WaPUG

River Data Collection Guide

Version W01

ACKNOWLEDGEMENTS

Version 1.0 of this manual has been prepared by Integrated Hydro Systems, North West Water, Yorkshire Water and Montgomery Watson for the WaPUG Committee. The Wastewater Planning User Group gratefully acknowledges their efforts in its production.

WaPUG would welcome any comments on this document which should be addressed to:

Technical Queries WaPUG Home Page http:\\www.wapug.org.uk

River Data Collection Guide

Contents

1. INTRODUCTION

The development of the data collection strategy should be integral with the model development and overall UPM modelling strategy and all the parties involved WSC, the survey contractors and the modellers should be involved in the process. This guide has been written to complement the WaPUG River Modelling Guide.

2. PLANNING A DATA COLLECTION STUDY

2.1 Liaison With Modeller

It is important that the survey contractor is in direct contact with the modeller and the client. The location of monitoring sites is likely to be a compromise between where the data is required and where it can be effectively and safely collected.

It would be advisable to undertake a site visits with representatives from the survey contractor, the Client and the river modeller walking the entire length of the study area so that all parties have a clear understanding of the objectives, site conditions and significant structures. This should take place as part of the river walking exercise.

It is important that all the parties are aware of what the data is to be used for and priorities on the data. A follow up meeting should then be held to sort out any problems arising from the site inspection.

2.2 Data Collection Sites

The location of data collection sites should be a collaborative task, between the survey contractor and the modeller, having taken onboard comments from the WSC and the EA. The modeller should be responsible for providing co-ordinates and a description of the sites and the contractor will be responsible for the physical location of the monitors.

2.3 Prioritisation of Sites

Within the data collection exercise there will be certain sites that will be critical to the modelling exercises. Without these sites there is little chance of building a satisfactory model. These sites will include river boundaries and principal input locations. They generally provide data that will be fed through to check the fundamental integrity of the model whereas the intermediate sites are used for calibration. It is therefore worthwhile to direct more resources at the critical sites in terms of planning, installation and maintenance visits. The modeller and the client will provide information about priorities to the contractor. The highest priority sites will generally be the upstream boundaries to the major tributaries, followed by the minor tributaries, then the downstream boundary of the watercourse.

2.4 Agreement of Collection Sites

This needs to be done as part of the study area walk or subsequent meeting detailed in section 3.1. All interested parties including the modeller must agree the final sites. A plan should be produced detailing all of the collection sites, the types of monitoring and the site reference labelling.

3. ASSET DATA COLLECTION

3.1 Site Visits

Made by modeller, client and survey contractor to determine the location of monitoring points. The visit could also include identifying cross sections and significant structures which should be surveyed.

Sketches of section or structures to be surveyed should be marked on 1:1250 plans/plus description/photos, information about access or the location of Benchmarks.

3.2 Survey Requirements – Cross Sections and Long Sections

All levels should be taken relative to Ordnance Datum.

In-bank channel x-sections at selected locations. Levels to be taken of bed across sections to pick out features of channel, normal to the direction of flow.

It is sufficient/beneficial to undertake a topographic survey to develop a model of the terrain in the area of interest. Cross sections are then produced by taking a line across the terrain model. This method gives a better estimate of typical section characteristics in the area of interest and gives flexibility to extract further sections from the terrain model if necessary.

Each X-section should display water surface elevation and the time and date of the survey. This information may be useful for hydraulic calibration.

Drawings of the cross-sections should be produced together with a plan view with background mapping in DXF format.

River cross sections should be provided in digital format in an ASCII file that can be easily inserted into model cross sectional databases. Within Mike 11 sections are identified by three parameters. River Name, [String of any length]; Topo ID [String of any length], Topographical identification; Chainage [Real number] kilometers. Providing that survey data is sufficiently well named that it can be cross referenced with these parameters then it is sufficient to provide survey data in separate delimited ASCII files with columns for x co-ordinates (Chainage across the cross-section m) and level in mAOD. This format can be pasted directly from a spreadsheet into MIKE11 version 4 Databases or converted to MIKE 11 version 3 text input files which have enough sections to generally represent the overall shape of a channel. For instance the format three columns in a text file with a name reflecting the chainage of the x-section.

Distance across section (m)	*Level (mAOD)*	*Chainage (km)*
-2	10	14.987
.5	5	14.987
0	5	14.987
.5	5	14.987
2	10	14.987

The provision of the grid reference of the mid point of the cross section data is required so that sections can be tied into background mapping and GIS systems. This date should be placed in a separate file with the following format:

Easting	*Northing*	*Chainage (km)*
564652	564652	12.500
123456	567432	14.987

Distances between cross sections in long culverted reaches. If culvert is known to be of uniform section this is not a problem (if model calibration of AD events shows extreme roughness values then perhaps further survey work will be required).

