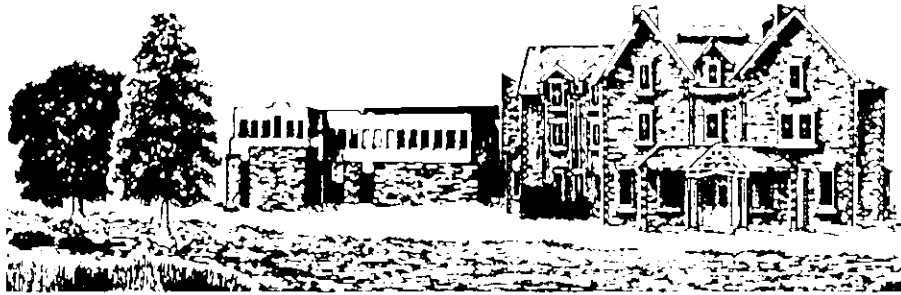




FRESHWATER
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The **Freshwater Biological Association** is the leading scientific research organisation for the freshwater environment in the United Kingdom. It was founded in 1929 as an independent organisation to pursue fundamental research into all aspects of freshwater biology and chemistry. The FBA has two main laboratories. The headquarters is at Windermere in the Lake District and the River Laboratory is in the south of England. A small unit has recently been established near Huntingdon to study slow flowing eastern rivers.

The FBA's primary source of funding is the Natural Environment Research Council but, in addition, the Association receives substantial support from the Department of the Environment and the Ministry of Agriculture, Fisheries and Food who commission research projects relevant to their interests and responsibilities. It also carries out contracts for consulting engineers, water authorities, private industry, conservation bodies, local government and international agencies.

The staff includes scientists who are acknowledged experts in all the major disciplines. They regularly attend international meetings and visit laboratories in other countries to extend their experience and keep up to date with new developments. Their own knowledge is backed by a library housing an unrivalled collection of books and periodicals on freshwater science and with access to computerized information retrieval services. A range of experimental facilities is available to carry out trials under controlled conditions. These resources can be made available to help solve many types of practical problems. Moreover, as a member of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council, the FBA is able to link up with other institutes to provide a wider range of environmental expertise as the occasion demands. Thus, the FBA is in a unique position to bring relevant expertise together for problems involving several disciplines.

Recent contracts have involved a wide variety of topics including biological monitoring, environmental impact assessment, fisheries problems, salmon counting, ecological effects of reservoirs and other engineering works, control of water weeds, control of insect pests and effects of chemicals on plants and animals.

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**A30 Okehampton Bypass
Control of Pollution
Biological Monitoring
Final Report**

**A report to Babbie Shaw & Morton,
Consulting Engineers**

M.T. Furse, R.J.M. Gunn & H.A. Johnson

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The Freshwater Biological Association is part of the Terrestrial and Freshwater Sciences Directorate of the Natural Environment Research Council.



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SECTION 1
INTRODUCTION

1. INTRODUCTION

The use of aquatic macro-invertebrates to monitor the environmental quality of streams and rivers is widely practised in Great Britain and other parts of the world.

Whereas chemical sampling gives precise measurements of the conditions pertaining at the time and place of collection, biological communities integrate all the chronic and extreme environmental conditions over the recent past.

The combined acquisition of chemical and biological data provide a greater understanding than either would on their own.

SECTION 2
DATA COLLECTION

2. DATA COLLECTION

Study sites

Study sites on the West and East Okement (Table 1) were selected following consultation between representatives of Devon County Council (DCC), South West Water (SWWA), Babbie, Shaw and Morton (BSM) and the Freshwater Biological Association (FBA).

Two control sites were chosen on the West Okement. One, at Vellake Cottage (W1), was upstream of the influence of Meldon Reservoir and the other, (W2), was downstream of the reservoir. This approach was adopted in case the reservoir itself was having a deleterious impact on the macro-invertebrate communities. Both control sites were upstream of the possible perturbing effects of Meldon Quarry and the bypass construction and crossing point.

Unfortunately the quarry adit is situated only some 50 m upstream of the bypass crossing point. The extent of the construction site is such that it was impossible to have a sampling site between these two potential sources of impact. This has inevitably led to difficulties in distinguishing between the effects of the two influences. Under these circumstances the existence of the environmentally similar East Okement stream, which is also crossed by the bypass but has no quarry workings, provides a form of control situation.

The remaining four sites on the West Okement (W3-W6) were at successive locations downstream of the quarry and bypass in order to examine the spatial persistence of any observed perturbation.

The bypass construction and crossing point was the only identified possible cause of perturbation on the East Okement. Consequently only one control site (E7) was chosen. The three remaining sites (E8-E10) were at successive distances downstream of the bypass.

During the study period the visual appearance of the Railway Stream deteriorated downstream of the point at which the bypass crossed it. In order to examine the macro-invertebrate communities of this stream sampling sites were selected upstream and downstream of the joint bypass and railway crossing point (Table 1). The two sites were well matched for slope, width, depth, substratum characteristics and degree of shading.

Sampling programme

The sampling programme was also devised following consultation between the four interested parties (DCC, SWWA, BSM and FBA).

Samples were taken at quarterly intervals between June 1987 and September 1988 (Table 2). By agreement with DCC the December 1987 samples were collected but not analysed. Provisional plans to sample in December 1988 were abandoned following consultations.

The Railway Stream was only sampled in December 1987 and these collections were fully analysed.

The first substantial construction work on the bypass began in late January 1987, prior to the first biological sampling but all major works had been completed immediately prior to the September 1988 sampling.

Sampling methods

At the suggestion of South West Water, macro-invertebrate samples from the West and East Okement were collected using a box sampler of the type recommended by the Standing Committee of Analysts (1982). The area enclosed by the sampler was 0.05 m².

Three separate samples were collected from each site on each sampling occasion.

A more common method of sampling used by most British Water Authorities and River Purification Boards is timed pond-netting (Furse *et al.* 1981). In order to compare the effectiveness of pond-netting and box-sampling, collections were made by both methods at each site visited in June 1987. A single pond-net sample, of three minutes duration, was taken at each location. The dimensions of the pond-net were a 900 µm mesh net, with an aperture of 230 x 255 mm and 275 mm bag depth, fitted to a 1.5 m handle.

Collections at the two Railway Stream sites were made by three minute pond-netting because the channel was too narrow and shallow to use the box sampler.

Sample analysis

Samples were preserved in formalin in the field and taken to the laboratory for examination. In most cases all macro-invertebrates were removed from the sample for identification, but occasionally sub-sampling procedures were adopted. Most taxa, with the exception of Oligochaeta (worms) and Chironomidae (midges) were identified to species where possible.

The following data were recorded:

1. Abundance of individual species in each sample.
2. Abundance of individual families in each sample.
3. Biological Monitoring Working Party (BMWP) scores, number of scoring taxa and Average Score per Taxon (ASPT).

The BMWP score system (Armitage *et al.* 1983) is the biological index most widely used by Water Authorities for assessing environmental quality of rivers. It was devised for, and used in, the national River Water Quality survey conducted by the Department of the Environment in 1980.

Each taxon (usually family) is ascribed a score reflecting the general pollution tolerance of its component species. The higher the taxon's score the less tolerant it is of pollution. The site BMWP score is the sum of the scores of the individual taxa recorded there. Thus the higher the site score the better its environmental quality is assumed to be. This is because a diverse range of high scoring (pollution intolerant) taxa indicate that a site is substantially unstressed.

The Average Score per Taxon (ASPT) is the average score of the taxa present. It is derived by dividing the site BMWP score by the number of scoring taxa. The higher the ASPT value the better the site's environmental quality is assumed to be.

However the precise BMWP scores and ASPT to be expected at an unpolluted site will depend upon season of sampling, the site's geographical location and its particular physical and chemical characteristics. These characteristics include substratum type, width, depth, current speed, distance from source, site altitude, slope and the unpolluted water chemistry.

The Freshwater Biological Association have developed a computer package (RIVPACS) which enables the BMWP score and ASPT of an unpolluted site in a particular season to be predicted from measured environmental features (Moss *et al.* 1987). Predictions are accompanied by 95% confidence intervals to allow for statistical variability in biological sampling. The necessary environmental data for the West and East Okement were collected during biological sampling visits or have been subsequently acquired from maps or South West Water (Table 3). In all cases the chemical values used were those from control sites (W2 and E7) since these represent the natural conditions which exist in the river upstream of any potential influence of bypass construction work.

The biological condition of the stream may be assessed by the following ratio

Observed value (score or ASPT) : Expected or predicted value (score or ASPT)

This ratio is termed the Environmental Quality Index (EQI). It has a value of one if the site exactly meets its optimal quality standard but falls below unity as quality declines. The values of ASPT acquired by sampling are less effort dependant, and therefore more reliable, than BMWP scores (Armitage *et al.* 1983). Confidence intervals around score-based EQI's are thus greater than around ASPT-based values of the index.

EQI values may also be computed for the observed and expected number of taxa and these may be applied to the whole community or to selected taxonomic groups.

Historical data

All known Water Authority data on the biological monitoring of the macro-invertebrate communities of the West and East Okement were made available to the authors by South West Water.

These have been used to compare the biological conditions of the sampling sites during, and immediately after, the bypass construction phase with those pertaining prior to these works.

SECTION 3
RESULTS

3. RESULTS

Comparison of box samples and pond-net samples

Individual pond-net samples collected at each site in June 1987 were compared with the equivalent combined results of the three box samples.

Mean BMWP score, number of scoring taxa and ASPT were usually slightly higher for pond-net samples than combined box samples. However the differences were never statistically significant, as assessed by the Wilcoxon Matched Pair test.

	Mean score	Mean no. taxa	Mean ASPT
Box samples	82.7	13.4	6.05
Pond-net samples	99.5	15.3	6.24
Wilcoxon Z value	-1.60	-1.82	-1.01

The patterns of environmental quality indicated by the two sampling methods were also similar. This was indicated by correlation analysis of the BMWP scores, number of scoring taxa and ASPT's for the 10 sites. In the case of score and number of scoring taxa the r values are highly significant (score $p < 0.02$; taxa $p < 0.01$) whilst ASPT only just fails to be significant.

In view of these analyses it was decided that future sampling should be by the box sampler. This procedure is approved by the Standing Committee of Analysts and may have more credibility in law or public enquiry.

Environmental quality

BMWP scores, number of scoring taxa and average score per taxon have been calculated for each West and East Okement site for each sampling occasion (Appendices 1 and 2). Quarterly results have been presented to Devon County Council in a series of interim reports (Furse *et al.* 1988) and are reproduced here in graphical form (Figure 1). Each point is derived from the combined taxon list from the three box samples collected at that site in that season.

These data have subsequently been compared with predicted values for the appropriate site and season (Figure 2). This enables direct temporal and spatial comparison between samples and also allows each site to be assessed against its optimal environmental quality in the absence of perturbation.

The historical samples collected by South West Water have been examined in the same way for comparative purposes. Environmental values used to predict historical indices are the mean of the individual data collected during 1987-88.

Sampling effort for historical data has not been standardised and score values obtained by South West Water may not necessarily be comparable with predicted values. This qualification should not apply to ASPT values which, as noted above, are much less effort dependent.

The two branches of the Okement will be considered separately on a site by site basis.

West Okement

Site W1: This control site is approximately 200 m upstream of Meldon Reservoir and approximately 3 km upstream of the quarry adit/bypass crossing point.

All observed scores and ASPT's lay within the 95% confidence intervals around the predicted values (Figure 2). The environmental quality of the site therefore met normal expectations.

Site W2: This control site is approximately 500 m downstream of Meldon Dam. It is approximately 100 m upstream of the quarry adit and 150 m upstream of the bypass crossing point.

All observed ASPT values and all but one of the observed scores fell within the 95% confidence limits around predicted values. The single exception was the score obtained by South West Water in December 1986. No details of the Authority's sampling method are given and the low value may be effort related. The observed ASPT value for this sample almost exactly matched the prediction.

The environmental quality of the site met normal expectations.

Site W3: This site is approximately 300 m downstream of the bypass crossing point and 350 m downstream of the quarry adit.

Historical ASPT values (June 1981 and December 1986) indicate that the environmental quality of the site met normal expectations at that time. The score in 1981 (two minutes pond-netting rather than the standard three) was just within the expected range but in 1986 (effort undefined) lay just below the lower 95% confidence interval.

Samples collected during and immediately after the bypass construction indicate a fall in environmental quality. Only once (March 1988) did the ASPT value fall within the 95% confidence intervals of the prediction. EQI's for score were consistently, and often considerably, below expectation.

The environmental quality of this site fell below normal expectations during 1987-88. This decline appeared to be on-going with poorer quality detected in June and September 1988 than in previous quarters. The EQI values in late 1988 are approximately equivalent to the NWC chemical water quality category 2 (fair).

Site W4: This site is approximately 1 km below the quarry adit and bypass crossing point.

The single historical EQI for ASPT (December 1986) closely matched expectations but the score, which was obtained using undefined effort, fell just below the lower 95% confidence intervals. During 1987-88 the majority of EQI's for ASPT and all EQI's for score were outside the acceptable range.

The environmental quality of this site fell below normal expectations during 1987-88. Again the values for June and September 1988 were noticeably poorer than earlier quarters. The EQI values in these months were approximately equivalent to NWC chemical water quality category 3 (poor).

Site W5: This site lies approximately 1.5 km downstream of the quarry adit and bypass crossing point. It also lies about 100 m downstream of the entry of the Railway Stream.

The average EQI values for this site were lower than for any other sampled. All values were well below expectations with the lowest EQI's again recorded in the last two quarters. Unfortunately no historical data have been found for this site to provide comparison.

The environmental quality of this site was approximately equivalent to NWC chemical classes 2-3 throughout 1987-88.

Site W6: This site is approximately 2 km downstream of the quarry adit and bypass crossing point. It is also about 1 km upstream of the confluence with the East Okement.

Most historical data (June 1981 and December 1986) indicate that the site met normal expectations at those times. Subsequent EQI values have, with one exception, been below the predicted range. Recorded values have been rather more erratic than for the sites upstream but once again the lowest EQI's were obtained in a later sample (September 1988).

The environmental quality of this site fell below normal expectations in 1987-88. Most EQI values were approximately equivalent to NWC chemical class 2 but the September 1988 values were indicative of chemical class 3.

General: Both control sites met normal environmental quality standards and therefore indicated no major perturbation to the fauna of the West Okement river upstream of the Meldon Quarry adit and bypass crossing point.

Historical data generally indicated that sites downstream of the current bypass crossing point also met normal environmental quality standards. This was particularly true of the less effort dependent EQI's derived from ASPT values.

Data collected from sites (W3-W6) downstream of the bypass crossing point show a marked and continuing decline in biologically-indicated environmental quality since construction work started.

Any assumption of a causal relationship between the roadworks and the declining environmental quality of the West Okement ignores another important and simultaneous development.

Drainage water from the adjacent Meldon Quarry has historically entered the West Okement near the new bypass crossing point. This quarry water had consistently low pH, i.e. was very acidic, and had consistently high levels of metal concentrations. These chemical conditions were considerably more extreme than normal levels in the West Okement.

Prior to 1987 most water was conveyed to the river via a channel known as the Meldon Quarry Stream. A smaller proportion drained across moist woodlands in poorly defined channels. This wetland area acted partially as a sink and partially as a filter and effectively reduced the effects of quarry water on the West Okement.

In 1987 the route of discharge of quarry water to the West Okement was altered to enable Meldon Quarry to be worked deeper (Construction News 1987). The new route was via a 60 m deep, 600 mm diameter drainage borehole in the quarry into a 2.1 m high and 1.6 m wide adit. The adit then gravity fed the collected water into the West Okement at a point approximately 50 m upstream of the bypass crossing point.

The precise date at which the adit became operational is not known but Construction News (1987) suggested that the contract to build the adit would be completed by the end of June 1987.

No data are available on the quantity or quality of water entering the West Okement via the adit. In view of the fact that the drained water receives no treatment it is reasonable to assume that the water entering the river is both very acidic and with high concentrations of dissolved and suspended metals. It is also possible that the increased depth of operation at the quarry and the more efficient drainage system will have led to a corresponding increase in the quantity of water entering the river.

The effects of any reduction in the pH of the waters of the West Okement and of any increase in metal loadings can be expected to be deleterious to many species of macro-invertebrates.

The relative impact of the Meldon Quarry discharge and the bypass construction must remain the subject of speculation on the basis of existing data. This situation is exacerbated by there being no opportunity to sample the river in the stretch between the adit and bypass. However, further circumstantial evidence is available from the East Okement where the detection of any impact of bypass construction would not be complicated by acid quarry drainage.

East Okement

Site E7: This control site lies approximately 100 m upstream of the bypass crossing point.

Most EQI's lay within the predicted 95% confidence intervals. Indeed two samples (September 1987 and June 1988) indicate a particularly rich fauna. The historical EQI for December 1986 fell below expectation as was the case for many samples taken at this time and whose method of collection is unknown.

The environmental quality of this site meets normal expectations.

Site E8: This site lies approximately 150 m downstream of the bypass crossing point.

All historical samples, and those collected during 1987-88 lay within the predicted 95% confidence intervals.

Environmental quality consistently met normal expectations and no significant environmental impact, of bypass construction work, upon aquatic macro-invertebrate communities was detected.

Site E9: This site is situated approximately 500 m downstream of the bypass crossing point.

No historical data were available but all EQI values for samples collected in 1987-88 lay within or exceeded normal expectations. No significant environmental quality reduction was recorded at this site. Lowest EQI values occurred in March and June 1988 but in all cases they were above the lower 95% confidence interval.

Site E10: This site is approximately 1.5 km downstream of the bypass crossing point. It is also about 400 m upstream of the confluence with the West Okement.

Historical samples indicate very good environmental quality at this site in June 1981 and December 1986. These high standards were maintained in 1987. A noticeable decline was recorded in March and June 1988, although on only one occasion did any EQI value fall below the acceptable range.

The decline in quality in these two months coincided with similar falls at E9. During the March 1988 biological sampling the river was heavily discoloured by a milky suspension of material emanating from construction work at the bypass crossing point. This, probably inorganic, material either in suspension or deposited may have been having slight deleterious effects upon the macro-invertebrate fauna.

Similar, but much less pronounced discolouration of the water, resulting from bypass construction work, was noted in June 1988.

On each occasion the presence and origin of the suspended material was reported to Devon County Council and it is understood that remedial action was taken (Devon County Council, pers. comm.).

EQI values for E10, and for E9, were at their usual high levels in September 1988 and therefore there was no chronic decline in environmental quality over the period of bypass construction.

General: The environmental quality of the East Okement has been maintained at an acceptably high standard. On only one occasion did either environmental quality index fall below the acceptable range. A possible reason for the decline was drawn to the attention of Devon County Council. The biologically-indicated environmental quality of all four sites, at the end of the construction period, was as good as the situation prior to the roadworks and/or predicted standards.

As indicated earlier, these findings provide circumstantial evidence to suggest that bypass construction may not have been the cause of the reduction in environmental quality recorded at sites W3-W6 on the West Okement.

Railway Stream

Site RS1: This site is situated 100 m upstream of the adjacent bypass and railway crossing point.

Predicted target values could not be obtained because streams of this small size are outside the operating range of RIVPACS. However, the recorded values in December 1987 of score (146) and ASPT (6.35) suggest the site is not perturbed and is of good environmental quality.

Site RS2: This site is approximately 200 m downstream of the adjacent bypass and railway crossing points.

The recorded values in December 1987 of score (6) and ASPT (3.0) suggest the site is severely perturbed and is of very poor environmental quality.

General: The decision to sample these sites was prompted by the oily appearance and diesel-like smell of the stream in September 1987.

Analysis of the samples revealed a major decline in environmental quality over the 300 m distance between sites.

Chemical analyses and information provided by Devon County Council suggest that the decline was most likely due to the release of acid quarry drainage water down the stream.

This water was previously carried by pipeline from Meldon Quarry to the Okehampton Railway Station. This pipeline was fractured near the course of the Railway Stream during highway construction and the released water, which is acidic and has high levels of metals, has subsequently flowed down the Railway Stream (Devon County Council, pers. comm.).

The added volume of acidic water to the West Okement, upstream of sites W5 and W6, may have further contributed to their poor environmental quality.

An alternative route, if economically feasible, would be to direct the pipeline water into a series of small rivulets which previously flowed across Okehampton Golf Course and disappeared into a wetland area adjacent to the West Okement.

New drainage arrangements alongside the bypass are reported to have substantially dried these water courses and this may lead to a consequent loss of wetland (Devon County Council, pers. comm.). Directing the quarry water down these channels would restore both them and the wetlands but the filtering action of the latter should prevent acidic water from entering the main river.

The fauna

One hundred and four distinct taxa, principally species, have been recorded from the study sites. The numbers found at each study site varied from 56 at site E9 on the lower East Okement to just 2 on the lower Railway Stream site (Table 4). These 104 taxa are distributed amongst 51 families or larger taxonomic groupings. The numbers of "families" at each site have also been counted (Table 4).

The highest number of taxa, both "species" and "families" were generally recorded at the East Okement sites but approximately similar numbers were taken from the two control sites (W1 and W2) on the West Okement. Numbers of species recorded downstream of the West Okement bypass crossing point and quarry adit were approximately half those recorded at the control sites.

Numbers of taxa at the two Railway Stream sites are based on a single season's sampling whereas all other lists are compiled from five separate seasons.

The frequency with which individual "species" were found in the fifteen box samples is given in Table 5. Other taxa recorded from the sites in the June 1987 pond-net samples or in samples collected by South West Water are also indicated to provide the most comprehensive listings for the sites and the river system as a whole. Similar family level data are provided in Table 6.

None of the taxa recorded are particularly rare or of notable conservation status. Full listings of the number of individuals in each species and family in each box sample from each site have already been presented to Devon County Council in a series of interim reports (Furse *et al.* 1988). These data are reproduced here (Appendices 3-6) whilst full species lists for the two Railway Stream sites are given in Appendix 7.

Scrutiny of these appendices shows that it was the high scoring BMWP families, i.e. those which are least tolerant of pollution, which were principally absent from, or scarce at, sites W3-W6. These taxa are mainly from three orders of insects, the Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddis).

As with BMWP score and ASPT, the Freshwater Biological Association's RIVPACS system enables the number of families of each order which were recorded at each site to be compared with the number expected and the result expressed as Environmental Quality Indices (EQI's).

A simple graphical presentation of the EQI's for each order at each site illustrates the changes occurring in the river (Figure 3). In these examples mean EQI's with standard deviations are plotted for each site.

On the West Okement there are marked declines in the EQI values for Ephemeroptera and Plecoptera downstream of the bypass crossing point and quarry adit, indicating fewer occurrences of these taxa than expected. A similar but less pronounced trend is apparent for Trichoptera which generally occur less frequently than expected throughout the river system. On the East Okement the frequency of occurrence of all three orders meets or exceeds expectation on almost all occasions.

SECTION 4
CONCLUSIONS

4. CONCLUSIONS

West Okement

Control sites on the river immediately upstream and downstream of Meldon Reservoir are of good environmental quality.

Historically, i.e. pre-1987, sites downstream of the Meldon Quarry adit and the Okehampton bypass crossing point were also of good environmental quality.

Environmental quality of the sites downstream of the quarry adit and the bypass crossing point declined markedly during the highway construction work (June 1987-September 1988).

Environmental quality at these sites was particularly poor in the latter half of 1988 when biologically-based environmental quality indices indicated equivalent NWC chemical quality classes 2 (fair) or 3 (poor).

The decline in quality indices resulted from a reduction in the number of taxa occurring at these sites, particularly the pollution intolerant insect groups, mayflies, stoneflies and caddis.

The fall in environmental quality at sites downstream of the bypass crossing point coincided with, but may not have been caused by, highway construction work.

Changes in the manner by which drainage water is discharged from Meldon Quarry into the West Okement were implemented in mid-1987.

The new drainage system may have led to an increase in the quantity of water entering the West Okement from the Meldon Quarry although no direct evidence is available to confirm this theory.

The quarry drainage water is very acidic and carries high levels of dissolved and suspended metals and this may have a deleterious effect on the fauna of the receiving stream, the West Okement.

The close proximity of the inflow adit from the quarry to the river and the highway construction sites precludes a sampling site being established between them and makes it difficult to distinguish between the impact of the two processes.

The absence of significant deterioration in the environmental quality of the East Okement, which is similar in size and character to the West Okement and has a bypass crossing but not quarrying activity, provides circumstantial evidence to suggest that highway construction may not be the cause of the decline in environmental quality on the West Okement.

East Okement

The control site and all three potential impact sites were of generally high quality throughout the period of highway construction.

Slight loss of quality was noted at the two downstream sites (E9 and E10) in March and June 1988 but even so Environmental Quality Indices were generally at an acceptable level.

The fall in environmental quality noted above coincided with discolouration of the river due to suspended, probably inorganic, material emanating from construction work at the bypass crossing point.

The suspended material, and its deposition, may have been deleterious to the aquatic fauna.

The occurrence of the excessive suspended solids load was reported to Devon County Council and remedial measures were taken.

The values of biologically-based environmental quality indices show that the quality of all four sites is as high at the end of the highway construction work as it was before work began.

Railway Stream

The Railway Stream, 100 m upstream of the adjacent bypass and railway crossing points, supported an abundant and diverse macro-invertebrate fauna in December 1987.

The same stream 200 m downstream of the crossing points was almost totally devoid of macro-invertebrates and was clearly severely perturbed.

This decline in quality is attributable to the continuous or intermittent release, into the stream, of acid water from Meldon Quarry via a pipeline fractured during highway construction.

This water subsequently enters the West Okement and may contribute to the poor environmental quality of the two sites downstream of the inflow point.

Diversion of the released quarry water into small watercourses that cross Okehampton Golf Course will restore discharge in these channels to pre-bypass levels and will help maintain wetlands adjacent to the West Okement.

Directing water onto these wetlands should lead to it percolating into the ground and not flowing directly into the West Okement.

General

South West Water are advised to obtain further information on the quantity and quality of water entering the West Okement from Meldon Quarry to ensure that it is not having an unacceptably deleterious effect on the environmental quality of the river.

SECTION 5
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5. ACKNOWLEDGEMENTS

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The text of this report was typed by Diana Morton.

SECTION 6
REFERENCES

6. REFERENCES

- Armitage, P.D.; Moss, D.; Wright, J.F. & Furse, M.T. (1983). The performance of a new biological water quality score system based on macroinvertebrates over a wide range of unpolluted running-water sites. Water Research, **17**, 333-347.
- Construction News (1987). Where cranes and mixers mingle with bluebells. Construction News, May 28, 14.
- Furse, M.T.; Blackburn, J.H. & Dear, B.E. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, September 1988, 1-15.
- Furse, M.T. & Gunn, R.J.M. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, June 1987, 1-16.
- Furse, M.T.; Gunn, R.J.M. & Hopgood, H.A. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, September 1987, 1-13.
- Furse, M.T.; Gunn, R.J.M. & Hopgood, H.A. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, December 1987, 1-3.
- Furse, M.T.; Gunn, R.J.M.; Hopgood, H.A. & Blackburn, J.H. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, March 1988, 1-13.
- Furse, M.T.; Gunn, R.J.M. & Johnson, H.A. (1988). A30 Okehampton Bypass. Control of Pollution. Biological Monitoring. An Interim Report to Babbie Shaw & Morton, Consulting Engineers, June 1988, 1-15.
- Furse, M.T.; Wright, J.F.; Armitage, P.D. & Moss, D. (1981) An appraisal of pond-net samples for biological monitoring of lotic macro-invertebrates. Water Research, **15**, 679-689.
- Moss, D.; Furse, M.T.; Wright, J.F. & Armitage, P.D. (1987). The prediction of the macro-invertebrate fauna of unpolluted running-water sites in Great Britain using environmental data. Freshwater Biology, **17**, 41-52.
- Standing Committee of Analysts (1982). Quantitative samplers for benthic macroinvertebrates in shallow flowing waters. 1980. London. HMSO, 1-16.

