plane.

The approach is to solve the 2<sup>nd</sup> derivative with finite differences at a number of points on a grid between the fixed boundaries. This produces a system of equations to be solved simultaneously. However the system of equations that is derived will not be linear, so an iterative process is required to solve it. An MS Excel spreadsheet was used to do the iterations and produce results within a preset tolerance. A range of initial values for each grid point was determined using Manning's equation, these however changed during the iteration process.

The Wark, Ervine & Sammuels equation, as described in section 5.2.2, is presented below:

$$gDS_{xf} - \frac{Bf|U|U}{8} + \frac{\partial}{\partial y} \left[ v_t D \frac{\partial U}{\partial y} \right] = 0 \qquad (Equation \ 7.3)$$

The lateral shear part of the formula, which contains the second order partial differential, may be written in the Finite-Difference format as follows:

$$\frac{\partial}{\partial y} \left[ v_t D \frac{\partial U}{\partial y} \right] \bigg|_{y_i}$$

$$=\frac{1}{h}\left[\left(\nu_{t}D\frac{\partial U}{\partial y}\right)_{y_{i+\frac{1}{2}}} - \left(\nu_{t}D\frac{\partial U}{\partial y}\right)_{y_{i-\frac{1}{2}}}\right]$$

$$= \frac{1}{h} \left[ \left( v_t D \right)_{y_{i+\frac{1}{2}}} \frac{U_{i+1} - U_i}{h} - \left( v_t D \right)_{y_{i-\frac{1}{2}}} \frac{U_i - U_{i-1}}{h} \right]$$
$$= \frac{1}{h^2} \left\{ \left( v_t D \right)_{y_{i-\frac{1}{2}}} U_{i-1} - \left[ \left( v_t D \right)_{y_{i-\frac{1}{2}}} + \left( v_t D \right)_{y_{i+\frac{1}{2}}} \right] U_i + \left( v_t D \right)_{y_{i+\frac{1}{2}}} U_{i+1} \right\}$$

The finite difference equation, based on the above partial differential equation, is as follows:

$$gDS_{xf} - \frac{Bf|U|U}{8} + \frac{1}{h^2} \left\{ \left( v_t D \right)_{y_{i-\frac{1}{2}}} U_{i-1} - \left[ \left( v_t D \right)_{y_{i-\frac{1}{2}}} + \left( v_t D \right)_{y_{i+\frac{1}{2}}} \right] U_i + \left( v_t D \right)_{y_{i+\frac{1}{2}}} U_{i+1} \right\} = 0$$
(Equation 7.3a)

#### Sample calculation:

For a sample calculation, data was used from an actual flow measurement so that results could be compared. The river section is at De Langes drift in the Klip river, DWAF station number C1H015. The measurement was done in February 1975, and a discharge of 179.48 m<sup>3</sup>/s was measured.

For the sample calculation, the following values were used:

Roughness coefficient (n) = 0.035

Bedslope streamwise  $(S_x) = 0.0001$ 

Eddy viscosity ( $\lambda$ ) = 0.16 (Proposed by Wormleaton, 1988)

Water density ( $\rho$ ) = 1000 kg/m<sup>3</sup>

Other sample calculation data are:

Chainage distance = 25 m (The centre of the river)

Water Depth (D) = 8.6 m

Start velocity  $(U_i)= 0.9686$  m/s (This value is to change during subsequent iterations)

Step size of grid (h) = 0.5 m

Lateral bed slope  $(S_y) = 0.03$ 

Bed shear  $(\tau_b) = \rho g R S_0 = 9810 \times 8.6 \times 0.0001 = 8.437 \text{ N/m}^2$ 

Shear velocity (U\*) = 
$$\sqrt{\frac{\tau_b}{\rho}} = \sqrt{\frac{8.437}{1000}} = 0.0918 \text{ m/s}$$

Lateral eddy viscosity (v<sub>t</sub>) =  $\lambda U_*D = 0.126 \text{ m}^2/\text{s}$ 

Friction factor (f) = 
$$\frac{8gn^2}{D^{\frac{1}{3}}} = 0.0469$$

Inclined slope stress factor (B) =  $\sqrt{\left(1 + S_x^2 + S_y^2\right)} = 1.000555$ 

Substituting the above values in Equation 7.3a:

Through a process of iterations the solution of the above equation should converge to zero.

#### 7.2.3 Results for the two 2-dimentional theoretical approaches

#### Results for the initial value problem:

The results were unsatisfactory. Close to the middle of the river the calculated velocities appear correct, but as one approaches the side of the river, the velocity tends to infinity instead of converging to zero. See **Appendix D**. No illustration of results is

presented for this approach: The river edge becomes a vertical asymptote where velocity theoretically tends to infinity.

Upon close inspection of the formulae and the constants, it was found that  $C_1$  and  $C_2$  are divided by depth (h). So as depth approaches zero at the river side, these values increase. As no sensible results were obtained, another approach had to be followed.

#### Results for the boundary value problem:

A table of results for the Klip river data mentioned above is presented in **Appendix E**. The graph in **Figure 7.1** indicates the resulting calculated velocity distribution compared to the measured values. The calculated data was done for step sizes h = 1mand h = 0.5m. The smaller the step size, the more accurate the velocity distribution. The measurement was done in the Klip river at De Langes drift in February 1975, the discharge was  $179m^3/s$ .

The resulting distribution for step size h=0.5 compares reasonably well to the measured velocities, however one problem was encountered with this method. The computational capacity of the program was unable to meet the preset tolerance. Approximately 100 equations had to be solved simultaneously. After 150 iterations the computer ends its calculation process without having achieved the preset level of accuracy.

The results gained are displayed for the h=1m interval. The velocity distribution is not realistic since the interval size is too large, for h=0,5mm the velocity distribution actually did closely relate to measured values during one run, but the same interval size produced a less representative velocity distribution during a next run: Each run randomly changes the figures during the iterative process, but does not reach the preset accuracy as the program abruptly stops due to the computer program's limited computational capacity.



Figure 7.1: A comparison of a measured velocity distribution and two calculated distributions using the Finite-differences method with boundary values.

Further attempts with the difference equation, using a program with sufficient computational capacity would allow interval sizes of h=0.1 to be solved to a required level of accuracy which might achieve acceptable results.

## 7.3 Empirical Approach

Not having achieved satisfactory velocity distribution results with the one- and two dimensional flow formulae, as discussed in 7.1 and 7.2, an empirical approach was investigated.

It is quite clear that a fixed pattern exists in the velocity profile distribution of the different river sections: where side slopes are steep, the velocity profile is concave, contrary to the convex shape proposed by the one-dimensional formulae, and where overbank flow occurs a distinctive dip in velocity is noticed at the interface of the

horizontal floodplain and the steep side slope of the main channel. These patterns are due to a loss in translational energy, which is spent on generating rotational energy in these areas.

#### 7.3.1 Empirical Approach Philosophy

This approach is based on the following:

Hypothesis : Energy is constant across the river.

Motivation: Water reacts rapidly to eliminate energy imbalances.



*Figure 7.2*: A typical river cross section schematically depicting the energy components which make up the total energy level.

In the centre of a river the translational energy content is high and the rotational energy content is low, and vice versa near the side of a river. From **Figure 7.2** it follows that KE = TE + RE. (Rooseboom 1988). KE describes Kinetic energy, TE and RE describe Translational and Rotational energy respectively.

Variables controlling the stream flow: The empirical method considers the lateral bed slope and the depth ratio (point depth over maximum depth) as some of the variables instrumental to the loss of translational energy. Utilising the available field data, there are about 2000 measured points for which the lateral bed-slope and depth ratio could be determined.

The alpha ( $\alpha$ ) factor compensates for variations in velocity, likely to occur due to energy losses. For each of the above points, an alpha factor is determined. An attempt is made to find a fixed pattern between the bed slope, depth ratio and the alpha values. These parameters are presented in a three dimensional graph: bed slope and depth ratio represent the X- and Y-axis. The alpha( $\alpha$ ) values, as determined for each measured velocity, are plotted with respect to the bed slope and depth ratio. All alpha( $\alpha$ ) values of similar size are then joined to form iso-lines.

#### 7.3.2 Determining the Alpha( $\alpha$ ) factor

The kinetic energy in the centre of the river where maximum flow velocity  $(V_{max})$  occurs, is described as follows (refer to Figure 7.2):

$$KE = \frac{V_{max}^2}{2g} \qquad (Equation 7.4)$$

From the above hypothesis, energy is constant across the river. Therefore translational energy reduces toward the side of the river as translational velocity (V) decreases, and the balance is made up by the higher rotational energy component closer to the river bank. It therefore follows that:
$$KE = \frac{V^2}{2g} + \frac{(\alpha - 1)V^2}{2g}$$
$$= \frac{V^2}{2g} + \frac{\alpha V^2}{2g} - \frac{V^2}{2g}$$
$$= \frac{\alpha V^2}{2g}$$
(Equation 7.5)

V represents the depth averaged velocity for any point laterally across a river. From Equations 7.4 and 7.5 it follows that:

$$\frac{\alpha V^2}{2g} = \frac{V_{\text{max}}^2}{2g}$$

$$\alpha = \frac{V_{\text{max}}^2}{V^2}$$
(Equation 7.6)

In the middle of a river  $V = V_{max}$ . This produces an alpha value equal to unity. However as one approaches the side of the river, velocities approach zero, the result is very large alpha values at the river edge. The scale of alpha values then being between one and infinity. To curb this problem, a Beta ( $\beta$ ) value was derived by dividing the alpha values into one, this resulted in a scale ratio between one and zero which is much simpler to work with. A logarithmic scale was used to represent the bed-slope values, since many of the values are below 0.1 and 0.01: On a linear scale from 0 to 1, these values would seem to lie on top of each other preventing a proper distribution of their respective weights.

A new challenge arose while plotting the near 2000 beta values on one graph, it was near impossible to identify, let alone connect, similar sized beta values.

To solve this problem, nine different graphs were created for the beta values 0.1, 0.2, 0.3 up to 1.0, each rounded down to the closest 0.1. A best-fit power-function for each set of data was determined (See **Appendix F**). All the function lines were then plotted

on a graph without the scatter of data points. See **Figure 7.3.** Note that all beta functions, accept one, plot in a sequential order from 0.1 up to 1.0: The beta function of 0.7 plots beneath the 0.5 function line.



Figure 7.3: The combined beta-function plot representing all measured data.

To determine an alpha value for a specific point, one must merely calculate the bed slope and depth-ratio, read off the applicable beta value from the graph above and determine the alpha value by dividing the beta value into one.

Now, employing the above hypothesis that energy is constant across a river, one may determine a velocity for that point. Equation 7.5 may be rewritten as follows:

$$V = \sqrt{\frac{KE \times 2g}{\alpha}}$$

(Equation 7.7)

#### 7.3.3 Sample calculation

For the sample calculation the empirical approach was applied to a cross section in the Klip river at De Langes drift, DWAF station no. C1H015. Data was used from measurements done in February 1975. The calculations for the Alpha value and other parameters are presented in **Appendix G**. See **Figure 7.4** for a plot of the measured and calculated velocity distributions.

The following methodology describes a typical application of the Beta-graph for any given river cross-section. Note that the Beta-graph has been determined using over 2000 data points measured in 11 different rivers. Therefore it may be applied in general to any river.

- Firstly: Using one-dimensional velocity formulae such as Chezy or Manning, calculate the maximum depth averaged velocity at the centre of a river. Now calculate the kinetic energy using Equation 7.4. The hypothesis in section 7.3.1 applies: The energy level is constant laterally across the river.
- Secondly: For every point laterally across the river where a velocity is required, calculate the lateral bed slope and depth ratio  $\left(\frac{y}{y_0}\right)$ .
- Thirdly: Using the bed-slope and depth ratios, read off applicable beta values from the Beta-graph in Appendix F

Fourth: Calculate the alpha value for each of these points 
$$\left(alpha = \frac{1}{beta}\right)$$

Fifth: Now determine a velocity for each of the above points using equation 7.7



Figure 7.4: The new alpha-calculated velocity distribution (Alpha-V) compared to the measured velocity distribution (Meas-V).

#### 7.3.4 Results:

**The beta graph**: The distributions of functions representing beta values for points 0.1 to 0.6, and from 0.8 to 1.0 follow in a chronological order as one would expect. There is however a discrepancy with the function for the beta value 0.7, it plots below the 0.5 beta function.

This points out a discontinuity in the system, but does not indicate exactly where it is. Other variables will have to be considered to eliminate this discontinuity.

The velocity distribution: If one were to discard the 0.7 beta function as an "outlier", it was found that the velocity distribution determined by the beta graph does not fit the measured velocity distribution closely enough to claim success, see **Figure 7.4**: For the compound section in the Klip river, the empirical method does not describe the energy losses at the interface of the flood plain and main channel.

The new velocity distribution does however show a reduction in the floodplain velocities, hence reduces the error of overestimation when calculating the total discharge: When using the Manning equation to determine the velocity distribution, the discharge was overestimated by 20%, as concluded by Garbrecht and Brown (1991) when dividing a channel into 10 or more sub-divisions. Upon applying the beta-graph methodology as presented by this work, the overestimation of total discharge is only 10%.

However, the aim of the beta–graph method is not to determine discharge but to model the velocity distribution laterally across a river, in so doing the delta factor may be determined with which to translate a point velocity to average river velocity. Other researchers have dealt with adjustment factors applied to the DCM to accurately predict total discharge; Ackers (1993), Wormleaton & Merrit (1990), Stephenson & Kolovopoulus (1990). Therefore the beta-graph is not proposed as an adjustment factor for the DCM.

#### 8 SUMMARY OF METHODS APPLIED

To summarise the results of the approaches for determining velocity distributions in this work, the following:

#### General

In a nutshell, application of the method works as follows: a single point surface velocity in the centre of a river must be factored by 0.8 to obtain the depth-averaged velocity for the vertical stream element. This new velocity value must then be factored with the Delta-factor, which is approximately 0.8 in the centre of a river, to obtain the average velocity for the river as a whole. The product of average velocity and discharge area produces total discharge.

In the case of a float gauging, which is often used by DWAF, the float velocity must therefore be factored by 0.64 to obtain average velocity for the river as a whole, and not by 0.8 as mentioned in section 2.1 of this work.

Note that all approaches followed to determine the  $Delta(\Delta)$  factor are applicable to straight prismatic sections in rivers. The theory has not been tested within bends in a river, and it may be expected that bends directly upstream or downstream of the considered cross section may have an influence on the lateral velocity profile.

#### **One Dimensional Flow formula**

This approach is attractively simple, but it does not produce a lateral velocity distribution to the degree of accuracy one would require for the calculation of the Delta-factor. The One-dimensional formulae do not bring into account energy losses due to transverse flow which results in an overestimation of velocity and thus discharge. However applying correction factors as suggested by Ackers (1993), Wormleaton & Merrit (1990), Stephenson & Kolvopoulus (1990), one could accurately calculate the total discharge for

the river as a whole, or separately for the main channel and floodplain in the case of compound channels.

#### Two Dimensional Flow Formula: Initial value approach

This method did not produce useable results. It is suggested that no further investigation is done considering the Runga-Kutta approach to numerical analysis. The Wormleaton equation, which was used in this approach, however should produce better results when using another mathematical model.

#### Two Dimensional Flow Formula: Boundary value approach

This method did show promising results, although not to the required degree of accuracy. The iterative process is not yet complete and may require a specialized program to attain an acceptable level of accuracy.

This method is not reliable at this stage, but promises to be a serious contender for a reliable approach to the theoretical velocity distribution.

#### **Empirical approach**

The empirical approach is simple and easy to apply. The basic theory is practical and the application robust. A glitch in the set-up however prevents a flawless distribution of the beta functions in the Beta-graph. To rectify this, fine tuning of the existing Beta-graph and further investigation into variables controlling stream flow are required.

Approximately 2000 real data points were used to set up the Beta-graph. Application of this method, regarding Beta = 0.7 as an outlier, produce a velocity distribution much closer representing the actual average velocity than does the One-dimensional flow formulae. This approach may be applied if kept in mind that the method needs refinement.

#### Analysis of field data

This showed the most promising results of all approaches. Geometry specific calculation of the Delta-factor produced values which gave results within 5% of the measured discharges. Further analyses of field data would secure delta factors for different types of section geometries. This is a very practical way of obtaining Delta-factors applicable to a wide variety of river channel geometries.

#### 9 DISCHAGRE AREA VARIATIONS

During relatively high discharges, or floods especially, scouring of the riverbed is likely to occur unless it is made up of rock or some hard conglomerate. This results in a larger discharge area than would be assumed by doing pre- or post flood surveys of the river section: after a flood peak passes a given cross section in a river, the scouring effect stops, velocities decrease and deposition of material takes place, building up the river to approximately its original shape prior to the flood.

Not bringing the scouring-effect into account, one would underestimate the actual discharge in the river.

This work does not cover investigations into scouring or erodable riverbeds. For all the discharge methods discussed in this work it is assumed that the riverbed is fixed and the cross section profile remains the same for low flow and flood conditions.

#### **10 CONCLUSIONS**

From the findings of this report, the following conclusions are drawn:

- Accurate measurement of flood flow in open channels is absolutely necessary to manage water resources optimally, especially in a water scarce country.
- Conventional methods of measurement such as current gaugings are accurate but often restricted due to lack of resources or accessibility to the river during upper regime discharges.
- From the processed field data it was found that fixed patterns exist for lateral velocity distributions at different flow levels in a river. This is an indication that a single delta-factor may be used as a constant, applicable for a whole range of flow levels in the application of the Single Point Velocity measurement approach to derive river discharges.
- The delta-factor at the centre of a river, and up to 20% of the main channel width either side of the centre point, is more stable than delta-values closer to the side of a river. Delta-values must therefore be determined close to the centre of a river for reliable results. The mean delta value in the centre of a river for all the measured data is 0.81, with a standard deviation of approximately 0.1.
- The delta-factor for channel-specific river profiles, such as trapezoidal or rectangular sections, has a mean value of 0.81 and 0.78 respectively in the centre of the river with standard deviations of 0.03 to 0.05, which is an indication of reliable data.
- Delta-factors for asymmetrical compound channels must be determined for each specific river section: when overbank flow occurs, the delta-factor increases as the centre of the river shifts relatively to the fixed measuring point. Therefore the general rule of delta being a constant does not apply. In a specific case of measured velocity in this work, delta changed from 0.8 up to 0.95 as the overbank flow depth increased.
- Using the method of velocity measurement by means of pressure measurements against bridge piers, allows for continuous data capturing at a fixed point in a river when using data loggers. This is ideal for application of the Single Point

Velocity Measurement method. However one must assume that the river bed remains fixed during floods.

- One dimensional-flow formulae, such as Manning's, does not give a representative velocity distribution laterally across a river. This results in an incorrect average velocity (10% to 20% overestimation) and thus incorrect deltafactors.
- The two-dimensional boundary value approach for calculating a velocity distribution approximates the measured velocity profile reasonably well, even though smaller step sizes for the numerical analysis and greater computational strength might produce more accurate velocity distributions.
- The empirical-approach showed promising results for lateral velocity distributions, but still needs refinement.

#### **11 RECOMMENDATIONS**

Based on the conclusions of this report, the following recommendations are made:

- For single channel rivers, determine a valid delta-factor and apply it as a constant to calculate upper regime discharges in the river, using the Single Point Velocity measurement approach.
- Determine delta-factors at the centre of a river, or close to the centre, to obtain the best results for reliable discharge calculations.
- From the vast resources of measured field data at DWAF head office, obtain more geometry-specific flow measurement data. Set up a large population of trapezoidal sections only, for example, and calculate their delta factors for statistical analysis. This should produce constant delta-values with low standard deviations. Such delta values would then be applicable to any trapezoidal section, with a resulting high level of accuracy expected for the calculated discharge.
- For asymmetrical compound channels, delta-factors must be calculated for each section individually: the width of the flood plain influences the variation of delta during overbank flow. Therefore delta must be calculated for flow in the main channel only, and for overbank flow conditions. These delta factors are then applicable only to this cross-section or others with similar geometry.
- Apply the pressure-measurement-against-a-bridge-pier method of point velocity measurement as described by Meyer and Rooseboom (2000) or Cloete and Rooseboom (2000). This results in a fixed point velocity measurement, operating remotely without losing data, which is ideal for application of the Single Point Velocity Measurement method.
- When applying the two-dimensional boundary value approach for calculating a lateral velocity distribution. Use smaller step sizes and larger computational capacity to solve several hundred equations simultaneously. The aim being to achieve a better represented velocity distribution.
- Further research is required to improve the empirical approach. By fine tuning the flow parameters one may achieve velocity distributions more closely representing the measured distributions, and thus accurate delta-factors.

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### **13 APPENDICES**

# **APPENDIX** A

## MINUTES OF MEETING WITH DWAF OFFICIALS CONCERNING VELOCITY DISTRIBUTION AND THE DELTA-FACTOR

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Flow measurement by means of pressure measurement at bridge piers.

# Muniutes of the meeting held on 24/08/2001 in the DWAF, Hydrometry division conference room, Pretoria.

(Minutes of the meeting were initially presented in Afrikaans, but for the purpose of this thesis it was translated into English)

Attendance list:

Pieter Wessels	DWAF Hidrometry PTA	012-336 7500
Danie van der Spuy	DWAF Hidrometry PTA	012-336 7922
Johan van Heerden	<b>DWAF Hidrometry PTA</b>	012-336 8068
Stephan van Biljon	<b>DWAF Hidrometry PTA</b>	012-336 7500
Gert Cloete	DWAF Western Cape	021-950 7100

#### **1** Introduction:

Mr Cloete welcomed all present and explained that he was doing his post graduate studies on distribution of depth averaged velocities laterally across a river. The aim was to find a theoretical approach to determine the velocity distribution and in so doing convert the point velocity determined at a bridge pier, as proposed by Meyer Rooseboom (2000) and Cloete Rooseboom (2000), to an average velocity for the river as a whole.

#### 2 Flow measurement method

• Present methodology

Applying the pitot tube principle to pressures measured at a bridge pier, a velocity is determined at the pier. This point velocity is converted to depth averaged velocity by applying the Vanoni equation.

This depth averaged velocity is converted to average velocity for the whole river by applying a conversion factor alpha ( $\alpha$ ) (NB. For this thesis the conversion factor has been changed to Delta ( $\Delta$ ), and will be referred to as such through the rest of the minutes).

For the purpose of this work it is assumed that the river bed is stable and no scouring takes place in the river, hence no increase in discharge area.

This approach works fine where measured data are available, as in the case of the White bridge over the Breede river in the Western Cape.

#### **3** Discussion

GC - In the case of a single concave channel the 1-dimensional flow formulae of Manning or Chezy may predict an acceptable velocity distribution, but when overbank flow occurs, another mathematical model must be considered to model the velocities at the main channel/floodplain interface

DvdS -  $\Delta_{\text{theoretical}}$  and  $\Delta_{\text{measured}}$  should approach each other if the slope is chosen correctly for the 1-dimensional theory.

PW - Look at different river profiles and consider isolating the main channel when determining the delta-factor. Investigate the difference in the delta-factor for the whole cross section and the main channel separately to "fine tune" for the best option.

JvH - What can the technician in the field do to get an accurate delta factor: The Orange river at Oranjedraai for example has erodeable bed material, so maybe some photos and a cross section survey would help.

Also consider determining the delta factor at sections further upstream or downstream of the gauging weir where the cross section is more stable (i.e. not erodeable).

PW - Use Chezy and sub sections with applicable roughness.

At sections with overbank flow, the delta-factor should start changing as water rises above the floodplains, consider using  $\frac{Q_{overbank}}{Q_{main channel}}$  as a factor to change the slope of delta.

Do a sensitivity analysis by calculating the delta-factor at 50/50, 60/40 and 70/30 of the channel width.

JvH, PW, DvdS - DWAF Hydrometry division are only interested in a simple and practical method of measuring floods. A complex 3-dimensional approach with overbank flow could be too complicated for the fieldworker to apply. A method applicable to a single concave section which gives good results would be sufficient.

#### 4 Information required

Require current gauging information with a definite main channel and flood plain to determine the variance of the delta-factor for overbank flow.

The following DWAF gauging points for current meters were identified as suitable for the purpose of this project:

C1H15, C8H028, C8H030, C6H006, D1H003, D1H009, D2H033, D3H012, D7H002, D7H012, V1H038, V1H057, V6H002, W4H013

A combined total of 130 current gaugings were selected. Foto copies of the raw field data were made and typed into an MS Excel spread sheet for further processing. Copies of the raw data are kept as reference.

#### 5 Next meeting

No date was fixed for a following meeting. It was agreed upon that a future meeting could be arranged after processing of the field data. Results from the analysis of the field data could assist in decision making and further discussions.

**Follow up meeting:** A meeting was held again on the 26<sup>th</sup> of May 2003 with the same group of people, accept for Mr. Van Biljon. No formal minutes were kept, but three main points came from the discussions:

- A two dimensional flow formula should give sufficient accuracy for the theoretical approach. Different formulae are available and should be investigated to find the most suitable one for this method of application.
- Consider only the main channel when determining the delta factor at 50\50, 60\40 and 70\30 % of the channel width.
- Accuracy in final calculated discharge of within 10% from measured discharge will be considered very accurate. Regard this as the goal to achieve.

# **APPENDIX B**

### STATISTICS OF DELTA-FACTORS AS DETERMINED FROM MEASURED VELOCITIES

### Statistical analysis of Delta-factors for combinations of measured data

Chainage as a percentage of	All measu comb 14 river	ured data bined: sections	Rectangu bed se 3 river s	ular fixed ctions: lections	Rectai erodeable 4 river s	ngular sections: ections	Rectang sect 1 river	ular best ion: section	Trapezium 3 river s	i sections: iections	Parabolic 1 river	section: section
channel width	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard
	average	deviation	average	deviation	average	deviation	average	deviation	average	deviation	average	deviation
20%	2.21	2.11	1.03	0.03		1.00	1.03	0.03	1.72	0.36		-
30%	0.89	0.18	0.84	0.05	0.86	0.10	0.75	0.01	0.89	0.14	0.83	0.05
40%	0.81	0.10	0.77	0.05	0.88	0.14	0.71	0.02	0.83	0.03	0.68	0.06
50%	0.81	0.12	0.78	0.05	0.92	0.16	0.72	0.03	0.81	0.05	0.66	0.04
60%	0.84	0.12	0.82	0.07	0.96	0.10	0.76	0.02	0.82	0.10	0.75	0.05
70%	0.91	0.16	0.88	0.10	1.03	0.13	0.81	0.03	0.82	0.07	0.83	0.07
80%	2.12	0.55	0.96	0.09	-	-	0.96	0.09	1.03	0.21	-	-
DWAF numbers of flow gauging stations where relevant data was collected Population	C1H15, 0 C8H030, D1H003, D2H033, D7H002, V1H038, V6H002,	C8H028, C6H006, D1H009, D3H012, D7H012, V1H057, W4H013	C8H028, W4H	V1H057, 1013	D1H009, D7H012,	D7H002, V6H002	C8H	1028	C6H006, V1F	D2H033, 1038	D3H	1012
Size	*79 flow	gaugings	*15 flow	gaugings	*23 flow	gaugings	*6 flow g	augings	*15 flow	gaugings	*9 flow g	gaugings

\* Each gauging consists of approximately 20 depth averaged velocity measurements

# **APPENDIX C**

## STATISTICS OF DELTA-FACTORS AS DETERMINED FROM THEORETICALLY CALCULATED VELOCITIES. MANNINGS' EQUATION WAS USED

### Statistical analysis of Delta-factors for combinations of calculated data (1-dimensional formula)

Chainage as a percentage of	All measi comb 14 river	ured data lined: sections	Rectange bed se 3 river s	ular fixed ctions: sections	Rectai erodeable 4 river s	ngular sections: ections	Rectange sect 1 river	ular best ion: section	Trapezium 3 river s	ections: ections	Parabolio 1 river	section: section
channel width	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard	Delta	Standard
	average	deviation	average	deviation	average	deviation	average	deviation	average	deviation	average	deviation
20%	1.01	0.07	0.99	0.02	100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100 - 100		0.99	0.021	1.00	0.07	-	-
30%	0.94	0.10	0.94	0.01	0.97	0.105	0.99	0.012	0.96	0.04	0.87	0.01
40%	0.94	0.09	0.96	0.04	0.99	0.125	1.01	0.018	0.96	0.05	0.90	0.00
50%	0.93	0.06	0.95	0.03	0.98	0.051	0.96	0.022	0.94	0.03	0.90	0.00
60%	0.95	0.08	0.97	0.03	1.02	0.092	0.95	0.016	0.94	0.03	0.86	0.01
70%	0.97	0.10	1.01	0.03	1.02	0.149	1.02	0.015	0.94	0.02	0.88	0.01
80%	1.03	0.05	0.97	0.02	-	-	0.97	0.016	0.98	0.09	-	-
DWAF numbers of flow gauging stations where relevant data was collected	C1H15, 0 C8H030, D1H003, D2H033, D7H002, V1H038, V6H002,	C8H028, C6H006, D1H009, D3H012, D7H012, V1H057, W4H013	C8H028, W4H	V1H057, 1013	D1H009, D7H012,	D7H002, V6H002	C8H	1028	C6H006, V1H	D2H033, 038	D3H	1012
Population size	*79 flow	gaugings	*15 flow	gaugings	*23 flow	gaugings	*6 flow g	gaugings	*15 flow	gaugings	*9 flow g	gaugings

\* Each gauging consists of approximately 20 depth averaged velocity measurements

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# APPENDIX D

## VELOCITY CALCULATIONS USING THE WORMLEATON 2-DIMENSIONAL FLOW FORMULA, SOLVED AS AN INITIAL VALUE PROBLEM USING THE FOURTH-ORDER RUNGA-KUTTA EQUATION

STAT	FION No.	: C1H015				<b>h</b> =	1						Start val	lues (m/s) 📑
RIVER	RNAME	: Klip				n=	0.035						*Un =	0.9 tia
PLACE	ENAME	: De Langes	s Drift			S =	0.00008						**Vn =	0 5
	DATE	: 25/02/197	5			R =	depth							
Mea	sured Q =	: 113.4 m°/s	3			lamda=	0.16	(Wormleat	on, 1988)					۲, S
hainage	dv	D	C1	C2	m1	<b>F1</b>	m2	12	m3	13	m4	4	II n+1	
25	0	7.0	0.010811	0.009454	0	-0.0007	-0.00035	-0.0007	-0.00035	-0.0007	0.899651	-0.0007	1 04971	-0.0007
26	1	7.0	0.010811	0.009454	-0.0007	0.002458	0.000531	0 002455	0.000529	0.002461	-0.00017	0.002464	1.049918	0.001761
27	2	7.0	0.010811	0.009454	0.001761	0.002463	0.002992	0.002473	0.002997	0.002479	0.004758	0.002496	1.053001	0.004238 ≤
28	3	7.0	0.010811	0.009454	0.004238	0.002533	0.005505	0.002556	0.005516	0.002563	0.009754	0.002593	1.059007	0.006799
29	4	7.0	0.010811	0.009454	0.006799	0.00267	0.008134	0.002707	0.008152	0.002714	0.014951	0.002759	1.06806	0.009511
30	5	7.0	0.010811	0.009454	0.009511	0.002879	0.01095	0.00293	0.010976	0.002938	0.020486	0.002997	1.080368	0.012446
31	6	7.0	0.010811	0.009454	0.012446	0.003164	0.014028	0.003232	0.014062	0.00324	0.026508	0.003317	1.096224	0.015684
32	7	6.5	0.013337	0.010565	0.015684	0.005461	0.018414	0.005566	0.018467	0.005584	0.03415	0.005708	1.116823	0.021262
33	8	6.5	0.013337	0.010565	0.021262	0.006069	0.024296	0.006211	0.024367	0.006231	0.045629	0.006394	1.144193	0.027487
34	9	6.5	0.013337	0.010565	0.027487	0.006895	0.030934	0.007078	0.031026	0.007101	0.058512	0.007309	1.179179	0.03458
35	10	6.5	0.013337	0.010565	0.03458	0.007979	0.03857	0.008209	0.038685	0.008236	0.073265	0.008495	1.222905	0.042808
36	11	4.7	0.033422	0.017184	0.042808	0.032798	0.059207	0.033514	0.059565	0.033788	0.102372	0.034789	1.286692	0.076506
37	12	4.7	0.033422	0.017184	0.076506	0.038149	0.09558	0.039427	0.09622	0.039746	0.172726	0.041364	1.392164	0.116149 🧿
38	13	4.7	0.033422	0.017184	0.116149	0.047592	0.139945	0.049533	0.140916	0.04993	0.257065	0.052301	1.547987	0.165952
39	14	3.5	0.077051	0.02674	0.165952	0.157895	0.2449	0.164289	0.248097	0.16733	0.414049	0.177011	1.808986	0.33231
40	15	3.5	0.077051	0.02674	0.33231	0.225405	0.445012	0.238207	0.451414	0.242549	0.783723	0.260187	2.2938	0.573494 76
41	16	3.5	0.077051	0.02674	0.573494	0.378667	0.762828	0.400761	0.773875	0.408055	1.347369	0.438295	3.126178	0.97926
42	17	1.6	0.70789	0.086513	0.97926	6.831688	4.395104	7.178292	4.568406	8.387312	5.547665	10.06562	7.201836	8.984012
43	18	1.6	0.70789	0.086513	8.984012	36.62921	27.29862	39.80905	28.88854	46.29142	37.87255	57.07911	33.74031	53.30222
44	19	1.6	0.70789	0.086513	53.30222	805.7815	456.193	824.6475	465.626	967.2487	518.9282	1135.393	436.385	974.1301
45	20	1.4	1.033418	0.105698	974.1301	196795.7	99371.99	197299.1	99623.66	248142.1	100597.8	299748.7	83696.92	232211.9
46	21	1.4	1.033418	0.105698	232211.9	7.24E+09	3.62E+09	7.24E+09	3.62E+09	9.11E+09	3.62E+09	1.1E+10	3.02E+09	8.49E+09
47	22	1.4	1.033418	0.105698	8.49E+09	9.4E+18	4.7E+18	9.4E+18	4.7E+18	1.18E+19	4.7E+18	1.43E+19	3.92E+18	1.1E+19
48	23	0.8	5.045265	0.244695	1.1E+19	7.75E+37	3.87E+37	7.75E+37	3.87E+37	1.75E+38	3.87E+37	2.73E+38	3.23E+37	1.43E+38
49	24	0.8	5.045265	0.244695	1.43E+38	5.26E+75	2.63E+75	5.26E+75	2.63E+75	1.19E+76	2.63E+75	1.85E+76	2.19E+75	9.68E+75
50	25	0.1	1826.581	5.536809	9.68E+75	8.8E+153	4.4E+153	8.8E+153	4.4E+153	4E+156	4.4E+153	8E+156	3.7E+153	2.7E+156

\* Un represents streamwise velocity. In the middel of the river the initial value is calculated from Mannings 1-dimensional flow formula, assuming no transverse flows exist. \*\* Vn represents lateral velocity, which is assumed zero in the middle of the river.

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Appendix

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# APPENDIX E

## VELOCITY CALCULATIONS USING THE WARK, IRVINE AND SAMUELS 2-DIMENSIONAL FLOW FORMULA, SOLVED AS A BOUNDARY VALUE PROBLEM USING THE FINITE-DIFFERENCE EQUATION

				right ba	nk.					
STA RIVE PLAC	TION No. : R NAME E NAME DATE	C1H015 Klip De Langes 23/02/1975	Mea Drift	sured Q = h = n = So =	179.4 m <sup>3</sup> /s 0.5 0.035 0.0001		Rho = 1000 g = 9.81 lambda = 0.16			
Chainage dy	Depth Interpolate	bed shear	shear velocity	nu t lat. eddy visc	f (Darcy friction factr)	B (lateral slope fact)	5	treamwise velocity U		
3.5		0	0	0	0	0	0.0000000	0.0000		
4	0.30	0.27795	0.016672	0.000756	0.146374	1.149396	0.0000115	0.0874		
4.5	0.58	0.5559	0.023578	0.002138	0.116177	1.149396	0.0001289	0.0661		
5	0.87	0.83385	0.028876	0.003927	0.10149	1.149396	0.0001918	0.0638		
5.5	1.15	1.1118	0.033344	0.006046	0.09221	1.149396	0.0002629	0.0624		
6	1.43	1.38975	0.03/2/9	0.00845	0.0856	1.149396	0.0001/58	0.0615		
0.5	1.72	1.00//	0.040837	0.011108	0.080552	1.10019	0.0011449	0.0504		
75	2.00	1.9/835	0.0444/9	0.014352	0.070494	1.183085	0.0001293	0.0743		
1.5	2.52	2.209	0.04/043	0.01/002	0.072403	1.103000	0.0001477	0.0000		
9.5	2.03	2.09900	0.050907	0.021010	0.009473	1.103003	0.0000920	0.0707		
0.5	2.90	2.9103	0.055947	0.020007	0.000907	1.103003	0.0010090	0.0000		
95	3.58	3 5316	0.050755	0.029014	0.004083	1.105005	0.0020709	0.0000		
10	3.90	3 6624	0.060518	0.036149	0.061972	1.034945	0.0002884	0.0699		
10.5	4.03	3 7932	0.061589	0.038103	0.061251	1.034945	0.0054562	0.0672		
11	4.17	3,924	0.062642	0.040091	0.060563	1.034945	0.0003885	0.0941		
11.5	4.30	4.0548	0.063677	0.042112	0.059905	1.034945	0.0009021	0.1154		
12	4.43	4,1856	0.064696	0.044166	0.059274	1.034945	0.0010714	0.1345		
12.5	4.57	4.3164	0.065699	0.046252	0.058669	1.044031	0.0002028	0.1525		
13	4.70	4.4799	0.066932	0.048905	0.057947	1.054093	0.0067458	0.1652		
13.5	4.87	4.6434	0.068142	0.051607	0.057258	1.054093	0.0073757	0.2011		
14	5.03	4.8069	0.069332	0.054356	0.056602	1.054093	0.0002808	0.2585		
14.5	5.20	4.9704	0.070501	0.057153	0.055974	1.054093	0.0147449	0.3085		
15	5.37	5.1339	0.071651	0.059996	0.055374	1.054093	0.0003117	0.3998		
15.5	5.53	5.2974	0.072783	0.062885	0.054798	1.192686	0.0002305	0.4821		
16	5.70	5.77155	0.075971	0.071514	0.053254	1.390843	0.0002379	0.5513		
16.5	6.18	6.2457	0.07903	0.080505	0.051871	1.390843	0.0003110	0.6066		
17	6.67	6.71985	0.081975	0.089844	0.050621	1.390843	0.0003482	0.6516		
17.5	7.15	7.194	0.084817	0.099519	0.049484	1.390843	0.0004807	0.6887		
18	7.63	7.66815	0.087568	0.109518	0.048442	1.390843	0.0006671	0.7198		
18.5	8.12	8.1423	0.090235	0.119832	0.047483	1.10353	0.0000549	0.7463		
19	8.60	8.12595	0.090144	0.119471	0.047515	1.000555	0.0001512	0.7699		
19.5	8.58	8.1096	0.090053	0.119111	0.047546	1.000555	0.0000047	0.7926		
20	8.57	8.09325	0.089962	0.11875	0.047578	1.000555	0.0000316	0.8143		
20.5	8.55	8.0769	0.089872	0.118391	0.047611	1.000555	0.0000406	0.8350		
21	8.53	8.06055	0.089781	0.118032	0.047643	1.000555	0.0001432	0.8548		
21.5	8.52	8.0442	0.089689	0.11/6/3	0.04/6/5	1	0.0001837	0.8736		
22	8.50	8.06055	0.089781	0.118032	0.047643	1.000555	0.0000265	0.8912		
22.0	0.52	8.0709	0.089872	0.110391	0.047611	1.000555	0.0010060	0.9060		
23	0.03	0.09325	0.089962	0.110111	0.04/5/8	1.000555	0.0009142	0.9220		
23.5	8.55	8 12505	0.090055	0.119111	0.047540	1.000555	0.0003123	0.9350		
24 5	8.58	8 1423	0.090144	0.110471	0.047313	1.000555	0.0007871	0.5470		
24.0	8.60	8 09325	0.030200	0 11875	0.047578	1.0000000	0.0017648	0.9686		
25 5	8.55	8 0442	0.089680	0 117673	0.047675	1.004988	0 0014974	0.9760		
20.0	8.50	7,99515	0.089416	0.116598	0.047772	1.004988	0.0043994	0.9813		
26.5	8 45	7.9461	0.089141	0.115527	0.04787	1.004988	0.0066040	0.9815		
27	8.40	7,89705	0.088865	0.114459	0.047969	1.004988	0.0002765	0.9740		
			0.000500	0 112204	0.049060	1 001240	0.0004557	0.005		

28	8.30	7.848	0.088589	0.113394	0.048069	1	0.0003669	0.9557
28.5	8.30	7.848	0.088589	0.113394	0.048069	1	0.0000451	0.9449
29	8.30	7.848	0.088589	0.113394	0.048069	1	0.0001582	0.9334
29.5	8.30	7.848	0.088589	0.113394	0.048069	1.004988	0.0000063	0.9210
30	8.30	7.7499	0.088034	0.111274	0.048271	1.019804	0.0000162	0.9076
30.5	8.20	7.6518	0.087475	0.109168	0.048476	1.019804	0.0000732	0.8931
31	8.10	7.5537	0.086912	0.107076	0.048685	1.019804	0.0000299	0.8773
31.5	8.00	7.4556	0.086346	0.104997	0.048898	1.004988	0.0000661	0.8602
32	7.90	7.4556	0.086346	0.104997	0.048898	1	0.0000389	0.8420
32.5	7.90	7.4556	0.086346	0.104997	0.048898	1.039364	0.0000030	0.8229
33	7.90	7.17765	0.084721	0.09918	0.049521	1.149396	0.0008022	0.8018
33.5	7.62	6.8997	0.083064	0.093475	0.050177	1.149396	0.0003517	0.7788
34	7.33	6.62175	0.081374	0.087884	0.05087	1.149396	0.0004499	0.7529
34.5	7.05	6.3438	0.079648	0.082409	0.051602	1.149396	0.0003388	0.7238
35	6.77	6.06585	0.077884	0.077053	0.052379	1.149396	0.0002998	0.6908
35.5	6.48	5.7879	0.076078	0.071818	0.053204	1.11068	0.0003370	0.6531
36	6.20	5.5917	0.074778	0.068197	0.053819	1.077033	0.0002281	0.6106
36.5	6.00	5.3955	0.073454	0.06464	0.054464	1.077033	0.0174474	0.5628
37	5.80	5.1993	0.072106	0.061146	0.05514	1.077033	0.0005017	0.5596
37.5	5.60	5.0031	0.070733	0.057718	0.055852	1.077033	0.0017282	0.5553
38	5.40	4.8069	0.069332	0.054356	0.056602	1.077033	0.0002629	0.5544
38.5	5.20	4.6107	0.067902	0.051062	0.057393	1.118034	0.0004300	0.5521
39	5.00	4.3164	0.065699	0.046252	0.058669	1.16619	0.0002036	0.5488
39.5	4.70	4.0221	0.06342	0.041604	0.060067	1.16619	0.0002174	0.5438
40	4.40	3.7278	0.061056	0.037122	0.061608	1.16619	0.0001802	0.5368
40.5	4.10	3.4335	0.058596	0.032814	0.06332	1.16619	0.0002211	0.5274
41	3.80	3.1392	0.056029	0.028687	0.06524	1.16619	0.0002801	0.5159
41.5	3.50	2.8449	0.053338	0.024749	0.067416	1.054093	0.0001653	0.5029
42	3.20	2.8122	0.05303	0.024323	0.067676	1.00222	0.0001760	0.4881
42.5	3.17	2.7795	0.052721	0.0239	0.067941	1.00222	0.0001761	0.4726
43	3.13	2.7468	0.05241	0.02348	0.068209	1.00222	0.0001276	0.4560
43.5	3.10	2.7141	0.052097	0.023062	0.068482	1.00222	0.0001202	0.4371
44	3.07	2.6814	0.051782	0.022646	0.068759	1.00222	0.0001472	0.4153
44.5	3.03	2.6487	0.051466	0.022233	0.069041	1.011187	0.0001048	0.3902
45	3.00	2.53425	0.050341	0.020808	0.070065	1.026861	0.0001215	0.3595
45.5	2.88	2.4198	0.049191	0.019414	0.071153	1.026861	0.0001058	0.3206
46	2.77	2.30535	0.048014	0.018053	0.072311	1.026861	0.0001048	0.2711
46.5	2.65	2.1909	0.046807	0.016726	0.073549	1.026861	0.0001574	0.2074
47	2.53	2.07645	0.045568	0.015432	0.074876	1.026861	0.0030554	0.1266
47.5	2.42	1.962	0.044294	0.014174	0.076305	1.048941	0.0007373	0.1184
48	2.30	1.7658	0.042021	0.012102	0.079032	1.077033	0.0003882	0.1197
48.5	2.10	1.5696	0.039618	0.010142	0.082197	1.077033	0.0003502	0.1205
49	1.90	1.3734	0.037059	0.008301	0.085938	1.077033	0.0002986	0.1215
49.5	1.70	1.1772	0.03431	0.006588	0.090469	1.077033	0.0002465	0.1227
50	1.50	0.981	0.031321	0.005011	0.096138	1.077033	0.0001927	0.1243
50.5	1.30	0.7848	0.028014	0.003586	0.103562	1.070955	0.0001496	0.1261
51	1.10	0.60495	0.024596	0.002427	0.112948	1.065103	0.0000640	0.1336
51.5	0.92	0.4251	0.020618	0.00143	0.127044	1.065103	0.0000307	0.1292
52	0.73	0.24525	0.01566	0.000626	0.15261	1.065103	0.0000146	0.1025
52.5	0.55	0.0654	0.008087	8.63E-05	0.237097	1.019804	0.0000040	0.0551
53	0.37	0.04905	0.007004	5.6E-05	0.260959	1.000672	0.0000117	0.0541
53.5	0.18	0.02943	0.005425	2.6E-05	0.309401	1.001249	0.0000074	0.0006
54	0.00	0	0	0	0	1	0.000000	0.0000
÷							0.0965215	

The Goal-Seek value was set to achieve 0.001

# **APPENDIX F**

### A COMBINED BETA-GRAPH FOR ALL BETA VALUES AS WELL AS BETA GRAPHS FOR THE INDIVIDUAL BETA VALUES NUMBERED FROM 0.1 UP TO 1.0 IN STEPS OF 0.1.

The numbers 1 to 11 on the individual beta graphs, represent data from the following DWAF station numbers in this order: C1H015, C8H028, C8H030, C6H006, D1H003, D1H009, D2H033, D3H012, D7H002, D7H012 and V1H038.



Appendix F

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YY0         Bedslope         Beta = 0.1         bedslope           0.65         0.50         0.12         0.52           0.55         0.58         0.67         0.11         0.52           0.32         0.18         0.12         0.21           0.22         0.28         0.06         0.21           0.22         0.28         0.06         0.21           0.22         0.28         0.06         0.21           0.44         0.47         0.07         0.55           0.72         0.48         0.06         0.52           0.58         0.5         0.07         0.03           0.45         0.45         0.06         0.55           0.27         0.32         0.07         0.003           0.67         0.1         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.06         0.17           0.5         0.22         0.06 <t< th=""><th>- 11</th><th>5.000 C</th><th></th><th>1.1.1.1.1.1</th><th></th><th>Linearised</th></t<>	- 11	5.000 C		1.1.1.1.1.1		Linearised
1         0.65         0.50         0.12         0.52           0.15         0.78         0.06         0.55           0.32         0.18         0.12         0.21           0.27         0.13         0.12         0.21           0.22         0.28         0.06         0.21           0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.55           0.55         0.5         0.07         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.55           0.58         0.5         0.07         0.033           0.67         0.12         0.032         0.07         0.026           0.67         0.28         0.05         0.26         0.67           0.86         0.48         0.13         0.007         0.28         0.86         0.1         0.003           0.77         0.43         0.1         0.107         0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17         0.55         0.1         0.007           0.28 <td>- 3</td> <td>Y/Y0</td> <td>Bedslope</td> <td>Beta = 0.1</td> <td></td> <td>bedslope</td>	- 3	Y/Y0	Bedslope	Beta = 0.1		bedslope
0.15         0.78         0.06         0.52           0.32         0.18         0.12         0.21           0.27         0.13         0.12         0.21           0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.55           0.58         0.5         0.07         0.52           0.58         0.5         0.07         0.52           0.58         0.5         0.07         0.52           0.72         0.48         0.06         0.52           0.72         0.32         0.07         0.003           0.44         0.45         0.06         0.55           0.59         0.27         0.32         0.07         0.003           0.67         0.1         0.05         0.26           0.66         0.41         0.007         0.26           0.67         0.28         0.05         0.26           0.71         0.22         0.11         0.007           0.72         0.43         0.1         0.75           0.9         0.06         0.1         0.007           0.28         0.62         0.13         0.75	1	0.65	0.50	0.12		0.52
0.68         0.67         0.11         0.52           0.32         0.18         0.12         0.21           0.22         0.28         0.06         0.21           0.22         0.28         0.06         0.21           0.44         0.47         0.07         0.55           0.72         0.48         0.06         0.52           0.53         0.17         0.1         0.21           0.44         0.47         0.07         0.55           0.58         0.5         0.07         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.55           0.27         0.32         0.08         0.1           0.92         0.32         0.07         0.033           0.67         0.18         0.13         0.003           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.66         0.43           0.52         0.9         0.35         0.66		0.15	0.78	0.06		0.5
0.32         0.18         0.12         0.21           0.22         0.28         0.06         0.21           0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.55           0.55         0.5         0.07         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.55           0.58         0.5         0.07         0.52           0.27         0.32         0.08         0.21           2         0.92         0.32         0.07         0.003           0.67         0.1         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.10         0.007           0.72         0.43         0.1         0.075           0.74         0.22         0.66         0.17           0.55         0.22         0.66         0.17           0.56         0.22         0.66 <t< td=""><td></td><td>0.68</td><td>0.67</td><td>0.11</td><td></td><td>0.52</td></t<>		0.68	0.67	0.11		0.52
0.27         0.13         0.12         0.21           0.22         0.28         0.06         0.21           0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.5           0.72         0.48         0.06         0.52           0.58         0.5         0.07         0.55           0.58         0.5         0.07         0.52           0.27         0.32         0.07         0.03           0.45         0.45         0.06         0.55           0.58         0.5         0.07         0.03           0.66         0.48         0.13         0.003           0.67         0.1         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.22         0.06         0.17           0.50         0.22         0.06         0.17           0.50         0.22         0.06         0.43		0.32	0.18	0.12		0.21
0.22         0.28         0.06         0.21           0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.55           0.72         0.48         0.06         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.55           0.58         0.5         0.07         0.52           0.72         0.32         0.08         0.21           0.92         0.32         0.07         0.033           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.22         0.07         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.23         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.24         0.66         0.17           0.58         0.22         0.10         0.007		0.27	0.13	0.12		0.21
0.23         0.3         0.06         0.21           0.44         0.47         0.07         0.55           0.72         0.48         0.06         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.55           0.53         0.5         0.07         0.52           0.27         0.32         0.07         0.003           0.67         0.1         0.05         0.26           0.66         0.48         0.13         0.003           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.65         0.1         0.007           0.5         0.21         0.06         0.17         0.55           0.5         0.22         0.06         0.17         0.55           0.5         0.22         0.6         0.17         0.55           0.5		0.22	0.28	0.06		0.21
0.44         0.47         0.07         0.5           0.72         0.48         0.06         0.52           0.53         0.17         0.1         0.21           0.45         0.45         0.06         0.5           0.52         0.27         0.32         0.08         0.21           2         0.92         0.32         0.07         0.003           0.66         0.44         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.66         0.44         0.13         0.003           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.007           0.8         0.41         0.1         0.007           0.72         0.43         0.1         0.077           0.8         0.41         0.13         0.17           0.58         0.44         0.13         0.17           0.58         0.44         0.13         0.17           0.52         0.19		0.23	0.3	0.06		0.21
0.72         0.48         0.06         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.52           0.58         0.5         0.07         0.52           0.92         0.32         0.07         0.003           0.94         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.88         0.41         0.1007         0.28         0.66         0.17           0.58         0.4         0.13         0.17         0.5         0.1         0.55           0.59         0.22         0.06         0.43         0.17         0.5         0.1         0.55           0.59         0.56         0.06         0.23         0.55		0.44	0.47	0.07		0.5
0.58         0.5         0.07         0.52           0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.5           0.27         0.32         0.07         0.003           0.94         0.22         0.92         0.32         0.07         0.003           0.67         0.1         0.05         0.26         0.67         0.26           0.67         0.22         0.07         0.26         0.26         0.67         0.28           0.67         0.28         0.05         0.26         0.71         0.22         0.07         0.26           0.67         0.28         0.06         0.11         0.007         0.28         0.86         0.13         0.75           0.9         0.08         0.1         0.007         0.28         0.86         0.43         0.17           0.58         0.4         0.13         0.17         0.55         0.1         0.55           0.5         0.22         0.06         0.43         0.12         0.07         0.5         0.1         0.55           0.5         0.23         0.26         0.11         0.23         0.23 <td< td=""><td></td><td>0.72</td><td>0.48</td><td>0.06</td><td></td><td>0.52</td></td<>		0.72	0.48	0.06		0.52
0.33         0.17         0.1         0.21           0.45         0.45         0.06         0.52           0.27         0.32         0.07         0.033           0.94         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.22         0.11         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.007           0.85         0.41         0.1         0.007           0.85         0.41         0.1         0.007           0.28         0.86         0.13         0.17           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.52         0.19         0.13         0.17           0.53         0.58         0.08         0.5           0.53         0.58         0.06         0.23		0.58	0.5	0.07		0.52
0.45         0.45         0.06         0.5           0.27         0.32         0.08         0.21           2         0.92         0.32         0.07         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.67         0.1         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.007           0.85         0.41         0.1         0.007           0.80         0.1         0.007         0.28           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           0.83         0.39         0.06         0.44           0.79         0.33         0.09         0.4           0.79         0.33         0.09         0.4 <td></td> <td>0.33</td> <td>0.17</td> <td>0.1</td> <td></td> <td>0.21</td>		0.33	0.17	0.1		0.21
0.58         0.5         0.07         0.52           0.27         0.32         0.08         0.21           2         0.92         0.32         0.07         0.003           0.94         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.67         0.1         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.007           0.7         0.43         0.1         0.07           0.9         0.08         0.1         0.007           0.7         0.43         0.1         0.075           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.51         0.52         0.19         0.1         0.12           0.79         0.33         0.09         0.4         0.5           0.79         0.33         0.		0.45	0.45	0.06		0.5
0.27         0.32         0.08         0.21           2         0.92         0.32         0.07         0.003           0.94         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.85         0.41         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.50         0.50         0.6         0.4           0.8         0.3         0.1         0.0125           0.79         0.33         0.09         0.		0.58	0.5	0.07		0.52
2         0.02         0.03         0.07         0.003           0.94         0.28         0.1         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.85         0.41         0.1         0.007           0.85         0.41         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.22         0.06         0.43           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.55           0.35         0.27         0.14         0		0.27	0.32	0.08		0.21
0.034         0.028         0.1         0.003           0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.85         0.41         0.1         0.007           0.9         0.06         0.11         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.52         0.19         0.13         0.17           0.51         0.52         0.19         0.13           0.7         0.5         0.1         0.55           0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.51           0.1         0.043         0.11         0.038 </td <td>2</td> <td>0.92</td> <td>0.32</td> <td>0.07</td> <td></td> <td>0.003</td>	2	0.92	0.32	0.07		0.003
0.67         0.1         0.05         0.26           0.86         0.48         0.13         0.003           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.7         0.43         0.1         0.075           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.59         0.22         0.06         0.43           0.51         0.25         0.19         0.13           0.79         0.33         0.09         0.4           0.79         0.33         0.09         0.4           0.70         0.5         0.1         0.23           0.23         0.29         0.13         0.1      <	-	0.94	0.28	01		0.003
0.03         0.03         0.033         0.033           0.71         0.32         0.07         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.003           3         0.9         0.1         0.1         0.007           0.85         0.41         0.1         0.007           0.9         0.86         0.1         0.007           0.9         0.86         0.1         0.007           0.28         0.86         0.13         0.77           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.22         0.06         0.43           0.52         0.19         0.13         0.17           0.83         0.39         0.06         0.44           0.80         0.3         0.1         0.0122           0.79         0.35         0.66         0.23           0.35         0.58         0.08         0.53           0.35         0.58         0.08         0.23           0.1         0.43         0.66         0.23 <td></td> <td>0.67</td> <td>0.1</td> <td>0.05</td> <td></td> <td>0.26</td>		0.67	0.1	0.05		0.26
0.03         0.07         0.26           0.67         0.28         0.05         0.26           0.71         0.2         0.11         0.26           0.85         0.41         0.1         0.003           3         0.9         0.1         0.1         0.007           0.9         0.85         0.41         0.1         0.007           0.9         0.86         0.1         0.007         0.28           0.5         0.22         0.06         0.17         0.58         0.4         0.13           0.5         0.22         0.06         0.44         0.52         0.19         0.13         0.17           0.58         0.4         0.13         0.17         0.55         0.1         0.0125           0.79         0.35         0.06         0.44         0.63         0.5           0.35         0.58         0.08         0.55         0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.53         0.58         0.63         0.23           0.28         0.82         0.11         0.233         0.24         0.06         0.23           0.12 <td></td> <td>0.86</td> <td>0.48</td> <td>0.03</td> <td></td> <td>0.003</td>		0.86	0.48	0.03		0.003
0.71         0.22         0.07         0.26           0.67         0.22         0.11         0.26           0.71         0.2         0.11         0.03           3         0.9         0.1         0.1         0.007           0.7         0.43         0.1         0.07           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           0.83         0.39         0.06         0.44           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.012           0.79         0.33         0.09         0.4           0.70         0.5         0.1         0.012           0.35         0.58         0.08         0.52           0.35         0.58         0.08         0.52           0.4         0.013         0.11         0.38      <		0.00	0.40	0.15		0.000
0.67         0.23         0.03         0.26           0.71         0.2         0.11         0.26           0.85         0.41         0.1         0.003           3         0.9         0.1         0.1         0.007           0.7         0.43         0.1         0.75           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.44           0.70         0.55         0.1         0.0125           0.79         0.33         0.09         0.4           0.70         0.5         0.1         0.0125           0.79         0.33         0.09         0.4           0.70         0.5         0.1         0.0125           0.70         0.5         0.1         0.0135           0.50         0.13         0.11         0.038           0.10         0.043         0.06         0.23           0.11         0.043         0.06         0.23 <td></td> <td>0.71</td> <td>0.32</td> <td>0.07</td> <td></td> <td>0.20</td>		0.71	0.32	0.07		0.20
0.71         0.2         0.11         0.03           0.85         0.41         0.1         0.003           3         0.7         0.43         0.1         0.75           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.55         0.22         0.06         0.17           0.58         0.40         0.13         0.17           0.58         0.22         0.06         0.43           0.52         0.19         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.6         0.33         0.1         0.0125         0.79         0.33         0.09         0.4           0.79         0.33         0.09         0.44         0.40         0.6         0.23           0.35         0.58         0.08         0.1         0.23         0.29         0.13         0.23           0.12         0.076         0.66         0.23         0.61         0.24         0.6		0.67	0.20	0.05		0.20
0.33         0.41         0.1         0.0007           0.7         0.43         0.1         0.07           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.52         0.19         0.13         0.17           0.52         0.19         0.35         0.06         0.44           0.79         0.33         0.09         0.4         0.0125           0.79         0.33         0.09         0.4         0.75         0.1         0.0125           0.79         0.33         0.04         0.013         0.11         0.038           0.23         0.29         0.13         0.11         0.23           0.10         0.43         0.66         0.23         0.61         0.23           0.61         0.24         0.66         0.23         0.22 <td><math>(\cdot, \cdot)</math></td> <td>0.71</td> <td>0.2</td> <td>0.11</td> <td></td> <td>0.20</td>	$(\cdot, \cdot)$	0.71	0.2	0.11		0.20
3         0.9         0.1         0.1         0.007           0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.0125           0.35         0.58         0.08         0.53           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.53           0.4         0.013         0.11         0.233           0.1         0.43         0.66         0.23           0.61         0.24         0.66         0.23		0.85	0.41	0.1		0.003
0.7         0.43         0.1         0.07           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           0.83         0.39         0.06         0.44           0.79         0.35         0.06         0.4           0.7         0.5         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.0125           0.79         0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.51         0.35           0.4         0.013         0.11         0.23           0.12         0.076         0.06         0.23           0.12         0.072         0.11         0.23           0.12         0.12         0.12	3	0.9	0.1	0.1		0.007
0.9         0.08         0.1         0.007           0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.8         0.3         0.1         0.0125         0.79           0.35         0.58         0.08         0.52         0.13         0.55           0.35         0.58         0.08         0.55         0.35         0.58         0.08           0.35         0.58         0.08         0.52         0.14         0.44           0.23         0.29         0.13         0.15         0.66         0.23           0.1         0.043         0.06         0.23         0.12         0.27           0.57         0.22         0.13         0.23         0.21         0.27           0.57         0.22         0.13         0.23		0.7	0.43	0.1		0.75
0.28         0.86         0.13         0.75           0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.79         0.33         0.09         0.4           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.55           0.35         0.58         0.08         0.55           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.55           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.12         0.27         0.13         0.23           0.61         0.24         0.06         0.17           0.57         0.22         0.13         0.23 <td></td> <td>0.9</td> <td>0.08</td> <td>0.1</td> <td></td> <td>0.007</td>		0.9	0.08	0.1		0.007
0.5         0.22         0.06         0.17           0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.55           0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.55           0.35         0.58         0.08         0.52           0.35         0.28         0.082         0.11         0.23           0.12         0.076         0.06         0.23           0.12         0.076         0.06         0.23           0.12         0.22         0.13         0.23           0.12         0.27         0.57         0.22         0.13         0.23           0.12         0.27         0.57         0.22         0.13         0.23		0.28	0.86	0.13		0.75
0.58         0.4         0.13         0.17           0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.44           0.79         0.33         0.09         0.4           0.79         0.33         0.09         0.4           0.70         0.5         0.1         0.55           0.35         0.58         0.08         0.55           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.55           0.4         0.013         0.11         0.233           0.12         0.076         0.06         0.233           0.12         0.076         0.06         0.233           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.17           0.72         0.15         0.06         0.17           0.57         0.22         0.13         0.27		0.5	0.22	0.06		0.17
0.83         0.39         0.06         0.43           0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.4           0.8         0.3         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.55           0.35         0.58         0.08         0.55           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.55           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.33           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.63         0.17         0.12         0.27           0.57         0.15         0.06         0.17     <		0.58	0.4	0.13		0.17
0.52         0.19         0.13         0.17           4         0.79         0.35         0.06         0.4           0.8         0.3         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.5           0.35         0.58         0.08         0.5           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.66         0.29         0.12         0.2           0.72         0.21         0.06         0.17           0.72         0.21         0.06         0.17           0.72         0.15         0.06         0.17		0.83	0.39	0.06		0.43
4         0.79         0.35         0.06         0.4           0.8         0.3         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.5           0.35         0.58         0.08         0.5           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           5         0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.17           0.72         0.21         0.06         0.17           0.72         0.21         0.06         0.17           0.33         0.14         0.08         0.17           0.35         0.11         0.09 <td< td=""><td></td><td>0.52</td><td>0.19</td><td>0.13</td><td></td><td>0.17</td></td<>		0.52	0.19	0.13		0.17
0.8         0.3         0.1         0.0125           0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.5           0.35         0.58         0.08         0.5           0.35         0.29         0.13         0.5           0.35         0.29         0.13         0.5           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.12         0.076         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.33           0.61         0.27         0.12         0.27           0.57         0.22         0.13         0.23           0.62         0.12         0.23         0.21           0.57         0.15         0.06         0.17           0.53         0.16         0.16         0.17	4	0.79	0.35	0.06		0.4
0.79         0.33         0.09         0.4           0.7         0.5         0.1         0.5           0.35         0.58         0.08         0.5           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           5         0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.38           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.64         0.29         0.12         0.2           0.57         0.21         0.06         0.17           0.53         0.14         0.08         0.3           0.41         0.13         0.09         0.12 <td></td> <td>0.8</td> <td>0.3</td> <td>0.1</td> <td></td> <td>0.0125</td>		0.8	0.3	0.1		0.0125
0.7         0.5         0.1         0.5           0.35         0.58         0.08         0.5           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           5         0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.66         0.29         0.12         0.27           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.17           0.57         0.22         0.13         0.23           0.61         0.24         0.06         0.17           0.57         0.15         0.06         0.17           0.33         0.14         0.08         0.33           0.45         0.18         0.1         0.3 <td></td> <td>0.79</td> <td>0.33</td> <td>0.09</td> <td></td> <td>0.4</td>		0.79	0.33	0.09		0.4
0.35         0.58         0.08         0.5           0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           5         0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.21           0.6         0.29         0.12         0.2         0.23           0.61         0.24         0.06         0.33         0.16         0.17           0.50         0.15         0.06         0.17         0.23           0.61         0.27         0.15         0.06         0.17           0.33         0.14         0.08         0.3         0.3           0.41         0.13         0.09         0.12           0.45         0.18		0.7	0.5	0.1		0.5
0.35         0.27         0.14         0.4           0.23         0.29         0.13         0.5           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.66         0.29         0.12         0.27           0.57         0.22         0.13         0.23           0.66         0.29         0.12         0.2           0.57         0.22         0.13         0.23           0.57         0.22         0.13         0.23           0.57         0.21         0.06         0.17           0.57         0.22         0.13         0.23           0.31         0.16         0.06         0.17           0.33         0.14         0.08         0.3           0.41         0.13         0.09         0.12		0.35	0.58	0.08		0.5
0.23         0.29         0.13         0.5           0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           0.66         0.29         0.12         0.22           0.72         0.15         0.06         0.17           0.33         0.14         0.08         0.33           0.41         0.13         0.09         0.12           0.45         0.18         0.1         0.33           0.41         0.18         0.07         0.12           0.45         0.18         0.07         0.12		0.35	0.27	0.14		0.4
5         0.4         0.013         0.11         0.038           0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.23           0.6         0.29         0.12         0.22           0.6         0.29         0.12         0.23           0.6         0.29         0.12         0.23           0.6         0.29         0.12         0.23           0.72         0.21         0.06         0.17           0.72         0.21         0.06         0.17           0.33         0.14         0.08         0.33           0.41         0.13         0.09         0.12           0.45         0.18         0.1         0.33           0.41         0.18         0.07         0.12           0.45         0.18         0.1		0.23	0.29	0.13	_	0.5
0.28         0.082         0.11         0.23           0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.2           0.6         0.29         0.12         0.2           8         0.27         0.15         0.06         0.17           0.72         0.21         0.06         0.17           0.33         0.14         0.08         0.3           0.31         0.16         0.06         0.17           0.33         0.14         0.08         0.3           0.41         0.13         0.09         0.12           0.45         0.18         0.1         0.3           0.41         0.13         0.09         0.12           0.45         0.18         0.1         0.3           0.45         0.18         0.07         0.12           0.45         0.16         0.17 <td< td=""><td>5</td><td>0.4</td><td>0.013</td><td>0.11</td><td></td><td>0.038</td></td<>	5	0.4	0.013	0.11		0.038
0.1         0.043         0.06         0.23           0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.2           0.6         0.29         0.12         0.2           8         0.27         0.15         0.06         0.17           0.72         0.21         0.06         0.33           0.31         0.16         0.06         0.17           0.33         0.14         0.08         0.3           0.41         0.13         0.09         0.12           0.45         0.18         0.1         0.3           0.35         0.11         0.09         0.12           0.44         0.18         0.08         0.17           9         0.72         0.11         0.07         0.16           0.54         0.15         0.05         0.16           0.73         0.11         0.08         0.16           0.73         0.11		0.28	0.082	0.11		0.23
0.12         0.076         0.06         0.23           0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.12           8         0.27         0.15         0.06         0.17           0.72         0.21         0.06         0.33         0.14         0.08         0.33           0.31         0.16         0.06         0.17         0.33         0.14         0.08         0.33         0.14         0.08         0.33         0.35         0.11         0.09         0.12         0.44         0.18         0.10         0.33         0.35         0.11         0.09         0.12         0.45         0.18         0.1         0.33         0.35         0.11         0.09         0.12         0.12         0.12         0.14         0.18         0.18         0.17         0.12         0.12         0.12         0.12         0.12         0.12         0.12         0.12         0.12         0.14         0.18         0.17         0.19         0.16         0.57         0.15         0.0		01	0.043	0.06		0.23
0.61         0.24         0.06         0.038           0.63         0.17         0.12         0.27           0.57         0.22         0.13         0.23           7         0.29         0.35         0.06         0.2           0.6         0.29         0.12         0.2           8         0.27         0.15         0.06         0.17           0.72         0.21         0.06         0.3         0.31         0.16         0.06           0.31         0.16         0.06         0.17         0.33         0.14         0.08         0.3           0.41         0.13         0.09         0.12         0.2         0.45         0.18         0.1         0.3           0.45         0.18         0.1         0.3         0.35         0.11         0.09         0.12           0.45         0.18         0.1         0.3         0.35         0.11         0.19         0.12           0.45         0.18         0.1         0.07         0.16         0.35         0.16           0.72         0.11         0.07         0.16         0.12         0.12           0.54         0.15         0.09	-	0.12	0.076	0.06		0.23
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.61	0.24	0.06		0.038
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.63	0.17	0.12		0.27
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.00	0.22	0.12		0.23
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7	0.29	0.22	0.06	-	0.2
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.25	0.33	0.00	1.1	0.2
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.0	0.25	0.12	-	0.17
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	0	0.27	0.15	0.00		0.17
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.72	0.21	0.00		0.3
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.31	0.16	0.06		0.1/
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.33	0.14	0.08		0.3
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.41	0.13	0.09		0.12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.45	0.10	0.1		0.5
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.35	0.11	0.09		0.12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.4	0.18	0.08	-	0.17
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	9	0.72	0.11	0.07		0.16
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.68	0.18	0.07		0.12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.54	0.15	0.05		0.16
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.73	0.11	0.08		0.16
0.8         0.07         0.12         0.12           0.69         0.09         0.07         0.12           0.43         0.12         0.05         0.16           0.57         0.15         0.09         0.16           0.75         0.11         0.11         0.16           0.84         0.01         0.09         0.12           0.84         0.01         0.09         0.12           0.84         0.01         0.09         0.12           0.81         0.07         0.1         0.01           0.71         0.09         0.07         0.12           10         0.6         0.35         0.06         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.41         0.62         0.14         0.59		0.83	0.01	0.1		0.01
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.8	0.07	0.12		0.12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.69	0.09	0.07		0.12
0.57         0.15         0.09         0.16           0.75         0.11         0.11         0.16           0.84         0.01         0.09         0.12           0.81         0.07         0.1         0.01           0.71         0.09         0.07         0.12           10         0.6         0.35         0.06         0.39           0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.41         0.62         0.14         0.59		0.43	0.12	0.05		0.16
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		0.57	0.15	0.09		0.16
0.84         0.01         0.09         0.12           0.81         0.07         0.1         0.01           0.71         0.09         0.07         0.12           10         0.6         0.35         0.06         0.39           0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59		0.75	0.11	0.11		0.16
0.81         0.07         0.1         0.01           0.71         0.09         0.07         0.12           10         0.6         0.35         0.06         0.39           0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59		0.84	0.01	0.09		0.12
0.71         0.09         0.07         0.12           10         0.6         0.35         0.06         0.39           0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59		0.81	0.07	0.1		0.01
10         0.6         0.35         0.06         0.39           0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59		0.71	0.09	0.07		0.12
0.54         0.31         0.08         0.39           0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59	10	0.6	0.35	0.06		0.39
0.55         0.11         0.14         0.016           11         0.48         0.5         0.14         0.59           0.42         0.24         0.14         0.59           0.41         0.62         0.14         0.59		0.54	0.31	0.08		0.39
11 0.48 0.5 0.14 0.59 0.42 0.24 0.14 0.59 0.41 0.62 0.14 0.59		0.55	0.11	0.14		0.016
0.42 0.24 0.14 0.59 0.41 0.62 0.14 0.59	11	0.48	0.5	0.14		0.59
0.41 0.62 0.14 0.59		0.42	0.24	0.14		0.59
		0.41	0.62	0.14		0.59



		1.11			Linearised
	Y/Y0	Bedslope	Beta = 0.2	-	bedslope
1	0.44	0.32	0.21		0.5
	0.9	0.15	0.22		0.031
	0.51	0.28	0.21		0.5
	0.34	0.37	0.2		0.52
	0.29	0.15	0.18		0.21
	0.3	0.15	0.17		0.21
	0.54	0.32	0.15		0.5
2	0.85	0.5	0.2		0.003
	0.91	0.4	0.2		0.003
	0.73	0.2	0.22		0.26
3	0.9	0.12	0.2		0.007
	0.5	0.6	0.2		0.75
	0.57	0.68	0.19		0.75
	0.58	0.4	0.21		0.17
	0.2	0.58	0.17		0.75
4	0.91	0.1	0.23		0.0125
	0.86	0.29	0.18		0.4
	0.9	0.35	0.23		0.4
5	0.78	0.11	0.23		0.038
	0.64	0.14	0.2		0.038
	0.61	0.1	0.19		0.27
6	0.61	0.04	0.24		0.004
	0.39	0.1	0.23		0.35
	0.95	0.35	0.21		0.38
	0.58	0.31	0.18		0.35
8	0.72	0.28	0.16		0.3
	0.46	0.25	0.18		0.17
	0.82	0.17	0.22		0.17
	0.57	0.35	0.19		0.3
	0.77	0.34	0.21		0.3
	0.46	0.24	0.23		0.12
	0.7	0.19	0.2		0.17
9	0.8	0.06	0.19		0.16
	0.81	0.13	0.24		0.16
10	0.47	0.46	0.21		0.66
	0.79	0.01	0.24		0.016
	0.78	0.06	0.15		0.016
	0.58	0.42	0.2		0.66
11	0.94	0.14	0.24		0.01
	0.58	0.68	0.21		0.59
	0.84	0.11	0.2		0.75
	0.37	0.7	0.24		0.59
	0.41	0.19	0.21		0.59
	0.65	0.34	0.18		0.75
	0.73	0.43	0.2		0.59
	0.4	0.54	0.17		0.75

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11		A. C	Sec. 14		Linearised
11	Y/Y0	Bedslope	Beta = 0.3		bedslope
1	0.90	42.00	0.34	111	0.52
18	0.51	0.32	0.27		0.5
	0.91	0.12	0.25		0.031
	0.91	0.15	0.26		0.031
	0.35	0.33	0.26		0.21
	0.92	0.12	0.25		0.031
	0.36	0.35	0.31		0.52
	0.55	0.3	0.27		0.5
	0.92	0.12	0.3		0.031
	0.37	0.33	0.32		0.52
1.1	0.35	0.15	0.25		0.21
2	0.86	0.01	0.33		0.003
- 1	0.84	0.11	0.26		0.26
	0.69	0.12	0.26		0.26
	0.72	0.08	0.29		0.26
	0.81	0.12	0.32		0.26
3	0.9	0.06	0.3		0.007
	1	0.04	0.3		0.007
	0.9	0.095	0.28		0.007
	0.7	0.55	0.32		0.75
	0.95	0.1	0.28		0.007
	0.95	0.07	0.29		0.007
	0.96	0.1	0.28		0.007
	0.46	0.65	0.31		0.75
4	0.91	0.01	0.29		0.0125
	0.84	0.5	0.27		0.5
	0.55	0.5	0.29		0.4
-	0.45	0.56	0.31	_	0.5
5	0.28	0	0.3		0.038
	0.53	0.16	0.28		0.038
	0.23	0.08	0.32		0.038
	0.25	0.15	0.3		0.038
	0.41	0.2	0.34		0.038
	0.57	0.2	0.20		0.038
	0.0	0.05	0.20		0.07
6	0.01	0.00	0.37		0.004
0	0.82	0.01	0.34		0.004
	0.74	0.07	0.27		0.004
	0.63	0.09	0.3		0.004
	0.64	0.04	0.26		0.004
	0.54	0.04	0.28		0.004
	0.56	0.022	0.33		0.004
	0.9	0.075	0.33		0.004
	0.81	0.04	0.33		0.004
	0.78	0.05	0.313		0.004
	0.71	0.06	0.3		0.004
	0.59	0.13	0.34		0.004
	0.89	0.14	0.26		0.004
7	0.92	0.2	0.29		0.07
	0.91	0.2	0.33		0.33
	0.94	0.2	0.27	-	0.07
8	0.98	0.12	0.33		0.3
	0.88	0.22	0.29		0.3
~	0.77	0.29	0.33		0.3
9	0.8	0.13	0.25		0.16
	0.88	0.17	0.3		0.16
	0.78	0.17	0.27		0.01
	0.89	0.17	0.27		0.16
	0.79	0.00	0.32		0.01
	0.81	0.06	0.3		0.16
	0.82	0.13	0.34		0.16
10	0.8	00	0.28		0.10
10	0.07	0.2	0.34		0.010
	0.02	0.06	0.5		0.016
11	0.85	0.33	0.26	-	0.75
	0.6	0.27	0.28		0.59
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	1000				Linearised
	Y/Y0	Bedslope	Beta =0.4		bedslope
1	0.91	0.40	0.40		0.52
	0.51	0.33	0.41		0.5
	0.91	0.42	0.35		0.52
	0.66	0.65	0.41		0.5
	0.92	0.4	0.39	_	0.52
2	0.9	0.01	0.4		0.003
	0.96	0.01	0.36		0.003
	0.92	0.03	0.39		0.003
	0.77	0.12	0.37		0.26
	0.0	0.01	0.39		0.003
	0.03	0	0.41		0.003
	0.00	0.11	0.44		0.003
	0.01	0.11	0.30		0.003
	0.01	0.02	0.42		0.003
	0.92	0.02	0.36		0.003
3	0.02	0.00	0.00	-	0.000
Ŭ	0.0	0.035	0.4		0.007
	1	0.02	0.44		0.007
	0.6	0.6	0.4		0.75
	0.7	0.54	0.44		0.75
	0.96	0.1	0.35		0.007
4	0.92	0.08	0.35		0.0125
	0.89	0.01	0.43		0.0125
	0.94	0.06	0.36		0.0125
5	0.68	0.14	0.38		0.038
	0.15	0.01	0.38		0.038
	0.79	0.06	0.41		0.038
	0.57	0.07	0.36		0.038
	0.61	0.07	0.39		0.038
	0.69	0.06	0.41		0.038
	0.64	0.07	0.43	_	0.038
6	1	0.03	0.43		0.004
	0.92	0.028	0.42		0.004
	0.92	0.02	0.41		0.004
	0.77	0.011	39		0.004
	0.52	0.001	0.39		0.004
	0.5	0.045	0.30		0.004
	0.97	0.04	0.44		0.004
	0.98	0.04	0.43		0.004
	0.78	0.02	0.44		0.004
	0.68	0.03	0.36		0.004
14	0.84	0.01	0.36		0.004
7	98	0.13	0.43		0.07
8	0.98	0.1	0.44		0.003
	1	0.03	0.41		0.003
	0.97	0.1	0.41		0.3
	0.98	0.1	0.39		0.003
	0.9	0.13	0.38		0.17
	0.87	0.16	0.38		0.17
9	0.96	0.02	0.44		0.16
	0.83	0.01	0.38		0.01
	0.84	0 00	0.4		0.01
	0.83	0.03	0.39		0.01
	0.90	0.02	0.3/		0.16
	0.05	0.01	0.41		0.01
	0.84	0.03	0.38		0.01
	0.89	0.17	0.36		0.16
	0.96	0.02	0.43		0.16
	0.85	0.01	0.39		0.01
	0.86	0	0.4		0.01
	0.85	0.03	0.37		0.01
10	0.8	0.05	0.38		0.016
	0.78	0.05	0.44		
	0.73	0.08	0.35		0.39
	0.84	0.06	0.41		0.016
	0.73	0.12	0.35		0.39
	0.72	0.06	0.44		0.016
	0.66	0.07	0.39		0.016
11	0.63	0.6	0.38		0.59
	0.66	0.66	0.35		0.75