3.3 Survey Requirements – Structures

A survey of a weir should incorporate a high resolution survey of the weir crest. In many cases weir crests are not level.

Topographic survey upstream and downstream of the weir is useful, and relatively straightforward. Produce cross sections by drape lines across 3D polylines. Each X-section should display water surface elevation and the time and date of the survey. This information may be useful for hydraulic calibration.

In addition to the weir crest survey, cross sections are required upstream and downstream of the weir. *Weirs should be included in modelling if they have influence on flow in a channel or if they have been identified as making a major contribution towards re-oxygenation. This question should have been resolved from the long section DO profiling exercise undertaken prior to modelling.*

The ponded areas behind weirs are frequently identified as critical reaches, so a good model of the hydraulics behind the weir is required Cross sections behind the weir should be taken, sufficient to represent the provided reach of water behind weir.

On the downstream side of the weir a single cross section should be taken. This section should preferably be 10 or 20 m downstream of the weir.

Note: The applicability of the EA standard for River Surveys to low flow modelling is currently being assessed.

3.4 Commissioning a Cross Section Survey

Sketch maps should be provided by the modeller to show where the cross sections should be taken. These should be provided on the best background mapping available.

Land ownership details will be required as to where to obtain permission to survey the site.

If specifications are liable for mis-interpretation or are complex, the modeller and the survey contractor must visit the river site together to stake out the locations of cross sections.

Cross section locations should also be provided with grid references, so accurate plans of the model can be drawn up and data transferred from model to GIS.

All of the cross sections should have the water level at the time of the survey shown, along with the time and the date the measurement was taken.

All cross sections should be recorded with levels relative to Ordnance Datum.

All cross sections should be taken normal to the direction of flow, unless specified otherwise.

Chainages between cross-sections are not required unless specified. It is assumed that these will be taken from maps of the area.

3.5 Important Features to Observe

Construction of hydraulic structures or new flood defences works.

Intakes and pump stations from watercourse.

Dischargers.

CSO outfalls. Reference should be made to FWR Report FRO466.

4. STATIC MONITORS – GENERAL

These monitors are located at a site for periods of months. They are generally in fixed cabinets or manholes. The static monitoring sites should house the flow monitors, water quality monitors and autosamplers for that study location.

4.1 Placement of Monitors General

The final location of site must be approved by all parties in the modelling process.

Good access to monitoring site is required. Access will have to be 24 hours a day, seven days a week.

The site must be secure as the data collection equipment is very expensive.

The use of the site must have the landowners permission and must not interfere with the normal operation of the site.

Samplers must not interfere with normal operation of the River.

Samplers should be correctly located with respect to where the model requires the data to be collected.

A sampler needs to be sufficiently close to the point the sample is taken from as the pumps in the AutoSamplers can only lift samples a height of 6 to 7 m.

Changes in river flow must be taken into account, so that samplers are located in such a position that they are not flooded out by high river flows.

Successful monitoring has been achieved with the use of buried monitors in manholes, and kiosks. Buried monitors can be vulnerable to flooding, kiosks are obvious to vandals.

Good sampler locations for water quality are well mixed sites, this makes them less suitable for flow monitoring. Although these issues are more relevant to in sewer monitoring they must also be reconciled for the purposes of river monitoring.

The kiosk or manhole must be of sufficient size to adequately hold all of the monitoring and sampling equipment.

4.2 Naming Conventions

A structured set naming conventions for events and sites is necessary to avoid confusion in later stages of a project.

The naming convention must suit all data logging systems in operation in the project. Site naming must be suitable for laboratory sample referencing, as well as the data collection contractor and the modeller.

River data collection sites form a small part of the overall data collection exercise in a UPM study. It is important that monitoring naming conventions are not duplicated in any aspect of the study. In addition, different storm or dry weather sampling event data could be collected for river and sewer model calibration. These events should be consecutively numbered even if the events are only specific to a subset of the study. For instance Storm 1 collected in the sewers, is often different to Storm 1 collected for river modelling. This can lead to confusion when trying to match data sets.

The data collection manager for the study should liaise with the survey contractors to attribute names and numbers to each event. This is particularly pertinent if data is collected/analysed by a number of different organisations.

All of the static locations from which data is collected should be differently numbered, once again sequentially, with no repetition. It will help the data users if there is a logic to the data collection numbering. If sites were lettered and events numbered that may remove a degree of confusion.