SECTION 7
TABLES

Table 1. Location of study sites, with equivalent chemical sampling site codes.

Code	Site name	NGR	Chemical sampling point
<u>West Okement</u>			
W1	Vellake Cottage	SX 555 906	SB1
W2	U/S of Meldon Quarry adit and bypass	SX 565 928	SB2
W3	D/S of bypass	SX 566 932	SB3
W4	U/S of Wigney	SX 568 935	SB4
W5	Okehampton Golf Course	SX 575 939	SB5
W6	Okehampton Castle	SX 585 944	SB6
<u>East Okement</u>			
E7	U/S of bypass	SX 604 947	SB7
E8	D/S of bypass	SX 602 948	SB8
E9	Ball Hill	SX 597 946	SB9
E10	Okehampton Grammar School	SX 589 949	SB10
<u>Railway Stream</u>			
RS1	100 m U/S bypass	SX 575 937	-
RS2	200 m D/S bypass	SX 576 935	-

Table 2. Sampling dates.

June 1987	8. 6.87	W1-W6, E7-E10
September 1987	10. 9.87	W1-W6, E7-E10
December 1987	30.11.87 1.12.87	W3-W4, W6, E7-E10, RS1-RS2 W1-W2, W5
March 1988	2. 3.88	W1-W6, E7-E10
June 1988	13. 6.88	W1-W6, E7-E10
September 1988	13. 9.88	W1-W6, E7-E10

Table 3. Environmental data used to predict expected BMWP scores, ASPT's and numbers of selected taxa.

3a West Okement

Variable	W1		W2		W3		W4		W5		W6	
	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988	1987	1988
Water width (m)	6.2	6.1	9.0	8.4	9.7	7.8	7.7	7.1	8.3	8.7	15.0	12.7
Mean depth (cm)	34.8	23.8	30.2	20.4	22.7	15.7	28.3	17.6	21.4	15.4	35.6	17.0
Surface velocity (category)*	4	4	4	4	4	4	4	3	4	4	3	3
Substratum cover (%)	79.7	82.7	77.0	84.7	80.3	81.7	83.3	78.3	83.3	78.3	67.7	86.6
Boulders & cobbles	17.0	14.7	20.3	14.7	16.0	17.0	13.0	20.3	14.0	20.0	26.0	11.0
Pebbles & gravel	3.3	2.7	2.0	0.3	3.0	0.3	2.3	0.7	1.7	1.0	3.0	0.7
Sand	0	0	0.7	0.3	0.7	1.0	1.3	0.7	1.0	0.7	3.3	1.7
Silt & clay	280	280	200	200	190	190	185	185	175	175	160	160
Altitude of site (m)	4-02	4-02	4-01	4-01	4-01	4-01	4-01	4-01	4-00	4-00	4-00	4-00
Longitude (°-' W)	50-42	50-42	50-43	50-43	50-43	50-43	50-43	50-43	50-43	50-43	50-44	50-44
Latitude (°-' N)	7.4	7.4	10.0	10.0	10.5	10.5	10.9	10.9	11.7	11.7	12.1	12.1
Distance from source (km)	19	19	25	25	20	20	16.5	16.5	10.2	10.2	12.7	12.7
Slope (m km ⁻¹)	2	2	2	2	2	2	2	2	2	2	2	2
Discharge category+	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Total alkalinity (mg l ⁻¹ CaCO ₃)	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
Chloride (mg l ⁻¹ Cl ⁻)												

*Surface velocity categories: 3 = >25-50 cm sec⁻¹, 4 = >50-100 cm sec⁻¹+Discharge category: 2 = >0.31-0.62 cubic metres sec⁻¹

3b East Okement

Variable	E7		E8		E9		E10	
	1987	1988	1987	1988	1987	1988	1987	1988
Water width (m)	8.7	8.8	7.0	7.8	7.5	7.0	9.0	9.3
Mean depth (cm)	29.4	24.3	41.6	27.7	23.2	19.7	24.6	17.3
Surface velocity (category)*	4	4	5	4	4	4	3	3
Substratum cover (%)	78.7	70.0	73.3	76.0	73.3	65.3	69.3	74.0
Boulders & cobbles	18.0	28.3	20.3	20.3	19.7	30.3	24.7	22.7
Pebbles & gravel	3.0	1.7	5.7	1.3	6.0	3.3	4.7	2.7
Sand	0.3	0	0.7	2.3	1.0	1.0	1.3	0.7
Silt & clay	195	195	185	185	175	175	157	157
Altitude of site (m)	4-58	4-58	4-58	4-58	4-59	4-59	4-59	4-59
Longitude ($^{\circ}$ -' W)	50-44	50-44	50-44	50-44	50-44	50-44	50-44	50-44
Latitude ($^{\circ}$ -' N)	6.8	6.8	7.0	7.0	7.4	7.4	8.4	8.4
Distance from source (km)	31.2	31.2	31.2	31.2	15.9	15.9	21.2	21.2
Slope (m km $^{-1}$)	2	2	2	2	2	2	2	2
Discharge category+	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Total alkalinity (mg l $^{-1}$ CaCO $_3$)	8.6	8.6	8.6	8.6	8.6	8.6	8.6	8.6
Chloride (mg l $^{-1}$ Cl $^{-}$)								

*Surface velocity categories: 3 and 4 see table 3a. 5 = >100 cm sec $^{-1}$

+Discharge category: 2 = >0.31-0.62 cubic metres sec $^{-1}$

Table 4. The number of distinct "species" and "families" recorded at each study site during 1987-88.

	W1	W2	W3	W4	W5	Site W6	RS1	RS2	E7	E8	E9	E10
Species	40	50	29	29	29	27	26	2	54	48	56	52
Families	24	30	19	22	21	20	23	2	31	30	35	34

TAXON	SITE											
	W1	W2	W3	W4	W5	W6	RS1	RS2	E7	E8	E9	E10
PLECOPTERA (STONEFLIES)												
Taeniopterygidae												
Brachyptera risi	3	1	-	-	-	-	-	-	-	1	1	-
Neouridae												
Protonemura aeyeri	8	2	-	-	2	1	+	-	3	2	2	N
Amphinemura sulcicollis	7	4	4	3	3	1	-	-	3	4	2	2
Nemurella picteti	-	-	-	-	-	-	-	-	-	-	1	-
Nemoura avicularis	-	1	-	-	-	-	-	-	-	1	1	3
Nemoura cambrica group	-	-	-	-	-	-	+	-	-	-	-	-
Leuctridae												
Leuctra geniculata	-	-	1	-	-	-	-	-	-	-	-	-
Leuctra inermis	10	10	4	3	2	H	-	-	7	4	2	-
Leuctra hippopus	3	3	2	1	1	-	-	-	1	-	-	1
Leuctra nigra	-	-	-	-	-	-	-	-	1	-	-	-
Leuctra fusca	7	8	2	1	-	3	-	-	8	6	6	5
Perlodidae												
Perloides microcephala	5	6	-	-	-	-	-	-	3	4	4	2
Isoperla grammatica	9	8	1	3	-	H	-	-	3	1	2	-
Perlidae												
Dinocras cephalotes	-	2	-	-	-	-	-	-	-	-	-	-
Chloroperlidae												
Chloroperla torrentium	8	10	2	2	-	2	+	-	12	4	4	2
Chloroperla tripunctata	4	9	1	1	3	H	-	-	12	8	7	8
ODONATA (DRAGON/DAMSELFLIES)												
Cordulegasteridae												
Cordulegaster boltonii	-	-	-	-	-	-	-	-	-	N	-	-
COLEOPTERA (BEETLES)												
Dytiscidae												
Dreodytes sanmarkii	-	2	-	-	1	-	-	-	-	-	2	1
Dreodytes septentrionalis	-	-	-	-	-	N	-	-	-	-	-	-
Hydroporus tessellatus	-	N	N	-	-	-	-	-	-	-	-	-
Gyrinidae												
Orectochilus villosus	H?	4	-	-	-	-	-	-	-	N	-	1
Hydrophilidae (incl. Hydraenidae)												
Hydraena gracilis	2	3	-	-	-	-	-	-	9	1	-	1
Helophorus brevipalpis	-	-	-	-	-	-	-	-	1	-	-	-
Anacaena globulus	-	-	-	-	-	N	-	-	-	-	-	-
Scirtidae (=Helodidae)												
Elodes (=Helodes) sp.	-	1	-	-	-	-	+	-	-	-	-	-
Elmidae												
Elmis aenea	14	4	1	-	-	2	+	-	6	6	13	7
Esolus parallelepipedus	-	-	-	-	-	-	-	-	-	3	13	11
Limnius volckmari	15	5	7	3	5	12	-	-	12	10	15	14
Oulimnius troglodytes	1	-	-	-	-	-	-	-	-	-	-	-
Oulimnius tuberculatus	4	-	-	-	-	1	-	-	-	-	3	-
SIALIDAE (ALDERFLIES)												
Sialidae												
Sialis lutaria	-	-	-	-	-	-	-	-	-	-	1	-
Sialis fuliginosa	-	1	-	1	N	1	-	-	N	-	-	-

Table 5 (cont.)

TAXON	SITE											
	W1	W2	W3	W4	W5	W6	RS1	RS2	E7	E8	E9	E10
TRICHOPTERA (CADDISFLIES)												
Rhyacophilidae (incl. Glossosomatidae)												
<i>Rhyacophila dorsalis</i>	5	3	2	-	-	-	+	-	4	9	8	2
<i>Rhyacophila munda</i>	-	-	-	-	-	-	-	-	-	N	-	-
<i>Agapetus</i> sp.	-	-	-	-	-	-	+	-	-	4	-	1
Philopotamidae												
<i>Philopotamus montanus</i>	-	-	-	-	-	-	+	-	1	-	-	-
<i>Normaldia</i> sp.	-	-	1	-	-	-	-	-	-	-	-	N
Polycentropodidae												
<i>Plectrocnemia conspersa</i>	-	-	-	-	-	-	-	-	1	-	1	1
<i>Plectrocnemia geniculata</i>	1	1	N	-	N	-	-	-	1	-	1	-
<i>Polycentropus flavomaculatus</i>	1	11	1	1	1	3	-	-	4	2	3	1
<i>Polycentropus kingi</i>	H	5	N	4	1	5	-	-	3	4	4	6
Psychomyiidae												
<i>Tinodes waeneri</i>	N	-	-	-	-	-	-	-	-	-	-	-
<i>Lype</i> sp.	-	-	-	-	-	-	+	-	-	-	-	-
Hydropsychidae												
<i>Hydropsyche pellucidula</i>	-	4	-	-	-	-	-	-	-	-	-	-
<i>Hydropsyche siltalai</i>	2	6	2	1	2	H	-	-	8	4	4	4
<i>Diplectrona felix</i>	-	-	1	-	-	-	+	-	-	-	-	-
Hydroptilidae												
<i>Hydroptila</i> sp.	H	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae												
<i>Drusus annulatus</i>	H	-	-	-	-	-	-	-	-	-	-	-
<i>Potamophylax cingulatus</i>	-	-	-	-	1	-	-	-	1	-	-	-
<i>Micropterna sequax</i>	-	-	-	-	-	-	+	-	-	-	-	-
Beraeidae												
<i>Beraea maurus</i>	-	-	-	-	-	-	+	-	-	-	-	-
Odontoceridae												
<i>Odontocera albicorne</i>	-	-	-	-	-	-	-	-	1	N	-	1
Leptoceridae												
<i>Athripsodes</i> sp.	-	-	-	-	-	-	-	-	-	-	1	3
<i>Mystacides azurea</i>	-	-	-	-	-	-	-	-	-	-	1	1
<i>Decetis</i> sp.	-	-	-	-	-	-	-	-	-	-	-	1
Goeridae												
<i>Silo pallipes</i>	-	-	-	-	-	-	-	-	4	1	N	2
Lepidostomatidae												
<i>Lepidostoma hirtum</i>	-	-	-	-	-	-	-	-	1	-	2	2
Sericostomatidae												
<i>Sericostoma personatum</i>	-	5	N	N	N	5	+	-	9	7	8	11
LEPIDOPTERA (AQUATIC MOTHS)												
Pyralidae												
	1	N	-	-	N	-	-	-	-	-	-	-

Table 6. The frequency of occurrence of "families" in the 15 box samples collected during 1987-88. West Okement (W1-W6). Railway Stream U/S Bypass (RS1), D/S Bypass (RS2). East Okement (E7-E10). N = absent from box samples, present in pond-net samples. H = Historical, pre-1987, only.

TAXON	SITE													
	W1	W2	W3	W4	W5	W6	RS1	RS2	E7	E8	E9	E10		
TRICLADIDA (FLATWORMS)														
Planariidae	11	6	6	10	4	4	+	-	5	8	7	5		
Dendrocoelidae	-	-	-	-	-	-	-	-	-	-	1	-		
NEMATODA (NEMATODES)														
Nematoda	1	-	-	1	-	-	-	-	1	1	2	1		
GASTRODA (SNAILS)														
Hydrobiidae	-	-	-	-	-	-	-	-	3	3	3	1		
Ancylidae	-	-	-	-	-	-	+	-	1	3	2	3		
Zonitidae	-	-	-	-	-	-	-	-	-	-	-	1		
BIVALVIA (BIVALVE SNAILS)														
Sphaeriidae	-	1	-	-	2	6	+	-	-	1	-	-		
OLIGOCHAETA (TRUE WORMS)														
Oligochaeta	15	14	15	15	15	15	+	+	15	15	15	15		
HIRUDINEA (LEECHES)														
Glossiphoniidae	-	1	-	-	1	-	-	-	-	-	-	-		
ARACHNIDA (SPIDERS & MITES)														
Hydracarina	8	7	3	1	3	2	-	-	3	8	9	11		
AMPHIPODA														
Gammaridae	-	1	-	1	-	-	+	-	1	7	3	3		
EPHEMEROPTERA (MAYFLIES)														
Baetidae	12	11	8	5	6	3	+	-	13	15	15	12		
Heptageniidae	3	15	3	2	-	2	+	-	14	11	12	13		
Leptophlebiidae	6	2	-	-	-	-	-	-	-	1	3	2		
Ephemerellidae	5	-	N	-	2	H	-	-	5	6	6	9		
Ephemeridae	-	-	-	-	-	-	-	-	-	-	-	N		
Caenidae	-	1	-	-	-	-	-	-	-	-	N	1		
PLECOPTERA (STONEFLIES)														
Taeniopterygidae	3	1	-	-	-	-	-	-	-	1	1	-		
Nemouridae	10	10	6	3	4	2	+	-	9	7	5	5		
Leuctridae	15	15	8	5	3	3	+	-	14	12	12	7		
Perlodidae	11	9	1	2	-	H	-	-	5	5	6	2		
Perlidae	-	2	-	-	-	-	-	-	-	-	-	-		
Chloroperlidae	12	15	4	4	3	2	+	-	15	12	10	11		
ODONATA (DRAGON/DAMSELFLIES)														
Cordulegasteridae	-	-	-	-	-	-	-	-	-	N	-	-		
COLEOPTERA (BEETLES)														
Dytiscidae	-	2	N	-	-	N	-	-	-	-	2	1		
Gyrinidae	1	3	-	-	1	-	-	-	-	N	-	1		
Hydrophilidae	2	2	-	-	-	N	-	-	9	1	1	1		
Scirtidae (=Melodidae)	-	1	-	-	-	-	+	-	-	-	-	-		
Elmidae	15	8	7	4	5	14	+	-	12	14	15	15		
SIALIDAE (ALDERFLIES)														
Sialidae	-	1	-	1	N	1	-	-	N	-	1	-		

TAXON	SITE											
	W1	W2	W3	W4	W5	W6	RS1	RS2	E7	E8	E9	E10
TRICHOPTERA (CADDISFLIES)												
Rhyacophilidae (incl. Glossosomatidae)	6	5	2	1	-	2	+	-	7	12	9	5
Philopotamidae	-	-	1	-	-	-	+	-	1	-	-	N
Polycentropodidae	9	11	3	8	3	10	+	-	10	8	12	12
Psychomyiidae	N	-	-	-	-	-	+	-	-	-	-	-
Hydropsychidae	3	9	5	1	3	H	+	-	10	4	6	4
Hydroptilidae	H	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	H	-	-	-	1	-	+	-	1	-	1	-
Beraeidae	-	-	-	-	-	-	+	-	-	-	-	-
Odontoceridae	-	-	-	-	-	-	-	-	1	N	-	1
Leptoceridae	-	-	-	-	-	-	-	-	-	-	1	4
Goeridae	-	-	-	-	-	-	-	-	4	4	N	3
Lepidostomatidae	-	-	-	-	-	-	-	-	1	-	2	3
Sericostomatidae	-	5	N	1	N	5	+	-	9	7	9	11
LEPIDOPTERA (AQUATIC MOTHS)												
Pyralidae	1	N	-	-	N	-	-	-	-	-	-	-
DIPTERA (TRUE FLIES)												
Tipulidae	11	5	N	4	7	3	+	+	11	11	6	7
Ceratopogonidae	-	-	1	1	3	4	-	-	1	1	2	1
Chironomidae	15	15	14	13	15	15	+	-	14	15	15	15
Simuliidae	11	8	5	-	2	1	+	-	12	10	4	-
Empididae	3	8	4	3	5	1	-	-	5	6	8	10
Dolichopodidae	-	-	-	-	-	-	-	-	-	-	1	-
Rhagionidae	-	3	1	2	1	2	-	-	4	6	5	3

SECTION 8
FIGURES

A30 OKEHAMPTON BYPASS SCHEME

MACRO-INVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - WEST OKEMENT, JUNE 8th 1987

COMBINED BOX SAMPLES

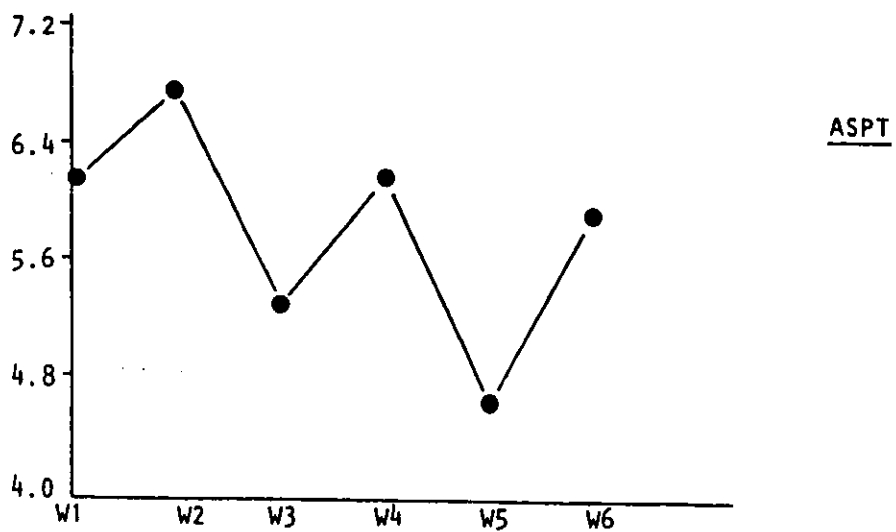
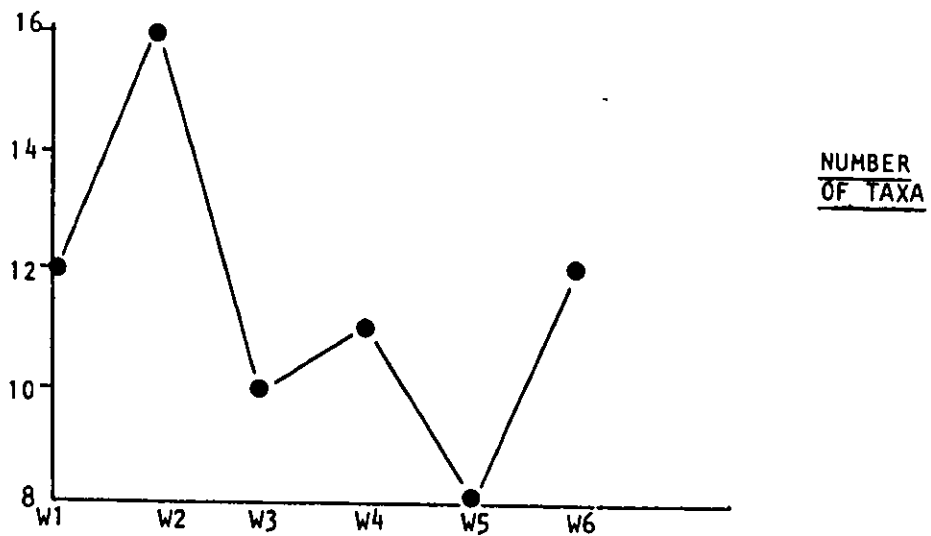
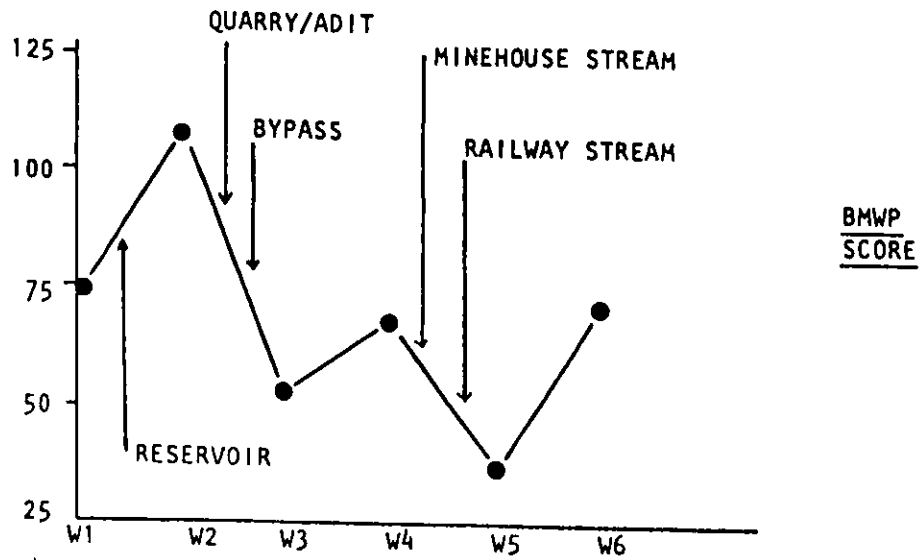
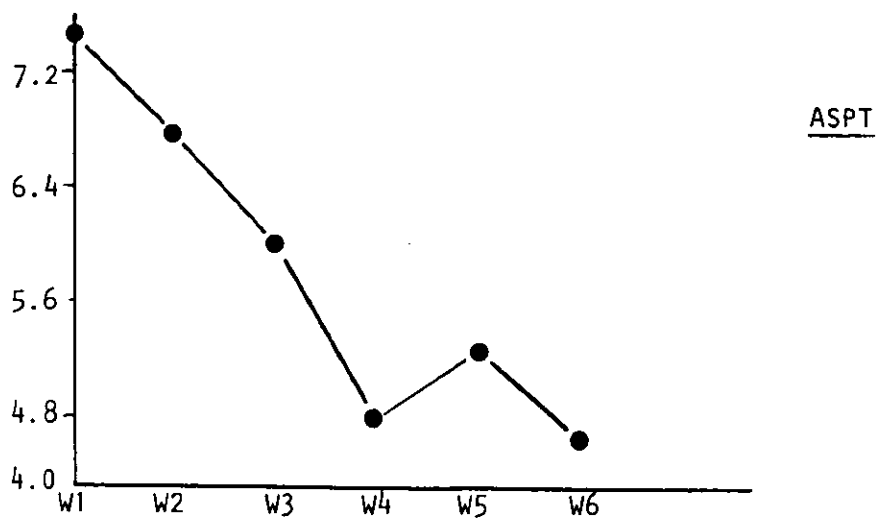
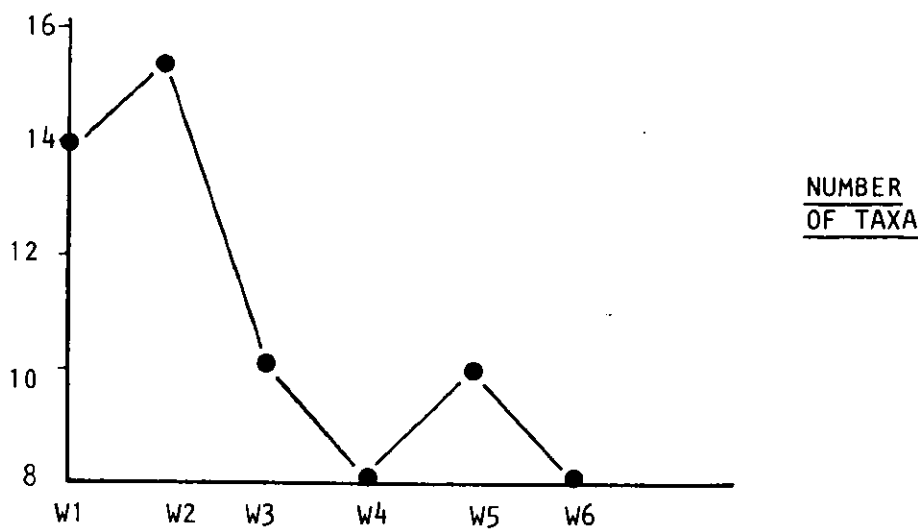
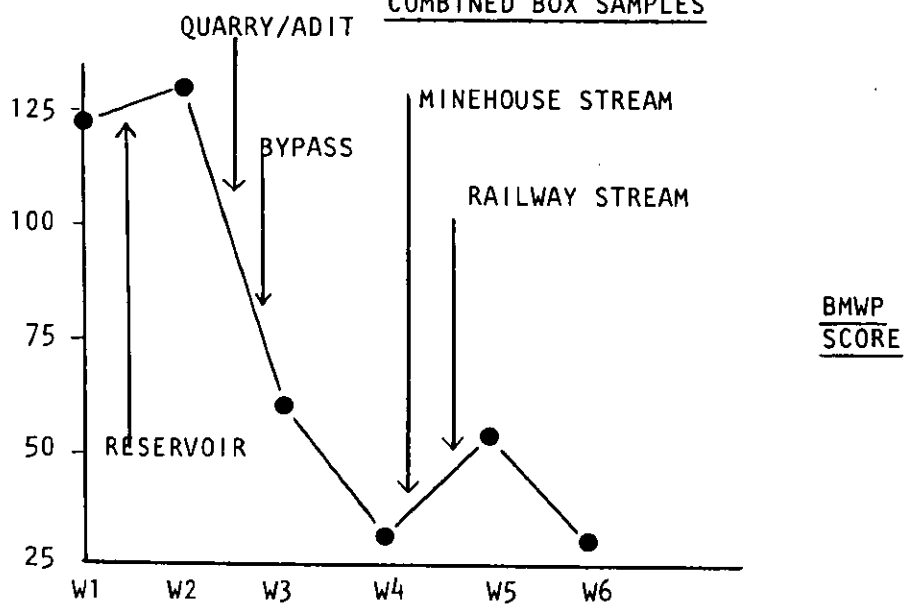