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	in the second			Linearised
	Y/Y0	Bedslope	Beta = 0.6	bedslope
1	0.60	0.67	0.64	0.5
	0.96	0.11	0.64	0.031
	0.64	0.65	0.64	0.5
	0.98	0.14	0.6	0.031
	1	07	0.58	0.031
	0.96	0.11	0.64	0.031
	0.00	0.11	0.04	0.031
	0.97	0.1	0.0	0.001
2	0.88	0.02	0.6	0.003
	1	0.04	0.64	0.003
19	0.96	0.01	0.64	0.003
	0.88	0.03	0.58	0.003
- 13	0.9	0.06	0.56	0.003
	0.85	0.08	0.57	0.003
	0.96	0.07	0.55	0.003
	1	0.01	0.64	0.003
	0.9	0.01	0.62	0.003
	0.9	0.01	0.02	0.003
	0.89	0.03	0.55	0.003
	0.93	0.01	0.6	0.003
	0.94	0.01	0.58	0.003
	0.94	0.02	0.59	0.003
	0.9	0.06	0.59	0.003
11	0.83	0.11	0.55	0.003
3	1	0.01	0.6	0.007
	1	0.05	0.6	0.007
	0.9	0.03	0.6	0.007
	1	0.03	0.6	0.007
	0.9	0.00	0.0	0.13
	0.5	0.1	0.0	0.13
	0.70	0.01	0.62	0.007
	0.78	0.32	0.57	0.007
_	0.883	0.31	0.63	0.007
	0.98	0.02	0.6	0.007
4	0.97	0.05	0.59	0.0125
	0.93	0.1	0.63	0.0125
5	0.79	0.17	0.55	0.038
1.5	0.71	0.2	0.57	0.038
	0.98	0.04	0.58	0.038
	0.86	0.07	0.64	0.038
	0.76	0.05	0.59	0.038
	0.69	0.04	0.59	0.038
6	0.00	0.04	0.55	0.000
0	0.69	0.04	0.57	0.004
	0.59	0.029	0.59	0.004
	0.83	0.05	0.58	0.004
	0.8	0.065	0.64	0.004
	0.74	0.04	0.58	0.004
	0.57	0.058	0.58	0.004
	0.61	0.038	0.59	0.004
	0.76	0.002	0.6	0.004
	0.83	0.024	0.612	0.004
	0.91	0.06	0.56	0.004
	0.79	0.16	0.63	0.35
	0.93	0.05	0.62	0.004
	0.84	0.03	0.62	0.004
-	0.04	0.02	0.02	0.004
1	1	0.02	0.63	0.07
	0.92	0.17	0.63	0.07
8	0.97	0.03	0.59	0.003
	0.91	0.02	0.61	0.003
	1	0.03	0.58	0.003
	0.92	0.09	0.6	0.17
9	0.83	0.01	0.57	0.01
	0.92	0	0.57	0.16
	0.9	0.03	0.63	0.01
	0.84	0.01	0.58	0.01
10	0.04	0.01	0.00	0.01
10	0.95	0.03	0.62	0.016
	0.94	0.03	0.6	0.016
	1	0.21	0.55	0.66
	0.76	0.07	0.6	0.016


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	YNO	Bedslope	Beta = 0.7	Linearised
1	0.97	0.00	0.72	0.031
2	0.66	0.65	0.69	0.5
2	0.97	0.02	0.71	0.003
	1	0.02	0.7	0.003
	0.96	0.01	0.73	0.003
	0.96	0.06	0.73	0.003
	0.93	0.05	0.73	0.003
	0.93	0.03	0.65	0.003
	0.96	0.04	0.69	0.003
	0.91	0.03	0.67	0.003
	0.96	0.02	0.7	0.003
3	1	0.013	0.7	0.007
	1	0.01	0.7	0.007
	1	0.03	0.7	0.007
	0.9	0.14	0.69	0.14
	0.97	0.039	0.69	0.007
	0.84	0.145	0.729	0.14
	0.97	0.038	0.67	0.007
	0.71	0.02	0.66	0.007
4	0.95	0.01	0.69	0.0125
	0.98	0.01	0.73	0.0125
	0.85	0.01	0.69	0.0125
	1	0.04	0.66	0.0125
5	0.85	0.4	0.71	0.0125
Ŭ	0.98	0.007	0.739	0.038
	1	0.13	0.67	0.07
	0.747	0.1	0.74	0.038
	0.922	0.037	0.738	0.038
	0.73	0.03	0.007	0.038
	0.98	0.07	0.69	0.038
	0.72	0.02	0.72	0.038
	0.97	0.01	0.72	0.038
	0.69	0.004	0.73	0.038
6	0.8	0.04	0.74	0.000
	0.7	0.1	0.7	0.004
	0.7	0.05	0.73	0.004
	0.8	0.02	0.74	0.004
	0.83	0.03	0.655	0.004
	0.8	0.04	0.69	0.004
	0.76	0.002	0.7	0.004
	0.76	0.01	0.69	0.004
	0.79	0.02	0.69	0.004
	0.8	0.02	0.65	0.004
	0.93	0.06	0.73	0.004
7	0.84	0.09	0.67	0.004
	1	0.02	0.66	0.07
	0.83	0.17	0.67	0.07
8	0.97	0.05	0.69	0.003
	0.96	0.06	0.72	0.003
	1	0.02	0.73	0.003
	0.98	0.1	0.69	0.003
9	0.91	0.08	0.69	0.003
	0.91	0	0.7	0.01
	0.89	0.03	0.65	0.01
	0.97	0.04	0.74	0.01
	0.9	0.01	0.74	0.01
	0.83	0.02	0.69	0.01
	0.97	0.04	0.72	0.01
	0.92	0.01	0.71	0.01
	0.85	0.02	0.66	0.01
10	0.94	0.02	0.73	0.016
	0.93	0.02	0.66	0.016
	0.79	0.03	0.65	0.016
	0.75	0.08	0.66	0.016
	0.92	0.05	0.7	0.016
	0.81	0.04	0.68	0.016
11	0.9	0.09	0.74	0.01
	0.99	0.06	0.65	0.01
- 1	0.54	0.24	07	0.01

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Linearised



	Y/Y0	Bedslope	Beta = 0.8		Linearised bedslope	
1	1.00	0.42	0.80		0.5	
	0.97	0.03	0.76		0.031	
	0.66	0.67	0.79		0.5	
	0.99	0.00	0.80		0.031	
2	0.99	0.16	0.81		0.003	
	0.86	0.14	0.84		0.003	
	0.94	0.03	0.78	6.4	0.003	
	0.92	0.06	0.83		0.003	
	0.87	0.03	0.78		0.003	
	0.90	0.03	0.78		0.003	
	0.92	0.19	0.75		0.003	l
	0.95	0.13	0.80		0.003	
	0.87	0.00	0.78		0.003	
	0.96	0.02	0.81		0.003	
	0.92	0.02	0.81		0.003	
	0.95	0.05	0.78		0.003	
	0.93	0.01	0.81		0.003	
	0.95	0.05	0.82		0.003	
2.9	0.92	0.01	0.76		0.003	
3	1.0	0 0 0 2 5	0.8		0.007	
	1.0	0.025	0.8		0.007	
	1	0.01	0.786		0.007	
	0.964	0.01	0.755		0.007	
	0.929	0.114	0.781		0.14	
	0.912	0.144	0.765		0.007	
	1	0.004	0.771		0.007	
	0.887	0.311	0.808		0.014	
	0.995	0.019	0.805		0.007	
1	0.892	0.311	0.831		0.014	
4	0.98	0.01	0.81		0.0125	
	0.95	0.04	0.76		0.0125	
	0.96	0.01	0.81		0.0125	
	0.83	0	0.76		0.0125	
	0.85	0.02	0.83		0.0125	Ϊ.
	1	0.05	0.77		0.0125	
5	0.92	0.03	0.783		0.0123	
	1	0.011	0.79		0.038	
	0.886	0.109	0.83		0.038	
	0.78	0.145	0.827		0.038	
1	0.731	0.063	0.788		0.038	
6	0.614	0.022	0.761	0	0.004	
	0.977	0.04	0.788		0.004	
	0.039	0.062	0.756		0.004	
	0.8	0.005	0.762		0.004	
	0.719	0.021	0.782		0.004	
	0.65	0.029	0.772		0.004	
	0.079	0.02	0.845		0.004	
	0.73	0.019	0.849		0.004	
	0.758	0.012	0.831		0.004	
	0.76	0.002	0.768		0.004	
	0.85	0.08	0.78		0.004	
	0.95	0.014	0.765		0.004	
	0.959	0.036	0.788		0.004	
	0.92	0.097	0.838		0.004	
7	0.89	0.01	0.78		0.07	
	0.88	0.01	0.84		0.07	
	0.93	0.01	0.82		0.07	
	0.94	0.02	0.77		0.07	
	1	0	0.79		0.07	
	0.95	0.03	0.81		0.07	
	0.99	0.02	0.76		0.07	
	0.95	0.03	0.75		0.07	
	0.92	0.01	0.8		0.07	

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	0.94	0.02	0.83		0.07	7
	0.94	0.02	0.77		0.07	7
8	0.93	0.04	0.83		0.003	3
	0.92	0.08	0.78		0.003	3
	0.96	0.08	0.77		0.003	3
	1	0.03	0.8		0.003	3
9	0.78	0	0.75		0.16	5
	0.79	0.01	0.83		0.0	1
	0.62	0.06	0.84		0.0	1
	0.96	0.01	0.82		0.0	1
	0.81	0.04	0.78		0.0	1
	0.84	0.01	0.75		0.0	1
	0.84	0.06	0.76		0.0	1
	0.88	0.01	0.84		0.0	1
	0.88	0.01	0.76		0.0	1
	1	0	0.83		0.0	1
	1	0	0.81		0.0	!
	0.92	0.01	0.79		0.0	!
	0.96	0.02	0.82	_	0.0	
10	0.75	0.01	0.77		0.016	5
	0.76	0.03	0.8		0.016	2
	0.83	0.01	0.8		0.016	2
	0.72	0.06	0.82		0.016	
	0.65	0.01	0.83		0.016	
	0.87	0.03	0.77		0.010	2
	0.77	0.01	0.0		0.016	
11	0.00	0.03	0.04		0.010	1
	0.01	0.1	0.0		0.0	1
	0.00	0.03	0.77		0.0	
	0.97	0.00	0.81		0.0	
	0.91	0.39	0.78		0.0	
	0.87	0.03	0.82		0.0	
	0.99	0.06	0.81		0.0	
	1	0.02	0.8		0.0	1
	0.97	0.08	0.82		0.0	1
	0.94	0.39	0.78		0.0	1
	0.64	0.18	0.76		0.0	1
	0.92	0.39	0.75		0.0	1
	0.82	0.18	0.82		0.0	1

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			0.85-0.94		Linearised
	Y/Y0	Bedslope	Beta = 0.9		bedslope
	0.63	0.65	0.88		0.031
	1.00	0.45	0.90		0.5
	0.98	0.02	0.86		0.031
	1.00	0.43	0.85		0.5
	1.00	0.02	0.93		0.031
	0.99	0.00	0.00		0.031
	0.97	0.06	0.94		0.031
	0.93	0.04	0.93	-	0.003
	0.85	0.08	0.94		0.003
	0.85	0.06	0.91		0.003
	0.93	0.04	0.89		0.62
	0.92	0.02	0.94		0.003
	0.93	0.07	0.89		0.62
	0.75	0.04	0.86		0.62
	1.00	0.09	0.90		0.003
	0.87	0.12	0.85		0.003
	0.91	0.17	0.87		0.62
	0.91	0.09	0.00		0.003
	0.01	0.03	0.00		0.003
	1 00	0.10	0.05		0.02
	0.81	0.05	0.86		0.003
3	1.0	0.008	0.9		0.007
-	1.0	0.038333	0.9		0.007
	1.0	0.01	0.9		0.007
	1.0	0.058	0.9		0.007
	1.0	0.0155	0.9		0.007
	0.9	0.155	0.062518		0.007
	0.9	0.095	0.281983		0.007
	0.9	0.12575	0.826343		0.14
	0.9	0.1425	0.692588		0.14
	0.97469	0.053333	0.891509		0.007
	0.952342	0.1275	0.883316		0.14
	0.954313	0.1275	0.860625	_	0.14
4	1.00	0.01	0.89		0.0125
	0.94	0.02	0.09		0.0125
	0.86	0.03	0.05		0.0125
	0.94	0.01	0.93	1.5	0.0125
5	0.847279	0.0671	0.866162		0.038
	0.869308	0.0169	0.91498		0.038
	0.983525	0.0226	0.919258	6.	0.038
	0.727323	0.1513	0.907165		0.07
	0.719919	0.0488	0.949478		0.07
	0.759554	0.0398	0.871111		0.038
	0.815081	0.0692	0.917785		0.038
	0.937104	0.0254	0.091009		0.038
-	0.021373	0.0130	0.910799		0.038
	0.94252	0.013	0.905378		0.038
	0.798749	0.0636	0.903142		0.038
	0.970751	0.012	0.948377		0.038
	0.979336	0.0201	0.884252		0.038
	0.775601	0.1471	0.85265	-	0.038
	0.837849	0.0802	0.877712		0.038
	0.84563	0.1167	0.85144	÷	0.038
	0 0705 40	0.0872	0.892648		0.038
	0.9/0543	0.0046	0.860363		0.038
	0.7643	0.1583	0.000303		0.038
	1	0.1276	0.942466		0.038
	0.957427	0.0515	0.901162		0.038
6	0.64	0.04	0.90		0.004
1	0.79	0.09	0.89		0.004
	0.93	0.02	0.90		0.004
	0.91	0.06	0.89		0.004
	0.79	0.01	0.88		0.004
	0.79	0.04	0.87		0.004
	0.67	0.01	0.90		0.004
	0.72	0.01	0.87		0.004
	0.74	0.02	0.85		0.004
	0.89	0.02	0.91		0.004
	0.97	0.02	0.85	-	0.004
7	0.85	0.03	0.50	-	0.004
1	0.92	0.04	0.87		0.07
	0.97	0.01	0.91		0.07

ar s	sun ac za	a	Page	2	13	of	14
1		0.02	0.00			0.07	
	0.94	0.03	0.09			0.07	
	0.99	0.01	0.90			0.07	
	0.89	0.02	0.91			0.07	
	0.94	0.07	0.00			0.07	
	1.00	0.02	0.85			0.07	
	1.00	0.02	0.88			0.07	
	0.82	0.02	0.89			0.07	
	0.94	0.07	0.86			0.07	
	0.88	0.01	0.88			0.07	
	0.98	0.03	0.86			0.07	
8	0.89	0.03	0.91			0.003	
	0.99	0.04	0.88			0.003	
	0.95	0.05	0.86			0.003	
9	0.97	0.04	0.85			0.01	
	0.96	0.02	0.94			0.01	
	0.94	0.02	0.94			0.01	
	0.93	0.01	0.92			0.01	
	0.91	0.02	0.86			0.01	
	0.89	0.01	0.88			0.01	
	0.88	0.00	0.93			0.01	
	0.96	0.02	0.86			0.01	
	0.94	0.02	0.94			0.01	
	1.00	0.00	0.89			0.01	
	0.97	0.01	0.85			0.01	
	0.94	0.02	0.90			0.01	
	0.93	0.01	0.94			0.01	
	0.90	0.01	0.86			0.01	
10	0.95	0.02	0.89			0.016	
	0.93	0.01	0.87			0.016	
	0.92	0.04	0.89			0.016	
	0.82	0.02	0.89			0.016	
	0.83	0.00	0.88			0.016	
	0.77	0.05	0.85			0.016	
	0.86	0.02	0.93			0.016	
	0.91	0.01	0.94		'	0.016	
	0.83	0.02	0.93			0.016	
	0.79	0.03	0.87			0.016	
	0.96	0.04	0.86			0.016	
	1.00	0.02	0.90			0.016	
	0.92	0.09	0.93			0.016	
11	0.84	0.07	0.94			0.01	
	0.84	0.03	0.87			0.01	
	0.87	0.07	0.89			0.01	
	0.83	0.04	0.88			0.01	
	0.89	0.09	0.85			0.01	
	1.00	0.03	0.87			0.01	
	0.94	0.03	0.85			0.01	
	0.92	0.08	0.92			0.01	
	0.95	0.06	0.88			0.01	
	1.00	0.14	0.92			0.01	
	0.73	0.14	0.92			0.01	
	0.71	0.09	0.86			0.01	



Linearised



	Y/Y0	Bedslope	Beta = 1.0	Linearised bedslope
41	0.94	0.03	1.00	0.031
	1.00	0.45	0.95	0.031
	0.97	0.02	1.00	0.031
	0.96	0.04	1.00	0.031
	0.98	0.02	0.98	0.031
	0.99	0.00	1.00	0.031
	0.96	0.02	1.00	0.031
	1.00	0.47	1.00	0.031
42	0.657605	0.068333	1	0.003
	0.859779	0.028833	0.956339	0.003
	0.747232	0.012333	0.950181	0.003
	0.885609	0.083333	1	0.003
	0.791549	0.053333	1	0.003
	0.690411	0.010007	0 957812	0.003
	0.927431	0.135	0.986726	0.003
	0.946203	0.062833	1	0.003
	0.927402	0.137167	1	0.003
43	0.926037	0.067667	0.992474	0.003
40	0.947452	0.045	1	0.007
	1	0.07375	0.980405	0.007
	0.998532	0.02475	0.99212	0.007
	0.969676	0.02175	0.952073	0.007
	1	0.02525	0.956022	0.007
	0.992532	0.02425	1	0.007
	0.982541	0.01/3/5	0 0770/3	0.007
	0.994581	0.0035	0.985746	0.007
	0.974384	0.084	1	0.007
	0.992194	0.058	1	0.007
44	0.992517	0.058	1	0.007
	0.978972	0.01125	1	0.0125
	0.899087	0.02625	1	0.0125
	0.883614	0.11225	1	0.0125
	0.895349	0.071	0.956459	0.0125
45	0.878563	0.0486	1	0.038
- 0	0.959274	0.0335	0.986276	0.038
	0.878149	0.0712	0.966401	0.038
	0.689974	0.1403	1	0.07
	0.975497	0.0372	1	0.038
	0.849971	0.1121	0.999632	0.038
	0.961874	0.083	0.985361	0.038
	0.966792	0.0212	0.959492	0.038
	0.986383	0.0106	1	0.038
	0.832917	0.1895	0.982662	0.038
	0.984659	0.0358	0.952936	0.038
46	0.634636	0.0347	1	0.004
	0.769091	0.0224	1	0.004
	0.760226	0.003	1	0.004
	0.88647	0.02075	1	0.004
	0.988823	0.0031	0.969001	0.004
47	0.855368	0.0139	1	0.07
	0.886578	0.023	0.991351	0.07
	0.86162	0.0209	1	0.07
	0.832916	0.0209	0.973761	0.07
	0.866601	0.0169	0.950857	0.07
	0.8/8862	0.0209	0 947985	0.07
	0.000240	0.0128	1	0.07
48	0.924503	0.041875	1	0.003
	0.899244	0.018125	1	0.003
	0.885965	0.04125	1	0.003
	0.91886	0.065	0.966411	0.003
49	0.961312	0.011667	1	0.01
	0.962/01	0.011667	1	0.01
	0.900892	0.017333	0.953191	0.01
	0.895733	0.0014	0.964133	0.01
50	0.986391	0.0141	0.966862	0.016
	0.831354	0.0156	0.97991	0.016
	0.8011	0.00475	1	0.016
	0.80	0.00	1.00	0.016
	0.831497	0.03295	1	0.016
51	0.84	0.03	1.00	0.01
	0.88	0.07	0.96	0.01
	0.90	0.02	1.00	0.01
	0.00	0.04	1.00	0.01

# **APPENDIX G**

# A SAMPLE OF VELOCITY CALCULATIONS USING THE BETA GRAPH

STATION No. : C1H015 Measured Q = 179.5 m³/s RIVER NAME : Klip PLACE NAME : De Langes Drift DATE : 23/02/1975									
Chainage	Y/Y0	Bedslope	Beta from table	Alpha	Velocity m/s				
3.5	0	0.600	0.01	100	0.11				
4	0.035	0.571	0.02	50	0.15				
7	0.233	0.600	0.05	20	0.24				
10	0.453	0.450	0.13	7.69	0.39				
13	0.547	0.300	0.23	4.35	0.52				
16	0.663	0.650	0.3	3.33	0.59				
19	1.000	0.467	1	1	1.08				
22	0.988	0.000	1	1	1.08				
25	1.000	0.033	1	1	1.08				
28	0.965	0.064	1	1	1.08				
29.7	0.965	0.108	1	1	1.08				
31.7	0.919	0.121	0.8	1.25	0.96				
33	0.919	0.395	0.8	1.25	0.96				
36	0.721	0.483	0.4	2.5	0.68				
39	0.581	0.500	0.27	3.70	0.56				
42	0.372	0.333	0.08	12.5	0.30				
45	0.349	0.150	0.07	14.29	0.28				
48	0.267	0.317	0.06	16.67	0.26				
51	0.128	0.383	0.04	25	0.22				
54	0.000	0.020	0.01	100	0				



# **APPENDIX H**

## PROCESSED FIELD DATA AND CALCULATION SHEET FOR 1-DIMENSIONAL FLOW FORMULA (MANNING)

DELTA-FACTORS FOR MEASURED- AND THEORETICAL VELOCITY DISTRIBUTIONS ARE INCLUDED

.

Station no.: C1H015 River: Klip Place: De Langes Drift









The values in the legend block describe measured discharge for the profile indicated



				Measure	d data			
STA	TION No. :	C1H015			STA	RT TIME	07h15	
RIVE PLAC	R NAME : E NAME : DATE :	Klip De Langes 25/02/1975	Drift	Avera	ge Gaugep	late reading :	6.205	m
					Main Ch	annel LEFT :	10	
					Main Cha	nnel RIGHT	47	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0,2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				0.622	182.4	113.38
1	7	0		0		0.000	0.0	0.00
2	10	2.4		0.2669		0.267	7.2	1.92
3	13	3.2		0.433		0.433	9.6	4.16
4	16	4.3		0.7607		0.761	12.9	9.81
5	19	7.2		0.8501		0.850	21.6	18.36
6	22	6.8		0.9481		0.948	20.4	19,34
7	25	7		0.8246		0.825	21.0	17.32
8	28	7		0.8033		0.803	16.5	13.21
9	29.7	7		0.6427		0.643	13.0	8.32
10	31.7	6.5		0.4451		0.445	10.7	4.77
11	33	6.5		0.5564		0.556	14.0	7.78
12	36	4.7		0.3308		0.331	14.1	4.66
13	39	3.5		0.1593		0.159	10.5	1.67
14	42	1.6		0.1828		0.183	4.8	0.88
15	45	1.4		0.1907		0.191	4.2	0.80
16	48	0.8		0.1829		0.183	2.0	0.37
17	50	0		0		0.000	0.0	0.00
18						0.000	0.0	0.00
19						0.000	0.0	0.00
						0.622	182.4	113.38
				Delta val	lue calcula	tions		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	16.4	16.00	19.00	0.76	0.85	0.77	0.80
	30%	19.6	19.00	22.00	0.85	0.95	0.67	0.71
	40%	22.8	22.00	25.00	0.95	0.82	0.92	0.68
	50%	26.0	26.00	28.00	0.82	080	0.82	0.76
	60%	29.2	28.00	29.70	0.80	0.64	0.69	0.90
	70%	32.4	31.70	33.00	0.45	0.56	0.51	1.23
	80%	35.6	33.00	36.00	0.56	0.33	0.36	1.72

Aanning	or Chezy	r:	M			Q =	134.0
		Sicpe	80000.0		L	V <sub>AVR</sub> =	0.73
loughness	coeff		Area reduction	n factor	1		
Sub	n		Sub	اړ			
Ø			0	1			
2	0.038		2	1			
0			0	1			
Chamage	Vertical	Sub	Area	Wetled P	H-Radius	Q	V
	or effective depth	Section	A	P	R	(m <sup>3</sup> /s)	Velocity
7	0	2	0.0	5.0	0	0.00	0.00
10	24	2	7.2	30	2.4	3.04	0.42
13	3.2	2	9.6	3.0	3.2	4 91	0.51
16	4.3	2	12.9	3.0	43	8 03	0.62
19	12	2	21.6	30	1.2	18.96	U.86
22	68	2	204	3U 8 0	0.0	17.22	0.84
20	7	2	21.0	3.0	<u>'</u>	14 (28	0.60 7.86
20	÷	5	13.0	19	÷,	11 15	0.86
31 7	65	5	10.7	17	65	<b>8</b> 79	0.82
33	85	2	14.0	22	6.5	11.40	0.82
36	4.7	2	14,1	3.0	47	Ø 31	0.66
39	3.5	2	10.5	3.0	3.5	5.70	0.64
42	16	2	4.8	30	1.6	1.56	0.32
45	1.4	2	4.2	3.0	1.4	1 24	0.29
48	0.8	2	2.0	2,5	0.8	0.41	0.20
50	Ð	2	0.0	1.0	0	0.00	00.00
	G	2	0.0	0.0	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			182.4		L	134.02	0.7
			Delta va	lue calcula	tions		
% Width	Act. Chin.	Lowet	Upper	V-lower	Vacupper	Vant	Delta
20%	16.4	16.00	19:00	0.62	0.88	0 66	1.12
30%	19.6	19.00	22.00	0 88	0.84	0.67	0.84
40%	22.8	22.00	25.00	0 84	0.66	0.85	0.87
50%	26.0	26.00	28.00	0.65	0.69	0.96	0.85
60%	29.2	28.00	29.70	0.86	0.86	D 86	0.86
70%	32.4	31.70	33.00	0.82	0.82	0.62	4.00
30%	28.5	54.06	1 36.56	0.9%	U-00	0.00	1.00

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			Me	easured da	ata		_	
STA	TION No. :	C1H015			STA	RT TIME	17h00	
RIVE	R NAME :	Klip		Averag	e Gaugepl	6.83	m	
PLAC	E NAME :	De Langes	Drift	-	• •	-		
	DATE :	24/02/1975						
					Main Cha	nnel LEFT :	10	
					Main Ohan		6	
				,	viain Chan		44	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				0.627	213 7	133 94
1	6	0		0		0.000	0.0	0.00
2	7	1.2		0.2244		0.224	2.4	0.54
3	10	3.1		0.171		0.171	9.3	1.59
4	13	4		0.4585		0.459	12.0	5.50
5	16	5		0.8331		0.833	15.0	12.50
6	19	7,9		0.8672		0.867	23.7	20.55
7	22	7.7		0.8884		0.888	23.1	20.52
8	25	7.8		0.8885		0.889	23.4	20.79
9	28	7.6		0.8885		0.889	17.9	15.87
10	29.7	7.6		0.7108		0.711	14.1	9.99
11	31.7	7.2		0.4485		0.449	11.9	5.33
12	33 00	(.2 5 /		0.5607		0.561	15.5	8.68
13	0C	5,4 9.0		0.301		0.301	10.2	4.00
14	5	3.2		0.1907		0.191	9.0	1.03
10	42	2.0		0.3095		0.310	63	1.95
10	48	2.1 1 7		0.3055		0.216	5.1	1 10
18	51	0.4		0		0.000	08	0.00
19	52	0		, o		0.000	0.0	0.00
						0.627	213.7	133.94
				Delta value (	calculation	15		1 5-4
	Per	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	16.4	16.00	19.00	0.83	0.87	0.84	0.76
	30%	19.6	19.00	22.00	0.87	0.89	0.87	0.72
	40%	22.8	22.00	25.00	0.89	0.89	0.89	0.71
	60%	20,0	20.00	20.00	0.89	0.89	0.76	0.82
	70%	374	20.00	23.00	0.03	0.56	0.51	1 23
	80%	35.6	33.00	36.00	0.40	0.30	0.34	1.87

Calculated data, 1-dimensional flow theory											
Manning	or Chezy	<i>r</i> :	M			Q =	154.3				
		Slope	0 00007			V <sub>AVR</sub> =	0.72				
Rouchness	coeff		Area reduct	ion factor	I						
Sub	ŋ		Sub	f.							
<u>^</u>			0								
2 6	0.039		2 5	-							
4	0.000		2	1							
5			U				+ v				
Cnainage	venical	500	Area	Anetted h	m-reactions	<b></b>	•				
	or affective	Section	A	Þ	R	(m /s)	Velocity				
-	depth	-									
6	0	2	0.0	35	0	0.00	0.00				
10	1.2	2	2.4	20	31	4 95	0.25				
13	4	2	12.0	3.0	4	6.65	0.55				
16	5	2	15.0	3.0	5	9.66	0.64				
19	79	2	23.7	30	7.9	20 70	0.87				
22	77	2	23.1	3.0	7.7	19.83	0.86				
25	7.8	2	23.4	3.0	7.8	20.26	0.67				
28	7.6	2	17.9	2.4	7.6	15.20	0.85				
29.7	76	2	141	19	76	11.97	0.85				
31.7	12	2	11.9	1.7	1.2	975	0.82				
00 36	1.4 5.4	2	100	30	54	14.7 BR	0.68				
39	32	2	96	30	32	4 59	0.48				
42	25	2	7.5	3.0	2.5	3.04	0.41				
45	2.1	2	6.3	3.0	2.1	2.27	0.36				
48	1.7	2	5.1	3.0	17	1.60	0.31				
51	0.4	2	0.8	20	0.4	0 10	0 12				
52	0	2	00	0.5	0	0.00	0.00				
			233.7			154.27	0.72				
		[	Jelta value	calculation	s						
% Width	Aci. Chu.	Lower	Upper	V-lower	V-Upper	V-int	Delta				
20%	16.4	16.00	19-00	0.64	0.87	0.67	1.07				
30%	19.6	19.00	22.00	0.87	0.86	0.87	0.83				
40%	22.8	22.00	25.00	0.85	0.87	0.86	0.84				
50%	25.0	25.00	28.00	0.87	0.85	0.86	0.84				
60%	29.2	28.00	2970	085	0.85	0.80	0.80				
20%	06A 36 0	2170	36.00	0.62	0.02 D.60	0.02	1 64				

STATION No. : C1H015         START TIME : 11h00           RIVER NAME : Klip         Average Gaugeplate reading : 7.03 m           PLACE NAME : De Langes Drift           DATE : 24/02/1975           Main Channel LEFT : 10           Main Channel LEFT : 10           Main Channel LEFT : 12           Or effective 0.2d         0.4d         O.84         9           Or effective 0.2d         0.4d         0.847         23.9         144.83           0         0.647         23.9         144.83           0.11         0         0         0           number         Vetical         Velocity				Me	asured da	ata			
RIVER NAME       Klip       Average Gaugeplate reading       7.03       m         PLACE NAME       De Langes Drift       DATE       24/02/1975       Main Channel LEFT       10       Main Channel LEFT       10         Jatt       2       3       4       5       6       7       8       9         Vertical       Chainage       Vetical       Velocity       Velocity       Velocity       Velocity       0.84       0.84       0.9         number       or effective       0.2d       0.4d       0.8d       (m/s)       (m <sup>2</sup> )       144.83         1       6       0       0       0       0.000       0.0       0.000       0.00       0.000       0.00       0.000       0.01       0.000       0.01       0.01       0.000       0.01       0.0	STA	TION No. :	C1H015			STA	RT TIME :	11h00	
Main Channel RIGHT         10           Main Channel RIGHT         42           1         2         3         4         5         6         7         8         9           Vertical number         Vartical depth         Velocity         Velocity         Velocity         Vares.         Area Area         Q           1         6         0         0.4d         0.8d         (m's)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         6         0         0         0         0.647         223.9         144.83           1         6         0         0         0         0.647         223.9         144.83           1         6         0         0         0         0.000         0.00         0.000           3         10         3.4         0.1528         0.1633         2.8         0.51           3         13         4.1         0.4457         0.446         12.3         5.48           0.912         0.9693         0.918         24.0         22.04         22.04           7         2.2         7.8         0.9012         0.9011         18.3         16.52           10         28.7	RIVE	R NAME : E NAME : DATE :	Klip De Langes 24/02/1975	Drift	Averag	e Gaugepl	ate reading :	7.03	m
Main Channel RIGHT         42           1         2         3         4         5         6         7         8         9           Vertical number         Verticat or effective         Velocity         Velocity         Velocity         Velocity         Valor         Area (m/s)         0           1         6         0         0.2d         0.4d         0.8d         (m/s)         (m <sup>2</sup> )         (m <sup>2</sup> /s)           3         10         3.4         0.1514         0.1633         2.8         0.51           4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9012         0.901         16.3         16.52           10         29.7         7.8         0.9022         0.901         16.3         16.52           10         29.7         7.8         0.9012         0.901         16.3         16.52           10         29.7         7.8         0.237         0.257         14.4         10.40           11         31.7         7.3         0.4228						Main Cha	innel LEFT :	10	
1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical or effective         Velocity         Velocity         Velocity         Vaver.         Area (m/s)         Q           1         6         0         0.4d         0.8d         (m/s)         (m <sup>3</sup> )s         (m <sup>3</sup> /s)           1         6         0         0         0.4d         0.8d         (m/s)         (m <sup>3</sup> )s           3         10         3.4         0.1828         0.183         2.8         0.51           3         10         3.4         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.9011         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40						Anin Chan		40	
1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical         Velocity         Velocity         Velocity         Velocity         Vaver.         Area         Q         Q           1         6         0         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)         0.000         0.000         0.000         0.000           2         7         1.4         0.1828         0.183         2.8         0.51           3         10         3.4         0.1813         2.8         0.51         0.22         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.9181         0.9182         22.42           7         22         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th>44</th><th></th></t<>								44	
Vertical number         Velocity or effective depth         Velocity 0.2d         Velocity 0.4d         Velocity 0.8d         Velocity (m <sup>2</sup> )         Vaver, (m <sup>3</sup> )         Area (m <sup>3</sup> )         Q           1         6         0         0.4d         0.8d         (m <sup>4</sup> )         144.83           1         6         0         0         0.000         0.00         0.000           2         7         1.4         0.1828         0.183         2.8         0.51           3         10         3.4         0.1514         0.151         10.2         1.54           4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.94           7         22         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.411.7         0.237         13.5         3.20	1	2	3	4	5	6	7	8	9
number         or effective depth         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         6         0         0         0.647         223.9         144.83           1         6         0         0         0.000         0.00         0.000           2         7         1.4         0.1828         0.183         2.8         0.51           3         10         3.4         0.1514         0.183         2.8         0.51           4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.94           7         22         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.9012         0.901         18.3         16.52           11         31.7         7.3         0.4928         0.443         12.0         5.94           12         33         7.3         0.616         0.616         15.7	Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
depth         Image         Other         Other <th< td=""><td>number</td><td></td><td>or effective</td><td>0.24</td><td>0.4d</td><td>0.84</td><td>(m/s)</td><td>(m<sup>2</sup>)</td><td>(m<sup>3</sup>/s)</td></th<>	number		or effective	0.24	0.4d	0.84	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
1         6         0         0         0.000         0.000         0.000           2         7         1.4         0.1828         0.183         2.8         0.51           3         10         3.4         0.1514         0.151         10.2         1.54           4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.6         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67			denth	0.24	0.14	0.00	0 647	223.9	144 83
2         7         1.4         0.1826         0.183         2.8         0.51           3         10         3.4         0.1514         0.151         10.2         1.54           4         13         4.1         0.4457         9.446         12.3         5.48           5         16         5.1         0.7778         0.778         5.3         11.90           6         19         8         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.492         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         <	1	6	0		0		0.000	0.0	0.00
3         10         3.4         0.1514         0.151         10.2         1.54           4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7776         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20	2	7	1.4		0.1828		0.183	2.8	0.51
4         13         4.1         0.4457         0.446         12.3         5.48           5         16         5.1         0.7778         0.778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47	3	10	3.4		0.1514		0.151	10.2	1.54
5         16         5.1         0.7778         0.7778         15.3         11.90           6         19         8         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.423         12.0         5.94           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         5.9         2.84	4	13	4.1		0.4457		0.446	12,3	5.48
6         19         8         0.9183         0.9183         0.918         24.0         22.04           7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.443         12.0         594           11         31.7         7.3         0.4928         0.493         12.0         594           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4	5	16	5.1		0,7778		0,778	15,3	11,90
7         22         7.8         0.9608         0.961         23.4         22.48           8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         0.000         0.00	6	19	8		0.9183		0.918	24.0	22.04
8         25         7.9         0.9693         0.969         23.7         22.97           9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.4237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.00           19         52         0         0         0         0.000         1.0         0.00           19         52         0         0         0         0.701         0.847	7	22	7.8		0.9608		0.961	23.4	22.48
9         28         7.8         0.9012         0.901         18.3         16.52           10         29.7         7.8         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.00           19         52         0         0         0         0.000         1.0         0.00           19         52         0         0         0         0.00         0.00         0.00         0.00           19         52         0         0         0         0.00 <td>8</td> <td>25</td> <td>7.9</td> <td></td> <td>0.9693</td> <td></td> <td>0.969</td> <td>23.7</td> <td>22.97</td>	8	25	7.9		0.9693		0.969	23.7	22.97
10         29.7         7.6         0.721         0.721         14.4         10.40           11         31.7         7.3         0.4928         0.493         12.0         5.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.000           19         52         0         0         0         0.000         1.0         0.000           19         52         0         0         0         0.000         1.0         0.000           18         51         0.5         0         0         0.000         0	9	28	7.8		0.9012		0.901	18.3	16.52
11         31.7         7.3         0.4926         0.4935         12.0         3.94           12         33         7.3         0.616         0.616         15.7         9.67           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.000           19         52         0         0         0.000         0.000         0.000           19         52         0         0         0         0.000         0.000         0.000           19         52         0         0         0         0.000         0.000         0.000           18         51         0.5         0         0         0.647         223	10	29.7	1.0		0.721		0.721	14.4	10.40
12         36         7.3         360         367         367           13         36         5.6         0.2712         0.271         16.8         4.56           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.000           19         52         0         0         0.000         0.0         0.000           19         52         0         0         0.000         0.0         0.000           19         52         0         0         0         0.000         0.0         0.000           19         52         0         0         0         0.647         223.9         144.83           14         16.00         19.00         2.78         0.92         0.80         0.81	12	31.7	7.3		0.4920		0.493	12.0	0.67
10         0.2112         0.2111         10.0         1.00           14         39         4.5         0.2371         0.237         13.5         3.20           15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.000           19         52         0         0         0.000         0.000         0.000           19         52         0         0         0.000         0.000         0.000           19         52         0         0         0         0.000         0.000           19         52         0         0         0         0.000         0.00         0.000           16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70	12	20	7.5		0.010		0.010	16.8	3.07 A 56
15         42         2.7         0.4287         0.429         8.1         3.47           16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.00           19         52         0         0         0.000         0.000         0.000           19         52         0         0         0.000         0.000         0.000           Delta value calculations           Per         Act. Chn.         Ch-Lower         Ch-Upper         V-Upper         V-int         Delta           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95 <t< td=""><td>14</td><td>39</td><td>45</td><td></td><td>0.2712</td><td></td><td>0.237</td><td>13.5</td><td>3.20</td></t<>	14	39	45		0.2712		0.237	13.5	3.20
16         45         2.3         0.4117         0.412         6.9         2.84           17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0.000         1.0         0.00           19         52         0         0         0         0.000         0.0         0.00           Delta value calculations           Delta value calculations           Delta value calculations           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56	15	42	27		0.4287		0.429	81	3.47
17         48         1.8         0.2414         0.241         5.4         1.30           18         51         0.5         0         0         0.000         1.0         0.00           19         52         0         0         0         0.000         0.0         0.00           19         52         0         0         0         0.00         0.00         0.00           19         52         0         0         0         0         0.00         0.00         0.00           19         52         0         0         0         0.00         0.00         0.00         0.00           19         52         0         0         0         0         0.00         0.00         0.00           19         52         0         0         0         0         0         0.00         0.00         0.00           19         0         0         0         0         0         0         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.97         0.96         0.67           50% <th< td=""><td>16</td><td>45</td><td>2.3</td><td></td><td>0 4117</td><td></td><td>0.412</td><td>69</td><td>2.84</td></th<>	16	45	2.3		0 4117		0.412	69	2.84
18         51         0.5         0         0         0.000         1.0         0.00           19         52         0         0         0         0         0.000         0.00         0.00           19         52         0         0         0         0         0.00         0.00         0.00           19         52         0         0         0         0         0.00         0.00         0.00           19         52         0         0         0         0         0.00         0.00         0.00           0.647         223.9         144.83           Delta value culations:           Per         Act. Chn.         Ch-Lower         Ch-Upper         V-Upper         V-Int         Delta           30%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70	17	48	1.8		0.2414		0.241	5.4	1,30
19         52         0         0         0.000         0.00         0.00           0.647         223.9         144.83           Delta value calculations           Per         Act. Chn.         Ch-Lower         Ch-Upper         V-Upper         V-Int         Delta           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.96         0.97         0.96         0.83         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.677           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04	18	51	0.5		0		0.000	1.0	0.00
Delta value calculations         V-Upper         V-int         Delta           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.677           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04	19	52	0		0		0.000	0.0	0.00
Per         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-int         Delta           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04							0.647	223.9	144.83
Per         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-int         Delta           20%         16.4         16.00         19.00         0.78         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04									
Per         Act. Cnn.         Cn-Lower         Cn-Upper         V-lower         V-upper         V-lower         V-lower <t< th=""><th colspan="9">Detta value carculations</th></t<>	Detta value carculations								
20%         16.4         16.00         19.00         0.76         0.92         0.80         0.81           30%         19.6         19.00         22.00         0.92         0.96         0.93         0.70           40%         22.8         22.00         25.00         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04		Per	Act. Cnn.	Cfi-Lower	Ch-Upper	V-lower	V-Upper	v-Int	Delta
40%         22.8         22.00         25.00         0.92         0.96         0.97         0.96         0.67           50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04		20%	10.4	16.00	19.00	0.78	0.92	0.80	0.81
50%         26.0         25.00         28.00         0.97         0.90         0.95         0.68           60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04		40%	72.0	19.00	22.00	0.92	0.96	0.93	0.70
60%         29.2         28.00         29.70         0.90         0.72         0.77         0.84           70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04		50%	26.0	22.00	25.00	0.90	0.97	0.90	0.67
70%         32.4         31.70         33.00         0.49         0.62         0.56         1.16           80%         35.6         33.00         36.00         0.62         0.27         0.32         2.04		60%	29.2	23.00	20.00	0.97	0.50	0.95	0.84
<b>80% 35.6</b> 33.00 36.00 0.62 0.27 0.32 <b>2.04</b>		70%	32.4	31 70	33.00	0.49	0.62	0.56	1.16
		80%	35.6	33.00	36.00	0.62	0.27	0.32	2.04

<u></u>	Cal	culated o	lata, 1-din	nensiona	I flow the	ory	
Manning	or Chezy	r;	M			Q =	175.3
		Slope	0.00008			V <sub>AVR</sub> =	0.78
<b>D</b>					I		
Rougnness	coen.		Area reduct	ion tactor			
300			300	<b>IA</b>			
0			0	1			
2	0.038		2	1			
0			0	1			
Chainage	Vertical	\$Ub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	A	P	R	(m³/s)	Velocity
	depth						
6	0	2	0.0	3.5	0	0.00	0 00
7	1.4	2	2.8	2.0	1.4	0.82	0.29
10	3.4	2	10.2	3.0	3.4	5 43	0.63
13	41	2	12.3	3.0	41	7 42	0.60
10	D.1	2	15.3	3.0	5.1	10.67 00.60	0.70
19	70	4	24.0	3.0	0 7 0	22.00	0.34
22	7 Q	2	23.7	30	7.0	77 13	0.00
20	78	2	18.3	24	78	16 97	0.93
29.7	7.8	2	14.4	19	78	13.36	0.93
31.7	73	2	12.0	1.7	7.3	10.67	0.89
33	73	2	15.7	2.2	7.3	13.90	0.89
36	5.6	2	16.8	3.0	5.6	12.47	0.74
39	4.5	2	13.5	3.0	4.5	8.66	0.64
42	27	2	8.1	3.0	2.7	370	0.46
45	23	2	6.9	3.0	2.3	2.83	0.41
48	1.8	2	5.4	3.0	1.8	1 BB	0.35
51	0.5	2	1.0	2.0	0.5	Q.15	0.15
0	0	2	0.0	0.5	0	0.00	0.00
			223.9		I	1/5.31	0.78
		[	)eita value (	aiculation	s		
% Width	Act Chn.	Lower	Upper	V-lower	V-Upper	V-int	Delta
20%	16.4	16.00	19.00	0.70	0.94	0.73	1.07
30%	19.6	19.00	22.00	0.94	0.93	0.94	0.83
40%	22.8	22.00	25.00	0.93	0.93	0 93	0.84
50%	26.0	25.00	28.00	0.93	0.93	0.93	0.84
60%	29.2	28.00	29.70	0.93	0.93	0.93	0.85
70%	32.4	31.70	33.00	0.89	0.89	0.89	0.88
80%	35.6	33.00	36.00	0.89	0.74	0.76	1.03

			Me	asured d	ata			
STA	TION No. :	C1H015			STA	RT TIME :	07h00	
RIVE PLAC	R NAME : E NAME : DATE :	Klip De Langes 24/02/1975	Drift	Averag	e Gaugepl	ate reading :	7.18	m
		• • • • • • • • • • • • • • • • • • • •			Main Cha	nnel LEFT :	10	
					Main Chan	nel RIGHT :	42	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				0.647	233.4	151.12
1	6	0		0		0.000	0.0	0.00
2	7	1,5		0.2042		0.204	3.0	0.61
3	10	3.4		0.1549		0.155	10.2	1.58
4	13	4.2		0.6272		0.627	12.6	7.90
5	16	5.4		0.8642		0.864	16.2	14.00
6	19	8.2		0.8981		0.898	24.6	22.09
7	22	8		0.9743		0.974	24.0	23.38
8	25	8.1		0.8896		0.890	24.3	21.62
9	28	8		0.9404		0.940	18.8	17.68
10	29.7	В		0.7523		0.752	14.8	11.13
11	31.7	7.5		0.4612		0.461	12.4	5.71
12	33	7.5		0.5765		0.577	16.1	9.30
13	36	5,7		0.221		0.221	17.1	3.78
14	39	4.5		0.2887		0.289	13.5	3.90
15	42	2.9		0.5003		0.500	8.7	4.35
16	45	2.5		0.3987		0.399	7.5	2.99
17	48	2		0.1702		0.170	6.0	1.02
18	51	0.7		0.0332		0.033	2.1	0.07
19]	54	0.5		U		0.000	1.5	0.00
						0.041	233.4	151.12
			[	Delta value (	calculatio	ns		
	Per	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	16.4	16 00	19.00	0.86	0.90	0 87	0.75
	30%	19.6	19.00	22.00	0.90	0.97	0.91	0.71
	40%	22.8	22.00	25.00	0.97	0.89	0.95	0.68
	50%	26.0	25.00	28.00	0.89	0.94	0.91	0.71
	60%	29.2	28 00	29 70	0.94	0.75	0 81	0.80
	70%	32.4	31.70	33.00	0.46	0.58	0.52	1.24
	80%	35.6	33.00	36.00	0.58	0.22	0.27	2.41

	Cal	culated	data, 1-dir	nensiona	I flow the	ory	1.1.1
Manning	or Chezy	<i>'</i> :	М			Q =	184.1
		Slopa	80000.0			V <sub>AVR</sub> =	0.79
<b>a</b>	~ ~ ~				1		
Rougnness	coen		Area reduct	ion factor			
				· · · ·			
0	0.020						
2	0.036		2				
0		~	0	1	11 Deaters	<u>^</u>	+ w
Chanage	venicei	500	Area	Anetted h	H-Macines	ي. د _ال	•
	ar affective	Section	A	þ	R	(m /s)	Velocity
<u> </u>	depth						
5	U 1 E	2	0.0	35	U 1 5	0.00	0.00
10	34	5	10.2	30	34	5 43	0.53
13	4.2	2	12.6	3.0	4.2	7.72	0.61
16	5.4	2	16.2	3.0	5.4	11.74	0.72
19	8.2	2	24.6	30	8.2	23 55	0.96
22	8	2	24.0	3.0	8	22.60	0.94
25	8.1	2	24.3	3.0	8.1	23.07	0.95
28	8	2	18.8	2.4	8	17.70	0.94
29.7	8	2	14.8	19	8	13 93	0.94
31.7	7.5 7.4	2	12.4	22	7.3 7 C	11.10	0.90
36	7.0	2	17 1	30	57	12.94	0.75
39	45	2	135	30	45	8 66	0.64
42	2.9	2	8.7	3.0	2.9	4 16	0.48
45	2.5	2	7.5	3.0	2.5	3.25	0.43
48	2	2	6.0	3.0	2	2.24	0.37
51	0.7	2	2.1	30	0.7	0.39	0 19
54	0.5	2	1.5	3.0	0.5	0.22	0.15
			233.4			184.13	0.7
			Delta value	calculation	s		
% Width	Act. Shin.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
20%	16.4	16 00	19 00	9.72	0.96	0.76	1.04
30%	19.6	19.00	22.00	0.96	0.94	0.95	0.83
40%	22.8	22.00	25.00	0.94	0.95	0.94	0.84
50%	26.0	25.00	28.00	0.95	0.94	0.95	0.83
60% 7.0%	29.2	28.00	2970	0.94	0.94	0.94	0.84
70%	32.A 26.0	31.70	23.00	0.90	0.90	0.90	1.02

			Me	asured d	ata			
STA	TION No. :	C1H015			STAF	RT TIME :	16h00	
RIVE	R NAME :	Klip		Averag	e Gaugepla	te reading :	7 605	m
PLAC	E NAME :	De Langes	Drift			-		
	DATE :	24/02/1975	5					
					Main Cha	nnel LEFT :	10	
					Jain Chan		43	
				,		en MiGHT .	<b>44</b>	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or offootive	0.24	0.44	004	(m/e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
COMMEN		dooth	6.20	0.44	u.au	0.897	240.7	173.05
1	4	02		n		0.000	0.3	0.00
2	7	1.8		0 1702		0.170	5.4	0.00
3	10	3.7		0.3056		0.306	11.1	3.39
4	13	4.6		0.441		0.441	13.8	6.09
5	16	5.6		0.7288		0.729	16.8	12.24
6	19	8,5		0.8642		0.864	17.0	14.69
7	20	8.4		1.0166		1.017	25.2	25.62
8	25	8.5		1.0674		1.067	34.0	36.29
9	28	8.2		1.1351		1.135	19.3	21.87
10	29.7	8.2		0.9081		0.908	15.2	13.78
11	31.7	7.8		0.5695		0.570	12.9	7.33
12	33	7.8		0.7119		0.712	16.8	11.94
13	36	6.1		0.2/1/		0.272	18.3	4,97
14	39	4,9		0.3056		0.306	14.7	4,49
10	42	3.1 2 P		0.0272		0.027	9.3	3.03 7.00
10	640 48	2,0		0.0004		0.330	63	1 30
18	40 51	2.1 N Q		0.221		0.041	27	0.11
19	54	0.5		0.0400		0.000	21	0.00
20	57	0.1		0		0.000	0.2	0.00
21	58	0				0.000	0.0	0.00
						0.697	249.7	173.95
		8-4 Ob	Ľ	elta value	calculatio	ns		L Dolla-
	Per	Act. Cnn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Dena
	20%	10,4 10 C	16.00	19.00	0.73	0.86	0.75	0.93
	A0%	19.0	19.00	20,00	1.02	1.02	1.95	0.75
	50%	26.0	20.00	28.00	1.02	1 14	1 09	0.64
	60%	29.2	28.00	29.70	1 14	0.91	0.97	0.71
	70%	32.4	31 70	33.00	0.57	0.71	0.66	1.08
	80%	35.6	33.00	36.00	0.71	0.27	0.33	2.11

	Calc	culated d	lata, 1-din	nensiona	al flow the	eory	
Manning	or Chez	y:	M			Q =	207.1
		Siope	0.000085			VAVR #	0.83
Roughness	coeff		Area reduc	ion factor	1		
Stub	0		Sub	<i>[.</i>			
				4			
U -			V .				
2	0.038		2	1			
0			0	1			
Chainage	Vertical	Sub	Area	Welled P	H-Radius	Q	V
	or effective	Section	A	Ą	R	(m²/s)	Velocity
	detith						
4	0.2	2	0.3	3.5	0.085714	0.01	6.05
7	1.8	2	5.4	3.0	1.8	1 94	0.36
10	3.7	2	11.1	30	3.7	6 44	0.58
13	4.6	2	13.8	30	4.6	9 26	0.67
16	5.6	2	16.8	3.0	5.6	12.85	0.77
19	8.5	2	17.0	2.0	8.5	17.18	1.01
20	8.4	2	25.2	3.0	84	25.26	1.00
25	8.5	2	34.0	4.0	8.5	34.36	1 01
28	8.2	2	19.3	2.4	8.2	19.01	0.89
29.7	8.2	2	15.2	19	8.2	14.97	0.99
31.7	7.8	2	12.9	1/	<i>1.8</i>	12.28	0.90
33	7.6	2	10.0	22	7.0	10.00	0.95
30	D.1 4 O	2	10.3	20	0.1	141 042	0.75
39	4.S 7.4	2	14./ G 3	3.0	4.5	4.90	0.67
42	9.4 7 g	5	94	30	28	4.05	0.45
48	21	2	63	30	21	251	0 40
51	ñg	2	27	30	0.9	0.61	0.23
54	07	2	2.1	30	0.7	0.40	0.19
57	0.1	2	0.2	20	0.1	0.01	0.05
0	0	2	0.0	05	0	0.00	0.00
			249,77			207.06	0.83
		I	)elta value i	salculation	15		
% Width	Act Chn.	Lower	Upper	V-iower	V Upper	V-int	Delta
20%	16.4	15.00	19.00	8.77	1.01	0.80	1.04
30%	19.6	19.00	20.00	1.01	1.00	1.01	0.82
40%	22.8	20.00	25.00	1.00	1 01	1.01	0.82
50%	26.0	25.00	28.00	1.01	0.99	1.00	0.83
60%	29.2	28.00	29.70	0.99	0.86	0.99	0.84
70%	32.4	31.70	33.00	0.95	0.96	0.95	0.8/
80%	35.6	38.00	35.00	8.95	0.81	0.83	1 1.00

			Me	asured d	ata			
STA	TION No. :	C1H015			STA	RT TIME :	13h00	
RIVE PLAC	R NAME : E NAME : DATE	Klip De Langes 23/02/1975	Drift	Average	e Gaugepli	ate reading :	7.67	m
					Main Cha	nnel LEFT ·	10	
				٨	Aain Chan	nel RIGHT :	42	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.24	0.4d	0 Bd	(m/s)	(m²)	(m <sup>3</sup> /s)
i di i dei		depth	0.24	0.44	0.00	0.707	253.8	179 48
1	3.5	0		0		0.000	0.0	0.00
2	4	0.3		0		0.000	0.5	0.00
3	7	2		0.1702		0.170	6.0	1.02
4	10	3.9		0.2548		0.255	11.7	2.98
5	13	4.7		0.5595		0.560	14.1	7.89
6	16	5.7		0.8981		0.898	17.1	15.36
7	19	8.6		1.0843		1.084	25.8	27.97
8	22	8.5		1.025		1.025	25.5	26.14
9	25	8.6		0.8981		0.898	25.8	23.17
10	28	8.3		1.0504		1.050	19.5	20.49
11	23.7	0.3 7.0		0.6403		0.640	13.4	7 79
12	31./	7.9		0.3900		0.746	17.0	12.67
14	36	62		0 204		0 204	18.6	3 79
15	39	5		0.2887		0.289	15.0	4.33
16	42	3.2		0.6103		0.610	9.6	5.86
17	45	3		0.5426		0,543	9.0	4.88
18	48	2.3		0.3056		0,306	6.9	2.11
19	51	1.1		0.0408		0.041	3.3	0.13
20	54	0		0		0.000	0.0	0.00
						0.707	253.8	179.48
			C	elta value o	calculatio	ns		
	Per	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-int	Delta
	20%	16.4	16.00	19.00	0.90	1.08	0.92	0.77
	30%	19.6	19.00	22.00	1 08	1.03	1.07	0.66
	40%	22.8	22.00	25.00	1.03	0.90	0.99	0.71
	50%	26.0	25.00	28.00	0.90	1.05	0.95	0.75
	60%	29.2	28.00	29.70	1.05	0.84	0.90	0.78
	70%	32.4	31.70	33.00	0.60	0.75	0.68	1.04
	80%	35.6	33.00	36.00	0.75	0.20	0.28	2.56

	Calc	ulated d	ata, 1-dir	nensiona	al flow the	eory	
Manning	or Chez	y:	М			Q =	207.0
		Slope	0.00008			V <sub>AVR</sub> =	0.82
Houghness	coett		Area reduc	tion factor			
Sub	n		Sub	1 <sub>A</sub>			
0			0	1			
2	0.038		2	1			
0			0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective depth	Section	A	β	R	(m <sup>3</sup> /s)	Velocity
3.5	0	2	0.0	2.0	0	00.00	0.00
4	03	2	0.5	1.8	0.3	0.06	0,11
7	2	2	6.0	3.0	2	2.24	0.37
10	39	2	11.7	3.0	39	6.62	0.56
13 16	4 / 5 7	2	14.1	3.0	57	# 51 17 84	0.00
10	86	2	25.8	3.0	86	25.49	0.99
22	85	2	25.5	3.0	85	25 00	0,98
25	8.6	2	25.8	3.0	86	25 49	0.99
28	83	2	19.5	2.4	83	18 <b>8</b> 2	0.96
29.7	83	2	15.4	1.9	8.3	14 82	0.96
31.7	79	2	13.0	1.7	79	12.17	0.93
33	79	2	17.0	22	79	15 86	0.93
30	0.2 R	2	10.0	30	0.2 R	10.33	0.75
42	37	5	96	30	37	4 91	0.51
45	3	2	9.0	3.0	3	4 41	0.49
48	23	2	6.9	3.0	2.3	2.83	0.41
51	11	2	3.3	3.0	1.1	0.83	0.25
54	0	2	0.0	1.5	0	0.00	0.00
			253.8			206.99	0.82
		C	elta value	calculation	15		
% Width	Act. Chn	Lower	Upper	V-lower	V-Upper	V-Int	Delfa
20%	16.4	16.00	19 00	0.75	0.99	0.78	1.04
30%	19.6	19.00	22.00	0.99	0.98	0.99	0.83
40%	22.8	22.00	25.00	0.96	0.99	0.98	0.83
50%	26.0	25.00	28.00	0.99	0.96	0.98	0.83
60%	29.2	28.00	29.70	0.96	0.96	0.96	0.85
70%	32.4	31.70	33.00	0.93	0.93	0.93	1.00
80%	39.9	23.00	55.00	0.80	0.00	u.81	1.00

Statn No.: C8H028 River: Wilge Place: Bavaria











The values in the legend block describe measured discharge for the profile indicated

STATION No. (200006)         STATION No. (200006)         Q = 357.9           Number Winge PLACE MAME: Brands DATE: 17/02/1599         Average Gaugelate reading: 2:1 m DATE: 17/02/1599         Main Channel LEFT: 5 Main Channel RIGHT: 63           Main Channel RIGHT: 63           Main Channel RIGHT: 63           Total State Date: 17/02/1599         Average Gaugelate reading: 2:1 m Main Channel RIGHT: 63           Main Channel RIGHT: 63           Total State 1 2 3 106 0.245067 100 00 000 3 105 2.250 2.022 16 0.035 5 128 00 40786 1100047 00150 0.000 5 128 2.26 1684733 1610017 1555 6.3 355.49 6 133 2.273 128828 12.2077 10.1 2.4085 111 2.200 6 133 2.273 128828 12.2077 80.3 355.20 6 133 2.273 128828 12.2077 80.3 15.23 7 120 2.28 2.207785 2.2077 10.1 2.4085 10 12.200 7 10 2.29 2.201 14 4.0 2.275 2.515 2.206 120.4 2.28 7 10 2.29 2.2057787 2.28528 12.07778 12.557 8.3 2.027 10.1 2.4085 10 12.200 7 10 2.29 2.203 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.207781 2.208 2.2 4.6 4.5 2.258 2.206 12.1 12.238 7 2.200778 2.260 2.2 4.6 0.30 2.202 17.8 1.208 7 10 2.29 2.2067787 2.207878 2.207781 8.6 2.277 1.38 8 2.208 2.2 4.6 0.30 2.202 17.8 1.208 7 11 3.226 2.216983 2.27618 8.2 2771 2.7 2.8 1.4 1.208 7 11 3.22 2.262 2.450383 2.27618 8.2 2771 8.8 2.277 7 3.0 2.2667787 2.26583 3.2761 8.6 2.2778 7 3.0 2.2667787 2.2662 3.3 3.272 1.264 3.278 2.267787 2.266 3.0 2.262 17.8 1.268 7 2.208 2.2 4.6 0.30 2.262 17.8 1.268 7 2.267787 2.268 3.3 2.2677				Me	asured d	ata						Cal	culated of	data, 1-dir	nensiona	al flow the	eory		
RUCER NAME:         Average Gaugeplate reacing:         2.1         m           PLACE NAME:         Simple:         Consisting	STA	TION No. :	C8H028			STAR	T TIME :	11h15			Manning	or Chezy	2	M			Q =	357.9	
PLACE NAME : Bayesing DATE : 17/02/1969           Man Channel LEFT : 3 Man Channel RIGHT : 53           Man Channel RIGHT : 53           Totaling a vertal member : vertal 0 attains 1 22 0	RIVE	R NAME :	Wilge		Averag	le Gaugepla	te reading :	2.1	m				Slope	0.0016			V <sub>AVR</sub> =	2.23	
Roughbase cell         Roughbase cell         Roughbase cell           Main Channel LEFT: 3 Main Channel RIGHT: 63         Roughbase cell         Colspan="2">Colspan="2">Colspan="2">Colspan="2"           1         Colspan="2"         Colspan="2"          Colspan="2"           The Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"           The Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"          Colspan="2"         Colspan="2"          Colspan="2"          Colspan="2"         Colspan="2"         Colspan="2"         Colspan="2"           Colspan="2"         Colspan="2"          Colspan="2"                Colspan="2" <th <="" colspa="2" th=""><th>PLAC</th><th>E NAME :</th><th>Bavaria</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></th>	<th>PLAC</th> <th>E NAME :</th> <th>Bavaria</th> <th></th>	PLAC	E NAME :	Bavaria															
Main Chennel LFT         Sub         <		DATE :	17/02/1989	•							Roughness	coeff		Area reduc	tion factor				
Main Chammel RIGHT         63         0         1           1         2         3         4         5         6         7         8         9           ummber         ventity						Main Chai	nnel LEFT :	3			Sub	n		Sub	T <sub>A</sub>				
1         2         3         4         5         6         7         8         9           1         2         0.035         2         1         0         1         0         0         1         0         0         1         0         0         1         0         0         1         0 <th></th> <th></th> <th></th> <th></th> <th></th> <th>Main Chanr</th> <th>el RIGHT :</th> <th>63</th> <th></th> <th></th> <th>0</th> <th></th> <th></th> <th>0</th> <th>1</th> <th></th> <th></th> <th></th>						Main Chanr	el RIGHT :	63			0			0	1				
1         2         3         4         5         6         7         8         9         0         0         1         0         1         4         0         0         1         0         0         1         0         1         0         1         0         1         0         1         0         0         1         0         0         0         0         0         0         0         1         0         1         2         0         0         0         0         0         1         0         1         0         1         0         1         0         1         0	-				-		-	•	•		2	0.035		2	1				
Virtical	1	2	3	4	5	6	- 1	8	9		0			0	1				
member         or effective         0.2d         0.4d         0.6d         (m <sup>2</sup> )         (m <sup>2</sup> )<	Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q		Chainege	Vertical	Sub	Area	Wetted P	H-Radius	Q	V	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)			or effective	Section	A	P	R	(m'/s)	Velocity	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$			depth				2.106	160.8	338.48			depth							
3       5       1.00       0.1000	1		1.06	0 245067	0.101097	0 15032	0.101	0.0	0.00		2	0	2	00	15	0 1 04	0.00 t so	0.00	
4       8       2.68       1.639733       1.631017       1.635       9.3       15.23       1       2.08       2       9.3       3.5       2.68       2.46       2.18         5       12       2.78       1.6223       1.984       1.805       11       2.006       12       2.77       2       11.1       4.0       2.75       2.168       2.26       2.77       2       11.1       4.0       2.75       2.43       2.28       2.44       2.28       2.43       2.25       3       2       9.3       3.5       2.66       2.77       2.43       2.28       2.44       2.38       2.44       2.38       2.44       2.38       2.44       2.38       2.46       2.44       2.38       2.44       2.38       2.44       2.38       2.44       2.38       2.44       2.38       2.44       2.38       2.44       2.33       2.66       3.0       2.662       2       6.6       3.0       2.662       1.86       3.0       2.662       1.86       3.0       2.662       2.86       3.0       2.662       2.86       3.0       2.662       2.86       3.0       2.662       2.86       3.0       2.662       3.0       2.662       3.0<	3	5	2.83	0.49785		1 003417	0.202	71	5.31		5	2.83	2	71	25	2.83	16.18	2.29	
5       12       2.78       1.6223       1.9884       18.05       11.1       20.06       2.78       2       11.1       4.0       2.78       2.813       2.28         6       16       2.73       2.15683       2.26733       2.26733       2.26733       2.26733       2.267       2       10.4       3.5       2.96       3.0       3       2.168       2.3       3       2.18885       2.607285       2.386       9.0       2.168       2.3       3       2       9.0       3.0       3       2.44       2.38       2.44       3.3       3.044       2.772       9.2       2.371       1.6623       3.0       2.032       2.661       3.0       3.0       3       2.449       2.38       2.44       3.3       3.0       3.0       2.032       11.1       1.0       2.662       1.30       2.032       11.1       1.11       1.0       1.0       3.3       3.0       3.0       3.2       2.44       2.44       3.3       3.0       2.032       2.662       2       3.6       3.0       2.662       1.11       1.11       1.0       1.11       1.0       1.11       1.0       1.11       1.0       2.002       2.03       3.3       <	4	8	2.66	1.639733		1.631017	1.635	9.3	15.23		8	2.66	2	9.3	3.5	2.66	20.43	2 19	
6       16       2.73       2.136533       2.267333       2.202       10.9       24.05       16       2.73       2       30.9       4.6       2.73       2.43       2.33       2.43       2.33       2.43       2.33       2.43       2.33       2.43       2.33       2.43       2.33       3.2       9.0       2.96       2.37       2       9.2       3.0       3.3       2.43       2.38       2.33       3.2       9.0       3.0       3.2       2.90       3.0       3.3       2.43       2.38       2.38       2.33       3.0       3.0       3.3       2.43       2.38       2.43       2.33       3.2       9.0       3.0       3.0       2.03       3.072       2.23       2.46       2.33       3.0       2.032       2.662       2.83       3.0       2.032       2.662       2.86       3.0       2.032       2.662       2.86       3.0       2.032       2.662       2.80       3.0       2.032       2.662       2.80       3.0       2.032       2.652       7.63       3.0       2.032       2.63       3.0       2.032       2.63       3.0       2.032       2.63       3.0       2.032       2.63       3.0       2.032	5	12	2.78	1.6223		1.9884	1.805	11.1	20.08		12	2,78	2	11.1	4.0	2.78	25 13	2.26	
7       200       2.296       2.2275       2.59895       2.407       10.4       2.493       20       2.266       2       10.4       3.5       2.96       2.41       2.38         9       26       3.072       2.110433       3.0344       2.572       9.2       2.371       26       3.072       2       9.0       3.0       3       2.438       2.38         10       29       2.032       2.807767       2.894333       2.261       6.1       17.78       29       2.032       2       6.1       3.0       2.022       11.8       1.48         11       32       2.662       2.50833       2.276183       2.607.85       2.879       3.5       2.862       2       3.6       3.0       2.862       9.0       3.0       2.862       11.8       1.48         13       38       2.269       2.578333       2.751       8.6       2.379       3.5       2.862       2       3.6       3.0       2.862       9.0       3.0       2.633       1.271       2.18       44       2.633       2       7.9       3.0       2.633       1.711       1.171       2.18       44       2.633       2       7.9       3.0	6	16	2.73	2.136583		2.267333	2.202	10.9	24.05		16	2.73	2	10.9	4.0	2.73	24 38	2.23	
8       2.3       3.3       2.198833       2.007253       2.257       2.2       2.371       2.6       3.072       2.19.0       3.072       2.24.0       2.44.0       2.42       2.42       3.0       3.072       2.2.80       3.072       2.2022       2.607767       2.804933       2.651       6.1       17.38       2.9       2.032       2       5.1       3.0       2.2022       11.18       1.48         11       3.2       2.662       2.60333       2.76148       8.6       2.379       3.5       2.862       2       8.6       3.0       2.262       2.80       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.86       3.0       2.262       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.862       2.86       3.0       2.263       1.18       2.260       1.462       2.862       2.79       3.8       2.653       1.16       2.263       1.16       2.862       2.79       3.8       2.653       1.16	7	20	2.96	2.22375		2.58985	2.407	10.4	24.93		20	2.96	2	10.4	3.5	2.96	24 41	2.36	
3       30       3074       2.372       9.2       9.2       37       30       307       2.371       2.371       2.371       2.371       2.371       2.371       2.371       3.0       3.07       2.032       2.003       2.2       5.0       3.0       2.032       2.031       2.032       2.031       2.032       2.031       2.032       2.031 <th2.031< th=""> <th2.031< td="" th<=""><td>8</td><td>23</td><td>3 070</td><td>2.188883</td><td></td><td>2.607283</td><td>2.398</td><td>9.0</td><td>21.58</td><td></td><td>23</td><td>5 0.070</td><td>2</td><td>90</td><td>30</td><td>3 070</td><td>21.40</td><td>2.33</td></th2.031<></th2.031<>	8	23	3 070	2.188883		2.607283	2.398	9.0	21.58		23	5 0.070	2	90	30	3 070	21.40	2.33	
1       3       2       2.60       2.60       6.0       20.62       2.60       3.0       2.764       2.80       3.0       2.80       2.80       2.20         12       35       2.862       2.528633       2.97333       2.751       8.6       2.379       35       2.862       2       8.6       3.0       2.862       300       2.862       2.41       309       2.249       2.862       2.41       309       2.249       2.862       2.79       3.0       2.633       17.13       2.16       16       7.79       2.13       44       2.633       2.711       16.71       2.92       2.852       2.97       3.0       2.964       2.037       2.38       2.41       2       8.3 </td <td>9</td> <td>20</td> <td>2 032</td> <td>2.010433</td> <td></td> <td>2 804033</td> <td>2.072</td> <td>9.2</td> <td>43.71</td> <td></td> <td>20</td> <td>2 142</td> <td>2</td> <td>51</td> <td>30</td> <td>2072</td> <td>11 18</td> <td>183</td>	9	20	2 032	2.010433		2 804033	2.072	9.2	43.71		20	2 142	2	51	30	2072	11 18	183	
12       35       2.882       2.528833       2.973883       2.751       8.6       23.79       35       2.862       2       3.6       3.0       2.862       201       2.21         13       38       2.69       2.310917       2.607283       2.290       9.3       2.122       41       3.8       2.49       2.3       3.3       3.0       3.0       2.89       2.010       2.22         15       4.4       2.633       2.607283       2.2921083       2.764       7.9       21.83       44       2.633       2       7.9       3.8       2.603       17.21       218         16       4.7       2.6264       1.979683       2.56667       2.299       8.9       9.0       2.145       4.7       2.62       7.9       3.8       2.623       17.11       2.18         18       5.3       2.711       1.0746       2.2499       1.962       8.1       1.596       5.3       2.711       2.6       8.9       3.0       2.624       4.037       2.18         19       56       2.606       1.4654       1.447967       1.457       6.22       58       2.14       2.0       2.14       1.430       2.18       2.16	11	32	2.662	2 450383		2 764183	2 607	80	20.82		32	2 662	2	8.0	3.0	2.662	17.53	2.20	
13       38       2.89       2.310917       2.7206       2.516       8.7       21.81       38       2.89       2       8.7       3.0       2.86       2.00       2.32         14       41       3.09       1.970967       2.607283       2.280       9.3       21.52       41       3.09       2       8.3       3.0       3.00       2.245       2.32         16       47       2.6207283       2.886217       2.721       7.9       21.45       44       2.632       2.79       3.0       2.623       17.18       2.18         17       50       2.964       1.979683       2.289       8.9       20.55       50       2.964       2       6.9       3.0       2.663       1.407       2.26         19       56       2.606       1.4654       1.447967       1.457       6.5       9.49       56       2.606       2       6.5       2.5       2.606       1.4107       2.18       2.18       2.18       2.18       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14       2.14	12	35	2.882	2.528833		2.973383	2.751	8.6	23.79		35	2,882	2	8.6	3.0	2.882	20.01	2.31	
14       41       3.09       1970967       2.607283       2.288       9.3       21.82       41       3.09       2       9.3       3.0       3.09       2.243       2.243       2.43         15       44       2.633       2.607283       2.921083       2.764       7.9       21.83       44       2.633       2       7.9       3.0       2.633       17.1       2.18         16       47       2.628       2.554963       2.569657       2.289       8.9       20.35       50       2.364       2.9       8.3       3.0       2.628       17.16       2.18         18       53       2.711       1.5746       2.2499       1.962       8.1       15.966       55       2.606       2       6.5       2.5       2.606       2       6.5       2.5       2.606       2       6.5       2.5       2.606       2       1.8       1.8       2.2       2.6       2.14       3.0       2.071       1.8       1.8       2.1       1.8       2.1       1.8       2.2       2.6       2.14       2.4       3.2       2.14       3.1       1.8       2.2       2.6       2.14       2.4       3.7       2.2       2.14 <td>13</td> <td>38</td> <td>2.89</td> <td>2.310917</td> <td></td> <td>2.7206</td> <td>2.516</td> <td>8.7</td> <td>21.81</td> <td></td> <td>38</td> <td>2.69</td> <td>2</td> <td>8.7</td> <td>3.0</td> <td>2.89</td> <td>20.10</td> <td>2 32</td>	13	38	2.89	2.310917		2.7206	2.516	8.7	21.81		38	2.69	2	8.7	3.0	2.89	20.10	2 32	
15       44       2.633       2.607283       2.921083       2.764       7.9       21.83       44       2.633       2       7.9       3.0       2.633       17.1       2.18         16       47       2.668       2.554983       2.88627       2.721       7.9       21.45       47       2.653       2       7.9       3.0       2.663       17.1       2.18         18       53       2.711       1.6746       2.2499       1.962       8.1       15.96       53       2.711       2       8.1       3.0       2.644       0.0       2.644       0.0       2.613       3.0       2.714       14.07       225         19       56       2.606       1.4654       1.479675       1.452       4.3       6.22       58       2.14       8.1       1.807       2.25         20       58       2.14       0.30671       0.533       3.2       1.69       60       2.12       2       3.2       1.5       2.12       4.0       1.40       4.4       2.86       4.3       2.0       2.14       8.4       1.89         21       60       2.12       0.68633       0.0267       4.7       1.26       61	14	41	3.09	1.970967		2.607283	2.289	9.3	21.22		41	3.09	2	9.3	3.0	3 09	22.48	2.42	
16       47       2.628       2.256483       2.866217       2.721       7.9       2.145       47       2.628       2       7.9       3.0       2.263       0.16	15	44	2.633	2.607283		2.921083	2.764	7.9	21.83		44	2.633	2	7.9	3.0	2.633	17 21	2 18	
17       301       2.994       1.996507       2.299       3.99       20.35       300       2.904       2       6.9       300       2.904       1.907       2.305       1.902       81       500       2.904       1.907       2.21       1.902       81       500       2.904       2.904       2.21       1.902       81       500       2.904       2.904       2.21       9.902       2.21       9.902       2.91       9.90       55       2.506       2.506       2.506       1.450       2.21       9.99       9.99       56       2.506       2.14       2.2       4.33       2.0       2.14       8.13       1.90       1.80       2.14       9.99       60       2.12       2       3.2       2.14       8.13       1.90       1.90       1.81       1.90       1.81       1.90       1.81       1.90       1.81       1.90       1.81       1.90       1.81       1.90 <t< td=""><td>16</td><td>47</td><td>2.628</td><td>2.554983</td><td></td><td>2.886217</td><td>2.721</td><td>7.9</td><td>21.45</td><td></td><td>47</td><td>2.528</td><td>2</td><td>/9</td><td>3.0</td><td>2.623</td><td>17.15</td><td>2.18</td></t<>	16	47	2.628	2.554983		2.886217	2.721	7.9	21.45		47	2.528	2	/9	3.0	2.623	17.15	2.18	
16       33       2.711       13743       2.2937       1457       6.5       3.9300       3.930       3.930<	1/	50	2.964	1.9/9683		2.598567	2.289	8.9	20.35		50	2.904	2	0.¥ 8.1	30	2,304	18.57	2.30	
10       58       2.14       1.3085       1.49015       1.452       4.3       6.22         21       60       2.12       0.698333       0.3671       0.533       3.2       1.69         22       61       2.14       0.349667       0.18405       0.267       4.7       1.26         23       64.4       0       0       0.133229       0       0.133       0.0       0.00         23       64.4       0       0       0.133229       0       0.1033       0.0       0.00         24       7 <t< td=""><td>10</td><td>56</td><td>2./11</td><td>1.0740</td><td></td><td>1 447967</td><td>1.902</td><td>6.1</td><td>9.49</td><td></td><td>56</td><td>2 606</td><td>2</td><td>65</td><td>25</td><td>2.606</td><td>14.10</td><td>2.16</td></t<>	10	56	2./11	1.0740		1 447967	1.902	6.1	9.49		56	2 606	2	65	25	2.606	14.10	2.16	
21       60       2.12       0.698333       0.3671       0.533       3.2       1.69       60       2.12       2       3.2       1.5       2.12       6.0       1.83         22       61       2.14       0.349667       0.133409       0.0267       4.7       1.26       61       2.14       2       4.7       2.2       2.14       8.94       1.90         23       64.4       0       0       0.133429       0       0.133       0.0       0.00       61       2.14       2       4.7       2.2       2.14       8.94       1.90       6.00       6.00       6.00       1.77       0       6.00       6.	20	58	2.14	1.3085		1.59615	1.452	4.3	6.22		58	2.14	2	4.3	2.0	2.14	8.12	1 90	
22       61       2.14       0.349667       0.18405       0.267       4.7       1.26       61       2.14       2       4.7       2.2       2.14       8.94       1.90         23       64.4       0       0       0.133429       0       0.133       0.0       0.00         2.106       160.8       338.48       160.75       367.92       2.2       2.14       8.94       1.90         5       Width       Act. Chn.       Ch-Lower       V-Upper       V-Int       Delta         20%       15.0       12.00       1600       181       2.20       2.10       1.00         30%       21.0       12.00       1600       181       2.20       2.10       1.00         30%       21.0       20.00       23.00       2.57       2.85       2.67       0.79         40%       27.0       28.00       29.00       2.57       2.85       2.67       0.79       80%       33.0       32.00       23.05       2.35       2.35       0.94         60%       39.0       38.00       41.00       2.52       2.99       2.44       0.86       50%       33.0       32.00       23.05       2.35	21	60	2.12	0.698333		0.3671	0.533	3.2	1.69		60	2.12	2	3.2	1.5	2.12	6.00	1 89	
23       64.4       0       0       0.133429       0       0.133       0.0       0.00         2.106       160.8       338.48       160.75       367.92       2.2         5       0       0.133429       0       0.133       0.0       0.00       64.4       0       2       0.0       1.7       0       0.00       0.00         2.106       160.8       338.48       160.75       160.75       160.75       2.2       2.2         % Width       Act. Chn.       Ch-Lower       Ch-Lower       V-lower       V-lower <td>22</td> <td>61</td> <td>2.14</td> <td>0.349667</td> <td></td> <td>0.18405</td> <td>0.267</td> <td>4.7</td> <td>1.26</td> <td></td> <td>61</td> <td>2.14</td> <td>2</td> <td>4.7</td> <td>2.2</td> <td>2.14</td> <td>8 94</td> <td>1 90</td>	22	61	2.14	0.349667		0.18405	0.267	4.7	1.26		61	2.14	2	4.7	2.2	2.14	8 94	1 90	
2.106         160.3         338.48         100.75         407.38         407.38         4.4           Delta value calculations         Vint         Delta           % Width         Act. Chn.         Ch-Upper         V-Upper         V-int         Delta         20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00         20%         16.00         2.26         2.23         2.24         0.99           30%         21.0         20.00         23.00         2.41         2.40         0.88         30%         21.0         20.00         2.36         2.32         2.36	23	64.4	0	0	0.133429	0	0.133	0.0	0.00		64.4	0	2	0.0	• /	0	0.00	0.00	
Width         Act. Chn.         Ch-Lower         Ch-Upper         V-Upper         V-int         Delta           20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00         20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00         20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00         20%         15.0         12.00         16.00         2.28         2.28         2.28         2.28         2.98         0.99           30%         21.0         20.00         23.00         2.41         2.40         2.40         0.88         30%         21.0         20.00         23.00         2.46         2.38         1.00           60%         33.0         32.00         2.61         2.75         2.66         0.79         50%         33.0         32.00         34.00         2.42         1.65							2.106	160.8	338,48					150.75			307.32	46~	
% Width         Act. Chr.         Ch-Lower         Ch-Upper         V-Upper         V-int         Delta         % Width         Act. Chr.         Upper         V-Upper         V-int         Delta           20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00         20%         15.0         12.00         16.00         2.26         2.27         2.24         0.39           30%         21.0         20.00         23.00         2.41         2.40         2.40         0.88         30%         21.0         20.00         2.36         2.38         2.38         2.38         0.94           40%         27.0         28.00         29.00         2.57         2.85         2.67         0.79         40%         27.0         26.00         2.41         2.40         0.88         30%         23.00         2.42         1.83         2.22         1.90         5.94         33.0         32.00         2.42         1.83         2.22         1.90         5.94         3.90         2.90         2.42         1.83         2.22         1.90         5.96         33.0         32.00         38.00         2.42         1.83         2.22         1.90         5.96				1	Delta value	calculation	IS							Delta value	calculation	15			
20%         15.0         12.00         16.00         1.81         2.20         2.10         1.00           30%         21.0         20.00         23.00         2.41         2.40         2.40         0.83         30%         21.0         20.00         23.00         2.41         2.40         2.40         0.83         30%         21.0         20.00         23.00         2.41         2.40         0.40         3.0%         21.0         20.00         2.26         2.26         2.26         2.36         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         3.30         <		% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-int	Delta	1	% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Alpha	
30%         21.0         20.00         23.00         2.41         2.40         2.40         0.89         30%         21.0         20.00         23.00         2.36         2.36         2.36         0.94           40%         27.0         26.00         29.00         2.57         2.85         2.67         0.79         40%         27.0         26.00         2.41         2.40         0.89         30%         27.0         26.00         2.42         1.63         2.42         1.63         2.42         1.63         2.42         1.63         2.42         1.00           50%         33.0         32.00         35.00         2.61         2.75         2.66         0.79         50%         33.0         32.00         35.00         2.43         1.60           60%         39.0         38.00         41.00         2.52         2.29         2.44         0.86         60%         39.0         36.00         2.33         2.42         2.45         0.95           70%         45.0         44.00         47.00         2.76         2.72         2.75         0.77         70%         45.0         44.00         47.00         2.18         2.18         1.02           80% <td></td> <td>20%</td> <td>15.0</td> <td>12.00</td> <td>16.00</td> <td>1.81</td> <td>2.20</td> <td>2.10</td> <td>1.00</td> <td></td> <td>20%</td> <td>15.0</td> <td>12.00</td> <td>46 00</td> <td>2.26</td> <td>2.23</td> <td>2.24</td> <td>0.99</td>		20%	15.0	12.00	16.00	1.81	2.20	2.10	1.00		20%	15.0	12.00	46 00	2.26	2.23	2.24	0.99	
40%         27.0         28 00         29 00         2.57         2.85         2.67         0.79         40%         27.0         24.00         29.00         2.42         183         2.22         1.00           50%         33.0         32.00         35.00         2.61         2.75         2.66         0.79         50%         33.0         32.00         35.00         2.61         2.75         2.66         0.79         50%         33.0         32.00         35.00         2.20         2.31         2.23         1.00           60%         39.0         38.00         41.00         2.62         2.29         2.44         0.86         60%         33.0         38.00         41.00         2.32         2.42         2.35         0.95           70%         45.0         44.00         47.00         2.76         2.72         2.75         0.77         76%         45.0         44.00         47.00         2.18         2.16         1.02           80%         51.0         50.00         53.00         2.29         1.96         2.18         0.97         50.00         53.00         2.31         2.22         2.31         0.96		30%	21.0	20.00	23.00	2.41	2.40	2.40	0.88		30%	21.0	20.00	23.00	2.36	2.38	2.98	0.94	
50%         33.0         32.00         35.00         2.61         2.75         2.66         0.79         50%         33.0         32.00         35.00         2.23         2.31         2.23         1.00           60%         39.0         38.00         41.00         2.52         2.29         2.44         0.86         60%         39.0         38.00         41.00         2.32         2.42         2.35         0.95           70%         45.0         44.00         47.00         2.76         2.72         2.75         0.77         70%         45.0         44.00         47.00         2.18         2.18         1.02           80%         51.0         50.00         53.00         7.29         1.96         2.18         0.97         80%         51.0         50.00         53.00         2.22         2.31         0.96		40%	27.0	26.00	29 00	2.57	2,85	2.67	0.79		40%	27.0	26.00	29.00	2.42	1 83	2.22	1.00	
bu%         35.0         38.00         41.00         2.62         2.29         2.44         0.80         50%         35.0         38.00         41.00         2.52         2.42         2.45         9.79           70%         45.0         44.00         47.00         2.76         2.72         2.75         0.77         70%         45.0         44.00         47.00         2.18         2.18         1.02           80%         51.0         50.00         53.00         2.29         1.96         2.18         0.97         36.00         53.00         2.38         2.22         2.31         0.98		50%	33.0	32.00	35.00	2.61	2.75	2.66	0,79		50%	33.0	32.00	35.00	2.20	231	2.23	1.00	
80% 510 5000 5300 229 196 218 0.97 80% 510 5000 5300 238 222 231 0.96		70%	39.0	38.00	41.00	2.62	2.29	2.44	0,80		70%	45.0	44.00	47.00	2.52	218	2.50	1.02	
		80%	51.0	50.00	53.00	2.76	1.96	2.15	0.97		80%	51.0	50.00	53.00	2.38	222	2.31	0.96	