4.3 Back-up Resources

Arrangements should be made for backup equipment and personnel to minimise problems during a survey.

The number of spare monitoring units should be specified in the contract for the data collection.

A site priority list should also be developed so that resources can be accurately targeted at the points of greatest need.

5. STATIC MONITORING OF FLOW

Note: *This section summarises best practise but is currently under review.*

5.1 Location of Monitors

The ideal locations will be upstream of weirs. These have the advantage that more reliable rating curves can be developed.

5.2 Development of Rating Curves

Rating curves can be developed for the measurement of flows, but in order to get a good degree of accuracy a large number of spot measurements need to be taken.

At an existing weir site perhaps 100 spot gaugings (by gulp dilution or propeller gaugings) would have to be taken to develop a reliable rating curve. An open channel site would require far more gaugings and would also be prone to seasonal changes i.e. due to weed growth and changes in channel morphology. It is not recommended that open channel sites are used for flow measurement in UPM studies.

Is it worth starting a flow data collection exercise prior to the main study to capture sufficient values to establish a rating curve.

5.3 Sophisticated Flow Monitors ADS, ADFM, Accusonics in Rivers

The major problem with installing ADS and ADFM type flow monitors at river locations are:

> The technology was originally designed for sewer flow monitoring and problems can be experienced locating the sensors so that they do not become covered by silt. In the case of depth measurement this is not a problem. For velocity measurement, however, this can be a real problem as signals become degraded by the silt resulting in eventual loss of signal.
>
> Velocity measurement of ADS and ADFM equipment in channels with large cross sections (>4 m) are also limited by the ability of the signal to penetration through the flow to find peak velocity.
>
> ADS monitors were designed for sewer applications and are therefore limited to an operating range to about 4 m.
>
> Acoustic Doppler flow metres (ADFM) were also developed for sewer applications but the technology was taken from offshore current profilers and therefore, they have a larger operating range, to about 5 m.

The Accusonic time of flight system was designed for permanent flow measurement sites in rivers and could be adapted for temporary survey work. It has an operating range of up to 500 m and is not affected by silt as the transducer send a signal through the flow horizontally to another transducer on the opposite bank. A regular cross section is required to quantify flow and to provide suitable monitoring position for the sensor alignment. This limits their use on temporary surveys to existing structures such as a bridge buttress or manmade banking.

Some general practical points about flow monitors are:-

Doppler Flow Monitors

- Collect average velocity and depth of water above sensor
- Can be mounted on site of abutments or channel and fire across it.
- Still requires propeller gaugings to check calibration.

- Will stand up to some silt build up, but require cleaning every so often. Incorporate some redundancy in the modelling to allow for failure of other device.
- Not effected by downstream controls in water level.
- Accurate river cross section required to solve flow from A.V where A=f(h).
- relatively cheap, discrete.
- Accuracy drops off with lower velocities

Doppler Profiling Monitor

- Accuracy drops off with lower velocities.
- Smaller, robust, easy to set up in larger rivers.
- Requires propeller gaugings to check calibration, so will require a detailed survey of the river X-Section.

5.4 Issues with Low Flow Monitoring

Streams with low flows can cause problems for flow monitoring equipment. The limitation in most cases is the physical size of the sensor. The ADS sensor has the smallest physical size and will work in the flows down to 20 mm. An additional problem occurs when trying to monitor streams as silty stream bed conditions mean that the sensor has to be installed above the silt to avoid becoming silted and therefore reducing the measurement depth. Also, the Doppler shift technology requires particles or microscopic bubbles to be present in the flow to be able to measure. They also require that flow velocities stay above 0.2 m/s.

ADFM sensors are much bigger in size - 205 x 106 x 28 mm. They have a minimum measurement requirement of 100 mm flow and the manufacturers claim they can measure flow down to 0.05 m/s. The sensor will suffer the same problems as the ADS sensor in silty conditions.

Accusonic technology would not be suitable for low flow monitoring.

Flumes or plate weirs can be used in small channel sections but are prone to vandalism.

6. TIME OF TRAVEL STUDIES

6.1 Fluorimetry (Sufficient)

The time of travel studies are frequently used to set timing for autosamplers so the time of travel studies must be undertaken before the water quality data collection exercises. The data is also critical to the hydraulic and advection dispersion calibration of the model.

Care must be taken when undertaking fluorimetry in watercourses from which drinking water is abstracted, where there are maximum thresholds for dye concentration.

Appendix B of this report details a time of travel methodology.