Figure 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME
 MACROINVERTEBRATE SURVEY
 INDICES OF ENVIRONMENTAL QUALITY - WEST OKEMENT, SEPTEMBER 10th 1987
 COMBINED BOX SAMPLES

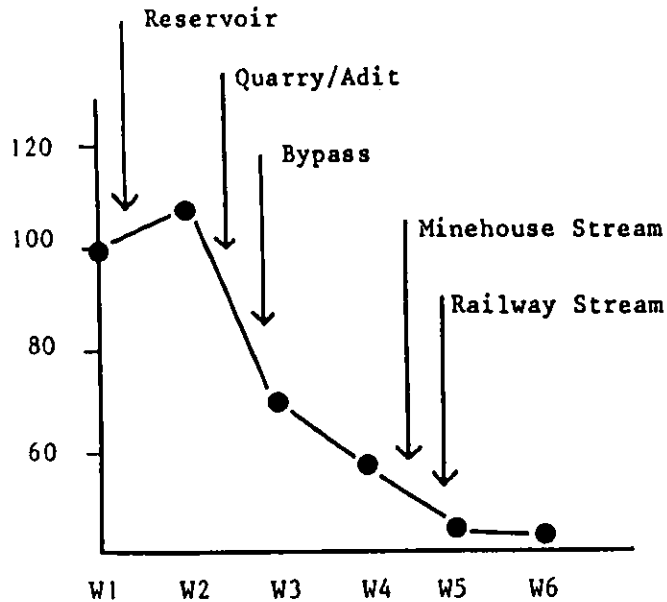


A30 OKEHAMPTON BYPASS SCHEME

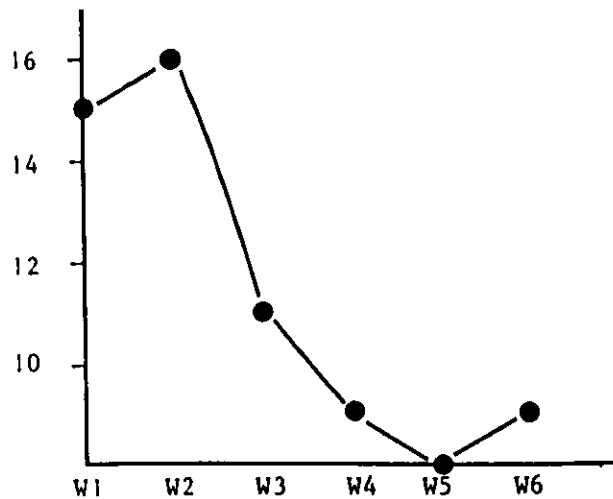
MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - WEST OKEMENT, 2nd MARCH 1988

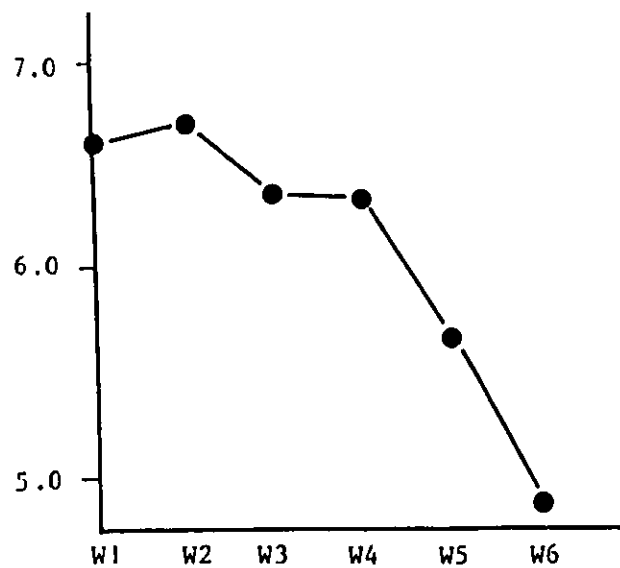
COMBINED BOX SAMPLES



BMWP
SCORE



NUMBER
OF TAXA



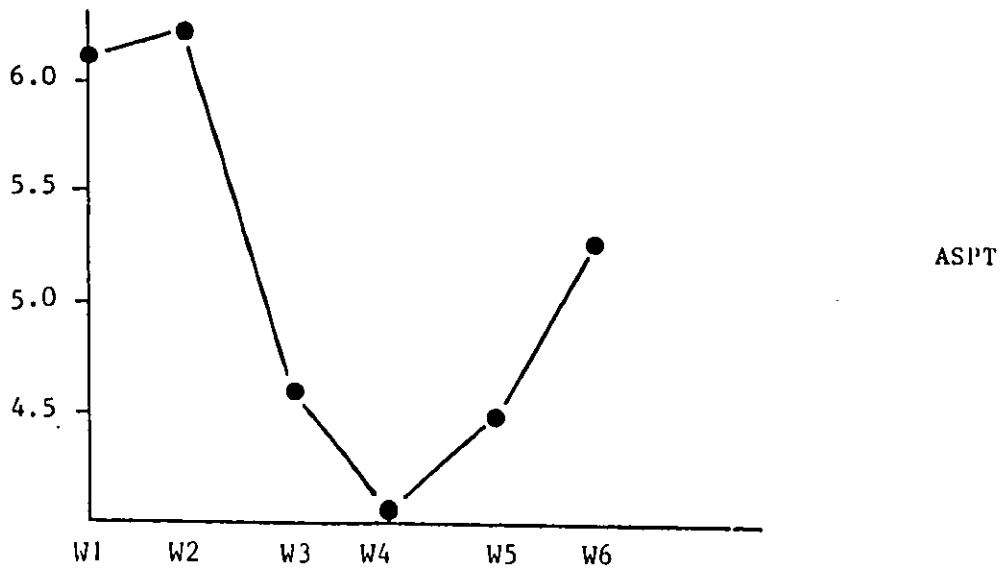
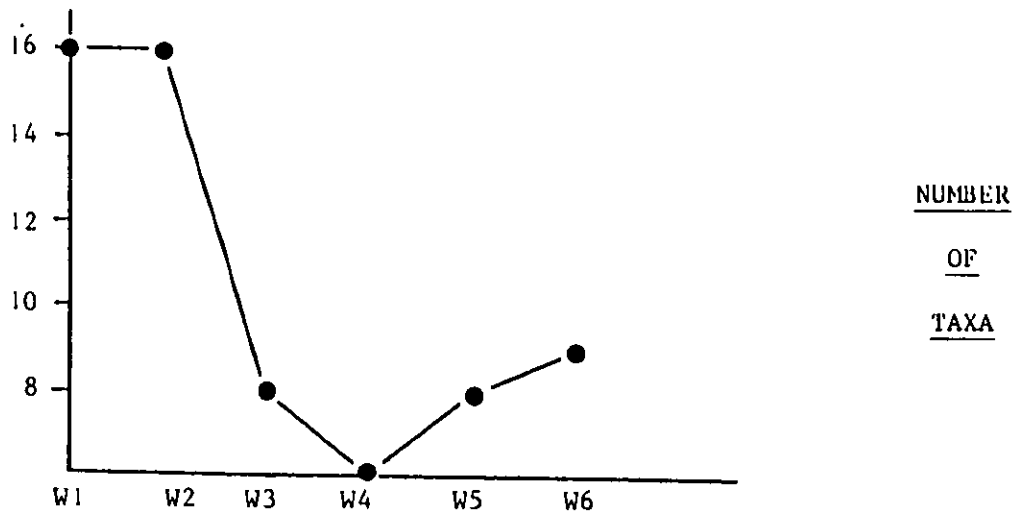
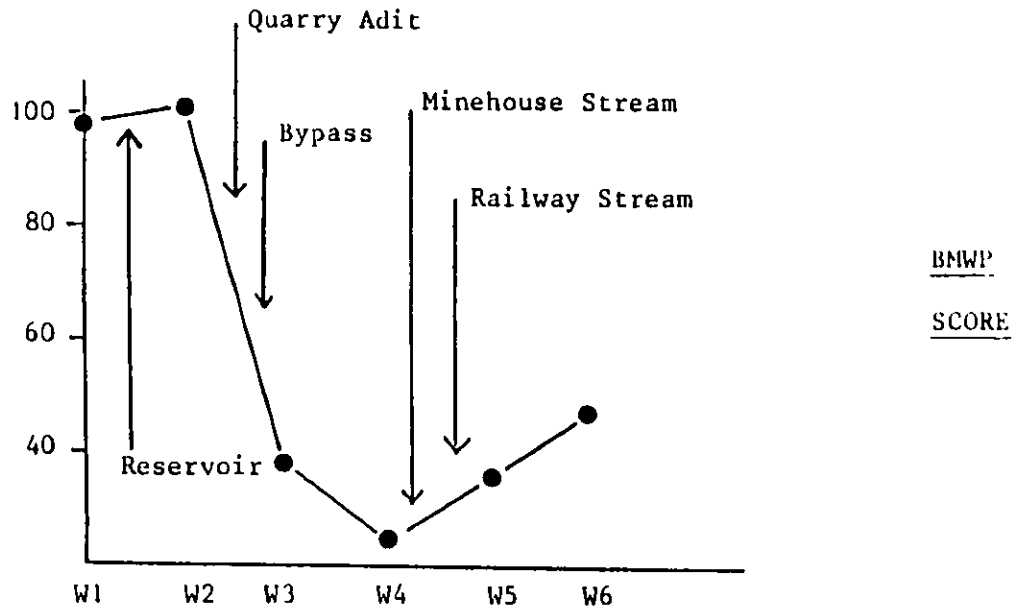
ASPT

A30 OKEHAMPTON BYPASS SCHEME

MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - WEST OKEMENT, JUNE 13th 1988

COMBINED BOX SAMPLES

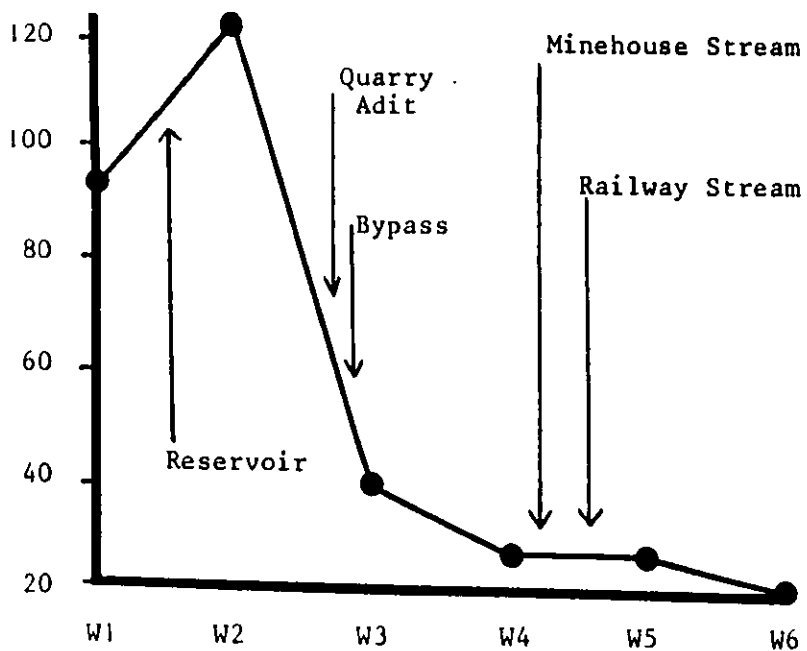


A30 OKEHAMPTON BYPASS SCHEME

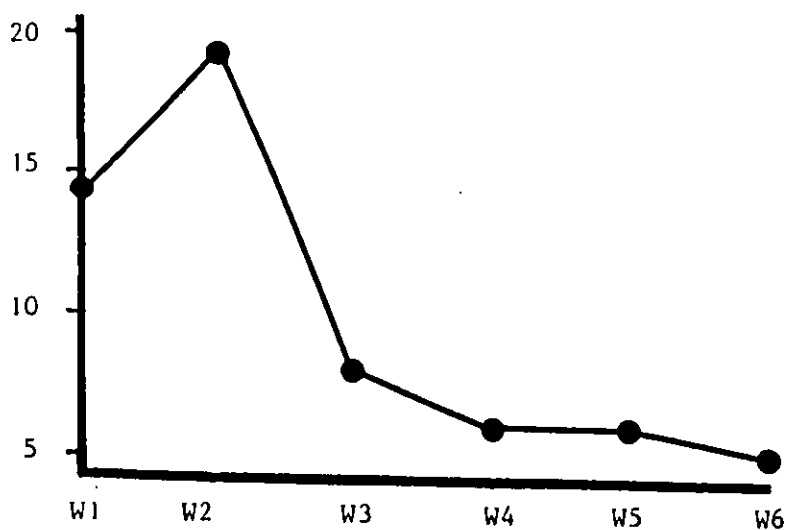
MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - WEST OKEMENT, SEPTEMBER 13th 1988

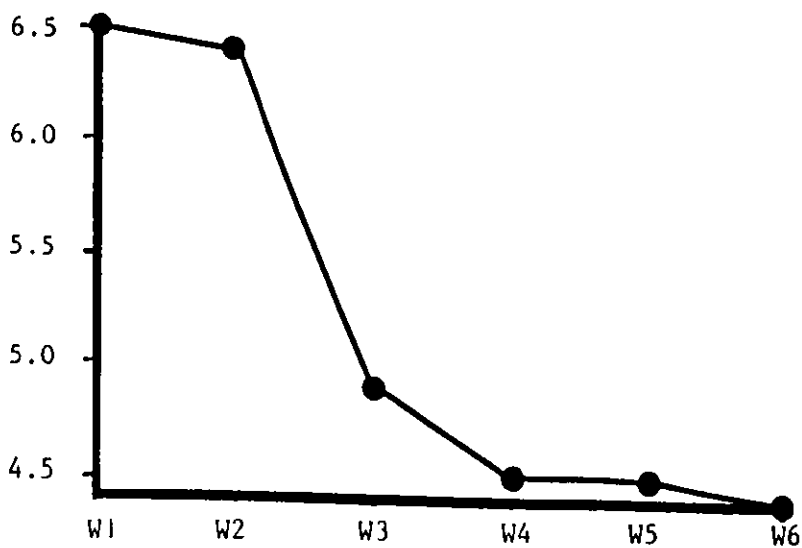
COMBINED BOX SAMPLES



BMWP
SCORE



NUMBER
OF
TAXA



ASPT

Figure 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME

MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - EAST OKEMENT, SEPTEMBER 10th 1987

COMBINED BOX SAMPLES

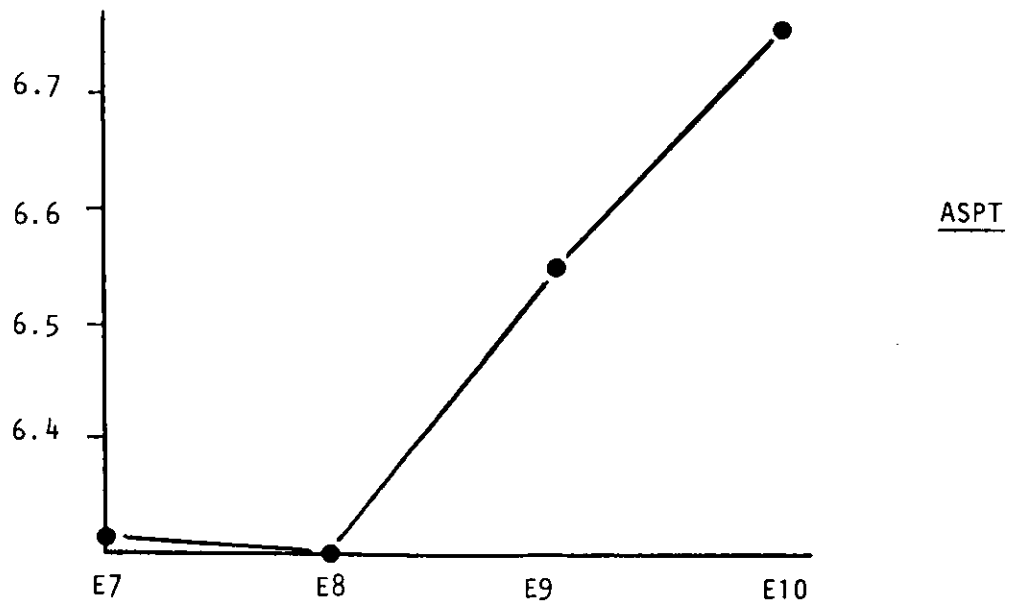
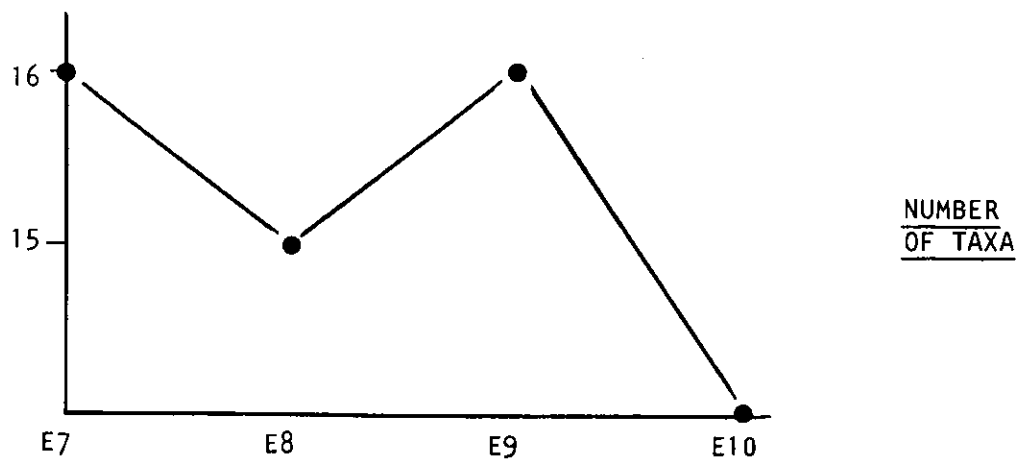
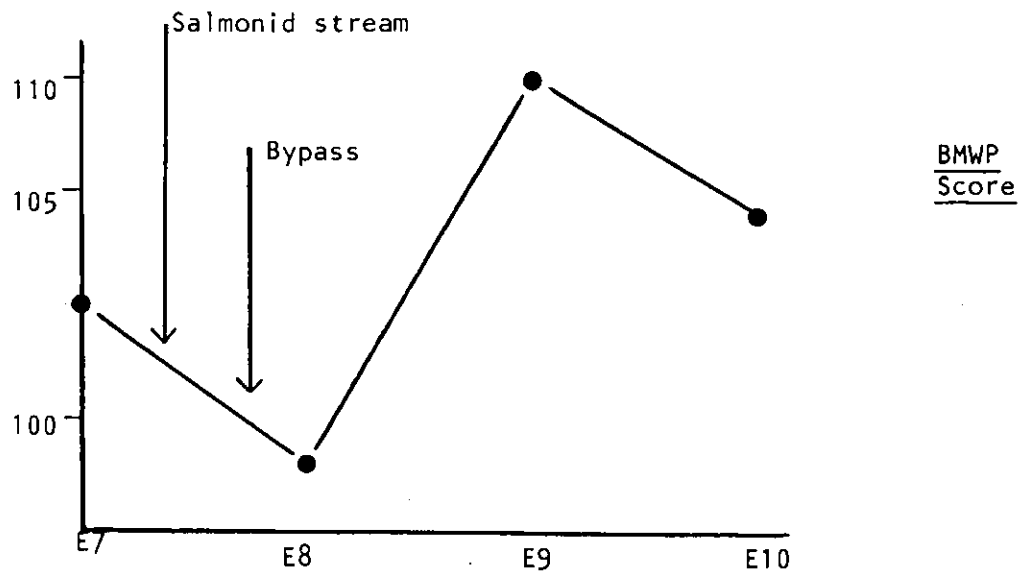


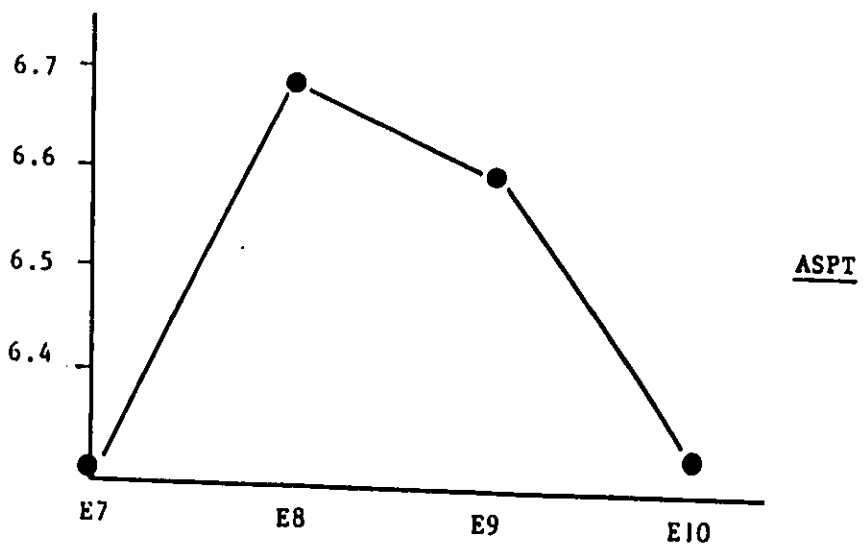
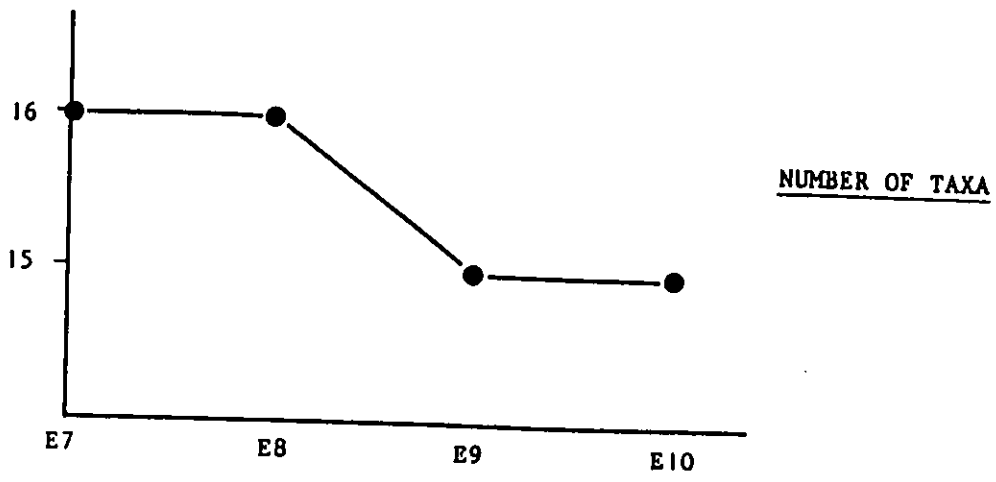
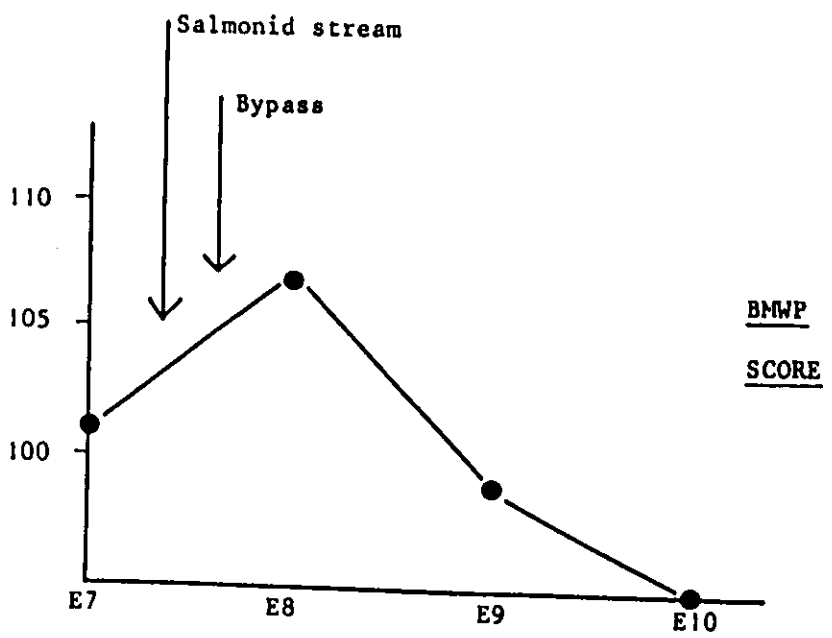
Figure 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME

MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - EAST OKEMENT, 2nd MARCH 1988