Appendix H

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	S		Me	asured d	ata					
STA	TION No. :	C8H028			STAR	T TIME :	05h45			
RIVE	R NAME :	Wilge Bavaria	Average Gaugeplate reading : 2.145 m							
	DATE	18/02/1989	I							
			Main Channel LEFT : 3							
					Main Chann	el RIGHT :	63			
1	2	3	4	5	6	7	8	9		
Vertical	Chainage	Vertical	Velocity	Velacity	Velocity	V aver.	Area	0		
	<b>.</b> g.		, clocky	( ciccut)	· choairy		(m <sup>2</sup> )	(m <sup>3</sup> /e)		
number		OL BLECTIVE	U.2d	0.40	0.80	(m/s)	(i+i )	(111 /3)		
		depth	~	0.000		2.057	1/4.5	358.97		
1	2.2	1 73	0	0.029	0 11/317	0.029	0.0	0.00		
ť a	3.4 5.0	3.05	CCCROAD		1 02095	0.057	2.0 7.6	0.15 6 5E		
4	82	3.11	1 613583		1 718183	1 666	10.9	18.12		
5	12.2	3	1 587433		1 875083	1 731	12.0	20.78		
6	162	2.852	1.892517		2.310917	2.102	11.4	23.98		
7	20.2	3.252	2.093		2.546267	2.320	11.4	26.40		
8	23.2	3.026	2.38065		2.842633	2.612	9,1	23.71		
9	26.2	3.005	2,110433		2.921083	2.516	9.0	22.68		
10	29.2	2.673	2.1976		3.0867	2.642	8.0	21.19		
11	32.2	2.996	2.310917		3.06055	2.686	9.0	24.14		
12	35.2	2.796	2.554983		2.85135	2.703	8.4	22.67		
13	38.2	2.823	2.127867		2.790333	2.459	8.5	20.83		
14	41.2	3.126	1.9361		2.790333	2.363	9.4	22,16		
15	44.2	2.806	2.53755		2.938517	2.738	8.4	23.05		
16	47.2	2.43	2.546267		2.842633	2.694	7.3	19.64		
17	50.2	2.88	2.842633		2.685733	2.764	8.6	23.88		
18	53.2	2.93	1./5305		2.3/1933	2.062	8.8	18.13		
19	56.2	2.51	1.3608		2.005833	1.083	6.3	10.56		
20	56.2	2.33	0.75025		0.480417	1.403	4.7	0.91		
21	61.2	2.19	0.10930		0.400417	0.020	5.5 4 F	1.04		
22	64.6	1 74	0.002200		0.0533	0.027	54	014		
24	67.37	0	õ	0	0.0000	0.000	0.0	0.00		
						2.057	174.5	358.97		
								•		
	% Width	Act Chn	Ch-I ower	Ch-Upper		S V-Linner	\/-int	Delta		
	20%	15.0	12 20	16.00	1 72	240	4.00	102		
	30%	21.0	220	73.20	227	2.10	7 40	0.98		
	40%	27.0	20.20	29.20	2.52	2.01	2.40	0.80		
	50%	33.0	32.20	35 20	2.02	270	2.69	0.76		
	60%	39.0	38.20	41.20	2.46	2.36	2.43	0.85		
	70%	45.0	44.20	47.20	2.74	2.69	2.73	0.75		
099999999999	0.00/	510	50.20	53 20	2.76	2.06	2.58	0 80		

Manning or Chezy:         M         Q = 396.7           Signam 0.0016           Roughness coeff         Area reduction factor           3ub         n         0         1           0         0         1         0         1           0         0         1         0         1           0         0         1         0         1           0         0         1         0         1           0         0         1         0         1           0         1         0         1         0         1           0         1         0         1         0         1         0           22         0.035         2         16         0         0.00         0.00           3.2         1.72         2         2.6         1.5         1.72         4.23         1.8           5.2         3.05         2         7.8         2.5         3.05         1.33         2.40           16.2         2.852         2         1.4         3.5         3.252         2.862         2.33           20.2         3.252         2.853         3.0		Calc	culated o	lata, 1-dir	nensiona	I flow the	ory	
Silogen         0.0016         VAUR         =         2.27           Roughness conff         n         Area reduction factor. Sub         f.         VAUR         =         2.27           0         0         1         0         1         0         1         0         1           2         0.035         2         1         0         1         0         1           Clinetings         Vertical         Bute         Area         Valled F         Hi-Radius         Q         V           2         0.035         2         0.0         1.8         0         0.0         0         0           3.2         1.72         2.8         1.5         1.72         4.33         1.64           5.2         3.05         2         7.6         2.5         3.05         1.63         2.40           16.2         2.652         2         11.4         4.0         2.852         2.852         2.952         2.953         2.95         2.953         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95         2.95	Manning	or Chezy	r.	M			Q =	396.7
Roughness coeff         Area reduction factor           Sub         n         Sub         fA           0         0         1         0         1           2         0.035         2         1         0         1           0         0         1         0         1         0         1           10         0         1         0         1         0         1           10         1         0         1         0         1         0         0           10         1         0         1         0         1         0         0         00			Slope	0.0016			V <sub>AVR</sub> =	2.27
Sub         n         Sub         f_A           0         0         0         1           2         0.035         2         1           0         0         1         1           0         0         1         1           0         0         1         1           0         0         1         1           0         0         1         1           0         0         1         1           0         2         0.0         16         0         20           172         2         1.5         1.72         4.33         1.64           5.2         3.05         2         7.6         2.5         3.06         16.33         2.40           12.2         3         2         12.0         4.0         3         3.80         2.80           16.2         2.852         2         11.4         4.0         2.852         2.85         2.30           20.2         3.252         2.80         3.0         2.80         3.0         2.85         2.30           21.2.2         3.05         2.90         3.0         2.86         2.	Roughness	coeff		Area reduc	ion factor			
0         0         1           0         0.035         0         1           0         0         1         2         1         0           Chainings         Vertical         Saus         Area         Wethod F         H-Ratifius         Q         V           0         1         F         P         R         (m <sup>3</sup> /3)         Vetiocity           0         2         0         2         0.0         1.6         0         # P         R         (m <sup>3</sup> /3)         Vetiocity           32         172         2         2.6         1.5         1.72         4.23         3.24           82         3.11         2         10.9         3.5         3.11         28.80         2.48           12.2         3         2         12.0         4.0         3         28.82         2.38           16.2         2.852         2         11.4         3.5         3.252         2.97.2         2.97.3         2.99.6         2.99.2         2.97.3         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6         2.99.6	Sub			Stith	f.			
0         0         1           2         0.035         2         1           0         1         0         1           0         0         1         P         R         (10*73)         Vetically           0         1         8         R         (10*73)         Vetically           0         1         8         R         (10*73)         Vetically           22         0         2         9.0         1.6         0         0.00         0.00           3.2         1.72         2         2.6         1.5         1.72         4.23         1.63         2.42         1.64           5.2         3.05         1.33         2.40         3         2.812         2.85         2.24         2.0         1.6         0         0.00         0.00         0.00           12.2         3         2         1.4         4.0         2.852         2.852         2.24         1.1         2.45         2.35           20.2         3.055         2         9.0         3.0         2.6673         3.026         2.171         2.36           21.2         9.0         3.0         2.673	0			0				
2         0.035         2         1           0         0         1           Cmainage         Verneti         Bub         Anna         Wathof F         Hi-Ratility         Q         V           or effectives         Becheni         A         F         R         (11 <sup>3</sup> 78)         Valicoffy           22         0         2         0.0         1.6         0         6.00         0.00           32         1.72         2         2.66         1.5         1.72         4.23         1.84           62         3.05         2         7.6         2.5         3.05         1.833         2.46           82         3.11         2         10.9         3.5         3.11         28.89         2.86           162         2.852         2         11.4         4.0         2.852         2.96         2.90           202         3.055         2         9.0         3.0         3.005         21.41         2.39           222         2.8673         2         9.0         3.0         3.005         21.43         2.39           232         2.966         2         9.0         3.0         2.966         1	0			0				
0         0         1         0         1           Chaphages         Vertrage         Stab         Area         Wethof F         H-Radius         Q         V           2.2         0         2         0.0         1.6         0         900         0.00           3.2         1.72         2         2.6         1.5         1.72         4.23         1.64           5.2         3.05         2         7.6         2.5         3.05         18.33         2.40           82         3.11         2         10.9         3.5         3.11         2.160         2.42           16.2         2.852         2         11.4         4.0         2.852         2.83         2.38           20.2         3.252         2         11.4         3.5         3.252         2.86         2.51           23.2         3.026         2         9.0         3.0         3.005         2.48         2.38           26.2         3.005         2         9.0         3.0         2.673         1.66         2.29           35.2         2.796         2         3.6         3.0         2.673         1.66         2.29	4	0.035		4	1			
Chainings         Variant         Stap         Area         Wathof P         H-Radius         C         V           depth          A         F         R         (m <sup>3</sup> /s)         Velocity           3.2         0         2         0.0         1.8         0         0.00         0.00           3.2         1.72         2.6         1.5         1.72         4.23         1.94           5.2         3.05         2         7.6         2.5         3.05         14.33         2.40           8.2         3.11         2         10.9         3.5         3.11         24.80         2.44           16.2         2.852         2         1.1.4         4.0         3         2.81         2.34           20.2         3.252         2         1.1.4         3.5         3.252         2.85         2.81           23.2         3.005         2         9.0         3.0         3.006         2.46         2.3           25.2         2.673         2         8.4         3.0         2.596         2.38         2.3           36.2         2.523         2         8.4         3.0         2.86         1.1.5 <t< th=""><th>C</th><th></th><th></th><th>0</th><th>1</th><th></th><th></th><th></th></t<>	C			0	1			
Jur effective orgen         Bachton (***)         A         P         R         (m**s) (***)         Velocity (***)           2.2         0         2         0.0         1.6         0         0.00         0.00           3.2         1.72         2         2.8         1.5         1.72         4.23         1.84           5.2         3.05         2.17         2.2         7.6         2.5         3.05         1.33         2.44           6.2         3.11         2         10.9         3.5         3.11         24.80         2.44           16.2         2.852         2         11.4         4.0         2.852         2.82         2.30           20.2         3.252         2         11.4         4.55         3.252         2.84         2.38           26.2         3.052         2         9.0         3.0         3.005         2.14         2.38           26.2         3.005         2         9.0         3.0         2.906         2.38         2.38           35.2         2.796         2         8.4         3.0         2.596         7.166         2.28           36.2         2.873         2         8.4	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	v
Jonguti         Jonguti <t< td=""><td></td><td>or effective</td><td>Section</td><td>A</td><td>ρ</td><td>R</td><td>(m³/s)</td><td>Velocity</td></t<>		or effective	Section	A	ρ	R	(m³/s)	Velocity
2.2         0         2         0.0         1.6         0         0.00           3.2         1.72         2         2.6         1.5         1.72         4.33         1.84           5.2         3.05         2         7.6         2.5         3.05         1.4.33         2.43           8.2         3.11         2         10.9         3.5         3.11         3.860         2.44           16.2         2.852         2         11.4         4.0         2.852         2.872         2.30           20.2         3.252         2         11.4         3.5         3.252         2.865         2.51           23.2         3.026         2         9.0         3.0         3.005         2.11         2.36           29.2         2.673         2         8.0         3.0         2.673         17.85         2.36           35.2         2.996         2         9.0         3.0         2.673         17.85         2.36           35.2         2.796         2         8.4         3.0         2.796         19.00         2.27           36.2         2.823         2         8.4         3.0         2.865         19.		depth						
3.2       1 72       2       2.6       1.5       1.72       4.23       1.64         5.2       3.05       2       7.6       2.5       3.05       14.33       2.40         8.2       3.11       2       10.9       3.5       3.11       2.680       2.43         12.2       3       2       12.0       4.0       3       2.852       2.23         20.2       3.252       2       11.4       3.5       3.252       2.945       2.31         23.2       3.026       2       9.0       3.0       3.005       2.14       2.38         26.2       3.005       2       9.0       3.0       3.005       2.144       2.38         29.2       2.673       2       8.0       3.0       2.573       17.85       2.20         32.2       2.906       2       9.0       3.0       2.573       17.85       2.26         35.2       2.796       2       8.4       3.0       2.523       16.33       2.24         36.2       2.623       2       8.4       3.0       2.523       16.33       2.24         41.2       3.126       2.41       2.44       2.5	2.2	0	2	0.0	1.6	0	0.00	0.00
5.2       3.05       2       7.6       2.5       3.05       14.33       2.40         8.2       3.11       2       10.9       3.5       3.11       20.80       2.43         16.2       2.852       2       11.4       4.0       2.852       22.2       2.20         20.2       3.252       2       11.4       4.5       3.252       2.64.5       2.51         23.2       3.026       2       9.1       3.0       3.026       2.111       2.39         26.2       3.005       2       9.0       3.0       3.005       21.44       2.38         29.2       2.673       2       9.0       3.0       2.673       17.85       2.36         35.2       2.996       2       9.0       3.0       2.996       11.45       2.36         35.2       2.796       2       8.4       3.0       2.796       19.03       2.27         38.2       2.623       2       8.4       3.0       2.896       19.03       2.27         38.2       2.623       2       8.4       3.0       2.806       19.03       2.27         38.2       2.623       2       8.4	3.2	172	2	26	15	1.72	4.23	1.64
8.2       3.11       2       10.9       3.5       3.11       2630       2.43         16.2       2.852       2       11.4       4.0       2.852       2.852       2.30         20.2       3.252       2       11.4       4.0       2.852       2.922       2.30         20.2       3.252       2       11.4       3.5       3.525       2.922       2.30         23.2       3.026       2       9.0       3.0       3.005       2.144       2.38         29.2       2.673       2       9.0       3.0       2.673       17.85       2.38         32.2       2.906       2       9.0       3.0       2.573       17.85       2.38         35.2       2.795       2       8.4       3.0       2.796       10.00       2.27         36.2       2.523       2       8.4       3.0       2.896       19.00       2.27         36.2       2.662       2       8.4       3.0       2.806       19.14       2.27         36.2       2.852       2       8.6       3.0       2.80       19.14       2.07         50.2       2.88       3.0       2.93	5.2	3 05	2	7.6	25	3.05	18,33	2.40
12.2       3       2       12.0       4.0       3       2852       236         16.2       2.852       2       11.4       4.0       2852       28.22       230         20.2       3.252       2       11.4       3.5       3252       28.65       251         23.2       3026       2       9.1       3.0       3.005       21.41       238         26.2       3.005       2       9.0       3.0       3.005       21.45       238         29.2       2.673       2       5.0       3.0       2.673       17.85       220         32.2       2.996       2       9.0       3.0       2.673       17.85       228         35.2       2.796       2       8.4       3.0       2.823       19.93       228         41.2       3.126       2       9.4       3.0       3.126       229       244         44.2       2.806       2       8.4       3.0       2.823       19.99       2.28         41.2       3.126       2       7.3       3.0       2.43       15.06       2.07         50.2       2.51       2       5.3       2.5	8.2	3 11	2	10.9	3.5	3.11	26.50	2.43
16.2       2.2852       2       11.4       4.0       22852       28.22       23.0         20.2       3.252       2       11.4       3.5       3.252       28.55       2.51         23.2       3.026       2       9.1       3.0       3.026       21.11       2.39         26.2       3.005       2       9.0       3.0       3.005       21.45       2.36         32.2       2.873       2       8.0       3.0       2.673       17.65       2.20         32.2       2.996       2       9.0       3.0       2.573       17.65       2.20         32.2       2.996       2       9.0       3.0       2.573       17.65       2.20         38.2       2.823       2       8.4       3.0       2.826       19.39       2.24         41.2       3.126       2       9.4       3.0       3.126       2.94       2.27         41.2       2.606       2       8.4       3.0       2.806       19.43       2.27         47.2       2.43       2       7.3       3.5       2.43       15.09       2.07         50.2       2.51       2.33       3.3	12.2	3	2	12.0	4.0	3	28.63	2.38
20.2       3.252       2       11.4       3.5       3.252       28.65       2.54         23.2       3.026       2       9.1       3.5       3.025       21.71       2.39         26.2       3.05       2       9.0       3.0       3.025       21.44       2.39         29.2       2.673       2       9.0       3.0       2.673       17.65       2.20         32.2       2.906       2       9.0       3.0       2.673       17.65       2.20         35.2       2.795       2       3.4       3.0       2.796       19.05       2.27         38.2       2.823       2       8.5       3.0       2.823       19.25       2.28         41.2       3.126       2       9.4       3.0       3.126       2.291       2.44         44.2       2.806       2       8.4       3.0       2.805       19.14       2.17         47.2       2.43       2       7.3       3.0       2.43       15.04       2.07         50.2       2.51       2.33       2.47       2.0       2.33       9.36       2.57       2.34         56.2       2.51       2.33	16.2	2.852	2	11.4	4.0	2.852	28.22	2.30
23.2         3.026         2         9.1         3.0         3.025         21.11         2.36           26.2         3.005         2         9.0         3.0         3.005         21.44         2.36           32.2         2.873         2         9.0         3.0         2.673         17.86         2.20           32.2         2.996         2         9.0         3.0         2.3966         21.35         2.38           35.2         2.796         2         8.4         3.0         2.796         19.09         2.27           38.2         2.823         2         8.4         3.0         2.876         19.39         2.28           41.2         3.126         2         9.4         3.50         3.125         2.291         2.44           44.2         2.806         2         8.4         3.0         2.805         19.14         2.07           50.2         2.88         2         8.6         3.0         2.63         19.99         2.31           53.2         2.93         2         5.3         2.51         14.25         2.11           56.2         2.51         2         2.33         3.36         2.19	20.2	3.252	2	11.4	3.5	3 252	28 55	2.51
26.2         3005;         2         9.0         3.0         3.005;         2.46         2.36           32.2         2.996;         2         9.0         3.0         2.573;         17.85;         2.20;           35.2         2.796;         2         8.4         3.0         2.796;         19.08;         2.22;           35.2         2.796;         2         8.4         3.0         2.796;         19.08;         2.22;           36.2         2.823;         2         8.5         3.0         2.896;         19.08;         2.22;           41.2         3.126;         2         9.4         3.0         3.126;         2.94;         2.44           44.2         2.506;         2         8.4         3.0         2.805;         16.14         2.27           47.2         2.43         2         7.3         3.0         2.43;         15.04;         2.07           50.2         2.88         2         6.6         3.0         2.92;         26.57;         2.34           56.2         2.51;         2.33;         2.6;         2.51;         13.25;         2.11           60.2         2.19;         2.33;         1.5; <t< td=""><td>23.2</td><td>3.026</td><td>2</td><td>9.1</td><td>3.0</td><td>3.026</td><td>21 71</td><td>2 39</td></t<>	23.2	3.026	2	9.1	3.0	3.026	21 71	2 39
29.2         2973         2         50         30         2573         1785         220           32.2         2996         2         90         30         2996         2135         238           35.2         2.796         2         8.4         30         2.796         19.03         227           38.2         2.823         2         8.5         3.0         2.823         19.33         228           41.2         3.126         2         8.4         3.0         3126         2291         244           44.2         2.603         2         8.4         3.0         2.823         15.96         2.07           47.2         2.43         2         7.3         3.0         2.843         15.96         2.07           50.2         2.38         2         6.6         3.0         2.93         2.057         2.34           56.2         2.51         2         6.3         2.0         2.33         3.36         2.01           60.2         2.19         2         3.3         1.5         2.19         8.28         195           61.2         2.06         2.45         2.22         2.06         8.29	26.2	3.005	2	9.0	3.0	3.005	21 45	2.38
32.2         2.9965         2         9.0         3.0         2.3955         7.35         2.35           35.2         2.796         2         3.4         3.0         2.796         19.03         2.27           38.2         2.823         2         3.5         3.0         2.823         19.03         2.27           41.2         3.126         2         9.4         3.0         3.126         2.291         2.44           44.2         2.866         2         8.4         3.0         2.805         19.14         2.77           47.2         2.43         2         7.3         3.0         2.43         15.06         2.07           50.2         2.86         2         6.6         3.0         2.93         2.057         2.34           56.2         2.51         2         6.3         2.53         2.51         13.25         2.11           58.2         2.33         2         4.7         2.0         2.33         9.36         195           61.2         2.06         2         4.5         2.2         2.06         8.39         45           64.6         1.74         2         5.4         3.1         1	29.2	2.673	2	80	30	2.6/3	17.85	2.20
35.2         2.796         2         8.4         3.0         2.796         19.03         2.27           38.2         2.823         2         8.5         3.0         2.823         19.33         2.24           41.2         3.126         2         9.4         3.0         3.126         22.91         2.44           44.2         2.605         2         8.4         3.0         2.805         19.14         2.77           47.2         2.43         2         7.3         3.0         2.43         16.06         2.07           50.2         2.38         2         8.6         3.0         2.63         19.99         2.31           53.2         2.93         2         6.3         2.53         2.51         13.25         2.11           56.2         2.51         2         6.3         2.53         2.51         13.25         2.11           56.2         2.33         2         4.7         2.0         2.33         3.36         2.01           60.2         2.19         2         3.3         1.5         2.19         8.32         193           61.2         2.06         2         4.5         2.2         2	32.2	2.996	2	80	30	2.996	21.35	2.38
36.2         2.5.2         2         3.3         2.5.2         3.4         3.0         3125         22.4           41.2         3.125         2         9.4         3.0         3125         22.41         2.44           44.2         2.805         2         8.4         3.0         2.805         19.44         2.77           47.2         2.43         2         7.3         3.0         2.43         16.05         2.07           50.2         2.38         2         8.6         3.0         2.83         19.99         2.31           53.2         2.93         2         6.3         2.53         2.51         13.25         2.11           56.2         2.51         2         6.3         2.53         2.51         13.25         2.11           56.2         2.51         2         3.3         1.5         2.19         8.33         195           61.2         2.06         2         4.5         2.2         2.06         8.39         165           64.6         1.74         2         5.4         3.1         1.74         8.57         165           20%         15.0         12.20         16.20         2.3	35.2	2/90	2	8.4	5U 20	2.796	19,03	2.27
41.2       3.120       2       9.44       3.0       3.120       22.37       24.45         44.2       2.605       2       8.4       3.0       2.805       19.14       2.27         47.2       2.43       2       7.3       3.0       2.43       16.06       2.07         50.2       2.38       2       8.6       3.0       2.63       19.99       2.31         53.2       2.93       2       6.3       2.53       2.51       13.25       2.11         56.2       2.51       2       6.3       2.53       2.51       13.25       2.11         56.2       2.33       2       4.7       2.0       2.33       3.36       2.01         60.2       2.19       2       3.3       1.5       2.19       8.32       193         61.2       2.06       2       4.5       2.2       2.06       8.39       165         64.6       1.74       2       5.4       3.1       1.74       8.67       2.27         Delta value calculations         30%       21.0       2.00       1.4       0       0.00       0.90         3174.47	38.2	2.823	2	8.5	3.0	2.823	19.33	2.26
444.2       2.600       2       6.4       3.0       2.605       10.14       2.47         47.2       2.43       2       7.3       3.0       2.43       16.06       2.07         50.2       2.38       2       8.6       3.0       2.63       19.99       2.31         53.2       2.93       2       6.8       3.0       2.93       20.57       2.34         56.2       2.51       2       6.3       2.53       2.51       13.25       2.11         58.2       2.33       2       4.7       2.0       2.33       3.36       2.01         60.2       2.19       2       3.3       1.5       2.19       8.32       193         61.2       2.06       2       4.5       2.2       2.06       8.39       165         64.6       1.74       2       5.4       3.1       1.74       8.67       165         67.37       0       2       0.0       1.4       0       0.00       0.00         Viewer       V-loper       V-ln       Alpha         20%       15.0       12.20       18.20       2.33       2.32       0.98         <	41.2	3,120	2	¥.4	3.0	3126	22.97	2.44
47.2       243       2       7.3       3.3       2.43       6.05       2.0         50.2       2.38       2       8.6       3.0       2.63       19.99       2.31         53.2       2.93       2       6.3       3.0       2.93       20.57       2.34         56.2       2.51       2       6.3       2.63       2.93       3.35       2.01         56.2       2.51       2       6.3       2.6       2.33       3.36       2.01         56.2       2.33       2       4.7       2.0       2.33       3.36       2.01         60.2       2.19       2       3.3       1.5       2.19       8.32       1.93         61.2       2.06       2       4.5       2.2       2.06       8.39       1.65         64.6       1.74       2       5.4       3.1       1.74       8.67       1.65         67.37       0       2       0.0       1.4       0       0.00       0.90         177.427       5.0       1.4       0       0.00       0.90         177.42       5.0       1.4       0       0.00       0.90       0	44.2	2.000	2	0.4	3.0	2 806	19 14 AE 00	2.21 5.017
50.2         2.86         2         6.8         3.0         2.60         10.56         2.31           53.2         2.93         2         6.8         3.0         2.93         20.57         2.34           56.2         2.51         2         6.3         2.53         2.51         13.25         2.11           58.2         2.33         2         4.7         2.0         2.33         9.36         19.35           60.2         2.19         2         3.3         1.5         2.19         8.32         193           61.2         2.06         2         4.5         2.2         2.06         8.39         165           64.6         1.74         2         5.4         3.1         1.74         8.67         1.65           67.37         0         2         0.0         1.4         0         0.00         0.00           Viewer         V-toper         V-toper         V-to         Alpha           20%         15.0         12.20         16.20         2.36         2.32         0.98           30%         21.0         20.20         23.4         2.00         2.32         0.98           30%	41.2	2.43	2	1.3	3.0	2.43	15 46	207
53.2         2433         2         6.8         3.0         2.43         2.05         2.34           56.2         2.51         2         6.3         2.5         2.51         13.25         2.11           58.2         2.33         2         4.7         2.0         2.33         9.36         2.01           60.2         2.19         2         3.3         1.5         2.19         8.32         1.93           61.2         2.06         2         4.5         2.2         2.06         8.39         1.65           64.6         1.74         2         5.4         3.1         1.74         8.87         1.65           67.37         0         2         0.0         1.4         0         0.00         0.09           ITA.47         Jeeka value calculations           Selfa value calculations           Selfa value calculations           Viower         V-toper         V-trit         Alpha           20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           30%         21.0         20.20         23.0         2.34         2.00	50.2	2.00	2	60	30	2.65	19.98	2.31
36.2         2.31         2         6.3         2.3         2.31         3.33         1.33         2.33         1.35         2.19         3.33         1.55         2.13         2.36         2.30         2.33         1.45         66         67.37         0         2         0.00	53.2	2 93	4	00	00 04	2.90	20.57	2.34
60.2         2.33         2.33         1.5         2.33         4.33         1.93           60.2         2.19         2         3.3         1.5         2.19         8.30         1.93           61.2         2.06         2         4.5         2.2         2.06         8.39         1.85           64.6         1.74         2         5.4         3.1         1.74         8.67         1.65           67.37         0         2         0.0         1.4         0         0.00         0.09           If74.47           Delta value calculations           V-lower         V-lower         V-lower         V-lower         V-lower         V-lower         0.91         Alpha           20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           30%         21.0         2020         23.02         2.33         2.39         2.46         0.92           Still and algoid	20.2	201	4	03	20	201	0.25	304
61.2         2.06         2         4.5         2.2         2.06         8.39         1.85           64.6         1.74         2         3.4         3.1         1.74         8.67         1.65           67.37         0         2         0.0         1.4         0         0.00         0.00           174.47         396.75         2.27         396.75         2.27           Delta value calculations           Viewer         V.0ppr         V-1m         Alpha           Delta value calculations           Viewer         V.0ppr         V-1m         Alpha           20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           30%         21.0         20.20         23.32         2.51         2.30         2.32         0.98           30%         21.0         20.20         23.30         2.33         0.92         0.92           40%         27.0         26.20         23.40         2.32         0.98         0.97           60%         33.0         32.20         35.20         2.34         2.37         2.35         0.98	00.2	2.33	2	70	15	2.00	6 32 6 32	102
64.6         1.74         2         5.4         3.1         1.74         8.87         1.65           67.37         0         2         0.0         1.4         0         0.00         0.00           174.47         396.75         2.27           Delta value calculations           Viower         Viower         Viower         Viower         Alpha           20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           396.75         2.27           Delta value calculations           Viower         Viower         Vioper         Vin         Alpha           20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           30%         21.0         20.20         23.30         2.32         0.98         0.92         40%         2.70         2.33         0.98         0.92           40%         27.0         26.20         234         2.27         2.35         0.98         0.97         60%         39.0         38.20         41.20         2.28         2.44         2.30         0.98	61.2	2.19	2	3.3	22	206	8.39	1.65
67.37         0         2         0.0         1.4         0         0.00         0.00           174.47         396.75         2.27           Delta value calculations           5% Width         Act. Chn.         Lower         Upper         V-lower         V-lower         V-loper         Alpha           20%         15.0         12.20         16.20         2.38         2.30         2.32         0.98           30%         21.0         20.20         25.02         2.38         2.30         2.32         0.98           30%         21.0         20.20         25.02         2.38         2.30         2.32         0.98           30%         21.0         20.20         25.30         2.38         2.20         2.32         0.98           40%         27.0         26.20         25.02         2.38         2.20         2.33         0.98         6.92           40%         33.0         32.20         35.20         2.38         2.44         2.30         0.98           50%         39.0         36.20         41.20         2.27         2.07         2.32         1.03           70%         45.0         44.20	64.6	4 7 8	2	4.3 4.4	31	174	8.87	1.65
Unit         Alpha         Unit         Unit <thu< td=""><td>67 37</td><td>n.</td><td>2</td><td>0.0</td><td>14</td><td>114</td><td>0.00</td><td>0.00</td></thu<>	67 37	n.	2	0.0	14	114	0.00	0.00
Delta value calculations           % Width         Act. Chn.         Lower         Upper         V-lower         V-upper         V-in         Alpha           20%         15.0         12.20         16.20         2.36         2.20         2.52         0.98           30%         21.0         20.20         25.20         2.51         2.39         2.46         0.92           40%         27.0         26.20         2.920         2.34         2.20         2.33         0.98           60%         33.0         32.20         35.20         2.34         2.27         2.35         0.97           60%         33.0         38.20         41.20         2.28         2.44         2.35         0.98           70%         45.0         44.20         47.20         2.27         2.07         2.22         1.03           80%         51.0         50.20         58.20         2.31         2.34         2.32         0.98	07.07		-	174.47		v	396.75	2.27
% Width         Act. Chn.         Lower         Upper         Viewer         Viewer         Viewer         Viewer         Viewer         Viewer         Viewer         Alpha           20%         15.0         12.20         15.20         238         230         232         0.98           30%         21.0         20.20         25.20         25.11         239         248         0.92           40%         27.0         26.20         29.20         234         240         233         0.98           50%         33.0         32.20         38.20         234         247         235         0.97           60%         39.0         38.20         41.20         277         235         0.98           70%         45.0         44.20         47.20         227         232         0.98           70%         45.0         44.20         47.20         231         234         232         0.98           70%         45.0         50.20         58.20         231         234         232         0.98				Jelfa mhre	calculation	4		
20%         15.0         12.20         16.20         2.36         2.30         2.32         0.98           30%         21.0         20.20         23.20         2.51         2.30         2.32         0.98           40%         27.0         26.20         23.20         2.51         2.30         2.46         0.92           40%         27.0         26.20         23.30         2.54         2.20         2.33         0.98           50%         33.0         32.20         35.20         2.34         2.27         2.35         0.97           60%         39.0         38.20         41.20         2.28         2.44         2.30         0.98           70%         45.0         44.20         47.20         2.28         2.44         2.30         0.98           70%         45.0         44.20         47.20         2.27         2.07         2.22         1.03           80%         51.0         50.20         58.20         2.31         2.34         2.32         0.98	% Width I	Act Chn I	l mover		Vilouna	Villoner	V.Jm	Alpha
30%         21.0         2020         23.0         2.61         2.29         2.46         0.92           40%         27.0         26.20         29.20         2.34         2.29         2.46         0.92           40%         27.0         26.20         29.20         2.34         2.29         2.46         0.92           60%         33.0         32.20         39.20         23.9         2.34         2.37         0.97           60%         39.0         38.20         41.20         2.28         2.44         2.30         0.98           70%         45.0         44.20         47.20         2.27         2.07         2.32         0.98           80%         51.0         50.20         58.20         2.31         2.34         2.32         0.98	20%	15.0	12.70	18 30	738	208	297	0.98
40%         27.0         2620         29.20         234         220         235         0.99           50%         33.0         3220         3520         234         227         235         0.99           50%         39.0         3220         3520         234         227         235         0.97           60%         39.0         3820         4120         228         244         230         0.98           70%         45.0         4420         4720         227         207         222         1.03           80%         51.0         50.20         5820         231         234         232         0.98	30%	21.0	20.70	29.30	2.64	220	2 49	0.92
50%         33.0         32.20         39.20         234         2.77         2.35         0.97           60%         39.0         38.20         41.20         2.28         2.44         2.30         0.98           70%         45.0         44.20         47.20         2.27         2.07         2.22         1.03           80%         51.0         50.20         53.20         2.31         2.34         2.32         0.98	40%	27.0	26.20	29.20	7 38	2.20	2 93	0.98
60%         39.0         38.20         41.20         2.28         2.44         2.30         0.98           70%         45.0         44.20         47.20         2.27         2.07         2.22         1.03           80%         51.0         50.20         53.20         2.31         2.34         2.32         0.98	50%	33.0	32 20	35.20	2.84	2 97	2 35	0.97
70%         45.0         44.20         47.20         2.27         2.67         2.22         1.03           80%         51.0         50.20         53.20         2.31         2.34         2.32         0.93	60%	39.0	38.20	41 20	2.78	2 44	2.33	0.98
80% 51.0 50.20 53.20 2.51 2.34 2.32 0.98	70%	45.0	44.20	47.20	2.27	2.07	222	1.03
	80%	51.0	50.20	53.20	231	2.34	2.32	0.98

Appendix H

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			Me	asured d	ata			
STA	TION No, :	C8H028			STAF	RT TIME :	09h30	
RIVE PLAC	R NAME : E NAME : DATE :	Wilge Bavaria 22/12/1975		Averag	e Gaugepla	ite reading :	4.135	m
					Main Cha	nnel LEFT :	3	
					Main Chanr		63	
			ie mein .	30				
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)
		depth			•	2.181	180.4	393,35
1	2	0		0		0.000	0.0	0.00
2	5	3.07		1.027		1.027	9.2	9.46
3	8	2.85		1.8121		1.812	8.6	15.49
4	11	3.03		1.9742		1.974	9.1	17.95
5	14	3		1.9657		1.966	9.0	17.69
6	17	3.01		2.179		2.179	9.0	19.68
7	20	3.46		2,4606		2.461	10.4	25.54
8	23	3.08		2.5545		2.555	9.2	23.60
9	26	3.3		2.7337		2.734	9.9	27.06
10	29	2.66		2.6825		2.683	8.0	21.41
11	32	3.55		2.7422		2.742	10.7	29.20
12	35	3.19		2.563		2.563	9.6	24.53
13	38	3.4		2.4777		2.478	10.2	25.27
14	41	3,54		2,4691		2.469	10.6	26.22
15	44	3.08		2.6739		2.674	9.2	24./1
16	4/	2.81		2.8958		2.896	8.4	24.41
11	ວບ ເກ	3.4		2.1449		2.145	10.2	21.88
10	00 56	3.23		1.9401		1,940	9.1	10.00
19	50 50	2.09		0.7454		1.030	0,1	14.30
20	59	2,33		0.1404		0.145	7.0	0.48
41 22	04 65	0.08		0.1005		0.100	0.0	0.40
23	65.5	0.00		0		0.000	0.1	0.00
						2.181	180.4	393.35
								1
			C	elta value	calculation	IS		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	15.0	14.00	17.00	1.97	2.18	2.04	1.07
	30%	21.0	20.00	23.00	2.46	2.55	2.49	0.88
	40%	27.0	26.00	29.00	2.73	2.68	2.72	0.80
	50%	33.0	32.00	35.00	2.74	2.56	2.68	0.81
	60%	39.0	38.00	41.00	2.48	2.47	2.47	0.88
	70%	45.0	44.00	47.00	2.67	2.90	2.75	0.79
	80%	51.0	50.00	53.00	2.14	1.94	2.08	1.05

	Calo	culated o	lata, 1-dir	nensiona	al flow the	ory	
Manning	or Chezy	:	M			Q =	424.8
		Slope	0.0016			V <sub>AVR</sub> =	2.36
ourthoese	s coeff		Area cartur	tion factor	1		
Sith			Ctub	10011140101 1			
005							
U			U				
2	0.036		2	1			
0			0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	A	p	R	(m³/s)	Velocity
	depth						
2	0	2	0.0	2.5	0	0.00	0.00
5	3.07	2	9.2	3.0	3.07	21.62	2.35
8	2.85	2	8.6	3.0	2.85	19 10	2.23
11	3.03	2	9.1	3.0	3.03	21 15	2 33
14	3	2	90	30	3	20.90	2.31
17	3 UI	4	30	30	3.01	20.92	2.32
20	3 40	2	10.4	50	0.40 9.04	20.36	2.34
23	3.00	2	9.2	20	3.00	41.73 97.08	2.30
20	2.3	2	9.9	0.0	3.3	24.25	2.40
29	2.00	2	10.7	30	2.00	11 42	2.15
35	3.10	2	10.7	3.0	3.10	21 04 70 64	2.30
38	3.4	5	10.2	3.0	34	25.63	251
41	3.54	2	10.6	30	3 54	22.00	2.58
44	3.08	2	92	30	3.08	21.73	2.35
47	2 81	$\overline{2}$	84	30	281	18.65	2.21
50	3.4	2	10.2	3.0	3.4	25.63	2.51
53	3.23	2	9.7	3.0	3.23	23 63	2.43
56	2.69	2	8.7	3.0	2.89	19 55	2.25
59	2.53	2	76	3.0	2.53	15 66	2.06
62	1	2	3.0	3.0	1	2.33	1.11
65	0.08	2	0.1	1.8	0.08	0.03	0.21
0	0	2	00	03	0	0.00	0.00
			180.38			424.82	2.3
		ľ	Selta value	calculation	IS		
% Width	Act. Chn.	Lower	Upper	V-itwer	V-Upper	V-int	Alpha
20%	15.0	14.00	17.00	2.31	2.32	2.34	1.02
30%	21.0	20.00	23.00	2.54	2 36	2.48	0.95
40%	27.0	28 00	29.00	2.48	2.13	2.35	1.00
50%	33.0	32.00	35.00	2.59	2.41	2.53	0.93
60%	39.0	38 CO	41 0C	2.51	2.58	2.54	0.93
70%	45.0	44 00	47.00	2.35	2.21	231	1.02
80%	51.0	60 00	53.00	2.61	2.43	2.48	0.95

			Me	easured d	ata			
STA	TION No. :	C8H028			STA	RT TIME	09h00	
RIVE PLAC	R NAME : E NAME : DATE :	Wilge Bavaria 24/03/1976	1	Averag	e Gaugepli	ate reading :	4.33	m
					Main Cha	nnel LEFT	3	
				I	Main Chan	nel RIGHT :	63	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective.	0.2d	0.4d	0.Bd	(m/s)	(m²)	(m³/s)
		depth	024			2 291	182.0	416 83
1	2	0		0		0.000	0.0	0.00
2	5	3.11		1.4067		1.407	9.3	13.12
3	8	3.02		2.0041		2.004	9.1	18.16
4	11	3.12		2.1022		2.102	9.4	19,68
5	14	3.15		2.0681		2.068	9,5	19,54
6	17	3.13		2.3027		2.303	9.4	21.62
7	20	3,41		2.6825		2.683	10.2	27.44
8	23	3.65		2.5118		2.512	11.0	27.50
9	26	3.36		2.7081		2.708	10.1	27.30
10	29	2.52		3.1305		3.131	7.6	23.67
11	32	3.46		2.8019		2.802	10.4	29.08
12	35	3.3		2.4649		2.465	9.9	24.40
13	38	3.41		2.5289		2.529	10.2	25.87
14	41	3,49		2.5929		2.593	10.5	27.15
15	44	3.18		2,7507		2.751	9.5	26.24
16	47	3.16		2.7678		2.768	9.5	26.24
17	50	3.26		2.3283		2.328	9.8	22.77
18	53	2.97		1.9273		1.927	8.9	17.17
19	56	2.6		1.8462		1.846	7.8	14.40
20	59	2.45		0.7155		0.716	7.4	5.26
21	62	0.9		0.0785		0.079	2.7	0.21
22	65	0		0		0.000	0.0	0.00
						2.291	182.0	416.83
			15					
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	15.0	14.00	17.00	2.07	2.30	2,15	1.07
	30%	21.0	20.00	23.00	2.68	2.51	2.63	0.87
	40%	27.0	26.00	29.00	2.71	3.13	2.85	0.80
	50%	33.0	32.00	35.00	2.80	2,46	2.69	0.85
	60%	39.0	38.00	41.00	2.63	2.59	2.55	0.90
	70%	45.0	44.00	47.00	2.75	2.77	2.76	0.83
	80%	51.0	50.00	53.00	2.33	1.93	2.19	1.04

£

	Cale	culated o	lata, 1-dir	nensiona	I flow the	ory	
lanning	or Chezy	<i>I</i> :	M			Q =	445.1
		Slope	0.0016			V <sub>AVR</sub> =	2.45
oughness	coeff		Area reduc	tion factor			
Sub	n		Sub	f,			
0			0	1			
2	0.035		2	1			
0			0	1			
Chaimage	Vertical	Sub	Area	Wetter P	H-Radeus	Ø	V
					0	(m <sup>3</sup> /s)	Matanat
	or enective	Decida		ł	A.	(1	vencony
2	Septi O	2	00	25	0	0.00	0.00
5	3.11	2	93	3.0	3.11	22.72	2.43
8	3.02	2	9.1	3.0	3.02	21.63	2.39
11	3.12	2	9.4	3,0	3.12	22.84	2.44
14	3.15	2	9.5	3.0	3.15	23 21	2.46
17	3.13	2	9.4	3.0	3.13	22 96	2 45
20	3.41	2	10.2	3.0	3.41	26.49	2.59
23	3 65	2	11 0	30	3.65	29.57	2.71
26	3 36	2	10.1	30	3.36	25.84	2.56
29	2.52	2	7.6	3.0	2.52	16,00	2.12
32	3.46	2	10.4	3.0	3.46	27 14	2.61
35	33	2	9.9	3.0	3.3	25 08	2.53
38	3.41	2	10.2	3.0	3.41	26 49	2 59
41	3 49	2	10.5	3.0	3.49	27 53	2.63
44	3.18	2	95	3.0	3.18	22.58	2.47
47	3 16	2	95	30	3.16	23.53	2.46
50	3.26	2	8.8	30	3.26	24.57	2.51
53	2.97	2	8.9	30	2.97	21.04	2.36
50	20	2	6.1 7.6	3.0	2.6	19.86	2.16
29	4.40	4	7.4	2.0	2.40	1921	200
02 65	U 9 n	2	2/	3.U 4 E	0.a D	4.00 0.00	200
001		-	404 02	1.9	•	446.14	• • • •
			10 1.00				<b>++</b> + <b>+</b>
			Jella value.	alculation	s		
6 Width	Act Chn.	Lower	Upper	V-lower	v Upper	V-Int	Alpha
20%	15.0	14 00	17.00	2.46	2.45	2.45	1.00
30%	21.0	20.00	23.00	2.59	2.71	2.53	0.93
40%	27.0	26.00	29.00	2.56	2.12	2.41	1.01
50%	33.0	32,00	35.00	261	2.53	2.59	0.95
60%	39.0	38.00	41.00	2.59	2.63	2.60	0.94
70%	45.0	44.00	47.00	2.47	2.46	2.47	0.99
80%	510	50:00	53.00	251	2.36	2.46	0.93

			Me	asured d	ata			
STA	TION No. :	C8H028			STA	RT TIME	15h30	
RIVE PLAC	R NAME : E NAME : DATE :	Wilge Bavaria 23/03/1976		Averag	e Gaugepli	ate reading :	472	m
	2/112 1				Main Cha	nnel LEFT :	3	
					Main Chan		63	
							- 00	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velacity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				2.488	192.9	480.03
1	0	0		0		0.000	0.0	0.00
2	5.2	3.235		1.4281		1.428	13.3	18.94
3	8.2	3.26		2.0809		2.081	9.8	20.35
4	11.2	3.383		2.3155		2.316	10.1	23.50
5	14.2	3.303		2.4862		2.486	9.9	24.64
6	17.2	3,349		2.5843		2.584	10.0	25.96
7	20.2	3.429		2.8745		2.875	10.3	29.57
8	23.2	3.456		2.6611		2.661	10,4	27.59
9	26.2	3.237		2.9854		2.985	9.7	28.99
10	29.2	2.46		3.1305		3.131	7.4	23.10
11	32.2	3.31		3.1774		3.177	9.9	31.55
12	35.2	3.27		2.883		2.883	9.8	28.28
13	38.2	3.407		2.8275		2.828	10.2	28.90
14	41.2	3,569		2,9513		2.951	10.7	31.60
15	44.2	2.886		2.9641		2.964	8.7	25.66
16	47.2	3.377		3.1987		3.199	10.1	32.41
17	50.2	3.263		2.6227		2.623	9.8	25.67
18	53.2	3.219		2.3539		2.354	9.7	22.73
19	56.2	2.916		2.3027		2.303	8.7	20.14
20	59.2	2.522		1.0697		1.070	7.6	8.09
21	62.2	1.697		0.3443		0.344	6.8	2.34
22	67.2	0		0		0.000	0.0	0.00
						2.488	192.9	480.03
			F	)elta value	calculatio	1\$		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	15.0	14 20	17.20	2.49	2.58	2.51	0.99
	30%	21.0	20.20	23 20	2.87	2.66	2.82	0.88
	40%	27.0	26 20	29 20	2.99	3.13	3.02	0.82
	50%	33.0	32.20	35.20	3.18	2.88	3.10	0,80
	60%	39.0	38.20	41.20	2.83	2.95	2.86	0.87
	70%	45.0	44.20	47.20	2.96	3 20	3.03	0.82
	80%	51.0	50.20	53.20	2.62	2.35	2.55	0.98

Calculated data, 1-dimensional flow theory											
Manning	or Chezy	r:	M			Q =	475.3				
		Slope	0.0016			V <sub>AVR</sub> =	2.46				
<b>9</b>					1						
voogamess	coen.		Area reduc	non lactor							
Sub	n		Sub	<u> </u>							
0			0	1							
2	0.035		2	1							
0			0	1							
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V				
	or officer up	Section		q	R	(m <sup>2</sup> /s)	Velocity				
	death	Gatha									
n	n interest	2	0.0	0.0	0	6.02	0.00				
5 2	2 200	5	13.3	41	9 235	31.65	250				
82	3.24	2	0.8	30	3.26	74.67	2.61				
11 2	7 387	2	10.1	30	7 183	76.14	2.58				
14 2	3 303	5	9.0	30	3 303	25.12	2.53				
17.2	3 349	5	100	30	3 349	25.70	2 56				
20.2	3 4 29	2	10.3	30	3 429	26.73	2.60				
23.2	3 456	2	10.4	30	3 456	27.09	2.61				
26.2	3 237	5	87	30	3 2 3 7	24.29	2.50				
29.2	246	2	74	30	2.46	15.27	2.08				
32.2	3.31	2	9.9	3.0	3.31	25.21	2.54				
35.2	3.27	2	98	3.0	3 27	24 70	2.52				
38.2	3.407	2	10.2	3.0	3.407	26 45	2.59				
41.2	3 569	2	10.7	30	3.569	26 58	2.67				
44.2	2 886	2	87	30	2.686	20.06	2.32				
47.2	3 377	2	10.1	30	3.377	26.06	2.57				
50.2	3.263	2	9.8	3.0	3 263	24.61	2.51				
53.2	3.219	2	9.7	3.0	3 2 1 9	24.06	2.49				
56.2	2.916	2	8.7	3,0	2 916	20.41	2.33				
59.2	2.522	2	7.6	3.0	2 522	16 02	2 12				
62.2	1.697	2	6.8	4.0	1.697	11 04	1 63				
67.2	0	2	G.0	2.5	0	0.00	0.00				
			192.90			475.35	2.46				
		r	elta value o	calculation	15						
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Alpha				
20%	15.0	14.20	17.20	2.60	2.58	2.54	0.97				
30%	21.0	20.20	23.20	2.60	2.61	2.60	0.95				
40%	27.0	26.20	29.20	2.50	2.08	2.39	1.03				
50%	33.0	32.20	36.20	2.54	2.62	2.62	0.97				
60%	39.0	38.20	41 20	2.59	2.67	2.61	0.94				
70%	45.0	44 20	47.20	2.32	2.57	2.38	1.03				
80%	51.0	50 20	53.20	2.51	2.49	2.51	0.98				

			Me	asured da	ata			
STA RIVE PLAC	TION No. : R NAME : E NAME : DATE :	C8H028 Wilge Bavaria 23/03/1976		Averag	09h00 4.915	m		
					Main Cha	nnel LEFT :	3	
				1	Main Chan	nel RIGHT :	63	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	6 7 A	0.44	n sə	(m/e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		deeth	0.20	0.40	u.uu	(1103)	400.5	EOF 45
	A	deptri		0		2.033	199.9	040.10
2	50	3 000		1 0730		1.000	127	12 64
4	82	3.059		20425		20/4	12.7	20.50
3	11.2	3 468		2 4170		2.040	10.1	20.09
5	14.2	3 427		2 5801		2 580	10.4	20.10
6	17.2	3 426		2 5971		2.597	10.3	26.69
7	20.2	3 525		2 8318		2.832	10.0	20,05
8	23.2	3 557		3 2755		3 276	10.0	34 05
q	26.2	3 465		3 1347		3 1 3 5	10.4	32.50
10	29.2	2 568		3 0494		3 049	77	23.40
11	32.2	3 398		3 395		3 395	10.2	34.61
12	35.2	3 391		3.0622		3.062	10.2	31 15
13	38.2	3 488		3 0835		3.084	10.5	32 27
14	41.2	3 664		3 1987		3 199	11.0	35.16
15	44.2	2,978		3.1433		3.143	8.9	28.08
16	47.2	3.393		3.3822		3.382	10.2	34.43
17	50.2	3.384		2.9555		2.956	10.2	30.00
18	53.2	3.307		2.6057		2.606	9.9	25.85
19	56.2	3.05		2.5118		2.512	9.2	22.98
20	59.2	2.677		1.5987		1.599	8.0	12.84
21	62.2	1.874		0.5705		0.571	5. <b>6</b>	3.21
22	65.2	0.863		0.3827		0.383	2.6	0.98
23	68.15	0		0		0.000	0.0	0.00
						2.633	199.5	525.15
			F	)elta value :		16		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V+Upper	V-Int	Deita
	20%	15.0	14 20	17.20	2 58	2 60	2.58	1.02
	30%	21.0	20.20	23.20	2.83	3,28	2.95	0.89
	40%	27.0	26.20	29.20	3 13	3 05	311	0.85
	50%	33.0	32.20	35.20	3.40	3.06	3.31	0.80
	60%	39.0	38 20	41.20	3.08	3.20	3.11	0.85
	70%	45.0	44.20	47.20	3.14	3.38	3.21	0.82
	80%	51.0	50.20	53.20	2.96	2.61	2.86	0.92

Calculated data, 1-dimensional flow theory										
Manning	or Chezy	r.	M			Q =	528.4			
		Slope	0.0016			V <sub>AVR</sub> =	2.65			
-					•					
Roughness	coeff		Area reduc	ion factor						
Sub	n		Sub	l <sub>A</sub>						
0			0	1						
2	0.033		2	1						
0			0	1						
Chanane	Vettical	Sub	Aless	Wetted P	H-Radius.	Q	l v			
	-			-		(m <sup>3</sup> /s)				
	deoth	Section	A	£	Я	(111 / 34)	velocity			
0	0	2	0.0	0.0	0	0.00	0.00			
5.2	3.099	2	12.7	41	3 099	32 74	2 58			
8.2	3.36	2	10.1	3.0	3.36	27 41	2.72			
11.2	3 468	2	10.4	3.0	3.468	26.69	2.78			
14.2	3.427	2	10.3	3.0	3 427	28 33	2.76			
17.2	3.426	2	10 3	3.0	3 426	28 31	2.75			
20.2	3.525	2	10.6	3.0	3.525	29.69	2.81			
23.2	3 557	2	10.7	3.0	3.557	30.14	2.82			
26.2	3.465	2	10.4	3.0	3.465	28.85	2.78			
29.2	2.568	2	77	3.0	2 568	17.51	2.27			
32.2	3.398	2	10.2	3.0	3.398	27 93	2.74			
35.2	3.391	2	10.2	3.0	3.391	27.83	2.74			
38.2	3.488	2	10.5	3.0	3 488	29.17	2.79			
41.2	3.664	2	11 0	3.0	3 664	31.67	2.88			
44.2	2.978	2	8.9	3.0	2.978	22.42	2.51			
47.2	3 393	2	10.2	3.0	3.393	27.86	2.74			
50.2	3.384	2	10.2	3.0	3 384	27.74	2.73			
53.2	3.307	2	9.9	3.0	3 307	26.69	2.69			
56.2	3.05	2	9.2	3.0	3.05	23 33	2.55			
59.2	2.677	2	0.8	30	2.5//	18.77	2 34			
62.2	1.874	2	5.8	30	18/4	10.36	1.84			
65.2	0.863	2	26	30	0.863	2.82	1 10			
68.15		2	0.0	1.5	0	6:00	0.00			
			199.47			528.44	2.6			
			Delta value	calculation	S					
% Width	Accession	Lower	Upper	V-lower	V-Upper	Viint	Alpha			
20%	15.0	14 2G	17.20	2.76	2.75	2.76	0.96			
30%	21.0	20 20	23 20	2.81	2.82	2.81	0.94			
40%	27.0	26.20	29.20	2.78	2.27	2.64	1.00			
50%	33.0	32.20	35.20	2.74	2.74	2.74	0.97			
60%	39.0	38.20	41.20	2 79	2.88	2 81	0.94			
70%	45.9	44 20	47 20	2 51	2 74	2.57	1.03			
80%	51.0	50.20	53.20	2.73	2.69	2.72	0.97			













The values in the legend block describe measured discharge for the profile indicated

			Me	easured da	ata			
STA	TION No. :	C8H030			STA	RT TIME :	07h30	
RIVE	R NAME :	Wilge		Averag	e Gaugepl	ate reading :	3.1	m
PLAC	E NAME :	Kimberley		-				
	DATE :	24/01/1988						
					Main Cha	innel LEFT :	50	
				1	Main Chan	nel RIGHT :	120	
1	2	3	4	5	G	7	8	9
Vartical	Chainana	Vatical	Velocitu	Valocitu	Velocitu	Vavor	Area	<u> </u>
* Erucat	Granage	¥ EFEIGAI	VENCRY	VEIDERY	VEIDERY	V aver.	(m <sup>2</sup> )	(m <sup>3</sup> /c)
number		or effective	0.2d	0.4d	0.8d	(m/s)	(111-)	(111 /\$)
		depth				1.090	273.7	298.40
1	53	0		0		0.000	0.0	0.00
2	64.9	4.22		0.1327		0.133	35.7	4.73
3	69.9	4.96		0.447		0.447	24.8	11.09
4	74.9	5.37		1.1293		1.129	26.9	30.32
5	79.9	5.27		1.3417		1.342	26.4	35.35
6	84.9	5.29		1.502		1.502	26.5	39.73
7	89.9	5.27		1.671		1.671	26.4	44.03
8	94.9	5.31		1.6103		1.610	26.6	42.75
9	99.9	5.35		1.3417		1.342	26.8	35.89
10	104.9	4.81		1.2073		1.207	24.1	29.04
11	109.9	4.03		1.0903		1.090	20.2	21.97
12	114.9	2.27		0.358		0.358	9.8	3.49
13	118.5	0		0		0.000	0.0	0.00
14						0.000	0,0	0.00
						1.090	273.7	298,40
			1	Delta value o	alculation	AS		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	64.0	53.00	64.90	0.00	0,13	0.12	8.89
	30%	71.0	69.90	74.90	0.45	1.13	0.60	1.83
	40%	78.0	74.90	79.90	1.13	1.34	1.26	0.86
	50%	85.0	84.90	89.90	1.50	1.67	1.51	0.72
	60%	92.0	89.90	94.90	1.67	1.61	1.65	0.66
	70%	99.0	94.90	99.90	1.61	1,34	1,39	0.78
	80%	106.0	104.90	109.90	1.21	1.09	1.18	0.92

		Calculat	ed data,	1-dimens	ional flo	w theory		
	Manning	or Chezy	:	М			Q =	420.4
			Slope	0.00035			V <sub>AVR</sub> =	1.54
	Roughness	coeff		Area reduct	ion factor	1		
	Sub	n		Sub	fA			
	0			0	1			
	2	0.035		2	1			
	- 0			ō	1			
					,	Li Desture	0	1 1/
	Cranage	venca	500	Ales	AABITEO H	m-reactions		l v
нн		or effective	Sector	A	P	R	(m <sup>-</sup> /s)	Velocity
		depth						
100	53	0	2	0.0	32.5	0	0.00	0.00
95,78	64.9	4.22	2	35.7	8.5	4.22	49 77	1.40
95.04	69.9	4.96	2	24.8	5.0	4.96	38.55	1.55
94.63	74.9	5 37	2	26.9	5.0	5.37	44 01	1.64
94.73	79.9	5.27	2	26.4	5.0	5.27	42.65	1.62
94.71	84.9	5.29	2	26.5	5.0	5 29	42 92	1.62
94.73	89.9	5 27	2	26.4	5.0	5.27	42.65	1.62
94.69	94.9	5 31	2	26.6	5.0	5.31	43.19	1.63
94.65	99.9	5.35	2	26.8	5.0	5.35	4374	1.64
95.19	104.9	4.51	2	24.1	50	4.81	36.63	1.52
95.97	109.9	403	2	20.2	5.0	4.03	27.26	1.35
97.73	114.9	2.27	2	9.8	4.3	2.21	9.01	0.92
100	118.5	0	2	0.0	1.0	0	0.00	0.00
100	0	Ų	2	010	ψ.u			
				6/00/6			440.42	1.04
				Delta value	calculation	5		
	% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-inf	Deita
	20%	64.0	53.00	64.90	0.00	1.40	1.29	1.19
	30%	71.0	69.90	74.90	1.55	1.64	1 57	0.98
	40%	78.0	74 90	79 90	1.64	1 62	1.63	0.94
	50%	85.0	84.90	69.90	1.62	1.62	1.62	0.95
	60%	92.0	89.90	94.90	1.62	1.63	1.62	0.95
	70%	99.0	94 90	99.90	1.63	1.64	1.63	0.94
	80%	106.0	104 90	109 90	1.52	1 35	1 49	1.03

	Measured data											
STA	TION No. :	C8H030			STAR	T TIME :	07h30					
RIVE PLAC	R NAME : E NAME : DATE	Wilge Kimberley 26/02/198	9	Average	e Gaugeplat	e reading :	3.9	m				
					Main Chan	nel I EET	50					
						. BUOLT						
				1	viain Chann	el RIGHI :	120					
1	2	3	4	5	6	7	8	9				
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q				
number		or effective	0.24	D 44	D 8H	(m/s)	(m²)	(m <sup>3</sup> /s)				
		depth	0.24	U. HU	0.04	1 234	334.4	412 57				
1	50	O	0	0.025	C	0.025	0.0	0.00				
2	55	1.44	0.044525		0.052675	0.049	7.2	0.35				
3	60	3.5	0.068975		0.093425	0.081	15.8	1.28				
4	64	4,79	0.193692		0.3196	0.257	19.2	4.92				
5	68	5,55	0.732058		0.844942	0.789	22.2	17.50				
6	72	5.76	0.9448		1.240033	1.092	20.2	22.02				
7	75	5.97	1.049		1.418042	1.234	17.9	22.09				
8	78	5.97	1.140175		1.57	1.355	17.9	24.27				
9	81	5.93	1.339892		1.617758	1.479	17.8	26.31				
10	84	6.16	1.474483		1,695908	1.585	18.5	29.29				
11	87	6.01	1.483167		1.791425	1.637	18.0	29.52				
12	90	0,90	1.921675		1.9347	1.928	17.9	34.42				
13	93	6.28	1.000833		1,999825	1.828	18.8	34.45				
14	90	0.10 E 00	1.0/4342		2.0000000	1.791	10.0	33.21				
10	98 102	6.22	1,040292		1.991142	1.770	71 1	33.02				
10	102	5.61	1 105442		1.578683	1 342	21.1	30.12				
18	110	4.96	1 235692		1 378967	1 307	19.8	25.94				
19	114	4 44	0 497608		0 732058	0.615	17.8	10.92				
20	118	1.48	0.211058		0.376042	0.294	4.8	1.41				
21	120.5	0	0	0.145	0	0.145	0.0	0.00				
22						0.000	0.0	0.00				
23						0.000	0.0	0.00				
24						0.000	0,0	0.00				
						1.234	334.4	412.57				
				olta valua	calculation							
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-int	Delta				
	20%	64.0	64.00	68.00	0.26	0.79	0.26	4.81				
	30%	71.0	68.00	72.00	0.79	1.09	1.02	1.21				
	40%	78.0	78.00	81.00	1.36	1.48	1.36	0.91				
	50%	85.0	84.00	87.00	1.59	1.64	1.60	0.77				
	60%	92.0	90.00	93.DO	1.93	1.83	1.86	0.66				
	70%	99.0	99.DQ	102.00	1.77	1.49	1.77	0.70				
	80%	106.0	106.00	110.00	1.34	1.31	1.34	0.92				

Calculated data, 1-dimensional flow theory										
	Manning	or Chez	y:	М			Q =	568.5		
			Sione	0.00035			VAVR =	1.70		
	Roughness	coeff		Area reduc	tion factor					
	Sub	n		Sub	fA					
	n			n	1					
	-	0.034		5						
		0.004		â						
				0			•			
	Chanage	Vettical	Sub	Atea	Watted P	H-Radius	ų	V		
нн		or effective	Section		q	R	(m²/s)	Velocity		
		depih								
100	50	Q	2	0.0	27.5	0	0 00	0.00		
98,56	55	1 44	2	72	50	1 44	5 05	070		
96.5	60 64	3.3	2	10.0	43	3 3 4 70	19/98 50 Ge	121		
90,21 Q4 45	04 68	8 55	5	75 7	4.0	5 55	28 80 28 90	1 72		
94 24	72	5 76	2	20 2	35	5 76	35.64	177		
94.03	75	5.97	2	179	30	5.97	32.43	1 81		
94.03	78	5.97	2	17.9	3.0	5.97	32 43	1 81		
94.07	81	5.93	2	17.8	3.0	5.93	32 07	1 80		
93.84	84	6.16	2	18.5	3.0	6.16	34 17	1 85		
93.99	87	6.01	2	18 G	30	6.01	32.7 <del>9</del>	182		
94.05	90	5.95	2	179	30	5.95	32.25	1 81		
93.72	93	0.20 6.19	2	10.0	30	0.20 6.19	50.29 97.24	1.0/		
03.02	90	6.22	2	18.7	30	6.22	94.79	186		
93.97	102	6.03	2	21.1	35	6.03	38 47	1.82		
94.39	106	5.61	2	22.4	4.0	5.61	38 98	174		
95.04	110	4.96	2	19.8	4.0	4.96	31 75	1 60		
95.56	114	4 44	2	178	40	4 44	25 40	1.49		
98.52	118	1.48	2	4.8	33	1.48	3 44	0.71		
100	120.5	Q	2	00	13	0	0 00	00.0		
		G	2	00	0.0	U	0 00	000		
		U C	2	00	00	0	0.00	0.00		
			4	23.4.4.4			568.48	170		
			2	elta value	calculation	15				
	% Width	Act Chn	Lawei	Upper	V-lower	Vilipper	V-int	Delta		
	20%	64.0	64 DC	68.00	1.56	1.72	1.56	1.09		
	30%	71.0	68.00	72.00	1.72	1.77	1.75	0.97		
	40%	78.0	76.00	81.00	1.81	1.80	1.81	0.94		
	50%	86.0	84.00	87.00	1.85	1.82	1.84	0.92		
	60%	92.0	90.00	93.00	1.81	1.87	1.85	0.92		
	90%	106.0	99.00	102.00	1.85	180	1.74	0.98		
			100.00	1						

STATION No.:         CBH030         START TIME         10h48           RIVER NAME         Wilge         Average Gaugeplate reading:         5.18         m           PLACE NAME         Kimberley DATE         25/02/1989         Main Channel LEFT         50           Main Channel LEFT         50         Main Channel RIGHT         120           1         2         3         4         5         6         7         8         9           Verical number         Varical         Velocity         Velocity         Velocity         Velocity         (m/s)         (m <sup>3</sup> )	Measured data											
RIVER NAME : Wilge         Average Gaugeplate reading : 5.18 m           PLACE NAME : Kimberley DATE : 25/02/1989           Main Channel LEFT : 50 Main Channel LEFT : 120           Main Channel LEFT : 50 Main Channel RIGHT : 120           1         2         3         4         5         6         7         8         9           Verical Velochy Velochy Velochy Velochy Velochy VaVer.         Area Q           0.0         0.0         0.0           0.0         0.0         0.0         0.0           To 0         0.0161         0.0022         0.018         0.0022           1.343         4.424         0.0032         0.018         0.0032           0.159         0.159         0.159         0.159           7.7.6         7.7.16         1.343         4.424           56.6         6.576         0.159         0.159         0.159         0.1510 </td <td>STA</td> <td>TION No.</td> <td>C8H030</td> <td></td> <td></td> <td>STAF</td> <td>RT TIME</td> <td>10h48</td> <td></td>	STA	TION No.	C8H030			STAF	RT TIME	10h48				
PLACE NAME         Kimberley DATE         25/02/1989           Main Channel LEFT         50 Main Channel LEFT         50 Main Channel LEFT         50 Main Channel LEFT           1         2         3         4         5         6         7         8         9           Vertical number         Vertical depth         Velocity         Velocity         Velocity         Velocity         Vare         Area         Q           1         47         0         0.0161         0.016         0.016         0.00         0.00           1         47         0         0.0161         0.016         0.016         0.00         0.00           3         57.6         4.424         0.0323         0.032         1.14         0.37         2.34         4.42           5         65.6         6.576         0.159         0.159         26.3         4.18           6         69.6         6.906         0.06365         0.637         2.76         1.743           9         79.6         7.132         1.598         1.540         2.15         3.14           11         24.6         7.22         1.8131         1.813         1.44         2.9.80           11	RIV/F		Milae		Averan	e Gaucenia	ite reading	5 18	-			
Proce Name : Annuerby DATE : 25/02/1999           Main Channel LEFT : 50           Main Channel RIGHT : 120           1         2         3         4         5         6         7         8         9           Vartical number         Vertical or effective 0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> /s)         (m <sup>3</sup> /s)           1         47         0         0.0161         0.016         0.0016         0.0022         1.343         412.6         5564.22           1         47         0         0.0161         0.016         0.002         1.143         412.6         5564.22           1         47         0         0.0161         0.016         0.002         1.143         412.6         5564.22           1         47         0         0.0161         0.016         0.00         0.002           2         53.6         2.146         0.0486         0.049         1.77         0.86           4         61.6         5.84         0.1594         0.159         2.34         4.42           5         65.6         6.578         0.1594         0.159         2.33         1.43           1         7.276         1.759			Kinskadav		Aiciay	e Gaugepia	ite reading .	5.10	44			
Main Channel LEFT         50 Main Channel RIGHT         120           1         2         3         4         5         6         7         8         9           Vertical number         Or affective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> )s)           1         47         0         0.0161         0.016         0.016         0.016         0.016         0.0161         0.016         0.0161         0.016         0.0161         0.016         0.0161         0.016         0.0161         0.016         0.0161         0.016         0.0161 <td>FLAC</td> <td>DATE -</td> <td>Cimberley</td> <td><b>.</b></td> <td></td> <td></td> <td></td> <td></td> <td></td>	FLAC	DATE -	Cimberley	<b>.</b>								
Main Channel RIGHT:         50           Main Channel RIGHT:         120           Vertical number         Vertical or effective         Velocity         Velocity         Valocity         Valo		DATE .	23/02/190	9								
Main Channel RIGHT         120           1         2         3         4         5         6         7         8         9           Vartical         Or affective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           number         or affective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         47         0         0.0161         0.016         0.0016         0.0016         0.00         0.0016           2         53.6         2.146         0.0323         0.032         11.4         0.37           3         57.6         4.424         0.0486         0.049         17.7         0.86           4         61.6         5.84         0.159         0.637         27.6         1.759           7.36         7.216         1.2444         1.2444         1.244         1.244         1.53         3.143           6         69.6         6.908         0.6365         0.637         21.4         35.45           10         82.6         7.321         1.6568         1.567         21.4         35.45           11         34.6						Main Cha	nnel LEFT :	50				
1         2         3         4         5         6         7         8         9           umber         or effective depth         0.2d         0.4d         0.8d         (m's)         (m <sup>3</sup> )         (m <sup>3</sup> )s)           1         47         0         0.2d         0.4d         0.8d         (m's)         (m <sup>3</sup> )         (m <sup>3</sup> )s)           2         53.6         2.146         0.0161         0.016         0.0         0.00           2         53.6         2.148         0.0323         0.032         11.4         0.37           3         57.6         4.424         0.0496         0.199         23.4         4.42           5         65.6         6.578         0.159         0.159         26.3         4.18           6         69.6         6.068         0.6365         0.637         27.6         17.59           7         73.5         7.216         1.2444         1.2444         1.244         25.3         3.143           8         76.6         7.171         1.5396         1.657         21.4         35.45           10         82.6         7.26         1.8131         1.813         1.44         26.11						Main Chanı	nel RIGHT :	120				
1         2         3         4         5         6         7         8         9           Vertical         Vertical         Velocity         Velocity         Velocity         Velocity         Valuer.         Area         0           number         or effective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         47         0         0.0161         0.016         0.0         0.000           2         53.6         2.146         0.0323         0.032         1.14         0.37           3         57.6         4.424         0.0486         0.049         17.7         0.86           4         61.6         5.84         0.1894         0.189         23.4         4.42           5         65.6         6.576         0.159         0.637         27.6         17.59           7.3.6         7.216         1.2444         1.244         1.244         53.31.2         31.43           8         76.6         7.132         1.6568         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.657         21.4         29.215         2												
Vertical number         Chanage or effective depth         Velocity         Velocity         Velocity         Velocity         Valuer, 0.8d         Area (m/s)         Q           1         47         0         0.0161         0.016         0.00         0.002           2         53.6         2.146         0.0323         0.032         1.1.343         412.6         554.22           1         47         0         0.0161         0.016         0.0         0.001           2         53.6         2.146         0.0323         0.032         1.1.4         0.37           3         57.6         4.424         0.0496         0.199         23.4         4.42           5         65.6         6.578         0.159         0.159         26.3         4.18           6         69.6         6.908         0.6365         0.637         27.6         17.59           7.3.6         7.216         1.2444         1.244         1.244         23.3         3.143           8         7.66         7.171         1.5396         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.657         21.4         32.70	1	2	3	4	5	6	7	8	9			
number         or effective depth         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         47         0         0.0161         0.016         0.016         0.0         0.002           2         53.6         2.146         0.0323         0.032         11.4         0.37           3         57.6         4.424         0.0486         0.049         17.7         0.86           4         61.6         5.84         0.1894         0.189         23.4         4.42           5         65.6         6.578         0.159         0.159         26.3         4.18           6         69.6         6.906         0.6385         0.637         27.6         17.59           7.7.5         7.216         1.2444         1.244         25.3         31.43           8         76.6         7.171         1.5396         1.540         21.5         33.14           10         82.6         7.321         1.6568         1.657         21.4         25.6         33.14           11         84.6         7.22         1.8131         1.813         1.44         26.11           12         86.6 <t< td=""><td>Vertical</td><td>Chainage</td><td>Vertical</td><td>Velocity</td><td>Velocity</td><td>Velocity</td><td>V aver.</td><td>Area</td><td>Q</td></t<>	Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q			
Initial depth         0.00         (Intrs)				0.24			(ma /a)	(m <sup>2</sup> )	$(m^{3}/s)$			
Image         Image <thimage< th="">         Image         <thi< td=""><td>number</td><td></td><td>or enecave</td><td>0.20</td><td>U.40</td><td>0,80</td><td>(m/s)</td><td>(11)</td><td>(11176)</td></thi<></thimage<>	number		or enecave	0.20	U.40	0,80	(m/s)	(11)	(11176)			
1       44       0       0.0181       0.032       11.4       0.37         3       57.6       4.424       0.0486       0.049       17.7       0.86         4       61.6       5.84       0.159       0.159       26.3       4.18         5       65.6       6.578       0.159       0.637       27.6       17.59         7       73.6       7.216       1.2444       1.244       25.3       31.43         8       76.6       7.171       1.5396       1.540       21.5       33.14         9       79.6       7.132       1.6568       1.657       21.4       35.45         10       82.6       7.381       1.7958       1.796       18.5       33.14         11       84.6       7.2       1.8131       1.813       14.4       26.11         12       86.6       7.26       1.9043       1.904       14.5       27.65         13       88.6       7.186       2.0736       2.074       14.4       29.80         14       90.6       7.492       2.1622       2.182       2.182       5.12.0       32.70         15       92.6       7.481       2.1952		47	depth		0.0464		1.343	412.6	554.22			
2         0.020         1.14         0.0320         1.14         0.039           3         57.6         4.424         0.0496         0.049         17.7         0.86           4         61.6         5.84         0.1894         0.189         23.4         4.42           5         65.6         6.578         0.159         0.159         26.3         4.18           6         69.6         6.908         0.6365         0.637         27.6         17.79           7         73.6         7.121         1.5396         1.540         21.5         33.12           9         79.6         7.132         1.6568         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.796         18.5         33.14           11         84.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8	2	4/ 52 B	2146		0.0101		0.010	11 4	0.00			
3         3         3         3         4         6         5         6         7         7         3         6         9         6         6         90         6         6         90         6         90         6         90         7         7         6         7         7         6         7         7         6         7         7         6         7         7         6         7         7         6         7         7         6         7         7         6         7         7         1         1         5         9         7         6         7         1         1         5         9         7         6         7         7         1         1         5         3         1         1         3         1         3         3         1         3         3         1         3         3         1         1         3         3         1         1         3         3         1         1         3         3         1         1         1         1         1         1         1         1         1         1         1 <th1< th="">         1         1         1</th1<>	4	57.6	4 424		0.0323		0.032	11.4	0.37			
5         65.6         6.576         0.159         0.159         0.159         2.63         4.18           6         69.6         6.908         0.6365         0.637         27.6         17.59           7         73.6         7.216         1.2444         1.244         25.3         31.43           8         76.6         7.171         1.5396         1.540         21.5         33.12           9         79.6         7.132         1.6568         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.796         18.5         33.14           11         84.6         7.22         1.8131         1.813         14.4         26.11           12         86.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1622         2.182         1.50         32.70           15         92.6         7.481         2.1952         2.095         15.0         31.20           17         96.6         7.477         2.0667 </td <td>4</td> <td>61.6</td> <td>5.84</td> <td></td> <td>0.0400</td> <td></td> <td>0.049</td> <td>22 4</td> <td>4 47</td>	4	61.6	5.84		0.0400		0.049	22 4	4 47			
6         60.0         6.00         0.	5	65.6	6 578		0.1034		0.169	20.4	4.42			
0         0.000         0.0	6	69.6	6 908		0.135		0.153	20.3	17.50			
8         76.6         7.171         1.5396         1.540         21.5         33.12           9         79.6         7.132         1.6568         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.796         18.5         33.14           11         84.6         7.2         1.8131         1.813         14.4         26.11           12         86.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1622         2.182         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0687         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           20         103.6         6.874         1.6395         1.	7	73.6	7 216		1 2444		1 244	27.0	31 43			
9         79.6         7.132         1.6568         1.657         21.4         35.45           10         82.6         7.381         1.7958         1.796         18.5         33.14           11         84.6         7.2         1.8131         1.813         14.4         26.11           12         86.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         15.0         32.70           15         92.6         7.481         2.1952         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.067         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.640         20.63         33.81           21         106.6         6.367         1.4788 <td< td=""><td>8</td><td>76.6</td><td>7 171</td><td></td><td>1 5396</td><td></td><td>1 540</td><td>21.5</td><td>33 12</td></td<>	8	76.6	7 171		1 5396		1 540	21.5	33 12			
0         82.6         7.381         1.7958         1.7968         1.796         1.8.5         33.14           11         84.6         7.2         1.8131         1.813         1.4.4         26.11           12         86.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         2.182         1.50         32.70           15         92.6         7.481         2.1952         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         <	9	79.6	7 132		1 6568		1 657	21.0	35.45			
11         84.6         7.2         1.8131         1.813         14.4         26.11           12         86.6         7.26         1.9043         1.904         14.5         27.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         1.50         32.70           15         92.6         7.481         2.1952         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.067         15.0         31.20           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         5.854         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588	10	82.6	7.381		1 7958		1 796	18.5	33.14			
12         86.6         7.26         1.9043         1.904         1.4         2.7.65           13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         15.0         32.70           15         92.6         7.481         2.1952         2.182         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         5.854         1.02373         1.024         16.4         16.79           22         110.6         5.854         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588	11	84.6	7.2		1.8131		1 813	14 4	26 11			
13         88.6         7.186         2.0736         2.074         14.4         29.80           14         90.6         7.492         2.1822         2.182         15.0         32.70           15         92.6         7.481         2.1952         2.182         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.067         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32            1.446         5.60	12	86.6	7.26		1.9043		1 904	14.5	27.65			
14         90.6         7.492         2.1822         2.182         15.0         32.70           15         92.6         7.481         2.1952         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         10.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.02373         1.024         16.4         16.79           24         119.5         0.451         0.2588         0.259         1.2         0.32           Vidue Act.Chn         Ch-Upper         V-Upper         V-Int         Delta           20%         64.0         61.60         6560         0.19	13	88.6	7,186		2.0736		2.074	14.4	29.80			
15         92.6         7.481         2.1952         2.195         15.0         32.84           16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4786         1.679         22.3         32.95           22         110.6         5.854         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Velocita value calculation           Value calculation           Velocita value calculation           Velocita value calculation           Velocita value calculation           Velocita value calculation	14	90.6	7.492		2.1822		2.182	15.0	32.70			
16         94.6         7.393         2.2039         2.204         14.8         32.59           17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4786         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Velocitations           Velocitations           Velocitations           Velocitations           Velocitations           Velocitations           Velocitations <td< td=""><td>15</td><td>92.6</td><td>7.481</td><td></td><td>2.1952</td><td></td><td>2.195</td><td>15.0</td><td>32.84</td></td<>	15	92.6	7.481		2.1952		2.195	15.0	32.84			
17         96.6         7.477         2.0867         2.087         15.0         31.20           18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Velocitations           V         Vitt         Delta           Velocitations           V         Vitt         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.69	16	94.6	7.393		2.2039		2.204	14.8	32.59			
18         98.6         7.331         1.9738         1.974         14.7         28.94           19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Verse value calculations	17	96.6	7.477		2.0867		2.087	15.0	31.20			
19         100.6         7.207         1.6916         1.692         18.0         30.48           20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Velocity 119.6         0.451         Older State         Velocity         Velocity         Velocity         0.35           Velocity 119.6         0.451         0.2588         0.259         1.2         0.32           Velocity 119.6         0.451         0.616         65.60         0.19         0.16         0.17         7.85           Velocity 119.6         0.64         65.60         0.19         0.16         0.64         1.58           Velocity 12.9         0.61         0.64         0.660         1.81         1.80         1	18	98.6	7.331		1.9738		1.974	14.7	28.94			
20         103.6         6.874         1.6395         1.640         20.6         33.81           21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           I.343         412.6         554.22           Volume calculations           Veloper         V-int         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.54         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.69         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.	19	100.6	7.207		1.6916		1.692	18.0	30.48			
21         106.6         6.367         1.4788         1.479         22.3         32.95           22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           I.343         412.6         554.22           Velocatulations           Veloper         V-int         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.59         0.84           50%	20	103.6	6.874		1.6395		1.640	20.6	33.81			
22         110.6         5.854         1.6004         1.600         23.4         37.47           23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           Image: Second Seco	21	106.6	6.367		1.4788		1.479	22.3	32.95			
23         114.6         3.645         1.02373         1.024         16.4         16.79           24         119.6         0.451         0.2588         0.259         1.2         0.32           1.343         412.6         554.22           Use the value calculations           % Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-int         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.69         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.64 </td <td>22</td> <td>110.6</td> <td>5.854</td> <td></td> <td>1.6004</td> <td></td> <td>1.600</td> <td>23.4</td> <td>37.47</td>	22	110.6	5.854		1.6004		1.600	23.4	37.47			
24         119.6         0.451         0.2588         0.259         1.2         0.32           1.343         412.6         554.22           Delfa value calculations           % Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-unt         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.69         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.64         1.48         1.51         0.89	23	114.6	3.645		1.02373		1.024	16.4	16.79			
Image: Non-State State         Image: Non-State         Image: Non-Stat	24	119.6	0.451		0.2588		0.259	1.2	0.32			
Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-upper         V-int         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.59         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.64         1.48         1.51         0.89							1.343	412.6	554.22			
% Width         Act. Chr.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-int         Delta           20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.54         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.59         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         100.60         1.97         1.69         1.92         0.61           70%         99.0         98.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.54         1.48         1.51         0.89					hatta value	aaloulati						
20%         64.0         61.60         65.60         0.19         0.16         0.17         7.85           30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.69         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.54         1.64         1.51         0.89		% Width	Act Chn	Ch-l ower	Children	Valower	Villoper	\/.let	Delta			
30%         71.0         69.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         73.60         0.64         1.24         0.85         1.58           40%         78.0         76.60         79.60         1.54         1.66         1.69         0.84           50%         85.0         84.60         86.60         1.81         1.90         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.54         1.48         1.51         0.89		20%	64.0	61.60	65.60	0.10	0.16	0.17	7 85			
40%         78.0         76.60         79.60         1.54         1.66         1.66         0.84           50%         85.0         84.60         86.60         1.81         1.60         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         93.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.54         1.48         1.51         0.89		30%	71.0	69.60	73.60	0.64	1 24	0.85	1 58			
50%         85.0         84.60         86.60         1.81         1.60         1.83         0.73           60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         98.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.54         1.48         1.51         0.89		40%	78.0	76.60	79.60	1.54	1.66	1.59	0.84			
60%         92.0         90.60         92.60         2.18         2.20         2.19         0.61           70%         99.0         98.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.64         1.48         1.51         0.89		50%	85.0	84 60	86 60	1.81	1.90	1.83	0.73			
70%         99.0         98.60         100.60         1.97         1.69         1.92         0.70           80%         106.0         103.60         106.60         1.64         1.48         1.51         0.89		60%	92.0	90 60	92 60	2.18	2.20	2 19	0.61			
80% 106.0 103.60 106.60 1.64 1.46 1.51 0.89		70%	99.0	98.60	100.60	1.97	1.69	1.92	0,70			
		80%	106.0	103.60	106.60	1.64	1.48	1.51	0.89			