7. WATER QUALITY SAMPLERS

All equipment timing should be set to an agreed project time frame (e.g. GMT or BST).

Data collection should be concurrent with all other elements of data collection.

7.1 Frequency of Samples

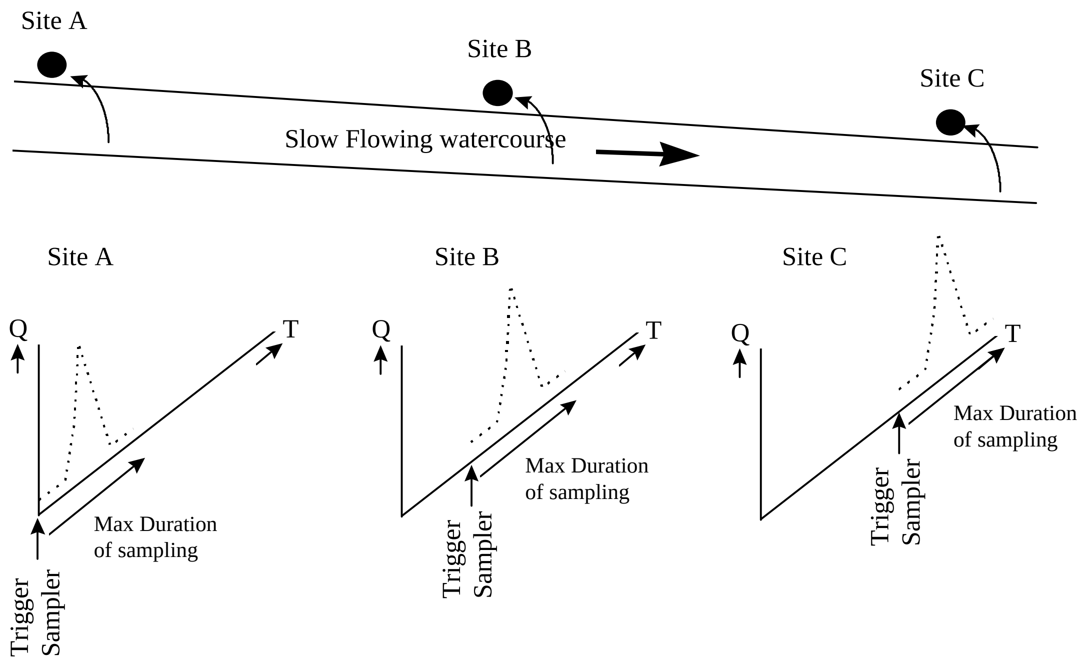
The triggering and frequency of sample collection is a complex matter. The collection exercise should endeavour to characterise the changes under gone in a specific parcel of water as it travels down through the river system. The sampling exercise is constrained by the capacity of the autosamplers and the maximum throughput of the laboratory.

DWF events

Changes in dry weather events would generally be expected to occur slowly. Sample collections can usually be set to between one and two hours. The lower frequency of sampling allows a longer time to be sampled. Two consecutive days sampling at two hour intervals would be more useful than a single days sampling at hourly intervals in a slowly changing system.

Information obtained from the time of travel studies will allow the trigger time of samplers to be set. This is necessary for staggering sampling when the time of travel between monitoring locations is close to the maximum period of sampling.

Figure 1
Staggering of monitors triggering in slow flowing watercourse



WWF events

Overall the data collection exercise will be a compromise between collecting the fast changes in the system with the CSO/wet weather inputs and the slower response before and after the flow events.

Different sampling intervals for sampling locations should be used. Upstream boundary will require high resolution, high priority monitoring to ensure the best quality input data to the model.

The duration of sampling should be longer at the downstream end of the system because it is required to take the duration of the event plus the duration of the time of travel in the study area.

7.2 Triggering of Samplers

Storm sampling programs should be automatically triggered from a flow monitor using either a flow or depth trigger. Sampling programs can then either be run directly from the flow monitor or start an internal program on the sampler.

Event notification should be used to mobilise sample collection crews by sending a signal at commencement of spill to either a mobile phone or pager from a flow monitor installed at the most frequent spilling overflow.

Unfortunately, because of IS certification the mobile phones have to be housed outside the confined space and this can lead to long lead times in gaining approvals to install conduit, particularly if the overflow manhole happens to be in the middle of a road. For this reason it may be easier to use Event Notification raingauges to send the signal on a predetermined rain event.

An event notification system which sends initialisation signals to samplers on the rivers to start the sampling programs would reduce the likelihood of missed events.