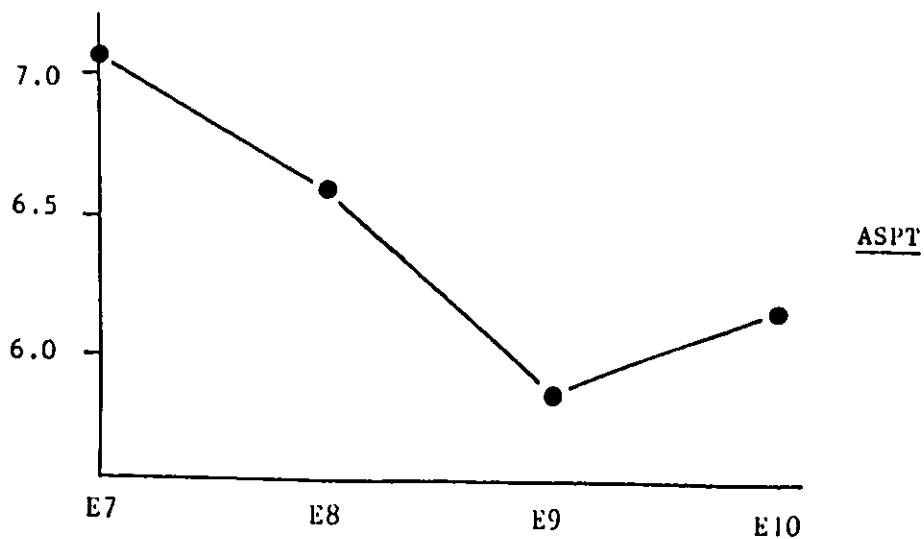
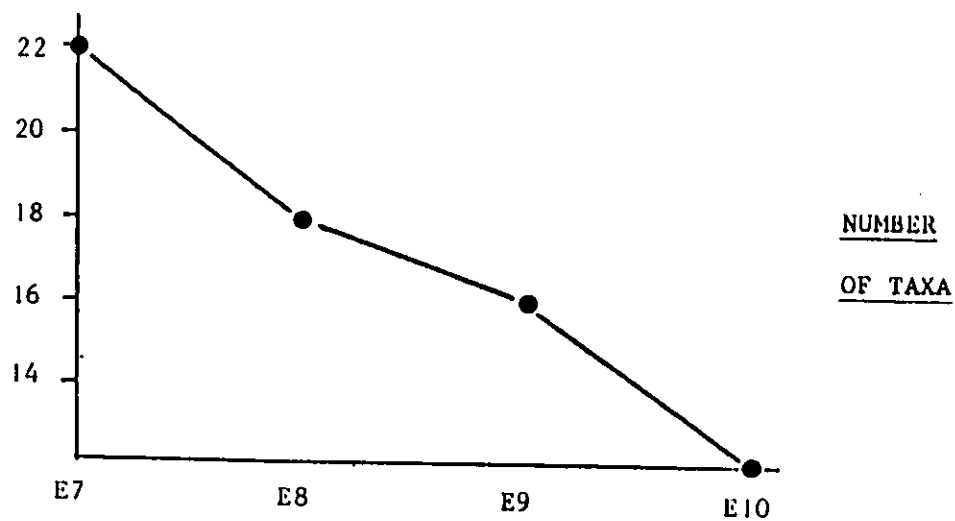
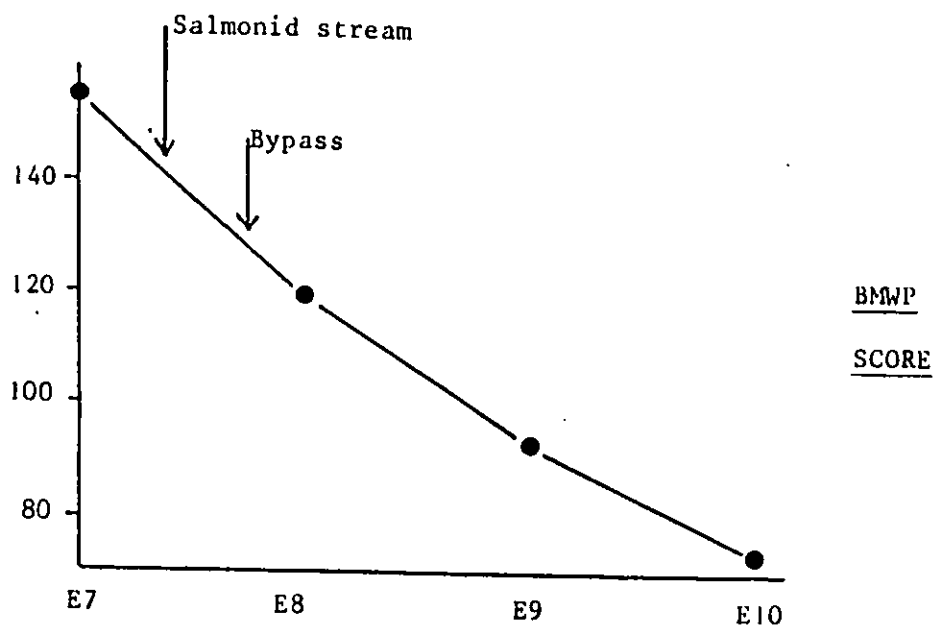
COMBINED BOX SAMPLES



A30 OKEHAMPTON BYPASS SCHEME

MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - EAST OKEMENT, JUNE 13th 1988
COMBINED BOX SAMPLES



A30 OKEHAMPTON BYPASS SCHEME

MACROINVERTEBRATE SURVEY

INDICES OF ENVIRONMENTAL QUALITY - EAST OKEMENT, SEPTEMBER 13th 1988

COMBINED BOX SAMPLES

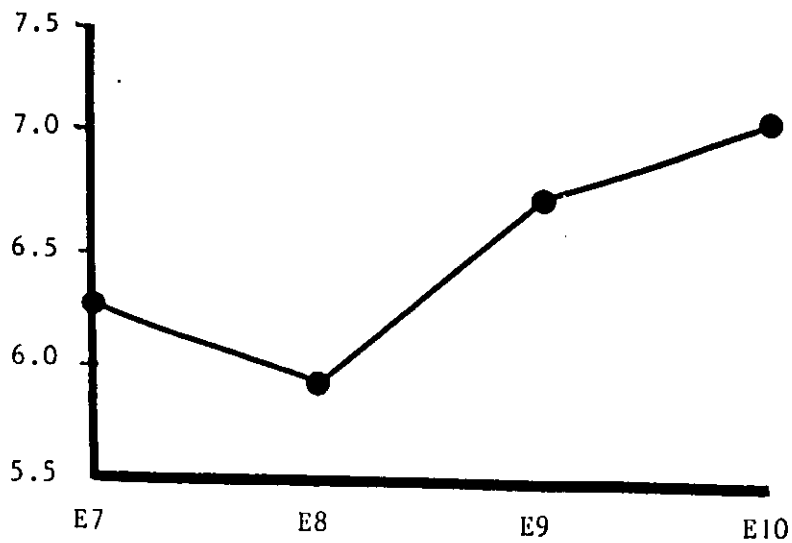
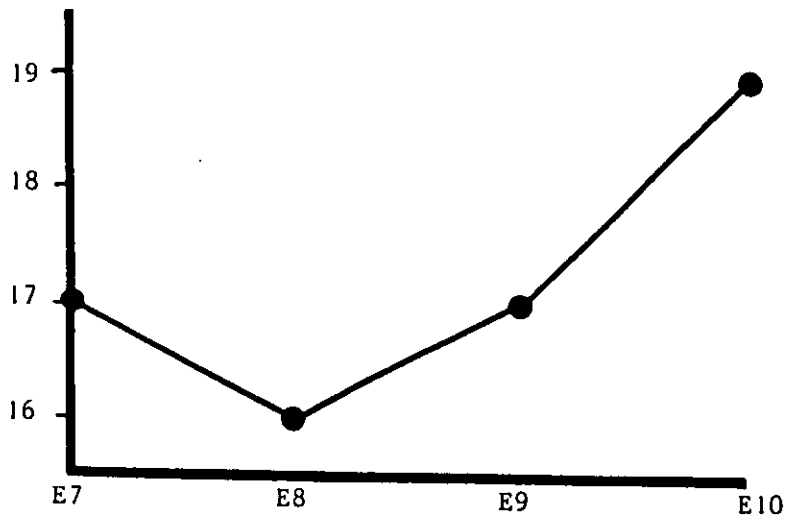
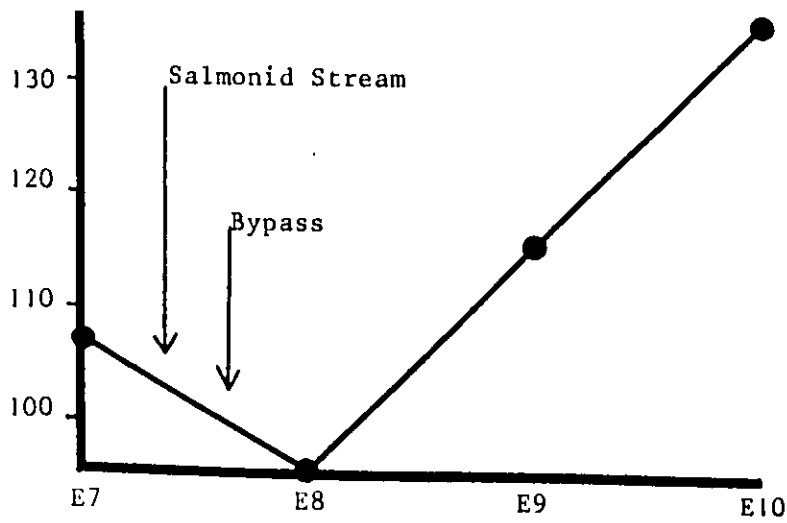


Figure 2. Environmental Quality Indices based on BMWP scores and ASPT. Squares historical data. Circles data collected by box sampler 1987-88. M = March, J = June, S = September, D = December. Solid horizontal line, EQI = 1. Broken horizontal lines are 95% confidence limits.

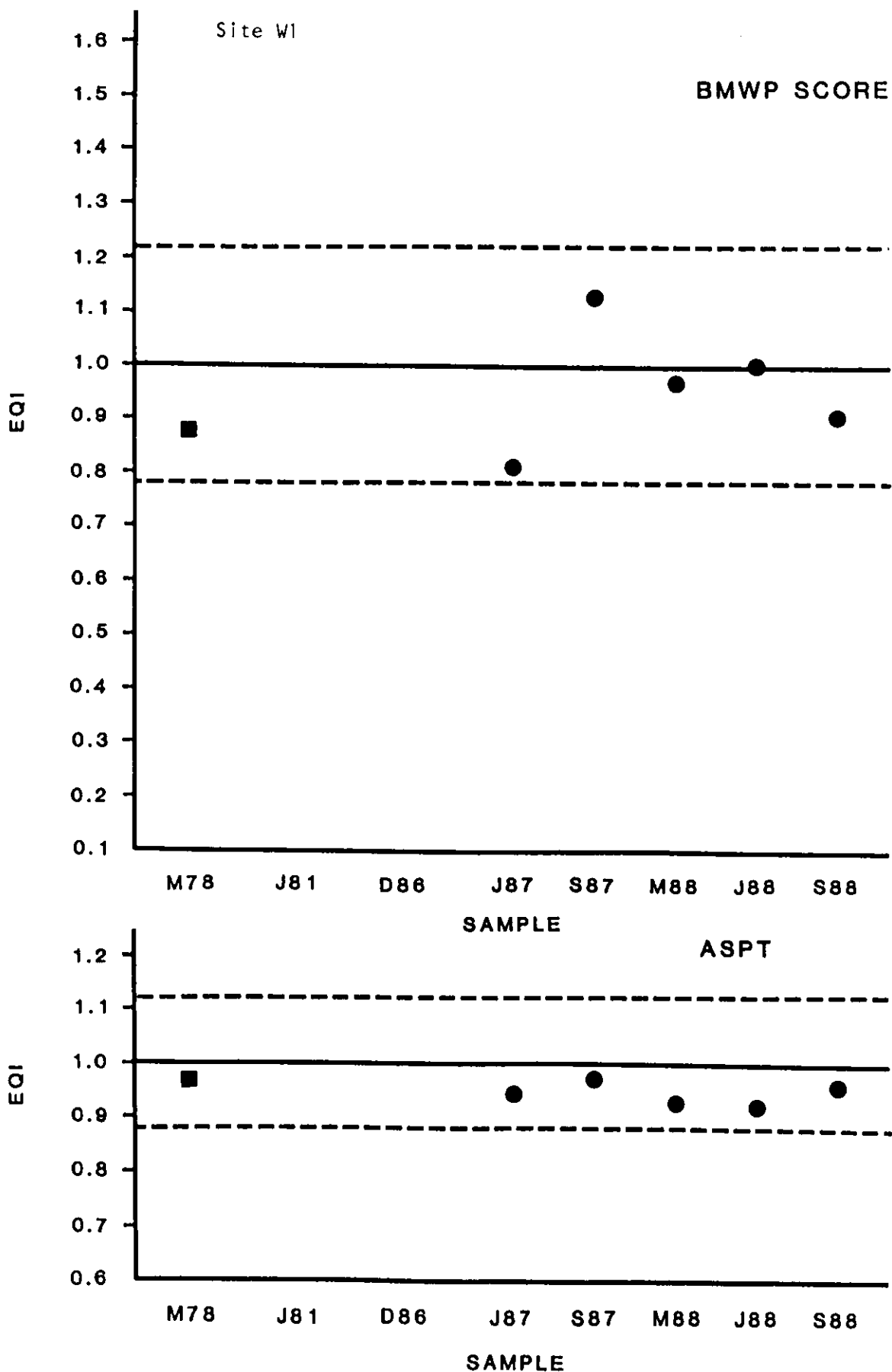


Figure 2 (cont.)

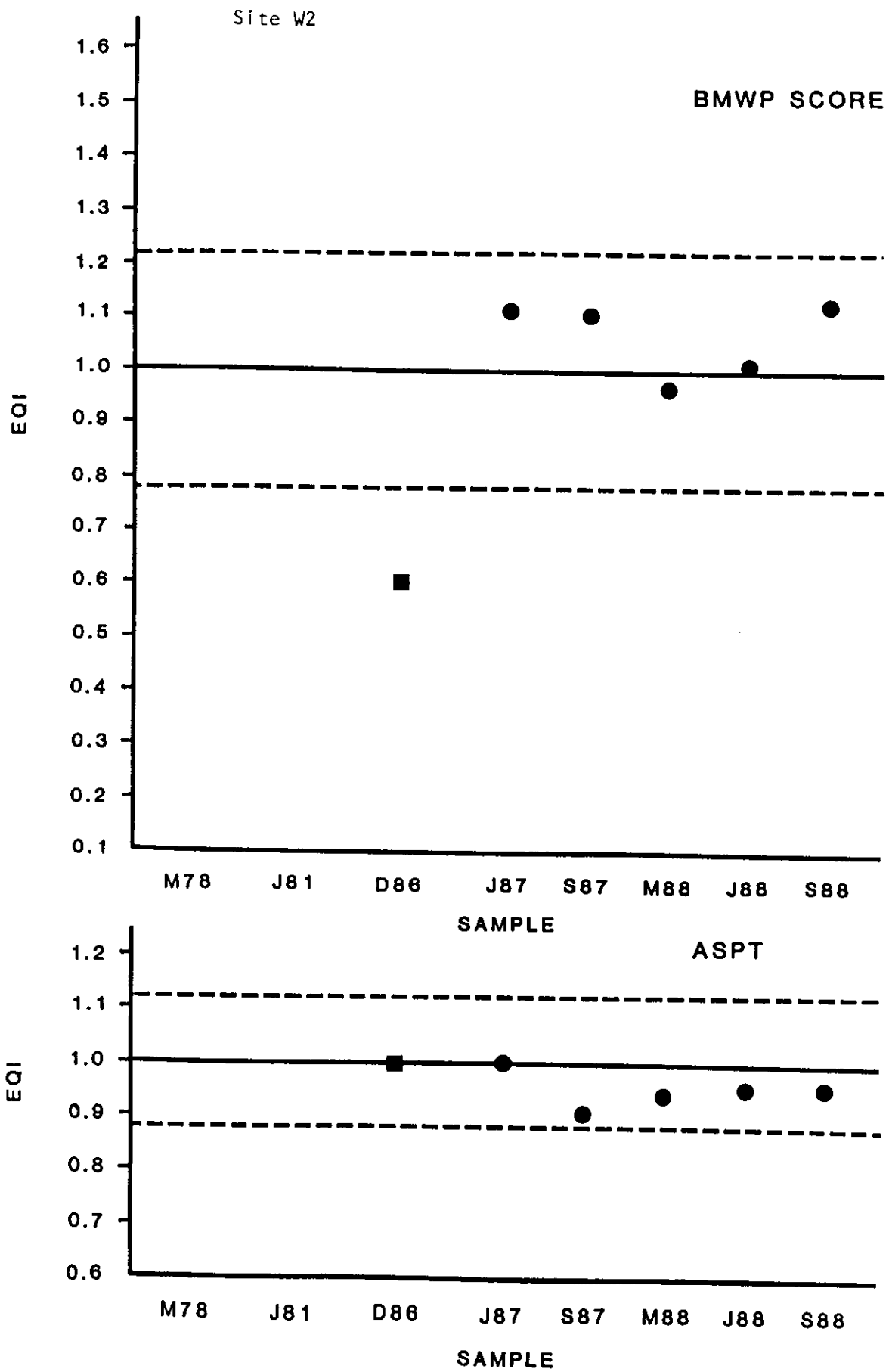
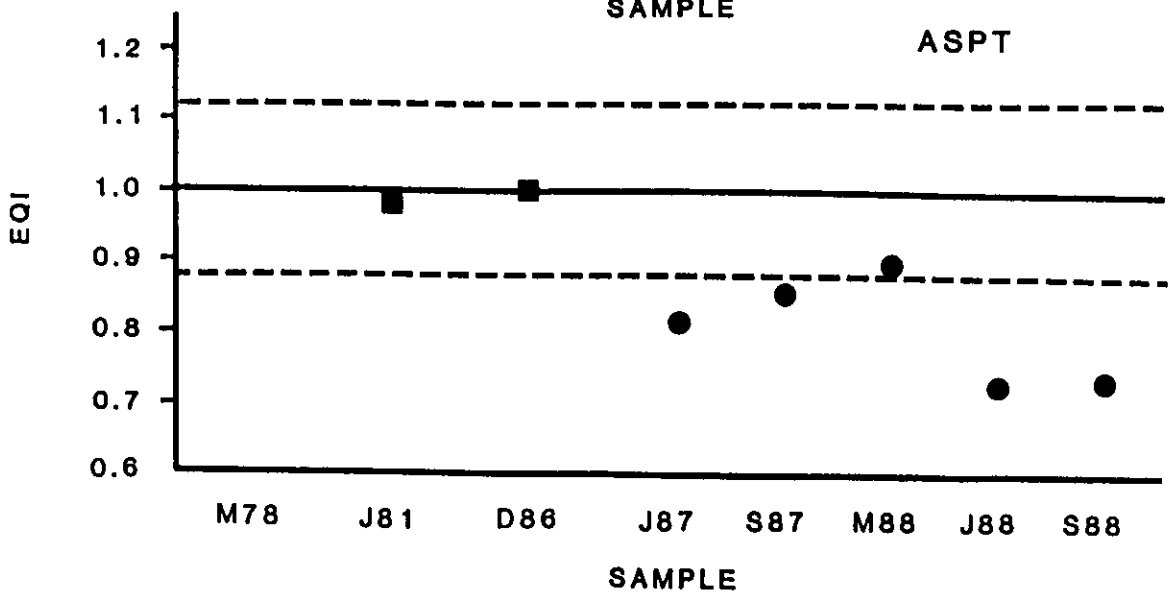
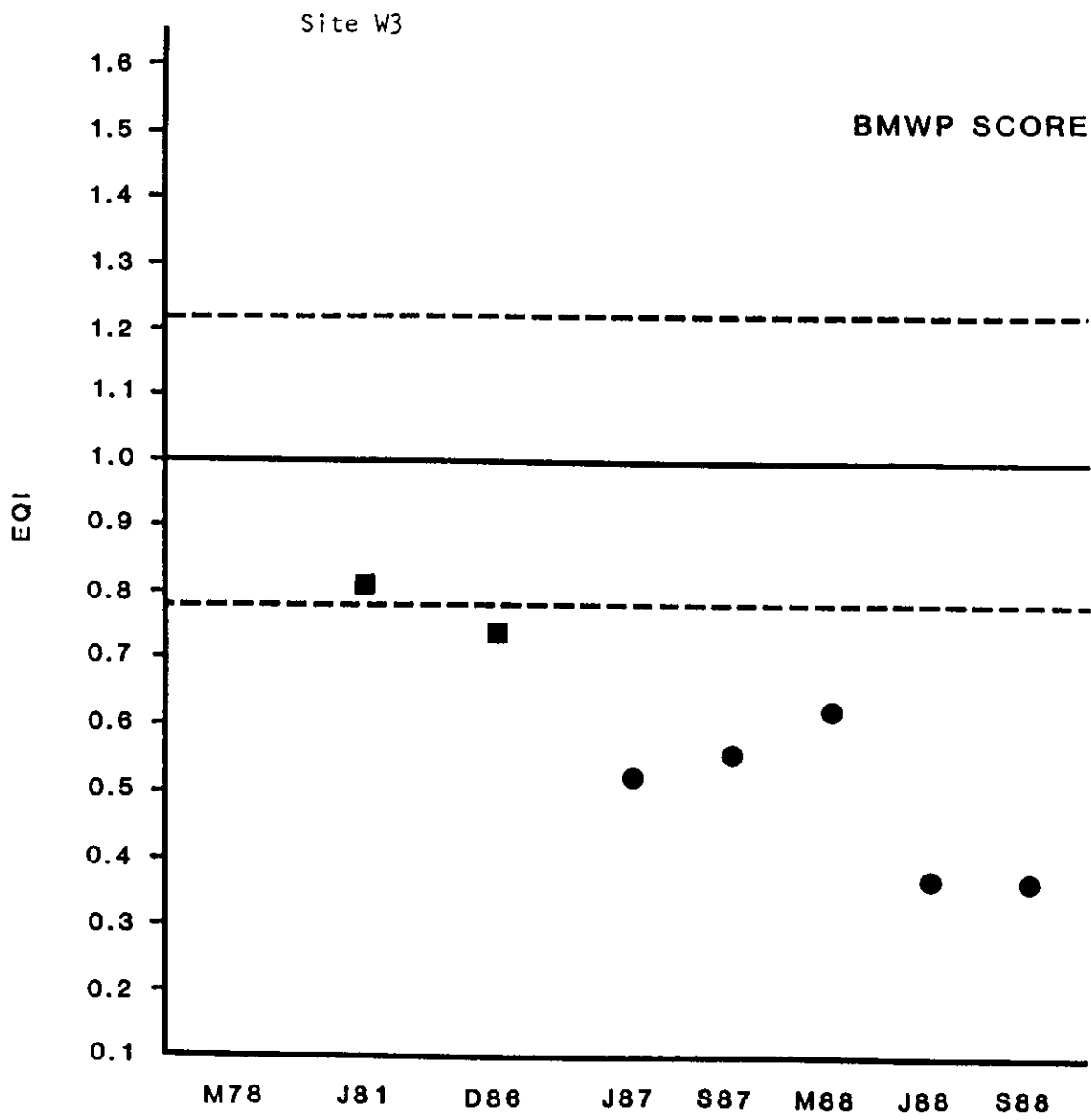


Figure 2 (cont.)



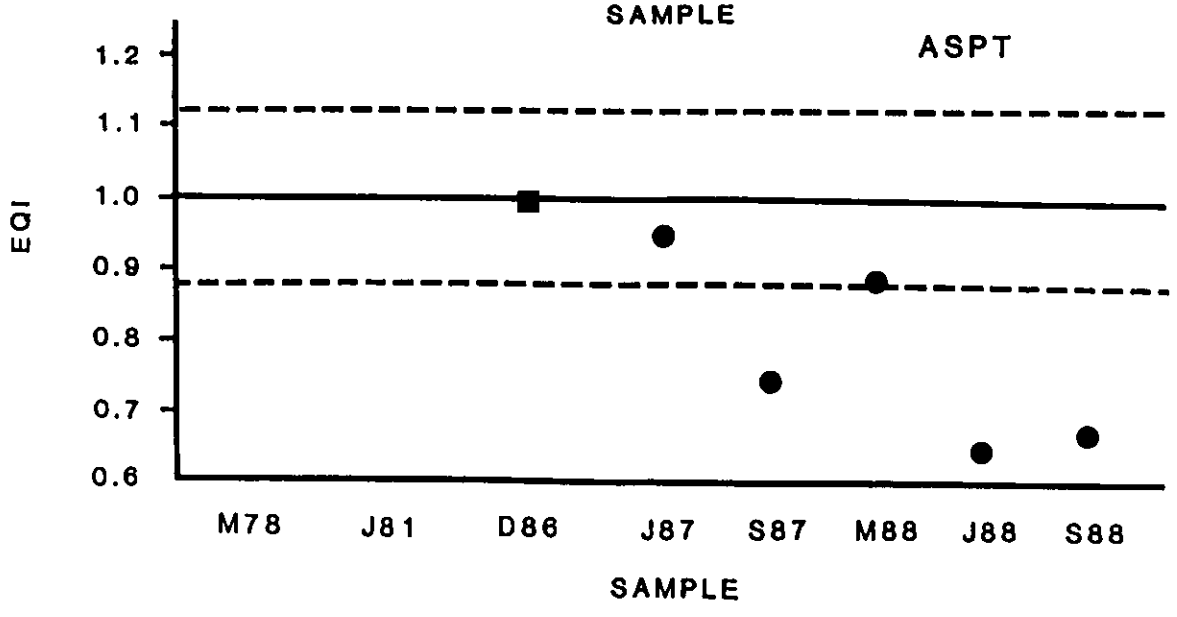
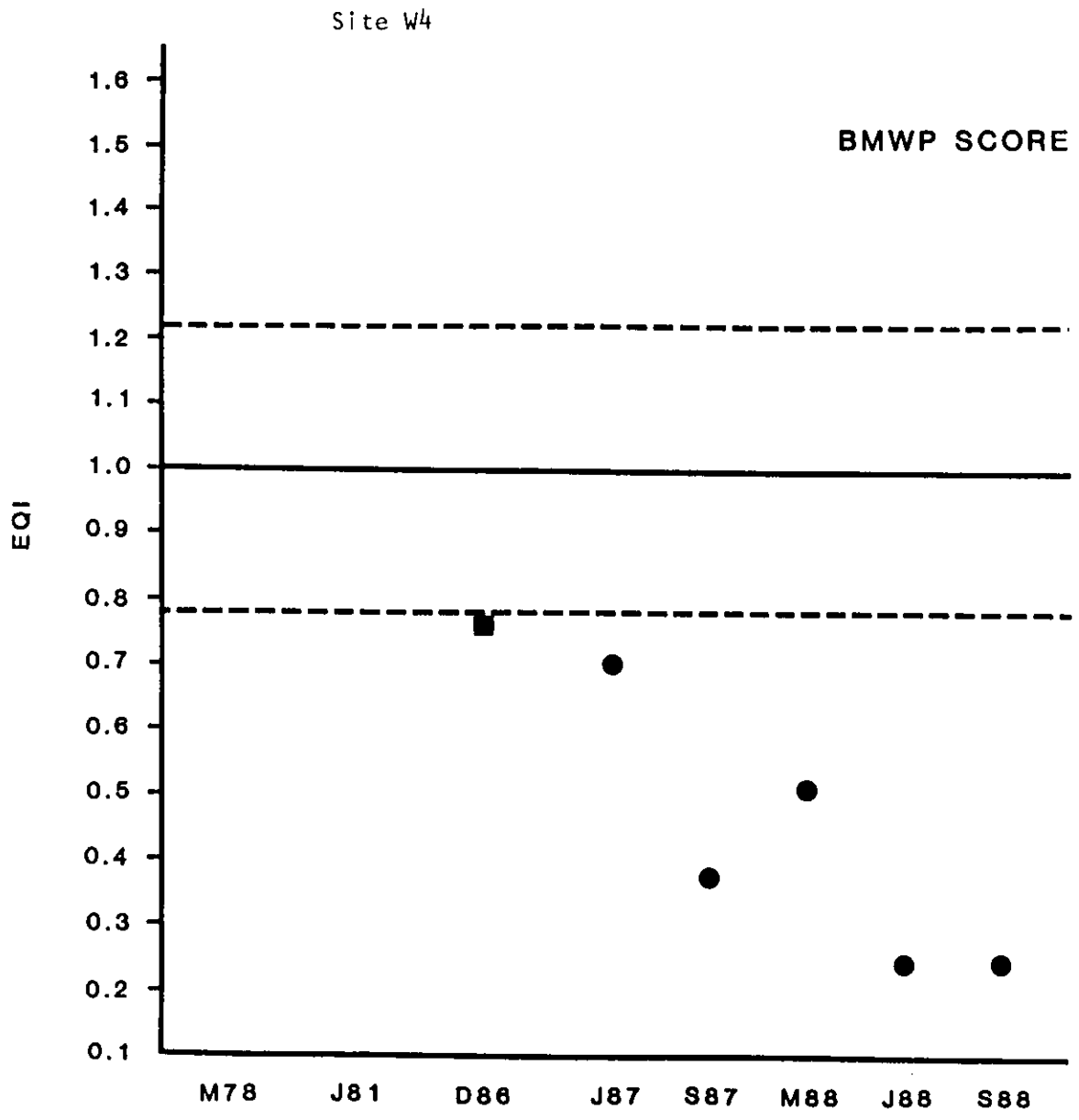
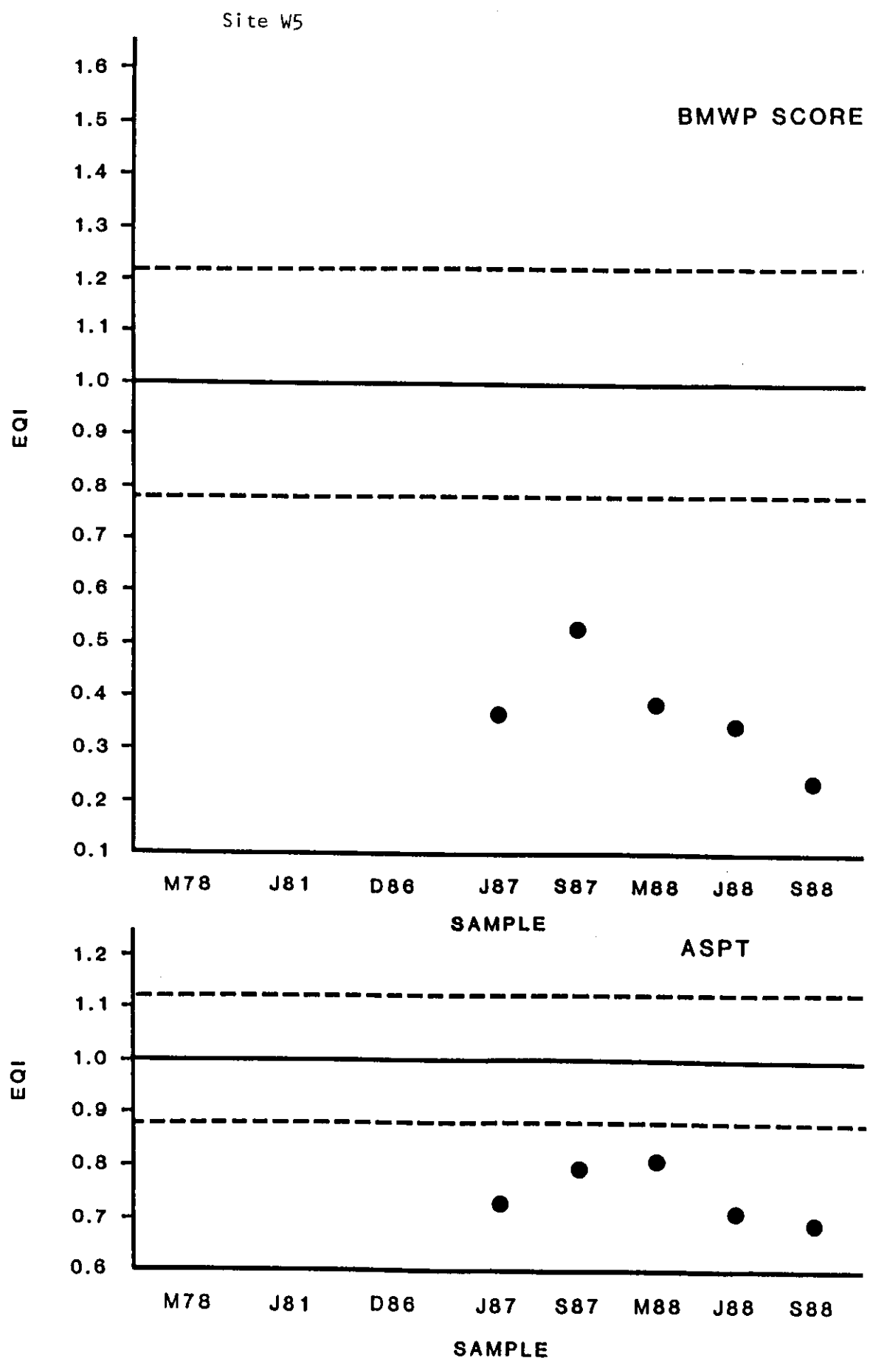