Calculated data, 1-dimensional flow theory										
	Manning	or Chez	y:	Μ			Q =	778.3		
			Sime	0.00038			V <sub>AVR</sub> =	1.89		
	Roughness	coeff		Area reduct	tion factor					
	Sub	n		Sub	fa					
	0			0	1					
		0.036		5						
	4	0,036		~						
	U			U	1					
	Chamage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V		
H#4		or effective	Section	A	Р	R	(m²/s)	Velocity		
		depth								
100	0	0	2	0.0	26.8	0	0.00	00.0		
96,765	5.2	2.146	2	11.4	5.3	2.146	10.25	0.90		
96.74	8.2	4.424	2	17.7	40	4.424	25.82	1 46		
96.617	11.2	5.84	2	23.4	40	5.84	41.02	1 76		
96,697	14.2	6.5/8	2	26.3	40	6.578	50.02	190		
90,001	20.2	0.900	2	27.0	4.0	0.900	54.27	196		
90.571	20.2	7 174	2	20.5	20	7 174	01.44 CC EN	202		
06 763	25.2	7 133	5	21.5	20	7 133	45.02	201		
07.54	20.2	7 391	5	19.5	50	7 394	42.00 97.00	2.01		
96.69	32.2	7 2	5	14.4	20	72	79.07	2.00		
96 73	35.2	7.26	2	14.5	20	7 26	75 AR	2.03		
96 593	38.2	7 186	2	14 4	20	7 186	28.96	2 02		
96 431	41.2	7 492	2	15.0	20	7 492	31.07	2.07		
97.114	44.2	7.481	2	15.0	2.0	7.481	30.99	2 07		
96,623	47.2	7.393	2	14.8	2.0	7.393	30.38	2.05		
96,737	50.2	7 477	2	15.0	2.0	7.477	30.96	2.07		
96,781	53.2	7 331	2	14.7	2.0	7.331	29.96	2.04		
97.084	56.2	7.207	2	18.0	2.5	7.207	36.40	2 02		
97.478	59.2	6.874	2	20.6	3.0	6.874	40.37	1 96		
98.303	62.2	6.367	2	22.3	3.5	6.367	41.45	1 86		
100	67.2	5.854	2	23.4	4.0	5.854	41.18	1 76		
		3.645	2	16.4	4.5	3.645	21.04	1 28		
		0.451	2	1.2	2.8	0.451	0.39	0.92		
				412.61			778.31	1.89		
				alta velve	en leu latier	ur.				
	V. Wilden	Act Chr.	L	ATTO ASTOR	Calcuador Michael	Nel Instat	V.brt	Delta		
	20%	SA C	an on	67.26	1.42		1.1	1.03		
	30%	71.0	67.20	0.00	1.76	1.28	1.79	1.06		
	40%	78.0	67.20	0.00	1 76	1.28	1.84	1.03		
	50%	85.0	67 20	0.00	176	1.28	1.89	1.00		
	60%	92.0	67 20	0.00	176	1.28	1.93	0.98		
	70%	99.0	67 20	0.00	176	1 28	1 98	0.95		
	80%	106.0	67 20	0.00	1 78	1.28	2.03	0.93		

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1			Me	asured d	ata			
STA RIVE PLAC	TION No. : R NAME : E NAME : DATE :	C8H030 Wilge Kimberley 18/02/1989	)	Averag	STAR e Gaugeplat	T TIME te reading :	08h00 6.456	m
					Main Char	inel LEFT :	50	
				I	Main Chann	el RIGHT :	120	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.24	0.44	0.84	(m/s)	(m²)	(m³/s)
, indirect		depth	0.20	4.44	0.04	1 433	515 8	739 11
1	42.9	0	0	0.092	0	0.092	0.0	0.00
2	55	3.54	0.035887		0.332967	0.184	28.5	5.26
3	59	6.49	0.13325		0.28955	0.211	26.0	5.49
4	63	7.07	0.254817		0.4719	0.363	28.3	10.28
5	67	7.83	0.506633		0.567417	0.537	31.3	16.82
6 7	/1 75	8.31	1.166567		1.114467	1.141	33.2	37.91
7 8	70 70	8.09 8.488	1 013333		1.401017	1,000	34.4	52.76
9	73 83	8 664	2 052267		1 757033	1.090	34.7	66.01
10	87	8.57	2.156467		2.0349	2.096	34.3	71.84
11	91	8.838	1.974117		2.225933	2.100	35.4	74.24
12	95	8.772	2.052267		2.2433	2.148	35.1	75.36
13	99	8.644	1.59205		2.261	1.927	34.6	66.61
14	103	8.256	1.791767		2.11305	1.952	33.0	64.48
15	107	7.638	1.59205		1.9828	1.787	30.6	54.61
10	111	/ 116	1.392		1.600/33	1.496	28.5	42.59
18	110	2.92	0.559733		0 7/0767	0.654	20.0	32.30 1 GD
19	121.9	2.10	0.0001.00	0 327	0.740707	0.327	0.0	0.00
20		-	-		-	0.000	0.0	0.00
21						0.000	0.0	0.00
22						0.000	0.0	0.00
23						0.000	0.0	0.00
24						0.000	0.0	0.00
						1.433	515.8	739.11
			מ	elta value	calculation	15		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	64.0	63.00	67.00	0.36	0,54	0.41	3,52
	30%	71.0	71.00	75 00	1.14	1.54	1.14	1.26
	40%	78.0	75.00	79.00	1.54	1.70	1.66	0,87
	50%	85,0	83.00	87.00	1.90	2.10	2.00	0.72
	60%	92.0	91.00	95.00	2.10	2.15	2.11	0,68
	70%	99.0	99.00	103.00	1.93	1.95	1.93	0,74
	80%	106.0	103.00	107.00	1.95	1,79	1.83	0.78

		Calculate	ed data,	1-dimens	sional flo	w theory		
	Manning	or Chez	y:	M			Q =	1025.2
			Sime	0.00035			$V_{AVR} =$	1.99
	Roughness	coeff		Area reduc	tion factor			
	Sub	n		Sub	f.			
	2	0.0365		2				
	Q			0	1			
	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
HHH		or effective	Section	A	Р	R	(m <sup>3</sup> /s)	Velocity
		decth						
100	42.9	0	2	0.0	27.5	0	0.00	0.00
96.46	55	3.54	2	28.5	8.1	3.54	33.93	1 19
93.51	59	6.49	2	26.0	4.0	6.49	45.30	1 78
92.93	63	7.07	2	28.3	4.0	7 07	53.39	1.88
92.17	67	7.83	2	31.3	4.0	7.83	63.30	2 02
91.69	71	8.31	2	33.2	4.0	8.31	69.90	2.10
91.41	/5	6.59	2	34.4	4.0	8.59	73.87	2.15
91,512	19	0.400	2	34.0	4.0	0.400	72.41	2 13 7 5g
01 /3	87	6.004 8.57	2	34 3	40	8 57	74.80 74.88	2.10
91 162	91	8 838	2	35.4	40	8 838	77.46	2 19
91,228	95	8.772	2	35.1	4.0	8.772	76.49	2 18
91.356	99	8.644	2	34.6	4.0	8.644	74 64	2 16
91.744	103	8.256	2	33.0	4.0	8.256	69.14	2.09
92.362	107	7.638	2	30.6	4.0	7.638	60.73	1 99
92.884	111	7 116	2	28.5	4.0	7.116	53.96	1 90
94.08	115	5.92	2	26.6	4.5	5.92	44.68	1 68
97.82	120	2.18	2	7.5	3.5	2.18	5.48	0.86
100	121.9	0	2	0.0	10	0	0.00	0.00
		0	2	0.0	0.0	0	0.00	0.00
		0	2	00	0.0	0	0.00	0.00
		0	5	0.0	0.0	0	0.00	0.00
		Ö	2	0.0	0.0	Ō	0.00	0.00
				515.76			1025.22	1.99
			2	eita value	calculation	15		
	% Width	Act. Chn.	Lower	Upper	v-iower	V-Upper	V-Int	Delta
	20%	64.0	63.00	67.00	189	2.02	192	1.03
	30%	71.0	71.00	75.00	2 10	2.15	2.10	0.95
	40%	78.0	75.00	79.00	2 15	2 13	2.14	0.93
	50%	80.0	83 00	87.00	216	4 15	415	0.92
	50%	92.0	90.44	33.00	218	4 10 2 60	2.19	0.01
	80%	106.0	103.00	107.00	210	199	201	0.99
	0U70			3	2.00			

			Me	asured d	lata						Calculate	ed data,	1-dimens	ional flo	w theory		
STA	TION No. :	C8H030		START TIME : 17h55 Average Gaugeplate reading : 7.18 m						Manning	or Chez	1:	М			Q =	1151.1
RIVE	R NAME :	Wilge		Averag	e Gaugeplal	le reading :	7.18	m				Slope	0.00035			V <sub>AVR</sub> =	1.94
PLAC	E NAME ;	Kimberley															
	DATE :	17/02/1988	)							Roughness	coeff		Area reduct	ion factor			
					Main Chan	inel LEFT :	50			Sub	n		Sub	f <sub>A</sub>			
					Main Chann	el RIGHT :	120			0			0	1			
										2	0.039		2	1			
1	2	3	4	5	6	7	8	9		0			G	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q		Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
number		or effective	D.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)	нн		or effective	Section	A	Р	R	(m <sup>3</sup> /s)	Velocity
		depth				1.390	592.7	823.77			clapth						
1	35	0	0	0.023	0	0.023	0.0	0.00	100	35	0	2	0.0	23.7	Q	0.00	0.00
2	47.4	2.983	0.027943		0.059717	0.044	30.4	1.33	97.017	47.4	2.983	2	30.4	10.2	2.983	30.25	0.99
3	55.4	4.596	0.035887		0.099433	0.068	29.9	2.02	95.404	55.4	4.596	2	29.9	6.5 # F	4.596	39.61	1 33
4 5	66 4	8.02	0.300917		0.437 107	0.372	44.1 47 Q	10.41	91.90	60.4 66.4	0.UZ 9.71	2	44.1	0.0 8 6	0.UZ 8.71	64 (6 63 30	192
6	71.4	9.19	1 3576		1 036317	1 197	46.0	55.00	90.81	71 4	9 19	2	48.0	50	9.19	96.71	210
7	76.4	9,68	1.7223		1.270767	1.497	48.4	72.43	90.32	76.4	9.68	2	48.4	5.0	9.68	105.45	2.18
8	81.4	9.429	2.043583		1.713617	1.879	42.4	79.71	90.571	81.4	9.429	2	42.4	4.5	9.429	90.84	2.14
9	85.4	9.33	2.104367		1.817817	1.961	37.3	73.19	90.67	85.4	9.33	2	37.3	4.0	9.33	79.34	2.13
10	89.4	9,511	2.286717		2.225933	2.256	38.0	85.84	90.489	89.4	9.511	2	38.0	4.0	9.511	B1 92	2 15
11	93.4	9,469	2.1391		2.32145	2,230	37.9	84.47	90.531	93.4	9.469	2	37.9	4.0	9.469	81.32	2.15
12	102.4	9,430	1.974117		2.200/1/	2,130	42.5	90.40 70.08	90.565	97.4 102.4	020 S	2	42.0	4.0	0808	90.94	2 14
14	105.4	8 524	1 757033		2 095683	1 926	25.6	49.26	91 476	105.4	8 524	2	25.6	30	8 524	51 19	200
15	108.4	8.121	1.661517		2.087	1.874	28.4	53.27	91.879	108.4	8.121	2	28.4	3.5	8.121	55.09	1 94
16	112.4	7.527	1.791767		1.609417	1.701	30.1	51.20	92.473	112.4	7.527	2	30.1	4.0	7.527	55.47	1 84
17	116.4	5.51	0.60215		1.348917	0.976	19.3	18.81	94.49	116.4	5.51	2	19.3	3.5	5.51	28.86	1 50
18	119.4	2.76	0.567417		1.045	0.806	6.9	5.56	97.24	119.4	2.76	2	6.9	2.5	2.76	6 51	0 94
19	121.4	1.2	0	0.091	0	0.091	1.7	0.15	98.8	121.4	1.2	2	1.7	1.4	1.2	0.92	0.54
20	122.22	U	U	0.046	U	0.046	0.0	0.00	100	122.22	U O	2	0.0	0.4	S C	0.00	0.00
27						0.000	0.0	0.00			0	2	0.0	60	G	0.00	0.00
23						0.000	0.0	0.00			Ó	2	G.D	0.0	O	0.00	0.00
24						0.000	0.0	0.00			0	2	0.0	0.0	0	0.00	0.00
						1.390	592.7	823.77					592.73			1151.05	1.94
1				alta valva	adaulation	-			r				altaustus		ur.		
	% Width I	Act Chn	Ch-I ower	Challoper		Vulinnar	Visint	Delta		% Width	Act Cha	L 70/Jef		- inver	v-Unner	Voint	Deita
	20%	64.0	60.40	66.40	0.37	0.29	0.32	4.34		20%	64.0	60.40	56.40	1 92	2.03	1.99	0.98
	30%	71.0	66.40	71,40	0 29	1.20	1.12	1.24		30%	71.0	66.40	71.40	2 03	2.10	2.10	0.93
	40%	78.0	76.40	81.40	1 50	1.88	1.62	0.86		40%	78.0	76.40	81.40	2 18	2.14	2.17	0.90
	50%	85.0	81.40	85.40	1 88	1.96	1,95	0.71		50%	85.0	81.40	85.40	2.14	2.13	2.13	0.91
	60%	92.0	89.40	93.40	2 26	2.23	2,24	0.62		60%	92.0	<b>89.40</b>	93.40	2 15	2.15	2.15	0.90
	70%	99.0 106.0	97.40	102.40	213	1.97	2,08	0.67		70%	99.0 102.0	97.40 ths.in	102.40	214	207	2.12	0.92
	00%	106.0	105,40	108.40	1.93	1.6/	1.92	0./3		ou78		103:40	100.40	2.00			

			Me	asured da	ata						Calculat	ed data,	1-dimens	ional flo	w theory		
STA RIVE PLAC	FION No. : R NAME : E NAME :	C8H030 Wilge Kimberley		Average	STAF Gaugepla	RT TIME	08h25 7.7675	m		Manning	or Chezy	Slope	M 0.00038			Q = V <sub>AVR</sub> =	1355.6 2.14
	DATE :	16/03/1988	3							Roughness	coeff		Area reduct	ion factor			
					Main Cha	nnel LEFT :	50			Sub	n		Sub	<u>, I</u>			
				N	lain Chani	nel RIGHT :	120			0	0.038		0	•			
1	2	3	4	5	6	7	8	9		0	0.000		0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q		Chainage	Vertical	Sub	Алеа	Wetted P	H-Radius	Q	V
number		or effective	0,2d	0,4d	0,8d	(m/s)	(m²)	(m²/s)	HHH		or effective	Section	A	ą	R	(m²/\$)	Velocity
		depth				1.518	633.9	962.24			depth						
1	33	2 035		0 1553		0.000	0.0	0.00	100	33	0	2	0.0	19.0	0	0.00	0.00
3	43	2.937		0.3577		0.155	10.2	5.25	97.063	38 43	2 035	2	14.7	5.0	2 035	a.36 15.45	1.05
4	48	4.198		0.5665		0.567	21.0	11.89	95.802	48	4 198	2	21.0	5.0	4 198	28.02	1.33
5	53	5.077		0.6796		0.680	25.4	17.25	94.923	53	5 077	2	25.4	5.0	5.077	38.47	1.52
6	58	8.18		0.3534		0.353	40.9	14.45	91.82	58	8.18	2	40.9	5.0	8.18	85.18	2.08
/ 8	63 68	9.175		0.2837		0.284	45.9	13.01	90.825	63 69	91/5	2	45.9	5.0	9.1/5	103.14	2.25
9	00 73	9.89		1.3104		1.310	46.5 49.5	85.66	90.35	73	9.00	2	40.5	50	9.00	116.88	236
10	78	9.77		1.6975		1.698	48.9	82.92	90,23	78	9 77	2	48.9	5.0	9.77	114.53	2.34
11	83	9.89		1.9977		1.998	49.5	98.79	90,11	83	9.89	2	49.5	5.0	9.89	116.88	2.36
12	88	10.15		1.9803		1.980	50.8	100.50	89.85	88	10.15	2	50.8	5.0	10.15	122.05	2.40
13	93	10.095		2.4153		2.415	50.5	121.91	89.905	93	10.095	2	50.5	5.0	10.095	120.95	2,40
14	98	9.89		2.4327		2.433	49.5	120.30	90,11	98	9.89	2	49.5	5.0	9.89	116.88	2,36
13	103	9.200		2.1499		2.150	40.3	99.49	90.745	103	9 200	2	40.3	5.0	9.200	104.64 83.62	2.40
17	113	6 113		1.5322		1.532	27.5	42.15	93 887	113	6 113	2	27.5	4.5	6 113	47.18	1.72
18	117	3.288		0.1676		0.168	13.2	2.20	96.712	117	3.286	2	13.2	4.0	3.288	14.92	1.13
19	121	0		0		0.000	0.0	0.00	100	121	0	2	0.0	2.1	0	0.00	0.00
20	121.2	0	0	0.3	0	0.300	0.0	0.00	100	121.2	0	2	0.0	0.1	0	00.0	0.00
21						0.000	0.0	0.00			0	2	0.0	0.0	0	0.00	0.00
22						0.000	0.0	0.00			U D	2	0.0	0.0	0	0.00	0.00
23						0.000	0.0	0.00			0	2	0.0	0.0	Ö	0.00	Q.00
				······		1.518	633.9	962.24					633.87			1355.64	2.14
I			n	elta value c	alculatio	ns			1			r	elta value o	alculation	15		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta		% Width	Act Chn.	LOWER	Upper	Valouter	V-Lipper	V-ini	Delta
	20%	64.0	63.00	68.00	0.28	1 31	0 49	3.10		20%	64.0	63 00	68 00	2.25	2 33	2.28	0.94
	30%	71.0	68.00	73.00	1 31	1 73	1.56	0.97		30%	71.0	68 00	73 00	2 33	2 36	2.35	0.91
	40%	78.0	78.00	83.00	1 70	2.00	1 70	0.89		40%	78.0	78 00	83 00	2 34	2 36	2.34	0.91
	50%	85.0	83.00	88.00	2 00	1.98	1 99	0.76		50%	85.0	83 00	88 00	2 36	2.40	2.38	0.90
	50% 70%	92.0	88.00	93.00	1.98	2.42	2.33	0.65		70%	99.0	00 00	103.00	2.40	2.40	2.40	0.91
	80%	106.0	103.00	108.00	2.45	1.93	2.02	0.75		80%	106.0	103.00	108.00	2.26	2 13	2.18	0.98
oonaanii ii ii ii			100.00	100.00	2.10	1											

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			Me	asured da	ata			
STA	TION No. :	C8H030			STAF	RT TIME :	15h50	
RIVE	R NAME : E NAME : DATE :	Wilge Kimberley 15/03/1988	1	Average	Gaugepla	te reading :	9.8975	m
					Main Cha	nnel LEFT :	50	
				N	lain Chanr	nel RIGHT :	120	
1	2	3	4	5	6	7	8	9
/ertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
umber		ar effective	0.24	0.4d	n su	(m(e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
(umea)		denth	0.24	0.46	0.64	1 490	849.8	1251 2
1	25	() ()		G		0.000	0.0	0.00
2	33	2.52		0		0.000	16.4	0.00
3	38	3.945		0.2707		0.271	19.7	5.34
4	43	4.897		0.4447		0.445	24.5	10.89
5	48	6.056		0.6057		0.606	30.3	18.34
6	53	7.056		0.8754		0.875	35.3	30.88
7	58	10.05		0.6144		0.614	50.3	30.87
8	63	11		0.262		0.262	55.0	14.41
9	68	11.675		1.3104		1.310	58.4	76.49
10	73	12.08		1.654		1.654	60.4	99.90
11	78	11.925		1.7497		1.750	59.6	104.33
12	63	11.98		1.7932		1.793	59.9	107.41
13	00	12.11		2.1499		2.100	60.0	130.10
14	98	12 075		2 4588		2.103	60.4	148 45
16	103	11 59		2 3109		2 311	58.0	133.92
17	108	10.8		2.2108		2 211	54.0	119.38
18	113	8.48		1.6236		1.624	42.4	68.84
19	118	5.418		0.5665		0.567	27.1	15.35
20	123	1.954		0.7057		0.706	6.8	4.83
21	125	0		0		0.000	0.0	0.00
22						0.000	0.0	0.00
23						0.000	0.0	0.00
24						0.000	0.0	0.00
						1.490	839.8	1251.16
			Q	elta value c	alculatio	ns		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-int	Delta
	20%	64.0	63.00	68.00	0.26	1,31	0.47	3.16
	30%	71.0	68.00	73.00	1.31	1.65	1.52	0.98
	40%	78.0	78.00	83.00	1.75	1.79	1.75	0.85
	50% 80%	85.0	83.00	88.00	1.79	215	1,94	0.77
	70%	99.0	08.00	103 00	215	210	210	0.61
	0.00	106.0	102.00	108.00	2.40	2.01	2.43	0.66

		Calculate	ed data,	1-dimens	ional flo	w theory		
	Manning	or Chezy	:	М			Q =	1786.8
			Slope	0.0003			V <sub>AVR</sub> =	2.13
						, ,		
	Roughness	coett		Area reduc	tion factor			
	Sub	0		Sub	1,			
	0			0	1			
	2	0.038		2	1			
	O			a	1			
	Chamage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
lata			Sautan		n	p	(m <sup>3</sup> /s)	Valoeibu
he		denth	Section		Ŧ	n	<b>*.</b>	venueny
100	25	0	2	0.0	16.5	Q	0.00	0.00
97.48	33	2 52	2	16.4	65	2 52	13.83	0.84
96.055	38	3.945	2	19.7	50	3 945	22.45	1.14
95.103	43	4.897	2	24.5	50	4 897	32.16	1.31
93.944	48	6.056	2	30.3	50	6.056	45.86	1.61
92.944	53	7.056	2	35.3	50	7 066	59.16	1.66
89.95	58	10 05	2	50.3	50	10.05	106.67	2.12
89	63	11	2	55.0	50	11	123.99	2.26
88.325	68	11 675	2	58.4	50	11 675	196.93	2.36
87.92	73	12 08	2	60.4	50	12 08	144.94	2.40
88.075	78	11.925	2	59.6	50	11 925	141.65	2.36
88.02	83	11 98	2	59.9	50	11.98	142.95	2.39
87.89	88	12 11	2	60.6	50	12 11	145.64	2.40
87.83	93	12 17	2	60.9	50	12 17	146.75	2.41
87.925	98	12.075	2	60.4	50	12 075	144.84	2.40
88.41	103	11 59	2	58.0	50	11 59	195.26	2.38
89.2	108	10.8	2	54.0	50	10.8	120.26	2.23
91.52	113	8 48	2	42.4	50	6.48	80.27	1.90
94.582	118	5.418	2	27.1	50	5.418	58.09	1.41
98.046	123	1.954	2	6.8	35	1 964	4.87	0.71
100	125	O	2	0.0	10	0	0.00	0.00
		0	2	0.0	0.0	0	0.00	0.00
		0	2	0.0	0.0	0	0.00	0.00
		0	2	0.0	0.0	G	0.00	0.00
				83997/S			17(66)(8(0)	2 13
	B/ TRUCES	Ant Che I	L	etta value	calculatio	1.9		Dalta
	A STRUCT		CUMPT	opper	A VEOMES	1.00000	2.83	0.64
	20%	74.0	02.00	700.00	2.23	2.00	0.00	0.94
	40%	79.0	70.00	1000	2.39	2.40	2.00	0.00
	40% E0%	250	10.00	00.00	2.00	2.00	2.00	0.89
	00%	00.0	00 00	00.00	2.09	2.40	2.00	0.88
	7.09/	02.0 00 0	00.00	100.00	2.40	2.41	2.40	0.89
	0.00	400.0	100 00	100.00	2.40	1		0.94

-		_	Me	asured d	ata					1	Calculat	ed data,	1-dimens	sional flo	w theory		
STA	TION No. :	C8H030			STAF	RT TIME	11H35			Manning	or Chez	v:	M			Q =	1848.3
RIVE	R NAME :	Wilde		Averad	e Gaudebla	ate readind :	10.42	m				Sione	0.0003			Vevr =	2.07
PLAC	E NAME	Kimberlev												I			
	DATE :	15/03/1988								Roughness	s coeff		Area reduc	tion factor			
					Main Cha	nnel I FFT	50			Sub	n		Sub	f,			
										•							
				1	Main Chani	nel RIGH I :	120			0			0				
	•	•		e	~	-	•	<u> </u>		2	0.04		2				
	4	3	4	σ	D		0	9		U			U	1		-	
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q		Chaintage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)	нн		or effective	Section	A	P	R	(m²/s)	Velocity
		depth				1.576	893.1	1407.59			depth						
1	23	0		0		0.000	0.0	0.00	100	23	0	2	0.0	14.0	0	00.00	0.00
2	28	1.336		0.0151		0.015	6,7	0.10	98.664	28	1.336	2	67	5.0	1.336	3.61	0.53
3	33	3.054		0.0728		0.073	15.3	1.11	96,946	33	3.054	2	153	50	3.054	13 92	0.91
4	38	4.47		0.3795		0.380	22.4	8.48	95.53	38	4.47	2	22.4	50	4.4/	26 26	1.18
5	43 49	5.422		0.005/		0.606	27.1	16.42	94.578	43	0.422	4	21.1	5.0	0.422	52 GL	1.34
7	5 2	7 330		1 1050		1 1 0 6	36.7	20.01	92 661	40	7 336	2	36.7	5.0	7 139	60.04	164
8	58	10.53		0 7144		0.714	527	37.61	89 47	58	10.53	2	52.7	5.0	10.53	109.53	2.08
9	63	11.525		0.6535		0.654	57.6	37.66	88.475	63	11.525	2	57.6	5.0	11.525	127.31	2.21
10	68	12.2		1.4278		1,428	61.0	87.10	87.8	68	12.2	2	61 0	5.0	12.2	139.96	2.29
11	73	12.605		1.6453		1.645	63.0	103.70	87,395	73	12.605	2	63 0	50	12.605	147 81	2.35
12	78	12.45		1.7584		1.758	62.3	109.46	87.55	78	12.45	2	62.3	50	12.45	144 79	2.33
13	83	12.505		1.8672		1.867	62.5	116.75	87.495	83	12.505	2	62.5	5.0	12.505	145 86	2.33
14	88	12.635		2.1586		2.159	63.2	136.37	87.365	88	12 635	2	63.2	5.0	12.635	148.40	2.35
15	93	12.695		2.1325		2.133	63.5	135.36	87.305	93	12 695	2	03,5	0.⊎ ∉ ∩	12 090	149.57	2.00
10	98 103	12.0		2.4000		2.407	63.U	151.62	07.4 97.995	90	12.0	2	60.6	5.0	12.0	140.21	2.54
18	103	11 325		2.2320		2.255	56 B	124.20	88 675	103	11 325	2	56.6	50	11 325	123.65	2.18
19	113	9 005		1 9411		1 941	45.0	87 40	90,995	113	9.005	2	45.0	50	9.005	84.39	1.87
20	118	5.943		1.3452		1.345	29.7	39.97	94.057	118	5.943	2	29.7	50	5.943	62.22	1.42
21	123	2.479		0.9841		0.984	8.7	8.54	97.521	123	2.479	2	8.7	3.5	2.479	6 88	0.79
22	125	1.854		0.4056		0.406	2.8	1.13	98.146	125	1 854	2	2.8	1.5	1 854	1 82	0.65
23	126	0		0		0.000	0.0	0.00	100	126	0	2	0.0	0.5	Q	0.00	0.00
24						0.000	0.0	0.00			C C	2	0.0	0.0		8104	0.00
						1.576	893.1	1407.59					893.13			1846.20	2.07
			r	alta value	calculatio	ne							Jeita value	calculation	15		
	% Width	Act Chn	Ch-Lower	Chilloner		V-Immer	V/Jnt	Delta		% Minth	Act Chr.	Galer	i poper	Viowet	V-Unner	V-int	Delta
	204	64 0	63.00	68.00	0.65	1 13	0.94	195		20%	54.0	63.00	68.00	221	2.29	2.23	0.93
	30%	71.0	68 00	73.00	1.43	1.65	1.56	1.01		30%	71.0	68.00	72.00	2,29	2.35	2.33	0.89
	40%	78.0	78.00	83.00	1.76	1.87	1.76	0.90		40%	78.0	78.00	83.00	2.33	2.53	2.33	0.89
	50%	85.0	83.00	88.00	1.87	2.16	1.98	0.79		50%	86.0	83 00	88.00	2.33	2 35	2.34	0.88
	60%	92.0	88.00	93 00	2.16	2.13	2.14	0.74		60%	92.0	BB 00	\$3.00	235	2.36	2.35	0.88
	70%	99.0	98.00	103.00	2.41	2.23	2.37	0.66		70%	99.0	96.00	103.00	2.34	2.26	2.33	0.89
	80%	106.0	103.00	108.00	2.23	2.19	2.21	0.71		80%	106.0	103 00	108.00	2.28	2.18	2.22	0.99

			Me	asured d	ata			
STA RIVE PLAC	TION No. : R NAME : E NAME : DATE :	C8H030 Wilge Kimberley 15/03/1988	3	Averag	STAf e Gaugepla	RT TIME	07H50 10.965	m
					Main Cha	nnel LEFT :	50	
				1	Main Chani	nel RIGHT :	120	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
mimber	•	ar affection	6.04	0.44	, 104	(m(n)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
sumper		di ellecuve	₩.20	0.40	0.80	((11/5)	053.0	4505 66
	18	nuepu.		<u>.</u>		0.000	0.0	1505.66
1	10 73	D Sea		0		0.000	0.0	0.00
â	23 28	1 878		0.0151		0.000	94	0.00
4	33	3 596		0.0234		0.023	18.0	0.42
5	38	5.012		0.2794		0.279	25.1	7.00
6	43	5.964		0.8014		0.801	29.8	23.90
7	48	7.123		1.1146		1.115	35.6	39.70
8	53	8.123		1.2886		1.289	40.6	52.34
9	58	11.072		1.0015		1.002	55.4	55.44
10	63	12.067		1.0102		1.010	60.3	60.95
11	68	12.742		1,3539		1.354	63.7	86.26
12	73	13.147		1.6366		1.637	65.7	107.58
13	78	12.992		1.741		1.741	65.0	113.10
14	83	13.047		1,8585		1.859	65.2	121.24
15	88	13.177		2.076		2.076	65.9	136.78
16	93	13.237		2.2891		2.289	66.2	151.50
17	98	13.142		2,4588		2.459	65.7	161.57
18	103	12.657		2.289		2.289	63.3	144.85
19	108	11.867		2.0400		2.046	09.3 47.7	121.37
20	113	9.047		0.5752		0.575	47.7	11 10
21	110	5 588		0.5752		0.159	16.8	2 67
23	124	2 708		0.6622		0.662	95	6.28
24	126	0		0		0.000	0.0	0.00
						1.582	952.0	1505.66
		ns						
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	64.0	63.00	68.00	1.01	1.35	1.08	1.47
	30%	71.0	68.00	73.00	1.35	1.64	1.52	1.04
	40%	78.0	78.00	83.00	1.74	1.86	1.74	0.91
	50%	85.0	83.00	88.00	1.86	2.08	1,95	0.81
	BU%	92.0	88.00	93.00	2.08	2.29	2.25	0,70
	80%	106.0	<b>3</b> 98.00 103.00 2.45 2.29 2.42					0.00
	00%	100.0	103,00	IDQ.OD	4.43	2,00	2.14	0,14

		Calculate	ed data,	1-dimens	ional flo	w theory		
	Manning	or Chez	y:	Μ			Q =	2019.8
			Siope	0.0003			VAVR #	2.12
	Roughness	coeff		Area reduc	ion factor			
	Sub	n		Sub	f.			
	U			U	1			
	2	0.04		2	1			
	0			0	1			
	Chadage	Vertical	Słub	Ares	Wetted P	H-Radius	Q	V
ىيى		or offending	Conton		ø	P	(m <sup>3</sup> /s)	1/inforcia/r
C#1		double of the	CHELICON	~				vesocity
100	18	() ()	2	0.0	44.5	0	0.00	9.50
99 137	23	0.863	2	43	50	0.863	1.69	0.98
98,122	28	1 878	2	9.4	5.0	1.878	<del>5</del> 19	0.66
96,404	33	3 596	2	18.0	5.0	3.596	18.27	1.02
94,988	38	5.012	2	25.1	5.0	5.012	31.76	1.27
94.036	43	5.964	2	29.8	5.0	5.964	42.47	1.42
92.877	48	7.123	2	35.6	5.0	7.123	57.09	1.60
91.877	53	8.123	2	40.6	5.0	8.123	71.07	1 75
88.928	58	11.072	2	55.4	5.0	11 072	119.06	2.15
87.933	63	12.067	2	60.3	5.0	12.067	197 45	2.28
87.258	68	12.742	2	63.7	5.0	12 742	150.60	2.96
86.853	73	13.147	2	65.7	5.0	13.147	158.66	2.41
87.008	78	12 992	2	65.0	5.0	12 992	155.45	2.99
86.953	83	13.047	2	65.2	5.0	13.047	156.65	2.40
86.823	88	13.177	2	65.9	5.0	13.177	159 16	2.42
86.763	93	13.237	2	66.2	5.0	13.237	160.47	2.42
86.858	98	13.142	2	65.7	50	13.142	158-46	2.41
87.343	103	12.657	2	53.3	5.0	12 667	140.00	2.35
88,133	108	11.667	2	59.3	2.0	0 547	133.57	4.20 4.95
90,453	113	9.54/	2	4/ /	2.0	6 495	9904	1.90
93.515	118	0.400	2	16.0	3.0	5 599	27.86	1 96
94.412	113	2.300	2	-0.0	3.0	2 708	7.97	0.84
100	124	2.100	2	00	10	0	0.00	0.00
100	120		-	95(19)3			2019.78	2.12
			D	eita value	calculation	16		
	% Width	Act. Chn.	Lowet	Upper	V-lower	V-Upper	V-lat	Delta
	20%	64.0	63.00	68.00	2.28	2.96	2.29	0.92
	30%	71.0	66.00	73.00	2.36	2.41	2.39	0.89
	40%	78.0	76.00	83.00	2.39	2 40	2.39	0.89
	50%	85 0	83.00	88.00	2.40	2.42	2.41	0.88
	60%	92.0	86.00	93.00	2.42	2 42	2.42	0.88
	70%	99 0	96.00	103.00	2.41	2 36	2.40	0.88
	80%	106.0	103 00	108.00	235	2.25	2.29	0.93

			Me	asured d	ata			
STA	TION No. :	C8H030			STAF	RT TIME :	16h30	
RIVE PLAC	R NAME : E NAME : DATE :	Wilge Kimberley 14/03/1988	1	Averag	e Gaugepla	te reading :	12.2525	m
					Main Cha	nnel LEFT :	50	
				1	Main Chani	nel RIGHT :	120	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number			6 <b>2</b> 4	0.44		(m/c)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
municer		danth	0.20	U:40	u.ed	(411/5)	4445 8	1976 60
4	n	deput O		n		0.000	1140.0	0.00
2	10	1 591		Ō		0.000	31 B	0.00
3	40	6.74		D.8364		0.836	118.0	98.65
4	45	7,593		1.1773		1.177	38.0	44.70
5	50	8.956		1.2635		1.264	44.8	56.58
6	55	9.714		1.4059		1.406	48.6	68.28
7	60	12.93		1.7056		1.706	64.7	110.27
8	65	13.965		1.9436		1.944	69.8	135.71
9	70	14.19		2.1815		2.182	71.0	154.78
10	75	14.315		2.1815		2.182	71.6	156.14
11	80	14.4		2.144		2.144	72.0	154.37
12	85	14.415		2.1065		2.107	72.1	151.83
13	90	14.635		2.0016		2.002	73.2	146.47
14	95	14.635		2.0841		2.084	73.2	152.50
15	100	14.25		1.6907		1.691	71.3	120.46
16	105	13,535		1.5595		1,560	67.7	105.54
17	110	12.885		1.4171		1.417	64.4	91,30
18	115	10.083		1.4808		1,481	50.4	/4,65
19	120	6.124		1.44/1		1.447	30,6	44,31
20	125	3.004		0.7802		0.780	12.9	10,06
21	121	U		U		0.000	0.0	0.00
22						0.000	0.0	0.00
20						0.000	0.0	0.00
47						1 639	1145.8	1876 60
							1144.0	1010.00
			l	Delta value	calculation	IS		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	64.0	60.00	65.00	1.71	1.94	1.90	0.86
	30%	71.0	70.00	75.00	2.18	2,18	2.18	0.75
	40%	78.0	75.00	80.00	2.18	2,14	2.16	0.76
	50%	85.0	85.00	90.00	2.11	2.00	2.11	0.78
	60%	92.0	90.00	95.00	2.00	2.08	2.03	0.80
	70%	99.0	95.00	100.00	2.08	1.69	1,77	0.93
	80%	106.0	105.00	130.00	1.56	1 42	1.53	1.07

Calculated data, 1-dimensional flow theory											
	Manning	or Chez	y:	M			Q =	2179.8			
				0.00022			$V_{\rm AVP} =$	1 90			
	Roughness	coeff.		Area reduct	tion factor						
	Sub	n		Sub	14						
				D	4						
	5	0.04									
	г П	0.04		0	1						
	Chainana	Vertical	5.0	Atea	Wetted P	H-Radius	Q	V			
			-				(m <sup>3</sup> /s)				
HE		or enective	Section	μ.	4	R.	0.0.00	Velocity			
100	n	022033 ()	2	0.0	0.0	6	6 (A)	0.66			
98,409	10	1.591	2	31.8	20.0	1 591	16.08	0.51			
93.26	40	6.74	2	118.0	17.5	6.74	156.06	1.32			
92.407	45	7 593	2	38.0	5.0	7 593	54 38	1.43			
91.044	50	8 956	2	44 8	5.0	8 956	71 61	1.60			
90.286	55	9714	2	48.6	5.0	9714	81 99	1.69			
87.07	60	12.93	2	64.7	5.0	12.93	132.08	2.04			
86.035	65	13,965	2	69.8	50	13.965	150.15	2.15			
85.81	70	14.19	2	71.0	50	14,19	154.20	2.17			
85.685	75	14.315	2	71.6	5.0	14.315	158.47	2.19			
85.6	80	14.4	2	72.0	5.0	14.4	158.02	2.19			
85,585	85	14.415	2	72.1	5.0	14.415	158 30	2.20			
85.365	90	14.635	2	73 2	5.0	14.635	162.35	2.22			
85.365	95	14.635	2	73.2	5.0	14.635	182.35	2.22			
85.75	100	14.25	2	71.3	5.0	14.25	186.29	2.18			
86.465	105	13,535	2	6/./	50	13.535	144.52	4.11			
87.115	110	14,885	2	64,4 80 4	50	12.000	131.00	2.04			
03.917	115	10.003	2	20.4	30 80	6 124	20120	1.74			
95.070	120	3 65.4	5	12 9	95	3 684	11.40				
100	120	0.004	\$		4.0	0	0.00	0.00			
100	141	ň	\$	00	0.0	0	0.00	0.00			
		ŭ.	,	0.0	0.0	Ō	0.00	0.00			
		0	2	6.0	0.0	0	0.00	0.00			
				1145 79			2179.81	1.90			
			1	Delta value	calculation	s					
	% width	Act. Chris	Lawer	Upper	V-ICIANES	A-Obbet	Vint	Della			
	20%	64.0	60.00	65.00	2.04	215	2.13	0.89			
	30%	71.0	70.00	75.00	217	2.19	2 18	0.87			
	40%	78.U 06 A	75.00	60.00	2.19	2.19	2.18	0.01			
	404)	00.00 00 A	00 00	06.00	2.40		5.70	A RR			
	700	00 A	ds on	100.00	2 22	2.44	2 10	0.87			
	BOP	105.0	105.00	110.00	244	2.04	209	0.91			
***************************************											



- 162.06

162.59

▲ 184.54
★ 409.06
★ 565.19

The values in the legend block describe measured discharge for the profile indicated

2

**Depth (m)** 4 2

> 6 7 8

			Mea	asured da	ta	and the second		
STA	TION No. :	C6H006			STA	RT TIME	11h49	
RIVE	RNAME	Vals		Averad	e Gaugepl	ate reading :	3 659	m
DI AC		Tweefontein (	Bothoválla)				2,000	
1 676		1/24/03	Domaxille)					
	DAIL .	172-455					_	
					Main Cha	innel LEF I :	9	
				1	Main Chan	nel RIGHT :	54	
1	2	3	4	5	G	7	8	9
Vartical		Vertical	Valaski	Valaak		Vavor	٨٠٠٠	•
venucat	Cnamage	venicai	velocity	velocity	velocity	v aver.	Alea	4
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m*)	(m³/s)
		depth				1.193	135.9	162.06
1	9.7	0		0		0.000	0.0	0.00
2	12	1.06		0.129		0.129	3.3	0.43
3	16	3.35		0.397		0.397	13.4	5.32
4	20	3.86		0.875		0.875	15.4	13.51
5	24	4.03		1,358		1.358	16.1	21.89
6	28	4.16		1.478		1.478	16.6	24.59
7	32	4.25		1.547		1.547	17.0	26.30
8	36	4.24		1.638		1.638	17.0	27.78
9	40	4.17		1.396		1.396	16,7	23.29
10	44	4.1		1.129		1.129	16.4	18.52
11	48	0.97		0.113		0.113	3.9	0.44
12	52	0		0		0.000	0.0	0.00
13						0.000	0.0	0.00
14						0.000	0.0	0.00
15						0.000	0.0	0.00
16						0.000	0.0	0.00
17						0.000	0.0	0.00
18						0.000	0.0	0.00
						1.193	135.9	162.06
			D	elta value ca	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-løwer	V-Upper	V-Int	Deita
	20%	18.0	16.00	20.00	0.40	0.88	0.64	1.88
	30%	22.5	20.00	24.00	0.88	1.36	1.18	1.01
	40%	27.0	24.00	28.00	1.36	1.48	1.45	0.82
	50%	31.5	28.00	32.00	1.48	1.55	1.54	0.78
	60%	36.0	36.00	40.00	1,64	1.40	1.64	0.73
	70%	40.5	40.00	44.00	1.40	1.13	1.36	0.88
	80%	45.0	44.00	48.00	1 13	0.11	0.88	1.36

		Calculat	ed data,	1-dimens	ional flo	w theory		
	Manning	or Chezy		M		Q = 206.5		
			Slope	0.00047			V <sub>AVR</sub> =	1.52
	Roughness	coeff		Area reduc	ion factor	1		
	Sub	3		Sub	fa			
	0			0	1			
		0.035		5				
	4	0.033		2	<u>,</u>			
	U			U			^	
	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	ų	V
нн		or effective	Section	A	р	R	(m°/\$)	Velocity
		depth						
100	9.7	0	2	0.0	6.0	0	0.00	0.00
98.94	12	1.06	2	3.3	3.2	1.06	2,15	0.64
96.65	16	3.35	2	13.4	4.0	3 35	18.58	1.39
96.14	20	3.86	2	15.4	40	3 86	23 53	1 52
95.97	24	4.03	2	16.1	4.0	4.03	25.29	1.57
95.84	28	4 16	2	16.6	4.0	4.16	26.66	1.60
95.75	32	4.25	2	17.0	40	4 25	27.63	1.63
95.76	36	4.24	2	17.0	40	4 24	27 52	1.62
95.83	40	4 1 /	2	16./	4.0	4.17	26.77	1.60
95.9	44	41	2	10.4	4.0	4.1	26.02	1.59
99.03	48	0.97	2	39	40	09/	2.30	0.61
100	52	0	2	0.0	20	U	000	000
		0	2	0.0	0.0	U	0.00	0.00
		U	2	00	0.0	U	0.00	0.00
		U	2	00	00	0		0.00
		U	2	00	00	0	0.00	0.00
		U	2	0.0	0.0	0	0.00	0.00
				176.95	0.0	0	206.61	4.6
				100.80				1.00
				Delta value calculations				
	% Width	Act. Chin.	Lower	Upper	V-lower	V-Upper	Vant	Della
	20%	18.0	† <b>6</b> .00	20.00	1 39	1.52	1.46	1.04
	30%	22.5	20.00	24.00	1.52	1.57	1.55	0.98
	40%	27.0	24.00	28.00	1.57	1.60	1.59	0.95
	50%	31.5	28.00	32.00	1 60	1 63	1 62	0.94
	60%	36.0	36.00	40.00	1.62	1.60	1.62	0.94
	70%	40.5	40.00	44.00	1.60	1.59	1.60	0.95
	80%	45.0	44.00	48.00	1.59	1 0,61	1.34	1.13

Page 28 of 92
			Me	asured da	Ita			
STA	TION No. :	C6H006			STA	RT TIME :	09h00	
RIVE	R NAME :	Vals		Averac	e Gaugepl	ate reading :	3.649	m
PLAC	E NAME	Tweefontein (	Bothaville)	•	•••	•		
	DATE	1/24/93	,					
					Main Cha		n	
					ividii) Ciliq		•	
					Main Chan	nel RIGHT :	54	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocitv	Velocity	V aver.	Area	Q
					,,	(	(m <sup>2</sup> )	(m <sup>3</sup> /s)
number		or effective	0.20	0.4d	0.8d	(m/s)	(10.)	(+11 / 8/
		depth				1.187	137.0	162.59
1	9.7	0		0		0.000	0.0	0.00
2	13.7	1.5		0.048		0.048	6.0	0.29
0	17.7	3.42		0.509		0.509	13.7	6.96
4	21.7	3.93		1 389		0.944	15.7	14.84
5	23.7	4.07		1,300		1.300	10.3	22.00
7	29.1	4.20		1.500		1.500	17.1	23.02
1	33.7	4.11		1.401		1.431	10.4	23.55
0	31.1	4.19		1.594		1.594	10.0	20.72
9	41.7	4.02		1.304		1.304	10.1	24.10
10	43.7	4.04		0.117		0.117	10.2	0.32
11	49.7	0.67		0.117		0.000	2.7	0.32
12	52	U		0		0.000	0.0	0.00
13						0.000	0.0	0.00
14						0.000	0.0	0.00
10						0.000	0.0	0.00
17						0.000	0.0	0.00
18						0.000	0.0	0.00
		<u></u>		1		1 187	137.0	162.59
			1	Delta value o	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	18.0	17,70	21.70	0.51	0.94	0.54	2.19
	30%	22.5	21.70	25.70	0.94	1.39	1.03	1.15
	40%	27.0	25.70	29.70	1.39	1.51	1.43	0.83
	50%	31.5	29.70	33.70	1 51	1.43	1.47	0.81
	60%	36.0	33.70	37.70	1.43	1.59	1.52	0.78
	70%	40.5	37.70	41.70	1.59	1 50	1.53	0.78
	80%	45.0	41.70	45 70	1,50	1 07	1,15	1.03

	Manning	or Chezy		М			Q =	2050
		Í	Slope	0.00046			V <sub>AVR</sub> =	1.50
	Development	440.0		<b>D</b>		· ·		
	nouginess	UUEn		Alea recisio				
	Sup	9		SUD	IA			
	0			0	1			
	2	0.035		2	1			
	0			0	1			
	Chainage	Vertical	Sub	Atea	Wetted P	H-Radius	Q	V
H		or affective	Section	A	p	R	(m <sup>3</sup> /s)	Velocity
		deoth						
100	9.7	0	2	0.0	6.9	G	0.00	0.00
98.5	13.7	1.5	2	6.0	4.0	15	4 82	0.80
96.58	17.7	3 42	2	13.7	4.0	3.42	19.03	1 39
96.07	21.7	3 93	2	15.7	4.0	3.93	23.99	1.53
95.93	25.7	4.07	2	16.3	40	4 07	25.43	1.56
95.72	29.7	4.28	2	17.1	40	4.28	27.66	1.62
95.89	33.7	4 11	2	16.4	4.0	4.11	25.85	1.57
95.81	37.7	4 19	2	16.8	4.0	4.19	26.69	1.59
95.98	41.7	4.02	2	16.1	40	402	24.91	1.00
95.96	45,7	4.04	2	10.2	4 U 2 C	404	25 12	1 55
99.13	49.7 EO	0.87	2	21	3.2	0.67	1.00	0.00
100	52	U	2	00	12	0	0.00	0.00
		U C	2	00	00	0	0.00	0.00
		0 0	5	0.0	00	i n	0.00	0.00
		0	2	0.0	0.0	o o	0.00	0.00
		ñ	2	00	0.0	o i	0.00	0.00
		ō	2	0.0	0.0	o	0.00	0.00
				136.98			205.03	1.5
	% Minth	Act Cha I	Lowar	Delta value		S Volumat	V.lat	Delta
	2004	49.0	1770			4.57	1.40	1.07
	30%	22.6	21 70	36.70	143	1.44	163	0.98
	4.0%	27.0	25.70	29.70	156	1.62	1.58	0.95
	50%	31.6	29.70	33.70	1.62	1.57	1.60	0.94
	60%	36.0	33.70	37.70	1.57	1.59	1.58	0.94
	70%	48.5	37 70	41 70	1.59	1 56	1 56	0.96
	80%	45.0	4170	45 70	1.55	1.55	1 55	0.96

			Me	easured da	ita						
STA	TION No. :	C6H006		START TIME : 06h46 Average Gaugeplate reading : 4.088 m							
RIVE	R NAME :	Vals		Averag	e Gaugepl	ate reading :	4.088	m			
PLAC	E NAME	Tweefontein (	Bothaville)			•					
	DATE	11/11/92	,								
					Main Cha	nnel I EET ·	o				
							a				
					Main Chan	nel RIGHT :	54				
1	2	3	4	5	6	7	8	9			
Vertical	Chainane	Vertical	Velocity	Velocity	Velocity	V aver	Area	Q			
			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		, ciccal)		(m <sup>2</sup> )	(m <sup>3</sup> /s)			
number		or effective	0.2d	0.4d	0.8d	(m/s)	()+1 J	(((( ) )))			
		depth				1.259	146.6	184.54			
1	8	0		0		0.000	0.0	0.00			
2	12.1	1.37		0.331		0.331	5.5	1.84			
3	16.1	3.46		0.526		0.526	13.8	7.28			
4	20.1	3.98		0.86		0.860	15.9	13.69			
5	24.1	4.24		1.377		1.377	17.0	23.35			
6	28.1	4.38		1.503		1.503	17.5	26.33			
/	32.1	4.33		1.589		1.589	17.3	27.52			
8	36,1	3,658		1.694		1.694	15,4	26,14			
9	40.1	3,938		1.798		1.798	15.0	28.32			
10	44.1	4.068		1.429		1.429	10.3	23.25			
11	46.1	3.05		0.000		0.565	12.0	0.01			
12	92	U		0		0.000	0.0	0.00			
13						0.000	0.0	0.00			
14						0.000	0.0	0.00			
10						0.000	0.0	0.00			
10						0.000	0.0	0.00			
18						0.000	0.0	0.00			
10				1		1 259	146.6	184 54			
						1	140.0	1 101101			
			l	Delta value c	alculation	S					
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta			
	20%	18.0	16,10	20.10	0.53	0.86	0.68	1.84			
	30%	22.5	20.10	24.10	0.86	1.38	1.17	1.08			
	40%	27.0	24.10	28.10	1.38	1.50	1.47	0.86			
	50%	31.5	28.10	32 10	1.50	1.59	1.58	0.80			
	60%	36.0	32.10	36.10	1.59 1.69		1.69	0.74			
	70%	40.5	40.10	44.10	1.80	1,43	1.76	0.71			
	80%	45.0	44.10	48.10	1.43	0.57	1.23	1.02			

			v theory	ional flov	1-aimens	eu uala,	Calculat		
	227.0	Q =			M		or Chezy	Manning	
	1.55	V <sub>AVR</sub> =	L		0.00046	Slope	L		
				ion factor	Area reduct		coeff.	Roughness	
				f <sub>A</sub>	Sub		n	Sub	
				1	a			n	
				1	2		0.034	2	
				1	0		0.004	0	
	v	Q	H-Radius	Wetted P	Area	Sub	Vertical	Chainage	
	Valacity	(m <sup>2</sup> /s)	Þ	6				-	
	velocity	<b>1</b>	n	٣	A	SECTION	Of energine		411
	5.60	0.00	n	61	0.0	2	01 01	8	100
	0.78	4.32	1.37	41	5.5	2	1 37	121	98 63
	1.44	19.97	3.46	40	13.8	2	3.46	16 1	96 54
	1 58	25 22	3.98	40	15.9	2	3.98	20.1	96.02
	1.65	28.03	4.24	4.0	17.0	2	4 24	24.1	95.76
	1.69	29.59	4.38	4.0	17.5	2	4 38	28.1	95.62
S :	1.68	29.03	4 33	40	17.3	2	4.33	32.1	95.67
	1 55	23 95	3 858	40	15.4	2	3.858	36.1	6.142
	1 57	24 78	3.938	4.0	15.8	2	3.938	40.1	96.062
	1.61	26,16	4.068	4.0	16.3	2	4.068	44.1	95.932
	1.33	15.98	3 05	4.0	12.0	2	3.05	48.1	96.95
	0.00	0.00	0	20	0.0	2	0	52	100
	0.00	0.00	0	0.0	0.0	2	0		
	0.00	0,00	0	0.0	0.0	2	0		
	0.00	0.00	o I	0.0	0.0	2	0		
	0.00	0.00	0	0.0	0.0	2	0		
	0.00	0.00	0	0.0	0.0	2	0		
	0.00	0.00	0	0.0	0.0	2	0		
	1.5	227.01	Ĺ		146.61				
			\$	alculation	elta value (				
	Delta	∀-int	V-Upper	V-lowet	Upper	Lower	Act. Chn.	% Width	
	1.03	1 51	1 58	1.44	20.10	16 10	18.0	20%	
	0.95	1.63	1.65	1.58	24.10	20.10	22.5	30%	
	0.92	1.68	1.69	1.65	28.10	24 10	27.0	40%	
	0.92	1 68	1 68	1 69	32 10	28 10	31.5	50%	
	1.00	1.55	1.55	1 68	36.10	32.10	36.0	60%	
	0.98	1.58	1.61	1.57	44.10	40.10	40.5	70%	
	1.00	1.54	1.33	1.61	48,10	44.10	45.0	80%	

			Me	asured da	Ita			
STA	TION No. :	C6H006			STA	RTTIME :	15h53	
RIVE	R NAME :	Vals		Averag	e Gaugepl	ate reading :	6.325	m
PLAC	E NAME :	Tweefontein	(Bothaville)					
	DATE :	11/10/92					_	
					Main Cha	innel LEF I :	9	
					Main Chan	nel RIGHT :	54	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		oreffective	0.24	0.44	0.84	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth	0.24		0.04	1.754	233.2	409.06
1	2.8	0		0		0.000	0.0	0.00
2	8	2.19		0.617		0.617	10.1	6.22
3	12	3.273		0.969		0.969	13.1	12.69
4	16	5.391		1.047		1.047	21.6	22.58
5	20	5.615		1.633		1.633	22.5	36.68
6	24	5.348		2.067		2.067	21.4	44,22
7	28	5.231		2.167		2.167	20.9	45.34
8	32	5.332		2.262		2.262	21.3	48.24
9	36	5.4		2.414		2,414	21.6	52.14
10	40	5.565		2.488		2.488	22.3	55.38
11	44	6.298		2.019		2.019	25.2	50.86
12	48	5.28		1.294		1.294	21.1	27.33
13	52	2.23		0.704		0.704	8.9	6.28
14	56	0.62		0.335		0.335	3,3	1.10
15	62.6	Ō		Ö		0.000	0.0	0.00
16						0.000	0.0	0.00
17						0.000	0.0	0.00
18						0.000	0,0	0.00
						1./04	235.2	409.06
			D	elta value c	alculation	IS		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	18.0	16.00	20.00	1.05	1.63	1.34	1.31
	30%	22.5	20.00	24.00	1,63	2.07	1.90	0.92
	40%	27.0	24.00	28.00	2.07	2.17	2.14	0.82
	50%	31.5	28.00	32.00	2 17	2.26	2.25	0.78
	60%	36.0	36.00	40.00	2.41	2.49	2.41	0.73
	70%	40.5	40.00	44.00	2.49	2.02	2,43	0.72
	80%	45,0	44,00	48.00	2.02	1.29	1,84	0.95

		Calculat	ed data,	1-dimens	ional flo	w theory		
	Manning	or Chezy	:	M			Q =	447.1
			Slope	0.00047			V <sub>AVR</sub> =	1.92
						1		
	Roughness	COEff		Area reduci	tion factor			
	Sub	n		Sub	f.			
	0			0	1			
	2	0.033		2	1			
	0			0	1			
	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
يباليو		or affective.	Section		þ	R	(m³/s)	Velocity
		denth	Conun					
100	2.8	0	2	0.0	40	0	0.00	0.00
97.81	8	2.19	2	10.1	46	2.19	11 16	1 11
96.727	12	3.273	2	13.1	4.0	3.273	18.96	1.45
94.609	16	5.391	2	21 6	4.0	5 391	43.58	2.02
94.385	20	5.615	2	22.5	40	5.615	46.61	2.08
94.652	24	5 348	2	21.4	40	5 348	42 98	2 01
94.769	28	5.231	2	20.9	4.0	5.231	41.42	1 98
94.668	32	5.332	2	213	4.0	5 332	42.76	2.01
94.6	36	5.4	2	21.6	40	5.4	43.68	2.02
94.435	40	5 565	2	22.3	40	5.565	45 92	2.06
93.702	44	6.298	2	25.2	4.0	6.298	56 44	2.24
94.72	48	5.28	2	211	4.0	5.28	42.07	1.99
97.77	52	2.23	2	8.9	40	2.23	10.00	1.12
99.38	56	0.62	2	3.3	53	0.62	1.57	0.45
100	62.6	0	2	00	3.3	0	0.00	0.00
		0	2	00	0.0	0	0.00	0.00
		0	4	0.0	00	0	0.00	0.00
		v	4	233.24			447.14	1.9
								1
				Delta value	calculation	15		
	% Width	Act. Chn.	LQwet	Upper	V-lower	V-Uppper	V-Int	Delta
	20%	18.0	16.00	20.00	2.02	2.08	2.05	0.94
	38%	22.5	20.00	24.00	2.08	2.01	2.03	0.94
	40%	27.0	24.00	28.00	2.01	198	199	0.96
	50%	31.5	28.00	32.00	1.98	2.01	2.00	0.96
	60%	36.0	36.00	40.00	2.02	2.06	2.02	0.95
	70%	40.5	40.00	44 00	206	2.24	2.09	0.82
	60%		44 00	465.003	4.24	1	4.10	0.00

Appendix H

			Me	asured da	ta			
STA	TION No. :	C6H006			STA	RT TIME :	09h14	
RIVE	RNAME	Vals		Averag	e Gaugepla	ate reading :	7.206	m
PLAC	E NAME :	Tweefontein	(Bothaville)	•	• •			
	DATE	11/10/92	()					
					Main Cha	nnellEFT	a	
					Wall Cite			
					Main Chan	nel RIGHT :	54	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocitv	Velocitv	V aver.	Area	0
		<i></i>	~~~				(m <sup>2</sup> )	(m <sup>3</sup> /e)
number		of effective	U.2d	U.4d	0.8d	(m/s)	(117)	(111 / 5)
		depth				1.884	299.9	565.19
1	0	0		0		0.000	0,0	0.00
2	4.3	1.84		0.366		0.366	7.6	2.79
3	0.3	2.53		0.943		0.943	10.1	9.54
4	12.3	3.97		1.3//		1.3/7	15.9	21.87
5 6	10.3	6,515		1.212		1.212	20,1	31.00
u 7	20.3	7.003		1.510		1.510	21.2	41.25 52.30
, 8	29.3	7.003		2 232		2.007	20.0	64.50
a	20.0	6,636		2 332		2.232	20.9	61.00
10	36.3	6.816		2 453		2.453	27.3	66.88
11	40.3	6.010 6.679		2 5 4 4		2544	26.7	67.97
12	44 3	6 468		2 488		2 488	25.9	64 37
13	48.3	6 1 1 1		2149		2 1 4 9	24.4	52 53
14	52.3	3.237		1 416		1 416	12.9	18.33
15	56.3	1.626		0.93		0.930	6.5	6.05
16	60.3	0.89		0 704		0.704	3.4	2.38
17	63.9	0.78		0.383		0.383	2.5	0,94
18	66.6	0		0		0.000	0,0	0.00
						1.884	299.9	565.19
			D	elta value c	alculation	s		_
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	20%	18.0	16.30	20.30	1.21	1.52	1.34	1.40
	30%	22.5	20.30	24.30	1.52	1.87	1.71	1.10
	40%	27.0	24.30	28.30	1.87	2.23	2.11	0.89
	50%	31.5	28.30	32.30	2.23	2.33	2.31	0.82
	60%	36.0	32.30	36.30	2.33	2.45	2.44	0.77
	70%	40.5	40.30	44.30	2.54	2.49	2.54	0.74
	80%	45.0	44.30	48.30	2.49	2.15	2.43	0.78

		Calculat	ed data,	1-dimens	ional flo	w theory		-
	Manning	or Chezy	:	M			Q =	584.0
			Slope	0.00047			V <sub>AVR</sub> =	1.95
		•						
	Roughness	coeff		Area reduc	ion factor			
	Sub	n		Sub	fa			
	0			0	•			
	2	0.036		2	1			
	0			0	1			
	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	l v
uu		or offerstore	Contion		0	a	(m²/s)	Valocity
		denth	Octore)					County
100	0	0	2	0.0	0.0	Q	0.00	0.00
98.16	4.3	1.84	2	7.6	42	1.84	6.90	0.90
97.47	8.3	2.53	2	10.1	4.0	2.53	11.32	1.12
96.03	12.3	3.97	2	15.9	40	3 97	23 98	1 51
93.485	16.3	6 515	2	26.1	4.0	6.515	54 74	2.10
93.197	20.3	6.803	2	27.2	4.0	6.803	56.84	2.16
92.997	24.3	7.003	2	28.0	4.0	7 003	61.75	2.20
92.776	28.3	7.224	2	28.9	4.0	7 224	65.03	2.25
93.364	32.3	6 636	2	26.5	4.0	6,636	56.45	2.13
93,184	36,3	6 816	2	27.3	40	6.816	59.02	2.16
93.321	40.3	6.679	2	26.7	4.0	6679	57.06	2 14
93.532	44.3	6.468	2	25.9	40	6.468	54 09	2.09
93.889	48,3	6.111	2	24.4	4.0	0.111	49.20	2.03
96.763	52.3	3 23/	2	12.9	40	3.237	17 UD 6 83	1.34
98.374	50.3	1.020	2	00	40	1 020 0 80	0.42 4.99	0.60
99.11	60.3	0.69	2	54	20	0.08	1 DD 1 DS	0.00
100	66 6	0.70	2	00	14	0.70	0.00	0.00
100	00.01			299.95			583.99	1.9
								•
				Delta value	calculation	IS.		
	So Wiells	Accie	Lower	Upper	Valgwet	V-Upper	V-int	Detta
	20%	18.0	16.30	20.30	2.40	2.16	2.13	0.92
	30%	22.6	20.30	24.30	2.16	2.20	2 19	0.89
	40%	27.0	24.30	28.30	2.20	2.25	2.24	0.87
	50%	31.6	28 30	32.30	2.25	2.13	2.15	0.90
	60%	36.0	32.30	36 30	2.13	2.16	2 16	0.90
	70%	40.5	40:30	44.30	2.14	2.09	2 13	0.91
	80%	45.0	44 30	48.30	2 09	1 2 81	2.08	1 U.94

Appendix H



The values in the legend block describe measured discharge for the profile indicated

			Mea	sured da	ata				12	Cal	culated o	lata, 1-dir	nension	al flow th	eory	
STA	TION No. :	D1H003			STAR	TTIME :	09h10		Manning	j or Chez	y:	M			<u>a</u> =	966.
RIVE	R NAME :	Oranje		Averag	e Gaugepla	te reading :	1.881	m			Slope	0.0009			V <sub>AVB</sub> =	2.2
PLAC	E NAME :	Aliwal Noord		-									•		L	
	DATE :	2/12/94							Roughness	s coeff		Area teduc	tion factor	1		
					Main Char	nnel LEFT :	50		Sub	n		Sub	f,	1		
					Main Chanr		160		0			n	1			
							100			0.035		,	1			
1	2	3	4	5	6	7	8	9	ō	0.000		0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Sub	Atea	Wetted P	H-Radius	Q	V
number		or effective	0.24	0.4d	0 8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)		nt effective.	Section		ø	R	(m <sup>3</sup> /s)	Valocit
		depth				2.102	433.4	911.08		denth						1
1	31	0	0	0	0	0.000	0.0	0.00	31	0	2	0.0	18.0	0	0.00	0.00
2	36	0.195	0	-0.404	0	-0.404	1.0	-0.39	36	0,195	2	1.0	50	0.195	0,28	0.23
3	41	0.38	0	-0.222	0	-0.222	1.9	-0.42	41	0.38	2	1,9	50	0.38	0.85	0.45
4	46	1.39	0	0.324	0	0.324	7.0	2.25	46	1.39	2	7.0	5.0	1.39	7 42	1.07
5	51	2.17	0.391	0.902	1.349	0.886	10.9	9.61	51	2.17	2	10.9	5.0	2.17	15 59	1 44
6	56	1.52	1.176	1.437	1,842	1.473	7.6	11.19	56	1.52	2	76	5.0	1.52	8 61	1 13
/ 8	66	2.06	1 343	1.2//	1,000	1.309	10.4	13.61	61	2.08		10.4	5.0	2.06	14.53	1.40
9	71	37	1 441	1 745	1.669	1.451	18.5	20.55	71	2.01	2	125	5.0	2.01	24.DH 97.07	2.04
10	76	4,277	2.23	2 104	1.005	2 000	21.4	42 76	76	4 277	2	21.4	50	4 277	48.30	2.0
11	81	5.367	2.205	2.458	2.015	2.284	26.8	61.29	81	5.367	2	26.8	50	5.367	70.51	2.63
12	86	4.577	2.618	2.564	2.256	2.501	22.9	57.22	86	4.577	2	22.9	5.0	4.577	64 07	2.36
13	91	4.696	2.407	2.72	2.433	2.570	23.5	60.34	91	4 696	2	23.5	5.0	4 696	56 44	2.40
14	96	4.746	2.407	2.884	2.572	2.687	23.7	63.76	96	4 7 4 6	2	23.7	5.0	4 7 4 6	57 44	2.42
15	101	5.182	2.294	2.741	2.897	2.668	25.9	69.13	101	5 182	2	25.9	5.0	5 182	88 50	2.57
16	106	5.081	2.197	2.745	2.985	2.668	25.4	67.78	106	5.081	2	25.4	5.0	5.081	84.38	2.53
17	111	5.313	0	2.576	0	2.576	26.6	68.43	111	5.313	2	26.6	50	5.313	69.33	2.61
10	116	5.307	0	2.31	U C	2.310	26.5	61.30	116	5.307	ź	20.0	50	0.307	69.20	2.63
19 20	121	5.24	0	1.093	0	2 201	20.2	49,60	121	5 400	5	20.2	50	5 400	64.70 74.30	2.00
20	120	3 929	0	2 559	0	2.201	19.6	50 27	131	3 979	5	19.6	50	3 929	41.93	213
22	136	3,889	Ø	2.618	õ	2.618	19.4	50.91	136	3 889	2	19.4	5.0	3 889	41.22	2 12
23	141	3.441	1.838	2.18	2.294	2.123	17.2	36.53	141	3.441	2	17.2	5.0	3 441	93 61	1 95
24	146	3.167	1.475	1.361	1.205	1.351	15.8	21.39	146	3.167	2	15.8	5.0	3.167	29.27	1 85
25	151	1.29	0	0.294	0	0.294	6.5	1.90	151	1.29	2	6.5	5.0	1.29	8.55	1 02
26	156	1.55	0	0.29	0	0.290	7.3	2.13	156	1.55	2	7.3	4.7	1.55	8.42	1 15
27	160.46	0	0	0	0	0.000	0.0	0.00	160.46	0	2	0.0	22	O O	0.00	0.00
28						0.000	0.0	0.00		0	2	0.0	0.0	1 <sup>0</sup>	0.00	0.00
						2.102	433,4	911.08				<b>433.38</b>			966.23	1 <sup>2</sup>
			D	elta value c	alculations							Delta value	calculation	15		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	PAGE STREET	Lower	Upper	Valences	VAUpper	V-Int	Delt
	30%	83.0	81.00	86.00	2.28	2.50	2.37	0.89	30%	83.0	81.00	68.00	2.63	2.38	2.52	0.88
	40%	94.0	91 00	96.00	2.57	2.69	2.64	0,80	40%	94.0	91 00	96.00	2.40	2.42	2.41	0.93
	50%	105.0	101.00	106.00	2.67	2.67	2.67	0.79	50%	105.0	101 00	106.00	2.57	2.53	2.54	0.88
	60% 70%	116.0	116.00	121.00	2.31	1.89	2.31	0.91	60%	116.0	116.00	121.00	2.61	2.59	2.61	0.84
	10%	12/.0	126.00	131.00	2.20	2.56	2.27	0.93	10%	12/0	128.00	1.01.00	4.64	1	2.54	1

.