7.3 Number of Samples

The usual constraint of the number of samples that can be taken is the through put of the analytical laboratory. The maximum capacity of the laboratory should be identified and strategies for prioritising samples to be analysed should be developed prior to the sampling exercise. This strategy should be developed by the modeller and the client and then agreed with the data collection contractor.

In addition a procedure for filtering out unnecessary samples should be agreed with the contractor in order to reduce laboratory costs.

7.4 Number of Samplers

The number of samplers used will be governed by their availability and the clients' requirements. Surveys have used samplers run consecutively in order to collect a longer duration of event.

7.5

Location of Samplers

Location of the inlet sampling hose will be site specific, but it mustn't be too close to the channel bed or sides to become silted up but it must also avoid being rendered ineffective or torn out by a build up a rags. The hose should be so located that it can sample data throughout the possible range of high and low flows.

7.6 Determinants

Total BOD

Dissolved BOD as surrogate parameter Filtered BOD

Total Suspended Solids

Total Ammonia

Nitrate concentrations have little effect on the overall UPM related parameters of DO and Ammonia although it is required for the Mike 11 water quality model, analysis cost could be reduced by only measuring nitrogen at the upstream boundary sites and the downstream boundary site.

7.7 Handling of Sampled Data

Adequate provision has to be made for:

- labelling of data bottles, ideally compatible with laboratory labelling systems;
- preservation of samples for the duration of the sampling exercise and subsequent transport to the laboratories;
- Sufficient volume of sample for laboratory analysis;

Sufficient transport to take the samples to the laboratory within the minimum time period.

7.8 Laboratory Analysis

Laboratory analysis of the collected samples is a major project expense and this area of specification should not be overlooked.

Throughout the project a chain of custody form should be used for tracking each sample.

It is recommended that COD testing is undertaken of samples to estimate BOD concentrations. This is so that the correct BOD dilution's can be chosen by laboratory staff for the BOD ranges of the samples.

BOD should be measured with 2 mg/l ATU.

Dissolved BOD should be measured with the surrogate of filtered BOD.

8.

WATER QUALITY MONITORS

8.1 Determinants

Dissolved oxygen and percentage saturation of concentration.

PH

Temperature

Ammonia, although the probes are difficult to calibrate in the field.

Suspended solids measured as surrogates e.g. conductivity, turbidity

8.2 Monitoring Duration

Quality monitors are continuous so are able to provide data before and after a data sampling event. Monitored data without its complementary sampled data is of limited use to the river model but it can impart important information about the processes in the watercourse. Data should be collected and provided for the duration of the entire period the survey is commissioned.

8.3 Calibration

All water quality monitors should be pre-calibrated in-house to known standards prior to deployment. Once installed, weekly checks should be provided with hand held devices against recorded values. Any parameters found to be outside set limits the devices should be replaced.

Monitors should be recalibrated wherever possible prior to a storm event.

In-house calibration standards:

DO	Standards zero and saturation
pH	pH standards 4 pH and 9 pH
Total Ammonia	Standards 1 and 10

Site sheets should be completed for every site visit and include details of hand held monitor readings compared with recorded values, notes on any maintenance work carried out, notes on state of river and monitoring site checks, stageboard readings, etc..

8.4 Location of Water Quality Sondes

The location of the probe of a Sonde is going to be site specific, however some guidelines can be given. The probe should not sit too close to the channel bottom in case it is buried by bedload sediment. The probe should be in the mainflow as far as possible but the problems of ragging should be guarded against. If the watercourse is subject to stratification then the probe should be placed in upper, better mixed, layer.

At some sample locations it will be worthwhile undertaking a preliminary survey to determine if there is any spatial variation in values over the section. Preliminary DO cross sectional profiling or desk studies will determine any stratification.

9. COMPLEMENTARY SURVEYS

9.1 Spot DO Monitoring

Ultimately the model will be used to develop DO profiles in the watercourse. Longitudinal DO profiling will have to be undertaken to develop confidence that the model is correctly predicting DO levels along the whole watercourse. To ensure this it is recommended that a DO profile along the watercourse is developed. This will have to be composed of a series of spot DO measurements. Figure 2 illustrates how logitudinal profiling could complement the fixed monitoring data.

These measurements should be taken at intervals down the watercourse, and at each site. The DO concentration, location, time and date should be recorded. Readings should be taken at higher spatial resolution at location were the largest DO changes are noticed or are likely to be. e.g. at weirs and ponded sections.