Figure 2 (cont.)



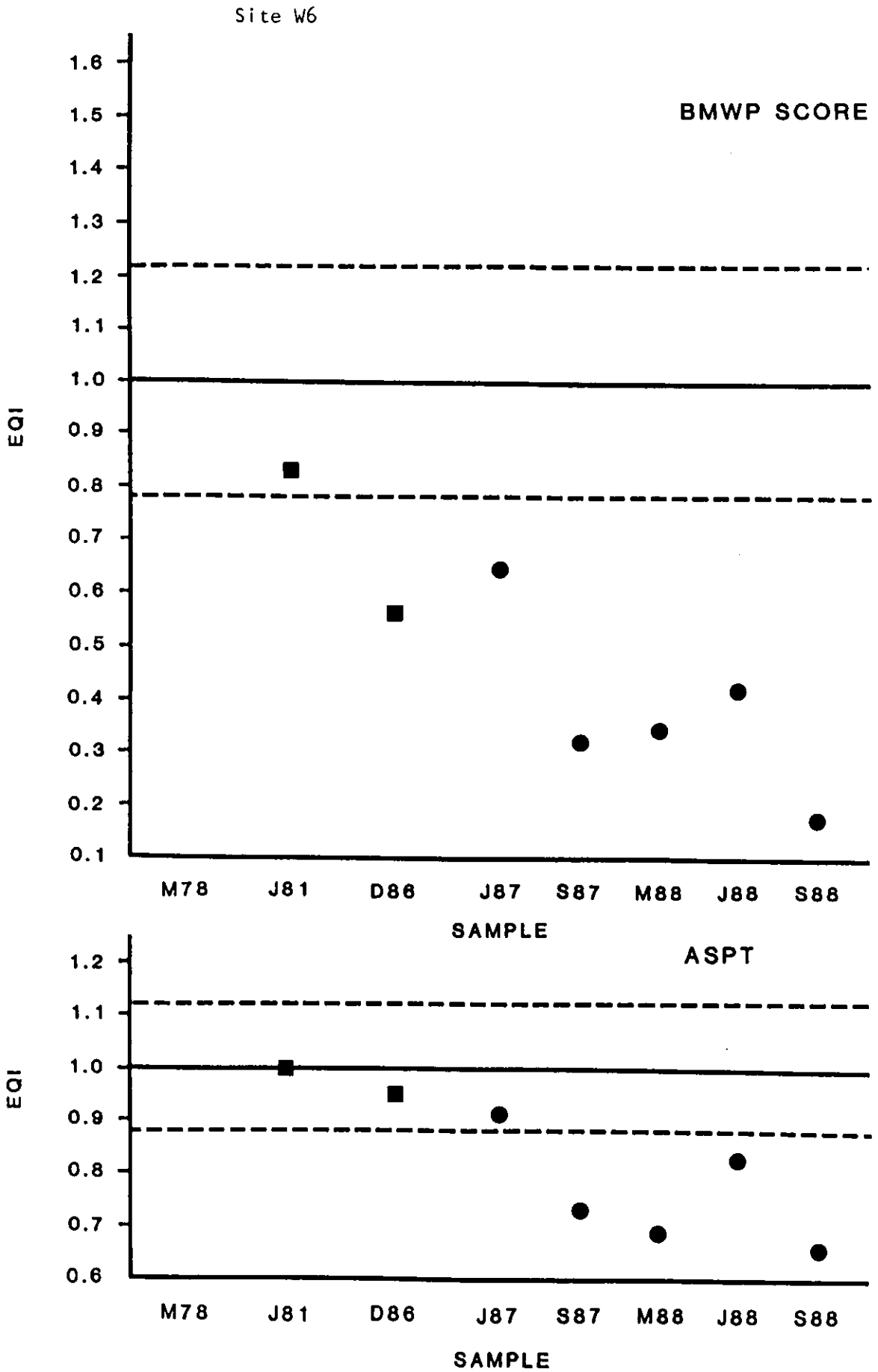


Figure 2 (cont.)

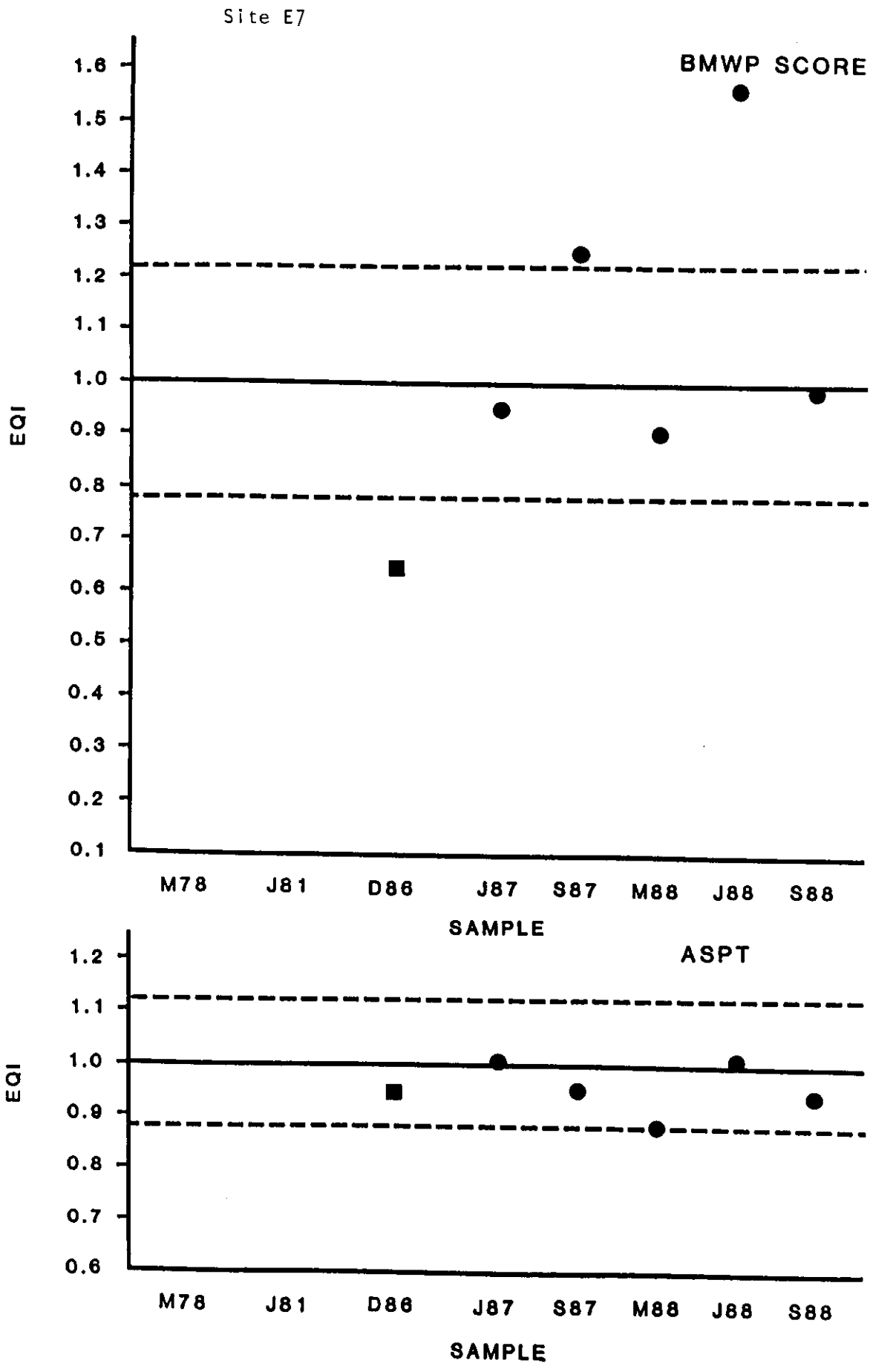


Figure 2 (cont.)

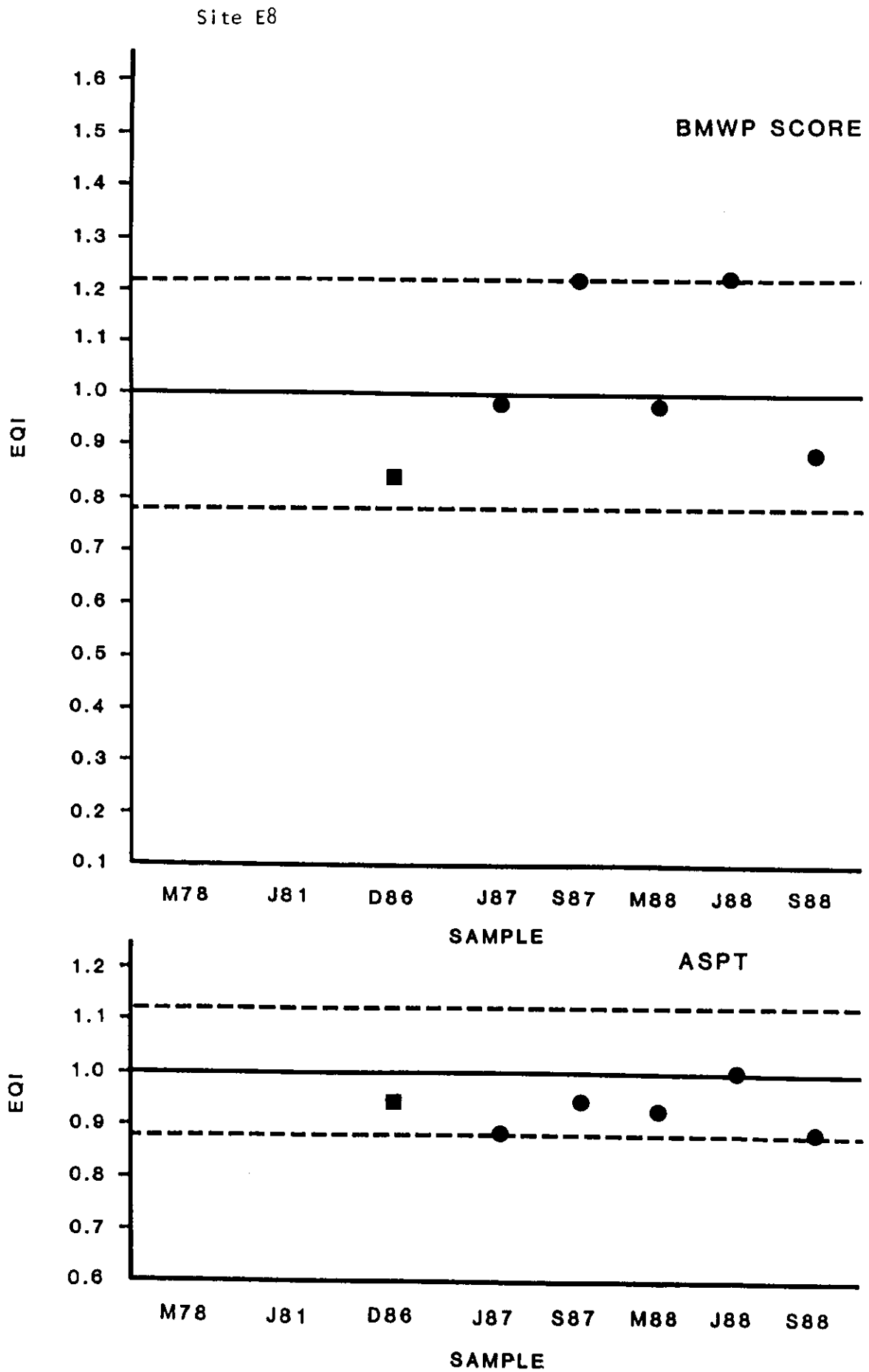


Figure 2 (cont.)

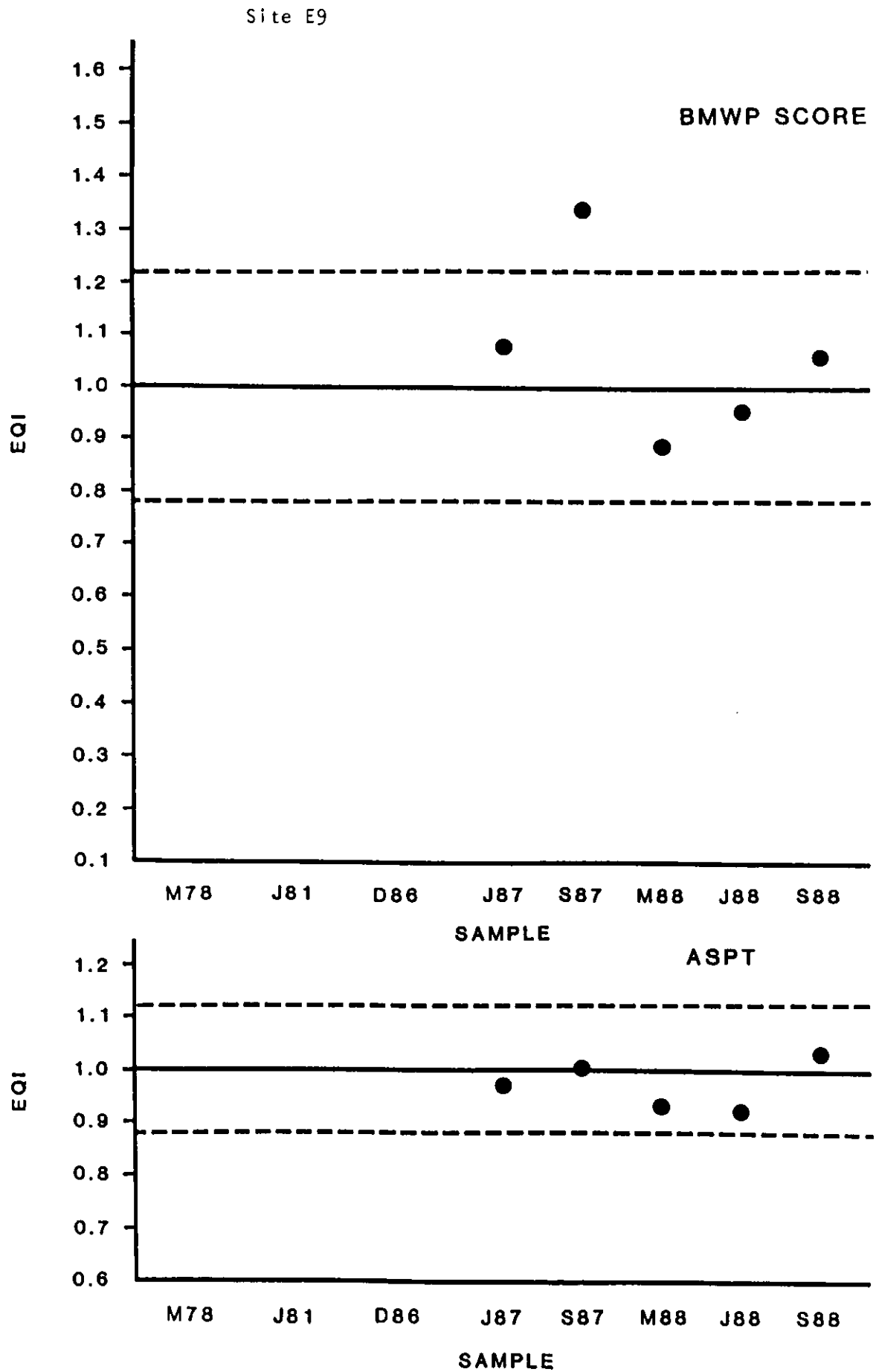


Figure 2 (cont.)

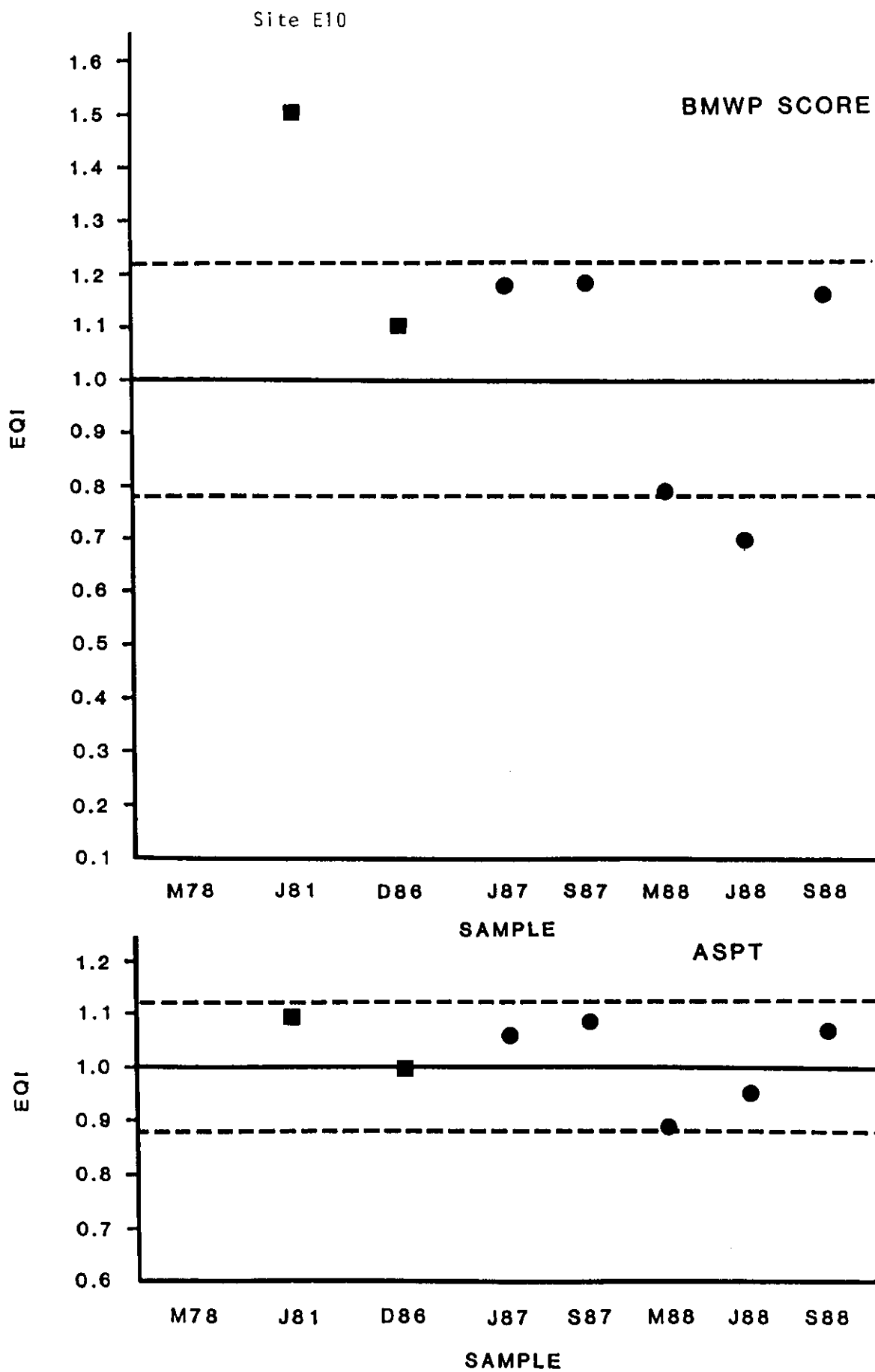
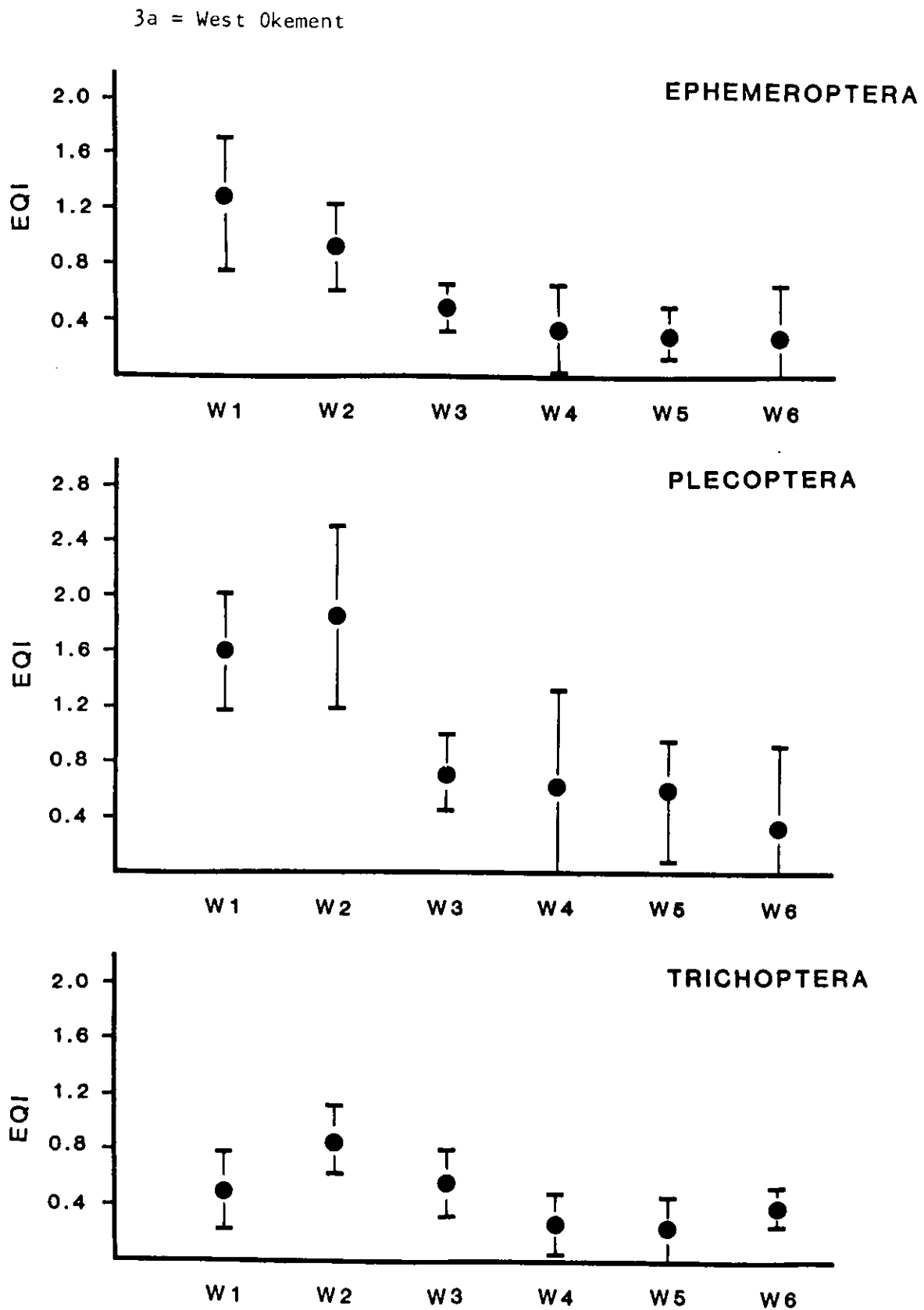
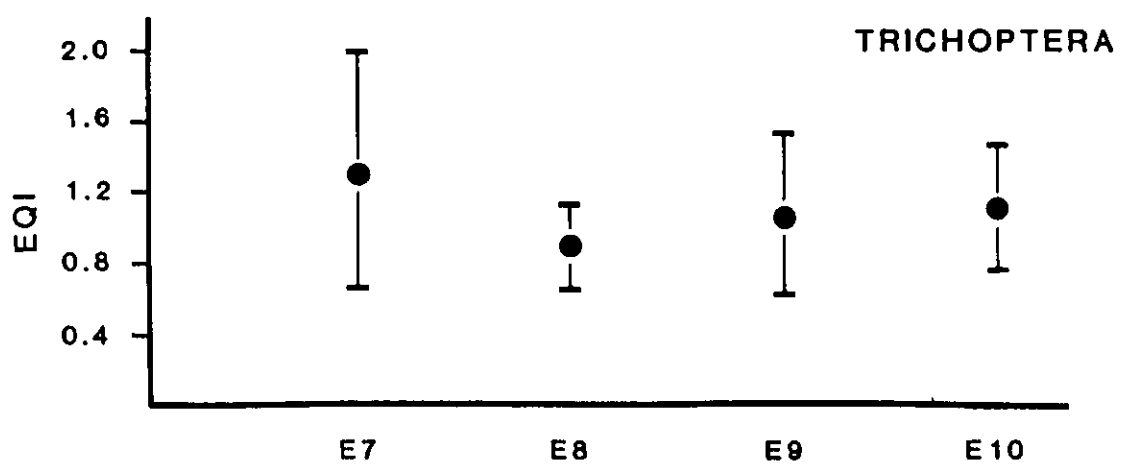
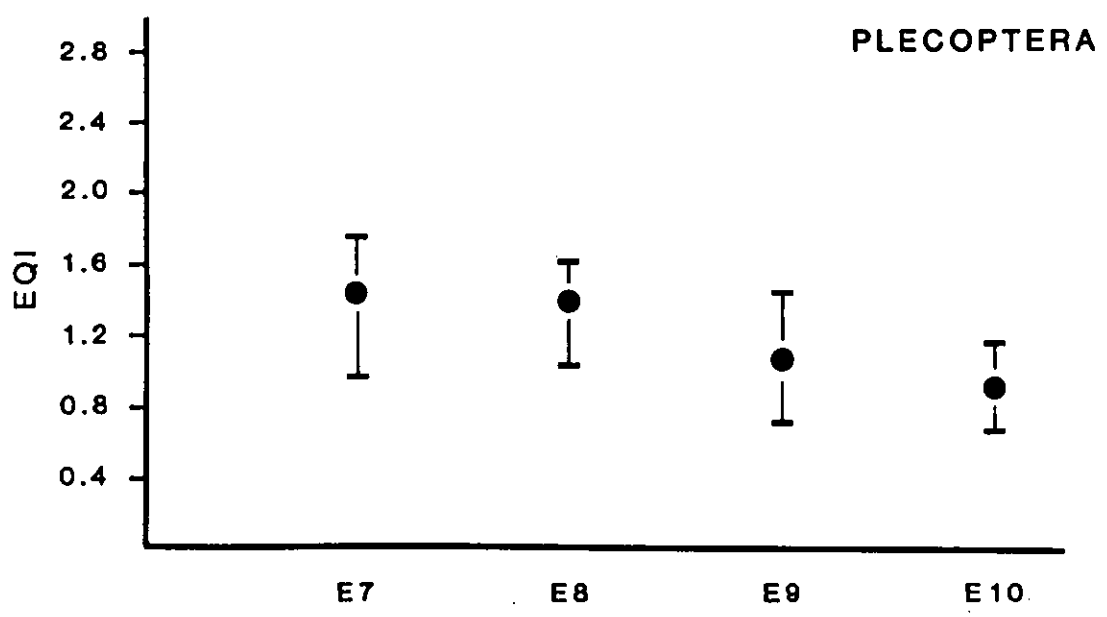
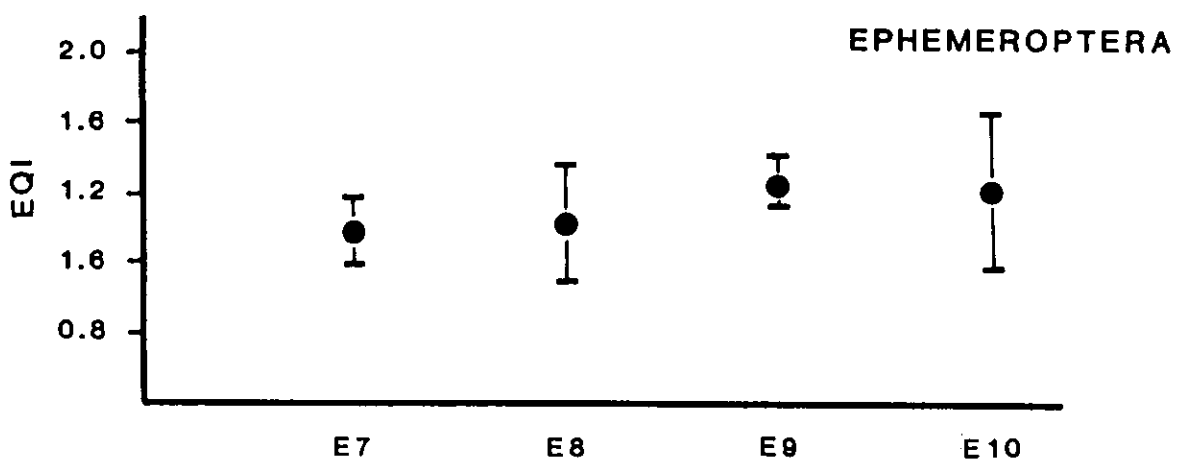