-			Me	asured da	ata				A	Calc	culated d	lata, 1-dii	nension	al flow th	eorv	
STA	TION No. :	D1H003			STA	RT TIME :	13H35		Manning	or Chez	y:	M			Q =	491
RIVE	R NAME :	Oranje		Averag	e Gaugepl	ate reading :	1.822	m			Slope	0.00022			V <sub>AVR</sub> =	= 1.1
PLAC	E NAME :	Aliwal Noord				-							•		L	
	DATE :	2/12/94							Roughness	coeff.		Area reduc	tion factor	1		
					Main Cha	annel LEFT :	50		Sub	n		Sub	f,	1		
					Main Chan		160		a			0	1			
							100		2	0.035		,	i			
1	2	3	4	5	6	7	8	9	0	0,000		ō	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	ΤV
number		or effective	D 24	Diad	0.84	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)			Cantan				(m <sup>3</sup> /s)	Valacit
		depth	0.24		0.00	2 085	438.2	913.83		dentile	Section		F			Venuen
1	31.4	0		0		0.000	0.0	0.00	50	Cites Ci	2	0.0	18.0	0	A 30	5.00
2	36	0.18		-0.162		-0.162	0.9	-0.14	57	G 18	2	0.9	4.8	0.18	0.12	0.14
3	41	0.515		-0.271		-0.271	2.6	-0.70	62	0.515	2	2.6	5.0	G.515	0.70	0.27
4	46	1.65		0.906		0.906	8.3	7.47	67	1.65	2	83	5.0	1.65	4.88	0 59
5	51	1.33		1.534		1.534	6.7	10.20	71	1.33	2	67	5.0	1.33	3.41	0.51
6	56	0.86		1.686		1.686	4.3	7.25	75	0.86	2	4.3	5.0	0.86	1.66	0.38
7	61	1.43		1.475		1.475	7.2	10.55	79	1.43	2	7.2	5.0	1.43	3.86	0.64
8	66 74	2.4		1.5/2		1.572	12.0	18.86	83	24	2	12.0	50	24	9 12	0.76
9 10	71	3.3		1.429		1.429	10.5	23,58	87	3.3	4	10.5	5.0	3.3	15,50	U.94
10	81	5 353		2.043		2 230	20.0	59.69	94	4 100	5	20.6 26 B	5.0	4 105	34 71	1 44
12	86	4,358		2 336		2.336	21.8	50.00	97	4 358	2	21.8	5.0	4 358	24 54	1 1 13
13	91	4,432		2.534		2.534	22.2	56.15	100	4.432	2	22.2	5.0	4.432	25 34	1 1 14
14	96	4.756		2.601		2.601	23.8	61.85	104	4.756	2	23.8	5.0	4.756	28.60	1.20
15	101	5.124		2.669		2.669	25.6	68.38	108	5.124	2	25.6	5.0	5 124	32.27	1.26
16	106	5.468		2.564		2.564	27.3	70.10	113	5.468	2	27.3	5.0	5 468	35.96	1.32
17	111	5.378		2.332		2.332	26.9	62.71	118	5 378	2	26,9	5.0	5 378	34.98	1.30
18	116	5.835		2.218		2.218	29.2	64.71		5.835	2	29.2	5.0	5.835	40.07	1.97
19	121	5.711		2.062		2.062	28.6	58.88		5.711	2	28.6	5.0	5.711	36.86	1 96
20	126	5.468		2.403		2.403	27.3	65.70		5.468	2	27 3	5.0	5.468	36 96	1 32
21	131	4.026		2.715		2.715	20,1	54.65		4.026	2	201	5.0	4.026	21.59	1 07
22	136	4.065		2.5		2.500	20.3	50.81		4.065	2	20.3	5.0	4.065	21 94	
20	141	3.52		1 310		1 310	17.0	23.80		3.52	4	17.0	5.0	3.52	17.20	0.80
25	151	3 306		0.467		0.467	16.5	7 73		3 306	2	18.5	50	3 306	15.66	1 0.64
20	156	1 59		0.407		0.349	73	2.54		1 50	2	73	46	1 59	4.30	0.96
27	160 15	0		0.040		0.000	0.0	0.00		0	2	0.0	21	0	0.00	0.00
28		-		-		0.000	0.0	0.00		Ō	2	0.0	0.0	0	0.00	0.00
						2.085	438.2	913.83				438.19			491.27	
	% Winth	Act Chn I	Chlower		alculation	1 <b>5</b>	N/ 1-4	Delta	A tatidet	Act Obe		Jeita vallie	calculation	15 Litterar	Valet	Dalt
	20%	92.0	en Do	vii-upper	v-lower	v-Opper	V-831	0.92	200/	2401 CAUSE	CLIME!	87.00	T 76	C G G A	0.78	d Al
	40%	94.0	91.00	00.00	2.25	2.34	2.27	0.92	40%	94.0	94.00	67.00	1 20	1 18	1 50	0.8
	50%	105.0	101.00	106.00	2.00	2.55	2.59	0.81	50%	105.0	104.00	108.00	1 20	1.26	1.21	0.9
	60%	116.0	116.00	121.00	2.22	2.06	2.22	0.94	60%	116.0	113.00	118.00	1.32	1 90	1.31	0.8
	70%	127.0	126.00	131.00	2.40	2.72	2.47	0.85	70%	127.0	118.00	0.00	1.50	1 37	1 30	0.87

Appendix H

			Mea	asured d	ata					Calc	culated d	lata, 1-dir	nension	al flow th	eory
ST/	ATION No. :	D1H003			STAF	RT TIME :	10H38		Manning	or Chez	y:	М			Q
RIVI	ER NAME :	Oranje		Averag	je Gaugepla	ite reading :	2.228	m			Siope	0.0009			V,
PLAC	CE NAME :	Aliwal Noord												_	
	DATE :	2/11/94							Roughness	coeff.		Area reduc	tion factor	]	
					Main Cha	nnel LEFT :	50		Sub	n		Sub	f <sub>A</sub>		
					Main Chani	nel RIGHT :	160		0			0	1		
	1								2	0.034		2	1		
1	2	3	4	5	6	7	8	9	0			0	1		
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chamage	Vertical	Sub	Area	Weffed P	H-Radius	
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)		or effective	Section	A	a	R	(n
		depth				2.142	530.7	1136.91		depth					
1	24.8	0		0		0.000	0.0	0.00	24.8	G	2	0.0	15.5	0	0
2	31	0.32		0		0.000	1.8	0.00	31	0.32	2	1.8	5.6	0.32	C
3	36	0.6		-0./42		-0.742	3.0	-2.23	36	0.8	2	3.0	5.0	0.6	
5	41	1 36	.0.57	-0.734	0.60	-0.734	3.0 6 B	-2.10	41	075	2	3.0 6 P	3.0	0.75	
6	51	2 36	0.64	0.050	0.00	0.503	11.8	610	40	2 36	5	0.G 11 B	5.0	2 36	
7	56	3,688	0.927	0.758	0.518	0.740	18.4	13.65	56	3,688	2	18.4	5.0	3,688	
8	61	4.749	1.475	1.332	1.585	1.431	23.7	33.98	61	4.749	2	237	5.0	4.749	5
9	66	4.825	1.99	1.935	1.749	1.902	24.1	45.89	66	4.825	2	24.1	5.0	4.825	6
10	71	5.333	2.184	2.197	1.711	2.072	26.7	55.26	71	5.333	2	26.7	5.0	5.333	7
11	76	5.282	2.049	2.762	1.994	2.392	26.4	63.17	76	5.282	2	26.4	5.0	5.282	71
12	81	6.081	2.597	2.812	2.353	2.644	30.4	80,38	81	6.081	2	30,4	5.0	6.081	B
13	86	5.39	2.703	2.859	2.399	2.705	27.0	72,90	86	5 39	2	27.0	5.0	5 39	7
14	91	4.996	2.871	2.968	2.526	2.833	25.0	70.77	91	4 996	2	25.0	5.0	4.996	6
10	96	5,546	2.707	3.04	2.132	2.000	27.7	79.00 PP.05	96	0.040 8.022	2	217	50	5.040	
10	106	5.932	2.492	3.100	3,107	2,909	133.2	395 27	106	5.534 4.918	5	133.2	20 H	5.532 8.918	20
18	146	3.67	1 754	1 661	1 193	1 567	82.6	129 42	146	3.67	2	82.6	22.5	3.67	1 17
19	151	3.73	0.497	0.429	0.475	0.458	18.7	8.53	151	3.73	2	18.7	5.0	3.73	3
20	156	2.01	0,126	0.162	0	0.113	10.1	1.13	156	2 01	2	10.1	5.0	2 01	
21	161	0	0	0	0	0.000	0.0	0.00	161	0	2	0.0	3.6	0	6
22	163.2	0	0	O	0	0.000	0.0	0.00		Ð	2	0.0	11	0	6
23						0.000	0.0	0.00		0	2	0.0	0.0	0	C
24						0.000	0.0	0.00		0	2	0.0	0.0	0	C
25						0.000	0.0	0.00		0	2	0.0	0.0	0	C
26						0.000	0.0	0.00		0	2	0 U 0 D	00	U C	0
2/						0.000	0.0	0.00		u a	2	00	0.0		
20						2 142	530.7	1136.91		•	4	530.63			13
						<u> </u>		1 100.01					l		
			D	elta value i	calculation	s						Delta value	calculation	15	
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	¥+lower	V-Upper	V-int	Delta	% Width	Act. Chn.	Lower	Lipper	V-lower	V-Upper	
	30%	83.0	81.00	86.00	2.64	2.71	2.67	0.80	30%	83.0	81.00	86.00	2.94	271	
	40%	94.0	91.00	96.00	2.83	2.88	2.86	0.75	40%	94.0	91.00	96.00	2.58	276	
	50%	105.0	101.00	106.00	2.97	2.97	2.97	0.72	50% CON	TUD.U	101 00	105.00	2.89	2.69	
	70%	110.0	106.00	146.00	2.97	1.57	2.02	0.82	70%	127.0	108.00	146.00	2.00	2 10	
	1.4 /0		100:00	190.00	2.31	1.3/	6.20					1			

Q #

Q (m³/s)

0.00

0.74

1.88

273

7 37

18.40

38.84

59-19

60.78

71.82

70.68

89.38

73.10

64.41

76 56

85 76

384.40

173.35

39.58

14.12

0.00

0.00

0.00

0.00

0.00

0.00

0.00

0.00

1233.26

Vant

2.85

2.69

2.89

2.69

2.47

VAVR = 2.51

1333.3

V

0.00

G.41

0.63

6,73

1.08

1 56

2.11

2.49

2.62

2.69

2.68

2.94

2.71

2.58

276

2.89

2 89

2.40

2,12

1.41

0.00

0.00

0.00

0.00

000

0.00

0.00

0.00 2.61

Delta

0.88

0.93

0.87

0.93

Velocity

			Me	asured da	ata				1 1
STA	TION No. :	D1H003			STAF	RT TIME :	15h10		Manning
RIVE	R NAME :	Oranje		Averag	e Gaugepla	te reading :	2.676	m	
PLAC	E NAME :	Aliwal Noord							Denshare
	DATE .	21004			Main Cha	nnel I FFT	50		Sub
					Main Chan		160		0
					viain Chan		100		2
1	2	3	4	5	6	7	8	9	0
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chamage
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)	
		depth				2.533	628.6	1592.48	
1	16	0		0		0.000	0.0	0.00	16
2	21	0.25		-0.509		-0,509	1.3	-0.64	21
3	26	0.36		-0.524		-0.524	1.8	-0.94	26
4	31	0.58		-0.411		-0.411	2.9	-1,19	31
5	36	0.85		-0.288		-0.288	4.3	-1.22	36
6	41	1.49		0.154		0.154	7.5	1.15	41
/	46	3.27		0.661		0.661	16.4	10.81	46
8	51	3.87		1.522		1.522	19.4	29.45	51
9 10	00 61	3.94 A EEE		2.032		2.032	19.7	40.03	50
10	01 66	4.383		2.340		2.340	22.0	55,40 69.40	60
11	00 71	5.024		2,000		2.000	20.3	72 97	71
14	76	5 359		2.905		3,005	20.1	82.03	76
14	81	6 477		3 238		3 238	32.4	104.86	81
15	86	5 489		3 234		3 234	27.4	88.76	86
16	91	5 841		3.403		3.403	29.2	99.38	91
17	96	6.61		3.378		3.378	33.1	111.64	96
18	101	6.671		3.314		3.314	33.4	110.54	101
19	106	6.73		3.2		3.200	33.7	107.68	106
20	111	6.872		2.635		2.635	34,4	90.54	111
21	116	6.791		2.825		2.825	118.8	335.73	116
22	146	4.216		2.133		2.133	73.8	157.37	146
23	151	4.3		1.159		1.159	21.5	24.92	151
24	156	2.53		0,404		0.404	12.7	5,11	156
25	161	0.88		0.15		0.150	4.4	0.66	161
26	166	Ø		0		0.000	0.0	0.00	166
27						0.000	0.0	0,00	
28						0:000	0.0	0.00	
						2.533	528.5	1592.48	
			C	elta value c	alculation	\$			
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width
	30%	83.0	81.00	86.00	3.24	3.23	3.24	0.78	30%
	40%	94.0	91.00	96 00	3.40	3.38	3.39	0.75	40%
	50%	105.0	101.00	106.00	3.31	3.20	3.22	0.79	50%
	60%	116.0	116.00	146.00	2.83	2.13	2.83	0.90	\$0%
	70%	127.0	116,00	146.00	2.83	2.13	2.57	0,99	fU/a

	Calculated data, 1-dimensional flow theory Ianning or Chezy: M Q = 1747.3													
Manning	or Chezy	r:	М			Q =	1747.3							
		Circle	0 0009			V =	2 78							
Rouchness	coeff		Area reduct	ion factor										
Sub			Sue	1.										
U			U	-										
2	0.033		2	1										
0			0	1										
Chamage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V							
	at affective	Section	A	9	R	(m <sup>3</sup> /s)	Velocity							
	denth													
16	3	2	0.0	10.5	0	000	0.00							
21	0.25	2	1.3	5.0	0.25	0.45	0.96							
26	0.36	2	1.8	5.0	0.36	0.63	0.46							
31	0.58	2	29	5.0	0.58	1.83	0 63							
36	0.85	2	43	5.0	0.85	3.47	0 82							
41	1.49	2	7.5	5.0	1.49	5.84	1.19							
46	3.27	2	16.4	5.0	3.27	32.75	2.00							
51	3.87	2	19.4	5.0	3 87	43.36	2.24							
56	3 94	2	19.7	5.0	3 94	44.68	2.27							
61	4 555	2	22.8	5.0	4 555	56.89	2.50							
66	5.254	2	26.3	5.0	5.254	72.18	2.76							
/1	5.024	2	251	5.0	5.024	66 99	2.67							
/6	5,359	2	26.8	50	5,359	/4 50	278							
81	5.4/7	2	32.4	2.0	5.4//	102.30	316							
00	5.469	2	21.4	5.0	5 469	0.8 14	2.00							
91 06	3 04 1	4	20.6	90 50	6 61	00-11 106-20	4.80							
90 101	601	4	33.1	3.0 # 0	6 67 4	102.02	3.20							
101	6.071 6.73	5	33.7	5.0	673	109.54	274							
100	6 872	2	34.4	50	6.872	112.91	3 29							
116	6 791	2	118.8	17.5	6 791	387 44	3 26							
146	4.216	2	73.8	175	4.216	175.04	2.27							
151	4,3	2	21.5	5.0	4.3	51.66	2.40							
156	2 53	2	12.7	5.0	2 53	21.35	1.69							
161	88.0	2	4.4	5.0	0.88	3.67	0.63							
166	Ø	2	0.0	2.5	0	0 00	0.00							
	G	2	0.0	0.0	0	0.00	0.00							
	0	2	0.0	0.0	0	0.00	0.00							
						1747.31	2.78							
A. 147		C	ella value	calculation	\$		Della							
	ACL CRO	Lowel	Upper	v-lower	VCOPDET	V-851	C era							
50%	83.0	87.00	86.00	5 16 A 05	2.83	2.03	0.92							
40%	54.0	97.00	96.00	2.95	2.54	2.0	0.90							
0076 608/	100.0	148.00	146.00	0.42 3.08	2.24	8.36	0.85							
70%	127.0	118.00	144.00	176	2 37	2.93	0.95							

Measured data												
STA RIVE PLAC	TION No. : R NAME : E NAME :	D1H003 Oranje Aliwal Noord	1	Average	STAR e Gaugepla	T TIME : te reading	08h15 2.835	m	Mannii			
	DATE :	2/10/94							Roughne			
					Main Char	nel LEFT :	50		Sub			
				1	Main Chanr	el RIGHT	160		0			
									2			
1	2	3	4	5	6	7	8	9	0			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainane			
aumhar	•	or affective		0.44	0.84	(111)	(m <sup>2</sup> )	(m <sup>3</sup> /s)				
number		douth	0.20	U.40	U:80	(IIVS) 2 60¢	677 0	4750 69				
	14 8	uepui O	0	n	0	2.090	011.0	1/09.00	14			
;	15.7	0.2	0	0 148	0	0.000	0.0	0.00	15			
23	20.7	0.2	ő	0.000	0	0.940	0.0	0.09	20			
4	25.7	0.10	õ	1.087	0	1.087	1.5	1.58	20.			
5	30.7	0.20	0 852	0.778	0 72	0.782	1.5	3.00	30			
6	35.7	1 35	0.002	0.636	0.72	0.702	4.U 6.8	4.29	35			
7	40.7	2.28		0.030	0	0.000	11 /	4.23	35.			
,	40.7	2.20	0 471	0.21	0 211	0,210	11,4	2.39	40			
0	45.7	3.02	1 402	1.625	1 27	1,633	10.1	0.50	45			
10	56.7	4.0 E 03	1.432	1.000	1.57	1.555	23.0	35.20 EE 47	50			
10	50.7	5.03	2.399	2.197	1.301	2.194	25.2	35.17	55.			
11	60.7 65.7	5.227	2.749	2,551	1.940	2.450	26.1	64.02	60.			
12	65,7	5.166	2.922	3.057	2.585	2.905	25.9	/5.36	65.			
13	70.7	5.417	3.082	3,108	2,568	2.967	27.1	80.35	70.			
14	/5./	5.582	3,154	3,403	2.72	3.170	27.9	88.4/	/5.			
15	80.7	6.888	2,496	3.289	2.85	2.981	34,4	102.67	80.			
16	85.7	6.03	3,078	3.365	3.057	3.216	30.2	96.97	85.			
17	90.7	6.086	2.715	3.382	3.192	3,168	30.4	96.39	90.			
18	95.7	7.197	2.753	3.445	3.331	3.244	36.0	116.72	95.			
19	100.7	6.958	3.078	3.487	3.399	3.363	34.8	116.99	100.			
20	105,7	6.985	2.682	3,323	3,546	3.219	34.9	112.41	105.			
21	110,7	7.004	2.209	2.88	3.673	2.911	35.0	101.93	110			
22	115.7	7.099	0	3.433	D	3.433	35.5	121.85	115.			
23	120.7	7.11	0	2.838	0	2,838	106,7	302.67	120			
24	145.7	4.13	0	2.234	0	2.234	62.0	138.40	145.			
25	150.7	4.35	1.062	1,197	1.344	1.200	21.8	26.10	150			
26	155.7	2.59	0.674	0.513	0.45	0.538	13.0	6.96	155			
27	160.7	0.96	0	0.117	0	0.117	4.9	0.57	160			
28	165.9	0	0	0.000	0	0.000	0.0	0.00	165.			
						2.596	677.8	1759.63				
				• <b>14</b> = = [								
	% Width	Act Chn	Children	Chilloner	alculation	S V Llonor	V int	Delta	er thriete			
	30%	82 A	an to	DE 70	7 OP	v-opper:	¥+lt)‡	0 P.4	A DECK			
	X0%	03.0	00 70	00.70	2.00	3.22	5.09	0.04	104			
	50%	34.0 10E 0	90.70	106 70	2.17	5.24	3.22	0.01	50%			
	60%	146.0	100.70	100.70	2.30	5.22	3.24	0.80	60%			
	70%	137.0	100.70	120.70	5.43	2.84	3.40	0.70	44%			
	1.4 /0		120.70	143.70	2.04	2.23	2.09					

	Calculated data, 1-dimensional flow theory anning or Chezy: M Q = 888.0													
Manning	or Chez	v:	M			Q #	888.0							
			0.00022			V =	1 31							
			0.00022			****	1.51							
Roughness	coeff		Area reduct	ion factor										
Sub			Sub	4.										
U			U	1										
2	0,036		2	1										
0			0	1										
Chainage	Vertical	544	Area	Wetted P	H-Radius	Q	V							
	or effective	Section	А	q	R	(m <sup>3</sup> /s)	Valocity							
	depth													
14.8	0	2	0.0	79	Ø	0.00	0.00							
15.7	0.2	2	0.6	3.0	0.2	0.08	0.14							
20.7	0.18	2	09	5.0	0.18	0 12	0.13							
25,7	Q.29	2	1 5	5,0	0.29	0 26	0 18							
30.7	0 79	2	40	5.0	0.79	1.39	0.35							
35.7	1.35	2	6.8	5.0	1.35	3.40	0.50							
40.7	2.28	2	11.4	5.0	2.28	8,14	0.71							
45.7	3.62	2	18.1	50	3.62	17.58	0.97							
50.7	4.6	2	23.0	50	4.6	26.21	1 14							
55.7	5.03	2	25.2	5.0	5.03	30.42	1.21							
60.7	5 227	2	26.1	5.0	5 227	32.43	1 24							
65,7	5 188	2	25 9	5.0	5 188	32 83	1.23							
70.7	5.417	2	27 1	5.0	5 417	94 42	1.27							
75.7	5.582	2	27 9	5.0	5.582	36.18	1.30							
80.7	6.888	2	34.4	5.0	6.888	51.37	1.49							
85.7	6.03	2	30.2	50	6.03	41.15	1.36							
90.7	6.066	2	30.4	50	6.066	41.79	1.37							
95.7	7 197	2	36.0	5.0	7 197	65.27	1.54							
100.7	6 958	2	34.8	5.0	6 958	52.24	1.50							
105.7	6 985	2	34 9	5.0	6 985	52 58	1 51							
110.7	7.004	2	35.0	5.0	7 004	52.82	1.51							
115.7	7.099	2	35.5	5.0	1.088	54.92	1.52							
120.7	/ 11	2	106.7	150	/ 11	102.47	152							
145.7	4.13	4	62.0	130	4.13	89.70	1.06							
150.7	4.35	2	21.8	50	4.35	23,66	110							
155.7	2.59	4	13.0	5 U 8 J	4.09	10.05	0.70							
160.7	0.30	2	4.9	9 I 7 D	0.90	0.00	0.40							
100,9		4	577 76	2:0		997 66	4 14							
			41113											
		I	)elta value i	calculation	8									
% Width	Act Chin.	Lower	Upper	V-lower	V-Upper	V-int	Detta							
30%	83.0	80 70	85.70	1.49	1.36	1 43	0.91							
40%	94.0	90.70	<b>66.70</b>	1 97	1.54	1 48	0.88							
50%	105.0	100.70	105 70	1 50	1.61	1.60	0.87							
60%	116.0	115.70	120.70	152	1.52	1.62	0.86							
70%	127.0	120.70	145 70	1.62	1.08	1.41	0.93							

			Me	asured da	ita				Atterne	Cal	culated	data, 1-dir	nension	al flow the	eory	
STA	TION No. :	D1H003			STAF	RT TIME :	09h33		Manning	or Chezy	<i>r</i> .	M			Q =	2472.
RIVE PLAC	R NAME : E NAME :	Oranje Aliwal Noord		Average	Gaugepla	ite reading :	3.406	m			Slope	0.001			V <sub>AVR</sub> =	3.01
	DATE :	2/9/94							Roughnes	s coeff		Area reduc	tion factor	1		
					Main Cha	nnel LEFT :	50		Sub	n		Sub	fa	1		
				N	lain Chani	nel RIGHT :	160		0			0	1	1		
									2	0.036		2	1			
1	2	3	4	5	6	7	8	9	0			0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chanage	Vertical	Sub	Area	vvetted P	H-Radius	Q	V
number		or effective	0.26	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)		ne office tive	Section	Δ.	9	R	(m <sup>3</sup> /s)	Velocity
		depth				2.962	821.7	2434.00		riscith						,
1	11.3	0		0		0.000	0.0	0.00	11.3	()	2	0.0	8 1	0	0.00	6.00
2	16.1	1.03		-0.546		-0.546	5,0	-2.76	16,1	1 63	2	50	4.9	1 03	4.62	0.90
3	21.1	0.47		-0.59		-0.590	2.4	+1.39	21.1	0.47	2	2.4	5.0	0.47	1.25	0.53
4	26.1	0.65		-0.662		-0.662	3.3	-2.15	26.1	0.65	2	3.3	5.0	0.65	2.14	0.66
-	31.1	1,45		-0.429		-0.429	1.3	-3,11	31.1	1.45	2	L / 3	5.0	1 45	8,16	1.13
5	41 1	2.55 4 78		1 305		1 395	22.0	•1.70 33 34	30.1	4.33 4.72	5	14./	50	4 78	20-30 60-67	5.00
8	46.1	5 15		2 167		2 167	25.8	55.80	46 1	4 10 4 16	5	25 8	50	5 15	67.45	267
g	51.1	5.37		2.551		2.551	26.9	68.49	51.1	5.37	2	26.9	5.0	5.37	72 33	2.69
10	56,1	5.844		2.99		2,990	29,2	87.37	56,1	5 844	2	29 2	5.0	5 844	83.28	2.85
11	61,1	5.771		3.344		3.344	28.9	96.49	61.1	5.771	2	28.9	5.0	5.771	81.55	2.83
12	66.1	5.801		3.373		3.373	29.0	97.83	66.1	5.801	2	29.0	5.0	5.801	82.26	2.84
13	71.1	6,149		3.466		3.466	30,7	106.56	71.1	6 149	2	30 7	5.0	6 149	90.64	2.95
14	76.1	6.427		3.601		3.601	32.1	115.72	76.1	6.427	2	32.1	50	6.427	97.58	3 04
15	81.1	1./32		3.757		3.757	38./	145.25	81.1	1/32	2	38.7	50	1734	132.79	3.43
10	00.1	7.004		3,905		3,905	32.0	121.19	00.1	0.014	2	32.0	30 ¢n	2 004	39.73	2.00
18	96.1	8 409		3 791		3 791	42 0	159.30	96.1	8.400	5	42.0	5.0	8.409	152 72	363
19	101 1	8 28		3,812		3 812	41.4	157 82	101.1	8 28	2	41 4	50	8.28	148 84	3.60
20	106.1	8.051		3.707		3.707	40.3	149.23	106.1	8.051	2	40.3	5.0	8.051	142.04	3 53
21	111.1	7.765		3.58		3.580	38.8	138.99	111.1	7 765	2	36.8	5.0	7 765	133.73	3.44
22	116.1	7.822		3.589		3.589	156.4	561.46	116.1	7.822	2	156.4	20.0	7.822	641.49	3 46
23	151.1	5.158		1.699		1.699	103.2	175.27	151.1	5 158	2	103.2	20.0	5 158	270.52	2.62
24	156.1	3.886		1.302		1.302	19.4	25.30	156.1	3.886	2	19.4	5.0	3.886	42.19	2.17
25	161.1	1.98		0.741		0.741	9.9	7.34	161.1	1.98	2	9.9	5.0	1.98	13.71	1.39
26	166.1	1.14		0.154		0.154	5.0	0.76	166.1	1.14	2	5.0	4.4	1.14	4 76	0.96
27	169,8	0		0		0.000	0,0	0.00	169.8	0	2	00	19	0	0.00	0.00
28	4					0.000	0.0	0.00			2	0.00	0.0	0	0.00	0.00
						2.302	041./	2434.00				621.0/			2472.20	1
			C	leita value c	alculation	15						Selta value	calculatio	<b>115</b>		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act. Chn.	Lower	Upper	Volgwer	V-Lopper	Vapt	Della
	30%	83.0	81,10	86.10	3.76	3.91	3.81	0.78	30%	83.0	81.10	86 10	3.43	3.06	3.29	0.91
	40%	94.0	91,10	96.10	3.87	3.79	3.82	0.77	40%	94.0	91 10	96.10	3.22	2.63	3.45	0.87
	50%	105.0	101,10	106,10	3.81	3,71	3,73	0.79	60%	105.0	101 10	106 10	3.50	3.53	3 54	0.85
	60%	116.0	111.10	116.10	3.58	3.59	3.59	0.83	60%	116.0	111.10	116.10	3 44	3.46	3.46	0.87
	70%	127.0	116.10	151.10	3:69	1.70	3.00	0.99	7.0%	147.0	116.10	151 10	3,48	2.62	a 20	0.94

2472.3 3.01

1.39 Ø 96 0.00 0.00 3.01

Deita 0.91 0.87 0.85 0.87 0.94













The values in the legend block describe measured discharge for the profile indicated

STATION No.:       D1H009       START TIME:       10h10       Manning or C         RIVER NAME:       Oranje       Average Gaugeplate reading :       1.96       m         PLACE NAME:       Oranjedraai       DATE:       2/12/91       Roughness coeff         Main Channel LEFT :       20       Sub       r	Shezy: Flope 7 035 float 540	M C 0008 Area reduc Sub 0 2 0	tion factor f <sub>A</sub> 1 1		Q = V <sub>AVR</sub> =	562.6 1.53
RIVER NAME : Oranje       Average Gaugeplate reading : 1.96 m         PLACE NAME : Oranjedraai       DATE : 2/12/91         Main Channel LEFT : 20       Sub	Flope           fr           0           035           rice:         300	0 0008 Ares reduc Sub 0 2 0	tion factor f <sub>4</sub> 1 1	1	V <sub>AVR</sub> =	1.53
PLACE NAME : Oranjedraal DATE : 2/12/91 Main Channel LEFT : 20 Sub r	ff 1 0.035	Area reduc Sub 0 2 0	tion factor f <sub>4</sub> 1 1			
DATE : 2/12/91 Main Channel LEFT : 20 Roughness coeff	ff. n 035	Area reduc Sub 0 2 0	tion factor f <sub>4</sub> 1 1	]		
Main Channel LEFT : 20 Sub n	n 035 Real: But	Sub 0 2 0	f <sub>λ</sub> 1 1			
	035 Mat Sub	0 2 0	1	1		
http://www.ipici.ut.com/	035 Histi Sub	0 2 0	1			
Main Channel RIGHT : 160 0	ricei Sub	0	1			
	dacasi Sulb		4			
	raca: Sub					1 . V
vencer chanage vencer vencer vencer vencer vencer vencer cave. Arca u chanage ven		Area	Afatted b	M-Radius	<u>ч</u>	v
number or effective 0.2d 0.4d 0.8d (m/s) (m ) (m /s) or effective 0.2d	fective Section	A	P	R	(m'/s)	Velocity
depth 1,405 367.2 515.69 dep	apth					
	0 2	00	10.0	0	0.00	0.00
2 20 2.11 0.04010 0.9405 1.04062 0.9405 10.5 10.01 20	2 2	10.6	5.0	2.11	14.03	1 33
	2 556 2	12.0	50	2 556	79.31	1.51
5 35 2 318 2 2 1032 2 2 317 2 2 3023 3 2 3 11 3 2 10 3 3 2 3 3 2 3 3 3 3 3 3 3 3 3 3 3 3 3	3 3 3 5 5 5	11.3	20	2.201	10.74	1.09
6 40 2 608 1 41248 1 9098 2 1855 1 8 2 4 8 40 3	2,000 2	12.0	5.0	2.330	10-04 46-07	
7 45 3265 1 471 1 6382 1 98932 1 564 16 3 27.49 45 3	3 285 2	183	50	3 265	29.03	1 17
8 50 2.971 1.68 1.93498 2.07292 1.906 14.9 28.31 50 2	2 971 2	14.9	50	2 971	24.81	1.67
9 55 3,664 1,43756 1,57968 1,71344 1,578 18.3 28.90 55 3	3664 2	18.3	50	3 664	36.19	1.92
10 60 3.684 1.1993 1.46682 1.66328 1.449 18.4 26.69 60 3	3.684 2	18.4	5.0	3.684	35.61	1.93
11 65 3.375 1.27454 1.41666 1.66328 1.443 16.9 24.35 65 3	3 375 2	16.9	50	3 375	30.68	1.82
12 70 3.4 1.22856 1.38322 1.6591 1.414 17.0 24.03 70	3.4 2	17 0	5.0	3.4	31.06	1 83
13 75 3.136 1.06136 1.18258 1.55878 1.246 15.7 19.54 75 3	3.136 2	15.7	5.0	3.136	27 15	1 73
14 80 2.846 1.25782 1.3874 1.52116 1.388 14.2 19.76 80 2	2 846 2	14.2	50	2 846	23.09	1.62
15 85 3.03 1.13242 1.2411 1.5337 1.287 15.2 19.50 85	3.03 2	15.2	5.0	3.03	25.64	1.69
16 90 2.746 0.98612 1.15332 1.35396 1.162 13.7 15.95 90 2	2 746 2	13.7	5.0	2.746	21.76	1.58
1/ 95 2.321 1.20348 1.15/5 1.349/8 1.21/ 11.6 14.12 95 2	2 321 2	11.6	50	2 321	16.44	1.42
	1.602 2	9.3	5.0	1.852	11.29	122
	1 917 2	90	50	1.917	11.93	1.23
	1042 2	11.0	50	1 042	17.02	1 14
21 13 2.51 0.5250 1.2460 1.2650 1.106 11.3 12.51 130 2	2041 2	11.3	5.0	2.041	16.74	1 30
	2022 2	10 1	50	2 022	13.06	1.29
24 130 1.882 1.25364 1.35814 1.4501 1.355 9.4 12.75 1.30 1	1882 2	94	5.0	1 882	11.59	1 23
25 135 1 767 1 4292 1 41666 1 58386 1 462 8.8 12.91 135 1	1 767 2	8.8	50	1 767	10.44	1.18
26 140 1.772 1.10316 1.27454 1.29126 1.236 8.9 10.95 140 1	1772 2	6.9	50	1 772	10.48	1.18
27 145 1.822 1.22438 1.41248 1.5128 1.391 9.1 12.67 145 1	1.822 2	9.1	5.0	1.822	10.98	1.21
28 150 1.954 1.14078 1.195 1.42502 1.239 9.8 12.11 150 1	1.954 2	9.8	5.0	1.954	12.34	1 26
29 155 2.074 1.1366 1.266 1.4501 1.280 10.4 13.27 155 2	2 074 2	10.4	5.0	2.074	13.63	1.31
30 160 2.526 0.94014 1.199 1.24946 1.147 10.7 12.31 160 2	2.526 2	10.7	4.3	2.526	16.09	1.60
31 163.5 2.525 0.56394 0.748 0.74786 0.702 7.2 5.05 163.5 2	2 525 2	72	28	2 525	10.78	1.50
32 165.7 0 0 0.000 0 0.000 0.0 165.7	0 2	0.0	1.1	0	0.00	0.00
1.405 367.2 515.69		367.17			562.64	1.5
Delta value salavisticas		Delle	colouint'-			
Width Act Chn Chuinner Chuinner Vulnuer Vulnuer Vulner Daite	Cho Lower	Lipoer	V-lower	Velimper	Vapt	Delta
30% 62.0 60.00 65.00 145 144 145 0.97	2.0 50.00	65.90	193	1.87	1.68	0.81
40% 76.0 75.00 80.00 126 139 127 110 40% 76	6.0 75.00	80.00	173	1.62	1.71	0.90
50% 90.0 90.00 9500 116 1.22 116 1.21 50% 90	0.0 90.00	99.00	1.58	1 42	1.58	0.97
60% 104.0 100.00 105.00 1.37 1.38 1.37 1.02 60% 104	100.00	105.00	1.22	1.25	1.24	1.23
70% 118.0 115.00 120.00 1.13 1.11 1.11 1.26 70% 111	8.0 116.00	120 00	1 44	139	1.41	1.09

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			Me	asured d	ata					Cal	culated o	lata, 1-di	mensiona	al flow the	eory	
STA	STATION No. : D1H009 START TIME : 12h04 RIVER NAME Orania Average Gaugesiate reading : 2,287 m							Manning	or Chezy		M			Q =	872.5	
RIVE	R NAME :	Oranje		Averag	e Gaugepla	ite reading :	2.257	m			Slope	0.0008			VAVR #	1.86
PLAC	E NAME :	Oranjedraai											<u> </u>	-		
	DATE .	10/0/07							Roughnes	s coell.		Area reduc	tion lactor	4		
					Main Cha	nnei LEF I :	20		Sub	fi		SHID	ΓA.	4		
					Main Chani	nel RIGHT :	160		0			0	1			
4	2	2	4	E	c		0	0	2	0.033		2				
Vertical	Chainana	Vector	•	C L	O	/ V avor	0 	9	U			U		11.0		T N
#Craca	ପ୍ରାଣ୍ଣା <b>ଯ</b> ୍ଯାର	veraca	velocity	VEICAL	velocity	V avei.	(m <sup>2</sup> )	(m <sup>3</sup> /c)	Chanage	Verscel	200	Ares	AAsueo :-	Lettedine	W.	
number		orestective	0.20	0.4d	0.8d	(m/s)	())) )	(11175)		of effective	Section	A	P	R	fiit (2)	Velocity
		depin A		0		1,640	4/0.3	//1.36	11	depth			7.5			
2	15	2.07		1 0335		1.034	93	9.63	15	2 67	5	9.3	45	207	12.97	+ 39
3	20	2.18		1.45		1.450	10.9	15.81	20	2 18	2	10.9	50	2.18	15.71	1.44
4	25	2.294		1.943		1.943	11,5	22.29	25	2.294	2	11 5	5.0	2 294	17.10	1.49
5	30	2.474		2.3935		2.394	12.4	29.61	30	2 474	2	12.4	5.0	2.474	19 39	1.57
6	35	2.693		2.5295		2.530	13,5	34.06	35	2.693	2	13 5	5.0	2 693	22.34	1 68
1	40 45	3.041		2.385		2.385	15.2	36.26	40	3 041	2	15.2	50	3.041	27 35	1.80
0 0	40 50	3,363		2.3933		2.394	17.9	42.90	45	3.585	2	11 9	20	3 565	35.99	201
10	55	3 083		2 0365		2.037	15.4	31 39	55	3,423	5	15.4	50	3 083	27.99	1.87
11	60	3.872		1.671		1.671	19.4	32.35	60	3.872	2	19.4	50	3.872	40.92	2.11
12	65	3,772		1.6795		1.680	18,9	31.68	65	3,772	2	18.9	5.0	3 772	39.17	2.08
13	70	3.465		1.8155		1.816	17.3	31.45	70	3 465	2	17.3	5.0	3.465	34.00	1.96
14	75	3.797		1.6625		1.663	19,0	31.56	75	3.797	2	19.0	5.0	3 797	39.60	2.09
15	80	3.053		1.6795		1.680	15.3	25.64	80	3.053	2	15.3	5.0	3.053	27.53	1.80
16	85 00	3.592		1.45		1.450	18.0	26.04	85	3,592	2	180	5.0	3 592	36.10	201
12	90	3.8		0 0005		1.195	19.0	46.00	90	30	2	12.0	50	2.0	33.00	1 0.6
19	100	3 12		1 4415		1 442	17.0	22 49	100	3 12	5	15 6	50	3.12	78.65	183
20	105	3		1.416		1.416	15.0	21.24	105	3	2	15.0	5.0	3	26.74	1.78
21	110	2.62		1.518		1.518	13.1	19,89	110	2.62	2	13.1	5.0	2.62	21 34	1.63
22	115	2.753		1.3905		1.391	13,8	19.14	115	2.753	2	13 8	5.0	2 753	23.17	1 68
23	120	3.263		1.518		1.518	16.3	24,77	120	3.263	2	16.3	5.0	3.263	30.76	1.89
24	125	2,86		1.4755		1.476	14,3	21.10	125	2.86	2	14 3	5.0	2.86	24.70	+73
25	130	3,15		1.5435		1.544	15.8	24.31	130	3.15	2	15.8	50	3 15	29.04	1.84
26	135	2.916		1.4075		1,408	14.0	20.52 22 EE	135	3 033	4	14.6	50 60	2.910	10.02	1 175
28	140	3 153		1 671		1.671	14,0	26.34	145	3 153	2	15.8	50	3 153	29.05	184
29	150	3,295		1.731		1.731	16.5	28.51	150	3.295	2	16.5	5.0	3.295	31.27	1.90
30	155	3.503		1.578		1.578	17.5	27.63	155	3 503	2	17.5	5.0	3.503	34.63	198
31	160	3.59		0.957		0.957	21.5	20.61	160	3,59	2	21.5	6.0	3.59	43.29	2.01
32	167	0		0.000		0.000	0.0	0.00	167	C	2	0.0	3.5	0	0.20	0.00
						1.640	470.3	1 771.36				470.25	1		872.62	1.8
			D	elta value	calculation	IS					1	Detta value	calculatio	ns		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act. Chin.	Lawer	Upper	V-lower	VAUpper	V-int	Delta
	30%	62.0	60.00	65.00	1.67	1.68	1.67	0.98	30%	\$2.0	60.00	65.00	211	2.08	2.10	0.68
	- 40%	76.0	75.00	80.00	1.66	1.68	1.67	0.98	40%	76.0	75.00	80.00	2.09	1.80	2.03	0.81
	50%	90.0	90.00	95.00	1.20	1.00	1.20	1.37	50%	90.0	90.00	95.00	2.09	1.94	2.09	0.89
	60%	104.0	100.00	105.00	1.44	1.42	1.42	1.15	60%	104.0	100.00	105.00	1.83	175	179	1.04
	10%	118.0	135.00	120.00	1.39	1.52	1.9/	1.14	1.		0001350100000	120.00	1.05	10001080	1 COLOR	

			Me	asured da	ata				11	Cal	culated d	lata, 1-dir	nension	al flow the	eory	
STA	TION No. :	D1H009			STA	RT TIME	08h36		Manning	j or Chez	y:	M			Q =	999.2
RIVE	R NAME :	Oranje		Averag	e Gaugeph	ate reading :	2.6	m			Slope	0.0008			V <sub>AVR</sub> =	1.84
PLAC	E NAME :	Oranjedraai								-				-		
	DATE .	10/10/6/			Main Cha	enel I EET -	20		Rougnnes			Area reduc	tion factor	4		
					IVIAIII CIIA		20			4		500	<b>'A</b>	4		
					Main Chan	nel RIGHT :	160		U A	0.000		0				
1	2	3	4	5	6	7	8	9	0	0.036		0				
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Sub	Area	Wetted P	H+Radius	Q	T V
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)		or effective	Section	A	p	R	(m <sup>3</sup> /s)	Velocity
		depth				1.841	542.0	998.03		depth						
1	11	0		0		0.000	0.0	0.00	11	0	2	0.0	75	0	0.00	0.00
2	15	2.43		0.821		0.821	10.9	8.98	15	2 43	2	10 9	4.5	2.43	15.53	1.42
3	20	3.17		1.5265		1.527	15.9	24.20	20	3.17	2	15.9	5.0	3.17	26.87	1 70
4	25	3.768		1.8835		1.884	18.8	35,49	25	3,768	2	18.8	50	3.768	36.84	1.90
5	30	4.413		1.943		1.943	22.1	42.87	30	4.413	2	22.1	5.0	4.413	46 54	2.11
6	35	4.313		2.0195		2.020	21.6	43.55	35	4 313	2	216	5.0	4.313	44 89	2.08
1	40	4.017		2.147		2.14/	20.1	43.12	40	4.017	2	20.1	5.0	4.017	39.88	1 99
Q Q	40	3.704		2.0000		2.054	18.5	38.01	45	3.704	2	18.5	50	3.702	34.60	1.58
10	55	3.334		2.2/40		2.2/5	17.0	37.04	50	3 094	2	17.0	3.0	3.394	30.31	1 4 40
11	60	3 478		2 1215		2 122	174	36.89	60	3 470	5	17 4	5.0	3 478	51 DG	1.80
12	65	3.088		1.9345		1 935	15.4	29.87	65	3.088	2	15.4	50	3 088	26.72	1.67
13	70	3.481		1.977		1,977	17.4	34.41	70	3.481	2	17.4	5.0	3.481	31 41	1.80
14	75	3,516		1.96		1,960	17.6	34.46	75	3 516	2	17 6	5.0	3.516	31 94	1.82
15	80	3.669		1.841		1.841	18.3	33.77	80	3.669	2	18.3	5.0	3.669	34.29	1.87
16	85	3.25		1.8665		1.867	16.3	30.33	85	3.25	2	16,3	50	3.25	28.01	1.72
17	90	3.539		1.9855		1.986	17.7	35.13	90	3.539	2	17.7	5.0	3.539	32.29	1.82
18	95	3.297		1.7305		1.731	16.5	28.53	95	3 297	2	16 5	5.0	3.297	28.69	174
19	100	3.171		2.011		2.011	15.9	31.88	100	3.171	2	15.9	5.0	3.171	26.89	1 70
20	105	3.508		1.892		1.892	17.5	33.19	105	3,506	2	17.5	50	3.508	31.82	1.81
21	110	3.615		1.603		1.603	18,1	28.97	110	3.615	2	18.1	5.0	3.615	33 45	1.85
22	115	3,655		1.756		1.756	18.3	32.09	115	3 695	2	183	5.0	3.655	34.07	1.86
20	120	3.632		1.824		1.824	19.2	34,95	120	3.032	2	19.2	5.U E A	3.632	20.00	1
29	120	3.403		1.0435		1.000	17.5	54.02	120	3.403	Ś	17.0	50	3.403	01.14 54.76	+ 64
20	130	3.51		1.9175		1.910	17.8	31 30	130	3.57	5	17.0	50	3.50	32.00	1 4 94
27	140	3 523		1 7475		1 748	17.6	30.78	140	3 579	5	17.6	50	3 523	32.04	1.87
28	145	3 705		1748		1 748	18.5	32 37	145	3 705	5	18.5	5.0	3 705	34.85	1.88
29	150	3 692		1 850		1 850	18.5	34 14	150	3 682	2	18.5	5.0	3 692	34.65	1.88
30	155	3.655		1.620		1.620	18.3	29.61	155	3.655	2	18.3	5.0	3.655	34.07	1.86
31	160	3.78		1.314		1.314	28.4	37.25	160	3 78	2	28.4	7.5	3.78	54.05	1.91
32	170	0		0.000		0.000	0.0	0.00	170	0	2	00	5.0	0	0.0 <b>0</b>	00.00
						1.841	542.0	998.03				542.01			999.22	1.
			F	Nelta value :	alculation	15					r	)eita value	calculation	16		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-int	Delta	% Width	Act Chn	Lower	Lipper	Vilower	V-Upper	V-int	Delta
	30%	62.0	60.00	65 00	2.12	193	2.05	0,90	30%	62.0	60.00	65.00	1.80	1.67	1.75	1.05
	40%	76.0	75.00	80.00	1.96	1.84	1.94	0.95	40%	76.0	75.00	80.00	1.82	1.87	1.63	1.01
	50%	90.0	90.00	95.00	1.99	1.73	1.99	0.93	50%	90.0	90.00	95 00	1.82	1 74	1.82	1.01
	60%	104.0	100.00	105.00	2.01	1.89	1.92	0.96	60%	104.0	100.00	105.00	1.70	1 81	1.79	1.03
	70%	118.0	115,00	120.00	1,76	1 82	1.80	1.02	70%	118.0	115 00	120,00	1 86	1.92	1.90	0.97

	Stellenbosch Univers	ity http://schola
Measured data		
START Average Gaugeplate	TIME : 14h36 reading : 3.27 m	Manning or Ci

#### ar.sun.ac.za

	DATE :	10/3/87			Main Cha	nnel LEFT :	20	
				N	<b>lain Chan</b> i	nel RIGHT :	160	
1	2	3	4	5	6	7	8	9
<b>stical</b>	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
mher		ar offective	0.34	0.44	<b>5</b> .04	(m/c)	(m²)	(m <sup>3</sup> /s)
nice.		dooth	020	U.Hu	0.00	9 444	500 0	1420.20
1	7	aepui A		0		2,444	0.0	0.00
,	11	1.6		1 2545		1 255	6.4	8.03
3	15	1 954		1 6115		1 612	8.8	14 17
4	20	2 458		2 0875		2 088	12 3	25.66
5	25	2,853		2 5635		2 564	14.3	36.57
6	30	3.034		2,589		2.589	15.2	39.28
7	35	3.232		2 9545		2 955	16.2	47 74
8	40	3.322		3.184		3.184	16.6	52 89
9	45	3.371		3.048		3.048	16.9	51.37
10	50	3.519		3.0905		3.091	17.6	54.38
11	55	3.578		3.1415		3 142	17.9	56.20
12	60	3.656		3.099		3.099	18 3	56 65
13	65	3.763		3.065		3.065	18.8	57.67
14	70	3.773		3.3625		3,363	18.9	63.43
15	75	3.793		2.946		2.946	19.0	55.87
16	80	3.753		2,5975		2.598	18.8	48.74
17	85	3.771		2.827		2.827	18.9	53,30
18	90	3.776		2.9545		2.955	18.9	55.78
19	95	3.799		2.8355		2.836	19.0	53,86
20	100	3.776		2.7845		2.785	18.9	52.57
21	105	3.934		2.793		2.793	19.7	54,94
22	110	4.004		2.8185		2.819	20.0	56.43
23	115	4.113		2.6315		2.632	20.6	54.12
24	120	4.246		2.2575		2.258	21.2	47.93
25	125	4.716		2,164		2.164	23.6	51.03
26	130	4.784		2.0875		2.088	23.9	49.93
27	135	4.963		1.977		1.977	24.8	49.06
28	140	4.861		1.714		1.714	24.3	41.65
29	145	4.842		1.977		1.977	24.2	47.86
30	150	4.761		1.612		1.612	23.8	38,36
31	155	4.311		1.382		1.382	21.6	29.79
32	160	4.6		1.136		1.136	29.9	33.95
33	168	Ō		0.000		0.000	0.0	0.00

STATION No.: D1H009

% Width Act. Chn.

30%

40%

50%

60%

70%

62.0

76.0

90.0

104.0

118.0

Ch-Lower

60.00

75.00

90.00

100.00

115.00

Ch+Upper

65.00

80.00

95.00

105.00

120.00

V-lower

3.10

2.95

2.95

2.78

2.63

V-Upper

3.07

2.60

2.84

2.79

2.26

V-Int

3.09

2.88

2.95

2 79

2.41

Delta

0.79

0.85

0.83

0.88

1.02

50%

60%

70%

90.0

104.0

118.0

90.00

100-00

115.00

95 00

105.00

120.00

	Cal	culated d	lata, 1-din	nensional	flow the	ory	
Manning	or Chezy	:	М			Q =	1064.8
		Siepe	0.0008			V <sub>AVR</sub> =	1.81
Roughmess	coeff		Areasteduc	ion factor			
Sub	n		Sub	fa -			
0			0	1			
2	0.039		2	4			
Ø			Q	1			
Chatimatha	Vation	Nith.		Motherd R	H.P.aduuc	0	M
en con augo	•Craces	Stat	mes	ereccos :		(m <sup>3</sup> /e)	
	or effective	Section	A	P	H	(++) (a)	velocity
7	Cepin	<u>.</u>		e e			2.02
11	18	5	6.6 8.4	4.0	1.6	6.35	0.49
15	1 954	2	8.8	45	1 954	9.97	1 13
20	2 458	2	12.3	50	2 458	16.23	1.32
25	2 853	2	14.3	5.0	2 853	20.81	146
30	3.034	2	15.2	5.0	3.034	23.05	3.52
35	3.232	2	16.2	5.0	3 2 3 2	29.62	1.92
40	3.322	2	16.6	5.0	3.322	25.82	1.61
45	3 371	2	16.9	5.0	3 371	27.48	1.63
50	3.519	2	17.6	5.0	3.519	29.82	1.68
55	3 578	2	17.9	5.0	3.578	30.35	170
60	3.656	2	18.3	5.0	3.656	31.45	1.72
65	3.763	2	18.8	5.0	3 763	33.01	175
70	3.773	2	18.9	50	2.772	33.16	1.78
(D) 00	3.793	4	19.0	2.0	3 183	40.40	1 / D 4 Ta
00 85	3 774	5	10.0	50	3.720	32.62	178
00 90	3 778	5	18.5	5.0	9 776	38.25	1 76
95	3 700	5	19.0	50	3 799	33.54	177
100	3,776	2	18.9	50	3.776	33.20	1.76
105	3 934	2	19 7	5.0	3 934	36.58	181
110	4.004	2	20.0	50	4.004	35.61	1.83
115	4 113	2	20.6	5.0	4 113	38.29	186
120	4.246	2	21.2	5.0	4.246	40.27	1.90
125	4.716	2	23.6	50	4.716	48.09	2.04
130	4 784	2	23.9	5.0	4 784	49.25	2.06
135	4,963	2	24.8	50	4.963	52.36	2.11
140	4 861	2	243	5.0	4 861	\$0.58	2.08
145	4.842	2	24.2	50	4,842	50.25	2.08
150	4 /61	2	238	5.0	4 /61	48.86	2.05
155	4,311	4	47.5	9 U 8 S	4,311	41.41 60.00	5.44
100	4 D n	2	23 3	40	40	0.00	0.00
100	- U	4	533.90			1064.85	1.8
			Jelta value :	calculation	\$		
% Width	Act. Chn.	LOWER	Upper	V-inwer	V-Upper	V-int	Delta
20%	62.0	60.00	65 00	177	1.75	9.79	1.04
4094	76.0	78 50	00.00	170	K 745	1.76	1.03

†*7*7

1.B1

190

1.75

178

1.85

1.76

180

1.89

1.03

1.01

0.96

.

STATION No.         Diffeod         START TIME         : 15+45         Main Channel         Average Gaugeplate reading:         4.545         m           PLACE NAME:         Oranje         Average Gaugeplate reading:         4.545         m           DATE:         101/87         Main Channel LEFT:         20         Main Channel LEFT:         20           Main Channel LEFT:         20         Main Channel LEFT:         20         0.0         1           1         2         0         0         0         1         2         0.08         2         1           1         2         0         0.44         0.84         0         1         2         0.08         2         1           1         2         0         0         0.000         0.0         0.000         0.0         0         0         1         2         0.7         5.3         3.16         3.752         1.8005         1.901         18.6         2.007         3.44         1.00         5.0         0         0           2         10         3.18         3.162         2.334         3.33         7.5         4.460         2.334         3.35         7.5         4.460         5.465				Me	easured d	ata					Ca	Iculated	data, 1-d	imension	nal flow th	heory
PUCE NAME         Oranje         Average Gaugeplate reading :: 4.545 m         Stope         0.011         Average Gaugeplate reading :: 4.545 m           PLACE NAME         Oranjedraat         DATE         101/187         Average Gaugeplate reading :: 4.545 m           Main Channel LEFT         20         Main Channel LEFT         20         0         1         Stape         0.011         Average Gaugeplate reading :: 4.545 m           Main Channel LEFT         20         Main Channel RIGHT         180         Change         Vertical         Number         Stape         0         1           Change         Ventority         Velocity	STA	TION No. :	D1H009			STAI	RT TIME :	15h45		Manning	or Chezy	r.	M			Q
PLACE RAME         Oranjestrasi           DATE         10/1/87           Main Channel REFT: 20 Main Channel REGHT: 180           1         2         3         4         5         6         7         8         9           2         0         0         1         2         0         1         2         0         1           2         0         0         1         2         0         1         2         0         1           2         0         0         1         2         0         1         2         0         1           2         10         3.18         1.62         1.620         20.7         3.349         10         5.18         2         20.0         5.0         0         0         0         0         0         0         0.0         3.752	RIVE	R NAME :	Oranje		Averag	e Gaugepla	ate reading :	4.545	m			Stope	0.0011			V
Main Channel LEFT:         20         Main Channel RIGHT:         180         Sub         n         Sub         n           1         2         3         4         5         6         7         8         9         0         1         2         0.038         0         1           1         2         3         4         5         6         7         8         9         0         0         1         2         0.038         0         1         1         2         0.038         0         1         1         1         0         0.04         0.0         0	PLAC	DATE :	Oranjedraal 10/1/87							Roughness	coeff		Area reduc	tion factor	1	
Main Channel RIGHT         160         0         1         2         3         4         5         6         7         8         9           1         2         3         4         5         6         7         8         9           number         0         0         1         2         0.038         0         1         2         1         2         1         2         1         1         1         2         0         0         1         1         2         0						Main Cha	nnel LEFT :	20		Sub	n		Sub	f,		
1         2         3         4         5         6         7         8         9           1         2         3         4         5         6         7         8         9         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         1         0         0         1         0         0         1         0						Main Chan		160		0			0	1		
1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical         Velocity         Valuer,         Area         Q           1         2         0 </th <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>100</th> <th></th> <th>2</th> <th>0.038</th> <th></th> <th>,</th> <th>4</th> <th></th> <th></th>								100		2	0.038		,	4		
Vertical	1	2	3	4	5	6	7	8	9	ō	0.000		0	1		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Vertical	Chainage	Vertical	Velacity	Velocity	Velocity	V aver.	Area	Q	Chamage	Vertical	\$ub	Atea	Wetted P	H-Radius	
depth         depth         2.438         910.6         2220.0         segin         <	number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)		or effective	Section	A	р	R	( <b>F</b>
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			depth				2.438	910.6	2220.0		depth					
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	1	2	0		0		0.000	0.0	0.00	2	0	2	0.0	5.0	0	0
3       15       3.752       1.9005       1.801       18.8       35.65       15       3.752       2       38.8       5.0       3.752       2         4       20       4.469       2.334       33.5       78.23       20       4.469       2       33.5       7.5       4.469       7         5       30       5.436       2.876       2.878       5.434       156.45       30       6.466       2       66.3       10.0       6.448       17         7       50       5.711       3.108       57.1       17.747       50       5.711       10.0       6.346       10.0       5.661       11.0       5.661       13.00       6.126       60.3       10.0       5.661       13.0       6.126       60.3       10.0       5.661       13.0       6.126       13.00       6.126       5.661       13.0       6.126       6.386       10.0       5.661       13.0       6.126       6.386       10.0       5.681       13.0       6.126       13.0.0       6.126       13.0.0       6.126       10.0       5.681       13.0       6.215       10.0       5.232       10.0       5.232       10.0       5.232       10.0       5.232	2	10	3.18		1.62		1.620	20.7	33.49	10	3.18	2	20.7	6.5	3.18	35
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	3	15	3.752		1.9005		1.901	18.8	35.65	15	3.752	2	18.8	5.0	3.752	25
5       30       5.436       2.878       2.878       5.437       5.4       156.45       30       5.436       2       5.43       100       5.438       44         6       40       6.045       2.8525       2.8525       2.853       60.5       172.43       40       6.045       2       50.6       100       5.711       100       5.711       100       5.711       100       5.711       100       5.811       2       56.6       100       5.861       19         9       70       6.126       2.2895       2.895       61.3       177.35       70       6.128       2       61.3       100       5.861       19         10       80       6.386       2.6315       2.632       63.9       168.05       80       6.386       2       63.9       100       5.322       100       5.323       100       5.325       100       5.325       100       5.325       100       5.325       100       5.325       100       5.326       100       5.326       100       5.386       100       5.326       100       5.326       100       5.326       100       5.387       100       5.322       100       5.327       <	4	20	4.469		2.334		2.334	33.5	78.23	20	4.469	2	33 5	75	4 469	75
6       40       6.045       2.252       2.853       60.5       7.2.43       40       6.045       2       60.3       10.0       6.045       3         7       50       5.711       3.1075       3.108       57.1       17.47       50       57.11       2       57.1       10.0       5.041       31         8       60       5.661       3.2605       3.261       56.6       184.58       60       5.661       2       61.3       10.0       6.126       2       61.3       10.0       6.126       310.0       6.126       311       9       70       6.126       2       61.3       17.7.35       70       6.126       2       61.3       10.0       6.386       32.24       32.24       52.3       117.67       100       5.232       2       52.3       10.0       5.213       32.1       32.1       32.24       10       5.23.2       32.2       32.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       33.2       23.3       10.0       5.213       38.6       30.0       5.271	5	30	5.436		2.878		2.878	54.4	156.45	30	5,436	2	54 4	10.0	5 436	14
7       90       5.711       3.1073       3.108       57.1       177.47       50       5.711       2       57.1       10.0       5.711	6	40	6.045		2.8525		2.853	60.5	172.43	40	6.045	2	60 5	10.0	6 045	17
6         60         5.661         34.261         36.5         184.58         600         5.661         10.0         6.126         2         61.3         10.0         6.126         2         61.3         10.0         6.126         2         61.3         10.0         6.126         2         61.3         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         6.126         10.0         5.335         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.385         10.0         5.387         10.0         5.387         10.0         5.387         10.0         5.387         10.0         5.387         10.0         5.387         10.0         5.387         10.0	1	50	5.711		3.1075		3.108	57.1	177.47	50	5.711	2	57.1	10.0	5.711	16
3       70       6.126       2.685       61.3       177.35       70       6.126       2       61.3       61.36       177.35       70       6.126       2       61.3       61.36	8	60	5.661		3.2605		3.261	56.6	184.58	60	5.661	2	58.6	10.0	5.661	15
10       00       5.36       2.6373       2.6373       10.03       5.37       100.03       2.335       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       2       30.03       50.03       50.03       50.03       50.03       50.03       50.03       50.03	9 10	/U en	6.120		2.893		2.895	61.3	177.35	70	6 125 C 705	4	61.3	10.0	0.120	
11       30       3.033       2.436       3.04       142.14       30       3.033       2       3.033       2       3.033       2       3.033       30.03       50.14       110       6.213       31.00       5.887       31.00       5.887       30.05       5.887       2       58.23       10.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.887       30.0       5.827       2       47.0       7.5       8.257       13.0       6.267       2       47.0       7.5       8.257       13.0       10.0       5.03       30.0       5.006       2       30.0       5.006       <	14	00	0.300		2.6315		2.632	63.9 59 4	100.00	00	6 306	2	63.9	10.0	5.300	19
12         100         5.2.13         2.130         62.1         11.0         100         5.2.13         2.130         62.1         12.34         100         5.2.13         100         1000         1000         2.2.13         100.12 <th1< td=""><td>12</td><td>100</td><td>5 232</td><td></td><td>2 2/90</td><td></td><td>2.450</td><td>52.3</td><td>117.67</td><td>100</td><td>5 722</td><td>5</td><td>53.3</td><td>10.0</td><td>5 000</td><td>+9</td></th1<>	12	100	5 232		2 2/90		2.450	52.3	117.67	100	5 722	5	53.3	10.0	5 000	+9
110         110         11000         11000         11000         11000         11000 <th1000< th="">         11000         110000</th1000<>	13	110	6 213		2 13		2 130	62.1	132.34	110	8 212	5	62.1	10.0	6 213	18
110       1100       1110       11000       11000       11	14	120	6 143		2 2065		2.100	61 4	135.55	120	6 143	5	61 4	10.0	E 143	
16         140         6.219         2.317         2.317         62.2         144.09         140         6.219         2         62.2         10.0         6.219         10.0         6.210	15	130	5 887		2 1895		2 190	58.9	128.90	130	5 887	2	58.9	10.0	5 887	16
17         150         6.267         2.13         2.130         47.0         100.12         150         6.267         2         47.0         7.5         6.257         13           18         155         6.008         1.943         3.0.0         58.37         155         6.008         2         30.0         5.0         6.005         9           19         160         6.079         1.4925         1.493         51.7         77.12         160         8.079         2         51.7         3.5         6.005         9         155         9.00         6.0         0	16	140	6 2 1 9		2 317		2 317	62.2	144.09	140	6 219	2	62.2	10.0	6 2 1 9	18
18         155         6.008         1.943         30.0         58.37         155         6.008         2         30.0         5.0         6.006         99           19         160         6.079         1.4925         1.493         51.7         77.12         160         6.079         2         51.7         3.5         6.006         99         155           20         172         0         0         0         0.000         0.0         0.000         172         3.5         6.006         99         155           20         172         0         0         0.000         0.00         0.000         172         3.2         0.0         6.0         0         0         0           21         2438         910.6         2219.98         910.60         2219.98         910.60         2219.98         910.60         2219.98         910.60         20.00         6.0         0         0         0         0           30%         62.0         80.00         70.00         3.26         2.90         3.19         0.76         30%         92.06         90.00         2.00         2.77         2.92         3.00         2.92         3.00         2.92<	17	150	6.267		2.13		2.130	47.0	100.12	150	6 267	2	47.0	7.5	6.267	13
19         160         6.079         1.4925         1.493         51.7         77.12         160         6.079         2         51.7         8.5         6.079         15           20         172         0         0         0.000         0.0         0.00         177         172         160         6.079         2         51.7         8.5         6.079         15           20         172         0         2         0.00         0.0         0.00         0.00         172         0         2         51.7         8.5         6.079         15           0.000         0.00         0.0         0.00         0.00         0.00         0.00         0.00         172         0         2         51.7         8.5         6.079         50         50         0         50         277         2	18	155	6.008		1,943		1.943	30.0	58.37	155	6 008	2	30.0	5.0	6.008	86
20         172         0         0         0.000         0.0         0.000         172         0         2         0.0         0.0         0.0         0.000         0.000         172         0         2         0.0         5.0         0	19	160	6.079		1.4925		1.493	51.7	77.12	160	6.079	2	51.7	8.5	6 079	15
2.438         910.6         2219.98         910.60         910.60         268           Width         Act. Chn.         Ch-Lower         V-lower	20	172	0		0		0.000	0.0	0.00	172	Q	2	00	6.0	0	0
Delta value calculations         Delta value calculations           % Width         Act. Chr.         Ch-Lower         Ch-Upper         V-lower         V-lit         Delta           30%         62.0         60.00         70.00         3.26         2.90         3.19         0.76         30%         62.0         60.00         70.00         3.26         2.90         3.19         0.76         30%         62.0         60.00         2.07         2.92         2.4         3.0%         62.0         60.00         2.00         2.77         2.92         2.4         3.0%         62.0         60.00         2.07         2.92         2.63         2.74         0.89         40%         76.0         70.00         80.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00         2.92         3.00 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2.438</td> <td>910.6</td> <td>2219.98</td> <td></td> <td></td> <td></td> <td>910.60</td> <td></td> <td></td> <td>215(5</td>							2.438	910.6	2219.98				910.60			215(5
% Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-loper         V-lnt         Delta         % Width         Act. Chn.         Lower         V-lower         V-loper         V-loper         V-lnt         Delta         % Width         Act. Chn.         Lower         V-lower         V-loper         V-loper         V-lnt         Delta         % Width         Act. Chn.         Lower         V-lower         V-loper         v           30%         62.0         60.00         70.00         3.26         2.90         3.19         0.76         30%         52.0         50.00         70.00         2.77         2.92         2.40         3.00         50.00         70.00         2.00         2.77         2.92         3.00         2.00		F			Delta value	calculation	16						Delfa vatu	e calculatio	vine .	
30%         62.0         60.00         70.00         3.26         2.90         3.19         0.76         30%         52.0         50.00         70.00         2.77         2.92         3.19         0.76         30%         52.0         50.00         70.00         2.77         2.92         3.19         0.76         30%         50%         50.00         70.00         2.77         2.92         3.00         2.92		% Width	Act Chn	Ch.I ower	Ch. lioner	V-lower	Villager	Vulnt	Delta	% Michte	Act Cho			C CONCORDENCE	100 Malifree	1
40%         76.0         70.00         80.00         2.90         2.63         2.74         0.89         40%         76.0         70.00         80.00         2.92         300         2.63         2.74         0.89         40%         76.0         70.00         80.00         2.92         300         2.63         2.74         0.89         40%         76.0         70.00         80.00         2.92         300         2.63         2.64         1.00         50%         90.0         80.00         2.83         2.65         2.63         2.64         1.00         50%         90.0         80.00         2.83         2.65         2.63         2.64         1.00         50%         90.0         80.00         2.83         2.65         2.63         2.63         2.64         1.00         50%         90.0         80.00         2.83         2.65         2.63         2.65         2.63         2.65         2.63         2.65         2.63         2.65         2.63         2.65         2.63         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65         2.65 <t< td=""><td></td><td>30%</td><td>62.0</td><td>60.00</td><td>70.00</td><td>3.08</td><td>2 90</td><td>9.10</td><td>0.76</td><td>30%</td><td>6.2.6</td><td>60212</td><td></td><td></td><td>202</td><td></td></t<>		30%	62.0	60.00	70.00	3.08	2 90	9.10	0.76	30%	6.2.6	60212			202	
50%         90.0         90.00         100.00         2.44         2.25         2.44         1.00         50%         90.0         90.00         100.00         2.63         2.65		40%	76.0	70.00	80.00	2.90	2.63	274	0.89	40%	76.0	70.00	80.00	297	3.00	l ŝ
60% 104.0 100.00 110.00 2.25 2.13 2.20 1.11 60% 104.0 100.00 110.00 2.83 2.85 2. 70% 118.0 110.00 120.00 2.13 2.21 2.18 1.11 70% 118.0 110.03 120.00 2.06 2.03		50%	90.0	90.00	100.00	2 44	2.00	2 44	1.00	50%	90.0	90.00	1 100 00	2.63	2.63	
70% 118.0 110.00 120.00 2.13 2.21 2.18 1.11 70% 118.0 190.03 120.00 2.96 2.93		60%	104.0	100.00	110.00	2 25	213	2 20	1 11	60%	104.0	100.00	110.00	2.63	2.95	
		70%	118.0	110.00	120.00	2.13	2.21	2.19	1.11	70%	118.0	110.00	120.00	2.96	2.93	2

•

Q =

Q

(m<sup>3</sup>/s)

0.00

39.01

29.64

79.37

146.68

176.08 169.28

156 94

179.01

191.85

165.06 137.62

183.27

179.64 167.52

183 56

139.45

88.66 150.22

0.00

2559.92

V-int

2.80

2.97 2.83

2.76

2.93

2559.9

V

0.00

1.89

2 11

2.37

2.79

2.77

2.92

3.00 2.83

263

2.95 2.99

2.85

2.95 2.97

2.88

2.91

0.00

Delta

1.00

0.95

0.99

1.02

0.96

2.81

Velocity

V<sub>AVR</sub> = 2.81

1			Mea	asured da	ita				
STA	TION No. :	D1H009			STAR	TTIME :	10h43		Manni
RIVE	R NAME :	Oranje Oranjedraal		Average	e Gaugepla	te reading :	6.439	m	
	DATE :	2/17/89			14 Ch				Roughn
				ı	Main Chanr	nel RIGHT :	20 160		0
1	2	3	4	5	6	7	8	9	2 0
Ventical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chamar
numbre	-	at all asking	0.04	0.44	0.84	(m/c)	(m <sup>2</sup> )	(m <sup>3</sup> /s)	
HUMDER		deeth	0.20	U.40	U.ou	(HVS) 9 557	4394.3	2277 44	
1	7	οeptn Ω	n	n	n	0.000	1204.2	0.00	
,	20	5 261	1 246	1 467	1 5775	1 439	60.5	87.08	
3	30	7 185	2 487	2 742	2 7845	2 689	71 9	193.20	
4	40	8 462	2 844	3 099	3 4135	3 114	84.6	263 50	
5	50	9.126	2 9205	3.15	3.286	3 127	91.3	285.34	
6	60	8.944	3.0735	3.3965	3.524	3.348	89.4	299.41	
7	70	9.024	3.269	3.371	3.592	3.401	90.2	306.88	
8	80	8.878	2.946	3.2435	3.473	3.227	88.8	286.45	
9	90	8.512	2.538	2 9035	3.2775	2.906	85,1	247,33	
10	100	7.696	2.6655	2.708	3.048	2.782	77.0	214.13	1
11	110	6.677	1.722	2.1725	2.9885	2.264	66.8	151.16	1
12	120	8.515	2.2575	2.708	3.0055	2.670	85.2	227.33	1
13	130	7.659	2.589	2.674	2.759	2.674	76.6	204.80	1
14	140	8.058	1.637	2.3935	2.674	2.275	80.6	183.28	1
15	150	7.472	2.1555	2.334	2.4955	2.330	74.7	174.08	1
16	160	8.108	1.637	1.7815	1.722	1.731	81.1	140.31	1
17	170	4.735	0.112	0.226	0.089	0.163	80,5	13.14	1
18	194	0	0	0	O	0.000	0,0	0.00	1
19						0.000	0.0	0.00	
						2.552	1284.2	3277.41	
			D	elta value c	alculation	6			
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	22 Miles
	30%	62.0	60.00	70.00	3.35	3.40	3.36	0.76	30%
	40%	76.0	70.00	80.00	3.40	3.23	3.30	0.77	40%
	50%	90.0	90.00	100.00	2.91	2.78	2.91	0.88	50%
	60%	104.0	100.00	110.00	2.78	2.26	2.57	0,99	60%
	70%	118.0	110.00	120.00	2.26	2.67	2.59	0.99	70%

A	Calc	ulated d	ata, 1-din	nensiona	al flow the	eory	and the second
Manning	or Chez	y:	M			Q =	3799
		Sicpe	0.0009			V <sub>AVR</sub> =	2,96
Roughness	coeff		Area reduct	ion factor	1		
Sub	n		Sub	f.			
0			0	4			
2 0	0.04		2				
U				1			
Chamage	Vertical	Sub	Area	Affetted b	M-Hadius	ч	V V
	or effective	Section	*	p	R	(m°/s)	Velocity
7	0	2	0.0	10.0	0	0.00	0.00
20	5.261	2	60.5	11.5	5.261	137.26	2.27
30	7 185	2	71.9	10.0	7.185	200.65	2.79
40	8 462	2	84.6	10.0	8 462	263.54	3,14
50	9 126	2	91.3	10.0	9.126	298.90	3,28
60	8 944	2	89.4	10.0	8 944	289.03	3.23
70	9 024	2	90.2	10.0	9.024	293.36	2.26
80	8.878	2	86.8	10.0	8.878	285 49	3 22
90	8.512	2	85 1	10.0	8.512	266 14	3 13
100	7.696	2	77 0	10.0	7.696	224.99	2.92
110	6.677	2	66.8	10.0	6.677	177.67	2.66
120	8.515	2	85.2	10.0	8 515	256,30	3.13
130	7 659	2	76.6	10.0	7 659	223.19	2.91
140	8 068	2	80.6	10.0	8 058	242.91	3.01
150	/ 4/2	2	74.7	10.0	/ 4/2	214 18	2.87
160	8.108	2	81 1	10.0	8.108	245 42	2.03
170	4./35	ź	8U 5	17.0	4,735	170.23	213
194	U c	2	0.0	12.0	0	0.00	0.00
		4				2700 47	2 94
			1204.10			0,00,11	2.00
			delta value.	calculation	\$		
% Width	Act. Chin.	Lower	Lipper	¥-lower	V-Upper	Viint	Delta
30%	62.0	60.00	70.00	3.23	3 25	3.24	0.91
40%	76.0	70.00	80.00	3.25	3.22	3.23	0.92
50%	90.0	90.00	100.00	5 13	2.92	3.13	0.95
60%	104.0	100 00	110.00	2.92	2.66	2.82	1.05
70%	0.877	130-00	120.00	2.66	3.13	9.04	0.90







The values in the legend block describe measured discharge for the profile indicated

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			Me	asured da	ata		-	
STA	TION No. :	D2H033			STA	RT TIME :	09h45	
RIVE	R NAME :	Caledon		Averaç	je Gaugepl	ate reading :	2.13	m
PLAC	CE NAME	Welbedachtd	am			-		
	DATE :	11/12/92						
					Main Cha	annel LEFT :	30	
					Main Char	nel RIGHT	90	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)
		depth				1.204	171.1	206.05
1	29.5	0		0		0.000	0.0	0.00
2	32.8	0.97		0.366		0.366	4.0	1.47
3	37.8	2.896		1.015		1.015	14.5	14.70
4	42.8	2.873		1.399		1.399	14.4	20.10
5	47.8	2.892		1.501		1.501	14,5	21.70
6	52.8	3.012		1.328		1.328	15.1	20.00
7	57.8	2.982		1.378		1.378	14.9	20.55
8	62.8	3.112		1.403		1,403	15.6	21.83
9	67.8	3.381		1.188		1.188	16.9	20.08
10	72.8	3.292		1.433		1.433	16.5	23.59
11	77.8	3.242		1.294		1.294	16.2	20.98
12	82.8	3.355		1.07		1.070	16.8	17.95
13	87.8	2.386		0.26		0.260	11,9	3.10
14	92.0	U		U		0.000	0.0	0.00
1:0						1 204	171 1	208.05
						1.204		1 200.00
			[	Delta value o	alculation	ns		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	48.0	47.80	52.80	1,50	1.33	1.49	0.81
	40%	54.0	52.80	57.80	1.33	1.38	1.34	0.90
	50%	60.0	57.80	62.80	1 38	1.40	1.39	0.87
	60% 70%	66.0	62.80	67.80	1.40	1.19	1.27	0.95
	70%	12.0	67.80	72.80	1.19	1.43	1.39	0.86

	Cal	culated o	lata, 1-din	nensiona	I flow the	ory	
Manning	or Chezy		M			Q =	227.5
		Slope	0.0005			V <sub>AVR</sub> =	1.33
Roughness	coeff.		Area reduct	ion factor	]		
Sub	n		Sub	fA			
0			0	1			
2	0.035		2	1			
<u>^</u>	0.000		2	4			
Cheinage	Vertical	Sub	0 Atea	Wetted P	H-Radius	Q	v
	or effectue	Sertion		ø	R	(m <sup>3</sup> /s)	Velocity
	denth	oconor)		,			
29.5	0	2	0.0	16.4	0	0.00	0.00
32.8	0 97	2	40	4.2	0.97	2 52	0.63
37.8	2.896	2	14.5	50	2.896	18.80	1 30
42.8	2.873	2	14.4	5.0	2.873	18.55	1.29
47.8	2 892	2	145	5.0	2.892	1875	1.30
52.8	3.012	2	15 1	5.0	3 012	20.07	1 33
57.8	2.982	2	14.9	5.0	2.982	19.73	1.32
62.8	3.112	2	15.6	50	3 1 1 2	21.19	1,36
67.8	3.381	2	16 9	5.0	3.381	24.33	1.44
72.8	3 292	2	16 5	5.0	3.292	23 27	1 41
77.8	3.242	2	16.2	5.0	3.242	22 69	1 40
82.8	3.355	2	16.8	5.0	3.355	24.02	1.43
87.8	2.336	2	11 9	5.0	2.386	13.61	1.14
92.8	0	2	0.0	2.5	0	0 00	0 00
	0	2	0.0	0.0	0	0.00	0.00
			171.14		18.960	227.52	1.33
		r	Jelta value r	alculation	\$		
% Width	Act. Chn. I	Lower	Upper	V-lower	V-Upper	V-int	Delta
30%	48.0	47.80	52.80	1.30	1 33	1.30	1.02
40%	54.0	52.80	57.80	1 33	1.32	1 33	1.00
50%	60.0	57 8G	62.60	1 32	1.38	1.34	0.99
60%	66.0	62.80	67.80	1.36	1.44	1.41	0.94
70%	72.0	67.80	72.80	1 44	1.41	1 42	0.94

Appendix H

			Me	asured da	ta			
STA	TION No. :	D2H033			STA	RT TIME :	21h40	
RIVE	R NAME :	Caledon		Averag	e Gaugepl	ate reading :	2 39	m
PLAC	E NAME	Welbedachto	lam		5,			
	DATE :	11/10/92						
					Main Cha	nnel LEFT	30	
					1-: OL		-	
				1	viain Chan		an	
1	2	3	4	5	6	7	8	9
/ertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
umber		or effective	0.24	044	0.84	(m/e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
number		deoth	<b>0.20</b>	0.40	U.OU	1 469	107.9	274 09
1	26.8	n		0		0.000	0.0	0.00
2	32.8	1 385		0 442		0.000	7.6	3 37
3	37.8	3.053		1 26		1 260	15.3	19.23
4	42.8	3.337		1 673		1 673	16.7	27.91
5	47.8	3,197		1.838		1.838	16.0	29.38
6	52.8	3.107		1.846		1.846	15.5	28.68
7	57.8	3.406		1.745		1.745	17.0	29.72
8	62.8	3.387		1.623		1.623	16.9	27.49
9	67.8	3,606		1.496		1.496	18.0	26.97
10	72.8	3.563		1.754		1.754	17.8	31.25
11	77.8	3.513		1.602		1.602	17.6	28.14
12	82.8	3.543		1.205		1.205	17.7	21.35
13	87.8	2.214		0.126		0.126	11,1	1,39
14	92.8	0		0		0.000	0.0	0.00
15						0.000	0.0	0.00
						1.468	187.2	274.88
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	48.0	47.80	52,80	1.84	1,85	1.84	0.80
	40%	54.0	52.80	57.80	1.85	1.75	1.82	0.81
	50%	60.0	57 80	62 80	175	1 62	1 69	0.87
	60%	66.0	62.80	67.80	1.62	1.50	1.54	0.95
	70%	72.0	67.80	72.80	1.50	1.75	1.71	0.86

	Cal	culated of	data, 1-dir	nensiona	al flow the	ory	
Manning	or Chezy	:	M			Q =	293.9
		Slope	0.0006			V <sub>AVR</sub> =	1.57
Roughness	coeff.		Area reduct	lion factor	]		
Sub	n		Sub	f,			
0			0	1			
2	0.034		2	1			
n l			- 0	4			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V I
	or affection	Spection		6	Þ	(m <sup>3</sup> /s)	Velocity
	denth	Securit					• • • • • • • •
26.8	0	2	0.0	16.4	0	0.00	0.00
32.8	1 385	2	7.6	55	1.385	6.82	0.90
37.8	3.053	2	15.3	5.0	3.053	23 14	1.52
42.8	3.337	2	16.7	5.0	3 337	28.84	1.61
47.8	3 197	2	16.0	5.0	3.197	24 99	1.56
52.8	3 107	2	15.5	50	3.107	23.63	1 53
57.8	3.406	2	17 0	5.0	3.406	27 77	1.63
62.8	3.387	2	16.9	5.0	3 387	27.52	1.62
67.8	3 606	2	18.0	5.0	3.606	3G 55	1.69
72.8	3 563	2	17.8	5.0	3.563	29.94	1 68
77.8	3.513	2	176	5.0	3.513	29.24	1.66
82.8	3.543	2	177	5.0	3 543	29.66	1.67
87.8	2 2 1 4	2	11.1	5.0	2.214	13.55	1.22
92.8	0	2	0.0	25	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			187.25		24.488	293.86	1.
			Delta value	calculation	15		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	48.0	47.60	52.60	1.56	1.63	1 56	1.00
40%	54.0	52.80	57.80	1.53	1.63	1.56	1.01
50%	60.0	57.80	62.80	1.63	1.62	1.63	0.96
60%	66.0	62.80	67 60	1 62	1.69	1.67	0.94
70%	72.0	67 60	72 60	169	1 68	1.68	0.93

			Me	asured da	ita			
STA	TION No. :	D2H033			STA	RT TIME :	14h54	
RIVE	R NAME :	Caledon		Averag	e Gaugepk	ate reading	2.73	m
PLAC	DATE :	Welbedachto 11/12/92	dam	-	Main Cha	- nnel LEFT :	30	
				1	Main Chan	nel RIGHT :	90	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)
		depth				1.552	206.3	320.33
1	23.2	0		0		0.000	0,0	0.00
2	32.8	1.82		0.699		0.699	13.3	9.29
3	37.8	3.295		1.555		1.555	16.5	25.62
4	42.8	3.534		1.804		1.804	17.7	31.88
5	47.8	3.534		1.893		1.893	17.7	33.45
6	52.8	3.325		1.868		1.868	16.6	31.06
7	57.8	3.743		1.779		1.779	18.7	33.29
8	62.8	3.992		1.745		1.745	20.0	34.83
9	67.8	3,986		1.685		1.685	19.9	33.58
10	72.8	3.978		1,779		1.779	19,9	35.38
11	77.8	3.779		1.707		1.707	18.9	32.25
12	82.8	3.674		1.02		1.020	18.4	18.74
13	87.8	1 77		0,109		0.109	8,9	0.96
14	92.8	o		o		0.000	0.0	0.00
15						0.000	0.0	0.00
						1.552	206.3	320.33
			n	elta value o	alculation	e		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	48.0	47.80	52.80	1.89	1.87	1.89	0.82
	40%	54.0	52.80	57.80	1.87	1.78	1.85	0.84
	50%	60.0	57.80	62 80	178	175	176	0.88
	60%	66.0	62.80	67.80	1.75	1.69	1.71	0.91
	70%	72.0	67.80	72 80	1 69	178	176	0.88

	Calo	culated o	lata, 1-dir	nensiona	I flow the	ory	
Manning	or Chezy		М			Q =	351.3
	l	Slope	0 0006			V <sub>AVR</sub> =	1.70
Roughness	coeff.		Area reduct	tion factor	1		
Sub	n		Sub	fa			
0			0	1			
2	0.033		2	1			
n l			ñ				
Chainage	Vertical	Sub	Area	vVetted P	H-Radius	0	V
					ъ	(m <sup>3</sup> /s)	
	dooth	Section	A.	Ŧ	п	(	Velocity
23.2	G	2	0.0	16.4	0	0.00	0.00
32.8	1.82	2	13.3	73	1.82	14.70	1 1 1
37.8	3.295	2	16.5	5.0	3 295	27.08	1.64
42.8	3.534	2	177	5.0	3 534	30.43	1.72
47.8	3 534	2	17.7	5.0	3.534	30.43	1.72
52.8	3 325	2	16.6	50	3.325	27 49	1 65
57.8	3.743	2	187	5.0	3 7 4 3	33.49	179
62.8	3.992	2	20.0	5.0	3 992	37.28	1.87
67.8	3 986	2	19.9	5.0	3.986	37 19	1 87
72.8	3.978	2	19.9	50	3.978	37 07	1 86
77.8	3.779	2	18 9	5.0	3.779	34 03	1.80
82.8	3.674	2	18.4	5.0	3 674	32.47	1 77
87.8	1 77	2	8.9	5.0	1.77	9.61	1.09
92.8	0	2	0.0	25	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			206.34		29.272	351.26	1.7
			Delta value -	calculation	15		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	48.0	47 8Q	52.60	172	1.65	172	0.99
40%	54.0	52.80	57.80	1.65	179	1.69	1.01
50%	60.0	57.80	62.80	1.79	1.87	1.82	0.93
60%	66.0	62.8G	67.80	1.87	1.87	1.87	0.91
70%	72.0	67 80	72.60	1.67	1.66	1.86	0.91