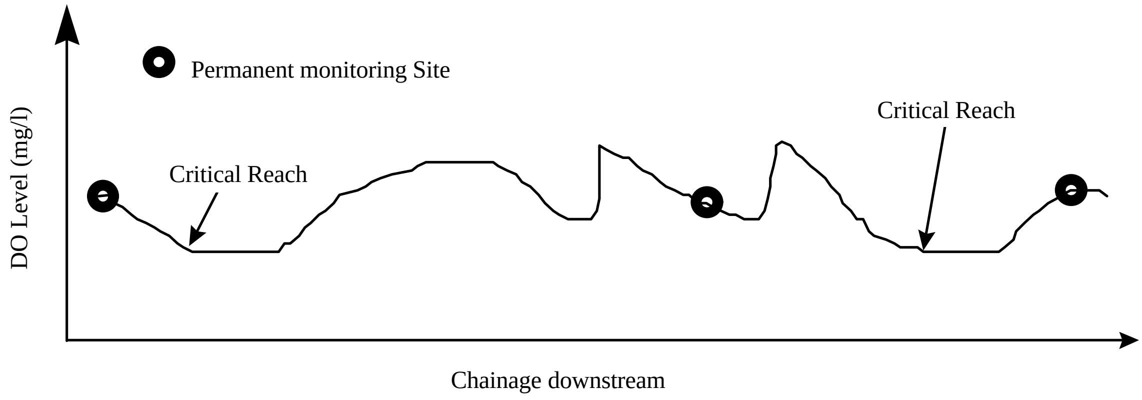
Where the watercourse is of sufficient size to take a boat, monitoring could be undertaken from the vessel, otherwise access will have to be gained from land.

The measurements should be taken as near to mid channel as possible as close to 0.8-0.6 channel depth as possible. Although this will probably be at a mean depth at a mid point in the channel.

The data collection should take place over as short a period as possible, to minimise temporal changes in oxygen levels.

Ideally the survey should take place at night, when DO levels are at their lowest, hence the maximum reaeration potential of structures and shallows can be assessed. An overcast day would be useful as photosynthetic activity would be at a minimum.

Figure 2
Longitudinal DO profile - how static monitors could miss critical reach locations



9.2 DO Monitoring of Supplementary Sites

There are generally WwTW effluents and key CSO Outfalls.

Current water quality monitoring equipment has not been designed to operate in raw sewage. Manufacturers should be contacted for further information about the performance of their sensors in such circumstances.

9.3 In River Sediments

It is extremely difficult to obtain quantitative data to establish parameter values for the coefficients in the sediment transport and sediment quality models. The values for the model have to be selected from the in-river datasets and adjusted until a reasonable fit is achieved. Supplementary sediment survey information allows values for the available sediment bed load and potency to be estimated.

Bed sediment sampling should be undertaken in dry weather flow only The requirements of the exercise are to gauge sediment potency, activity (i.e. is it inert or taking up oxygen) and availability.

The sampling locations should be specified by the modeller after the river walk.

The samples should be obtained by grab sampling

Methodologies for the analysis of river bed sediments are given in Appendix A.

River bed oxygen demand monitors have been developed and could be useful for monitoring uptake of oxygen by organic sediments. However this equipment is likely to be expensive to use in the field and will not be able to monitor sediment demands during a storm when the reserves of oxygen demanding sediments are being eroded.

9.4 Location of Outfalls

These are specified by the chainage down river, level above river (X, Y, Z co-ordinates) and the Grid reference.

A review of the sewer plans prior to a river walk allows outfalls to be anticipated and identified. However all CSOs or large outfalls (diameter greater than 450mm) should be noted.

The impact modelling requires the location of all outfalls to be incorporated in the modelling. The contractor may be required to locate these.

The level of the outfall may affect the future design of sewerage solutions. The level may also affect reaeration or sediment entrainment.

A photograph of outfall showing relationship to river is also required.

9.5 Important Features to Observe

These may be determined from the hydrometric survey.

10. FURTHER REQUIREMENTS

10.1 Quality Control of Data

Independent Checks

These checks should be made on the raw data that has been collected and should be made by the contractor. The level of checking should be specified in the data collection contract. The checks are made upon individual data elements; and are listed as follows:-

- Sufficient data has been obtained to satisfy the criteria that a full event has been met, i.e. sufficient number of bottles were filled.

- Sufficient numbers of samplers are working.

- Sufficient monitors were operational to satisfy the criteria that a full event has been met.

- The values in the data provided are within acceptable values and that any extreme or unexpected values are not attributable, laboratory technique or data collections errors.

- Values have not been taken when some of the monitors were out of calibration or going out of calibration.