Figure 3. Environmental Quality Indices based on the number of selected orders of insects occurring at each site. Values are means of five separate sampling occasions with standard deviations.

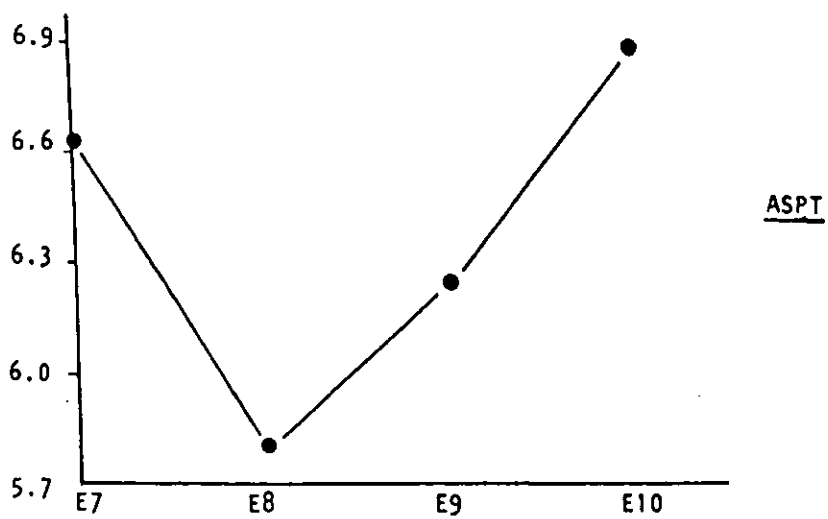
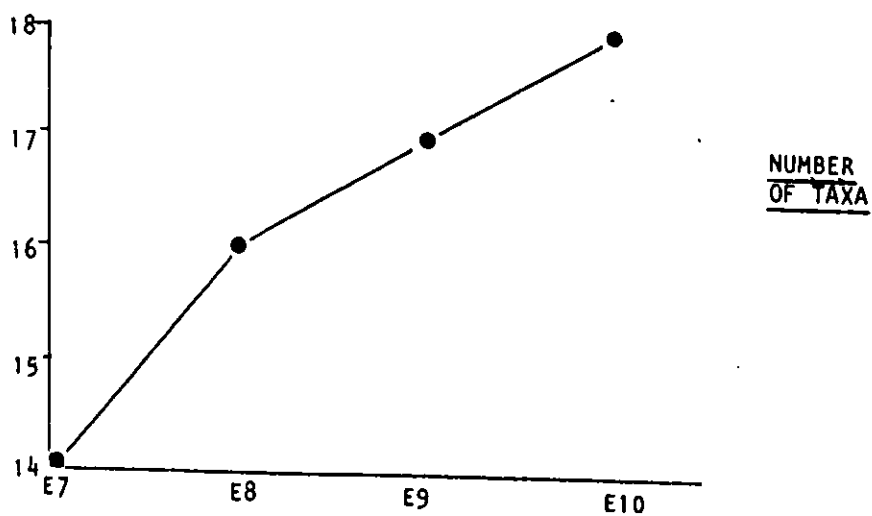
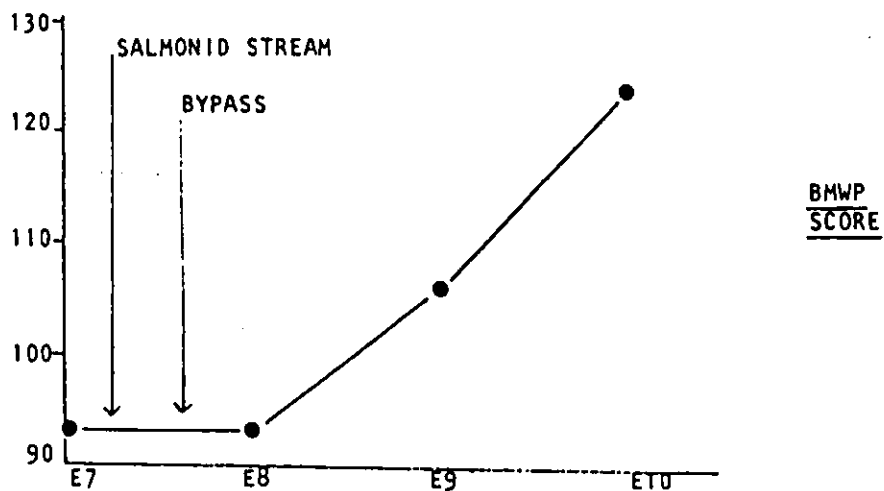


3b = East Okement



SECTION 9
APPENDICES

Figure 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEMEMACROINVERTEBRATE SURVEYINDICES OF ENVIRONMENTAL QUALITY - EAST OKEMENT, JUNE 8th 1987COMBINED BOX SAMPLES

Appendix 1. West Okement. BMWP scores, number of scoring taxa and ASPT's for each individual box-sample.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - JUNE 8th 1987 (BS=BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME																	
	VELLAKE COTTAGE SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON CASTLE SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	27	64	47	65	44	103	25	27	36	19	31	56	6	34	20	25	64	44
COMB. SCORE	74			108			53			68			37			71		
No. TAXA	6	11	8	9	7	15	5	6	7	5	6	9	3	7	5	5	11	8
COMB. No. TAXA	12			16			10			11			8			12		
ASPT	4.50	5.82	5.88	7.22	6.29	6.87	5.00	4.50	5.14	3.80	5.17	6.22	2.00	4.86	4.00	5.00	5.82	5.50
COMB. ASPT	6.17			6.75			5.30			6.18			4.63			5.92		

Appendix 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - SEPT. 10th 1987 (B9-BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME																	
	VELLAKE COTTAGE SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON CASTLE SITE W6		
	B51	B52	B53	B51	B52	B53	B51	B52	B53	B51	B52	B53	B51	B52	B53	B51	B52	B53
BMWP SCORE	86	86	91	92	86	93	35	46	8	9	29	8	21	26	55	18	22	35
COMB. SCORE	113			118			63			40			38			39		
No. TAXA	13	14	14	14	14	15	6	9	3	3	6	3	5	6	10	5	6	7
COMB. No. TAXA	17			19			11			8			11			8		
ASPT	6.62	6.14	6.50	6.57	6.14	6.20	5.87	5.11	2.67	3.00	4.83	2.67	4.20	4.33	5.50	3.60	3.67	5.00
COMB. ASPT	6.65			6.21			5.73			5.00			5.27			4.88		

Appendix 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - MARCH 2nd 1988 (BS=BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME																	
	VELLAKE COTTAGE SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON CASTLE SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	77	79	87	102	55	47	45	33	55	16	52	47	25	30	3	33	8	37
COMB. SCORE	99			107			70			57			45			44		
No. TAXA	12	12	13	15	8	8	7	5	9	3	8	8	5	6	2	7	3	8
COMB. No. TAXA	15			16			11			9			8			9		
ASPT	6.42	6.58	6.69	6.80	6.88	5.88	6.43	6.60	6.11	5.33	6.50	5.88	5.00	5.00	1.50	4.71	2.67	4.63
COMB. ASPT	6.60			6.69			6.36			6.33			5.63			4.89		

Appendix 1 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENENT RIVERS.
WEST OKENENT - JUNE 13th 1988 (D9-D0X SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME																	
	VELLAKE COTTAGE SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIDNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON CASTLE SITE W6		
	D91	D92	D93	D91	D92	D93	D91	D92	D93	D91	D92	D93	D91	D92	D93	D91	D92	D93
BMWP SCORE	88	93	76	79	68	81	18	12	17	13	20	15	19	15	24	30	25	33
COMB. SCORE		98			100				37		25			36			48	
No. TAXA	14	15	13	13	11	12	4	4	5	4	5	4	5	4	6	6	5	7
COMB. No. TAXA		16			16				8		6			8			9	
ASPT	6.29	6.20	5.85	6.08	6.18	6.75	4.50	3.00	3.40	3.25	4.00	3.75	3.80	3.75	4.00	5.00	5.00	4.71
COMB. ASPT		6.13			6.25			4.63			4.17			4.50			5.33	

Appendix 1 (cont.)

A30 OKENHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENENT RIVERS.
WEST OKENENT - SEPTEMBER 13th 1988 (BS-BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME																	
	VELLAKE COTTAGE SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKENHAMPTON CASTLE SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	49	59	74	83	74	78	39	27	12	15	27	23	27	7	12	8	22	8
COMB. SCORE		91			122			39			27			27			22	
No. TAXA	9	10	11	14	11	13	0	6	4	4	6	5	6	3	4	3	5	3
COMB. No. TAXA		14			19			8			6			6			5	
ASPT	5.44	5.90	6.73	5.93	6.73	6.00	4.88	4.50	3.00	3.75	4.50	3.00	4.50	2.33	3.00	2.67	4.40	2.67
COMB. ASPT		6.50			6.42			4.88			4.50			4.50			4.40	

Appendix 2. East Okement. BMWP scores, number of scoring taxa and ASPT's for each individual box-sample.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - JUNE 8th 1987 (BS=BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

<u>INDEX</u>	<u>SITE NAME</u>											
	<u>U/S BYPASS</u>			<u>D/S BYPASS</u>			<u>BALL HILL</u>			<u>GRAMMAR SCHOOL</u>		
	<u>SITE E7</u>			<u>SITE E8</u>			<u>SITE E9</u>			<u>SITE E10</u>		
	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>
<u>BMWP SCORE</u>	44	66	57	62	53	84	96	57	49	71	119	84
<u>COMB. SCORE</u>		93			93			106			124	
<u>No. TAXA</u>	7	11	9	11	10	14	15	10	8	11	17	12
<u>COMB. No. TAXA</u>		14			16			17			18	
<u>ASPT</u>	6.29	6.00	6.33	5.64	5.30	6.00	6.40	5.70	6.13	6.45	7.00	7.00
<u>COMB. ASPT</u>		6.64			5.81			6.24			6.89	

Appendix 2 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - SEPT. 10th 1987 (BS=BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

<u>INDEX</u>	<u>SITE NAME</u>											
	<u>U/S BYPASS</u>			<u>D/S BYPASS</u>			<u>BALL HILL</u>			<u>GRAMMAR SCHOOL</u>		
	<u>SITE E7</u>			<u>SITE E8</u>			<u>SITE E9</u>			<u>SITE E10</u>		
	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>
BMWP SCORE	114	106	105	115	100	105	122	121	102	116	90	98
COMB. SCORE		135			128			145			139	
No. TAXA	18	17	17	17	15	16	18	17	15	16	13	14
COMB. No. TAXA		21			20			21			19	
ASPT	6.33	6.24	6.18	6.76	6.67	6.56	6.78	7.12	6.80	7.25	6.92	7.00
COMB. ASPT		6.43			6.40			6.90			7.32	

Appendix 2 (cont.)

A30 OXEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - MARCH 2nd 1988 (BS-BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	72	80	84	60	76	77	64	73	67	58	50	62
COMB. SCORE	101			107			99			95		
No. TAXA	11	13	13	10	11	13	10	12	11	10	8	10
COMB. No. TAXA	16			16			15			15		
ASPT	6.55	6.15	6.46	6.00	6.91	5.92	6.40	6.08	6.09	5.80	6.25	6.20
COMB. ASPT	6.31			6.69			6.60			6.33		

Appendix 2 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENENT RIVERS.
EAST OKENENT - JUNE 13th 1988 (BS-BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME											
	U/B BYPASS SITE E7			O/B BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	108	121	103	89	81	71	64	81	61	34	59	49
COMB. SCORE		155			119			94			74	
No. TAXA	17	17	15	14	13	12	12	13	10	7	10	8
COMB. No. TAXA		22			18			16			18	
ASPT	6.35	7.12	6.87	6.36	6.23	5.92	5.33	6.23	6.10	4.86	5.90	6.13
COMB. ASPT		7.05			6.61			5.88			6.17	

A10 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - SEPTEMBER 13th 1988 (BS=BOX SAMPLE)
BIOLOGICAL MONITORING WORKING PARTY (BMWP) SCORES AND AVERAGE SCORES PER TAXON (ASPT)

INDEX	SITE NAME											
	U/S BYPASS SITE E7			D/B BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
BMWP SCORE	62	79	87	80	84	59	74	58	78	75	71	87
COMB. SCORE		107			95			115			135	
No. TAXA	10	13	14	13	14	10	11	10	13	12	11	13
COMB. No. TAXA		17			16			17			19	
ASPT	6.20	6.08	6.21	6.15	6.00	5.90	6.73	5.80	6.00	6.25	6.45	6.69
COMB. ASPT		6.29			5.94			6.76			7.11	

Appendix 3. West Okement. Abundance of each individual "species" in each box-sample for each month of sampling.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - JUNE 8th 1987 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMP. CASTLE		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)																		
Planariidae																		
Polycelis felina	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0
Phagocata vitta	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
NEMATODA (NEMATODES)																		
OLIGOCHAETA (TRUE WORMS)	1	61	21	0	2	44	7	47	21	15	8	100	43	38	13	2	34	7
HIRUDINEA (LEECHES)																		
Glossiphoniidae																		
Glossiphonia complanata	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Helobdella stagnalis	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
ARACHNIDA (SPIDERS & MITES)																		
Hydracarina	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oribatidae	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
EPHEMEROPTERA (MAYFLIES)																		
Baetidae																		
Baetis sp.	0	0	0	0	0	15	0	0	0	0	0	1	0	1	0	0	0	0
Baetis scambus	0	0	0	0	3	6	0	0	0	0	0	0	0	1	0	0	0	0
Baetis vernus	2	4	7	8	7	51	0	2	0	1	1	1	0	0	0	0	1	1
Baetis rhodani	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Heptageniidae																		
Heptagenia lateralis	0	0	0	1	1	4	0	0	0	0	0	0	0	0	0	0	0	0
Ecdyonurus sp.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Ephemerellidae																		
Ephemerella ignita	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA (STONEFLIES)																		
Nemouridae																		
Amphinemura sulcicollis	0	1	0	0	0	4	0	0	2	0	0	1	0	1	1	0	1	0
Leuctridae																		
Leuctra sp.	0	4	2	0	4	17	5	0	1	0	0	2	0	0	0	0	8	23
Leuctra geniculata	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Leuctra inermis	7	18	8	6	2	32	1	0	0	0	0	1	0	1	0	0	0	0
Leuctra fusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	3
Perlodidae																		
Isoperla grammatica	0	0	1	3	0	1	0	0	0	0	0	2	0	0	0	0	0	0
Perlidae																		
Dinocras cephalotes	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae																		
Chloroperla torrentium	0	1	0	1	14	17	0	0	0	0	1	1	0	0	0	0	4	2
COLEOPTERA (BEETLES)																		
Hydrophilidae																		
Hydraena gracilis	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae																		
Elmis aenea	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnius volckmari	2	12	10	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1
Oulinus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oulinus troglodytes	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oulinus tuberculatus	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Appendix 3 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - JUNE 8th 1987 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT.			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMP. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICHOPTERA (CADDISFLIES)																		
Rhyacophilidae																		
Rhyacophila sp.	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Rhyacophila dorsalis	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Polycentropodidae	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Polycentropus flavomaculatus	0	0	0	4	1	2	3	0	0	0	0	0	0	0	0	0	0	0
Polycentropus kingi	0	0	0	1	4	0	0	0	0	1	3	0	0	0	0	2	0	4
Hydropsychidae																		
Hydropsyche siltalai	0	0	0	3	0	0	0	2	0	0	0	0	0	1	1	0	0	0
Sericostomatidae																		
Sericostoma personatum	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA (TRUE FLIES)																		
Diptera indet.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Tipulidae																		
Eloeophila sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Dicranota sp.	0	4	2	0	0	0	0	0	0	0	0	1	0	1	1	0	1	1
Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1
Simuliidae																		
Simulium sp.	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Simulium cryophilum group	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium vernal group	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simulium ornatum group	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0
Simulium variegatum group	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chironomidae	5	2	4	74	37	48	11	9	12	37	53	36	7	2	3	12	16	13
ANURA (FROGS & TOADS) *																		
Tadpoles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	7

* = VERTEBRATES

Appendix 3 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - SEPT, 10th 1987 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT.			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMP. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
MEGALOPTERA (ALDERFLIES)																		
Sialidae																		
<i>Sialis fuliginosa</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
TRICHOPTERA (CADDISFLIES)																		
Rhyacophilidae																		
<i>Rhyacophila dorsalis</i>	0	2	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Polycentropodidae																		
<i>Plectrocnemia geniculata</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polycentropus flavomaculatus</i>	9	0	0	5	5	1	0	0	0	0	1	0	0	0	1	0	2	4
<i>Polycentropus kingi</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Hydropsychidae																		
<i>Hydropsyche</i> sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Hydropsyche pellucidula</i>	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Sericostomatidae																		
<i>Sericostoma personatum</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
DIPTERA (TRUE FLIES)																		
Diptera indet.																		
Tipulidae																		
<i>Eloeophila</i> sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dicranota</i> sp.	2	7	1	3	3	3	0	0	0	0	0	1	1	1	1	0	0	0
Ceratopogonidae																		
<i>Simuliidae</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Simulium cryophilum</i> group	0	6	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Simulium americanum</i>	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Simulium ornatum</i> group	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Simulium variegatum</i> group	0	6	4	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0
Chironomidae																		
	171	57	27	65	117	133	13	17	14	34	30	31	22	46	31	11	16	90
Empididae																		
<i>Heimerodroia</i> group	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
<i>Wiedemannia</i> group	0	1	0	2	0	1	1	3	0	0	0	0	0	3	4	0	0	0
Rhagionidae																		
<i>Atherix marginata</i>	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Appendix 3 (cont.)

A30 OXENHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENENT RIVERS.
WEST OKENENT - MARCH 2nd 1988 (BS=901 SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OXENAMP. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)																		
Planariidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Polycelis felina	0	0	1	1	0	0	1	0	1	1	2	3	0	0	0	2	0	0
Phagocata vilta	1	1	0	1	0	2	0	0	0	0	1	2	1	0	0	0	0	0
BIVALVIA (MUSSELS)																		
Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
OLIGOCHAETA (TRUE WORMS)																		
	96	174	119	23	3	3	48	63	132	7	50	86	55	57	11	31	5	4
HIKUDINEA																		
Glossiphoniidae																		
Melobdella stagnalis	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARACHNIDA (SPIDERS & MITES)																		
Hydracarina	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA (MAYFLIES)																		
Baetidae																		
Baetis rhodani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Heptageniidae																		
Heptagenia lateralis	0	0	0	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Ecdyonurus sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leptophlebiidae																		
Leptophlebia marginata	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA (STONEFLIES)																		
Taeniopterygidae																		
Brachyptera risi	39	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neouridae																		
Protonemura sp.	24	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Protonemura meyeri	8	2	2	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0
Aphineura sulcicollis	11	22	20	20	28	4	1	5	1	0	1	4	0	1	0	0	0	0
Leuctridae																		
Leuctra inerals	271	186	109	43	31	10	1	1	2	1	0	2	1	0	0	0	0	0
Leuctra hippopus	2	2	4	7	2	6	0	3	1	0	1	0	1	0	0	0	0	0
Perlodidae																		
Perlodes microcephala	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla grammatica	1	4	37	4	1	0	0	0	0	0	1	1	0	0	0	0	0	0
Chloroperlidae																		
Chloroperla sp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Chloroperla torrentium	45	26	54	11	3	6	0	1	1	0	0	0	0	0	0	0	0	0
Chloroperla tripunctata	0	0	0	8	4	0	0	0	0	0	1	0	0	1	0	0	0	0
COLEOPTERA (BEETLES)																		
Gyrinidae																		
Orectochilus villosus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae																		
Hydraena gracilis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae																		
Elais aenea	5	36	18	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Laninus volckmari	17	36	34	0	0	0	0	0	2	0	0	0	0	0	0	6	2	2
Oulianius sp.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0

Appendix 3 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
WEST OKEMENT - MARCH 2nd 1988 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT, SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON, CASTLE SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICHOPTERA (CADDISFLIES)																		
Rhyacophilidae																		
Rhyacophila dorsalis	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philopotamidae																		
Mornaldia sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Polycentropodidae	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
Plectrocnemia sp.	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Polycentropus flavomaculatus	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Hydropsychidae																		
Hydropsyche siltalai	0	0	0	1	6	0	0	0	0	0	0	1	0	0	0	0	0	0
Diplectrona felix	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Sericostomatidae																		
Sericostoma personatum	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	2	0	1
DIPTERA (TRUE FLIES)																		
Dicranota sp.	9	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	4	2	0
Simuliidae																		
Simulium sp.	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Simulium arcticum	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomidae	9	7	2	2	2	2	4	0	2	0	5	3	4	5	2	8	3	13
Epididae																		
Miedemannia group	0	0	1	1	0	1	0	4	0	1	0	2	1	2	1	1	0	0
Rhagionidae																		
Atherix sp.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Atherix marginata	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0

Appendix 3 (cont.)