			Mea	asured da	Ita			
STA	TION No. :	D2H033			STA	RT TIME :	16h16	
RIVE	R NAME	Caledon		Averac	e Gaugeni	ate reading	273	m
PLAC		Welhedachtd	am	menug	ic Oungepi	are reading .	* 1 4	
1 646	DATE -	11/12/02	a(+)					
	DAIL .	111232						
					Main Gria	INNELLEFI.	30	
					Main Chan	nel RIGHT :	90	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		ar affective		0.44		(m/o)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
number		or enecuve	U.2U	U.4U	<b>U.0</b> 0	(1105)	000.0	200.07
4	22.7	deptri				1.034	209.2	320.97
2	20.2	1 82		0 607		0.000	12.2	0.00
4 3	37.0	3 445		0.027		0.027	13.3	0.33
5	37.0	3.413		1.000		1.300	17.1	20.00
7	42.0	3.534		1.042		1.042	17.7	32.33
5 6	47.0 52.9	3 375		1,009		1,009	17.9	33.03
7	57.8	3 833		1 754		1 754	10.0	29.00
8	62.8	4 022		1 644		1.644	20.1	33.06
g	67.8	4.022		1 644		1 644	20.1	33 52
10	72.8	4 048		1 838		1 838	20.2	37.20
11	77.8	3 868		1 635		1 635	193	31.62
12	82.8	3 704		1 083		1 083	18.5	20.06
13	87.8	1.77		0.117		0.117	8.9	1.04
14	92.8	0		0		0.000	0.0	0.00
15						0.000	0.0	0.00
						1.534	209.2	320.97
			D	elta value c	alculation	\$		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	48.0	47.80	52,80	1,89	1.78	1.88	0.81
	40%	54.0	52.80	57.80	1.78	1.75	1.77	0.87
	50%	60.0	57 80	62 80	1 75	1 64	171	0.90
	60%	66.0	62.80	67.80	1.64	1.64	1.64	0.93
	70%	72.0	67.80	72.80	1.64	1.84	1.81	0.85

	Cal	culated o	lata, 1-din	nensiona	I flow the	ory	
Manning	or Chezy	:	M			Q =	329.8
		Slope	0.0006			V <sub>AVR</sub> =	1.58
Roughness	coeff.		Area reduct	ion factor	1		
Sub	n		Sub	fa			
0			0	1			
2	0.036		2	1			
n l			ō	4			
Сранада	Vertical	Sim	Area	Wetterd P	H-Radius	0	V
						(m <sup>3</sup> /s)	
	or ellective	Gection	A	¥	R.	(	velocity
23.0	depth	2	0.0	16.4	0	0.00	0.00
20.2	1 82	2	12.3	73	1 87	13.46	1.01
37.8	3.415	2	17.1	50	3 415	26.35	1.54
42.8	3.534	2	177	50	3 5 3 4	27.89	1.58
47.8	3 584	2	17.9	5.0	3.584	28.56	1.59
52.8	3.325	2	16.6	50	3.325	25.20	1.52
57.8	3.833	2	19.2	5.0	3 833	31 94	1.67
62.8	4.022	2	20.1	5.0	4 022	34.61	1.72
67.8	4 0 7 8	2	20.4	5.0	4.078	35.41	1.74
72.8	4 048	2	20.2	50	4.048	34.98	173
77.8	3.863	2	193	5.0	3 368	32.43	1 68
82.8	3.704	2	18.5	5.0	3 704	30.17	1.63
87.8	1 77	2	8.9	5.0	1.77	8.81	1.00
92.8	G	2	0.0	2.5	0	0.00	0.00
	0	2	0.00	0.0	<u> </u>	0.00	666
			209.19		21.464	329.81	1.53
			Delta value:	calculation	S		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	48.0	47.60	52.80	1 59	1 52	1 59	0.99
40%	54.0	52.80	57.80	1.52	1.67	1 55	1.02
50%	60.0	57.80	62.80	1.67	1.72	1.69	0.93
60%	66.0	62.BO	67 80	172	174	1.73	0.91
70%	72.0	67.80	72.80	174	173	173	0.91

STATION No. : C8H030         START TIME         17h40           RIVER NAME : Wilge PLACE NAME : Kimberley DATE : 19/02/1989         Average Gaugeplate reading Gaugeplate reading Main Channel LEFT : 30         30           Main Channel RIGHT : 90         Main Channel RIGHT : 90         90           Vertical number         Vertical or effective depth         4         5         6         7         8         9           1         17         0         0.2d         0.4d         0.8d         (m/s)         (m <sup>2</sup> )         (m <sup>3</sup> ) <th></th> <th></th> <th></th> <th>Me</th> <th>easured d</th> <th>ata</th> <th>_</th> <th></th> <th></th>				Me	easured d	ata	_		
RIVER NAME       Wilge       Average Gaugeplate reading       4.145       m         PLACE NAME       Kimberley       DATE       19/02/1989       Main Channel LEFT       30         Main Channel RIGHT       30       Main Channel RIGHT       30       Main Channel RIGHT       90         Vertical       Chainage       Vertical       Velocity       Velocity       Velocity       Velocity       Velocity       Main Channel RIGHT       90         number       Or effective       0.2d       0.4d       0.8d       (m's)       (m <sup>2</sup> )/s)       (m <sup>3</sup> /s)         1       17       0       0       0.000       0.00       0.000       0.000         2       22.8       1.411       0.707       0.707       7.6       5.39         3       27.8       2.02       0.61       0.610       0.610       0.61       0.610       0.61	STA	TION No. :	C8H030			STAI	RT TIME	17h40	
PLACE NAME : Kimberley DATE : 19/02/1969           Main Channel LEFT : 30 Main Channel RIGHT : 90           1         2         3         4         5         6         7         8         9           Vertical number         Vertical or effective         Velocity         Velocity         Velocity         Velocity         Vaver.         Area 4         0           1         17         0         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           2         2.28         1.411         0.707         0.707         7.6         5.39           3         2.7.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.432         2.412         2.412         2.412         2.47         59.54           7         47.8         5.035         2.458         2.458         25.2         61.88           8         52.8         4.739         2.534         2.672         2.572         2.68         68.93           10	RIVE	R NAME :	Wilge		Averag	e Gaugepk	ate reading :	4.145	m
Main Channel LEFT : 30         1       2       3       4       5       6       7       8       9         Vertical number       Vertical depth       Velocity       Velocity<	PLAC	E NAME :	Kimberley						
Main Channel LEFT:         30           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical         Velocity         Velocity         Velocity         Valocity         Qaint		DATE :	19/02/1989						
Main Channel RIGHT:         90           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical or effective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         17         0         0.4d         0.8d         (m/s)         3111.1         633.68           1         17         0         0         0.00         0.000         0.00         0.00           2         22.8         1.411         0.707         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.412         2.417         52.67           6         42.8         4.937         2.412         2.412         2.417         52.67           6         42.8         4.739         2.534         2.534         2.534         2.534         2.534         2.53         60.04           9         57.8         5.163         2.623         2.684         2.684         2.684<						Main Cha	nnel LEFT :	30	
1         2         3         4         5         6         7         8         9           Vertical         Chainage         Vertical         Velocity         Velocity         Velocity         Velocity         Valuer,         Area         Q           number         or effective         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         17         0         0         0         0.000         0.0         0.000           2         22.8         1.411         0.707         0.707         7.6         5.39           3         27.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.44.7         59.54         2.673           7         47.8         5.035         2.458         2.534         2.37         60.04           9         57.8         5.163         2.623         2.684         2.572 <t< td=""><td></td><td></td><td></td><td></td><td></td><td>Main Chan</td><td>nel RIGHT :</td><td>90</td><td></td></t<>						Main Chan	nel RIGHT :	90	
1         2         3         4         5         6         7         8         9           Vertical         Vertical         Velocity         Velocity         Velocity         Velocity         Vaver.         Area         Q           number         or effective         0.2d         0.4d         0.8d         (m's)         (m')         (m')s)           1         17         0         0         0         0.000         0.00         0.000           2         22.8         1.411         0.707         6         5.39         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         2.47         52.67           6         42.8         4.937         2.412         2.412         2.47         59.54           7         47.8         5.035         2.458         2.534         2.37         60.04           9         57.8         5.163         2.623         2.623         2.58         67.50           10         62.8         5.36         2.572 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>									
Vertical number         Vertical or effective depth         Velocity 0.2d         Velocity 0.4d         Velocity 0.8d         Vaver. (m's)         Area (m's)         Q           1         17         0         0.2d         0.4d         0.8d         (m/s)         (m <sup>2</sup> )         (m <sup>3</sup> /s)           2         22.8         1.411         0.707         0         0.000         0.00         0.000           2         22.8         1.411         0.707         0.707         7.6         5.39           3         27.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         2.47         59.54           7         47.8         5.035         2.458         2.458         2.534         23.7         60.04           9         57.8         5.163         2.623         2.548         67.71         2.623         25.8         67.71           10         62.8	1	2	3	4	5	6	7	8	9
number         or effective depth         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         17         0         0         0         0.000         0.0         0.00           2         22.8         1.411         0.707         0.61         0.610         10.1         616           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         24.7         59.54           7         47.8         5.035         2.458         2.534         23.7         60.04           9         57.8         5.163         2.623         2.53         25.72         26.8         68.93           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.057         2.365         2.365         25.3         59.60           13         77.8         5.057         2.365         2.365         25.3         59.60	Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
depth         depth         2.037         311.1         633.68           1         17         0         0         0.000         0.00         0.00           2         22.8         1.411         0.707         7.6         5.39           3         27.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         24.7         59.54           7         47.8         5.035         2.458         2.458         25.2         61.88           8         52.8         4.739         2.623         2.623         2.63         8.93           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.35         2.694         2.694         2.694         26.92         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60	number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)
1         17         0         0         0         0.000         0.0         0.000           2         22.8         1.411         0.707         0.707         7.6         5.39           3         27.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         24.7         59.54           7         47.8         5.035         2.458         2.534         2.534         2.37         60.04           9         57.8         5.163         2.623         2.623         2.63         8.93           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.35         2.694         2.694         2.694         2.62.2         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60           14         82.8			depth				2.037	311.1	633.68
2       22.8       1.411       0.707       7.6       5.39         3       27.8       2.02       0.61       0.610       10.1       6.16         4       32.8       3.239       0.914       0.914       16.2       14.80         5       37.8       4.939       2.133       2.133       24.7       52.67         6       42.8       4.937       2.412       2.412       24.7       59.54         7       47.8       5.035       2.458       2.458       25.2       61.88         8       52.8       4.739       2.534       2.534       2.53       60.04         9       57.8       5.163       2.623       2.623       25.8       67.71         10       62.8       5.36       2.572       2.572       26.8       68.93         11       67.8       5.057       2.365       2.365       25.3       59.80         13       77.8       5.057       2.365       2.365       25.3       59.80         14       82.8       5.043       1.387       1.387       2.52       34.97         15       67.8       3.179       0.218       0.218       15.9       <	1	17	0		0		0.000	0.0	0.00
3         27.8         2.02         0.61         0.610         10.1         6.16           4         32.8         3.239         0.914         0.914         16.2         14.80           5         37.8         4.939         2.133         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         24.7         59.54           7         47.8         5.035         2.458         2.458         2.458         2.534         2.37         60.04           9         57.8         5.163         2.623         2.58         67.71           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.356         2.694         2.694         26.94         26.8         72.20           12         72.8         5.232         2.496         2.496         26.2         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60           14         82.8         5.043         1.387         1.387         2.365         25.3         59.80           14         82.8         <	2	22.8	1.411		0.707		0.707	7.6	5.39
4       32.8       3.239       0.914       0.914       16.2       14.80         5       37.8       4.939       2.133       2.133       24.7       52.67         6       42.8       4.937       2.412       2.412       24.7       59.54         7       47.8       5.035       2.458       2.458       2.458       25.2       61.88         8       52.8       4.739       2.534       2.534       2.37       60.04         9       57.8       5.163       2.623       2.623       25.8       67.71         10       62.8       5.36       2.572       2.572       26.8       68.93         11       67.8       5.36       2.694       2.694       26.8       72.20         12       72.8       5.232       2.496       2.496       26.2       65.30         13       77.8       5.057       2.365       2.365       25.3       59.80         14       82.8       5.043       1.387       1.387       2.337       311.1       633.68         ***********************************	3	27.8	2.02		0.61		0.610	10.1	6.16
5         37.8         4.939         2.133         24.7         52.67           6         42.8         4.937         2.412         2.412         2.412         24.7         59.54           7         47.8         5.035         2.458         2.458         2.458         25.2         61.88           8         52.8         4.739         2.534         2.623         2.623         25.8         67.71           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.36         2.694         2.694         26.8         72.20           12         72.8         5.232         2.496         2.496         26.62         65.30           13         77.8         5.057         2.365         2.365         25.3         59.80           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.216         0.218         15.9         3.47           Sectors           V-Int         Delta           30%         48.0         47.80         52.80         2.46	4	32.8	3.239		0.914		0.914	16.2	14.80
6         42.8         4.937         2.412         2.412         2.412         2.47         59.54           7         47.8         5.035         2.458         2.458         2.458         2.458         2.534         2.37         60.04           9         57.8         5.163         2.623         2.623         25.8         67.71           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.36         2.694         2.694         26.8         72.20           12         72.8         5.232         2.496         2.496         26.92         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Delta value calculations           V-int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           30%	5	37.8	4.939		2.133		2.133	24.7	52.67
7         47.8         5.035         2.458         2.458         2.458         2.458         2.52         61.88           8         52.8         4.739         2.534         2.534         2.534         2.534         2.623         2.623         2.623         2.623         2.623         2.623         2.623         2.623         2.628         68.93           10         62.8         5.36         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.694         2.693         5.057         2.365         2.365         2.53         59.60           13         77.8         5.057         2.365         2.365         2.53         59.60         1.387         2.52         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Viower         V-loper         V-int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40	6	42.8	4.937		2.412		2.412	24.7	59.54
8         52.8         4.739         2.534         2.534         23.7         60.04           9         57.8         5.163         2.623         2.623         2.623         2.623         2.63         60.04           10         62.8         5.36         2.572         2.623         25.8         67.71           10         62.8         5.36         2.572         2.694         2.694         26.8         68.93           11         67.8         5.36         2.694         2.694         26.8         72.20           12         72.8         5.232         2.496         2.496         26.92         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Videt Mate Act. Chn.         Ch-Lower         Ch-Upper         V-Upper         V-Int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83	7	47.8	5.035		2.458		2.458	25.2	61.88
9         57.8         5.163         2.623         2.623         25.8         67.71           10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.36         2.694         2.694         26.94         26.8         72.20           12         72.8         5.232         2.496         2.496         26.92         65.30           13         77.8         5.057         2.365         2.365         25.3         59.60           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.216         0.218         15.9         3.47           Delta value calculations           Vint         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.65         0.80           50%         60.0         57.80         52.80         2.62         2.57         2.60         0.78           60%         66.0         52.80         <	8	52.8	4.739		2.534		2.534	23.7	60.04
10         62.8         5.36         2.572         2.572         26.8         68.93           11         67.8         5.36         2.694         2.694         2.694         26.8         72.20           12         72.8         5.232         2.496         2.496         2.496         26.2         65.30           13         77.8         5.057         2.365         2.365         25.3         59.80           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Delta value calculations           V-lint         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.65         0.80           50%         60.0         57.80         52.80         2.62         2.57         2.60         0.78           60%         66.0         52.80         67.80         2.57         2.65         0.77	9	57.8	5.163		2.623		2.623	25.8	67.71
11         67.8         5.36         2.694         2.694         26.8         72.20           12         72.8         5.232         2.496         2.496         2.496         26.8         72.20           13         77.8         5.057         2.365         2.365         25.3         59.80           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Delta value calculations           V-lower         V-lipper         V-int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.65         0.78           60%         60.0         57.80         62.80         2.65         0.77	10	62.8	5.36		2.572		2.572	26.8	68.93
12     72.8     5.232     2.496     2.496     26.2     65.30       13     77.8     5.057     2.365     2.365     25.3     59.60       14     82.8     5.043     1.387     1.387     25.2     34.97       15     87.8     3.179     0.218     0.218     15.9     3.47       Delta value calculations       V-int     633.68       30%     48.0     47.80     52.80     2.46     2.53     2.46     0.83       30%     48.0     47.80     52.80     2.46     2.53     2.46     0.83       40%     54.0     52.80     57.80     2.53     2.65     0.78       50%     60.0     57.80     62.80     2.62     2.57     2.60     0.78       60%     66.0     62.80     67.80     2.57     2.65     0.77	11	67.8	5,36		2.694		2.694	26.8	72.20
13         77.8         5.057         2.365         2.365         25.3         59.80           14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         0.218         15.9         3.47           Delta value calculations           Video Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-lipper         V-lint         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.65         0.80           50%         60.0         57.80         52.80         2.65         0.77	12	72.8	5.232		2.496		2.496	26.2	65.30
14         82.8         5.043         1.387         1.387         25.2         34.97           15         87.8         3.179         0.218         1.387         0.218         15.9         3.47           2.037         311.1         633.68           V-lower         V-loper         V-loper         V-loper         V-loper         V-loper         V-loper         V-loper         V-loper         0.213         0.83	13	77.8	5.057		2.365		2.365	25.3	59.80
15         87.8         3.179         0.218         0.218         15.9         3.47           2.037         311.1         633.68           Delta value calculations           % Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-lipper         V-lint         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.62         2.56         0.80           50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77	14	82.8	5.043		1.387		1.387	25.2	34.97
2.037         311.1         633.68           Delta value calculations           % Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-Int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.62         2.56         0.80           50%         60.0         57.80         62.80         2.67         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77	15	87.8	3.179		0.218		0.218	15.9	3.47
Delta value calculations           % Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-Int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.65         0.80           50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77							2.037	311.1	633.68
% Width         Act. Chn.         Ch-Lower         Ch-Upper         V-lower         V-Upper         V-int         Delta           30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.62         2.56         0.80           50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77					Volta volue v	aleulation			
30%         48.0         47.80         52.80         2.46         2.53         2.46         0.83           40%         54.0         52.80         57.80         2.53         2.62         2.56         0.80           50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         52.80         67.80         2.57         2.69         2.65         0.77		% Width	Act Chn	Chloum				M lot	Dolta
40%         54.0         52.80         57.80         2.53         2.62         2.56         0.83           50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77		30%	48.0	47 80	52.90	2.48	7.52	7.00	0.93
50%         60.0         57.80         62.80         2.62         2.57         2.60         0.78           60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77		40%	54.0	52.80	57.80	2.53	2.60	2.40	0.80
60%         66.0         62.80         67.80         2.57         2.69         2.65         0.77		50%	60.0	57.80	62.60	2.00	2.57	2.00	0.78
		60%	66.0	67.80	67.80	2.02	2.69	2.65	0.77
		70%	72.0	67.80	72 80	2.69	2.50	2.53	0.81

	Cal	culated o	lata, 1-dir	nensiona	I flow the	ory	
Manning	or Chezy	4	M			Q =	714.1
		Slope	0.0009			V <sub>AVR</sub> =	2.30
Roughness	coeff.		Area reduci	lion factor	1		
Sub	n		Sub	fx			
0			0	1			
2	0.036		2	1			
n			n	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	A	A	R	(m³/s)	Velocity
	depth						
17	C	2	0.0	11.4	0	0.00	0.00
22.8	1.411	2	7.6	5.4	1 411	7 99	1.05
27.8	2.02	2	10.1	5.0	2.02	13.45	1.33
32.8	3.239	2	16.2	5.0	3.239	29.54	1 82
37,8	4 939	2	24.7	50	4.939	59 68	2 42
42.8	4.937	2	24.7	5.0	4.937	59.64	2.42
47.8	5.035	2	25 2	5,0	5 035	61.63	2.45
52.8	4.739	2	23.7	5.0	4.739	55.71	2.35
57.8	5 163	2	25.8	50	5.163	64.26	2 49
62.8	5.36	2	26.8	5.0	5.36	68-40	2.55
67.8	5,36	2	26 8	5.0	5.36	68.40	2.55
72.8	5.232	2	26.2	5.0	5.232	85.70	2.51
77.8	5 067	2	26.3	50	5.057	62.06	2 46
82.8	5.043	2	25.2	5.0	5.043	6179	2.45
87.8	3.175	2	15.9	5.0	31/9	28.64	06.1
			511.09		47 610	/ 14.14	2.34
		[	Jeita value	calculation	IS		
% Width	Act. Chil.	Lawer	Upper	A-jomet	V-Upper	V-Int	Delta
30%	48.0	47.80	52.80	2.45	2 35	2 44	0,94
40%	54.0	52.80	57.80	2.35	2.49	2.38	0.96
50%	60.0	57.80	62.80	2.49	2.55	2.52	0.91
60%	66.0	62 80	67.80	2 55	2 55	2 55	0.90
70%	72.0	67 60	72.60	2 66	2.51	2 52	0.91

Statn No.: D3H012 River: Oranje Place: Doornkuiken

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The values in the legend block describe measured discharge for the profile indicated

		and the second second	Mea	asured da	ta		I		
STA	TION No. :	D3H012			STAI	RT TIME	9h55		
RIVE	R NAME : E NAME : DATE :	Oranje Doornkuiken 10/29/87		Averag	2.829	m			
				1	Main Cha Main Chan	Channel LEFT : 50 hannel RIGHT 140			
1	2	3	4	5	6	7	8	9	
Vertical	Chainage	Vertical	Velocitv	Velocity	Velocity	V aver.	Area	Q	
		ar offerstore				(m/a)	(m <sup>2</sup> )	(m <sup>3</sup> /s)	
numper		donth	0.20	0.40	0.80	(11/5)	E87 1	325 77	
1	35	n		0		0.074	0.0	0.00	
2	40	0 97		0 D		0.000	63	0.00	
3	48	1 94		ň		0,000	15.5	0.00	
4	56	2.82		0.096		0.096	22.6	2.17	
5	64	5.41		0.387		0.387	43.3	16.75	
6	72	7.37		0.557		0.557	59.0	32.84	
7	80	7.29		0.744		0.744	58.3	43.39	
8	88	6.88		0.753		0.753	55.0	41.45	
9	96	6.98		0.965		0.965	55.8	53.89	
10	104	7.55		0.735		0.735	60.4	44.39	
11	112	7.47		0.77		0.770	59.8	46.02	
12	120	5.85		0.455		0.455	46,8	21.29	
13	128	5.03		0.277		0.277	40.2	11.15	
14	136	3.51		0.413		0.413	21.1	8.70	
15	140	2.03		0.243		0.243	8.1	1.97	
16	144	2.29		0.119		0.119	14.9	1.77	
17	153	0		0		0.000	0.0	0.00	
18						0.000	0.0	0.00	
19						0.000	0.0	0.00	
						0.574	567.1	325.77	
			D	elta value c	alculation	s			
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	
	30%	77.0	72 00	80 00	0.56	074	0 67	0.85	
	40%	86.0	80.00	88.00	0.74	0.75	0.75	0.77	
	50%	95.0	88.00	96.00	0.75	0.97	0.94	0.61	
	60%	104.0	104.00	112.00	0.74	0.77	0.74	0.78	
	70%	113.0	112.00	120.00	0.77	0.46	0.73	0.79	

	Cal	culated o	lata, 1-din	nensiona	I flow the	ory	
Manning	or Chezy	r;	М			Q =	478.6
		Slope	0.00008			V <sub>AVR</sub> =	0.84
Roughness	coeff.		Area reduct	ion factor			
Sub	6		Sub	fA			
Ø			0	1			
2	0.035		2	1			
0			o	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	orefective	Section	A	р	R	(m²/s)	Velocity
	depth						
35	0	2	0.0	20.0	0	0.00	0.00
40	0 97	2	6.3	6.5	0.97	1.58	0.25
48	1,94	2	15.5	8.0	194	6.17	0.40
56	2.82	2	22.6	80	2.82	11 51	0.51
64	5 41	2	43.3	8.0	5,41	34.08	0.79
72	7 37	2	59.0	8.0	7.37	57.06	0.97
80	7.29	2	58.3	8.0	7 29	56.03	0.96
88	6.88	2	55.0	8.0	6.88	50 88	0.92
96	6 98	2	55.8	8.0	6.98	52.12	0.93
104	7 55	2	60.4	8.0	7.55	59.40	0.98
112	7.47	2	59.8	80	7 47	58.36	0.98
120	5.85	2	46.8	8.0	5 85	38 83	0.83
128	5 03	2	40.2	8.0	5.03	30.19	0.75
136	3 51	2	21.1	6.0	3.51	12,43	0.59
140	2.03	2	8.1	40	2 03	3.33	0.41
144	2.29	2	14.9	6.5	2.29	6 61	0.44
153	0	2	0.0	4.5	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
	0	2	0.0	0.0	G	00:00	0 00
			567.09			478.58	0.84
			Delta value	calculation	15		
% Width	Act. Chira	Lower	Upper	V-lower	V-Upper	V-Int	Delta
300/	777.0	77.00	80.00	0.97	0.96	0.96	0.88
40%	86.0	80.00	88.00	0.96	0.92	0.93	0.90
50%	95.0	88.00	96.00	0.92	0.93	0.93	0.91
60%	104.0	104.00	112.00	() GR	0.98	0.98	0.86
70%	113.0	112.00	120.00	0.98	0.63	0.96	0.88

Appendix H

			Me	asured da	Ita			
STA	TION No. :	D3H012			STA	RT TIME :	16h48	
RIVE	R NAME :	Oranje		Averag	e Gaugepk	ate reading :	3.209	m
PLAC	E NAME :	Doornkuiken						
	DATE :	10/28/87						
					Main Cha	nnel LEFT :	50	
				I	Main Chan	nel RIGHT :	140	
1	2	3	4	5	6	7	8	Q
Montional	<b>•</b>	• 1/1	•	· · · ·	•	1 Mayor		<u> </u>
venicai	Cnamage	venical	Velocity	Velocity	Velocity	v aver.	Area	<b>u</b>
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m~)	(m*/s)
		depth				0.758	618.3	468.93
1	33	0		0		0.000	0.0	0.00
2	40	1.36		0.135		0.135	7.5	1.01
3	44	1.75		0.05		0.050	10.5	0.53
4	52	2.84		0.112		0.112	28.4	3.18
5	64	5.68		0.328		0.328	68.2	22.36
6	76	7.8		0.872		0.872	78.0	68.02
7	84	_7.4		1.195		1.195	59.2	70.74
8	92	7.14		1.314		1.314	57.1	75.06
9	100	7.69		1.093		1.093	61.5	67.24
10	108	7.94		0.846		0.846	63.5	53.74
11	116	7.28		1.016		1.016	58.2	59.17
12	124	6.51		0.617		0.617	52.1	32.13
13	132	4.64		0,217		0.217	37,1	8,05
14	140	2.49		0.319		0.319	14.9	4,77
15	144	2.71		0.243		0.243	10.8	2.63
16	148	1.95		0.027		0.027	11.2	0.30
17	155.5	0		0		0.000	0.0	0.00
18						0.000	0.0	0.00
19						0.000	0.0	0.00
						0.758	618.3	468.93
			D	elta value c	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	77.0	76.00	84.00	0.87	1.20	0,91	0.83
	40%	86.0	84.00	92.00	1.20	1.31	1.22	0.62
	50%	95.0	92 00	100 00	1 31	1 09	1 2 3	0.62
	60%	104.0	100.00	108.00	1.09	0.85	0.97	0.78
	70%	113.0	108.00	116.00	0.85	1.02	0.95	0.80

	Cale	culated d	lata, 1-dir	nensiona	l flow the	ory	
Manning	or Chezy	:	M			Q =	570.2
	l	Slope	0.00008			V <sub>AVR</sub> =	0,92
loughness	coeff		Area reduc	lion factor	1		
Sub	n		Sub	fA			
0			0	1			
2	0.033		2	1			
<u> </u>	0.000		2				
0			U	l		-	l
Chainage	Vertical	Sub	Atea	Wetted P	H-Radius	ų	v
	or affective	Section	A	P	R	(m'/s)	Velocity
	depth						
33	0	2	0.0	20.0	O	0.00	0.00
40	1.36	2	7.5	55	1 36	2 49	0 33
44	1 75	2	10.5	6.0	1.75	4 13	0.39
52	2.84	2	28.4	10.0	2.84	15,44	0.54
64	5.68	2	68.2	12.0	5.68	58.81	0.86
/6	/.6 	ž	78.0	10.0	18	83 15	10/
84	+ 4	2	59.4	0.U 0.0	7.4	60 93 E7 44	1.00
92	7 00	2	1 10	0.U 0.0	7.14	31.41 ax ca	1.00
100	7.03	2	635	80	7 08	69.60	1.00
116	7.04	5	58.0	80	7 28	40 00 50 00	1.02
124	6 44	5	52 1	80	6.51	49.71	n 94
132	464	2	37 1	80	4.64	27.99	0.75
140	2 49	2	149	60	2 49	7 44	0 50
144	271	2	10.8	4.0	2.71	571	0.53
148	1 95	2	11.2	5.8	1.95	4.74	0.42
155.5	0	2	0.0	3.8	Q	0.00	0.00
	0	2	0.0	0.0	0	0 00	0 00
	0	2	0.0	0.0	0	0.00	0.00
			618.33		I	570.23	0.9
		[	Jelta value	calculation	IS		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-init	Delta
30%	77.0	76.00	84 00	1 07	1 03	1 06	0.87
40%	86.0	84 00	92.00	1.03	1.00	1.02	0.90
60%	96.0	92.00	100.00	1.00	1.06	1.02	0.90
60%	104.0	100.00	108.00	1.06	1.08	1.07	0.86
70%	113.0	108.00	116.00	1 08	1.02	1 04	0.89

			Me	asured da	ata					Cal	culated o	lata, 1-dii	mensiona	al flow the	eory	
STA	TION No. :	D3H012			STAF	RT TIME	11h35		Manning	or Chezy	r:	M			Q =	872.9
RIVE	R NAME :	Oranje		Average	Gaugepla	ate reading :	3.875	m			Sicion	0.00015			VAVR =	1.23
PLAC	E NAME :	Doornkuiker	n												L	
	DATE :	10/22/87							Roughnes	s coeff.		Area reduit	tion factor	1		
					Main Cha	nnel LEFT :	50		Sub	n		Sub	f,			
					Iain Chan		4.60		0			0	4	1		
				"			140		ž	0.036		l š				
1	2	3	4	5	6	7	8	9	0	0.000		ō				
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chanage	Vertical	Sub	Area	Wetted P	H-Radius	Q	T V
number		or effective	fl 2d	0.4d	0 Bd	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)			Cardina		n .	Þ	(m <sup>3</sup> /s)	Velocity
		depth		0.10	0.04	0.957	711.6	681 10		denth	COLORI					Verocay
1	28.5	0		0		0.000	0.0	0.00	28.5	0	2	0.0	16.0	0	t 00 00	0.00
2	32	0.86		0.1		0.100	3.2	0.32	32	0.86	2	3.2	3.8	0.86	0.99	0.31
3	36	1.435		0.092		0.092	5.7	0.53	36	1 435	2	57	4.0	1 435	2.48	6.43
4	40	2.19		0.108		0.108	8.8	0.95	40	2.19	2	8.8	4.0	2.19	5.03	0.57
5	44	2.465		0.306		0.306	9.9	3.02	44	2.465	2	9.9	4.0	2.465	6.12	0 62
6	48	2.93		0.428		0.428	11.7	5.02	48	2.93	2	11 7	4.0	2 93	8.16	0.70
	52	3.61		0.467		0.467	14.4	6.74	52	3.61	2	14.4	4.0	3.61	11.56	0.80
0	00	3.90		0.484		0.484	15.8	7.65	56	395	2	15.8	4.0	3.95	13 43	0.85
10	64	6.75		0.879		0.879	20.0	19.01	60	5.01	ž	20.0	4.0	5.01 6.7E	19,90	1.00 1.00
11	68	7 75		0.831		0.831	21.0 91.0	25.76	68	7 75	5	31.0	70	7 75	41 30	+ 39
12	72	8.49		0.988		0.988	34.0	33.55	72	8 49	5	34.0	40	8 49	48.05	1.42
13	76	8.575		0.966		0.966	34.3	33.13	76	8.575	2	34.3	4.0	8.575	48.80	t 43
14	80	8.43		1.313		1.313	33.7	44.27	80	8.43	2	337	4.0	8.43	47.62	1.41
15	84	8.1		1.37		1.370	32.4	44.39	84	81	2	32.4	4.0	8.1	44 46	1.37
16	88	7.83		1.548		1.548	31.3	48.48	88	7.83	2	31.3	4.0	7.83	42.02	: 34
17	92	7.77		1.478		1.478	31.1	45.94	92	7.77	2	31.1	4.0	7 77	41.48	1.23
18	96	8.09		1.27		1.270	32.4	41.10	96	8.09	2	32.4	40	8,09	44 37	1 37
19	100	8.45		1.361		1.361	33.8	46.00	100	8.45	2	338	4.0	8.45	47.73	1 41
20	104	8.71		1,452		1.452	34.8	50,59	104	0./1 e 70	2	34.0	4.0	0./1	DU. 10	1 1 44
21	100	0.70		1.320		1.326	30.0	40.40	100	0.70	2	00.0	40	0.10	40 GC	4 #0
23	112	7 955		n 949		0.949	31.8	30.20	116	7 955	5	31.8	4.0	7 955	43 14	136
24	120	7 54		0 836		0.836	30.2	25 21	120	7 54	2	30.2	4.0	7.54	39 45	1 31
25	124	7.39		0.597		0.597	29.6	17.65	124	7.39	2	29.6	4.0	7.39	28.15	1.29
26	128	6.17		0.435117		0.435	24.7	10.74	128	6.17	2	24.7	40	6,17	28 26	1 14
27	132	5.26		0.439458		0.439	21.0	9.25	132	5.26	2	21 0	4.0	5.28	21 65	1 03
28	136	4.725		0.648		0.648	18.9	12.24	136	4.725	2	18.9	4.0	4.725	18.11	0.95
29	140	3.25		0.344		0.344	13.0	4.47	140	3.25	2	13.0	40	3.25	9.70	0.76
30	144	3,385		0.613		0.613	13.5	8.30	144	3.385	2	13.5	4.0	3 385	10.28	0.77
31	148	2.1		0.170		0.170	14.2	2.41	148	21	2	14.2	6.8	21	1 7 91	0.95
32	15/.5	0		0.000		0.000	0.0	0:00	157.5	0	2	0.0	4.8	<u> </u>	0.00	0.00
						0.90/	/11.0	681.10				/11.62			012.92	1 1-4
			C	)elta value c	alculation	ns						Jeita value	calculatio	ns		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act. Chins	Lower	Uisiper	V-IOMOI	V-Upper	V-int	Delta
	30%	77.0	76.00	80.00	0.97	1.31	1.05	0.91	30%	77.0	76 20	80.00	: 43	1 4 1	1.42	0.86
	40%	86.0	84 00	88.00	1 37	1.55	1.46	0.66	40%	86.0	84.00	88.00	1.37	1 34	1 36	0.90
	50%	95.0	92.00	96.00	1.48	1.27	1.32	0.72	50%	95.0	92.00	86 00	1 32	1.37	1.36	0.90
	60%	104.0	104.00	108.00	1.45	1.33	1.45	0.66	60%	104.0	104.00	108.00	1.44	1.45	1.44	0.85
	1476	113.0	112.00	116.00	1.28	0.95	1.20	0.80	7076	113.0	112.00	116.00	1.43	1.36	1.43	U.0/

Delta

1.23

	_		Me	asured da	ata			
STA	TION No. :	D3H012			STA	RT TIME :	11h05	
RIVE	R NAME : E NAME : DATE :	Oranje Doornkuiken 10/21/87		Averag	e Gaugepli	ate reading :	4.185	m
					Main Cha	nnel LEFT :	50	
					Main Chan	nel RIGHT :	140	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	Vaver	Area	<u> </u>
Verticel	Chanage	vertical	VEIDURY	Veibbily	VEIDURY	v aver.	(m <sup>2</sup> )	<b>ب_</b> عرب
number		or effective	0.2d	0.4d	0.8d	(m/s)	(0))	(111 /\$)
		depth				1.049	754.6	791.39
1	28	0		0		0.000	0.0	0.00
2	32	1.18		0.026		0.026	4.7	0.12
3	36	1.72		0.241		0.241	6.9	1.66
4	40	2.4/		0.349		0.349	14.8	5.17
0	48 FC	3.23		0.462		0.462	25.8	11.94
0 7	50	4.22		0.736		0.736	33.8	24.85
/	64 70			0.884		0.884	56.0	49.50
0	12	0.07		1.053		1.053	71.0	74.72
9	00	0,07		1.422		1.422	09.4	98,63
10	00	0.00		1.535		1.535	04.0	99.22
11	90	0.30		1.309		1.509	07.0	101.16
12	104	9.12		1.37		1,370	73.0	99,90
13	112	0.94		1.309		1.309	63.4	93,02
14	120	1.92		0.844		0.944	603.4 51 D	29.01
10	120	4 05		0.000		0.645	30.6	25.23
10	100	4.30		0.045		0.045	33.0	0.57
18	148	2.85		0.034		0.450	22.0	9.07 0.68
19	158	2.00		0.004		0.000	00	0.00
						1 049	754.6	791.39
						L		1 10 1.00
			D	elta value c	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	77.0	72.00	80.00	1.05	1.42	1.28	0.82
	40%	86.0	80.00	88.00	1.42	1.54	1.51	0.70
	50%	95.0	88.00	96.00	1.54	1.51	1.51	0.69
	60%	104.0	104.00	112.00	1.37	1.31	1.37	0.77
	70%	113.0	112.00	120.00	1,31	0.94	1.26	0.83

have the second	Cal	culated o	lata, 1-dir	nensiona	I flow the	ory	
Manning	or Chezy	:	M			Q =	898.4
		Slope	0.00015			V <sub>AVR</sub> =	1.19
Roudhness	coeff		Area reduct	lion factor	1		
Sub	n		Sub	f.			
0			0	•			
2	0.038		<b>4</b>				
2	0.030						
U			U	1		-	1 17
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	ų	V I
	or effective	Section	A	Ą	R	(m~/s)	Velocity
	depth						
28	G	2	0.0	16 0	0	0.00	00.00
32	1.18	2	4.7	40	1.18	170	0.36
36	1.72	2	89	4.0	1 72	3 18	0.46
40	2.47	2	14.8	6.0	2.47	8.73	0.59
48	3.23	2	25.8	0.8	3.23	18.20	0.70
56	4.22	2	33.8	8.0	4.22	28.41	Q 64
64	7	2	56 0	8.0	7	66.05	1 18
72	8.87	2	71 0	0.8	8.87	98.00	1.38
80	8.67	2	69.4	8.0	8.67	94.34	1 36
88	8.08	2	64.6	8.0	808	83.89	1 30
96	8.38	2	67 0	8.0	8.36	89 14	1 33
104	9.12	2	73.0	0.8	9.12	102.65	1.41
112	8.94	2	71.5	8.0	8.94	99.29	1 39
120	7.92	2	63.4	8.0	7.92	61 14	1 28
128	64	2	51 2	8.0	6.4	56.88	1 11
136	4.95	2	39.6	8.0	4.95	37.07	0.94
144	3.66	2	22.0	6.0	3.66	16.81	0.77
148	2.85	2	20.0	70	2.65	12 93	0.65
158	0	2	0.0	5.0	0	0.00	00.0
			754.57			898.41	1.1
		[	Deita value	calculation	S		
% Width	Act Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	77.0	72.00	60.00	1 38	1.36	1 37	0.87
40%	86.0	80.00	88.00	1.36	1.30	1 31	0.91
50%	95.0	88.00	96.00	1.30	1.33	1.33	0.90
60%	104.0	104.00	112.00	141	1.39	1.41	0.85
70%	113.0	112.00	120.00	1 39	1 26	1 37	0.87













The values in the legend block describe measured discharge for the profile indicated

			Me	easured d	ata					Ca	lculated	data, 1-di	mension	al flow th	eory
STA	TION No. :	D7H002			STA	RT TIME :	10h45		Manning	or Chezy	r:	М			0
RIVE	R NAME :	Oranje -		Average	e Gaugepla	ate reading :	2.195	m			Slope	0.0004			<u> </u>
PLAC	DATE :	Prieska 10/31/87							Roughness	coeff		Area reductir	n factor	٦	
					Main Cha	nnel LEFT :	20		Sub	n		Sub	f		
				1	Main Chan	nel RIGHT :	220		0			0	1		
	0	•	•		•		•	•	2	0.035		2	1		
1	4	3	4	5	D		8	9	0			C	1		
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainege	Vertical	Sub	Area	Watted P	H-Radius	
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m*)	(m~/s)		or effective	Section	A	P	R	(n
		depth				1.016	440.9	448.15		depth					
1	16.5	0		0		0.000	0.0	0.00	16.5	0	2	0.0	9.5	0	0
2	19	2.39		0.5/45		0.575	9.0	5.15	19	2.39	2	9.0	3.8	2.39	9
2 4	44 29	2.40		1.06/5		1 346	12.3	13.08	24	2 40	4	12.3	5 U 7 E	4.45	
5	39	3.02		1 178		1.240	30.2	35.58	29	2.30	5	30.2	10.0	3.02	
6	49	2 96		1 2205		1 221	29.6	36.13	49	2 GR	5	29 B	10.0	2 86	
7	59	2.8		1.076		1 076	28.0	30.13	59	2.8	2	28.0	10.0	2.8	3
8	69	2.87		1.059		1.059	28.7	30.39	69	2.87	2	28.7	10.0	2.87	3
9	79	2.84		1.135		1.135	28.4	32.23	79	2.84	2	28.4	10.0	2.84	
10	89	2.62		1.1865		1.187	26.2	31.09	89	2.62	2	26.2	10.0	2.62	2
11	99	3.61		0.923		0.923	36.1	33.32	99	3 61	2	36.1	10 Ø	3.61	44
12	109	2.92		1.059		1.059	29.2	30.92	109	2.92	2	29.2	10.0	2.92	3
13	119	2.99		0.974		0,974	29,9	29.12	119	2.99	2	29.9	10.0	2 99	32
14	129	1.98		1.042		1.042	19.8	20.63	129	1.98	2	19.8	10.0	1.98	
15	139	2.05		0.9654		0.965	20.5	19.79	139	2 05	2	20.5	10 0	2.05	10.46
16	149	1.99		0.8889		0.889	19.9	17.69	149	1.99	2	19.9	10.0	1 99	
17	159	1.23		0.8124		0.812	12.3	9.99	159	1.23	2	12.3	10.0	1 23	8
18	169	0.78		0.804		0.804	/.8	6.27	169	0.78	2	/ 0	10.0	0.78	
19	1/9	1.14		0.7614		0.761	11.2	6.53	1/9	1 14	2	10.4	100	1.14	
20	109	1.63		0.000		0.860	10.3	11 68	109	1 22	5	12.2	10.0	1 22	
55	209	1.68		0.9399		0.940	12.6	11.84	209	1.68	5	12.6	75	1 68	
23	214	0.73		0.5319		0.532	31	1.65	214	0.73	2	31	43	0.73	
24	217.5	0		0		0.000	0.0	0.00	217.5	Ō	2	0.0	1.8	0	( C
						1.016	440.9	448.15				440.92			46
	[		1	Delta value	calculatio	ns						Delta value	calculatio	ns	
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act Chn	Lower	Lipper	V-lower	VAUpper	
	30%	80.0	79.00	89.00	1 14	1.19	1.14	0.89	30%	80.0	79.00	89.00	1.15	1 09	
	40%	100.0	99.00	109.00	0.92	1.06	0.94	1.09	40%	100.0	99.00	109.00	1 34	1 17	
	50%	120.0	119.00	129.00	0.97	1.04	0.98	1.04	50%	120.0	119.00	129.00	1 19	0.90	
	60%	140.0	139.00	149.00	0.97	0.89	0.96	1.06	60%	140.0	139.00	149.00	0.92	0.90	1
	70%	160.0	159.00	169 00	0.81	0.80	0.81	1.25	70%	160.0	159-00	169-00	0.66	0.48	

+

Q =

Q

(m<sup>3</sup>/s)

0.00 9.15

12.72

17 93 38 06

34.87

31.79

33 12

32.65

28,45

48.54

34 09 35 46

17.84 18.90 17 99

8.07

3.78 6.90

12.90

7.96

10,18

1.44 0.00

460.68

Volist

1 14 1.32

V<sub>AVR</sub> =

460.7

1.04

¥

0.00

1.02

1.04 1.01

1 19

1.18

1.14

1 15

1 15

1.09 1.34

0.90 0.92

0.90

0.66 0.48

0.82

079

0.65

0,81 0.46

0.00

Delta 0.92 0.79

0.90 1.14

1.64

1.04

Velocity

STATION No.         D7H02         START TIME         OBH5           PIVER NAME         Prineska DATE         427/8         Main Channel LEFT         22         m           Vertical         Channel deptin         Vanco	INVERSIVECTIVALE:         OPERATION No.: DTHOD2           START TIME::         OPERATION No.: DTHOD2           Average Gaugeplate reading::         2.82         m           Main Channel LEFT::         20         T         Classing         Variantia         Varia <th>0.90</th> <th>1.20</th> <th>1.05</th> <th>1.20</th> <th>170.00</th> <th>160.00</th> <th>160.0</th> <th>70%</th> <th></th>	0.90	1.20	1.05	1.20	170.00	160.00	160.0	70%					
STATION No.         D7H02         START TIME         OBH4           PLACE NAME         Priesta DATE         427/88         Main Channel LEFT         22         m           Varical         Channel DATE         Varical         Valority         Valority<	Imreasured caractering:         STATION No: DTHO2           STATET TIME:         OBH5           Average Gaugeplate reading:         2.82         m           Main Channel LEFT:         20           Average Gaugeplate reading:         2.82         m           Main Channel LEFT:         20           Average Gaugeplate reading:         2.82         m           Main Channel LEFT:         20           Variadi         Variadi         Variadi         Variadi         Variadi         Variadi         Colspan="2">Main Channel LEFT:         20           Variadi         Variadi         Variadi         Variadi         Colspan="2"           Variadi         Variadi         Variadi         Colspan="2"           Variadi         Variadi         Variadi         Colspan="2"           Variadi         Variadi         Variadi         Variadi <th <="" colspan="2" td=""><td>1.17</td><td>0.93</td><td>1.04</td><td>0.93</td><td>130.00</td><td>120.00</td><td>120.0</td><td>20%</td><td></td></th>	<td>1.17</td> <td>0.93</td> <td>1.04</td> <td>0.93</td> <td>130.00</td> <td>120.00</td> <td>120.0</td> <td>20%</td> <td></td>		1.17	0.93	1.04	0.93	130.00	120.00	120.0	20%			
STATION No.         DTHO2         STATTINIC         STATTINIC         STATTINIC         Clanic           PLACE NAME         Private         Private         Private         Private         Main Channel LEFT         20         Main Channel RIGHT         20         0.00	INVERSIVENTIAL IN Calaboration of the section	1.12	0.97	1.06	0.97	110.00	100.00	100.0	40%					
STATION No.         DTHO2         STATTINK         STATTINK         STATTINK         Clanaje           PLACE NAME         Prieska DATE         427/88         Main Channel LEFT         20         Main Channel LEFT         20           1         2         3         4         5         6         7         8         9           Varitual number         Chanage         Vencity         1.086         90         <	Interstret rike:         STATION No. IDTHO2         START TIME:         ORAGE NAME:         START TIME:         ORAGE NAME:         START TIME:         ORAGE NAME:         Claimage         START TIME:         ORAGE NAME:         Channel LEFT:         20         START TIME:         ORAGE NAME:         Claimage         START TIME:         ORAGE NAME:         Claimage         START TIME:         20         START TIME:         20         START TIME:         20         START TIME:         20         Main Channel LEFT:         20           A 4         S         6         T         S           Valued         Value         Valued <th< td=""><td>0.96</td><td>1.13</td><td>1.07</td><td>1.13</td><td>90.00</td><td>80.00</td><td>80.0</td><td>30%</td><td></td></th<>	0.96	1.13	1.07	1.13	90.00	80.00	80.0	30%					
STATION No.         DTHO2         START TIME         Clanis         Average Gaugeplate reading         2.82         m           PLACE NAME         Prieska DATE         Prieska Place         Verical         0.80         0.80         Verical         Verical         0.80 <td>Interstret data           STATION No. ID/HOIZ         STATION Cata           STATION No. ID/HOIZ         A verage Gaugeplate reading: 2.82 m           Main Channel LEFT: 20           Main Channel RIGHT: 200           O o o o o o o o o o o o deflace         Noted to NM         Verication Note to NM         Note of NM         Note of NM         Note of NM         Note of NM         O O         O O         O         Main Channel LEFT: 20         Multication Note of NM         Note of NM         Note of NM         Note of NM         O         O         O          Note of NM</td> <td>Delta</td> <td>V-Int</td> <td>V-Upper</td> <td>V-lower</td> <td>Ch-Upper</td> <td>Ch-Lower</td> <td>Act. Chn.</td> <td>% Width</td> <td></td>	Interstret data           STATION No. ID/HOIZ         STATION Cata           STATION No. ID/HOIZ         A verage Gaugeplate reading: 2.82 m           Main Channel LEFT: 20           Main Channel RIGHT: 200           O o o o o o o o o o o o deflace         Noted to NM         Verication Note to NM         Note of NM         Note of NM         Note of NM         Note of NM         O O         O O         O         Main Channel LEFT: 20         Multication Note of NM         Note of NM         Note of NM         Note of NM         O         O         O          Note of NM	Delta	V-Int	V-Upper	V-lower	Ch-Upper	Ch-Lower	Act. Chn.	% Width					
STATION No. : D7H002         STATION STATION STATINE : Oranie PLACE NAME : Oranie DATE : Prieska DATE : 21788         Average Gaugeplate reading : 2.32 m Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Channage dagem         Velocity         Valor.         Area dagem         0.3         2.98         1.1015         1.086         835.6         907.68           1         2         25         3.00         0.247         1.285         1.008         90.0         0.804         1.098         835.6         907.68         90.7         9           2         25         3.02         1.285         1.1015         1.285         33.0         41.40           1         100         5.28         1.0275         1.285         33.0         41.40           12         120         5.16         1.285         33.0         41.40         53.6         9.84.7         53.6           12         120         5.16         1.285         1.059 <t< td=""><td>Interstret clara           STATION No. ID/HO02         STATION Cata           STATION INC. ID/HO02         START TIME : ID/AP           PLACE NAME : Oranje DATE : Huska DATE : Hu</td><td></td><td></td><td>8</td><td>alculation</td><td>)elta value (</td><td>-</td><td></td><td></td><td></td></t<>	Interstret clara           STATION No. ID/HO02         STATION Cata           STATION INC. ID/HO02         START TIME : ID/AP           PLACE NAME : Oranje DATE : Huska DATE : Hu			8	alculation	)elta value (	-							
STATION No. : D7H002         STATION No. : D7H02         STATION No. : D7H02         STATION No. : D7H02           RIVER NAME         Oranie DATE         Phasea         Average Gaugeplate reading : 2.32         m           1         2         3         4         5         6         7         8         9           Vertical number         Channege         Vencell         Velocity         Velocit	IMeasured Cata           STATION No: D7H002         STATION Cata         STATION Cata           STATION No: D7H002         STATION No: D7H02         STATION No: D7H02 <td>907.68</td> <td>835.6</td> <td>1.086</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	907.68	835.6	1.086										
STATION No. : D7H02         START TIME : 08h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.92 m           Main Channel LEFT : 20         Main Channel LEFT : 20           Varical 3         Chainage or effective 4         Varical 3         Varical 3         Varical 4         Valocity 6         Valocity 7         Valocity 8         Valocity 9         Valocity 9         Valocity 1.227         Valocity 1.386         Valocity 9         Valocity 1.0804         Valocity 0.804         Valocity 1.0804	IMPESTINCIAL         STATION No: D7H002         STATION No: D7H02         STATION No: D7H02<	0.00	0.0	0.000	1			A STATE OF STATE	State of the second sec	24				
STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranja DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           Main Channel LEFT : 20         Main Channel LEFT : 20           Vertical         Chainage         Vertical         Ventical         Valority         Valority         Valority         Valority         Valority         Main Channel RIGHT :         20           2         25         3.00         0.24         0.44         5         6         7         8         9           3         30         2.98         1.1015         1.026         1.285         3.00         1.036         1.230         3.01         1.230         3.01         1.230         3.01         1.230         3.01         1.230         3.01         1.230         3.01         1.230         3.01         1.230		0.00	0.0	0.000		0		0	220	23				
STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.92 m           Main Channel LEFT : 20         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vencal         Velocity         Valority         Valority<	INMeasured cara           STATION No. : D7H002         STATI TIME : 08H45           STATT TIME : 08H45           PLACE NAME : Prieska           DATE : 427/88           Main Channel LEFT : 20           Main Channel LEFT : 20           Main Channel LEFT : 20           Varical         Varical         Varical         Valocity	7.20	11.2	0.643		0.6425		2.24	215	22				
STATION No.:         D7H002         START TIME         :         OB45           RIVER NAME:         Oranja         Average Gaugeplate reading:         2.82         m           LACE NAME:         Prieska DATE:         4/27/88         Main Channel LEFT:         20           Verkial         Chainage         Verkical         Valocity         Valoc		20.54	25.3	0.813		0.8125		3.37	210	21				
STATION No.:         D7H002         START TIME         Clamie         Average Gaugeplate reading         2.82         m           RIVER NAME         Cranje         4/27/88         Main Channel LEFT         20         2         n           Vertical         Chainage         ventical         ventical         0.2d         0.4d         5         6         7         8         9           1         2         2         3.06         0.2d         0.4d         0.804         1.066         835.6         907.68           2         2         3.06         0.2d         0.4d         0.804         1.066         835.6         907.68           3         3.0         2.98         1.1015         1.2645         1.1015         1.2645         1.264           4         4.00         2.47         1.285         1.2645         1.265         3.0.0         1.102         2.2.4         2.462           10         100         5.28         1.1015         1.2645         1.162         2.2.4         2.462           11         110         5.35         1.0675         1.265         3.0.0         4.462         4.9.9         3.123         3.1230         1.178         4.2.4		49.77	47.0	1.059		1.059		4.7	200	20				
STATION No. : D7H002         START TIME : 08H45         OBH45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical         Valocity         Velocity         Velocity         Velocity         Velocity         Velocity         Valocity         Q         Q           1         2         20         3.02         1.1015         1.1086         835.6         907.88         907.88           1         1.002         2.4         2.4         1.297         3.0.2         3.0.1         1.3.25         3.0.1         3.0.2         3.0.1	Imeasured data           STATION No. : D7H002         START TIME : 08h45           RVER NAME : Oranje PLACE NAME : Priska DATE : 4/27/88         START TIME : 08h45           DATE : 4/27/88         Priska Main Channel LEFT : 20         Main Channel LEFT : 20           Vertical         Chainage         vertical degm         Velocity         Valocity         Q	48.57	45.5	1.068		1.0675		4.55	190	19				
STATION No. : D7H002         START TIME : Osh45         Osh45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m         1         20           1         2         3         4         5         6         7         8         9           Vertical number         Chanage depth         Vencial depth         Velocity         Velocity         Velocity         Velocity         Velocity         1102         2.24         90         0.00         0.0	Measured data           STATION No. : D7H002         START TIME         O8h45           RIVER NAME         Chanje         Average Gaugeplate reading         2.82         m           PLACE NAME         Prieska         DATE         4/27/88         Main Channel LEFT         20           Verkal         Chaninage         Verkical         Main Channel RIGHT         20           1         20         0         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00 <td>47.77</td> <td>44.4</td> <td>1.076</td> <td></td> <td>1.076</td> <td></td> <td>4.44</td> <td>180</td> <td>18</td>	47.77	44.4	1.076		1.076		4.44	180	18				
STATION No. : D7H002         START TIME : 08In45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           Main Channel LEFT : 20           Ventcal         Channage         Ventcal         Velocity         Velocity <td>Measured data           STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82         m           PLACE NAME : Prieska         Main Channel LEFT : 20         Main Channel LEFT : 20           Vertical         Chanage         Vertical         0.20         0         0.00         &lt;</td> <td>44.65</td> <td>42.5</td> <td>1.051</td> <td></td> <td>1.0505</td> <td></td> <td>4.25</td> <td>170</td> <td>17</td>	Measured data           STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82         m           PLACE NAME : Prieska         Main Channel LEFT : 20         Main Channel LEFT : 20           Vertical         Chanage         Vertical         0.20         0         0.00         <	44.65	42.5	1.051		1.0505		4.25	170	17				
STATION No. : D7H002         START TIME : OBIN45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           DATE : 4/27/88         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Venical depth         Velocity         Velocity         Velocity         Velocity         Velocity         Velocity         1.086         83.5         97.60           2         2.0         0.4d         0.8d         (m/s)         (m <sup>3</sup> /s)         1.000         0.00         0.0	Measured data           STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82         m           PLACE NAME : Prieska         Main Channel LEFT : 20         Main Channel LEFT : 20           Ventcal         Chainage         ventcal         velocity         Velocity         Velocity         Velocity         Velocity         Velocity         Velocity         1.086         835.6         907.88           1         20         3         44         5         6         7         8         9           ventcat         Velocity         Velocity         Velocity         1.086         835.6         907.88           1         20         0         0         0         0.000         0.0         0.000           3         30         2.98         1.1015         1.2545         1.286         3.31         1.237           4         40         2.47         1.287         3.02         3.02         3.01         1.255         3.02         3.01         1.237           10         1.00         5.28         1.178         1.178         1.177         4.24         4.93         1.175         1.255	51.99	43.2	1.204		1.2035		4.32	160	16				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Measured data           STATION No.: D7H002         START TIME         OBIA5           RIVER NAME         Oranje         Average Gaugeplate reading         2.32         m           PLACE NAME         Prieska         DATE         4/27/88         Main Channel LEFT         20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Vertical         Velocity         Velocity         Velocity         Velocity         0.804         1.02         2.24         4.62         9           1         20         0         0.44         0.84         (m/s)         (m <sup>2</sup> )         (m <sup>3</sup> /s)           1         20         0         0.44         0.804         1.086         835.6         907.88           2         25         3.06         1.1015         1.102         2.24         2.462         1.365         2.4.7         3.372         3.02         1.287         3.3.72         3.02         1.127         3.4.24         1.102         2.2.4         2.462         1.1287         3.02         3.01         1.14.62         3.02         3.01         1.1465         1.1287         3.02	55.41	50.3	1.102		1.1015		5.03	150	15				
STATION No. : D7H002         START TIME :         08H45           RIVER NAME :         Oranje PLACE NAME :         Average Gaugeplate reading :         2.82         m           DATE :         4/27/88         Main Channel LEFT :         20         Main Channel RIGHT :         22           1         2         3         4         5         6         7         8         9           Vertical number         Channel 4         20         0         0.44         0.8d         (m/s)         (m <sup>2</sup> )         (m/s)         (m <sup>3</sup> )         (m	Measured data           STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82 m           PLACE NAME : Prieska DATE : 4/27/88         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage depth         Vencity         Velocity         Velocity         Velocity         Velocity         1.086         8.35.6         97.88           2         20         3.00         0.2d         0.4d         1.1015         1.1015         1.102         22.4         24.62           3         30         2.98         1.1015         1.102         22.4         24.62           4         400         2.47         1.265         3.00         0.00         0.0         0.0           4         400         3.01         1.127         1.265         3.02         1.237         3.32         1.242         24.7         3.32         1.255         3.03         41.40           10         100         5.28         10.655         1.068         49.7         5.30.5         51.43           11         1042         5.0	63.86	51.6	1.238		1.2375		5.16	140	14				
STATION No. : D7H002         START TIME : 09h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           DATE : 4/27/88         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Ventcal number         Chainage         Vencal depth         Velocity         Velocity         Velocity         Velocity         Velocity         0.804         1.086         835.6         907.88           2         25         3.06         0.2d         0.4d         0.804         1.086         835.6         907.88           1         20         0         0.2d         0.4d         0.804         1.086         835.6         907.88           2         25         3.06         1.1015         1.102         2.2.4         2.462           1         100         5.35         1.2545         1.255         3.0         1.03           1         100         5.35         1.127         1.127         48.7         5.3.0           1         1.0075         1.0575         1.059         5.3.5         50.0           2         1.0075         1.059         5.3.5 </td <td>Measured data           STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Oranje DATE : 4/27/88         START TIME : 08h45 Average Gaugeplate reading : 2.82 m           Verical number         Prieska DATE : 4/27/88         Main Channel LEFT : 20 Verical         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           1         20         3         4         5         6         7         8         9           1         20         3         4         5         6         7         8         9           2         25         3.06         0.2d         0.4d         0.8d         1.1015         1.1015         1.1015           2         26         3.02         1.1015         1.1015         1.1026         83.5.6         907.68           10         2.00         3.02         1.1015         1.127         1.127         1.236         33.0         41.40           10         3.00         5.28         1.0675         1.0675         1.068         42.4         49.95           110         5.3         1.055         1.0675         0.974         53.05         53.5         54.88</td> <td>54.18</td> <td>52.0</td> <td>1.042</td> <td></td> <td>1.042</td> <td></td> <td>5.2</td> <td>130</td> <td>ಚೆ</td>	Measured data           STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Oranje DATE : 4/27/88         START TIME : 08h45 Average Gaugeplate reading : 2.82 m           Verical number         Prieska DATE : 4/27/88         Main Channel LEFT : 20 Verical         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           1         20         3         4         5         6         7         8         9           1         20         3         4         5         6         7         8         9           2         25         3.06         0.2d         0.4d         0.8d         1.1015         1.1015         1.1015           2         26         3.02         1.1015         1.1015         1.1026         83.5.6         907.68           10         2.00         3.02         1.1015         1.127         1.127         1.236         33.0         41.40           10         3.00         5.28         1.0675         1.0675         1.068         42.4         49.95           110         5.3         1.055         1.0675         0.974         53.05         53.5         54.88	54.18	52.0	1.042		1.042		5.2	130	ಚೆ				
STATION No. : D7H002         START TIME : 09h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           Main Channel LEFT : 20           Main Channel LEFT : 20           Ventical number         Ventical depth         Vencial 0.2d         Vencial 0.2d         Vencial 0.2d         Vencial 0.2d         Vencial 0.2d         Vencial 0.4d         Main Channel LEFT : 20           1         20 0         20 0.2d         0.2d         0.4d         0.8d         1.086         83.5         907.6s           2         25 50         3.02 3.02         4.1015         1.1015         1.102         22.4         24.62           4         40         2.487         1.2897         1.2897         1.2897         3.02         3.01           4         40         5.28         1.177         1.2897         1.127         1.127         3.01           4         40         5.28         0.974         1.087         3.02         3.01           5         50         3.02         1.177         1.287         3.02         3.01           10         100         5.38         907.68         1.177         1.287         3.02         3.01           9	Measured data           STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82 m         Main Channel LEFT : 20           DATE :         4/27/88         Main Channel LEFT : 20         Main Channel LEFT : 20           Vertical         Chanage         Ventical         Velocity	46.58	50.0	1.000		0 9315		0.00	120	13 :				
STATION No. : D7H002         START TIME : 09h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m           DATE : 4/27/88         Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Ventical number         Chainage         Ventical depth         Velocity         Velocity         Velocity         Velocity         Velocity         Velocity         1.086         835.6         907.88           1         20         0.2d         0.4d         0.8d         (m/s)         (m <sup>3</sup> )         (m <sup>3</sup> )           2         25         3.06         0         0.804         1.086         835.6         907.68           2         20         3.02         1.1015         1.102         22.4         2.462           3         30         2.98         1.1015         1.265         33.0         4.42           4         40         2.47         1.297         1.287         30.72         30.17           5         50         3.02         1.165         1.065         24.7         33.72           10         400         4.87         1.2845         1.165 <td>Measured data           STATION No. : D7H002         START TIME         : 08h45           RIVER NAME         Oranje         Average Gaugeplate reading         : 2.82         m           PLACE NAME         Prisska         DATE         : 4/27/88         Main Channel LEFT         : 20           Ventical Number         Ventical         Vencitiv         Valority         Vencitiv         Vencitiv</td> <td>56 66</td> <td>53 5</td> <td>1 059</td> <td></td> <td>1 059</td> <td></td> <td>5 35</td> <td>110</td> <td>± ;</td>	Measured data           STATION No. : D7H002         START TIME         : 08h45           RIVER NAME         Oranje         Average Gaugeplate reading         : 2.82         m           PLACE NAME         Prisska         DATE         : 4/27/88         Main Channel LEFT         : 20           Ventical Number         Ventical         Vencitiv         Valority         Vencitiv	56 66	53 5	1 059		1 059		5 35	110	± ;				
STATION No. : D7H002       START TIME : 09h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       DATE : 4/27/88         DATE : 4/27/88       Main Channel LEFT : 20         Ventical       Chainage         Ventical       Ventical         1       20         2       25         30       2,25         30       2,98         4       40         2       2,0         30       2,98         4       0.804         1,1015       1,102         2       2,0         300       2,00         2       3,00         2       3,00         2       3,00         2       2,09         3       3,00         2       3,00         2       2,09         4       4,00         2,1127       1,1015         1,102       2,24         2,42       1,125         3,00       1,102         4       4,00         4       1,1287         4       1,1287         4,87       1,1287	Image         Vertical         Channege         Ventical         Ventical         Channege         Ventical         Channege         Ventical         Old         Old <td>51 42</td> <td>73 10</td> <td>0 074</td> <td></td> <td>0 074</td> <td></td> <td>л. ог</td> <td>3 8</td> <td>ż.</td>	51 42	73 10	0 074		0 074		л. ог	3 8	ż.				
STATION No. : D7H002         START TIME : 09h45           RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88         Average Gaugeplate reading : 2.82 m Main Channel LEFT : 20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Ventical depth         Velocity         Velocity         Velocity         Velocity         Velocity         Velocity         1.1015         1.1006         835.6         907.68           2         25         3.06         0.4d         0.8d         (ms)         (m <sup>3</sup> )         (m <sup>3</sup> s)           1         20         0         0.804         1.1015         1.102         22.4         24.62           2         25         3.02         3.02         1.365         1.1256         3.02         3.12.30           2         20         0         0.804         1.125         3.02         3.12.30           3         300         2.98         1.175         1.256         3.02         3.12.30           4         40         2.47         1.256         3.02         3.12.30         3.12.30           5         60         3.02         3.02         3.172         4.1	measured data           STATION No. : D7H002         START TIME : 08H45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82         m           PLACE NAME : Prisska         DATE : 4/27/88         Main Channel LEFT : 20         Main Channel LEFT : 20           I         2         3         4         5         6         7         8         9           Vertical number         Chainage         Ventical depth         O 2d         0.2d         0.4d         0.8d         (ms) $(m^3)$	53 05	49 7	1 068		1 0675		4 97	8 8	9 0				
STATION No. : D7H002         START TIME         : 09h45           RIVER NAME         Oranje         Average Gaugeplate reading         : 2.82         m           PLACE NAME         Prieska         Main Channel LEFT         : 20           Main Channel LEFT         : 20         Main Channel RIGHT         : 20           Vertical number         Vertical depth         0.2d         0.4d         0.8d         I.086         835.6         907.68           1         20         0         0         0.4d         0.8d         (ms)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           1         20         0         0         0.804         1.1015         1.1086         835.6         907.68           2         25         3.06         3.02         1.247         1.245         1.257         3.02         3.01         3.02         3.02         1.245         1.256         3.02         4.17         3.72         3.01         3.01         1.1456         1.125         3.02         4.1456         4.155         3.02         4.1456         4.155         3.02         4.1456         4.155         3.02         4.1456         4.155         3.02         4.1456         4.155         3.02         4.1456         4.155	STATION No. : D7H002         START TIME         : 08H45           RIVER NAME         Oranje         Average Gaugeplate reading         2.82         m           PLACE NAME         Prieska DATE         Prieska         Main Channel LEFT         20           1         2         3         4         5         6         7         8         9           Vertical number         Chainage         Ventical depth         O         0.2d         0.4d         0.8d         (ms)         (m <sup>3</sup> )         (m <sup>3</sup> /s)           2         25         3.06         0.2d         0.8d         1.1015         1.365         24.7         3.372           4         40         2.47         1.365         1.297         1.297         3.02<	40.00	42.4	1 1 7 7		1 1 2 7		4 87	8 6	<b>x</b> - <b>x</b>				
STATION No. : D7H002       START TIME : 08H45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20         DATE : 4/27/88       Main Channel LEFT : 20         Vertical number       Vertical or effective       0.2d         1       20       0         2       25       3.06         3       30       2.98         4       40       2.427         5       50       3.02         5       50       3.02	Image         Vertical         Chainage         Vertical         Chainage         Vertical         Chainage         Vertical         O 20	41.40	33.0	1 4 7 9		1 4 7 8		4 34	70	10				
STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82 m           PLACE NAME : Prieska         4/27/88           DATE : 4/27/88         4/27/88           Vertical         Chainage           Vertical         Vertical           Vertical         Vertical           1         20           2         30           2         25           300         2.98           4         400           2         26           300         2.47           2         26           300         2.98           4         400           2         26           300         2.98           1.1015         1.102           2         26           300         2.47           4         400	Image         Ventical         Ventical         Ventical         Ventical         Ventical         Oranje         Ventical         Oranje         Ventical         Oranje         Average Gaugeplate reading         2.82         m           1         2         3         4         5         6         7         8         9           ventical         Chainage         ventical         Ventical         0.2d         0.4d         0.8d         1.086         835.6         907.68           2         25         3.06         2.98         1.1015         1.1015         1.102         22.4         23.12.30           4         40         2.98         1.1015         1.365         2.4.7         3.37.2	39.17	30.2	1.297		1.221		3.02	8 2	טמ				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	measured dataSTATION No. : D7H002START TIME : 08H45RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88Average Gaugeplate reading : 2.82mMain Channel LEFT : 202Main Channel LEFT : 20Main Channel RIGHT : 220Vertical NumberChainage or effective 20.20OO120O0.200.200.20O120O0OOO120O0OO0OOOOOOOOOOOOOOOOOOOOOOOOOO <th <="" colspan="4" td=""><td>33.72</td><td>24.7</td><td>1.365</td><td></td><td>1.365</td><td></td><td>2.47</td><td>5 6</td><td>4 1</td></th>	<td>33.72</td> <td>24.7</td> <td>1.365</td> <td></td> <td>1.365</td> <td></td> <td>2.47</td> <td>5 6</td> <td>4 1</td>				33.72	24.7	1.365		1.365		2.47	5 6	4 1
STATION No. : D7H002         START TIME : 08h45           RIVER NAME : Oranje         Average Gaugeplate reading : 2.82 m           PLACE NAME : Prieska         4/27/88           DATE : 4/27/88         4/27/88           I         2           Vertical         Chainage           vertical         Vertical           Vertical         Vertical           1         20           2         25           3.06         0.804           1         20           2         3.06	measured dataSTATION No. : D7H002START TIME : 08h45RIVER NAME : Oranje PLACE NAME : Prieska DATE : $4/27/88$ Average Gaugeplate reading : 2.82 mMain Channel LEFT : DATE : $4/27/88$ Main Channel LEFT : 20T23456789Vertical numberChainage depthVelocity depthVelocity 0.2dVelocity 0.804Velocity 0.804Valor. (ms)Area (m <sup>3</sup> )012000.2d0.8040.80415.312.30	24.62	22.4	1.102		1.1015		2.98	30	. 00				
STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20         DATE : 4/27/88       Main Channel RIGHT : 20         1       2       3       4       5       6       7       8       9         Vertical number       Chainage       Venticat       Velocity       Velocity       Velocity       Velocity       1.086       835.6       907.68         1       20       0       0       0       0.00       0.00       0.00	Image       Ventical       Ve	12.30	15.3	0.804		0.804		3.06	25	N				
STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20         DATE : 4/27/88       Main Channel LEFT : 20         Vertical       Chainage       Ventical         Vertical       Chainage       Ventical         Vertical       Or effective       0.2d         Velocity       Velocity       Velocity         Velocity       0.8d       (m/s)         1.086       835.6       907.88	Image Number       STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m       m         PLACE NAME : Prieska       DATE : 4/27/88       Main Channel LEFT : 20       m         Vertical       Chanage       Vertical       Main       T       8       9         Vertical       Chanage       Vertical       Vertical       Vertical       Vertical       (m/s)       (m <sup>2</sup> )       (m <sup>3</sup> /s)         Number       Vertical       O 2d       0.4d       0.8d       1.086       835.6       907.68	0.00	0.0	0.000		0		0	20	1				
STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Hiteland         DATE : 4/27/88       Hiteland         1       2         Vertical       Chainage         Vertical       Vertical         Vertical       Vertical         0.2d       0.2d         0.2d       0.4d         0.8d       (m/s)         (ms)       (m <sup>2</sup> )	Measured data         STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20       Main Channel LEFT : 20       Main Channel RIGHT : 220         Vertical       Chanage       Vertical       Vertical       Vertical       Vertical       Vertical       Vertical       Vertical       Vertical       Vertical       Main       Area       Q         Vertical       Chanage       Vertical       Vertical       Vertical       Vertical       (m/s)       (m <sup>2</sup> )       (m <sup>3</sup> )       (m <sup>3</sup> )	907.68	835.6	1.086				depth		Alternation of the second s				
STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Jatte : 4/27/88         DATE : 4/27/88       Main Channel LEFT : 20         Main Channel RIGHT : 220       Main Channel RIGHT : 220         Vertical       Ventical       Velocity       Velocity       Velocity	Image       Image <thimage< th=""> <thimage< th=""> <thim< td=""><td>(m<sup>3</sup>/s)</td><td>(m<sup>2</sup>)</td><td>(m/s)</td><td>0.8d</td><td>0.4d</td><td>0.2d</td><td>or effective</td><td></td><td>number</td></thim<></thimage<></thimage<>	(m <sup>3</sup> /s)	(m <sup>2</sup> )	(m/s)	0.8d	0.4d	0.2d	or effective		number				
STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20         DATE : 4/27/88       Main Channel LEFT : 20         Main Channel RIGHT : 220       9	Measured data         STATION No. : D7H002       START TIME : 08H45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Main Channel LEFT : 20         DATE : 4/27/88       Main Channel RIGHT : 220         Main Channel RIGHT : 220       282         Station Channel Right : 220       Station Channel Right : 220         Station Channel Right : 220       Station Channel Right : 220         Station Channel Right : 220       Station Channel Right : 220	Q	Area	V aver.	Velocity	Velocity	Velocity	Vertical	Chainage	Vertical				
STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88 Main Channel LEFT : 20 Main Channel RIGHT : 220	Measured data         STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       DATE : 4/27/88         DATE : 4/27/88       Main Channel LEFT : 20         Main Channel RIGHT : 220       220	9	8	7	6	G	4	ω	N	1				
STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88 Main Channel LEFT : 20 Main Channel Dicutt : 700	Measured cata         STATION No.: D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       DATE : 4/27/88         Main Channel LEFT : 20       Main Channel LEFT : 20		5											
STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88 Main Channel LEFT : 20	Measured cata         STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       Average Gaugeplate reading : 2.82 m         DATE : 4/27/88       Main Channel LEFT : 20		335											
STATION No. : D7H002 RIVER NAME : Oranje PLACE NAME : Prieska DATE : 4/27/88 Station No. : D7H002 Average Gaugeplate reading : 2.82 m Average Gaugeplate reading : 2.82 m	Measured data         STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m         PLACE NAME : Prieska       DATE : 4/27/88		20	nel LEFT :	Main Char									
STATION No. : D7H002 START TIME : 08h45 RIVER NAME : Oranje Average Gaugeplate reading : 2.82 m	Measured data         STATION No. : D7H002       START TIME : 08h45         RIVER NAME : Oranje       Average Gaugeplate reading : 2.82 m							Prieska 4/27/88	DATE :	PLAC				
STATION No. : D7H002 START TIME : 08h45	Measured data STATION No. : D7H002 STATION No. : D7H002 START TIME : 08H45	З	2.82	te reading :	Gaugepla	Average		Oranje	R NAME :	RIVE				
	Measured data		08h45	RT TIME :	STAF			D7H002	TION No. :	STA				

70%	60%	50%	40%	% WIGEN					220	215	210	200	190	180	170	160	33	1 20	120	110	100	80	80	70	60	50	40	8	25 20			Chainage	0	N	0	SUD	Rondunes	Development		Manning	
160.0	140.0	120.0	100.0	Act. Chn.				0	0	2.24	3.37	4.7	4,55	4.44	4.25	4.32	л ș 22	n Ch	n 5 (1)	0.30 n	5.28	4.97	4.87	4.24	3.3	3.02	2.47	2.98	306 0	depth	or effective	Vertical		0.036		-	COBIT.			or Chezy	
160.00	140.00	120.00	100.00	Lower				2	N	N	2	2	2	N	N	N 1	<b>.</b> .	<b>J</b> N	) N	) N	• N	N	N	N	N	N	N	2	NN		Section	Sub							Slope	1	Calculate
170,00	150.00	130.00	110.00	Upper		Dalta vali	835,63	0.0	0.0	11.2	25.3	47.0	45.5	44.4	42.5	43.2	50.2	л+ »	50.0	53.5	52.8	49.7	48,7	42.4	33.0	30.2	24.7	22.4	15.3		Э	Area	0	N	0	ouc	Area reductio		0.00028	M	d data, 1-c
1.23	1.39	1.36	1.41	A-lower	le carculau	ite innien al		0.0	2.5	5.0	7,5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	7.5	12.5 5.0		סי	Wetted P	1	-	1	IA	on ractor				limensio
1.22	1.36	ī.	1.42	V-Upper		000		0	0	2.24	3.37	4.7	4.55	4.44	4.25	4.32	л ( С	л с s N	<sup>n</sup> 0	D.30	5.28	4.97	4.87	4.24	3.3	3.02	2.47	2.98	3 0 8		נג	H-Radius						-			nal flow th
1.23	1.39	1.36	1.41	MEA			1051.52	0,00	0.00	8.91	26.41	61.30	58.07	55.75	51.83	53.26	68 64	74 P2	77 65	76.07	74.42	67.28	65.04	51.63	34.00	29.33	20.98	21.51	0.00		(m°/s)	, O							VAVR =	Ю 11	leory
1.02	0.91	0.93	0.89	Deita	-		1.26	0.00	0.00	0.80	1.04	1.30	1.28	1.26	1.22	123	38		1.30	1,42	1.41	1,35	1.34	1.22	1.03	0.97	0.85	0,96	0.98		Velocity	<							1.26	1051.5	

1.18	1.36	1.45	1.36	170.00	160.00	160.0	70%	
1.01	1.58	1.60	1.58	150.00	140.00	140.0	60%	
0.78	2.05	1.93	2.05	130.00	120.00	120.0	50%	
0.72	2.21	2.11	2.21	110.00	100.00	100.0	40%	
0.84	1.91	2.04	1.91	90.00	80.00	80.0	30%	
Delta	V-Int	V-Upper	V-lower	Ch-Upper	Ch-Lower	Act. Chn.	% Width	
		ons	e calculation	Delta value				
1664.09	1041.2	1.598						
0.00	0.0	0.000						24
0.00	0.0	0.000						23
0.00	0.0	0.000		0		0	220	12
43.16	39.8	1.085		1.0845		3.98	210	23
54.88	41.5	1.323		1.3225		4.15	200	20
77.61	49.2	1.578		1.5775		4.92	190	19
71.45	47.6	1.501		1.501		4.76	180	18
71.78	49.5	1.450		1.45		4.95	170	17
74.88	55.2	1.357		1.3565		5.52	160	16
94.58	59.0	1.603		1.603		5.9	150	15
108.85	69.0	1.578		1.5775		6.9	140	14
111.52	57.9	1.926		1.926		5.79	130	13
115.95	56.7	2.045		2.045		5.67	120	12
119.17	56.4	2.113		2.113		5.64	110	1
119.37	54.1	2.207		2.2065		5.41	100	10
105.69	51.9	2.037		2.0365		5.19	90	9
111.10	58.2	1.909		1.909		5.82	8	00
95.46	54.1	1.765		1.7645		5.41	70	7
82.22	56.7	1.450		1.45		5.67	8	S
77.20	64.6	1.195		1.195		6.46	55	СЛ
78.03	59.0	1.323		1.3225		5.9	40	4
46.99	45.1	1.042		1.042		4.51	3	ω
4.20	15.7	0.269		0.2685		2.16	20	N
0.00	0.0	0.000		0		0	15.5	1
1664.09	1041.2	1.598				depth		
(m <sup>3</sup> /s)	(m <sup>4</sup> )	(m/s)	0.8d	0.4d	0.2d	or effective		number
Q	Area	V aver.	Velocity	Velocity	Velocity	Vertical	Chainage	Vertical
9	8	7	6	U	4	ω	N	-
	2							
	200	NA RIGHT .	Main Chanr					
	20	nnel LEFT :	Main Chai					
						4/23/88	DATE :	5
Э	3.765	te reading :	Gaugepla	Average		Oranje	R NAME :	RIVE
	13h00	RT TIME :	STAF			D7H002	TION No. :	STA
			uata	0000				
			data	Dasiired	2			