- No additional discharges occurred during the data collection event e.g. the wash off of large amounts of solids from a construction site.

- Plots of time series data have been be produced to identify outlyers in the data set which may need to be explained.

11. DEPENDANT CHECKS

These checks are made on the raw data and look at the consistency of the data points and series in respect to each other. The responsibility for which party undertakes these checks should be specified in the contract document. The following checks are proposed:

- Plot hydrographs at all river modelling sites along the main stretch of river to assess water balance.

- Plot dye tracer data (concentration vs time) along river to assess consistency in measurements.

- Check quality and flow data is available for all boundary sites and that flows are available at any permanent monitoring sites.

- Check water quality data is consistent, demonstrated by plotting (concentration vs time) data series collected from different sampling sites against one another. This is useful for suspended solids, Ammonia and total BOD values.

- That BOD fractions balance (Dissolved BOD < Total BOD) and that any difference there can be accounted for. In dry weather it is also likely that the ratio of total BOD to dissolved BOD is relatively consistent.

- Any major changes in SS or BOD are cross checked against each other and other sites to determine whether they look authentic.

Data Formats

The following format is proposed for the provision of river data. No row of the spreadsheet should contain the same time and data. All dates and times should be in consecutive order. This fixed format should be used for all data sets although it is proposed that separate files are used for different types of data, i.e. Probe data, Sample data etc. The name of the file should reflect the type of data, the location and the event that has been captured.

Column	1	Blank	
Column	2	Date and Time	
Column	3	Rainfall	(Raingauge)
Column	4	Flow Depth	(Pressure transducer)
Column	5	DO mg/l	(Probe Data)
Column	6	Temperature Deg C	(Probe Data)
Column	7	pH	(Probe Data)
Column	8	Ammonia mg/l	(Probe Data)
Column	9	Total BOD	(Sample Data)
Column	10	Filtered BOD	(Sample Data)
Column	11	Total Suspended Solids	(Sample Data)
Column	12	Total Ammonia	(Sample Data)
Column	13	pH	(Sample Data)
Column	14	Nitrate	(Sample Data)
Column	15	Flow	(Flow monitor)
Column	16	Spare	
Column	17	Spare	
Column	18	Spare	
Column	19	Spare	
Column	20	Dye	(ToT)

A final report should be provided with all data in a standard ASCII or Excel / Access format on CD ROM.*Phasing of Data Collection/Provision*

The data provision should be in parallel with the modelling process.

Table 1: Proposed phasing of model data provisions

	Phase of Dynamic Model Construction	**Data Requirement**
1	River System Description	Cross Section data Plans of River System
2	Hydraulic Calibration - Dry Weather	Time of travel dye tracer studies. River flows for dye tracer studies. River flows/levels for dry weather sampling.
3	Calibration of Advection Dispersion model.	Time of travel dye tracer studies. River flows for dye tracer studies.
4	Stability testing of the WQ model. Run WQ data set in AD model then rerun in WQ mode. Typical WQ values should be adopted.	EA Routine sample data . Typical flow values.
5	Hydraulic Calibration - Wet Weather	River flows/levels from Storm Studies. CSO / surface water outfall spill flow data.
6	Water Quality Calibration – Dry Weather	River flows for dry weather sampling. Water quality data from sampling exercise. DO long section profile. Sediment sample data.
7	Water Quality Calibration – Wet Weather	River flows from Storm Studies. CSO / surface water outfall spill flow and quality data.

Reporting

Weekly reports should be produced detailing the status of the monitors and including any datasets that are available release either event data or routine measurements. This data will allow continuous assessment of the field data and the overall data collection strategy.

E-mail would offer an efficient method of transporting the data to all of the interested parties.

11.1 Auditing Data

It is recommended that the data is independently audited. Data auditing answers the questions.

Is data fit for purpose?

Has the data collection been undertaken properly?

12. WEATHER FORECASTING

Use Met Office for general weather forecasting. Rainfall Radar and FRONTIERS data can be used for review during storm standby conditions.

APPENDIX A

A1. SEDIMENT ANALYSIS LABORATORY PROCEDURE

A1.1 Remove stones over 25 mm and any unrepresentative material from the sample.

A.1.2 Stir the sample to obtain uniform consistency.

A.1.3 Take 100g of the stirred sample and place it in an industrial blender with 200 ml tap water. Blend for 30 seconds then transfer to a litre measuring cylinder, make up to a litre with tap water and shake to mix. This is the blended sample.

A.1.4 Take sub-samples of the blended sample and analyse them for BOD (ATU) and NH_4.