ASO OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENET RIVERS.
WEST OKENET - JUNE 13th 1988 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			OKEHAMPTON CASTLE SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)																		
Planariidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Polycelis felina	0	4	2	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0
Phagocata vitta	14	15	4	0	0	0	0	0	0	1	3	0	1	0	1	1	0	0
BIVALVIA (BIVALVE SNAILS)																		
Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
OLIGOCHAETA (TRUE WORMS)																		
ARACHNIDA (SPIDERS & MITES)	653	152	232	49	14	316	344	40	108	68	62	56	100	16	46	9	33	23
Hydracarina	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
EPHEMEROPTERA (MAYFLIES)																		
Baetidae																		
Baetis sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis scabus	0	0	0	2	1	6	0	0	0	0	0	0	0	0	0	0	0	0
Baetis vernus	59	61	32	0	0	11	0	0	0	0	0	0	0	0	2	0	0	0
Baetis rhodani	0	0	0	1	0	4	0	1	3	0	0	0	1	0	0	0	0	0
Heptageniidae																		
Heptagenia lateralis	0	0	0	8	4	2	0	0	0	0	0	0	0	0	0	1	0	0
Ephemerellidae																		
Ephemerella ignita	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae																		
Caenis rivulorum	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA (STONEFLIES)																		
Meaouridae																		
Protonemura seyri	15	7	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aphnemura sulcirostris	29	20	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuctridae																		
Leuctra sp.	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuctra inerals	30	34	6	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Leuctra fusca	28	80	14	6	6	36	0	0	0	0	0	0	0	0	0	0	0	0
Perlodidae																		
Isoperla grammica	7	2	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae																		
Chloroperla torrentium	18	18	1	3	3	13	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperla tripunctata	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COLEOPTERA (BEETLES)																		
Hydrophilidae																		
Hydraena gracilis	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae																		
Oreodytes sanmarkii	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae																		
Elmis aenea	4	15	7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Limenus volckmari	16	22	11	1	0	1	1	0	0	1	0	0	0	0	4	0	1	0
Oulianus sp.	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1

Appendix 3 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - SEPT. 13th 1980 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMPTON CASTLE		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)																		
Planariidae																		
Polycelis felina	0	0	0	0	0	2	0	0	0	2	1	0	1	0	0	0	0	0
Phagocata vitta	0	1	0	0	0	0	0	0	0	3	0	1	1	0	0	0	0	0
Crenobia alpina	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BIVALVIA (BIVALVE SNAILS)																		
Sphaeriidae																		
Pisidium sp.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OLIGOCHAETA (TRUE WORMS)																		
ARACHNIDA (SPIDERS & MITES)																		
Hydracarina	1	1	1	2	2	0	1	0	1	0	0	0	1	0	1	0	0	0
AMPHIPODA																		
Gammaridae																		
Gammarus pulex	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EPHEMEROPTERA (MAYFLIES)																		
Baetidae																		
Baetis sp.	0	0	0	0	10	3	1	0	0	0	0	0	0	1	0	0	0	0
Baetis scambus	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Baetis vernus	1	1	1	0	1	3	1	1	0	2	1	0	1	0	1	0	0	0
Baetis rhodani	0	1	0	3	8	5	2	0	1	8	2	0	0	0	0	0	0	0
Heptageniidae																		
Rhythrogena semicolorata	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Ecdyonurus sp.	0	0	1	6	9	5	1	1	0	0	1	1	0	0	0	0	0	0
Leptophlebiidae	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemereillidae																		
FLECOPTERA (STONEFLIES)																		
Neouridae																		
Protonetura sp.	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Anchinetura sp.	0	2	0	3	6	8	2	0	0	0	0	0	0	0	0	0	0	0
Leuctridae																		
Leuctra sp.	14	13	9	11	2	3	0	0	0	0	0	0	1	0	0	0	0	0
Leuctra inerals	0	1	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0
Leuctra fusca	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
Perlodidae																		
Perlodes microcephala	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoperla grammica	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Perlidae																		
Dinocras cephalotes	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae																		
Chloroperla torrentium	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperla tripunctata	0	0	1	8	1	1	0	0	0	0	0	0	0	0	0	0	0	0
COLEOPTERA (BEETLES)																		
Gyrinidae																		
Orectochilus villosus	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae																		
Elmis aenea	8	10	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnius volckmari	12	11	26	1	0	0	3	1	0	0	1	1	1	0	2	1	0	1
Quilianus sp.	1	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1

Appendix 4. East Okement. Abundance of each individual "species" in each box sample for each month of sampling.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - JUNE 8th 1987 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL WILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)												
Planariidae												
<i>Polycelis felina</i>	0	0	0	0	0	2	1	0	0	0	1	0
GASTROPODA (SNAILS)												
Hydrobiidae												
<i>Potamopyrgus jenkinsi</i>	0	0	0	0	2	0	1	0	0	0	0	0
Ancylidae												
<i>Ancylus fluviatilis</i>	0	0	0	0	0	1	0	0	0	0	0	0
Zonitidae												
<i>Zonitoides nitidus</i>	0	0	0	0	0	0	0	0	0	0	1	0
OLIGOCHAETA (TRUE WORMS)	4	4	1	32	8	5	10	12	7	29	44	10
ARACHNIDA (SPIDERS & MITES)												
Hydracarina	0	0	0	1	1	1	3	2	1	3	3	5
AMPHIPODA (SHRIMPS)												
Gammaridae												
<i>Gammarus pulex</i>	0	0	0	1	1	0	0	0	0	0	2	0
EPHEMEROPTERA (MAYFLIES)												
Baetidae												
<i>Baetis</i> sp.	0	5	5	3	6	6	5	6	3	7	1	3
<i>Baetis scambus</i>	1	4	6	17	29	40	43	46	28	50	81	74
<i>Baetis vernus</i>	0	1	5	0	0	0	0	0	0	0	0	0
<i>Baetis rhodani</i>	0	0	6	4	0	7	6	4	3	0	0	1
Heptageniidae												
<i>Rhithrogena semicolorata</i>	0	0	2	0	0	0	1	0	0	0	0	0
<i>Heptagenia lateralis</i>	0	0	2	0	0	0	0	0	1	1	2	1
<i>Ecdyonurus</i> sp.	1	0	0	0	0	0	0	0	0	1	0	0
Ephemerellidae												
<i>Ephemerella ignita</i>	1	0	4	1	3	5	6	5	0	7	13	3
Caenidae												
<i>Caenis rivulorum</i>	0	0	0	0	0	0	0	0	0	0	2	0
PLECOPTERA (STONEFLIES)												
Nesouridae												
<i>Protonemura</i> sp.	0	0	0	0	0	0	1	0	0	0	0	0
<i>Protonemura meyeri</i>	0	1	0	0	0	1	0	0	0	0	0	0
<i>Amphinemura sulcicollis</i>	0	1	0	1	0	0	0	0	0	0	0	0
Leuctridae												
<i>Leuctra</i> sp.	0	0	5	4	4	3	4	2	1	1	5	7
<i>Leuctra inermis</i>	0	7	7	4	0	1	0	0	0	0	0	0
<i>Leuctra fusca</i>	0	0	0	0	0	0	0	0	1	0	1	1
Perlodidae												
<i>Isoperla grammatica</i>	0	2	0	0	0	0	0	0	0	0	0	0
Chloroperlidae												
<i>Chloroperla</i> sp.	0	0	1	0	0	2	0	0	1	1	5	2
<i>Chloroperla torrentium</i>	4	6	6	0	0	2	0	3	0	0	0	0
<i>Chloroperla tripunctata</i>	0	0	2	0	0	0	1	0	0	1	1	0

Appendix 4 (cont.)

A30 OKENHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKENENT RIVERS,
EAST OKENENT - JUNE 8th 1987 (BS-BS1 SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
COLEOPTERA (BEETLES)												
Elmidae												
<i>Elmis aenea</i>	0	0	0	0	0	2	1	1	1	0	0	1
<i>Esolus parallelipedus</i>	0	0	0	0	0	0	1	2	0	4	2	0
<i>Limnius volckwari</i>	0	1	0	1	0	0	2	3	3	6	5	3
<i>Oulimnius</i> sp.	0	0	0	0	0	0	0	0	0	1	1	0
<i>Oulimnius tuberculatus</i>	0	0	0	0	0	0	0	0	2	0	0	0
TRICHOPTERA (CADDISFLIES)												
Rhyacophilidae												
<i>Rhyacophila</i> sp.	0	1	0	0	0	0	0	0	0	1	0	0
<i>Rhyacophila dorsalis</i>	0	0	0	2	4	1	1	0	0	0	1	0
Polycentropodidae	0	0	0	0	0	0	0	0	0	1	2	1
<i>Plectrocnemia conspersa</i>	0	0	0	0	0	0	0	0	1	0	0	0
<i>Polycentropus kingi</i>	1	0	0	0	0	1	2	0	0	2	6	1
Hydropsychidae												
<i>Hydropsyche siltalai</i>	0	1	5	0	0	0	0	1	0	1	0	1
Goeridae												
<i>Silo</i> sp.	0	0	0	0	0	0	0	0	0	0	1	0
<i>Silo pallipes</i>	0	0	0	0	0	0	0	0	0	0	0	1
Lepidostomatidae												
<i>Lepidostoma hirtum</i>	0	0	0	0	0	0	0	0	0	0	1	0
Sericostomatidae												
<i>Sericostoma personatum</i>	0	0	0	0	0	0	3	0	0	0	5	1
Tipulidae												
<i>Dicranota</i> sp.	0	0	0	3	1	1	0	1	0	0	2	0
Simuliidae												
<i>Simulium</i> sp.	0	4	1	0	0	0	0	0	0	0	0	0
<i>Simulium cryophilum</i>	0	2	0	0	0	0	0	0	0	0	0	0
<i>Simulium vernum</i> group	0	0	0	2	1	0	1	1	0	0	0	0
<i>Simulium ornatum</i> group	0	1	0	0	0	0	0	0	0	0	0	0
<i>Simulium variegatum</i> group	0	66	21	0	0	1	0	0	0	0	0	0
Chironomidae	7	25	15	27	15	10	13	15	10	22	47	11
Empididae												
<i>Chelifera</i> group	0	0	0	0	0	1	0	0	0	1	0	1
<i>Wiedemannia</i> group	0	0	0	1	0	1	1	0	0	1	2	0

Appendix 4 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - SEPT.10th 1987 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)												
Planariidae	0	0	0	1	0	0	0	0	0	0	0	0
Polycelis felina	0	0	2	0	0	1	0	0	0	0	0	0
Phagocata vitta	0	0	0	2	0	0	0	0	0	0	0	0
NEMATODA (NEMATODES)	0	1	0	0	0	0	0	0	0	0	0	0
GASTROPODA (SNAILS)												
Hydrobiidae												
Potamopyrgus jenkinsi	1	1	1	0	0	2	0	0	0	0	0	0
Ancyliidae												
Ancyclus fluviatilis	0	0	0	1	0	0	0	0	0	0	0	0
OLIGOCHAETA (TRUE WORMS)	174	149	542	91	152	148	94	119	134	65	95	60
ARACHNIDA (SPIDERS & MITES)												
Hydracarina	0	0	0	1	5	3	4	4	13	13	12	4
AMPHIPODA (SHRIMPS)												
Gammaridae												
Gammarus pulex	0	0	5	3	1	10	0	2	7	0	1	0
EPHEMEROPTERA (MAYFLIES)												
Baetidae												
Baetis sp.	0	0	0	0	41	22	0	0	17	0	0	0
Baetis scambus	0	0	0	0	0	0	0	0	1	0	2	1
Baetis vernus	1	0	0	2	1	0	0	0	0	0	0	0
Baetis rhodani	12	7	9	41	50	21	3	11	32	10	6	5
Baetis muticus	2	1	0	0	0	0	0	0	0	0	0	0
Centroptilum luteolum	0	0	0	0	0	0	1	0	0	0	1	0
Heptageniidae	4	6	10	4	14	5	3	18	49	10	2	3
Rhithrogena semicolorata	0	2	2	0	12	0	0	2	2	0	0	0
Heptagenia lateralis	0	0	0	0	0	0	0	0	0	2	0	0
Ecdyonurus sp.	8	4	6	3	6	5	2	6	12	5	1	3
Leptophlebiidae	0	0	0	0	0	0	0	1	0	0	0	0
Paraleptophlebia submarginata	0	0	0	0	0	0	2	0	1	0	2	0
Ephemerellidae												
Ephemerella ignita	0	0	0	0	0	0	0	0	0	1	0	1
PLECOPTERA (STONEFLIES)												
Nemouridae												
Protonemura sp.	13	6	7	0	0	0	0	0	0	0	0	0
Aephenemura sulcicollis	0	0	0	0	0	0	0	3	0	0	0	1
Nemurella picteti	0	0	0	0	0	0	1	0	0	0	0	0
Nemoura avicularis	0	0	0	1	0	0	4	0	0	0	1	2
Leuctridae												
Leuctra sp.	4	17	9	8	1	5	3	8	36	3	8	15
Leuctra nigra	0	1	0	0	0	0	0	0	0	0	0	0
Leuctra fusca	1	4	5	11	3	7	5	7	4	12	3	4
Perlodidae	0	0	0	0	0	0	0	1	0	0	0	0
Perlodes microcephala	0	3	2	2	1	2	1	2	1	1	0	0
Isoperla grammica	0	0	0	0	0	0	0	0	1	0	0	0
Chloroperlidae												
Chloroperla torrentium	0	0	1	0	1	0	0	0	0	0	0	0
Chloroperla tripunctata	23	21	10	3	1	2	8	10	14	17	16	5

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.

EAST OKEMENT - SEPT.10th 1987 (BS=BOX SAMPLE)

ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
COLEOPTERA (BEETLES)												
Hydrophilidae												
Hydraena gracilis	4	2	3	0	1	0	0	0	0	1	0	0
Helophorus sp.	0	0	0	0	0	0	1	0	0	0	0	0
Elmidae												
Elais aenea	0	0	2	0	7	2	5	11	12	8	2	8
Esolus parallelipipedus	0	0	0	1	0	0	5	2	4	4	3	1
Limnius volckmari	1	2	3	2	16	3	24	13	10	4	2	0
Oulimnius sp.	0	0	0	1	0	6	29	3	4	4	11	10
Oulimnius tuberculatus	0	0	0	0	0	0	0	1	0	0	0	0
MEGALOPTERA (ALDERFLIES)												
Sialidae												
Sialis lutaria	0	0	0	0	0	0	1	0	0	0	0	0
TRICHOPTERA (CADDISFLIES)												
Rhyacophilidae												
Rhyacophila sp.	2	1	5	1	0	0	1	4	4	1	0	0
Rhyacophila dorsalis	1	0	0	0	3	0	0	1	1	0	0	1
Agapetus sp.	0	0	0	0	2	1	0	0	0	0	0	0
Philopotamidae												
Philopotamus montanus	1	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae												
Plectrocnemia conspersa	0	0	0	0	0	0	0	3	6	2	0	1
Plectrocnemia geniculata	0	0	0	0	0	0	1	0	0	0	0	0
Polycentropus flavomaculatus	0	2	0	3	0	2	3	2	1	2	0	0
Hydropsychidae												
Hydropsyche sp.	0	5	0	0	0	0	1	0	1	0	0	0
Limnephilidae												
Limnephila sp.	0	0	0	0	0	0	0	1	0	0	0	0
Leptoceridae												
Athripsodes sp.	0	0	0	0	0	0	1	0	0	1	0	0
Mystacides azurea	0	0	0	0	0	0	5	0	0	0	0	1
Decetis sp.	0	0	0	0	0	0	0	0	0	0	0	1
Goeridae												
Silo sp.	0	0	0	1	1	1	0	0	0	0	0	0
Silo pallipes	1	0	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae												
Lepidostoma hirtum	0	0	0	0	0	0	0	3	0	0	3	0
Sericostomatidae												
Sericostoma personatum	1	2	4	29	3	31	13	1	9	2	3	6
Tipulidae												
Pedicia rivosa	0	0	1	0	0	0	0	0	0	0	0	0
Dicranota sp.	2	13	15	2	5	9	3	1	2	1	1	1
Simuliidae												
Simulium cryophilum group	7	3	2	0	0	0	0	0	0	0	0	0
Simulium variegatum group	32	5	5	0	1	0	0	0	0	0	0	0
Ceratopogonidae												
Ceratopogon sp.	0	0	0	0	0	1	0	1	0	0	0	0
Chironomidae												
Chironomus sp.	30	49	47	70	16	69	144	88	128	59	60	59
Empididae												
Chelifera group	0	0	0	0	0	0	0	0	1	0	0	0
Wiedemannia group	2	0	0	0	0	0	0	0	1	0	0	0
Rhagionidae												
Atherix marginata	0	2	1	3	1	0	0	0	2	0	0	0

Appendix 4 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - MARCH 2nd 1989 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)												
Planariidae												
<i>Polycelis felina</i>	1	0	0	1	0	1	1	0	0	1	0	0
<i>Phagocata vitta</i>	0	4	0	0	0	0	5	1	1	0	0	0
NEMATODA (NEMATODES)	0	0	0	0	0	0	0	0	1	0	0	0
GASTROPODA (SNAILS)												
Hydrobiidae												
<i>Potamopyrgus jenkinsi</i>	0	0	0	0	0	0	0	0	0	1	0	0
OLIGOCHAETA (TRUE WORMS)	160	80	272	15	130	76	179	283	236	281	250	240
ARACHNIDA (SPIDERS & MITES)												
Hydracarina	0	0	0	1	0	0	0	0	0	0	1	0
AMPHIPODA (SHRIMPS)												
Gammaridae												
<i>Gammarus pulex</i>	0	0	0	1	0	1	0	0	1	0	0	0
EPHEMEROPTERA (MAYFLIES)												
Baetidae												
<i>Baetis rhodani</i>	0	0	2	1	5	16	20	38	22	0	0	0
Heptageniidae	0	0	0	0	0	2	0	0	0	0	0	0
<i>Rhithrogena semicolorata</i>	4	5	11	0	18	9	4	8	5	0	1	0
<i>Heptagenia lateralis</i>	0	0	1	0	0	0	0	0	0	0	0	0
<i>Ecdyonurus</i> sp.	3	0	0	2	0	4	4	4	1	3	5	2
PLECOPTERA (STONEFLIES)												
Taeniopterygidae												
<i>Brachyptera risi</i>	0	0	0	0	1	0	0	4	0	0	0	0
Nemouridae												
<i>Protonaura meyeri</i>	0	0	1	0	0	1	0	1	1	0	0	0
<i>Aphineaura</i> sp.	1	0	0	0	0	0	0	0	0	0	0	0
<i>Aphineaura sulcicoilis</i>	0	0	4	1	1	3	0	0	3	0	0	1
Leuctridae												
<i>Leuctra inerais</i>	28	36	43	0	2	2	1	0	0	0	0	0
<i>Leuctra hippopus</i>	0	1	0	0	0	0	0	0	0	0	0	1
Perlodidae												
<i>Perlodes microcephala</i>	0	0	0	2	0	0	0	0	1	0	0	0
<i>Isoperla grammica</i>	0	0	1	0	0	0	1	0	0	0	0	0
Chloroperlidae												
<i>Chloroperla</i> sp.	48	24	42	1	2	7	2	1	4	0	5	2
<i>Chloroperla torrentium</i>	23	10	29	0	1	0	1	1	3	1	0	1
<i>Chloroperla tripunctata</i>	5	12	2	1	1	2	2	0	3	2	0	1

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - JUNE 13th 1988 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)												
Planariidae												
<i>Polycelis felina</i>	2	0	0	0	2	0	0	0	0	0	2	0
<i>Phagocata vitta</i>	1	0	0	0	0	0	1	0	0	0	0	0
Dendrocoelidae												
<i>Dendrocoelum lacteum</i>	0	0	0	0	0	0	0	1	0	0	0	0
GASTROPODA (SNAILS)												
Hydrobiidae												
<i>Potamopyrgus jenkinsi</i>	0	0	0	1	0	0	1	0	0	0	0	0
NEMATODA (NEMATODES)												
<i>Potamopyrgus jenkinsi</i>	0	0	0	0	1	0	0	0	1	1	0	0
OLIGOCHAETA (TRUE WORMS)												
<i>Potamopyrgus jenkinsi</i>	280	112	176	68	304	168	220	352	94	56	102	204
ARACHNIDA (SPIDERS & MITES)												
<i>Potamopyrgus jenkinsi</i>	0	0	2	1	0	0	0	2	0	1	0	0
EPHEMEROPTERA (MAYFLIES)												
Baetidae												
<i>Baetis</i> sp.	2	4	1	0	0	8	6	20	4	2	6	0
<i>Baetis scambus</i>	14	30	18	72	74	28	106	147	80	68	72	96
<i>Baetis rhodani</i>	18	3	5	5	86	44	32	93	4	2	0	0
Heptageniidae												
<i>Rhithrogena semicolorata</i>	0	1	0	0	0	0	0	0	0	0	0	0
<i>Heptagenia lateralis</i>	2	3	2	1	0	0	1	0	0	0	1	0
<i>Ecdyonurus</i> sp.	1	0	0	0	0	0	0	0	0	0	0	0
<i>Ecdyonurus venosus</i>	0	0	0	0	0	0	3	2	0	0	0	0
Leptophlebiidae												
<i>Habrophlebia fusca</i>	0	0	0	1	0	0	0	0	0	0	0	0
Ephemerellidae												
<i>Ephemerella ignita</i>	7	4	4	16	13	3	14	29	11	6	7	6
PLECOPTERA (STONEFLIES)												
Neanouridae												
<i>Protonemura meyeri</i>	5	0	0	0	0	0	0	0	0	0	0	0
<i>Aephenemura sulcirostris</i>	6	0	0	0	0	0	0	0	0	0	0	0
Leuctridae												
<i>Leuctra</i> sp.	20	0	0	0	0	0	0	0	0	0	0	0
<i>Leuctra inermis</i>	9	0	4	0	0	0	1	0	0	0	0	0
<i>Leuctra fusca</i>	25	15	34	1	3	0	0	2	1	0	0	0
Perlodidae												
<i>Isoperla grammica</i>	0	1	0	1	0	0	0	0	0	0	0	0
Chloroperlidae												
<i>Chloroperla</i> sp.	0	0	0	0	0	1	0	0	0	0	0	2
<i>Chloroperla torrentium</i>	20	18	13	0	1	0	0	0	0	0	0	0
<i>Chloroperla tripunctata</i>	5	0	4	0	0	0	0	0	0	0	0	0

A30 OXEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - JUNE 13th 1988 (BS-BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
COLEOPTERA (BEETLES)												
Hydrophilidae												
Hydraena gracilis	1	2	0	0	0	0	0	0	0	0	0	0
Melophorus brevipalpis	0	1	0	0	0	0	0	0	0	0	0	0
Dytiscidae												
Oreodytes sanmarkii	0	0	0	0	0	0	2	0	2	3	0	0
Elmidae												
Elmis aenea	1	2	0	0	4	2	2	3	1	0	0	0
Esolus parallelipedus	0	0	0	0	0	0	1	1	1	2	0	6
Lianius volckmari	1	2	0	1	0	2	1	3	8	10	3	1
Oulimnius sp.	0	0	0	1	0	0	2	0	3	1	1	4
TRICHOPTERA (CADDISFLIES)	0	0	0	0	0	0	0	0	0	0	1	0
Rhyacophilidae												
Rhyacophila sp.	2	1	2	0	2	1	1	0	0	0	0	0
Rhyacophila dorsalis	3	1	1	4	3	3	1	3	1	0	0	0
Polycentropodidae	1	2	2	1	0	0	1	2	0	2	1	0
Plectrocnemia geniculata	1	0	0	0	0	0	0	0	0	0	0	0
Polycentropus sp.	0	0	0	0	0	0	0	0	2	0	0	0
Polycentropus flavomaculatus	0	6	5	0	0	0	0	0	0	0	0	0
Polycentropus kingi	0	4	5	2	1	1	5	3	10	6	7	11
Hydropsychidae												
Hydropsyche siltalai	20	2	2	0	0	1	0	0	0	0	0	0
Limnephilidae												
Potamophylax cingulatus	0	0	1	0	0	0	0	0	0	0	0	0
Odontoceridae												
Odontocerum albicorne	0	1	0	0	0	0	0	0	0	0	0	0
Goeridae												
Silo pallipes	0	1	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae												
Lepidostoma hirtum	0	0	3	0	0	0	0	0	0	0	0	0
Sericostomatidae												
Sericostoma personatum	5	9	1	0	3	0	0	4	2	0	1	1
Tipulidae												
Eloeophila sp.	1	0	0	2	3	3	0	2	0	0	1	0
Dicranota sp.	13	0	1	0	0	0	0	0	0	0	0	0
Simuliidae												
Simulium sp.	0	0	0	0	1	0	0	0	0	0	0	0
Simulium cryophilum	1	1	0	0	0	0	0	2	0	0	0	0
Simulium vernum group	2	8	0	0	0	0	3	2	0	0	0	0
Simulium ornatum group	0	0	0	0	0	2	1	2	0	0	0	0
Simulium variegatum group	2	0	1	1	2	2	2	0	0	0	0	0
Chironomidae	64	94	74	93	200	72	124	180	92	136	88	100
Epididae	0	1	2	0	3	1	1	2	1	1	2	2
Chelifera group	0	0	0	0	0	0	0	0	0	0	0	1
Hemerodromia group	1	0	0	0	0	0	0	0	0	0	0	0
Wiedemannia group	1	0	0	0	3	0	0	2	0	0	0	1
Dolichopodidae	0	0	0	0	0	0	0	0	1	0	0	0
Rhagionidae												
Atherix marginata	1	0	0	1	4	0	0	2	1	0	1	0