		Calculate	ed data, 1-di	mensior	al flow th	eory	
Manning	or Chezy		M			0 1	1803.7
		Slope	0.00042			VAVR =	1.73
Roughness	coeff.		Area reduction	factor			
Sub	P		Sub	۴			
0			0	-1			
2	0.0365		2				
0			0	1			
Chainage	Ventical	Sub	Area	Wetted P	H-Radius	ø	٨
	or effective	Section	>	σ	סק	(m <sup>3</sup> /s)	Velocity
	depth						
15.5	0	2	0.0	10,0	0	0.00	0.00
20	2.16	N	15.7	7.3	2.16	14.69	0.94
30	4.51	2	45.1	10.0	4.51	69.12	1.63
5 I	5,9	N	59.0	10.0	5.9	108.16	1.83
200	0.40	<b>)</b> N	ла 7		л а7	10.021	1.95
70	5.41	N 1	54.2	10.0	5. 4.	93.61	1.73
80	5.82	N	58.2	10.0	5.82	105.73	1.82
90	5,19	N	51.9	10.0	5.19	87.35	1.68
100	5,41	N	54.1	10.0	5.41	93.61	1.73
120	5.04 5.04	NN	56 7	10.0	5.67	101.23	1.79
130	5.79	N	57.9	10.0	5.79	104.82	1.81
140	6.9	2	69.0	10.0	6.9	140.42	2.04
150	л (л л (л л) (2)	งง	59.0	10.0	л о Л С	108.16	1,83
170	4.95	2	49.5	10.0	4.95	80.72	1.63
180	4.76	N	47.6	10.0	4.76	75.63	1,59
190	4.92	N	49.2	10.0	4.92	79.91	1,62
200	4.15	N N	41.5	10.0	4,15	60.17	1,45
220	0	N 1	0.0	5.0	0	0.00	0.00
	0	N	0.0	0.0	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			1041.16			1803.66	1.73
			Delta value	calculatio	SUC		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	80.0	80.00	00.06	1.82	1,68	1.82	0.95
40%	100.0	100.00	110.00	1.73	1.78	1.73	1.00
50%	120.0	120.00	130.00	1.79	1.81	1.79	0.97
70%	160.0	160.00	170.00	1.75		1.75	0.99
91.01	100,0	100.00	170.00	07.1	1.00	011	0.00

								,	25	31	2 2	21	23	t t	10	1	1E	14	13	12	-	10	0	œ	2	6	<i>(</i> 7)	~	65	N) -		number	Vertical	-				PF	RIV	ST	
70%	60%	50%	40%	30%	% Width				ļ	224	220	210	200	100	180	160	150	140	130	120	110	100	90	80	, 70	60	50	40	3	8 7			Chainage	2			DATE :	CE NAME :	ER NAME :	ATION No. :	
160.0	140.0	120.0	100.0	0.08	Act. Chn.						1.57	4 47	4 25	4.01	2.0	6.2	5.47	5.58	5.86	5.6	5.64	5.46	5.28	5.34	5.58	6.4	5.96	6.26	4.44	2.29	depth	or effective	Vertical	3			4/21/88	Prieska	Oranje	D7H002	
160.00	140.00	120.00	100.00	80.00	Ch-Lower																											0.2d	Velocity	4							2
170.00	150.00	130.00	110.00	90.00	Ch-Upper	Delta valu				0.000	0.3535	1 348	1.0790	1.0205	1.0003	1.603	1.773	2.062	2.2235	2.3765	2.504	2.725	2.725	2.5295	2.317	2.045	1.9345	1.7475	1.365	0.345	>	0.4d	Velocity	IJ				(	Averag		heasured
1.60	2.06	2.38	2.73	2.53	V-lower	e calculatio																										0.8d	Velocity	6	Main Chan	Main Cha	2		le Gaugepla	STA	data
1.56	1.77	2.22	2.50	2.73	V-Upper	ons	7001	1 962	0,000	0,000	0.354	1 348	1.000	1 690	1.000	1.603	1.773	2.062	2.224	2.377	2.504	2.725	2.725	2.530	2.317	2.045	1.935	1.748	1.365	0.345	1.962	(m/s)	V aver.	7	nel RIGHT :	nnel LEFT :		c	ite reading :	RT TIME :	
1.60	2.06	2.38	2.73	2.53	V-Int		1000.0	1058.5	3.6	22		44.7	49.5	40	20,0	62.0	54.7	55.8	58.6	56.0	56.4	54.6	52.8	53.4	55.8	64.0	59.6	62.6	44.4	18.3	1056.5	(m <sup>4</sup> )	Area	8	220	20			4.165	14h15	
1.22	0.95	0.83	0.72	0.78	Delta		01.2.02	2072 46	0.00	0.00	3 88	80.05	71 02	77 50	28.00	99.39	96.98	115.06	130.30	133.08	141.23	148.79	143.88	135.08	129.29	130.88	115.30	109.39	60.61	6.32	2072.46	(m <sup>3</sup> /s)	Q	9					3		

70%	60%	50%	40%	% Width				224	220	210	200	190	180	170	3 2	145	130	120	110	100	06	88	70	60	5	40	8	28 7	14		Chainage	0	N	0	one	Settifica		Manning	
160.0	140.0	120.0	100.0	Act. Chn.			0	0	1.57	4.47	4.25	4.62	4.81	о о i	, i . i	7 DC	5,86	5.6	5.64	5.46	5.28	5.34	5.58	6.4	5.96	6.26	4.44	2.29	U	or effective	Vertical		0.038		n	S COBIL		<b>J</b> or Chezy	
160.00	140.00	120.00	100.00	Lower			2	N	N	N	2	2	N	N 1	5 N	) N	) N	N	N	N	N	N	N	N	N	N	N	N 1	\$	Section	Sub						Slope		Calculate
170.00	150.00	130.00	110.00	Upper	Deita Valu	1056.51	0.0	0,0	11.0	44.7	42.5	46.2	48.1	55.0	25	50.8	58.6	56.0	56.4	54.6	52.8	53.4	55.8	64.0	59.6	62.6	44.4	18.3	00	Þ	Area	0	2	0	SUD	Area reduction	0.0007	Μ	ed data, 1-d
2.35	2.19	2.20	2.16	V-lower	a calculatio		0.0	2.0	7.0	10.0	10.0	10.0	10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.8	10.0	Ū	Welted P	1	1	1	1A	Tactor			imensior
2.17	2.16	2.26	2.21	V-Upper			0	0	1.57	4.47	4.25	4.62	4.81	5 0 5 1		7 0,00	5,86	5.6	5.64	5,46	5.28	5.34	5.58	6,4	5,96	6.26	4.44	2.29	>	ער	H-Radius								al flow th
2.35	2.19	2.20	2.16	V-Int		2251.42	0.00	0.00	10,34	84.45	77.64	89.23	95,43	119.32	145 60	27771	132.62	122.95	124.42	117.87	111,47	113.69	122.22	153.60	136.41	148.04	83.51	22,16	000	(m <sup>,</sup> /s)	Q						VAVR =	0 11	leory
0.91	0.97	0.97	0.99	Delta	,	2.13	0.00	0.00	0.94	1.89	1.83	1.93	1,98	2.17	225	210	2.26	2.20	2.21	2,16	2.11	2,13	2.19	2,40	2.29	2.36	1.88	1.21	030	Velocity	۷						2.13	2251.4	

			N	leasured	data					
STA	TION No. :	D7H002			STA	RT TIME :	08h29		Mannin	go
RIVE	R NAME :	Oranje		Average	e Gaugepla	ate reading :	8.365	m		
PLAC	E NAME : DATE :	Prieska 3/22/88							Roughnes	is cr
					Main Cha	nnel LEFT :	10		Sub	T
				1	Main Chan	nel RIGHT :	310		0	
1	2	3	4	5	6	7	8	9	2	
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)	-	
		denth		0.40	0.00	2 767	2126.2	5993 37		
1	97	0		0 2686		0.269	0.0	0.00	2	2
2	10	2.16		0.3361		0.336	11.1	3.74	25	
3	20	3.26		0.6873		0.687	32.6	22.41	33	3
4	30	4.327		0.8844		0.884	43.3	38.27	38	3
5	40	5.989		1.0643		1.064	59.9	63.74	43	3
6	50	6.558		1.6896		1.690	40.0	67.59	48	3
7	52.2	6.686		2.0152		2.015	20.4	41.09	53	3
8	56.1	7.341		2.2122		2.212	28.6	63.34	58	3
9	60	7,997		2.6748		2.675	55.6	148.66	63	3
10	70	7.561		3.3601		3.360	75.6	254.06	68	3
11	80	8.049		3.7371		3.737	80.5	300.80	73	3
12	90	8.323		3.7028		3.703	83.2	308.18	78	3
13	100	7.994		3.9255		3.926	79.9	313.80	83	3
14	110	8.001		4.054		4.054	72.0	291.92	88	3
15	118	7.784		3.9255		3.926	58.4	229.17	93	3
16	125	7.76		3.8913		3.891	66.0	256.67	98	3
1/	135	7.566		3.7628		3.763	56.7	213.52	103	3
18	140	7.401		3.797		3.797	55.5	210.76	108	
19	150	7.353		3.917		3.917	73.5	288.02		5
20	170	7.429		3.7199		3.720	74.3	270.35	10	2
21	170	7.494		2.00//		2.000	74.9	322.68	124	
23	100	7 404		3 2573		3 257	02.6	301.46	126	
24	205	6 897		3 2573		3 257	86.2	280.82	12	1
	200	0.007		0.2010		2.767	2126.2	5883.37		-
			Lui I							
	% Width	Act. Chn	Ch-l ower	Ch-Upper	V-lower	V-Linner	V-Int	Delta	% Width	A
ŀ	30%	100.0	100.00	110.00	3 93	4.05	3 03	0.70	30%	1
	40%	130.0	125.00	135.00	3.89	3.76	3.83	0.72	40%	
	50%	160.0	160.00	170.00	3.72	2.66	3.72	0.74	50%	
	60%	190.0	180.00	195.00	3.39	3,26	3.30	0.84	60%	
	70%	220.0	220.00	230.00	3 15	2.67	3.15	0.88	70%	

		Calculate	ed data, 1-di	mensior	al flow th	eory	
Manning	or Chezy	/:	М			Q =	7427.6
		Slope	0.0015			V <sub>AVR</sub> =	3.49
Rouchness	coeff		Area raduction	factor	1. 181.		
Sub			Sub	f			
Sub	1		300	'A			
0			0	1			
2	0.04		2	1			
0			0	1			
Chainage	Vertical	Sub	Area	Wetled P	H-Radius	Q	V
	or effective	Section	А	Р	R	(m³/s)	Velocity
	depth						
23	0	2	0.0	5.0	0	0.00	0.00
28	2.16	2	11.1	5.2	2.16	18.00	1.62
33	3.26	2	32.6	10.0	3.26	69.40	2.13
38	4.327	2	43.3	10.0	4.327	111.25	2.57
43	5.989	2	59.9	10.0	5.989	191.24	3.19
48	6.558	2	40.0	6.1	6,558	135.71	3.39
53	6.686	2	20.4	3.1	6.686	70.07	3.44
58	7.341	2	28.6	3.9	7.341	104.71	3.66
63	7.997	2	55.6	7.0	7.997	215.20	3.87
68	7.561	2	75.6	10.0	7.561	282.02	3.73
73	8.049	2	80.5	10,0	8.049	313.01	3.89
78	8.323	2	83.2	10.0	8.323	330,97	3.98
83	7.994	2	79.9	10.0	7.994	309,45	3.87
88	8.001	2	72.0	9.0	8.001	276.91	3.87
93	7.784	2	58.4	7.5	7.784	222.02	3.80
98	7,76	2	66.0	8.5	7.76	250.33	3.80
103	7.566	2	56.7	7,5	7.566	211.76	3.73
108	7.401	2	55.5	7.5	7.401	204.11	3.68
113	7.353	2	73.5	10.0	7.353	269.21	3.66
118	7.429	2	74.3	10.0	7.429	273.86	3.69
123	7.494	2	74.9	10.0	7.494	277.87	3.71
125	7.605	2	95.1	12.5	7.605	355.95	3.74
126	7,404	2	92.6	12.5	7.404	340.41	3.68
	6.897	2	86.2	12.5	6,897	302.46	3.51
			2126.21			7427.61	3.49
			Delta value	calculatio	ns		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	100.0	98,00	103.00	3.80	3.73	3.77	0.93
40%	130.0	126.00	0.00	3.68	3.51	3.68	0.95
50%	160.0	126.00	0.00	3.68	3.51	3.72	0.94
60%	190.0	126.00	0.00	3.68	3.51	3.76	0.93
		400.00	0.00	3.68	3.54	3.80	0.92

		-						24	23	N	21	20	16	18	17	16	5	14	5	5	-	10		~	7		(B	4	~	M .		number	Ventical						PLA	RIV	ST	
. 70%	60%	50%	40%	% Width		1		1 205	195	180	170	160	150	145	135	125	118	110	100	90	80	70	60	56.1	52.2	55	40	30	20	10	7 6		Chainage	2	N			DATE :	CE NAME :	ER NAME :	ATION No. :	
220.0	190.0	160.0	130.0	Act. Chn.	2			7.207	7.714	7.915	7.804	7.739	7.663	7.711	7.876	7.98	8.094	8.311	8.304	8.633	8.359	7.871	8.307	7.651	6.996	6.868	6.299	4.637	3.2	2.37	0 udebu	or effective	Vertical	:	ω			3/15/88	Prieska	Oranje	D7H002	
220.00	180.00	160.00	125.00	Ch-Lower																												0.2d	Velocity	:	4							
230.00	195.00	170.00	135.00	Ch-Upper	Deita vaiu			3.5487	3.4537	3.4681	3.6689	4.0415	4.2056	4.1949	4.2359	3.7839	4.141	4.2662	3.9562	3.8348	3.6634	3.0032	2.5821	2.2275	2.0921	1.8502	1.2074	0.9176	0.7827	0.4552	0.3848	0.4d	Velocity	:	თ					Averag		heasured
3.21	3.47	4.04	3.78	V-lower	e calculati						•																					0.8d	Velocity		ი	Main Chan	Main Cha			e Gaugepla	STA	data
2.88	3.45	3.67	4.24	V-Upper	ons		2.873	3.549	3.454	3.468	3.669	4.042	4.206	4.195	4.236	3.784	4.141	4.266	3.956	3.835	3.663	3.003	2.582	2.228	2.092	1.850	1.207	0.918	0.783	0.455	1 385	(m/s)	v aver.		7	nel RIGHT :	Innel LEFT :			ate reading :	RT TIME :	
3.21	3.46	4.04	4.01	V-Int			2258.5	90.1	96.4	98.9	78.0	77.4	57.5	57.8	78.8	67.8	60.7	74.8	83.0	86.3	83.6	78.7	57.7	29.8	21.3	41.9	63.0	46.4	32.0	12.2	C.8677	( )	Area		~	310	10			8.675	10h37	
0.89	0.83	0.71	0.72	Delta	2		6487.94	319.69	333.02	343.13	286.32	312.77	241.71	242.60	333.62	256.66	251.38	319.11	328,52	331.06	306.22	236.38	149.07	66.47	44.64	77.51	76.05	42.55	25.05	5.56	0.00	(e/ m)	2	>	9					З		

70%	60%	50%	40%	30%	% Width			205	195	180	170	160	150	145	135	125	118	110	100	8 8	3 3	3 8		770	550	40	30	20	10	0.7		Chainage	0	2	0	Sub	Roughnes		Manning	
220.0	180.0	160.0	130.0	100.0	Act. Chn.			7.207	7.714	7,915	7.804	7.739	7.663	7,711	7.876	7.98	8 094	R 311	8 304	8 633	8 350	7 871	5 00 1	0.990	6.868	6.299	4.637	3.2	2.37	0	or effective	Vertical		0.04		7	s coeff.		J or Chezy	
220.00	180.00	160.00	125.00	100.00	Lower			2	N	N	N	2	N	N	N	N 1	<b>.</b> ,	<b>.</b> , .	<b>.</b> ,	<b></b>	<b>.</b> , ,	0 N	5 N	<b></b> N	) N	N	N	N	NN	J	Section	Sub						Slope		Calculate
230.00	195.00	170.00	135.00	110.00	Upper	Delta valu	2258.54	90.1	96.4	98.9	78.0	77.4	57.5	57.8	78.8	67.8	7 03	74.8	0.00	6. 98 0.00	958	78.7	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	8 0C	41.9	63.0	46.4	32.0	12.2	0.0	A	Area	0	N	0	Sub	Area reduction	0.0015	M	ed data, 1-d
3.60	3.85	3.79	3.87	3.97	V-lower	e calculatio		12.5	12.5	12.5	10.0	10.0	7.5	7.5	10.0	00 57	~1 ( 57 ()	3 2	100		100	10 0	4 0	2 (J 2 -		10.0	10.0	10.0	5.2	70	טי	Wetted P	1	-	-	1 <sub>A</sub>	factor			imensior
3.57	3.78	3.81	3.83	3.97	V-Upper	suc		7.207	7.714	7,915	7.804	7.739	7.663	7.711	7.876	7.98	8.094	8311	8 304	8 633	8 350	7 871	8 2021	0.990	6.868	6.299	4.637	3.2	2.37	0	ע	H-Radius								al flow th
3.60	3.80	3.79	3.85	3.97	V-Int		8118.40	325.45	364.50	380,46	297.29	203.18	216.29	218,56	301.88	262.27	236.95	297 16	329.71	361 77	333.36	901 26 67.877	00.000	112 18	146.57	208.02	124.85	67.28	21.01	0.00	(m³/s)	Q						VAVR =	0 	eory
1.00	0.95	0.95	0.93	0.91	Delta		3.59	3.61	3.78	3.85	3.81	3,79	3.76	3.78	3.83	3.87	3.90	3.97	3.97	4 07	3.99	3.83	2 07	. 3. 76	3.50	3.30	2.69	2,10	1.72	0.00	Velocity	v						- 3.59	8118.4	
			N	leasured	data		1000																																	
---------------------	---	-----------------------------	---	----------	-----------	-------------	-------------------	---------------------	--	--	--	--																												
STA RIVE PLAC	TION No. : R NAME : E NAME :	D7H002 Oranje Prieska	START TIME : 09h00 Average Gaugeplate reading : 9.35 m 88																																					
	DATE :	3/17/88			Main Cha		10																																	
					Main Cha	nnei LEFI :	10																																	
				1	Main Chan	nel RIGHT :	310																																	
1	2	3	4	5	6	7	8	9																																
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q																																
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)																																
		denth	0.20	0.44	0.00	2 935	2476 0	7270 72																																
1	97	3		0.6076		0.608	0.5	0.27																																
2	10	3		0 759		0.759	15.5	11 73																																
3	20	4.04		1.0077		1 008	40.4	40.71																																
4	30	5,307		1,3358		1.336	53.1	70.89																																
5	40	6,969		1,4439		1.444	69.7	100.63																																
6	50	7.538		2.391		2.391	46.0	109.94																																
7	52.2	7.666		2.5354		2.535	23.4	59.28																																
8	56.1	8.321		2.6137		2.614	32.5	84.82																																
9	60	8.977		2.8505		2.851	62.4	177.84																																
10	70	8.541		3.2927		3.293	85.4	281.23																																
11	80	9.029		3.6848		3.685	90.3	332.70																																
12	90	9.303		4.1005		4.101	93.0	381.47																																
13	100	8.974		3.9436		3.944	89.7	353.90																																
14	110	8.981		4.0057		4.006	80.8	323.78																																
15	118	8.764		4.117		4.117	65.7	270.61																																
16	125	8.65		4.2071		4.207	73.5	309.33																																
17	135	8.546		4.3487		4.349	64.1	278.73																																
18	140	8.381		4.2457		4.246	62.9	266.87																																
19	150	8.333		4.27		4.270	83.3	355.82																																
20	160	8.409		4.024		4.024	84.1	338.38																																
- 21	170	8.474		3.6317		3.632	84.7	307.75																																
22	180	8.585		3.6724		3.672	107.3	394.09																																
23	195	8.384		3.4585		3.459	104.8	362.45																																
24	205	7.877		3.5292		3.529	98.5	347.49																																
						2.935	2476.9	7270.72																																
	Delta value calculations																																							
	% Width Act. Chn. Ch-Lower Ch-Upper V-lower V-Upper V-Int Delta																																							
	30%	100.0	100.00	110.00	3.94	4.01	3.94	0.74																																
	40%	130.0	125.00	135.00	4.21	4.35	4.28	0.69																																
	50%	160.0	160.00	170.00	4.02	3.63	4.02	0.73																																
	60%	190.0	180.00	195.00	3 67	3.46	3.53	0.83																																
	70%	220.0	220.00	230.00	3.31	2.94	3.31	0.89																																
								1																																

		Calculat	ed data, 1-d	imensior	hal flow the	eory	
Manning	or Chezy	r:	M			Q =	9420.6
		Slope	0.0015			V <sub>AVR</sub> =	= <u>3.80</u>
Roughness	coeff.		Area reduction	factor	1		
Sub	n		Sub	f <sub>A</sub>			
0			0	1			
0	0.04		0				
2	0.04		2	1			
0			0	1			1011 C
Chainage	Vertical	Sub	Area	Wetled P	H-Radius	Q	V
	or effective	Section	A	Р	R	(m <sup>3</sup> /s)	Velocity
	deoth						
9.7	3	2	0.5	5.0	0.09	0.09	0.19
10	3	2	15.5	5.2	3	31.12	2.01
20	4.04	2	40.4	10.0	4.04	99.23	2.46
30	5.307	2	53.1	10.0	5.307	156.34	2.95
40	6.969	2	69.7	10,0	6.969	246.19	3.53
50	7.538	2	46.0	6.1	7.538	171.16	3.72
52.2	7.666	2	23.4	3.1	7.666	88.02	3.76
56.1	8.321	2	32.5	3.9	8.321	129.03	3.98
60	8.977	2	62.4	7.0	8.977	260.93	4.18
70	8.541	2	85.4	10.0	8.541	345.54	4.05
80	9.029	2	90.3	10,0	9.029	379.07	4.20
90	9.303	2	93.0	10.0	9.303	395.43	4.28
100	8.974	4	69.7	10.0	0.9/4	3/5.23	4,10
110	0.901	2	00.0	9.0	0.901	330,14	4,10
110	0.704	2	00.7	1.0	0.704	270.03	4.12
120	8.546	2	FA 1	7.5	8.546	259.50	4.05
140	8 381	2	62.9	7.5	8 381	251 12	3.99
150	8 333	2	83.3	10.0	8 333	331 63	3.98
160	8 409	2	84.1	10.0	8 409	336.69	4.00
170	8.474	2	84.7	10.0	8.474	341.04	4.02
180	8,585	2	107.3	12.5	8,585	435.64	4.06
195	8.384	2	104.8	12.5	8.384	418.78	4.00
205	7.877	2	98.5	12.5	7.877	377.42	3.83
			2476.93			9420.56	3.80
			Delta value	e calculatio	ons		
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta
30%	100.0	100.00	110.00	4.18	4.18	4,18	0.91
40%	130.0	125.00	135.00	4.08	4.05	4.06	0.94
50%	160.0	160.00	170.00	4.00	4.02	4.00	0.95
60%	190.0	180.00	195.00	4.06	4.00	4.02	0.95
70%	2200	220.00	1 230.00	3.82	379	3.82	1.00













The values in the legend block describe measured discharge for the profile indicated

			Mea	asured da	ita					Cal	culate
STA	TION No. :	D7H012			STAF	RT TIME :	14h08		Manning	or Chezy	:
RIVE	R NAME :	Oranje Irone		Averag	e Gaugepla	ite reading :	2.375	m			Slo
FUNC	DATE :	3/16/89							Roughness	coeff	
					Main Cha	nnel LEFT :	20		Sub	n	
					Main Chanr	nel RIGHT :	163		0		
									2	0.035	
1	2	3	4	5	6	7	8	9	0		
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Su
number		or effective	0.24	Dad	0.84	(m/e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)		ac affordado	Cart
		deoth	0.20	U.HU	U.CU	0 682	1005 3	696 09		dooth	Secu
1	19	0 0	0	n	0	0.000	0.0	0.00	19	orebou	2
2	25	3 96	0 485	0.400	0 447	0.433	31.7	13.72	25	3.96	2
3	35	7.38	0 497	0.510	0.674	0.548	73.8	40.42	35	7 38	2
4	45	8.03	0.670	0.766	0.771	0.743	80.3	59.68	45	8 03	2
5	55	7.98	0.745	0,808	0.855	0.804	79.8	64.18	55	7.98	2
6	65	8.45	0.716	0.813	0.897	0.810	84.5	68.40	65	8.45	2
7	75	8.335	0.787	0.973	0.981	0.928	83.4	77.38	75	8.335	2
8	85	8.168	0.888	0.973	0.943	0.944	81.7	77.12	85	8.168	2
9	95	8.023	0.867	0.897	0.897	0.889	80.2	71.36	95	8.023	2
10	105	7.849	0.670	0.787	0.813	0.764	78.5	59.99	105	7.849	2
11	115	7.659	0.623	0.632	0.703	0.648	76.6	49.60	115	7 659	2
12	125	6.72	0.430	0.623	0.657	0.583	67.2	39.21	125	6 72	2
13	135	6.68	0,358	0.464	0.569	0.464	66.8	30,96	135	6.68	2
14	145	6,55	0.384	0.363	0.371	0.370	65.5	24.23	145	6.55	2
15	155	5.43	0.161	0.182	0.186	0.177	55.4	9.83	155	5 43	2
16	165,4	0	0	0	0	0.000	0.0	0.00	165.4	0	2
17						0.000	0,0	0.00		0	2
						0.682	1005.3	686.08			
			D	elta value c	alculation	s					
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Acil City	Low
	30%	62.9	55.00	65.00	0.80	0.81	0.81	0.84	30%	62.9	55.0
	40%	77.2	75.00	85.00	0.93	0.94	0.93	0.73	40%	77.2	75.0
	50%	91.5	85.00	95.00	0.94	0.89	0.91	0.75	50%	91.6	85 (
	60%	105.8	105.00	115.00	0.76	0.65	0.75	0.90	60%	105.8	105
	70%	120.1	115.00	125.00	0.65	0.58	0.61	1.11	70%	120.1	115

Calculated data, 1-dimensional flow theory													
Manning	M     Q = 847.6       Stope     0.00006												
		Slope	0.00006			V <sub>AVR</sub> =	0.84						
Roughness	coeff		Area reduct	ion factor									
Sub	n		Sub	f,									
0			0	1									
2	0.035		2	1									
n			n	1									
					11 Destus		l v						
Cueinade	Aeuca	500	Area	AAGUED H	ri-reactions	ų	v						
	ar effective	Section	A	P	R	(m /s)	Velocity						
	depth												
19	0	2	0.0	12.5	0	0.00	0.00						
25	3.96	2	31.7	80	3 96	17 55	0 55						
35	7 38	2	73.8	10.0	7.38	61 91	0.84						
45	8.03	2	80.3	10.0	8.03	71.26	0.89						
55	7.98	2	/9.8	10.0	798	10.53	0.00						
00 75	0.45	4	04.5	10.0	5.40 9.395	75 00	0.92						
75	0.330	2	00.4 81 7	100	9.169	70.00	nan						
05	8 003	2	80.7	10.0	8 023	71 16	0.90						
105	7 849	2	78 5	10.0	7 849	68.61	0.87						
115	7 659	2	78.6	10 0	7 659	65.86	0.86						
125	6 72	2	67.2	10.0	6.72	52.96	0.79						
135	6.68	2	66.8	10.0	6.68	52.44	0.78						
145	6.55	2	65.5	10.0	6 55	50 75	0 77						
155	5 43	2	55.4	10.2	5.43	37 87	0.68						
165.4	0	2	0.0	5.2	O	0.00	0.00						
	0	2	0.0	0.0	0	0.00	0.00						
			1005.31			847.62	0.84						
			hits value	calculation	u <b>e</b>								
% Width	Act Chn	i nver		Vinuer	Villaner	V-Inf	Delta						
30%	62.9	55.00	65.00	0.88	0.97	0.94	0,93						
40%	77.2	75.00	85.00	0.91	0.90	0.91	0.93						
50%	91.6	85 00	95 00	0.90	0.89	0.89	0.96						
60%	105.8	105.00	115.00	0.87	0.86	0.87	0.97						
70%	120.1	115.00	125.00	0.66	0.79	0.82	1.02						

flow theory	nensional	ata, 1-din	culated d	Calc					ta	sured da	Mea			
G		M	:	or Chezy	Manning		10h05	TTIME :	STAR			D7H012	FION No. :	STA
<u>v</u> ,		0.00022	Slope	l		m	3.14	e reading :	e Gaugeplat	Average		Oranje Irene	R NAME :	RIVEI PLAC
	on factor	Area reduct		coeff	Roughness							3/6/89	DATE :	
	f <sub>A</sub>	Sub		n	Sub		20	nel LEFT :	Main Chan					
	1	0			0		163		Aain Chann	A				
	1	2		0.034	2									
	1	0			0	9	8	7	6	5	4	3	2	1
H-Radius	Wetted P	Aree	Sub	Vertical	Chamage	Q	Area	V aver.	Velocity	Velocity	Velocity	Vertical	Chainage	ertical
e (r	þ		Sactore	oreflactua		(m <sup>3</sup> /s)	(m <sup>2</sup> )	(m/s)	0.84	0.44	0.24	or effective		imber
14			OBUIGH	denth		1092 00	934.9	1.168	0.00	0.40	0.20	depth		
0 0	10.0	0.0	2	C	17.8	0.00	0.0	0.000	0	0	0	0	17.8	1
2.29 1	6.1	14.0	2	2.29	20	5.98	14.0	0.428	0.294	0.473	0.473	2.29	20	2
7.999 1:	10.0	80.0	2	7 999	30	84.20	80.0	1.053	1.085	1.161	0.804	7.999	30	3
7.539 12	10.0	75.4	2	7 539	40	85.93	75.4	1.140	1.280	1.161	0.957	7.539	40	4
7 455 12	10.0	74.6	2	7.455	50	102.24	74.6	1.371	1.365	1.399	1.323	7,455	50	5
7.32 12	10.0	73.2	2	7.32	60	101.63	73.2	1.388	1.450	1.433	1.238	7.32	60	6
6.65 10	10.0	66.5	2	6.65	70	96.99	66.5	1.459	1.569	1.493	1.280	6.65	70	7
6.408 9	10.0	64.1	2	6.408	80	94.41	64.1	1.473	1.544	1.501	1.348	6.408	80	8
6.555 10	10.0	65.6	2	6.555	90	91.29	65, <b>6</b>	1.393	1.467	1.416	1.272	6,555	90	9
6 097 8	10.0	61.0	2	6.097	100	80.50	61.0	1.320	1,476	1.323	1.161	6.097	100	10
5.967 8	10.0	59.7	2	5 967	110	77.27	59.7	1.295	1.416	1.314	1.136	5.967	110	11
6.336 9	10.0	63.4	2	6 336	120	75.31	63.4	1.189	1.280	1.187	1.102	6.336	120	12
6.51 9	10.0	65.1	2	6.51	130	69,63	65,1	1.070	1.153	1.059	1.008	6.51	130	13
6 664 10	10.0	66.6	2	6.664	140	67.03	66.6	1.006	1.051	1.025	0.923	6.664	140	14
6.575 10	10.0	65.8	2	6 575	150	53.00	65.8	0.806	0.736	0.864	0.762	6.575	150	15
4.655 4	8.6	40.1	2	4 655	160	6.60	40.1	0.164	0.158	0.1325	0.2345	4.655	160	16
0 0	3.6	0.0	2	0	167.25	0.00	0.0	0.000	0	0	0	0	167.25	17
14-		934.87				1092.00	934.9	1.168	L					
	alculation	eita value o	1						alculations	lta value c	De			Γ
V-Upper	Vilower	Upper	Lower	Act Chn.	% Width	Delta	V-Int	V-Upper	V-lower	Ch-Upper	Ch-Lower	Act. Chn.	% Width	
1 54	164	70.00	60.00	62.9	30%	0.83	1 41	1 46	1 39	70 00	60 00	62.9	30%	
1.51	1.54	80.00	70.00	77.2	40%	0.80	1.47	1.47	1.46	80.00	70.00	77.2	40%	
1.46	1.53	100.00	90.00	91.6	50%	0.85	1,38	1.32	1.39	100.00	90,00	91.5	50%	
1.44	146	110.00	00.00	105.8	60%	0.89	1.31	1.29	1.32	110.00	100.00	105.8	60%	
1.52	1.49	130.00	120.00	120.1	70%	0.98	1.19	1.07	1 19	130.00	120.00	120.1	70%	

.

Q =

Q

(m<sup>3</sup>/s)

0.00

10.59

139.57

126 45

124.11

120.39

102.59

96 44

100.16

88.77

85.64

94 64

99.01

102.95

100.67

48.83

0.00 1440.81

V-Int

1.62

1.52

1.52

1 44

1.49

 $V_{AVR} = 1.54$ 

1440.8

٧

0.00

0.76

174

1 68

1.66

1.64

1.54

151

1.53 1.48

1.44

1 49

1.52

1.54

0.00

Delta

0.95 1.02

1.02 1.07

1.03

1.54

Velocity

			Me	asured da	ata				Calculated data, 1-dimensional flow theory Manning or Chezy: M				eory			
STA	ATION No. :	D7H012			STAR	T TIME :	08h30		Manning	or Chezy	r:	М			Q ±	2075.:
RIVE PLA	ER NAME :	Oranje		Averag	le Gaugepla	te reading :	4.149	m			Slope	0.0005			V <sub>AVR</sub> =	2.09
1 640	DATE :	3/4/89							Roughness	s coeff		Area reduc	tion factor	1		
					Main Char	nel LEFT :	20		Sub	n		Sub	f <sub>A</sub>			
					Main Chann	el RIGHT :	163		0			0	1	1		
1	2	3	4	5	6	7	8	9	2 0	0.039		2 0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Sub	Atea	Wetted P	H-Radius	Q	V
number		or effective	0.24	D 4d	0.8d	(m/c)	(m <sup>2</sup> )	(m <sup>3</sup> /s)		ar affordivo	Carluna		n	D	(m <sup>3</sup> /s)	Velocitu
maniper		depth	0.20	0.40	U.UU	1.824	995.3	1815.01		denth.	Jesosara.					Velocity
1	15	0	0	0	0	0.000	0.0	0.00	15	0	2	0.0	10.0	G	0.00	0.00
2	20	3.66	0.651	0.719	1.051	0.785	27.5	21.54	20	3.66	2	27 5	75	3 66	37 38	1 36
3	30	8.867	1.476	1.739	1.875	1.707	88.7	151.37	30	8.867	2	88.7	10.0	8.867	217 80	2.46
4	40	7.76	1.629	1.969	2.156	1.930	77.6	149.79	40	7.76	2	77.6	10.0	7.76	174.39	2.25
5	50	7.071	2.088	2.113	2.122	2.109	70,7	149.11	50	7.071	2	70.7	10.0	7 071	149.36	2.11
0	60 70	7.369	1.952	2.190	2.317	2.162	/3./	159.31	60	7.369	2	/3./	10.0	7 369	159 99	
/ 8	70 80	7.119	1.994	2.402	2.420	2.300	735	104.19	10	7.119	2	/1.2 +3 g	10.0	7.119	101.00	- 1.7
9	90	6 858	1.903	2 1 2 2	2.331	2.002	73.5 68.6	146.22	90	7 040 8 858	2	68 B	10.0	F 858	141.93	2.07
10	100	6 377	1 739	2147	2 343	2 094	63.8	133.53	100	6 377	2	63 B	10.0	6 377	125.73	1 97
11	110	5.745	1 969	2.088	2 283	2.107	57.5	121.03	110	5 745	2	57.5	10.0	5 745	105.66	1.84
12	120	6.633	1.680	1.901	2.028	1.877	66.3	124.51	120	6.633	2	66.3	10.0	6.633	134.26	2.02
13	130	7,403	1.340	1.722	1,833	1.654	74.0	122.45	130	7.403	2	74.0	10.0	7 403	161.23	2.18
14	140	6.951	1.391	1.561	1.586	1.524	69.5	105.96	140	6.951	2	69.5	10.0	6 951	145 16	2 09
15	150	6.431	1.306	1.374	1.382	1.359	64.3	87.37	150	6.431	2	64.3	10.0	6.431	127 51	1 98
16	160	5.305	0.6085	0.464	0.702	0.560	48.5	27.16	160	5.305	2	48.5	9.2	5.305	84.65	1.74
17	168.3	0	0	0	0	0.000	0.0	0.00	168.3	0	2	0.0	42	0	0.00	0 00
						1.824	995.3	1815.01				995.29			2075.25	2.4
			D	elta value c	alculations	5						Delta value	calculation	IS		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V+lower	V-Upper	V+Int	Delta	% Width	Actochin	Lower	Upper	Vabwer	V-Upper	V-Int	Delta
	30%	62.9	60.00	70.00	2.16	2.31	2.20	0.83	30%	62.9	60.00	70.00	2.17	2.12	2.16	0.97
	40%	77.2	70,00	80.00	2.31	2.06	2.13	0.86	40%	77.2	70.00	80.00	2.12	2.17	2.15	0.97
	50%	91.5	90.00	100.00	2.13	2.09	2.13	0.86	50%	91.5	90.00	100.00	2 07	1.97	2.05	1.01
	60% 70%	105.8	100.00	110.00	2.09	2.11	2.10	0.87	60% 70%	105.8	100.00	110.00	197	1.84	1.89	1.70
	70%	120.1	120.00	130.00	1.88	1.65	1.87	0.97	/0%	120.1	120.00	130.00	2.02	2.36	2.03	1.03

2075.3

2.09

			Mea	asured da	ta				
STA	TION No. :	D7H012			STAF	T TIME	16h16		Mannii
PLAC	R NAME :	Oranje		Average	e Gaugepla	te reading :	4.429	m	
	DATE :	3/3/89							Roughne
					Main Char	nnel LEFT :	20		Sub
				N	/lain Chanr	el RIGHT :	163		0
1	2	3	4	5	6	7	8	9	2 0
Vertical	Chainage	Vertical	Velocitv	Velocity	Velocity	V aver.	Area	0	Chanse
						( ()	(m <sup>2</sup> )	(m <sup>3</sup> /s)	
number		or enective	U.20	U.40	U.8d	(m/s)	005.0	(11173)	
1	14.9	depin		0	2	2.106	985.8	2075.94	
2	20	3 99	0 796	0.847	1.068	0.000	0.0	26.00	14
3	30	8 261	1 561	1.960	1.858	1.835	82.6	151.56	
4	40	7.586	2.020	2.283	2 224	2.202	75.9	167.06	
5	50	7.168	2.088	2.385	2.377	2.309	71.7	165.47	
6	60	7.067	2.436	2.555	2.623	2.542	70.7	179.66	
7	70	7.545	2.436	2.564	2.674	2.559	75.5	193.10	
8	80	6.869	2.394	2.674	2.793	2.634	68.7	180.90	
9	90	6.886	2,411	2.555	2.640	2.540	68.9	174.91	
10	100	6,499	2.300	2.513	2.513	2.459	65.0	159.83	1(
11	110	6.36	2.258	2.402	2.351	2.353	63.6	149.66	1
12	120	6.726	1.943	2.283	2.164	2.168	67.3	145.84	1
13	130	7.193	1.731	1.935	2.037	1.909	71.9	137.31	
14	140	0.903	1.464	1.748	1.773	1.000	69.5	117.37	
10	100	0.00	1.400 D.464	0.77	016.1	0.734	00.0 13.9	32.13	1
17	169.5		0.404	0.17	0.5510	0.000	0.0	0.00	169
			~		-	2.106	985.8	2075.94	
	% Width	Act Chn	D Chillower	elta value ci	alculations	Villoper	V. Int	Delta	N/ Mariett
	30%	62.9	60.00	70.00	2 54	2.56	2.55	0.83	3.04
	40%	77.2	70.00	80.00	2.56	2.63	2.33	0.81	4.0%
	50%	91.5	90.00	100.00	2 54	2 46	2.53	0.83	50%
	60%	105.8	100.00	110.00	2.46	2.35	2.40	0.88	60%
	70%	120.1	120.00	130.00	2.17	1,91	2.17	0.97	70%

Calculated data, 1-dimensional flow theory											
Manning	or Chezy	:	M			Q =	2346.4				
		Slope	0.0007			V <sub>AVR</sub> =	2.38				
Roughness	coeff		Area reduc	ion factor							
Sub	n		Sub	fA							
0			0	1							
2	0.04		2	1							
0			0	1							
Chainane	Verhical	Sup	Aten	Wetted P	H-Radius	Q	l v				
				-		(m <sup>3</sup> /s)					
	di enective	Section	A	Ŧ	п	(111.13)	VEIOCITY				
14.8	O D	2	0.0	10.0	C	0.00	0.00				
20	3.99	2	30.3	76	3 99	50 46	1 66				
30	8.261	2	82.6	10.0	8.261	223 29	2.70				
40	7.586	2	75.9	10.0	7.586	193.72	2.55				
50	7 168	2	71.7	10.0	7 168	176.26	2.46				
60	7.067	2	70.7	10.0	7 067	172 14	2 44				
70	7.545	2	75.5	10.0	7,545	191.98	2 54				
80	6.869	2	68.7	10.0	6.869	164.18	2.39				
90	6.886	2	68.9	10.0	6.886	164.85	2.39				
100	6.499	2	65.0	10.0	6 499	149 70	2 30				
110	6 36	2	63.6	10.0	6.36	144 41	2.27				
120	6.726	2	67.3	10.0	6.726	158.52	2.36				
130	7 193	2	71.9	10.0	7 193	177.29	2.46				
140	6.953	2	69.5	10.0	6 953	167 54	2.41				
150	6.06	2	80.6	10.0	6.06	133.23	2.20				
160	4 49	2	438	8.6	4.49	/6.63	1.50				
109.5	<u>.</u>	2		<b>14</b> :0	U		0.00				
			300.03			2.340.37	063				
			Delta value	calculation	s	<u> </u>					
% Width	Active	cower	Upper	Velower	V-Upper	V-int	Delta				
30%	62.9	60.00	70.00	2.44	2.54	2.47	0.96				
40%	77.2	70.00	80.00	2.54	2.39	2.43	0.98				
50%	91.6	90 00	100.00	2 39	2 30	2 38	1.00				
60%	105.8	100.00	110.00	2.30	2.27	2.28	1.04				
70%	120.1	120.00	130.00	2.36	2.46	2.36	1.01				

-	-		Me	asured da	ata					Cal	culated o	data, 1-dir	nensiona	I flow the	eory	
STA	ATION No. :	D7H012			STAR	TTIME :	12h43		Manning	or Chezy	<i>r</i> ;	М			Q =	2715.8
RIVE	ER NAME :	Oranje		Averag	e Gaugepla	te reading :	4.767	m			Slope	0.00043			V <sub>AVR</sub> =	2.23
PLAC	CE NAME :	Irene												_		
	DATE :	2/27/89							Roughness	coeff		Area reduc	tion factor			
					Main Char	nnel LEFT :	20		Sub	n		Sub	ł <sub>A</sub>			
					Main Chann	el RIGHT :	163		0			0	1			
									2	0.04		2	1			
1	2	3	4	5	6	7	8	9	0			0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chamage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m³/s)		or effective	Section	A	Þ	R	(m³/s)	Velocity
		depth				1.984	1215.4	2411.00		deoth						
1	13.5	0	0	0	0	0.000	0.0	0.00	13.5	0	2	0.0	12.5	0	0.00	0.00
2	25	6.52	1.170	1.238	1.059	1.176	70.1	82.42	25	6.52	2	70 1	10.8	6.52	126.81	1.81
3	35	9.047	1.595	2.011	1.765	1.845	90.5	166.94	35	9 047	2	90.5	10 0	9.047	203.63	2.25
4	45	10.335	2.011	2.309	2.139	2.192	103.4	226.50	45	10 335	2	103.4	10.0	10.335	254.21	2 46
5	55	10.749	2.173	2.521	2,513	2.432	107.5	261,39	55	10.749	2	107 5	10.0	10.749	271.41	2.52
6	65	11.195	2.232	2.504	2,708	2.487	112.0	278.42	65	11.195	2	112.0	10.0	11.195	290.43	2.59
7	75	11.223	2.419	2.683	2.700	2.621	112.2	294.14	75	11 223	2	112.2	10.0	11.223	291.65	2.60
8	85	10.343	2.309	2.606	2.606	2.532	103.4	261.85	85	10 343	2	103.4	10.0	10.343	254 54	2 46
9	95	9.52	2.283	2,513	2,317	2.406	95.2	229.08	95	9.52	2	95.2	10.0	9.52	221.68	2.33
10	105	8.525	1.850	2.071	2.139	2.032	85.3	173.25	105	8.525	2	85.3	10.0	8 525	184.43	2.16
11	115	8.038	1.552	1.756	1.909	1.743	80.4	140.12	115	8 038	2	80.4	10.0	8.038	167.21	2.08
12	125	7.389	1.459	1.722	1.612	1.629	/3.9	120.33	125	1 389	2	/3.9	100	7.389	145.32	1.97
13	135	6.68	1,331	1,391	1.161	1,318	66.8	88.06	135	6.68	2	66.8	10.0	5.68	122.83	1.84
14	145	6.13	0.906	1.0/6	0.889	0.987	61.3	60.49	145	6.13	2	613	10.0	0.13	108.44	1 /4
10	100	4.40	0.473	0.092	0.439	0.524	0.00	26.02	100	4 40	2	20.3	120	4.40	12.10	1.40
10	103	Ų	0	Ų	U	0.000	0.0	0.00	109	0	2	0.0	00	ő	0.00 0.00	0.00
	L	11				1.984	1215.4	2411.00			-	1215.35			2715.76	2.23
	A/ 140		D	elta value o	alculation	5						Defta value	calculation	S		
	% Width	ACT. CINI.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% width	ACT. CDA	Lower	Upper	V-lower	V-Upper	V-Int	Delta
	40%	77.2	55.00 76.00	00.00	2.43	2.49	2.48	0.80	3078	02.8 77 9	55 UU 76 00	00.00	2.52	2.23	2 58	0.87
	E0%	91.5	75.00	05.00	2.02	2.33	2.00	0.76	<b>4</b> 0%	01.6	00.01 10.00	00.00	2.00	2.40	2.07	n 94
	60%	105.8	105.00	115.00	2,03	4.4) 174	2.40	0.01	60%	105.8	105.00 105.00	115 00	2.40	2.55	2.57	1.04
	70%	120 1	115.00	125.00	174	1.63	1 68	1.18	70%	120 1	115.00	125.00	2.08	1 97	2.02	1 10
	1.0.10			120.00				1+19								

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The values in the legend block describe measured discharge for the profile indicated

			Me	asured da	ata			
STA	TION No. :	V1H038			STA	RT TIME	14H15	
RIVE	R NAME :	Klip		Averag	e Gaugepl	ate reading :	3	m
PLAC	E NAME :	Ladysmith			21			
	DATE :	2/17/81						
					Main Cha	nnel LEFT :	5	
					Main Chon		27	
							32	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.24	D 4d	0.84	(m/e)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
namber		depth	0.20	0.40	U.OU	(11//5)	71 4	08.08
1	55	Gebui O		n		0.000	0.0	0.00
2	0,0 8	25		0 158		0.000	56	0.89
3	10	3.2		0.895		0.895	6.4	5 73
4	12	3.05		1.564		1.564	6.1	9.54
5	14	2.85		1.767		1.767	5.7	10.07
6	16	2.76		1.623		1.623	5.5	8,96
7	18	2.84		1.818		1.818	5.7	10.33
8	20	2.86		1.699		1.699	5.7	9.72
9	22	2.97		1.716		1.716	5.9	10.19
10	24	3.15		1.598		1.598	6.3	10.07
11	26	3.35		1.462		1.462	6.7	9.80
12	28	3,4		1,411		1,411	6.8	9.59
13	30	1.96		0.836		0.836	4,9	4.10
14	33	0		0		0.000	0.0	0.00
15						0.000	0.0	0.00
10						0.000	0.0	0.00
17						0.000	74.4	0.00
						1.301	11.4	96.96
1			E	)elta value c	alculation	s		
	% Width	Act. Chn.	- Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	13.1	12.00	14.00	1.56	1 77	1.68	0.83
	40%	15.8	14.00	16.00	1 77	1.62	1.64	0.85
	50%	18.5	18.00	20.00	1.82	1.70	1.79	0.78
	60%	21.2	20.00	22.00	1 70	1.72	1.71	0.81
	70%	23.9	22.00	24.00	1.72	1.60	1.60	0.86

	Calculated data, 1-dimensional flow theory												
Manning	or Chez	y:	M			Q =	118.1						
		Slope	0.0008			V <sub>AVR</sub> =	1.65						
Roughness	coeff		Area reduct	ion factor	1								
Sub	n		Sub	f,									
0			0	1	1								
,	0.035		2	1									
n -	0.000		<u>^</u>	*									
			U										
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V						
	or effective	Section	A	P	R	(m³/s)	Velocity						
	depth												
5,5	0	2	0.0	40	0	0.00	0.00						
8	2.5	2	56	2.3	2.5	8 37	1.49						
10	3.2	2	6.4	20	3.2	11.23	1.75						
12	3 05	2	61	2.0	3.06	10.37	1.70						
14	2.85	2	5.7	20	2.85	9.26	1.62						
10	210	2	50	2.0	2.75	878	1.59						
20	2.04	2	57	20	2.04	0.34	1.62						
20	200	2	59	20	2.00	9 99	1.65						
24	3 15	2	83	20	3 15	10.94	1.74						
26	3.35	2	6.7	20	3 35	12.12	1.61						
28	3.4	2	6.8	2.0	3.4	12.43	1.83						
30	1,96	2	4,9	25	1 96	6.20	1.27						
33	Q	2	0.0	1.5	0	000	0.00						
	0	2	0.0	00	0	0.00	0.00						
	0	2	0.0	0.0	0	0.00	0.00						
	0	2	0.0	0.0	0	0.00	0.00						
			71.39			118.13	1.65						
			Jelta velue	calculation	e								
Delta	Act Chn	Ount		Walter General Control	Valiener	Vdet	Delta						
30%				1 75		1.66	1.00						
40%	15.8	14:00	16.00	1.62	1 59	1.59	1.04						
50%	18.5	18.00	20.00	1.62	1.63	1.62	1.02						
60%	21.2	20.00	22.00	1 63	1.67	1.65	1.00						
70%	23.9	22.00	24 00	1.67	1.74	173	0.95						

f 92

			Mea	asured da	ta			
STA	TION No. :	V1H038			STA	RT TIME :	12H40	
RIVE PLAC	R NAME : E NAME : DATE :	Klip Ladysmith 2/17/81		Averag	e Gaugepli	ate reading :	3.75	m
					Main Cha	nnel I FFT	5	
					Main Chan	nel RIGHT :	32	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or offentium	0.04			(m(c)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
number		death	0.20	0.40	0.80	(1105)	00 4	142.47
1	5	depth		0		0.000	99.4	144.17
2	8	33		0.243		0.000	83	2.00
3	10	3.75		0.802	0.602	7.5	6.02	
4	12	12 3.73 1.674				1.674	7.5	12.49
5	14	3.92		1.75		1.750	7.8	13.72
6	16	4.02		1.784		1.784	8.0	14.34
7	18	4		1.649		1.649	8.0	13.19
8	20	4.36		1.776		1.776	8.7	15.49
9	22	4.46		1.665		1.665	8.9	14.85
10	24	4.47		1.598		1.598	8.9	14.29
11	26	4.35		1.606		1.606	8.7	13.97
12	28	4.05		1.572		1.572	8.1	12.73
13	30	2.81		1.098		1.098	2.0	0,17
14	34	1.07		0.07		0.000	0.0	0.00
16	54	Ű				0.000	0.0	0.00
17						0.000	0.0	0.00
						1.430	99.4	142.17
			C	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	13.1	12.00	14.00	1 67	1.75	1.72	0.83
	40%	15.8	14.00	16.00	1,75	1.78	1.78	0.80
	50%	18.5	18.00	20.00	1 65	1.78	1.68	0.85
	60% 70%	21.2	20.00	22.00	1.78	1.67	1.71	0.84
	/0%	23.9	22.00	24.00	1 67	1.60	1.60	0.89

	Calc	ulated o	lata, 1-din	nensiona	I flow the	ory	1.27.20			
Manning	or Chezy	<i> </i> :	М			Q =	164.6			
		Slope	0.00055			V <sub>AVR</sub> =	1.66			
Roughness	coeff.		Area reduct	ion factor	1					
Sub	n		Sub	f <sub>A</sub>						
n			0	1						
2	0.035		2	•						
6	0.000									
U			U	1						
Chainage	Vertical	Sud	Area	Wetted P	H-Radius	Q	V			
	or effective	Section	A	P	R	(m²/s)	Velocity			
	depth									
5	0	2	0.0	4.0	0	0.00	0.00			
8	33	2	8.3	25	3.3	12.25	1 49			
10	3 75	2	7.5	2.0	3,75	12 13	1.62			
12	3.73	2	7.5	2.0	373	12.02	1 61			
14	3 92	2	7.8	2.0	3.92	13.06	1.67			
16	4.02	2	8.0	20	4 02	13.52	1 69			
18	4	2	8.0	2.0	4	13 51	1.69			
20	4.36	2	8.7	2.0	4 36	15.59	1 79			
22	4 46	2	69	2.0	4,46	15 19	1.82			
24	4.47	2	8.9	20	4 47	16.26	1.82			
26	4 35	2	B /	20	4.35	15 53	1.79			
28	4.05	2	8.1	20	4.05	13.79	170			
30	2 81	2	20	20	4.61	7 60	1.33			
32	1.0/	2	3.3	2.0	1 67	0.10	0.94			
34	0	2	00	0.0	0	0.00	0.00			
	0	2	0.0	0.0	0	0.00	0.00			
		4	99.43	0.0	C.	164.61	1.66			
			Delta value (	calculation	s					
Delta	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-int	Delta			
30%	13.1	12.00	14.00	1 61	1.67	1.64	1.01			
40%	15.8	14.00	16 00	1.67	1.69	1 69	0.98			
50%	18.5	18 00	20.00	1 69	1 79	1.71	0.97			
60%	21.2	20.00	22.00	1.79	1.82	1 80	0.92			
70%	23.9	22.00	24.00	1 82	1.82	1.62	0.91			

			Me	asured da	ta				
STA	TION No. :	V1H038			STA	RT TIME	11h50		Manning
RIVE	R NAME :	Klip		Average	e Gaugepli	ate reading :	4.2	m	
PLAC	DATE :	2/17/81							Roughness
					Main Cha	nnel LEFT :	5		Sub
				,	Anin Chan		22		n
				1			J∠		2
1	2	3	4	5	6	7	8	9	0
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chamage
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)	
		depth	0.24		0.04	1,424	113.5	161.63	
1	4	0		0		0.000	0.0	0.00	4
2	6	1.7		0.311		0.311	3.4	1.06	6
3	8	3.15		0.379		0.379	6.3	2.39	8
4	10	4.05		0.933		0.933	8.1	7.56	10
5	12	4.48		1.682		1.682	9.0	15.07	12
6	14	4.15		1.657		1.657	8.3	13.75	14
7	16	4.37		1.75		1.750	8.7	15.30	16
8	18	4,45		1.826		1.826	8,9	16.25	18
9	20	4.52		1.716		1.716	9.0	15.51	20
10	22	4.7		1.64		1.640	9.4	15.42	22
11	24	4.77		1.632		1.632	9.5	15.57	24
12	26 29	4.01		1.607		1.007	9.2	15.28	20
13	20	4.47		1.010		1.010	6.1	7.63	20
15	30	1 98		0.827		0.827	4.0	3.27	32
16	34	23		0.683		0.683	46	3 14	34
17	36	0		0		0.000	0.0	0.00	36
				·		1.424	113.5	161.63	
				elta valua o	aloulation	-			
	% Width	Act. Chn.	Ch-l ower	Ch-Upper	V-lower	V-Upper	¥-Int	Delta	Delta
	30%	13.1	12.00	14.00	1.68	1.66	1.67	0.85	30%
	40%	15.8	14.00	16.00	1.66	1.75	174	0.82	40%
	50%	18.5	18 00	20.00	1.83	1 72	1.80	0.79	50%
	60%	21.2	20.00	22.00	1.72	1.64	1.67	0.85	60%
	70%	23.9	22.00	24.00	1.64	1.63	1.63	0.87	70%

		Calc	ulated o	lata, 1-din	nensiona	I flow the	eory	
Mann	ing	or Chezy	ſ.	М			Q =	188.9
			Slope	0.0005			V <sub>AVR</sub> =	1.66
		l						
Roughn	vess	coeff.		Area reduct	ion factor			
Sub		n		Sub	fA			
D				0	1			
- -		0.034		2	1			
4 0		0.004		2	-			
				U	I			L
Chaina	ge	Verticel	Sub	Area	Wetted P	M-Radius	. ч ,	V
		or effective	Section	A	β	R	(m*/s)	Velocity
		depth						
	4	0	2	0.0	30	0	00.0	0.00
	6	1.7	2	3.4	2.0	17	3 19	0.94
	8	3.15	2	63	20	3.15	8.90	1.41
	10	4.05	2	8.1	2.0	4 05	13.64	1.67
	12	4.48	2	9.0	20	4.48	16.01	1.79
	14	4 15	2	8.3	2.0	4 15	14.10	1.70
	16	4.3/	2	87	20	4.37	15.36	1/6
	18	4,45	2	0.9	2.0	4 40	10.84	1.76
	20	4.94	2	30	20	4.32	62.01 57.76	1.00
	22	4.7	2	9.4 0.5	2.0	47	17.30	1.00
	24	4.11	2	35	20	4.77	11.10 Ke an	1.80
	20	4.61	2	9.4	2.0	4 01	10.00 4E DE	1.02
	20	4.47	2	0.0 B 1	20	9.06	10.30 S //	1.76
	30	3.00	2	4.0	2.0	1 08	A 11	1.00
	34	1.90	2	40	20	23	a 97	1 15
	36	0	5	0.0	1.0	0	0.00	0.00
				113.50			188.88	1.66
								•
				Delta value	calculation	5		
Deit	3	Act. Chn.	Lowet	Upper	V-lower	V-Upper	V-Int	Delta
30%		13.1	12.00	14.00	1.79	1 70	1.74	0.96
40%		15.8	14.00	16.00	1 70	1.76	1 75	0.95
50%		18.5	18.00	20 00	1.78	1 80	1 78	0.93
60%	•	21.2	20.00	22.00	1 80	1.85	1 83	0.91
70%		23.9	22.00	24 00	1.85	1.86	1.86	D.89

			Me	asured da	ita			
STA	TION No. :	V1H038			STA	RT TIME	14h15	
RIVE PLAC	R NAME : E NAME : DATE :	Klip Ladysmith 2/26/85		Averag	e Gaugepli	ate reading :	5.98	m
					Main Cha	Innel LEFT :	5	
						52		
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0 2d	0.4d	0.84	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth			0.04	1 738	137 6	239 10
1	1	0		0		0.000	0.0	0.00
2	4	1.98		0.683		0.683	5.9	4.06
3	7	3.73		1.018		1.018	11.2	11,39
4	10	4.04		1.987		1.987	12.1	24.08
5	13	5.75		2.334		2.334	17.3	40.26
6	16	4.87		2.427		2.427	14.6	35.46
7	19	4.17		2.326		2.326	12.5	29.10
8	22	4.06		2.254		2.254	12.2	27.45
9	25	3.66		2.118		2.118	11.0	23.26
10	28	5,15		1.699		1.699	15.5	26.25
11	31	4.19		1.085		1.085	12.6	13,64
12	34	2.00		0.425		0.425	1.1	3.25
13	37	1.72		0.175		0.175	J.2 0.0	0.90
15		0		0		0.000	0.0	0.00
16						0.000	00	0.00
17						0.000	0.0	0.00
						1.738	137.6	239.10
			Ľ	elta value c	alculation	5		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	13.1	13.00	16.00	2.33	2.43	2.34	0.74
	40%	15.8	13.00	16.00	2.33	2.43	2 42	0.72
	50% 60%	18.5	16 00	19.00	2.43	2.33	2.34	0.74
	70%	21.2	19.00	22.00	2.33	2.25	2.21	0.70
	70%	29.9	22.00	25.00	2.25	2.12	2.37	1 0.80

Anning or Chezy:     M     Q = 26       Siope     0.0006     Vare reduction factor       Sub     n     0     1       0     0     1     0     1       0     0     1     0     1       0     0     1     0     1       0     0     1     0     1       0     0     1     0     1     Q     Veloci       depth     Bub     Area     Velue IP     H-Radius     Q     Veloci       1     0     2     0.0     2.0     0     0.00     0.0       1     0     2     5.9     3.0     1.96     6.96     1.1       1     0     2     5.9     3.0     1.96     6.96     1.1       1     0     2     1.3     3.73     18.96     1.1       1     0     2     1.2     3.0     5.75     41.10     2.3       10     4.04		Calc	ulated d	lata, 1-din	nensiona	I flow the	ory	
Stope     0.0006     Vave = 1.3       Sub     n     Area reduction factor     Sub     fA       0     0     1     0     1     0     1       2     0.033     2     1     0     1     0     1       0     0     1     2     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0	Aanning	or Chezy	y:	М			Q =	263.0
Area reduction factor       Sub     n       O     0     1       2     0.033     2     1       0     0     1     2     1       0     0     1     2     1     0     1       Chainage     vertices     Bub     Area     Vertice     H-Radius     Q     Vertice       or effactive     Section     A     P     R     (m³/s)     Veloci       1     0     2     0.0     2.0     0     0.00     0.0       4     1.96     2     5.93     3.0     1.98     6.95     1.3       1     0     2     0.0     2.0     0     0.00     0.0       4     1.96     2     5.93     3.0     1.98     6.95     1.3       1     0     2     0.0     2.0     0     0.00     0.00       4     1.96     2     1.2     3.0     3.73     1.9.8 <th1.7< th=""></th1.7<>			Slope	0.0006			V <sub>AVR</sub> =	1.91
Sub     n     Area reduction factor       Sub     n     Sub     f_A       0     0     1       2     0.033     2     1       0     0     1     2     1       0     0     1     2     1       0     0     1     2     1       0     0     1     0     2     1       0     0     1     0     2     1       0     2     0.0     1     Veloci     Veloci       or effective     Section     A     e     R     (m³/s)     Veloci       1     0     2     0.0     20     0     0.00     0.0       4     1.96     2     5.9     3.0     1.98     6.95     1.1       10     4.04     2     12.1     3.0     4.04     22.82     1.0       13     5.76     2     17.3     3.0     5.75     4.110     2.3 <								
Sub     n     Sub     fA       0     0     1     0     1       2     0.033     2     1     0     1       0     0     1     0     1     0     1       0     0     1     0     1     0     1     0       0     0     1     0     1     0     1     0     1     0     1     0     1     0     1     0	loughness	coeff		Area reduct	ion factor			
0     0.033     0     1       2     0.033     2     1       0     1     0     1       0     0     1     0     1       0     0     1     0     1       0     0     1     0     1     0     1       0     0     Anna     Vestad P     H-Radius     Q     Velocities       0     0     2     0.0     2.0     0     0.00     0.00       4     1.98     2     5.9     3.0     1.96     6.06     1.1       1     0     2     0.0     2.0     0     0.00     0.0       4     1.98     2     5.9     3.0     1.96     6.06     1.1       10     4.04     2     12.1     3.0     3.73     1.98     1.1       13     5.76     2     17.3     3.0     5.75     4.1     2.3       14     4.87     2     1.2	Sub	n		Sub	1 <sub>A</sub>			
2   0.033   2   1   0   1     Chamage   ventors   Bub   Arna   ventor   H-Radius   Q   M     or effactive   Section   A   P   H-Radius   Q   M     depth   0   2   0.00   2.0   0   0.00   0.0     1   0   2   0.00   2.0   0   0.00   0.0     4   1.96   2   5.9   3.0   1.98   6.95   1.1     7   3.73   2   11.2   3.0   3.73   19.98   1.7     10   4.04   2   1.21   3.0   4.04   22.82   1.6     13   5.75   2   1.73   3.0   5.75   41.10   2.3     19   4.17   2   1.25   3.0   4.17   24.00   1.4     22   4.06   2   11.2   3.0   3.66   19.36   17     19   4.17   2   12.5   3.0   5.15   34.20   23.3   1.6	0			0	1			
0     0     1       0     0     1       0     1     0     1       0     or effective depth     Section     A     P     H-Radius R     Q     A       1     0     2     0.0     2.0     0     0.00     0.0       4     1.96     2     5.9     3.0     1.98     6.95     1.1       7     3.73     2     11.2     3.0     3.73     19.96     1.7       10     4.04     2     12.1     3.0     4.04     22.82     1.6       13     5.75     2     17.3     3.0     5.75     41.10     2.3       16     4.87     2     14.6     3.0     4.87     31.16     2.7       22     4.06     2     12.2     3.0     4.06     23.01     1.6       25     3.66     2     11.0     3.0     3.68     19.36     1.7       28     5.15     2     7.7	2	0.033		2	1			
Openange     Vertice     Bub     Area     Wetted P     H-Radius     Q     M       or effective     Section     A     P     R     (m³/s)     Veloci       1     0     2     0.0     2.0     0     0.00     0.0       4     1.98     2     5.9     3.0     1.98     6.95     1.1       7     3.73     2     11.2     3.0     3.73     19.98     1.9       10     4.04     2     12.1     3.0     4.04     22.82     1.6       13     5.75     2     17.3     3.0     5.75     41.10     2.2       16     4.87     2     12.2     3.0     4.87     31.18     2.1       22     4.08     2     12.2     3.0     4.17     24.06     1.2       23     3.66     2     11.0     3.0     3.68     19.36     1.7       24     0.8     2.15.5     3.0     5.15     34.20     2.2	- 0	01000		- 0	4			
Chanage     Vertical     Bub     Area     Vertical P     Perkaduus     C     C     Vertical       arent     Section     A     P     R     (m <sup>3</sup> /s)     Vertical     Vertical				0	,		~ ~	I
or effactive     Section     A     p     R     (m 7s)     Velocities       depth     1     0     2     0.0     2.0     0     0.00     0.00       4     1.98     2     5.9     3.0     1.98     6.95     1.1       7     3.73     2     11.2     3.0     3.73     19.98     1.7       10     4.04     2     12.1     3.0     4.04     22.82     1.6       13     5.75     2     1.73     3.0     5.75     44.10     2.3       16     4.87     2     1.46     3.0     4.87     34.16     2.4       19     4.17     2     1.25     3.0     4.06     23.03     1.6       22     4.06     2     12.2     3.0     4.06     1.9     1.7       28     5.15     2     15.5     3.0     5.15     34.20     2.4       34     2.65     2     7.7     3.0     2.55     1.60<	Chainage	Vertical	Bub	Area	Wetted P	H-Radius	Ч	v
depth     0     2     0.0     2.0     0     0.00     0.00       4     1.95     2     5.9     3.0     1.96     6.95     1.9       7     3.73     2     11.2     3.0     3.73     19.96     1.7       10     4.04     2     12.1     3.0     4.04     22.82     1.6       13     5.75     2     17.3     3.0     5.75     41.10     2.3       16     4.87     2     12.5     3.0     4.17     24.06     14.2       19     4.17     2     12.5     3.0     4.06     23.01     1.6       22     4.06     2     12.2     3.0     4.06     13.3     1.6     1.7       25     3.66     2     11.0     3.0     3.66     19.36     1.7       28     5.15     2     16.5     3.0     5.15     34.20     2.4       34     2.55     2     7.7     3.0     2.55		or effective	Section	A	ρ	R	(m <sup>-</sup> /\$)	Velocity
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		depth						
4   1.96   2   5.9   3.0   1.96   6.96   1.1     7   3.73   2   11.2   3.0   3.73   19.98   1.1     10   4.04   2   12.1   3.0   4.04   22.82   1.6     13   5.75   2   17.3   3.0   5.75   41.10   2.3     16   4.87   2   14.6   3.0   4.87   31.16   2.4     19   4.17   2   12.5   3.0   4.17   24.06   1.6     22   4.06   2   12.2   3.0   4.06   23.01   1.6     25   3.66   2   11.0   3.0   3.68   19.36   1.7     28   5.15   2   15.5   3.0   5.15   34.20   24     31   4.19   2   12.6   3.0   4.19   24.25   1.4     34   2.55   2   7.7   3.0   2.55   10.60   1.5     40   0   2   0.0   1.5   0   0.00	1	0	2	0.0	20	0	0.00	0.00
7   3.73   2   11.2   3.0   3.73   19.96   17.73     10   4.04   2   12.1   3.0   4.04   22.82   1.6     13   5.75   2   17.3   3.0   5.75   41.10   2.3     16   4.87   2   14.6   3.0   4.87   31.18   2.1     19   4.17   2   12.5   3.0   4.17   24.06   1.8     22   4.06   2   12.2   3.0   4.06   23.01   1.6     25   3.66   2   11.0   3.0   3.66   19.36   1.7     28   5.15   2   15.5   3.0   5.15   34.20   2.2     31   4.19   2   12.8   3.0   4.19   24.25   1.6     34   2.55   2   7.7   3.0   2.55   10.60   1.3     37   1.72   2   5.2   3.0   1.72   3.50   1.6     40   0   2   0.0   0.0   0   0.00 <td>4</td> <td>1.98</td> <td>2</td> <td>5.9</td> <td>3.0</td> <td>1 98</td> <td>6.95</td> <td>1.17</td>	4	1.98	2	5.9	3.0	1 98	6.95	1.17
10   4.04   2   12.1   3.0   4.04   22.82   1.6     13   5.75   2   17.3   3.0   5.75   41.10   2.3     16   4.87   2   14.6   3.0   4.87   31.16   2.1     19   4.17   2   12.5   3.0   4.17   24.06   1.6     22   4.06   2   12.2   3.0   4.06   23.01   1.6     22   4.06   2   12.2   3.0   4.06   23.01   1.6     25   3.66   2   11.0   3.0   3.66   19.36   1.7     28   5.15   2   15.5   3.0   5.15   34.20   22     31   4.19   2   12.8   3.0   4.19   24.25   1.1     34   2.55   2   7.7   3.0   2.55   10.60   1.3     37   1.72   2   5.2   3.0   1.72   3.50   1.6     40   0   2   0.0   0.0   0   0.00	7	3.73	2	11 2	30	3.73	19.98	1.79
13   576   2   173   30   575   4116   22     16   4.87   2   14.6   3.0   4.87   3115   21     19   4.17   2   12.5   3.0   4.17   24.06   16     22   4.06   2   12.2   3.0   4.06   23.05   16     25   3.66   2   11.0   3.0   3.66   19.36   17     28   5.15   2   15.5   3.0   6.15   34.20   23     31   4.19   2   12.6   3.0   4.19   24.28   1.6     34   2.55   2   7.7   3.0   2.55   10.60   1.3     37   1.72   2   5.2   3.0   1.72   3.50   1.6     40   0   2   0.0   1.5   0   0.00   0.0   0.00     0   2   0.0   0.0   0   0.00   0.0   0.00   0.0     0   2   0.0   0.0   0   0.00	10	4.04	2	12.1	3.0	4 04	22.82	1.86
16   4.87   2   14.6   3.0   4.87   37.79   4.17     19   4.17   2   12.5   3.0   4.17   24.06   14     22   4.06   2   12.2   3.0   4.06   23.01   16     25   3.66   2   11.0   3.0   3.66   19.36   17     28   5.15   2   15.5   3.0   5.15   34.20   24     31   4.19   2   12.6   3.0   4.19   24.25   16     34   2.655   2   7.7   3.0   2.55   10.60   15     37   1.72   2   5.2   3.0   1.72   5.50   1.0     40   0   2   0.0   1.5   0   0.00   0.0   0.0     0   2   0.0   0.0   0   0.00   0.0   0.0   0.0     0   2   0.0   0.0   0   0.00   0.0   0.0   0.0     0   2   0.0   0.0   0	13	0,/0	2	1/ 3	30	5./5	41 10	2.38
19   4.17   2   12.0   4.17   12.400   12.2     22   4.06   2   12.2   3.0   4.06   23.01   1.8     25   3.66   2   11.0   3.0   3.66   19.36   1.7     28   5.15   2   16.5   3.0   5.15   34.20   2.3     31   4.19   2   12.6   3.0   4.19   24.25   1.6     34   2.65   2   7.7   3.0   2.55   10.60   1.3     37   1.72   2   5.2   3.0   1.72   5.50   1.0     40   0   2   0.0   1.5   0   0.00   0.0     0   2   0.0   0.0   0   0.00   0.0   0.00   0.0     0   2   0.0   0.0   0   0.00   0.00   0.0   0.00   0.0     0   2   0.0   0.0   0   0.00   0.0   0.0   0.0   0.0     0   2   0.0   0.0	10	4.0/	2	14.6	3.0	4 67	31.10	1.07
22   3.66   2   11.0   3.0   3.66   19.36   1.7     28   5.15   2   15.5   3.0   5.15   34.20   2.2     31   4.19   2   12.6   3.0   4.19   24.25   1.4     34   2.55   2   7.7   3.0   2.55   10.60   13     37   1.72   2   5.2   3.0   1.72   5.50   10     40   0   2   0.0   1.5   0   0.00   0.0     0   2   0.0   0.0   0   0.00   0.0   0.00     0   2   0.0   0.0   0   0.00   0.0   0.00     0   2   0.0   0.0   0   0.00   0.0   0.00   0.0     0   2   0.0   0.0   0   0.00   0.00   0.0     0   2   0.0   0.0   0   0.00   0.0   0.0     0   2   0.0   0.0   0   0.00   0.0   0.0	13	4.17 4.08	2	12.0	20	4.17	24.00	1.82
28 5.15 2 15.5 3.0 5.15 34.20 2.3   31 4.19 2 12.8 3.0 4.19 24.25 1.6   34 2.55 2 7.7 3.0 2.55 10.80 1.3   37 1.72 2 5.2 3.0 1.72 5.50 1.6   40 0 2 0.0 1.5 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6   0 2 0.0 0.0 0 0.00 0.6	25	3 66	5	11.0	3.0	3.66	19.36	176
31   4.19   2   12.6   3.0   4.19   24.25   14.3     34   2.65   2   7.7   3.0   2.65   10.60   13.3     37   1.72   2   5.2   3.0   1.72   5.50   10.6     40   0   2   0.0   1.5   0   0.00   0.0     0   2   0.0   0.0   0   0.60   0.0 <td>28</td> <td>5 15</td> <td>2</td> <td>15.5</td> <td>30</td> <td>5 15</td> <td>34.20</td> <td>2.21</td>	28	5 15	2	15.5	30	5 15	34.20	2.21
34     2.55     2     7.7     3.0     2.55     40.60     13       37     1.72     2     5.2     3.0     1.72     5.50     1.6       40     0     2     0.6     1.5     6     0.00     0.6       0     2     0.0     0.0     0     0.66     0.6       0     2     0.0     0.0     0     0.66     0.6       0     2     0.0     0.0     0     0.66     0.6       0     2     0.0     0.0     0     0.66     0.6       0     2     0.0     0.0     0     0.66     0.6       0     2     0.0     0.0     0     0.66     0.6	31	4.19	2	12.6	30	4.19	24.25	1.93
37     1.72     2     5.2     3.0     1.72     5.50     1.0       40     0     2     0.0     1.5     0     0.00     0.0       0     2     0.0     0.0     0     0.00     0.0     0	34	2.55	2	7.7	3.0	2 55	10.60	1.39
40 0 2 0.0 1.5 0 0.00 0.0 0 2 0.0 0.0 0 0 0.0 0 2 0.0 0.0 0 0 0 0 0 0 2 0.0 0.0 0 0 0 0 137.61 262.97	37	1.72	2	52	30	1.72	5.50	1.07
0 2 0.0 0.0 0 0.0 0.0 0.0 0.0 0.0 0.0 0.	40	0	2	0.0	1.5	0	0.00	0.00
0 2 0.0 0.0 0 0.0 00 0 2 0.0 0.0 0 0.0 00 137.61 262.97		0	2	0.0	0.0	0	00.0	0.00
0 2 0.0 0.0 0 0.00 0.0 137.61 262.97		0	2	0.0	0.0	0	0.00	0.00
137.61 262.97		0	2	0.0	00	0	0.00	0.00
				137.61			262.97	1.91
Delta value calculations				Delta value (	calculation	5		
Delta Act. Chn. Lower Upper V-lower V-lipper V-int Del	Deita	Act. Chn.	Lowet	Upper	V-lower	V-Upper	V-Inl	Deita
30% 13.1 13.00 16.00 2.36 2.13 2.37 0.0	30%	13.1	13.00	16.00	2.38	2.13	2.37	0.80
40% 15.8 13.00 16.00 2.38 2.13 2.15 0.1	40%	15.8	13.00	16.00	2 38	2.13	2 15	0.89
50% 18.5 16.00 19.00 2.13 1.92 1.98 0.1	50%	18.5	16.00	19.00	2.13	1.92	1.98	0.98
60% 21.2 19.00 22.00 1.92 1.89 1.90 1.0	60%	21.2	19.00	22.00	1 92	1.89	1.90	1.01
70% 23.9 22.00 25.00 1.89 1.76 1.81 1.0	70%	23.9	22.00	25.00	1.89	1 76	1.81	1.06

			Me	asured da	ita			
STA RIVE PLAC	TION No. : R NAME : E NAME : DATE :	V1H038 Klip Ladysmith 2/26/85		Averag	STA e Gaugepli	RT TIME ate reading :	11h30 6.86	m
					Main Cha	nnel LEFT :	5	
				1	Main Chan	nel RIGHT :	32	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth			0.00	1.825	183.8	335.53
1	0	0		0		0.000	0.0	0.00
2	2	1.77		0.179		0.179	4.4	0.79
3	5	2.98		0,984		0.984	8.9	8.80
4	8	5		1.415		1.415	15.0	21.23
5	11	6.91		2.08		2.080	20.7	43.12
6	14	7.35		2.339		2.339	22.1	51.57
7	17	7.53		2.398		2.398	22.6	54.17
8	20	5.12		2.389		2.389	15.4	36.70
9	23	6.18		2.178		2.178	18.5	40,38
10	26	4.04		2.008		2.008	12.1	24.34
11	29	4.75		1.678		1.678	14.3	23.91
12	32	4.5		1.28		1.280	13.5	17.28
13	35	3.13		0.895		0.895	9.1	8.12
14	37.8	3.1		0.895		0.895	5.1	4.58
15	38.3	1.1		0.256		0.256	0.7	0.17
16	39	1.1		0.256		0.256	1.5	0.38
17	41	U		0		0.000	0.0	0.00
						1,625	163.8	1 335,53
			Ē	)elta value c	alculation	\$		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	∀-Int	Delta
	30%	13.1	11 00	14.00	2.08	2.34	2.26	0.81
	40%	15.8	14.00	17 00	2.34	2,40	2 37	0.77
	50%	18.5	17 00	20.00	2.40	2.39	2.39	0.76
	60%	21.2	20.00	23.00	2.39	2,18	2 30	0.79
	70%	23.9	23.00	26.00	2.18	2.01	2.13	0.86

· · · · · · · · · · · · · · · · · · ·	Galc	ulateu	uala, I-UII	1611310118	in now the	ion y	
wanning	orunezy	<i>r</i> :	IM			<b>u</b> =	349.5
	l	Slope	0.0005		ļ	$V_{AVR} =$	1.90
Roughness	coeff		Area reduct	ion factor	1		
Sub	n		Sub	fA			
0			D	1			
2	0.036		-				
~	0.000		2				
U			Ū	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	A	P	R	(m³/s)	Velocity
	depth						
0	0	2	0.0	0.0	0	0.00	0.00
5.2	1.77	2	4.4	2.5	1 77	4.02	0.91
8.2	2.98	2	89	30	2.98	11 50	1.29
11.2	5	2	15.0	3.0	5	27.24	1.82
14.2	6.91	2	20.7	30	6.91	46.71	2.25
17.2	7.35	2	22.1	3.0	7 36	61.77	2.35
20.2	7.53	2	22.6	30	7.53	53.90	2.39
23.2	5 12	2	15.4	3.0	5.12	28.34	1.85
20.2	0.10	2	100	20	0.10	40.40	1.09
29.2	4.04	2	143	3.0	4 75	25.04	176
35.2	4.10	2	135	30	4.5	22.86	1 69
38.2	3 13	2	91	29	3.13	12.06	1.33
41.2	3.1	2	5.1	1.7	31	6.75	1.32
44.2	1 1	2	0.7	0.6	1,1	0.44	0.66
47.2	1.1	2	1.5	1,4	1 1	0.98	0.66
50.2	0	2	0.0	10	0	0.00	0 00
			183.84			349.48	1.9
			Delta value	calculation	5		
Deita	Act. Chn.	Lowet	Upper	V-lower	V-Upper	V-Int	Delta
30%	13.1	11.20	14.20	1.82	2.26	2.09	0.91
40%	15.8	14.20	17.20	2.25	2.35	2 30	0.83
50%	18.5	17 20	20 20	2.35	2 39	2.36	0.80
60%	21.2	20.20	23.20	2 39	1.85	2 21	0.86
70%	23.9	23 20	26 20	1.85	2 09	1.90	1.00

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Velocity (m/s)











The values in the legend block describe measured discharge for the profile indicated