A.1.5 Take another 100 g of the stirred sample, place it in a litre measuring cylinder, and make up to a litre with tap water. Mix thoroughly using a gentle rolling and inverting motion to avoid entrainment of air. This is the **mixed sample.**

A.1.6 Immediately after mixing, take sub-samples of the mixed sample for determination of total suspended solids (TSS), BOD (ATU) and Ammonia. Ignore large solids which settle before they can be sub-sampled, they are not required. The settling velocity of the fine fraction should be determined using sediment from a sub-sample in the same way.

A.1.7 Allow the remainder of the mixed sample to settle in the cylinder for 15 minutes, then decant off the supernatant liquor. This is the **dissolved and very (DVF)** sample.

A.1.8 Take sub-samples of the dissolved and very fine sample and analyse them for TSS, BOD (ATU) and Ammonia.

Once this procedure has been completed, the following results will be available:

Dissolved	TSS	(mg/l)
Very Fine	BOD (ATU)	(mg/l)
Sample	Ammonia	(mg/l)

APPENDIX B

B.1. METHODOLOGY FOR TIME OF TRAVEL EXPERIMENTS

B.1.1 Extent of surveys

There shall be at least 3 sampling points for each survey. The first point should be sufficiently far downstream of the injection point to have allowed full mixing to occur. Where the survey involves a confluence, then one of the sampling points shall be below the confluence point, to allow the junction characteristics to be determined.

Where attenuation/dilution of the tracer in the river system makes it necessary to use more than one injection point, then each downstream injection point must be upstream of the previous lowest survey point, to provide overlapping time of travel traces. The injections should be so planned that there is no interference between traces.

The surveys should specify the flow bands for which data is to be collected, and the number of experiments required within each flow band. These bands should be related back to stage measurements at the principal gauging stations in the study area.

The following percentile flow bands are recommended:

For intake protection	low : <10, medium : 15 - 45, high >45
For impact modelling	low : < 25, medium : 25 - 55

B.1.2 Mass of dye required

Time of travel experiments should only be carried out using Rhodamine Wt tracer.

The mass of dye (W) required should be calculated in advance, using Churchs' equation, as listed below, to produce a maximum concentration (C_p) at the most downstream site of no more than 0.2 µg/l above background.

$W = 0.76 \times C_p \times [\, Q \times L / U \,]^{0.93}$

Where :-

W = Dry weight of 20% Rhodamine Wt dye solution (mg)

C_p = Peak concentration (μg/l)

Q = Discharge (cumecs)

L = Reach Length (m)

U = Mean velocity (m/s)

A default travel time for each reach can be calculated from the following equation.

$T = L / \; [\, S * Q^{0.93}]$

Where :-

T = Travel time (secs)

L = Reach Length (m)

S = Slope factor (from 0.1 for flat catchments to 0.5 for steep catchments)

Q = Discharge (cumecs)

Prior to any intended survey, there should be at least 24 hours notice to the nominated contacts of both the Water Company and the Environment Agency, and a table of proposed injection and site arrival times produced.

B.1.3 Experiment methodology

Dye injection shall be by the gulp method.

Preliminary site measurements should be made to establish the background fluorescence of the reaches.

Data should be collected using continuously measuring fluorimeter. The waveband filter of the fluorimeter should be chosen to minimise the background interference to the trace. The equipment should not require mains power to work.

Sufficient fluorimeters should be used enable all of the data acceptability criteria to be met.

Tracer studies should not be carried out in adverse weather conditions. Tracing exercises, whenever possible, should be undertaken at a constant discharge for the duration of the experiment.

Backup equipment or alternative support system should be on hand throughout the survey to ensure continued sampling throughout the survey and adequate protection for any potable water supply intakes.

B.1.4 Acceptable data collection

Data collected from surveys will only be regarded as acceptable if the time - concentration curve shows for each site :

- the arrival time of the tracer
- clear peak definition
- a tail receding to at least 5% of the peak concentration.

The time v concentration data should be provided in an agreed electronic format for each survey. The survey site should be clearly identified. All measurements should be date and time stamped to local clock time reference frame.

A summary table should be provided for each survey, covering the following information :

- Date and time of gulp injection, and mass of dye injected
- For each downstream site :
    - Sampling site and distance downstream of injection site
    - First arrival time
    - End time and concentration
    - Peak concentration and time

A single summary graph, showing all the travel time curves for the individual sites, should be provided.

Where the time of travel characteristics have been analysed, the following information should also be provided :

- Time to centroid
- Individual reach mean velocity
- Steady state gain/loss
- Estimated discharge for the reach