			Me	asured da	ita			
STA	TION No. :	V1H057			STA	RT TIME	15H15	
RIVE PLAC	R NAME : E NAME : DATE	Tugela Spioenkop da 2/10/86	am	Averag	e Gaugepla	te reading :	2.6	m
					Main Cha	nnel I FFT	10	
				N	Main Chan	nel RIGHT	60	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth				0.715	112.7	80.52
1	8	0		0		0.000	0.0	0.00
2	12	1.48		0.54		0.540	5.9	3.20
3	16	2.3		0.688		0.688	9.2	6.33
4	20	2.74		0.866		0.866	11.0	9,49
5	24	2.75		0.907		0.907	11.0	9.98
6	28	2.7		1.044		1.044	10.8	11.28
1	32	2.6		0.994		0.994	10.4	10.34
8	36	2.77		0.817		0.817	11,1	9.05
9	40	2.31		0.759		0.759	9.2	7.01
10	44	2.22		0.673		0.673	8.9	5.98
11	48	2.05		0.444		0.444	8.2	3.64
12	52	2 25		0.32		0.320	8.0	2.56
10 14	50	2.25		0.185		0,165	90	1.67
14	00	U		U		0.000	0.0	0.00
10 16						0.000	0.0	0.00
17						0.000	0.0	0.00
		•		1		0.715	112.7	80.52
			D	elta value c	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lawer	V-Upper	V-Int	Deita
	30%	25.0	24.00	28.00	0.91	1.04	0.94	0.76
	40%	30.0	28.00	32.00	1.04	0.99	1.02	0.70
	50%	35.0	32.00	36.00	0.99	0.82	0.86	0.83
	60%	40.0	40.00	44.00	0.76	0.67	0.76	0.94
	70%	45 0	44.00	48.00	ri 67	0 44	0.62	1 16

	Cal	culated o	lata, 1-dir	nensiona	I flow the	ory	
Manning	or Chezy	:	M			Q =	102.8
		Slope	0.0003			V <sub>AVR</sub> =	0.91
Roughness	coeff		Area reduc	tion factor	1		
Sub	n		Sub	f <sub>A</sub>			
0			0	1			
2	0.034		2	1			
n l							
							I
Chanage	Verboal	Sub	Area	Vvetted P	H-Kadius	u .	v
	or effective	Section	A	P	R	(m*/s)	Velocity
8	0epm G	2	0.0	6.0	0	0.00	0.00
12	1 48	2	59	4.0	1.48	3 92	0.66
16	23	2	9.2	40	2.3	8 17	0.89
20	2.74	2	11.0	40	274	10.93	1.00
24	2 75	2	11 0	4.0	2.75	11.00	1.00
28	2.7	2	10.8	4.0	2.7	10.67	0.99
32	2.6	2	10.4	40	2.6	10.02	0.96
36	2.77	2	11.1	4.0	2.77	11.13	1.00
40	2.31	2	92	4.0	2.31	8.23	0.89
44	2.22	2	89	4.0	2.22	7 70	0.87
48	2.05	2	8.2	40	205	674	0.82
52	2005	2	8.0	40	2	6.4/ Hott	U.81
50	220	2	90	4.0	2.20	1.01	0.00
ου	0	4	00	20	o o	0.00	0.00
	n	5	0.0	00	ŏ	0.00	0.00
	0	2	0.0	00	ŏ	0.00	0.00
			112.68			102.84	0.9
		<b>0</b> -2					1
9/ Mildeh	Act Che I	Derta .	value calcu	adons			Dette
204	26.0	24.00	00,90	1.005	0.00	1 00	0.92
40%	30.0	24.00	20.00	0.00	0.99	0.00	0.94
50%	35.0	20.00	36.00	0.06	1 00	n oo	0.92
60%	40.0	40.00	44.00	0.89	0.67	0.89	1.03
70%	45.0	44.00	48.00	0.87	0.62	0.86	1.07

	_		Me	asured da	ta			
STA RIVE PLAC	TION No. : R NAME E NAME DATE	V1H057 Tugela Spioenkop da 1/29/81	am	Average	STAF e Gaugepla	RT TIME :	12H20 3.28	m
					Main Cha	nnel LEFT :	10	
				٨	Aain Chanı	nel RIGHT :	60	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.54	0.4d	0.84	/m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
namoer		denth	0.20	0.40	0.00	1 040	144 3	149 97
1	6	0		0		0.000	0.0	0.00
2	8	0.7		0.058		0.058	2.1	0.12
3	12	1.83		0.68		0.680	7.3	4.98
4	16	2.9		0.883		0.883	11.6	10.24
5	20	3.1		1.048		1.048	12.4	13.00
6	24	3.32		1.315		1.315	13.3	17.46
7	28	3.32		1.374		1.374	13.3	18.25
8	32	3.38		1.324		1.324	13.5	17.90
9	36	3.37		1.362		1.362	13.5	18.36
10	40	2.93		1.353		1.353	11.7	15.86
11	44	2.88		1.158		1.158	11.5	13.34
12	48	2.68		0.862		0.862	10.7	9.24
13	52	2.7		0.591		0.591	10.8	6.38
14	56	2.78		0.387		0.387	12.5	4.84
15	61	U		U		0.000	0.0	0.00
10						0.000	0.0	0.00
10				1		1 040	144 3	149.97
						1.044	144.0	1.140.01
			D	elta value c	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lawer	V-Upper	V-Int	Delta
	30%	25.0	24 00	28.00	1.32	1,37	1.33	0.78
	40%	30.0	28.00	32.00	1.37	1.32	1.35	0.77
	50%	35.0	32.00	36.00	1.32	1.36	1.35	0.77
	60%	40.0	40.00	44.00	1.35	1.16	1.35	0.77
	70%	45.0	44.00	48.00	1.16	0.86	1.08	0.96

	Calo	culated o	lata, 1-din	nensiona	I flow the	ory	
Aanning	or Chezy:		M			Q =	179.5
		Slope	0.0004			V <sub>AVR</sub> =	1.24
coughness	coeff		Area reduct	tion factor	1		
Sub	n		Sub	f <sub>A</sub>			
n			G	4			
•	0.000		Š				
4	0.033		- 2	•			
0			0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	Α	q	R	(m <sup>3</sup> /s)	Velocity
	rippile						
6	<u></u>	2	0.0	4.0	n	0.00	6.66
8	07	2	21	30	07	1 00	0.48
12	1 83	2	73	40	1.83	6 64	0.91
16	29	2	11.6	40	2.9	14.30	1.23
20	3.1	2	12.4	4.0	3.1	15.98	1.29
24	3 32	2	13 3	4.0	3.32	17 91	1 35
28	3.32	2	13.3	40	3 32	17.91	1 35
32	3.38	2	13.5	40	3 38	18.45	1.36
36	3 37	2	13.5	4.0	3.37	18.36	1.36
40	2.93	2	117	4.0	2.93	14 54	1 24
44	2.88	2	11.5	40	2.88	14 13	1 23
48	2.68	2	10.7	40	2 68	12.54	1.17
52	2.7	2	10.8	4.0	2.7	12.69	1.18
56	2 7 8	2	12.5	4.5	2.78	14 99	1 20
61	0	2	0.0	2.5	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			144.25			179.45	1.2
		Deita	value calcu	ations			1
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Ini	Delta
30%	25.0	24.00	28.00	1.35	1.35	1 35	0.92
40%	30.0	28.00	32.00	1 35	1.36	1.36	0.92
50%	35.0	32.00	36.00	1 36	1 36	1.36	0.91
60%	40.0	40.00	44.00	1.24	1.23	1 2 4	1.00
70%	45.0	44.00	48 00	1.23	1.17	1 2 1	1.03

			Me	asured da	ta			
STA	TION No. :	V1H057			STA	RT TIME :	08h20	
RIVE	R NAME :	Tugela		Averag	e Gaugepl	ate reading :	5.73	m
PLAC	ENAME :	Spiaenkap d	am					
	DATE	1/28/81						
					Main Cha	nnel LEFT :	10	
				I	Main Chan	nel RIGHT :	60	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity		Velocity	V aver	Area	0
	ernan ege				1 closely		(m <sup>2</sup> )	/m <sup>3</sup> /e)
numper		or effective	0.2d	U.4d	0.80	(m/s)	400 4	465 74
4	6	depth		0		1.034	160.4	165./4
2	0	0.62		0.054		0.000	1.9	0.00
3	12	2.2		0.26		0 260	88	2 29
4	16	3,3		0.819		0.819	13.2	10.81
5	20	3.55		1,141		1.141	14.2	16.20
6	24	3.7		1.158		1.158	14.8	17.14
7	28	3.62		1.362		1.362	14.5	19.72
8	32	3.55		1.294		1.294	14.2	18.37
9	36	3.8		1.319		1.319	15,2	20.05
10	40	3.65		1.413		1.413	14.6	20.63
11	44	3.2		1.2		1.200	12.8	15,36
12	48	2.66		0.96		0.980	11.5	0.93
13	56	282		0.019		0.311	12.0	3.00
15	61	2.02		0.511		0.000	00	0.00
16				Ŭ		0 000	0.0	0.00
17						0.000	0.0	0.00
						1.034	160.4	165.74
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lawer	V-Upper	V-Int	Delta
	30%	25.0	24.00	28.00	1,16	1.36	1.21	0.85
	40%	30.0	28.00	32.00	1.36	1.29	1.33	0.78
	50%	35.0	32.00	36.00	1.29	1.32	1,31	0.79
	70%	40.0	40.00	44.00	1.41	1.20	1.41	0.73
	1076	40.0	44.00	40,00	1.20	0.90	1.12	0.90

Calculated data, 1-dimensional flow theory											
Aanning	or Chezy	<i>l</i> :	М			Q =	196.8				
		Slope	0.0004			V <sub>AVR</sub> =	1.23				
oughness	coeff.		Area reduc	tion factor	1						
Sub	n		Sub	f <sub>A</sub>							
0			0	1							
,	0.036			1							
0	0.000		0	1							
Chanane	Vertical	Sup	Area	Wetted P	H-Radius	Q	v				
				-	•	(m <sup>3</sup> /s)	V Andreaster				
	or enective	Section	A	t	R	(1) 137	Velocity				
6	0	2	0.0	4.0	0 D	0.00	0.00				
8	0.62	2	1.9	3.0	0.62	0.75	0.40				
12	2.2	2	8.8	40	2.2	8 27	0.94				
16	33	2	13 2	4.0	33	16.25	1.23				
20	3 55	2	14.2	4.0	3.55	18.36	1 2 9				
24	3.7	2	14.8	4.0	3.7	19 67	1.33				
28	3.62	2	145	4.0	3 62	18.97	1 31				
32	3 55	2	14.2	40	3.55	18 36	1.29				
36	38	2	15.2	4.0	3.8	20.56	1.35				
40	3.65	2	14.6	4.0	3.65	19,23	1 32				
44	3.2	2	12.8	40	3.2	15 44	1.21				
48	2.88	2	11 5	4.0	2 88	12.96	1 12				
52	3	2	12.0	40	3	13.87	1.16				
56	2.82	2	12.7	4.5	2.82	14 07	1.11				
61	0	2	0.0	2.5	0	0.00	0 00				
	0	2	0.0	00	0	0 00	0.00				
	0	2	0.0	0.0	0	0.00	0.00				
			160.35			196.76	1.2				
		Delta	value calcu	lations			]				
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Deita				
30%	25.0	24.00	28.00	1.33	1 31	1.32	0.93				
40%	30.0	28 00	32.00	1 31	1.29	1 30	0.94				
50%	35.0	32.00	36.00	1.29	1 35	1.34	0.92				
60%	40.0	40.00	44 00	1.32	1 21	1.32	0.93				
70%	45.0	44 00	48.00	1 2 1	1.12	1 19	1.03				

	E. 1. 3		Me	asured da	ta			
STA	TION No. :	V1H057			STA	RT TIME	09h00	
RIVE	R NAME	Tugela Spicenkon di	m	Average	e Gaugepla	ate reading :	3.88	m
	DATE :	2/4/81	4111		M-1- 01-			
					Main Cha	nneilefi:	10	
				Α	Aain Chan	nel RIGHT :	60	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velacity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth			0.00	1.344	178.1	239.42
1	4	0		0		0.000	0.0	0.00
2	8	1.4		0.188		0.188	5.6	1.05
3	12	2.64		0.957		0.957	10. <b>6</b>	10.11
4	16	3.48		1.252		1.252	13.9	17.43
5	20	3.77		1.468		1.468	15.1	22.14
6	24	3.89		1.511		1.511	15.6	23.51
7	28	3.95		1.762		1.762	15.8	27.84
8	32	4.02		1.649		1.649	16.1	26.52
9	36	3.94		1.589		1.589	15.8	25.04
10	40	3.45		1.779		1.779	13.8	24.55
11	44	3.45		1.468		1.468	13.8	20.26
12	48	3.22		1.416		1.416	12.9	18.24
13	52	3.28		1.044		1.044	13.1	13.70
14	50	3.4		0.56		0.360	10.2	9.04
15	01.0	U				0.000	0.0	0.00
17						0.000	0.0	0.00
				1		1.344	178.1	239.42
1				- 14 1	-1 -1 -1			
	% Midth	Act Chn	Chilowor		alculation	S	V/ lot	Delta
	30%	25.0	24.00	28.00	1.51	1.76	1.67	0.85
	40%	30.0	24.00	32.00	1.21	1.65	171	0.00
	50%	35.0	32.00	36.00	1.65	1 50	1.60	0.84
	60%	40.0	40.00	44.00	1.78	1.47	178	0.76
	70%	45.0	44.00	48.00	1.47	1.42	1 46	0.92

Calculated data, 1-dimensional flow theory											
Aanning	or Chezy		M			Q =	278.3				
		Slope	0.0007			V <sub>AVR</sub> =	1.56				
oughness	coeff		Area reduc	tion factor	1						
Sub	n		Sub	fa							
0											
U			U	I							
2	0.039		2	1							
0			0	1							
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V				
	ot effective	Section	A	P	R	(m³/s)	Velocity				
	rienfh						l ,				
4	G.	2	6.0	40	0	0.00	0.00				
8	1.4	2	56	4.0	1.4	475	0.85				
12	2.64	2	10.6	40	2.64	13.68	1 30				
16	3.48	2	13.9	40	3 48	21.69	1.56				
20	3 77	2	15.1	4.0	3.77	24.78	1.64				
24	3.89	2	15.6	4.0	3.89	26 11	1 68				
28	3.95	2	15.8	40	3.95	26.78	1 70				
32	4.02	2	16.1	40	4 02	27.58	1.72				
36	3 94	2	15.8	4.0	3.94	26.67	1.69				
40	3 45	2	13.8	4.0	3.45	21 38	1.55				
44	3.45	2	13.8	40	3.45	21.38	1.55				
48	3.22	2	12.9	40	3.22	19.05	1.48				
52	3.28	2	13.1	4.0	3.28	19.65	1.50				
56	3.4	2	16.2	4.8	3.4	24 77	1.53				
61.5	Ö	2	0.0	28	Q	0.00	0.00				
	0	2	0.0	00	0	0.00	0.00				
	U	2	0.0	0.0	0	0.00	0.00				
			1/8.11			2/8.2/	1.5				
		Deita	value calcu	lations			1				
% Width	Act Chn	Lower	Linner	V-lower	V-Upper	V-Int	Deita				
30%	25.0	24.00	28.00	1.84	1 70	1.68	0.93				
40%	30.0	28.00	32.00	1 70	1 7 2	121	0.92				
50%	35.0	32.00	36.00	172	1 69	1.70	0.92				
60%	40.0	40.00	44.00	1.55	1.55	1 55	1.01				
70%	45.0	44.00	48.00	1.55	1.48	1 53	1.02				

			Me	asured da	ta			
STA	TION No. :	V1H057			STA	RT TIME :	14h45	
RIVE PLAC	R NAME :	Tugela Spioenkop di	am	Average	e Gaugepla	ate reading :	4.22	m
	DATE .	213101			Main Cha	nnel I FFT ·	10	
				N	Asin Chan		60	
						lernon.	<b>~</b>	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.24	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth	0.24		0.00	1.501	204.7	307.28
1	0	0		0		0.000	0.0	0.00
2	4	0.8		0.184		0.184	3.2	0.59
3	8	1.73		0.551		0.551	6.9	3.81
4	12	2.89		1.098		1.098	11.6	12.69
5	16	3.74		1.286		1.286	15.0	19.24
6	20	4.1		1.606		1.606	16.4	26.34
7	24	4.15		1.701		1.701	16. <b>6</b>	28.24
8	28	4.38		1.866		1.866	17.5	32.69
9	32	4.36		2.004		2.004	17.4	34.95
10	36	4.33		1.857		1.857	17.3	32.16
11	40	3.95		2.013		2.013	15.8	31.81
12	44	3.82		1.831		1.831	15.3	27.98
13	48	3.69		1.693		1.693	14.8	24.99
14	52	3.75		1.286		1.286	15.0	19.29
15	56	3.83		0.611		0.611	15.3	9.36
16	60	1.66		0.4/3		0.473	6,6	3,14
	04	0				0.000	2047	0.00
						1.001	204.7	1 307.20
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	25.0	24.00	28 00	1.70	1.87	1.74	0.86
	40%	30.0	28.00	32.00	1.87	2.00	1.94	0.78
	50%	35.0	32.00	36.00	2.00	1.86	1.89	0.79
	60%	40.0	40.00	44.00	2.01	1.83	2.01	0.75
	70%	45.0	44.00	48.00	1.83	1.69	1.80	0.84

Calculated data, 1-dimensional flow theory											
Manning	or Chezy		M			Q =	354.3				
		Slope	0.00075			V <sub>AVR</sub> =	1.73				
Roughness	coeff		Area reduc	lion factor	1						
Sub	n		Sub	f <sub>A</sub>							
0			0	1	1						
2	0.038			1							
	0.000										
U											
Chanage	Vertical	Sub	Area	Wetted P	H-Radius	ų	v				
	or effective	Section	A	P	R	(m*/s)	Velocity				
n	depth A	2	0.0	0.0	n	0.00	0.00				
4	0.8	2	32	4.0	0.8	199	0.62				
8	1.73	2	6.9	40	173	7 19	1.04				
12	2.89	2	11.6	4.0	2.89	16.90	1.46				
16	374	2	15.0	4.0	3.74	25 <del>9</del> 8	1.74				
20	4.1	2	16.4	4.0	4.1	30 28	1 85				
24	4.15	2	16.6	40	4 15	30.89	1 86				
28	4.38	2	17.5	40	4 38	33.80	1.93				
32	4 36	2	1/4	4.0	4.36	33.54	1.92				
36	4 33	2	1/ 3	4.0	4.33	33 10	191				
40	3.50	2	10.0	40	3.83	20 40	1.76				
48	20.0	2	14 8	40	3.69	25.40	172				
52	375	2	150	4.0	3.75	26 09	174				
56	3.83	2	15.3	40	3.83	27.03	1 76				
60	1.66	2	6.6	40	1.66	6.71	1 01				
64	0	2	0.0	2.0	0	0 00	0.00				
			204.72			354.33	1.7				
		Deita	value calcu	lations			1				
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-Int	Delta				
30%	25.0	24 00	28.00	1.86	1.93	1 88	0.92				
40%	30.0	28.00	32.00	1 93	1.92	1.93	0.90				
50%	35.0	32.00	36.00	1 92	1.91	1.92	0.90				
60%	40.0	40.00	44.00	1.80	1.76	1 80	0.96				
70%	45.0	44 00	48.00	1.76	172	1/5	0.89				

<u>▲</u> 30%

× 40%

-0-60%

-70%





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The values in the legend block describe measured discharge for the profile indicated

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Measured data								Calc	ulated o	lata, 1-din	nensiona	I flow the	eory			
STA	TION No. :	V6H002			STAI	RT TIME :	9h40		Manning	or Chez	Y:	M			Q #	90.9
RIVE	R NAME	Tugela		Averag	e Gaugeola	ate reading :	0 745	m			Sinne	0.002			V =	1 16
PLAC	E NAME	Tugela Ferry				<b>y</b> .	••••					CIGGE			~~~	
	DATE :	12/2/93							Roughness	coeff		Area raduct	ion factor			
					Main Cha	nnel I FFT	15		Sub			Sub	f.			
					Main Chan	nel RIGHT :	105		U			U U	1			
	-	•		-	•				2	0.035		2	1			
	4	3	4	Ð	6	/	8	9	0			0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
number		or effective	0.24	0.4d	0.8d	(m/s)	(m²)	(m³/s)		or effective	Section	A	P	R	(m <sup>3</sup> /s)	Velocity
		depth				1.121	78.5	88.04		depth						
1	6	0		0		0.000	0.0	0.00	6	0	2	0.0	4.0	0	0.00	0.00
2	8	0.45		0.5103		0.510	1.4	0.69	8	0.45	2	1.4	3.0	0.45	1.01	0.75
3	12	0.85		1.1895		1.190	3.4	4.04	12	0.85	2	3.4	40	0.85	3.90	1.15
4	16	0.64		1.3736		1.374	2.6	3.52	16	0.64	2	2.6	40	0.64	2.43	0.95
5	20	0.56		1.3081		1.308	2.2	2.93	20	0.56	2	2.2	40	0.56	1.94	0.87
6	24	0.59		1.2591		1.259	2.4	2.97	24	0.59	2	2.4	4.0	0.59	2.12	0.90
7	28	0.55		1.0217		1.022	2.2	2.25	28	0.55	2	22	4.0	0.55	1 89	0.86
8	32	0,56		1,0913		1.091	2.2	2.44	32	U.56	4	44	4.0	0.00	1 94	0.87
9	30	0.56		1,0749		1.075	2.2	2.41	36	0.06	2	2.4	4.0	0.06	1.94	0.67
10	40	0.55		1.1000		1,157	2.2	2.54	40	0.55	2	24	40	0.00	1.09	08.0
12	48	0.00		1 124		1.275	2.5	2.30	44	0.00	2	2.0	40	0.00	3.18	0.05
13	52	0.67		1 2263		1 226	27	3.29	52	0.67	5	2.3	40	0.67	2.82	0.68
14	56	0.7		1 1568		1 157	28	3 24	56	0.7	2	2.8	4.0	0.7	2.82	1.01
15	60	0.78		1,2263		1.226	31	3.83	60	0.78	2	31	4.0	0.78	3.38	1 08
16	64	0.84		1.124		1.124	3.4	3.78	64	0.84	2	3.4	4.0	0.84	3 82	1 14
17	68	0.94		1.0381		1.038	3.8	3.90	68	0.94	2	3.8	4.0	0.94	4 61	1 29
18	72	0.98		1.2754		1.275	3.9	5.00	72	0.98	2	3.9	4.0	0.98	4.94	1.28
19	76	1.06		1.124		1.124	4.2	4.77	76	1.06	2	4.2	40	1.06	5.63	1.33
20	80	1.03		1.2591		1.259	4.1	5.19	80	1.03	2	4.1	40	1.03	5.37	1.30
21	84	1.08		1.1404		1.140	4.3	4.93	84	1.08	2	4.3	40	1.08	5.81	1.36
22	88	1.1		1.1731		1.173	4.4	5.16	88	1.1	2	4.4	4.0	11	5.90	1.36
23	92	1.2		1.1036		1.104	4.8	5.30	92	1.2	2	4.8	4.0	1.2	6 93	1 44
24	96	1,28		0.989		0.989	5.1	5.06	96	1.28	2	5.1	4.0	1.28	7 71	1.51
25	100	1.1		0.854		0.854	4.4	3.76	100	1.1	2	44	4.0	11	5 99	3.36
26	104	0,66		0.7067		0.707	2.0	1.40	104	Q.00	4	20	3.0	00.U	1.94	6.05
21	106	U		U		0.000	0.0	0.00	106	0	2	00	0.0	20	0.00	0.00
20						0.000	0.0	0.00		0	5	0.0	0.0	c C	0.00	0.00
23						1 121	78.5	88 04		v,	-	78.53		-	90.86	1.16
						L										
			٦	elta value c	alculation	S						Delta value (	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act. Chn	Lawer	Upper	V-lower	V-Upper	V-Int	Delta
	30%	42.0	40.00	44.00	1.16	1.28	1.22	0.92	30%	42.0	40.00	44.00	0.86	0.69	0.87	1.32
	40%	51.0	48.00	52.00	1.12	1.23	1.20	0.93	40%	51.0	46.00	52.00	0.91	0.98	0.96	1.20
	50%	60.0	60.00	64 00	1.23	1.12	1.23	0.91	50%	60.0	60 00	64.00	1.08	1.14	1 08	1.07
	60%	69.0	68.00	72 00	1.04	1.28	1.10	1.02	60%	69.0	68 00	72.00	1.23	1.26	1 23	0.94
	70%	78.0	76.00	80.00	1.12	1.26	1.19	0.94	70%	78.0	76.00	80.00	1 33	1 30	1.32	0.88

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	Measured data								Calculated data, 1-dimensional flow theory							
STA	TION No. :	V6H002			STA	RT TIME	11h20		Manning	or Chezy	r	М			Q #	231.7
RIVE	R NAME :	Tugela		Averag	e Gaugepla	ate reading :	173	m			Signe	0.0008			V <sub>AVR</sub> =	1.25
PLAC	E NAME :	Tugela Ferry											,			
	DATE :	1/4/94							Roughness	coeff		Area reduc	tion factor	1		
					Main Cha	nnel LEFT :	15		Sub	,		Sub	fa			
					Main Chan	nel RIGHT ·	105		G			Q	1	1		
									2	0.034		,	1			
1	2	3	4	5	6	7	8	9	ō			Ō	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver	Area	0	Chainara	Vartusat	C. Ja	Area	Avertoe D	Ho Paduto.	0	I V
a limbar							(m <sup>2</sup> )	(m <sup>3</sup> /s)	- conditioning d	veneca.	GCD	maa	A & Classica J		len <sup>3</sup> le)	L
numper			0.2a	U.4d	0.8đ	(m/s)	404.0	((1) / \$)		or effective	Section	A	P	H	011 121	Velocity
4	1 9	depin N		0		1.109	184.0	204.69	1.0	depth		0.0				
,	25	0.28		0 383		0.000	0.0	0.00	1.9	0 80 0	2	0.0	1.5	0 00	0.00	0.56
3	6.5	0.56		0.924		0.924	22	2 07	65	0.20	5	22	40	0.20	4.27	0.57
4	10.5	1.78		1.267		1.267	7.1	9.02	10.5	1.78	2	71	40	1.78	8.70	1 22
5	14.5	1.88		1.181		1.181	7.5	8.88	14.5	1.88	2	7.5	40	1.88	9.53	1.27
6	18.5	1.98		1.267		1.267	7.9	10.03	18.5	1.98	2	7.9	4.0	1 98	10.39	1.31
7	22.5	1.78		1,136		1.136	7.1	8.09	22.5	1 78	2	7.1	4.0	1 78	<b>B</b> 70	1.22
8	26.5	1.66		1.071		1.071	6.6	7,11	26.5	1.66	2	6.6	4.0	1.66	774	1.17
9	30.5	1,65		1.099		1.099	6.6 F 0	7.25	30.5	1.65	2	6.6	4.0	1.65	7 67	1 18
10	38.5	1,40		1.014		1.014	5.9	6.00	34.5	1.48	2	5.9	4.0	1.48	6.40	1.08
12	42.5	1.01		1.05		1.050	6.4 6.4	6.79	42.5	1.91	2	64	40	1.01	1.20 7.51	1.14
13	46.5	1.59		1.067		1.067	6.4	6.79	46.5	1.59	2	6.4	40	1.59	7.21	1 13
14	50.5	1.7		1.034		1.034	6.8	7.03	50.5	1.7	2	6.8	4.0	1.7	6.06	1.18
15	54.5	1.9		0.846		0.846	7.6	6.43	54.5	19	2	7.6	4.0	19	9 70	1.28
16	58.5	1,65		1.026		1.026	6.6	6,77	58.5	1.65	2	6.6	4.0	1.65	7 67	1 16
17	62.5	1.87		1.173		1.173	7.5	8.77	62.5	1.87	2	7.5	4.0	1.87	9 44	1.28
18	66.5	2.1		0.944		0.944	8.4	7.93	66.5	21	2	8.4	4.0	2.1	11.48	1 36
19	70.5	1.8		1.005		1.005	7.2	7.24	70.5	1.8	2	7.2	40	1.8	8.85	1 23
20	79.E	2.03		1.189		1,189	8.1	9,65	/4.5 79 E	4.03	2	81	40	4.03	10.85	1.33
21	82.5	2.34		1 406		1.124	5.4 8 1	11.32	82.5	2.34	2	9.4	40	2.34	15.83	4 3 3
23	86.5	2.03		1 304		1 304	9.0	11.68	86.5	2 24	2	90	40	2 24	12.76	1.42
24	90.5	2.02		1,447		1.447	8.1	11.69	90.5	2.02	2	8.1	4.0	2.02	1074	1.33
25	94,5	2.5		1,157		1.157	10.0	11.57	94,5	2.5	2	10.0	4.0	2.5	15.32	1.52
26	98.5	1,9		1.067		1.067	7.6	8.11	98.5	1.9	2	7.6	4.0	19	<b>9</b> 70	1.28
27	102.5	1.75		0.924		0.924	7.0	6.47	102.5	1.75	2	7.0	4.0	1 75	8 48	1.21
28	106.5	0.8		0,149		0.149	2.4	0.36	106.5	0.8	2	2.4	3.0	0.8	1.72	0.72
29	108.5	0		0.000		0.000	0,0	0.00	108.5	0	2	0.0	1.0	0	0.00	0.00
						1.109	184.6	204.69				184.60			234.67	12
				elita value e	alculation	•						Delta unitue	calculation	16		
	% Width	Act. Chn	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	% Width	Act. Chn	Lower	Upper	Viower	V-Qoger	V-Int	Delta
	30%	42.0	38.50	42.50	1.05	1.07	1.06	1.04	30%	42.0	38.50	42.50	1 14	1 13	1.13	1.11
	40%	51.0	50.50	54.60	1.03	0.85	1.01	1.10	40%	51.0	50.60	54.60	1 15	1 28	1 20	1.05
	50%	60,0	58.50	62.50	1.03	1.17	1.08	1.03	50%	60.0	58.50	\$2.50	1.18	1 28	1 20	1.05
	60%	69.0	66.50	70.50	0,94	1.01	0.98	1.13	60%	69.0	66 50	70.50	1.36	1 23	1 28	0.98
	70%	78.0	74.50	78.50	1.19	1.12	1.13	0.98	70%	78.0	74.50	76.50	1 33	1.47	1.45	0 87

Measured data										
STA	TION No. :	V6H002			STA	RT TIME :	12h35		M	
RIVE	R NAME :	Tudela		Average	e Gaudebl	ate reading *	1 842	m		
PLAC		Tudela Ferry		, nong	. daagepi	ne rouging .	114114			
	DATE	3/16/94							100	
					Main Cha		46			
						nnei left .	13			
				1	Main Chan	nel RIGHT :	105			
1	2	3	4	5	6	7	8	9		
Vertical	Chainada	Vertical	Valocity	Veloribi	Volación	V avor	Area	0		
	Chanage	• citibat	velocity	veldený	reiocity	•		<b>4</b>		
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m)	(m /s)		
		depth				1.053	217.0	228.56		
1	2.5	0		0		0.000	0.0	0.00		
2	3.5	0.87		0.252		0.252	1.7	0.44		
3	6.5	1.63		0.842		0.842	5.7	4.80		
4 E	10.5	2.30		1.15/		1.157	9.4	10.92		
Э С	14,0	2.30		1.079		1.079	9.5	10.27		
0 7	10.0	2.07		1,181		1.181	8.3	9.78		
, 8	22.5	1.9		1.100		1,100	7.0	0.42		
a	20.5	1,90		1.003		1.065	7,9 7 A	0.42		
10	34.5	2 25		0.085		0.085	1.4 0.0	7.55		
11	38.5	2 38		1 104		1 104	9.0	10.51		
12	42.5	1 72		1 054		1.054	60	7 25		
13	46 5	1.85		1 21		1.004	74	8.95		
14	50.5	2 03		1 112		1 1 1 1 2	81	9.00		
15	54.5	2 25		1 181		1 181	9.0	10.63		
16	58.5	1.81		1 239		1 239	72	8.97		
17	62.5	2.32		1 063		1.063	9.3	9.86		
18	66.5	2.38		0.899		0.899	9.5	8.56		
19	70.5	2.3		1.165		1.165	9.2	10.72		
20	74.5	2.04		1.206		1.206	8.2	9.84		
21	78.5	2.14		1.144		1.144	8.6	9,79		
22	82.5	1.87		1.116		1.116	7.5	8.35		
23	86.5	2.32		1.042		1.042	9.3	9.67		
24	90.5	2.45		1.108		1.108	9.8	10.86		
25	94.5	2.38		1.14		1.140	9.5	10.85		
26	98.5	2.23		0.809		0.809	8,9	7.22		
27	102.5	2.2		0.87		0.870	8,8	7.66		
28	106.5	1.21		0.104		0.104	3.8	0.39		
29	108.7	0		0.000		0.000	0.0	0.00		
						1.053	217.0	228.56		
1			n	elta value o	alculation	¢				
	% Width	Act. Chn. I	Ch-Lower	Ch-Upper	V-lower	V-Upper	¥-Int	Delta		
	30%	42.0	38.50	42.50	1,10	1,05	1.06	0.99		
	40%	51.0	50.50	54.50	1,11	1.18	1.12	0.94		
	50%	60.0	58.50	62.50	1.24	1.06	1,17	0.90		
	60%	69.0	66.5D	70.50	0.90	1 17	1.07	0.99		
	70%	78.0	74.50	78.50	1.21	1.14	1.15	0.91		

Calculated data, 1-dimensional flow theory												
Manning or Chezy: M Q =	242.6											
Siene 0.0005	1 12											
-AVR												
Reprinting coaff Arms reduction factor												
Sab a Sub I												
2 0.033 2 1												
0 0 1												
Chainage Vertical Sub Area Wetted P H-Radius Q	V											
and the second s	Valantes											
	velocity											
35 087 2 17 20 087 102	n.63											
65 163 2 57 35 163 536	0.64											
10.5 2.36 2 9.4 4.0 2.36 11.34	1.20											
14.5 2.38 2 9.5 4.0 2.38 11.50	1.21											
18.5 2.07 2 8.3 4.0 2.07 9.11	1.10											
22.5 1.9 2 7.6 4.0 1.9 7.90	1 04											
26.5 1.98 2 7.9 4.0 1.98 8.45	107											
30.5 1.85 2 7.4 4.0 1.85 7.56	1.02											
34.5 2.25 2 9.0 4.0 2.25 10.47	1 16											
38.5 2.38 2 9.5 4.0 2.38 11.60	1.21											
42.5 1.72 2 6.9 4.0 1.72 6.6e	0.97											
46.5 1.85 2 7.4 4.0 1.85 7.96	1.02											
50.5 2.03 2 8.1 4.0 2.03 8.82	1.09											
54.5 <u>2.25</u> 2 9.0 40 2.25 10.47	1.18											
20.5 1.01 2 2 2 2 101 2 2 2 2 2 2 2 2 2 2 2 2 2	+ 40											
C 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	+ 54											
705 23 2 82 40 23 40 80	1 16											
745 204 2 82 40 204 889	1.09											
78.5 2.14 2 8.6 4.0 2.14 9.63	1.13											
82.5 1.87 2 7.5 4.0 1.87 7.69	1.03											
86.5 2.32 2 9.3 4.0 2.32 11.02	1 19											
90.5 2.45 2 9.8 4.0 2.45 12.07	1 23											
94.5 2.38 2 9.5 4.0 2.38 11.50	1 21											
98.5 2.23 2 8.9 4.0 2.23 10.32	1 16											
102.5 2.2 2 8.8 40 2.2 10.09	1 15											
106.5 1.21 2 3.8 3.1 1.21 2.89	0.77											
108.7 0 2 0.0 1.1 0 0.00	0.00											
217.04 242.57	1.12											
Della volue estadationa												
Vena vane carcustons	Detta											
	1 12											
40% 810 5050 5450 120 130 100	1 02											
50% 50.0 50.50 62.50 1.01 1.19 1.07	1 04											
60% 69.0 96.50 70.50 1.21 1.18 1.19	0.94											
70% 78.0 74.50 78.50 1.09 1.13 1.12	1.00											

	Measured data							Calculated data, 1-dimensional flow theory								
STA	TION No. :	V6H002			STA	RT TIME :	10h00		Manninc	or Chez	Y:	M			Q =	436.5
RIVE	R NAME :	Tugela		Averag	e Gaugepl	ate reading :	2.455	m			Sione	0.001			V <sub>AVR</sub> =	1.64
PLAC	E NAME :	Tugela Ferry				-									L	
	DATE :	2/6/94							Roughness	coeff		Area reduct	ion factor			
					Main Cha	nnel LEFT :	15		Sub	n		Sub	fA			
					Main Chan	nel RIGHT	105		O			0	1			
									2	0.036		2	1			
1	2	3	4	5	6	7	8	9	o			0	1			
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q	Chavaane	Vettical	Sub		Watted P	H-Parting	0	v
number		or offective	5 0 <del>1</del>			(male)	(m <sup>2</sup> )	$(m^{3}/s)$							(m <sup>3</sup> /s)	
(GFFIQE)		denth	0.20	U.40	0.60	(11/5)	365 E	ADE 30		or enective	Section	· · · ·	đ.	ĸ		velocuty
1	1	0		0		0.000	0.0	420.09	1	alepsis ()	2	0.0	1.0	n	0.00	0.00
2	2	1.18		0.974		0.974	3.0	2.87	2	1.18	2	30	2.5	1.18	2.89	0.98
3	6	2		1.457		1.457	8.0	11.66	6	2	2	8.0	4.0	2	11.16	1 39
4	10	2.41		1.64		1.640	9.6	15.81	10	2.41	2	9.6	40	2.41	15.22	1.66
5	14	2.89		1.714		1.714	11.6	19.81	14	2.89	2	11.6	4.0	2.89	20.60	1.78
6	18	3.01		1.876		1.876	12.0	22,59	18	3 01	2	12.0	4.0	3 01	22.05	1.83
7	22	2.52		1.915		1.915	10.1	19,30	22	2.52	2	10.1	4.0	2 52	16.40	1.83
8	26	2.76		1.871		1.871	11.0	20.66	26	2.76	2	11.0	4.0	2.76	19.08	173
9	30	2.77		1.771		1.771	11.1	19.62	30	2.77	2	11 1	4.0	2.77	19-20	173
10	34	2.72		1.749		1.749	10.9	19.03	34	2.72	2	10.9	4.0	2.72	18.62	1 71
13	0C Ch	2.69		1.906		1.906	10.5	20.51	38	2.69	2	10.8	40	2.69	18.28	170
12	48	2.07		1.701		1.701	10.7	16.17	42	2.67	2	10.7	40	2.67	10.00	1.09
14	50	2.50		1.023		1.525	10.3	17.58	40	2.00	4	10.3	40 70	2.50	18:00	1.05
15	54	2 48		1 662		1 662	9.9	16.49	54	2 48	2	9.0	40	2 48	16 07	1 81
16	58	2.58		1.54		1 540	10.3	15.89	58	2.58	2	10.3	4.0	2.58	17.05	1.86
17	62	2.02		1.767		1.767	8.1	14.28	62	2.02	2	81	4.0	2.02	11 34	1 40
18	66	1.85		1.915		1,915	7.4	14.17	66	1,85	2	74	4.0	1,85	9.80	1 32
19	70	1.97		1.945		1.945	7.9	15.33	70	1,97	2	79	40	1,97	10.88	1 38
20	74	2.12		1.88		1.880	8.5	15.94	74	2.12	2	8.5	4.0	2.12	12.29	1.45
21	78	2.1		1.85		1.850	8.4	15.54	78	21	2	8.4	4.0	21	12.10	1,44
22	82	2.12		1.775		1.775	8.5	15.05	82	2 12	2	8.5	4.0	2 12	12.29	1.45
23	86	2.7		1,658		1.658	10.8	17,91	86	27	2	10.6	4.0	2/	18.39	1.70
24	90	3.5		1.083		1.083	14.0	15,16	90	33	4	14.0	40	3.3	28.35	2.02
20	94	3.17		1,357		1.357	14.1	17.21	94	217	2	14.7	4.0	5 44	24.04	1.90
20	102	2.00		1.300		1.300	10.4	11.85	102	2.00	2	10.4	4.0	2.00	17 16	1.66
27	102	1 99		0.324		0.324	8.0	2.58	102	4 99	2	80	40	1 99	11:06	1 39
29	110	0		0.000		0.000	0.0	0.00	110	0	2	00	2.0	Ö	0.00	0.00
				1		1.606	265.5	426.39				265.51			436.52	1.64
	AV 180 104 1		1	Delta value c	alculation	S						Delta value	calculation	5		C. Delte
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta	74 Width	ACL CHA	Lower	UCD61	VHOWEI	V-Upper	vsint	Diena
	30%	42.0 E4.0	42.00	46.00	1.70	1.52	1.70	0,94	\$U%	42.U	42.00	40.00	1.09	1.60	1 4 4	1 00
	40% 50%	60.0	50.00	54.00	1.71	1.00	1 /0	0.95	#0%	60.0	58.00	62.00	1 66	1 40	1 69	1.08
	60%	69.0	56.00 66.00	70.00	1.04	105	1.05	0.83	80%	69.0	66.00	70.00	1.32	1.28	1 37	1.20
	70%	78.0	78.00	82.00	1 85	1.78	1.85	0.87	70%	78.0	78.00	82.00	1 44	1.45	1.44	1.14

			Me	asured da	ta						
STA	TION No. :	V6H002			STAF	RT TIME :	12h30				
RIVE PLAC	R NAME : E NAME : DATE :	Tugela Tugela Ferry 2/6/94		Average Gaugeplate reading : 2.555 m							
					Main Cha		15				
				I	Main Chan	nel RIGHT :	105				
1	2	3	4	5	6	7	8	9			
Vertical	Chainade	Vertical	Valacity	Velocitu	Malaaibu	Vavor	Area	<u> </u>			
rendeat	Charlinge	<b>Ferrica</b>	velocity	Vesucity	velocity	v avei.	Alca	<b>4</b> 3			
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>-</sup> )	(m~/s)			
		depth				1.648	301.9	497.47			
1	0	0		Ō		0.000	0.0	0.00			
2	1	1.33		1.104		1.104	3,3	3.67			
3	5	2.22		1.518		1.518	10.0	15.16			
4	10	3.07		1.693		1.693	15.4	25.99			
5	15	2.71		1.906		1.906	13.6	25.83			
6	20	2.31		2.02		2.020	11.6	23.33			
/	25	2.62		1.767		1.767	13.1	23.15			
8	30	2.71		1,854		1.854	13.6	25,12			
9	35	2.8		2.015		2.015	14.0	28.21			
10	40	2.84		1.775		1.775	14.2	25.21			
11	45	2.61		1.793		1.793	13.1	23.40			
12	50	2.94		1.732		1.732	14.7	25.46			
13	55	2.8		1.728		1.728	14.0	24.19			
14	60	2.92		1.736		1.736	14.6	25.35			
15	65	2.99		1.627		1.627	15.0	24.32			
16	70	2.59		1,51		1.510	13.0	19,55			
17	75	3.22		1.667		1.667	16.1	26.84			
18	80	3.06		1.379		1.379	15.3	21.10			
19	85	2.95		1.47		1.470	14.8	21.68			
20	90	2.92		1.719		1.719	14.6	25.10			
21	95	3.09		1.575		1.575	15.5	24.33			
22	100	2.92		1.457		1.457	14.6	21.27			
23	105	2.62		1.292		1.292	13.1	16,93			
24	110	1.28		0.446		0.446	5.1	2.26			
25	113	U		0		0.000	0.0	0.00			
26						0.000	0.0	0,00			
27						0.000	0.0	0.00			
28						0.000	0.0	0.00			
29						0.000	0.0	0.00			
						1,648	301.9	497.47			
	AV. 1845 147		C	lelta value c	alculation	s					
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta			
	30%	42.0	40.00	45.00	1.78	1.79	1.78	0.92			
	40%	51.0	50.00	55.00	1.73	1 73	1.73	0,95			

65.00

70.00

80.00

60.00

65.00

75.00

60.0

69.0

78.0

50%

60%

70%

1.74

1.63

1.67

1.63

1.51

1,38

1.74

1.53

1.49

0,95

1.07

1.10

50%

60%

70%

60.0

69.0

78.0

57.60

65.80

77 60

61.60

69.60

B1 60

	Calc	ulated d	ata, 1-din	nensiona	al flow the	eory	
Manning	or Chezy	r:	M			Q =	497.1
	l	Siope	0.0009			V <sub>AVR</sub> #	1.65
Roughness	coeff.		Area reduct	ion factor	1		
Sub	n		Sub	6			
0				•			
4	0.035			1			
0			0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective	Section	A	Þ	R	(m²/s)	Velocity
	depth	-					
45	0	2	0.0	0.0	0	0.00	000
49.6	1.33	2	33	2.5	1.53	3 33	101
53.0	4.44	2	100	4.0	4.44	14 77	142
0.10	3.07	4	13.4	0.0	3.07	27.02	176
01.0	2.71	2	13.0	5.0	2.71	21.85	1.62
0.00	2 31	2	11.0	50	2 31	18,82	1,46
73.6	4.02	2	13.1	50 # 0	4 02	24,75	1.56
73.0	4 / I	2	13.0	50	2.11	21.90	1.62
91 G	2.0	2	14.0	50	2.0	20.10	1.00
01.0	2.04	2	14.2	0.U E 0	2.04	2073	1.07
00.0	2.01	2	131	2.9	2.01	30.05 20.05	1.20
09.0	2.54	2	147	5.0	2.54	2014	
93.0 07.6	2.0	2	14.0	20	2.0	23.40	1.00
97.0 101.6	2.94	2	14.0	90 E 0	2.92	24.00	1.70
101.0	2 40	4	13.0	90 # 0	4 99 2 FO	23.60	1.73
100.0	2.00	ź	13.0	50	4 6 F	20.35	1.57
112.0	3.22	2	16.1	3.U E 0	3.22	29.29	1.62
113.0	3.00	2	13.3	2.0	3.06	20.61	1.70
101.0	2.22	2	140	2.9	2.95	40.40	
121.2	2.94	4	14.0	0.0	2.94	24.00 HT 04	
	3.09	2	13.5	50	3.09	47.41 57.08	1.70
	2.92	2	14.0	90 E 0	2.92	24.00	1.70
	4 94	2	6.1	40	4 02	20.10	3.56
	1.20	2	0.0	4.5	0	3.05	0.80
	U a	2	0.0	15	0	4.00	0.00
	0	2	0.0	00	0	0.00	0.00
	U	2	0.0	00	0	0.00	0.00
	U A	2	0.0	0.0	0	0.00	000
	U	2	301.89	0.0	U	497.12	1.65
		1	Selta value d	alculation	5		
% Width	Act: China	Lower	Шррег	V-lower	V-Upper	V-int	Deita
30%	42.0	#9¥/A	#NJ/A	#N/A	#NVA	#NU/A	#N/A
4.0.07	E4 0	40 .00	an en			# +P	4 49

1 76

1.46

1.66

1 62

1.58

1.67

1.68

1.58

1 66

0.98

1.05

0.99













The values in the legend block describe measured discharge for the profile indicated

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			Mea	asured da	ita		_	
STA	TION No. :	W4H013			STA	RT TIME :	13h00	
RIVE	R NAME :	Pongola		Averag	e Gaugepla	ate reading :	1.44	m
PLAC	E NAME :	Josini		-	••	Ŭ		
	DATE :	9/16/84						
					Main Cha	nnel LEFT :	30	
					Aain Chan		74	
					VIAILI CILALI		/4	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.24	D 4d	0.84	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth				0.434	223.0	96 81
1	0	0		0		0.000	0.0	0.00
2	4	1.82		0.079		0.079	7.3	0.58
3	8	2.34		0.487		0.487	9.4	4.56
4	12	2.35		0.585		0.585	9.4	5.50
5	16	2.37		0.712		0.712	9.5	6.75
6	20	2.37		0.832		0.832	9.5	7.89
7	24	2.35		0.75		0.750	9.4	7.05
8	28	2.3		0.836		0.836	9.2	7.69
9	32	2.65		0.866		0,866	10.6	9.18
10	36	2.82		0.838		0.838	11.3	9.45
11	40	3.09		0.804		0.804	12.4	9.94
12	44	3.44		0,662		0.662	13.8	9,11
13	48	3.88		0.588		0.588	15.5	9.13
14	52	4.65		0.21		0.210	18.6	3.91
15	56	5.51		0.118		0.118	22.0	2.60
16	60	5.32		0.07		0.070	21.3	1.49
17	64	4.4		0.081		0.081	17.6	1.43
18	68 74	3.27		0.035		0.035	16.4	0.57
19	/4	υ		0		0.000	0.0	0.00
						0,454	223.0	90.01
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	43.2	40.00	44.00	0.80	0.66	0.69	0.63
	40%	47.6	44.00	48.00	0.66	0.59	0.60	0.73
	50%	52.0	52.00	56.00	0.21	0.12	0.21	2.07
	60%	56.4	56.00	60.00	0.12	0,07	0.11	3.84
	70%	60.8	60.00	64,00	0.07	0.08	0.07	6.01

	Calc	ulated	lata, 1-din	nensiona	al flow the	ory	
Aanning	or Chezy	:	М			Q =	104.6
		Skope	0.00005			V <sub>AVR</sub> =	0.47
oughness	coeff.		Area reduct	tion factor	1		
Sub	n		Sub	fA	1		
0			0	1			
2	0.035		2	1			
ō	0.000		- 0				
Chainage	Vertical	Sub	Aree	Vvetted P	H-Radius	Q	V
		Gootlaa			ø	(m <sup>2</sup> /s)	Molecultu
	denetosve -	Becuun	×	۴	, n	···· -/	VEICERY
0	() Ol	2	0.0	0.0	n	0.00	0.00
4	1.82	2	73	4.0	1.82	2.19	0.30
8	2.34	2	94	40	2.34	3 33	0.36
12	2.35	2	9.4	4.0	2.35	3.36	0.36
16	2.37	2	95	40	2.37	3.40	0.36
20	2.37	2	95	4.0	2.37	3 40	0.36
24	2.35	2	9.4	4.0	2.35	3.36	0.36
28	23	2	92	40	2.3	3.24	0.35
32	2.65	2	10.6	<b>4</b> .C	2.65	4.10	0.39
36	2.82	2	11.3	4.0	2.82	4.55	0.40
40	3.09	2	12.4	40	3.09	5 30	0.43
44	3.44	2	13.6	4,0	3.44	6.33	0.46
48	3.88	2	15.5	40	3.88	774	0.50
52	4.65	2	18.6	<b>4</b> .C	4.65	10.47	0.58
56	5.51	2	22.0	4.0	5.51	13.89	0.63
60	6.32	2	21 3	40	5.32	13 10	0.62
64	4.4	2	1/.6	4.0	44	9.55	0.54
68	3.21	2	10.4	50	3.27	7.28	0.45
/4	UI	2	222.99	30	U	104.60	0.0
							-
		Delta	value calcu	ations			- Delle
78 WIGIA	ACL CHR.	Lower	Upper	V-Kower	I Arobbet	V-IN	Dena
30%	43.2	40.00	44 00	0.43	0.46	0.45	1.03
40%	4/.0	44.00	48 00	0.46	0.50	0.50	0.95
0074 607/	50.0	52.00	20.00	0.56	0.03	0.00	0.75
70%	60.9	00.00 80.00	62.00	0.03	0.62	0.65	0.78

			Me	asured da	ta			
STA	TION No. :	W4H013			STA	RT TIME :	07h30	
RIVE PLAC	R NAME : E NAME : DATE :	Pongola Josini 9/16/84		Averag	e Gaugepli	ate reading :	3.9	m
	DATE .	0/10/04			Main Cha	nnel LEFT :	30	
				N	Aain Chan	nel RIGHT :	74	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0 8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth				0.575	246.3	141.59
1	0	0		0		0.000	0.0	0.00
2	4	1.45		0.043		0.043	58	0.25
3	8	2.58		0.397		0.397	10.3	4.10
4	12	2.63		0.735		0.735	10.5	7.73
5	16	2.61		0.911		0.911	10.4	9.51
6	20	2.6		1.037		1.037	10.4	10.78
7	24	2.62		1.155		1.155	10.5	12.10
8	28	2.64		1.029		1.029	10.6	10.87
9	32	2.82		1.099		1.099	11.3	12.40
10	36	2.93		1.02		1.020	11.7	11.95
11	40	3.19		1.067		1.067	12.8	13.61
12	44	3.5		1.048		1.048	14.0	14.67
13	48	3.93		0.919		0.919	15.7	14.45
14	52	4.41		0.631		0.631	17.6	11.13
15	56	5.22		0.154		0.154	20.9	3.22
16	60	5.72		0.043		0.043	22.9	0.98
17	64 C0	4.99		0.062		0.062	20.0	1.24
10	00 72	4.1		0.091		0.091	10.4	1.49
131	12	2.5		0.0701		0.575	246.3	1 141 59
						0.010	240.0	1 141.00
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	43.2	40.00	44.00	1.07	1.05	1.05	0.55
	40%	47.6	44.00	48.00	1.05	0.92	0.93	0.62
	50%	52.0	52.00	56.00	0.63	0,15	0.63	0.91
	60%	56.4	56.00	60.00	0.15	0.04	0.14	4.02
	70%	60.8	60.00	64.00	0.04	0.06	0.05	12.29

	Cal	culated	data, 1-dir	nensiona	I flow the	ory	
Manning	or Chezy	:	М			Q =	154.0
		Slope	0.00008		l	V <sub>AVR</sub> =	0.63
Roughness	s coeff		Area reduc	tion factor	1		
Sub	n		Sub	f <sub>A</sub>			
0			0	1			
2	0.034		2	1			
0			0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	or effective depth	Section	A	P	R	(m³/s)	Velocity
0	0	2	0.0	0.0	0	0.00	0.00
4	1 45	2	5.8	4.0	1.45	1 95	0.34
8	2.58	2	10.3	40	2.58	5.11	0.49
12	2.63	2	10.5	40	2.63	5.27	0.50
16	261	2	10.4	4.0	2.61	5.21	0.50
20	2.6	2	104	4.0	2.6	51/	0.50
24	264	2	10.5	40	2.02	5 31	0.50
32	282	2	11.3	40	2.82	5.92	0.53
36	2.93	2	117	4.0	2.93	631	0.54
40	3.19	2	12.8	40	3 19	1 21	0.57
44	35	2	14.0	40	3.5	8.49	0.61
48	3.93	2	15.7	4.0	3.93	10.30	0.66
52	4 4 1	2	17.6	4.0	4.41	12 48	0.71
56	5.22	2	20.9	40	5.22	16.53	0.79
60	5.72	2	22.9	40	5.72	19.25	0.84
64	4 99	2	20.0	4.0	4.99	15.33	0.77
68	4.1	2	16.4	4.0	4.1	11.05	0.67
(2	2.9	2	14.3	50	2.9	157.00	0.53
			240.26		1	199.90	1 0.0.
	·····	Delta	value calcu	lations			]
% Width	Act. Chn.	Lawer	Upper	V-lower	V-Upper	V-int	Delta
30%	43.2	40.00	44.00	0.57	0.61	0.60	1.04
40%	47.6	44 QQ	48.00	0.61	0.66	0.65	0.96
50%	52.0	52 00	56 00	0.71	0.79	071	0.88
60%	56.4	56.00	60.00	079	0.84	0.80	0.78
70%	8.00	60.00	64.00	0.84	0.77	0.83	0.76

			Me	asured da	Ita			
STA	TION No. :	W4H013			STA	RT TIME :	06h00	
RIVE	R NAME : E NAME : DATE :	Pongola Josini 9/17/84		Averag	e Gaugepl	ate reading :	1.94	m
					Main Cha	nnel i FFT	зn	
					inani ona			
				I	Main Chan	nel RIGHT :	74	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.84	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		denth	0.24	0.10	0.00	0.778	269 B	209.81
1	0	0		0		0.000	0.0	0.00
2	4	1,58		0.049		0.049	63	0.31
3	8	2.82		0.487		0.487	11.3	5.49
4	12	2.95		0.812		0.812	11.8	9.58
5	16	2.93		1.063		1.063	11.7	12.46
6	20	2.86		1.262		1.262	11.4	14.44
7	24	2.94		1.277		1.277	11.8	15.02
8	28	2.97		1.359		1.359	11.9	16,14
9	32	2.99		1.493		1,493	12.0	17.86
10	36	3.21		1.339		1.339	12.8	17.19
11	40	3.49		1.496		1.496	14.0	20.88
12	44	3,94		1.367		1.367	15.8	21.54
13	48	4.24		1.251		1.251	17.0	21.22
14	52	4.8		0.9		0.900	19.2	17.28
15	56	5.68		0.472		0.472	22.7	10.72
16	60	6.05		0.17		0.170	24.2	4.11
1/	64	5.53		0.108		0.108	22.1	2.39
18	68 70	4.45		0.097		0.097	17.8	1./3
19	12	3.24		0.104		0.104	13.0 260 C	1.00
						0.770	209.0	203.01
			D	elta value c	alculation	S		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	43.2	40.00	44.00	1.50	1.37	1.39	0.56
	40%	47.6	44.00	48.00	1.37	1.25	1.26	0.62
	50%	52.0	52.00	56.00	0.90	0.47	0.90	0.86
	60%	56.4	56.00	60.00	0.47	0.17	0.44	1.76
	70%	60.8	60.00	64.00	0,17	0.11	0,16	4.94

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	Calo	culated o	lata, 1-din	nensiona	al flow the	ory	
Manning	or Chezy	/:	M			Q =	233.3
		Slope	0.00013			V <sub>AVR</sub> =	0.87
loughness	s coeff.		Area reduct	ion factor	1		
Sub	n		Sub	fA			
0			n	1			
2	0.033						
~ ^	0.000		<u>^</u>	-			
0	Mantana	61.h	U	1	lil Daduur	0	I w
Снянада	* PHIGH	ວມມ	Alta	Averied to	+ +-rtaulus	<b>بر</b> (س <sup>ع</sup> اد)	
	or effective	Section	A	P	R	(#+ #9)	Velocity
0	depm Bi	2	0.01	0.0	0	0.00	0.00
4	1.58	2	63	4.0	158	2.96	0.47
8	2.82	2	11.3	40	2.82	7 78	0.69
12	2.95	2	11 8	4.0	2 95	8.39	071
16	2 93	2	11.7	4.0	2.93	8.29	0.71
20	2.86	2	11.4	4.0	2.86	7 96	0,70
24	2.94	2	11.8	4.0	2.94	8.34	071
28	297	2	11.9	40	2.97	8 48	0.71
32	2.99	2	120	4.0	2 99	8 58	0.72
36	3.21	2	12.8	4.0	3.21	9.65	0.75
40	3 49	2	14.0	40	3.49	11 10	0.79
44	3.94	2	15.8	4.0	3 94	13.58	0.86
48	4 24	2	17.0	40	4.24	15.35	0.91
52	48	2	19.2	4.0	4.8	18.88	0.98
56	5.68	2	22.7	4.0	5 68	24.99	1 10
60	6 06	2	24.2	40	6.05	27.76	1.15
64	5.53	2	22.1	4.0	5.53	23 90	1.08
68	4.45	2	1/8	4.0	4.45	15.54	0.93
12	3.24	2	000.52	40	5.24	223 20	0.07
			205.35		1	200,00	0.01
		Delta	value calcul	ations			1
% Width	Act. Chins	Lower	Upper	V-lower	V-Upper	V-Int	Deita
30%	43.2	40.00	44 00	0.79	0.86	0.85	1.02
40%	47.6	44.00	48.00	0.86	0.91	0.90	0.96
50%	52.0	52 00	56.00	86.0	1.10	0.98	0.88
60%	56.4	56.00	60.00	1.10	1 15	1.10	0.78
70%	60.8	60.00	64 00	1.15	1.08	1.13	0.76

			Me	asured da	ita			
STA	TION No. :	W4H013			STAI	RT TIME :	08h45	
RIVE PLAC	R NAME :	Pongola Josini 8/05/04		Averag	e Gaugepla	ate reading :	2.48	m
	DAIL .	0120104			Main Cha	noel   EET ·	10	
							10	
				ſ	Main Chan	nel RIGH I :	100	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velacity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth		0.10	0.04	1.030	310.3	319.58
1	8	0		0		0.000	0.0	0.00
2	12	1.47		0.199		0.199	5.9	1.17
3	16	3.15		0.355		0.355	12.6	4.47
4	20	3.48		0.719		0.719	13.9	10.01
5	24	4.03		0.694		0.694	16.1	11.19
6	28	4.42		0.981		0.981	17.7	17.34
7	32	4.15		1.104		1.104	16.6	18.33
8	36	3.83		1.345		1.345	15.3	20.61
9	40	3.9		1.451		1.451	15.6	22.64
10	44	3.87		1.447		1.447	15.5	22.40
11	48	3.78		1.603		1.603	15.1	24.24
12	52	3.77		1,496		1.496	15.1	22,56
13	0C CO	3.82		1.668		1,668	15.3	25.49
14	60 64	3.09		1.64		1.640	14.8	24.21
10	69	3.73		1.400		1 274	14.9	22.20
10	72	3.74		1.374		1.374	15.6	19.84
17	76	3.89		0.924		0.924	15.6	14 38
19	80	3.7		0.535		0.535	14.8	7.92
						1.030	310.3	319.58
			D	elta value c	alculation	5		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	37.0	36.00	40.00	1.35	1.45	1.37	0.75
	40%	46.0	44.00	48.00	1.45	1.60	1.53	0.68
	50%	55.0	52.00	56.00	1,50	1,67	1.63	0.63
	60%	64.0	64.00	68.00	1.49	1.37	1.49	0.69
	70%	73.0	72.00	76.00	1.28	0.92	1.19	0.87

	Ca	culated of	data, 1-dir	nensiona	I flow the	ory	3.2.11
Manning	or Chezy	r:	М			Q =	436.4
		Slope	0.00045			V <sub>AVR</sub> =	1.41
Roughness	coeff		Area reduc	tion factor	1		
Sub	n		Sub	fA			
0			0	4	1		
2	0.036		2	4			
n –	4.000		- 0	1			
~					W Dodure	0	
Chanadha	verscar	200	Area	werted b	. maulus	<u>بر</u>	
	or effective	Section	A	р	R	(m /s)	Velocity
	depth	-					
8	<del>.</del>	2	00	6.U	U 4 47	0.00	0.00
12	14/	2	128	4.0	1.4/	4 40 14 04	1.57
20	249	5	170	40	348	18.84	1 35
20	4 03	2	16 1	40	4 03	24.06	1 49
28	4 4 2	2	177	40	4 42	28.06	1 59
32	415	2	16.6	40	4 15	25.26	1.52
36	3.83	2	15.3	40	3.83	22.10	1.44
40	3.9	2	15.6	4.0	3.9	22.78	1.46
44	3.87	2	15.5	4.0	3.87	22 48	1.45
48	3.78	2	15.1	40	378	21.62	1.43
52	3.77	2	15.1	40	377	21.52	1.43
56	3.82	2	15.3	4.0	3.82	22.00	1 4 4
60	3 69	2	14.8	4.0	3.69	20 77	1 41
64	3.73	2	14.9	40	3.73	21.15	1.42
68	3.74	2	15.0	40	374	21.24	1.42
72	3.89	2	15.6	4.0	3.89	22.68	1.46
76	3.89	2	15.6	4.0	3.89	22.68	1.46
80	37	2	14.8	4.0	37	20.86	1.41
			310.28			436.42	1.41
		Det-	ualua calcu	Intionr			1
Be Millerer	Act Che	Dena	value catcu	Halford's			Detta
	17.0	LOWET	topper	V+IOWER	1 / AD	1 45	0 97
109/	46.0	30.00	40.00	1 44	1 40	1 4 4	0.97
R/14/	55.0	62.00	56.00	1.42	1 4 4	1 44	0.98
60%	64.0	64 MM	68.00	1 42	4.47	147	0 99
70%	73.0	77.00	76.00	1 46	1 46	1 46	0.97
			1				

			Me	asured da	ta		-	
STA	TION No. :	W4H013 Popoola		Averag	STAI	RT TIME	10h00	-
PLAC	E NAME : DATE :	Josini 3/7/85		Averagi	Main Cha	nnel LEFT :	10	m
				N	Main Chan	nel RIGHT :	100	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m <sup>2</sup> )	(m <sup>3</sup> /s)
		depth				1.146	316.7	362.78
1	5	0		0		0.000	0.0	0.00
2	10	1.48		0.345		0.345	8.1	2.81
3	16	2.74		0.611		0.611	16.4	10.04
4	22	3.36		1.056		1.056	20.2	21.29
5	28	4.06		1.251		1.251	24.4	30.47
6	34	4.02		1.361		1.361	24.1	32.83
/	40	4.14		1.513		1.513	24.8	37.58
0	40 50	4.15		1.000		1.080	24.9	39.47
10	52	3.90		1.309		1.339	20.9	33.74
11	64	3.8		1 365		1 365	20.0	31 12
12	70	3.76		1 297		1 297	22.6	29.26
13	76	3.85		1 259		1 259	23.1	29.08
14	82	3.79		0.692		0.692	22.7	15.74
15	88	3.93		0.438		0.438	23.6	10.33
16	94	1.74		0.158		0.158	11.3	1.79
17	101	0		0		0.000	0.0	0.00
18						0.000	0.0	0.00
19						0.000	0.0	0.00
						1.146	316.7	362.78
			D	elta value c	alculation	\$		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	37.0	34.00	40.00	1.36	1.51	1 44	0.80
	40%	46.0	46.00	52.00	1.59	1.56	1.59	0.72
	50%	55.0	52.00	58.00	1.56	1.42	1,49	0.77
	60%	64.0	64.00	70.00	1.37	1.30	1.37	0.84
	70%	73.0	70.00	76.00	1.30	1.26	1 28	0.90

Maranizar	Cal or Choru	culated	data, 1-din	nensiona	il flow the	ory	422.4
wanung	Of Ghezy		tVI			ια = ν =	433.4
		siope	0.0005		l	VAVR -	1.37
Roughness	coeff.		Area reduct	tion factor	1		
Sub	n		Sub	f <sub>A</sub>	1		
0			0	1	1		
,	0.039		2	1			
0	C.GOD		0	1			
Chainage	Vertical	Sub	Area	Wetted P	H-Radius	Q	V
	tot effective	Rection	, I	n	P	(m <sup>3</sup> /s)	Volocity
	depth	adupon				•	v disson y
5	0	2	0.0	5.0	0	0.00	0.00
10	1.48	2	8.1	55	1.48	6.06	0.74
16	2.74	2	16.4	6.0	2.74	18.46	1.12
22	3 36	2	20.2	6.0	3.36	25 93	1.29
28	4.06	2	24.4	6.0	4.06	35.55	1.46
34	4.02	2	24.1	60	4.02	34,96	1 45
40	4 14	2	24.8	6.0	4.14	36.72	1.48
46	4 15	2	24.9	6.0	4.15	36 87	1.48
52	3.98	2	23.9	6.0	3.98	34 39	1.44
58	3.96	2	23.8	60	3.96	34.10	1 44
64	3.8	2	22.8	6.0	3.8	31.83	1 40
70	3 76	2	22.6	6.0	3.76	31 28	1.39
76	3.85	2	23.1	60	3.85	32.53	1.41
82	3.79	2	22.7	60	3.79	31.69	1 39
88	3.93	2	23.6	6.0	3.93	33.67	1 4 3
94	1 74	2	11.3	6.5	1.74	9 38	0.83
101	0	2	0.0	35	0	0.00	00.0
	0	2	0.0	00	0	0.00	0.00
	0	2	0.0	0.0	0	0.00	0.00
			316.69		l	433.42	1.3
		Delta	value calcu	lations			1
% Width	Act. Chn.	Lower	Upper	V-lower	V-Upper	V-int	Delta
30%	37.0	34 00	40.00	1.45	1 48	1.46	0.93
40%	46.0	45.00	52 00	1 48	1.44	1.48	0.92
50%	55.0	52.00	58.00	1 44	1 44	1.44	0.95
60%	64.0	64 00	70.00	1.40	1 39	1 40	0.98
70%	73.0	70 00	76.00	1.39	1 41	1 40	86.0

2			Mea	asured da	ata	1.75	1.1.1	
STA	TION No. :	W4H013			STAR	TTIME :	09H17	
RIVE	R NAME : E NAME : DATE :	Pongola Josini 3/8/85		Averag	le Gaugepla	te reading :	2.67	m
					Main Char	nel LEFT :	10	
					Main Chanr	el RIGHT	100	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				1.187	323,7	384.12
1	5	0	0	0	0	0.000	0.0	0.00
2	10	1.64	0	0	0	0.000	9.0	0.00
3	16	2.86	0.92467	0.624091	0.602924	0.694	17.2	11.91
4	22	3.17	1.216781	1.132111	0.916203	1.099	19.0	20.91
5	28	4.15	1.398822	1.250649	0.971238	1.218	24.9	30.32
6	34	4.09	1.563928	1.415756	1.119411	1.379	24.5	33.83
7	40	4.19	1.724801	1.572395	1.199847	1.517	25.1	38.15
8	46	4.28	1.758669	1.623197	1.436923	1.610	25.7	41.36
9	52	4.08	1.78407	1.563928	1.373421	1.571	24,5	38.47
10	58	4.02	1.77137	1.60203	1.398822	1.594	24.1	38.44
11	64	3.83	1.610497	1.576629	1.331086	1.524	23.0	35.01
12	70	3.88	1.487725	1.483492	1.212548	1.417	23.3	32.98
13	76	3.9	1.487725	1.19138	1.017807	1.222	23.4	28.60
14	82	3.76	0.933137	0.92467	0.68336	0.866	22.6	19.55
15	88	3.98	0.649492	0.628325	0.539421	0.611	23.9	14.60
16	94	2.08	0	0	0	0.000	13.5	0.00
17	101	0	0	0	0	0.000	0.0	0.00
18						0.000	0.0	0.00
19						0.000	0.0	0.00
						1.187	323.7	384.12
	-			olto volvo d	alculation			
	% Width	Act Chn	Ch-l ower	Chilipper	V-lower	Valinnet	V-Int	Delta
	30%	37.0	34.00	10.00	1.39	1.52	1 45	0.82
	40%	46.0	46.00	52.00	1.50	1.67	1.40	0.74
	R0%	55.0	40.00	59.00	1.01	1.50	1.01	0.74
	60%	64.0	52.00 64.00	70.00	1.57	1.00	1.50	0.78
	70%	73.0	7n nn	76.00	1.54	100	1.32	0.90
	14/4	4.919	10.00	10.00	1.74		1.94	

Calculated data, 1-dimensional flow theory											
Manning	or Chezy	/:	M			Q =	436.0				
		Slope	0.0005			V <sub>AVR</sub> =	1.35				
					_						
Roughness	coeff.		Area reduc	tion factor							
Sub	n		Sub	fA							
0			0	1							
2	0.04		2	1							
ō			ā	4							
							<u> </u>				
Cheinage	Vertical	500	Area	wetted P	m-Radius	4	· ·				
	or effective	Section	A	q	R	(m*/s)	Velocity				
5	00000	2	0.0	5.0	0	0.00	0.00				
10	1.64	2	9.0	5.5	1.64	7.01	0.78				
16	2.86	2	17.2	60	2.86	19 33	1.13				
22	3,17	2	19.0	6.0	3 17	22.94	1.21				
28	4 15	2	24.9	60	4.15	35.95	1.44				
34	4.09	2	24.5	6.0	4.09	35 08	1.43				
40	4.19	2	25 1	6.0	4 19	36.53	1 45				
46	4 28	2	25.7	60	4.28	37 84	1.47				
52	4.08	2	24.5	6.0	4.08	34 94	1.43				
58	4.02	2	24.1	6.0	4.02	34.09	1.41				
64	3 83	2	23.0	60	3.83	31 45	1.37				
70	3.88	2	23 3	6.0	3 88	32.13	1.38				
76	3.9	2	23.4	60	3.9	32.41	1 39				
82	3.75	2	22.6	6.U	376	30 49	1.35				
88	3.98	2	439	0.0 6 E	390	33.33 43.33	140				
94 101	200	4	10.0	20	200	0.00	3.05				
101	0	5	00	0.0	0	n nn	0.00				
	u A	2	00	00	0 0	0.00	0.00				
		-	323.68		-	436.04	1.3				
							-				
		Delta	value calcu	ations							
% Width	ACE CINES	Fomet	Upper	V-lower	V-Opper	Valtit	Detta				
30%	37.0	34.00	40.00	1.43	1 45	1.44	0.93				
40%	46.0	46.00	52.00	1 47	143	1.47	0.97				
60%	55.0	52 00	58.00	143	1.41	142	0.90				
60% 70%	77.0	64.00 70.00	70.00	1.37	1.38	1.37	0.88				
1974	10.0	70.00	10.00	1.30	1	1.13					

T			Me	asured da	ta			
STA	TION No. :	W4H013			STA	RT TIME :	07H55	
RIVE PLAC	R NAME : E NAME : DATE :	Pongola Josini 3/9/85		Averag	e Gaugepla	te reading :	2.665	m
					Main Cha	nnel LEFT :	10	
				١	Main Chan	nel RIGHT :	100	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Veloaity	Velocity	V aver.	Area	Q
number		or effective	0.2d	0.4d	0.8d	(m/s)	(m²)	(m <sup>3</sup> /s)
		depth				1.225	322.3	394.71
1	5	0		0		0.000	0.0	0.00
2	10	1.6		0.386		0.386	8.8	3.40
3	16	2.92		0.802		0.802	17.5	14.05
4	22	3.27		1.208		1.208	19.6	23.70
5	28	4.15		1.263		1.263	24.9	31.45
6	34	4.05		1.411		1.411	24.3	34.29
7	40	4.1		1.505		1.505	24.6	37.02
8	46	4.25		1.551		1.551	25.5	39.55
9	52	4.02		1.619		1.619	24.1	39.05
10	58	4.03		1.606		1.606	24.2	38.83
11	64	3.88		1.522		1.522	23.3	35.43
12	70	3.79		1.49		1.490	22.7	33.88
13	76	3.87		1.2		1.200	23.2	27.86
14	82	3.79		0.827		0.827	22.7	18.81
15	88	3.98		0.662		0.662	23.9	15.81
16	94	1.99		0.122		0.122	12.9	1.58
17	101	U		U		0.000	0.0	0.00
10						0.000	0.0	0.00
19				1		0.000	0.0	0.00
						1.225	322.3	394./1
			D	elta value c	alculation	5		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	37.0	34.00	40.00	1.41	1.51	1.46	0.84
	40%	46.0	46.00	52.00	1.55	1.62	1.55	0.79
	50%	55.0	52.00	58.00	1.62	1.61	1.61	0.76
	60%	64.0	64.00	70.00	1.52	1.49	1.52	0.80
	70%	73.0	70.00	76.00	1.49	1 20	1.35	0.91

	Ca	culated o	lata, 1-dir	nensiona	I flow the	ory	
Manning or Chezy:			M			Q =	433.2
		Slope	0.0005			V <sub>AVR</sub> =	1.34
Renriguos	coeff		Area reduc	lion factor	1		
Sub	n		Sub	fA			
0			0	1			
2	0.04		2	1			
0	0.04		0	1			
Chainade	Vertical	Sub	Area	Wetted P	H-Radius	Q	l v
-	or effective depth	Section	A	P	R	(m <sup>3</sup> /s)	Velocity
5	0	2	0.0	5.0	0	0.00	0.00
10	1.6	2	8.8	5.5	1.6	673	0 76
16	2.92	2	17.5	60	2.92	20.01	1 14
22	3.27	2	19.6	60	3.27	24.16	1.23
28	4 15	2	24.9	6.0	4.15	35.95	1.44
34	4 05	2	24.3	6.0	4.05	34 51	1.42
40	4.1	2	24.6	60	4.1	35.23	1.43
46	4.25	2	25.5	60	4.25	37.40	1 47
52	4 02	2	24.1	6.0	4.02	34.09	1.41
58	4 03	2	24.2	6.0	4.03	34.23	1 42
64	3.88	2	23.3	80	3 88	52 13	1 38
70	3.79	2	22.7	6U	379	30.90	1.36
76	38/	2	23.2	6.U	3.67	32.00	1.33
62 00	3/3	2	221	0.0 e n	3.19	20.80	1.30
00	3.30		170	65	1.00	11 44	0.88
101	96.1	2	12.5	24	n	0.00	0.00
101	0	2	00	0.0	n n	0.00	0.00
	n N	2	0.0	0.0	õ	0.00	0.00
		-	322.34			433.21	1.3
		<b>P</b> 4		latian			7
9/ 16/1 date	Act Chr	Della	value calcu	anons		1. 64	Datte
200	ACA. COMB.	LOWET	Upper	VHOWER	viopper	V-833	o o a
ADP/	46.0	44.000	40.00	142	43	1.43	0.94
40 % ENe/	40.0	40.00	50.00	147		1.47	0.92
60% 60%	84.0	52.00	70.00	1 20	142	141	0.53
70%	73.0	70.00	76.00	1 30	1 39	1 37	n 98
	10.0	10.00	10.00	1.00			8 8000082-02-02

			Me	asured da	ita		-	
STA	TION No. :	W4H013			STA	RT TIME :	14H15	
RIVE PLAC	R NAME : E NAME : DATE	Pongola Josini 9/17/84		Averag	e Gaugepl	ate reading :	3.15	m
				I	Main Cha Main Chan	nnel LEFT : nel RIGHT :	10 100	
1	2	3	4	5	6	7	8	9
Vertical	Chainage	Vertical	Velocity	Velocity	Velocity	V aver.	Area	Q
number		or effective depth	0.2d	0.4d	0.8d	(m/s) 1.500	(m <sup>2</sup> ) 392.6	(m <sup>3</sup> /s) 588.98
1	0	0		0		0.000	0.0	0.00
2	4	0.65		0.184		0.184	3.3	0.60
3	10	2.17		0.937		0.937	13.0	12.20
4	16	3.35		1.439		1.439	20.1	28.92
5	22	4		1.657		1.657	24.0	39.77
6	28	4.7		1.788		1.788	28.2	50.42
7	34	4.49		2.008		2.008	26.9	54.10
8	40	4.68		2.017		2.017	28.1	56.64
9	46	4.62		2.055		2,055	27.7	56.96
10	52	4.53		2.068		2.068	27.2	56.21
11	58	4.43		1.89		1.890	26.6	50.24
12	04 70	4.27		1.052		1.852	25,6	47.45
10	70	4.21		1.805		1.805	25.3	45.59
14	70 87	4.53		1.453		1.433	20.0	20.00
10	02 88	3.06		0.506		0.506	20,1	12 02
10	94	2 25		0.500		0.531	13.5	7 17
18	100	2.43		0.201		0.201	26.7	5 37
19	116	0		0		0.000	0.0	0.00
				1		1.500	392.6	588.98
			D	elta value c	alculation	s		
	% Width	Act. Chn.	Ch-Lower	Ch-Upper	V-lower	V-Upper	V-Int	Delta
	30%	37.0	34.00	40.00	2.01	2.02	2.01	0.75
	40%	46.0	46.00	52.00	2.06	2.07	2.06	0.73
	50%	55.0	52.00	58.00	2.07	1.89	1.98	0.76
	60%	64.0	64.00	70.00	1,85	1.81	1.85	0.81
	70%	73,0	70.00	76.00	1,81	1.43	1.62	0,93

0.77	Calo	culated o	lata, 1-din	nensiona	I flow the	ory	3
Manning or Chezy: M Q = 712.9							712.9
		Slope	0.00075			V <sub>AVR</sub> =	1.82
Rouchness	coeff		American and unit	in frates	1		
1.000 (B)	coopii,		C.L				
000			500	14			
0	0.000						
4	0.030		2				
0			0	1			
Chainage	Vertical	Sub	Atea	Wetted P	H-Radius	Q	V
	or effective depth	Section	A	P	R	(m <sup>3</sup> /s)	Velocity
0	0	2	0.0	0.0	0	0.00	0.00
4	0.65	2	3.3	5.0	0.65	1.76	0.54
10	2.17	2	13.0	6.0	2.17	1573	1.21
16	3,35	2	20.1	6.0	3 35	32.43	1.61
22	4	2	24.0	60	4	43.58	1.82
28	4.7	2	28.2	6.0	4.7	57 02	2.02
34	4.49	2	26.9	6.0	4 49	52.84	196
40	4 68	2	28.1	60	4,68	66 62	2.02
46	4.62	2	27.7	6.0	4.62	55.42	2.00
52	4.53	2	27.2	6.0	4.53	53,63	19/
58	4 43	2	20.5	5U	4.43	515/	1.94
64 70	4.41	2	200	0.U e n	4 27	45.50	1.90
70	4 21	2	20.0	60	4.21	41.40	1.66
70	4.33	5	20.0	0.0 6 0	4.55 A 45	4974 57 DE	1.81
88	7.70 3 QF	2	23.8	6.0 6 A	396	42.86	1.80
94	2 25	2	13.5	60	2.25	16.71	1.24
100	2.43	2	26.7	11.0	2.43	34.82	1 30
116	G	2	0.0	80	0	0.00	0.00
			392.62			712.95	1.82
		Delta	value calcul	ations			1
% Width	Act. Chn.	Lower	Upper	A-jowet	V-Upper	V-int	Deita
30%	37.0	34.00	40.00	1.96	2.02	1.99	0.91
40%	46.0	46.00	52.00	2.00	1.97	2.00	0.91
50%	55.0	52 00	58.00	1 97	1.94	1 96	0.93
60%	64.0	64.00	70 00	1,90	1 88	1.90	0.96
70%	73.0	70.00	76.00	1.88	1.91	1.90	0.96