A30 OKENHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - SEPT. 13th 1988 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
TRICLADIDA (FLATWORMS)												
Planariidae	0	0	1	1	0	0	0	0	0	0	0	0
Polycelis felina	0	0	3	1	1	0	0	1	0	1	0	1
Phagocata vitta	0	0	0	1	3	0	0	2	1	0	0	0
BIVALVIA												
Sphaeriidae												
Pisidium sp.	0	0	0	0	1	0	0	0	0	0	0	0
GASTROPODA (SNAILS)												
Hydrobiidae												
Potamoopyrgus jenkinsi	0	0	0	0	0	0	0	0	1	0	0	0
Ancylidae												
Ancylus fluviatilis	0	0	1	6	0	0	0	2	2	1	1	6
OLIGOCHAETA (TRUE WORMS)	83	29	39	98	99	73	39	46	38	77	60	85
ARACHNIDA (SPIDERS & MITES)												
Hydracarina	0	1	1	0	0	0	3	1	0	3	1	3
AMPHIPODA												
Gammaridae												
Gammarus pulex	0	0	0	0	0	0	0	0	0	0	1	0
EPHEMEROPTERA (MAYFLIES)												
Baetidae												
Baetis sp.	0	0	0	0	0	0	0	0	19	0	0	0
Baetis scambus	0	0	0	0	0	0	4	1	0	2	2	6
Baetis rhodani	8	4	5	25	54	13	8	62	20	11	5	6
Baetis muticus	0	2	1	0	0	0	0	0	0	0	0	0
Heptageniidae												
Rhithrogena seaiolorata	7	9	4	2	0	0	0	0	0	1	0	0
Ecdyonurus sp.	11	12	21	8	4	6	5	0	3	16	6	8
Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	3	0
Ephemerellidae												
Ephemerella ignita	0	0	0	0	0	0	0	1	0	0	0	1
PLECOPTERA (STONEFLIES)												
Nesouridae												
Protonemura sp.	0	3	2	0	2	0	0	0	0	1	1	0
Nemoura avicularis	0	0	0	0	0	0	0	0	0	0	1	0
Leuctridae												
Leuctra sp.	1	2	6	2	1	0	2	1	1	0	0	0
Leuctra inermis	0	1	0	0	0	0	0	0	0	0	0	0
Leuctra fusca	0	1	4	0	1	0	0	0	0	0	0	0
Perlodidae	0	0	0	0	0	0	1	0	0	0	0	0
Perlodes microcephala	0	0	0	0	0	0	0	0	0	1	0	0
Chloroperlidae												
Chloroperla sp.	0	0	0	1	0	0	0	0	0	0	0	0
Chloroperla torrentium	0	1	1	0	0	0	0	0	0	0	0	0
Chloroperla tripunctata	2	15	25	0	1	2	1	0	0	2	0	0

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - SEPT. 13th 1988 (BS=BOX SAMPLE)
ABUNDANCES OF INDIVIDUAL SPECIES IN EACH SAMPLE

TAXON NAME	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
COLEOPTERA (BEETLES)												
Hydrophilidae												
Hydraena gracilis	1	3	0	0	0	0	0	0	0	0	0	0
Elmidae												
Elmis aenea	0	2	2	5	0	0	3	7	3	3	7	14
Esolus parallelepipedus	0	0	0	0	1	0	3	5	3	2	5	2
Limnius volckmari	2	2	1	15	1	5	11	10	3	16	14	9
Oulienius sp.	0	0	1	0	0	0	4	1	1	6	5	2
Oulienius tuberculatus	0	0	0	0	0	0	0	1	0	0	0	0
TRICHOPTERA (CADDISFLIES)												
Rhyacophilidae												
Rhyacophila sp.	0	0	0	1	0	1	0	0	0	0	0	1
Rhyacophila dorsalis	0	0	0	0	2	1	2	0	0	0	0	0
Agapetus sp.	0	0	0	1	0	1	0	0	0	0	0	1
Polycentropodidae												
Polycentropus sp.	0	0	0	0	0	0	0	0	0	0	0	1
Polycentropus flavomaculatus	0	0	1	0	0	0	0	0	0	0	0	0
Hydropsychidae												
Hydropsyche siltalai	0	2	0	1	4	0	2	6	1	3	0	0
Odontoceridae												
Odontocera albicorne	0	0	0	0	0	0	0	0	0	0	0	1
Leptoceridae												
Athripsodes sp.	0	0	0	0	0	0	0	0	0	0	1	1
Goeridae												
Silo pallipes	1	1	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae												
Lepidostoma hirtum	0	0	0	0	0	0	0	0	1	0	0	0
Sericostomatidae												
Sericostoma personatum	0	0	1	1	1	1	1	0	2	2	1	3
DIPTERA (TRUE FLIES)												
Diptera indet.												
Diptera indet.	0	0	0	0	0	0	0	0	0	0	1	1
Tipulidae												
Dicranota sp.	2	2	3	2	0	1	0	0	0	0	0	0
Simuliidae												
Simulium cryophilum	0	3	0	0	0	0	0	0	0	0	0	0
Simulium ornatum group	0	0	1	0	0	0	0	0	0	0	0	0
Simulium variegatum group	0	1	1	0	3	2	0	0	0	0	0	0
Ceratopogonidae												
Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	1	0
Chironomidae												
Chironomidae	3	6	8	20	12	9	7	9	14	31	16	16
Epididae												
Epididae	0	0	0	0	0	0	0	0	1	0	0	0
Chelifera group												
Chelifera group	0	0	0	0	1	0	0	0	2	2	0	2
Heaerodromia group												
Heaerodromia group	0	0	0	0	0	0	0	0	1	0	0	1
Wiedemannia group												
Wiedemannia group	1	0	0	1	2	0	3	0	0	1	3	2
Rhagionidae												
Atherix marginata	0	1	0	1	3	0	1	2	0	0	0	2

Appendix 5. West Okement. Abundance of each individual "family" in each box-sample for each month of sampling.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - JUNE Bth 1987 (BS=BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMP. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	0	2	0	0	0	1	1	0	1	1	0	0	0	0	0	0	3	0
OLIGOCHAETA (1)	1	61	21	0	2	44	7	47	21	15	8	100	43	38	13	2	34	7
Glossiphoniidae (3)	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Hydracarina (/)	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dribatidae (/)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Baetidae (4)	2	4	7	8	10	72	0	2	1	1	1	2	0	3	0	0	1	1
Heptageniidae (10)	0	0	0	1	2	4	0	0	0	0	0	0	0	0	0	0	1	0
Ephemerellidae (10)	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemouridae (7)	0	1	0	0	0	4	0	0	2	0	0	1	0	1	1	0	1	0
Leuctridae (10)	7	22	10	6	6	49	6	1	1	0	0	3	0	1	0	2	10	26
Perlodidae (10)	0	0	1	3	0	1	0	0	0	0	0	2	0	0	0	0	0	0
Perlidae (10)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae (10)	0	1	0	1	14	17	0	0	0	0	1	1	0	0	0	0	4	2
Hydrophilidae (5)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae (5)	3	19	14	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2
Rhyacophilidae (7)	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0
Polycentropodidae (7)	0	0	0	5	5	4	3	0	0	1	3	1	0	0	0	2	0	4
Hydropsychidae (5)	0	0	0	3	0	0	0	2	0	0	0	0	0	1	1	0	0	0
Sericostomatidae (10)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae (5)	0	4	2	0	0	0	0	0	0	0	0	1	0	1	1	0	3	1
Ceratopogonidae (/)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1
Simuliidae (5)	1	8	0	0	0	2	0	2	0	0	0	0	0	0	0	0	1	0
Chironomidae (2)	5	2	4	74	37	48	11	9	12	37	53	36	7	2	3	12	16	13

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY. (/)=NON-SCORING TAXON.

Appendix 5 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - SEPT 10th 1987 (BS-BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WISNEY			GOLF COURSE			OKEHAMPT. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	0	2	7	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Sphaeriidae	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	3	1	7
OLIGOCHAETA (1)	140	260	228	90	39	52	106	191	56	53	29	46	158	123	272	5	10	7
Hydracarina (/)	2	0	1	2	2	1	1	0	0	0	0	1	1	0	0	0	0	0
Oribatidae (/)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammaridae (6)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Baetidae (4)	4	51	7	0	7	4	0	15	0	0	0	0	0	0	0	0	0	0
Heptageniidae (10)	0	1	1	17	24	25	0	0	0	0	0	0	0	0	0	0	0	0
Leptophlebiidae (10)	2	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroellidae (10)	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Nemouridae (7)	2	1	0	7	8	13	0	1	0	0	0	0	0	0	0	0	0	0
Leuctridae (10)	27	20	30	20	30	25	2	1	0	0	1	0	0	0	0	0	0	0
Perlodidae (10)	1	2	3	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae (10)	1	1	4	13	9	15	1	0	0	0	0	0	0	2	3	0	0	0
Dytiscidae (5)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gyrinidae (5)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Hydrophilidae (5)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helodidae (5)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae (5)	43	41	42	1	3	4	3	4	1	0	0	0	0	3	5	3	3	4
Sialidae (4)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
Rhyacophilidae (7)	0	2	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1
Polycentropodidae (7)	9	0	1	6	5	1	1	0	0	0	2	0	0	0	2	1	2	4
Hydropsychidae (5)	0	1	0	1	5	6	0	4	0	0	0	0	0	0	1	0	0	0
Sericostomatidae (10)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Tipulidae (5)	3	7	1	3	3	3	0	0	0	0	0	2	1	1	1	0	0	0
Ceratopogonidae (/)	0	0	0	0	0	0	1	0	0	0	0	0	1	4	4	0	0	0
Simuliidae (5)	1	16	6	0	3	1	0	0	0	0	0	0	0	0	2	0	0	0
Chironomidae (2)	171	57	27	65	117	153	13	17	14	34	30	31	22	46	31	2	16	90
Epididae (/)	0	1	0	2	0	1	1	4	0	0	0	0	0	3	4	0	0	0
Rhagionidae (/)	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY. (/)=NON-SCORING TAXON.

Appendix 5 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OXHEMPT RIVERS,
WEST OXHEMPT - MARCH 2nd 1988 (BS-001 SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME																	
	VELLAKE COTT			U/S ADIT/BYPASS			D/S BYPASS			U/S WIGNEY			GOLF COURSE			OKEHAMPT. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	1	1	1	2	0	2	1	0	1	1	3	5	1	0	0	2	0	1
Sphaeriidae (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
OLIGOCHAETA (1)	96	174	119	23	3	3	48	63	132	7	50	86	55	57	11	31	5	4
Glossiphoniidae (3)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydracarina (/)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetidae (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptageniidae (10)	0	0	0	4	1	0	1	0	0	0	0	0	0	0	0	0	0	2
Leptophlebiidae (10)	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Taeniopterygidae (10)	39	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neanouridae (7)	43	40	22	21	29	4	1	5	1	0	1	4	1	2	0	1	0	0
Leuctridae (10)	273	188	113	50	33	16	1	4	3	1	1	2	2	0	0	0	0	0
Perlodidae (10)	1	6	37	4	1	0	0	0	0	0	1	0	0	0	0	0	0	0
Chloroperlidae (10)	45	26	54	19	7	6	1	1	1	0	1	1	0	1	0	0	0	0
Gyrinidae (5)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae (5)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Elmidae (5)	22	72	54	0	0	1	0	0	2	0	0	0	0	0	0	7	2	2
Rhyacophilidae (7)	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Philopotamidae (8)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Polycentropodidae (7)	2	1	2	3	0	2	0	0	1	0	1	1	0	0	0	0	0	0
Hydropsychidae (5)	0	0	0	1	6	0	0	1	0	0	1	0	0	0	0	0	0	1
Sericostomatidae (10)	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DIPTERA (/)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Tipulidae (5)	9	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Ceratopogonidae (/)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Siauliidae (5)	3	1	0	0	0	0	0	0	0	0	0	0	0	1	0	4	2	0
Chironomidae (2)	9	7	2	2	2	2	4	0	2	0	5	3	4	5	2	8	3	13
Epididae (/)	0	0	1	1	0	1	0	4	0	1	0	2	1	2	1	1	0	0
Rhagionidae (/)	0	0	0	1	0	0	0	0	1	3	0	0	0	0	0	0	0	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY. (/)=NON-SCORING TAXON.

Appendix 5 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
WEST OKEMENT - JUNE 13th 1988 (BS-BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BWP SCORE)	SITE NAME																	
	VELLAKE COTT			U/B ADIT/BYPASS			D/S BYPASS			U/B WIGNEY			GOLF COURSE			OKEHAMPT. CASTLE		
	SITE W1			SITE W2			SITE W3			SITE W4			SITE W5			SITE W6		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	14	19	6	1	1	0	0	0	1	2	4	0	1	0	1	1	0	0
Sphaeriidae (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
OLIGOCHAETA (1)	653	152	232	49	14	316	344	40	108	68	62	56	100	16	46	9	33	23
Hydracarina (/)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Baetidae (4)	59	61	32	4	1	21	0	1	3	0	0	0	1	0	2	0	0	0
Heptageniidae (10)	0	0	0	8	4	2	0	0	0	0	0	0	0	0	0	1	0	0
Ephemeroptera (10)	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caenidae (7)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Meaenuridae (7)	44	27	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leuctridae (10)	58	112	20	8	9	39	0	0	0	0	0	0	0	0	0	0	0	0
Perlodidae (10)	7	2	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
Chloroperlidae (10)	18	18	1	5	3	13	0	0	0	0	0	0	0	0	0	0	0	0
Dytiscidae (5)	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrophilidae (5)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eimidae (5)	20	38	18	2	0	1	1	0	0	1	0	0	0	0	4	1	2	1
Sialidae (4)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhyacophilidae (7)	4	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae (7)	2	1	0	11	9	8	0	0	0	0	1	1	0	1	4	2	1	2
Hydropsychidae (5)	2	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Lianophilidae (7)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Sericostomatidae (10)	0	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	1	1
Lepidoptera (/)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipulidae (5)	0	1	2	1	1	0	0	0	0	0	4	1	0	1	0	0	0	1
Simuliidae (5)	7	11	12	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Chironomidae (2)	10	2	13	31	61	12	22	2	6	8	20	24	14	12	17	45	183	156
Epididae (/)	1	0	0	1	2	1	0	0	0	0	1	0	0	0	0	0	0	0
Rhagionidae (/)	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BWP) SCORE FOR THE FAMILY. (/)=NON-SCORING TAXON.

Appendix 5 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEHENT RIVERS.
WEST OKEHENT - SEPTEMBER 13th 1988 (BS-BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME																		
	VELLAKE COTT SITE W1			U/S ADIT/BYPASS SITE W2			D/S BYPASS SITE W3			U/S WIGNEY SITE W4			GOLF COURSE SITE W5			O'EHAMP. CASTLE SITE W6			
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	
Planariidae (5)	1	1	0	0	0	2	0	0	0	5	1	1	2	0	0	0	0	0	0
Sphaeriidae (3)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OLIGOCHAETA (1)	18	17	93	8	4	12	36	11	2	27	30	19	72	35	61	7	19	9	
Hydracarina (/)	1	1	1	2	2	0	1	0	1	0	0	0	1	0	1	0	0	0	
Gammaridae (6)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Baetidae (4)	1	2	1	3	19	11	4	1	1	10	4	0	1	1	1	0	0	0	
Heptageniidae (10)	0	0	1	6	11	5	1	1	0	0	1	1	0	0	0	0	0	0	
Leptophlebiidae	2	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nemouridae (7)	0	2	0	4	7	9	2	0	0	0	0	0	0	0	0	0	0	0	
Leuctridae (10)	14	15	9	11	7	7	0	0	0	0	0	0	1	0	0	0	0	0	
Perlodidae (10)	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Perlidae (10)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chloroperlidae (10)	0	1	1	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	
Gyrinidae (5)	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
Elmidae (5)	21	23	34	2	0	0	3	1	0	1	1	1	1	0	2	1	2	2	
Rhyacophilidae (7)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
Polycentropodidae (7)	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	
Hydropsychidae (5)	0	0	0	4	5	10	2	0	0	0	0	0	0	0	0	0	0	0	
Tipulidae (5)	6	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sialidae (5)	0	2	0	3	28	2	3	1	4	0	0	0	0	0	0	0	0	0	
Chironomidae (2)	15	12	7	8	51	30	4	1	6	0	3	5	1	4	7	9	8	5	
Egidae (/)	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
Rhagionidae (/)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY. (/)=NON-SCORING TAXON.

Appendix 6. East Okement. Abundance of each individual "family" in each box-sample for each month of sampling.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - JUNE 8th 1987 (BS=BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	0	0	0	0	0	2	1	0	0	0	1	0
Hydrobiidae (3)	0	0	0	0	2	0	1	0	0	0	0	0
Ancylidae (6)	0	0	0	0	0	1	0	0	0	0	0	0
Zonitidae (/)	0	0	0	0	0	0	0	0	0	0	1	0
OLIGOCHAETA (1)	4	4	1	32	8	5	10	12	7	29	44	10
Hydracarina (/)	0	0	0	1	1	1	3	2	1	3	3	5
Gammaridae (6)	0	0	0	1	1	0	0	0	0	0	2	0
Baetidae (4)	1	10	22	24	35	53	54	56	34	57	82	78
Heptageniidae (10)	1	0	4	0	0	0	1	0	1	2	2	1
Ephemeroellidae (10)	1	0	4	1	3	5	6	5	0	7	13	3
Caenidae (7)	0	0	0	0	0	0	0	0	0	0	2	0
Nemouridae (7)	0	2	0	1	0	1	1	0	0	0	0	0
Leuctridae (10)	0	7	12	8	4	4	4	2	2	1	6	8
Perlodidae (10)	0	2	0	0	0	0	0	0	0	0	0	0
Chloroperlidae (10)	4	6	9	0	0	4	1	3	1	2	6	2
Gyrinidae (5)	0	0	0	0	0	1	0	0	0	0	0	0
Elmidae (5)	0	1	0	1	0	2	4	6	6	11	8	4
Rhyacophilidae (7)	0	1	0	2	4	1	1	0	0	1	1	0
Philopotamidae (8)	0	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae (7)	1	0	0	0	0	1	2	0	1	3	8	2
Hydropsychidae (5)	0	1	5	0	0	0	0	1	0	1	0	1
Goeridae (10)	0	0	0	0	0	0	0	0	0	0	1	1
Lepidostomatidae (10)	0	0	0	0	0	0	0	0	0	0	1	0
Sericostomatidae (10)	0	0	0	0	0	0	3	0	0	0	5	1
Tipulidae (5)	0	0	0	3	1	1	0	1	0	0	2	0
Simuliidae (5)	0	73	25	2	1	1	1	1	0	0	0	0
Chironomidae (2)	7	25	15	27	15	10	13	15	10	22	47	11
Empididae (/)	0	0	0	1	0	2	2	0	0	2	2	1

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY.
 (/)=NON-SCORING TAXON.

Appendix 6 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - SEPT. 10th 1987 (BS=BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	0	0	2	3	0	1	0	0	0	0	0	0
Hydrobiidae (3)	1	1	1	0	0	2	0	0	0	0	0	0
Ancylidae (6)	0	0	0	1	0	0	0	0	0	0	0	0
OLIGOCHAETA (1)	174	149	542	91	152	148	94	119	134	65	95	60
Hydracarina (/)	0	0	0	1	5	3	4	4	13	13	12	4
Gammaridae (6)	0	0	5	3	1	10	0	2	7	0	1	0
Baetidae (4)	15	8	9	43	92	43	4	11	50	10	9	6
Heptageniidae (10)	12	12	18	7	32	10	5	26	63	17	3	6
Leptophlebiidae (10)	0	0	0	0	0	0	2	1	1	0	2	0
EphemereIIDae (10)	0	0	0	0	0	0	0	0	0	1	0	1
Nemouridae (7)	13	6	7	1	0	0	5	3	0	0	1	3
Leuctridae (10)	6	22	14	19	4	12	8	15	40	15	11	19
Perlodidae (10)	0	3	2	2	1	2	1	3	2	1	0	0
Chloroperlidae (10)	23	21	11	3	2	2	8	10	14	17	16	5
Hydrophilidae (5)	4	2	3	0	1	0	1	0	0	1	0	0
Elmidae (5)	1	2	5	4	23	11	63	30	30	20	18	19
Sialidae (4)	0	0	0	0	0	0	1	0	0	0	0	0
Rhyacophilidae (7)	3	1	5	1	5	1	1	5	5	1	0	1
Philopotamidae (8)	1	0	0	0	0	0	0	0	0	0	0	0
Polycentropodidae (7)	1	2	0	3	0	2	4	5	7	5	0	1
Hydropsychidae (5)	2	1	0	0	0	0	1	0	1	0	0	0
Limnephilidae (7)	0	0	0	0	0	0	0	1	0	0	0	0
Leptoceridae (10)	0	0	0	0	0	0	6	0	0	1	0	1
Goeridae (10)	1	0	0	1	1	1	0	0	0	0	0	0
Lepidostomatidae (10)	0	0	0	0	0	0	0	3	0	1	3	0
Sericostomatidae (10)	1	3	4	29	3	31	13	1	9	2	3	6
Tipulidae (5)	2	13	16	2	5	9	3	1	2	1	1	1
Simuliidae (5)	39	8	7	0	1	0	0	0	0	0	0	0
Ceratopogonidae (/)	0	0	0	0	0	1	0	1	0	0	0	0
Chironomidae (2)	30	49	47	70	16	69	144	88	128	59	60	59
Epididae (/)	2	0	0	0	0	0	0	0	2	0	0	0
Rhagionidae (/)	0	2	1	3	1	0	0	0	2	0	0	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY.
(/)=NON-SCORING TAXON.

Appendix 6 (cont.)

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS,
EAST OKEMENT - MARCH 2nd 1988 (BS=BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	1	4	0	1	0	1	6	1	1	1	0	0
Hydrobiidae (3)	0	0	0	0	0	0	0	0	0	1	0	0
OLIGOCHAETA (1)	160	80	272	15	130	76	179	283	236	281	250	240
Hydracarina (/)	0	0	0	1	0	0	0	0	0	0	1	0
Gammaridae (6)	0	0	0	1	0	1	0	0	1	0	0	0
Baetidae (4)	0	0	2	1	5	16	20	38	22	0	0	0
Heptageniidae (10)	7	5	12	2	18	15	8	12	6	3	6	2
Taeniopterygidae(10)	0	0	0	0	1	0	0	4	0	0	0	0
Nemouridae (7)	1	0	5	1	1	4	0	1	4	0	0	1
Leuctridae (10)	28	37	43	0	2	2	1	0	0	0	0	1
Perlodidae (10)	0	0	1	2	0	0	1	0	1	0	0	0
Chloroperlidae (10)	76	46	73	2	4	9	5	2	10	3	5	4
Gyrinidae(5)	0	0	0	0	0	0	0	0	0	0	1	0
Hydrophilidae (5)	0	1	1	0	0	0	0	0	0	0	0	0
Elmidae (5)	4	2	5	1	1	1	14	7	3	2	12	12
Rhyacophilidae (7)	0	0	0	0	0	0	0	1	0	0	0	0
Polycentropodidae (7)	9	6	1	0	2	5	3	5	4	4	11	13
Hydropsychidae (5)	0	1	4	0	0	1	0	0	0	0	0	1
Goeridae (10)	0	0	0	0	1	0	0	0	0	0	1	0
Sericostomatidae (10)	5	1	0	0	0	0	0	0	0	4	0	0
Tipulidae (5)	4	1	2	0	0	0	0	1	0	3	0	2
Simuliidae (5)	0	1	4	0	0	1	0	0	0	0	0	0
Ceratopogonidae (/)	0	1	0	0	0	0	0	0	1	0	0	1
Chironomidae (2)	27	2	0	2	12	18	13	15	2	14	27	37
Epididae (/)	0	0	0	0	0	0	0	0	1	1	0	0
Rhagionidae (/)	0	0	0	0	0	0	0	0	0	0	1	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY.
 (/)=NON-SCORING TAXON.

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - JUNE 13th 1988 (BS=BOX SAMPLE)
FAMILY ABUNDANCES

TAXON NAME (BMWP SCORE)	SITE NAME											
	U/S BYPASS SITE E7			D/S BYPASS SITE E8			BALL HILL SITE E9			GRAMMAR SCHOOL SITE E10		
	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3	BS1	BS2	BS3
Planariidae (5)	3	0	0	0	2	0	1	0	0	0	2	0
Dendrocoelidae (5)	0	0	0	0	0	0	0	1	0	0	0	0
Hydrobiidae (3)	0	0	0	1	0	0	1	0	0	0	0	0
OLIGOCHAETA (1)	280	112	176	68	304	168	220	352	94	56	102	204
Hydracarina (/)	0	0	2	1	0	0	0	2	0	1	0	0
Baetidae (4)	34	37	24	77	160	80	144	260	88	72	78	96
Heptageniidae (10)	3	4	2	1	0	1	4	2	0	0	1	0
Leptophlebiidae (10)	0	0	0	1	0	0	0	0	0	0	0	0
Ephemereilidae (10)	7	4	4	16	13	3	14	29	11	6	7	6
Nemouridae (7)	11	0	0	0	0	0	0	0	0	0	0	0
Leuctridae (10)	54	15	38	1	3	0	0	3	1	0	0	0
Perlodidae (10)	0	1	0	1	0	0	0	0	0	0	0	0
Chloroperlidae (10)	25	18	17	0	1	1	0	0	0	0	0	2
Dytiscidae (5)	0	0	0	0	0	0	2	0	2	3	0	0
Hydrophilidae (5)	1	3	0	0	0	0	0	0	0	0	0	0
Elmidae (5)	2	4	0	2	4	4	6	7	13	13	4	11
Rhyacophilidae (7)	5	2	3	4	5	4	2	3	1	0	0	0
Polycentropodidae (7)	2	12	12	3	1	1	6	5	12	8	8	11
Hydropsychidae (5)	20	2	2	0	0	1	0	0	0	0	0	0
Limnephilidae (7)	0	0	1	0	0	0	0	0	0	0	0	0
Odontoceridae (10)	0	1	0	0	0	0	0	0	0	0	0	0
Goeridae (10)	0	1	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae (10)	0	0	3	0	0	0	0	0	0	0	0	0
Sericostomatidae (10)	5	9	1	0	3	0	0	4	2	0	1	1
Tipulidae (5)	14	0	1	2	3	3	0	2	0	0	1	0
Simuliidae (5)	5	9	1	1	3	4	6	6	0	0	0	0
Chironomidae (2)	64	94	74	93	200	72	124	180	92	136	88	100
Epididae (/)	2	1	2	0	6	1	1	4	1	1	2	4
Dolichopodidae (/)	0	0	0	0	0	0	0	0	1	0	0	0
Rhagionidae (/)	1	0	0	1	4	0	0	2	1	0	1	0

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY.
 (/)=NON-SCORING TAXON.

A30 OKHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
EAST OKEMENT - SEPTEMBER 13th 1988 (BS=BOX SAMPLE)

FAMILY ABUNDANCES

<u>TAXON NAME (BMWP SCORE)</u>	<u>SITE NAME</u>											
	<u>U/S BYPASS</u>			<u>D/S BYPASS</u>			<u>BALL HILL</u>			<u>GRAMMAR SCHOOL</u>		
	<u>SITE E7</u>			<u>SITE E8</u>			<u>SITE E9</u>			<u>SITE E10</u>		
	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>	<u>BS1</u>	<u>BS2</u>	<u>BS3</u>
Planariidae (5)	0	0	4	3	4	0	0	3	1	1	0	1
Hydrobiidae (3)	0	0	0	0	0	0	0	0	1	0	0	0
Ancylidae	0	0	1	6	0	0	0	2	2	1	1	6
Sphaeriidae (3)	0	0	0	0	1	0	0	0	0	0	0	0
OLIGOCHAETA (1)	83	29	39	98	99	73	39	46	38	77	60	85
Hydracarina (/)	0	1	1	0	0	0	3	1	0	3	1	3
Gammaridae (6)	0	0	0	0	0	0	0	0	0	0	1	0
Baetidae (4)	8	6	6	25	54	13	12	63	39	13	7	12
Heptageniidae (10)	18	21	25	10	4	6	5	0	3	17	6	8
Leptophlebiidae (10)	0	0	0	0	0	0	0	0	0	0	3	0
Ephemeroptera (10)	0	0	0	0	0	0	0	1	0	0	0	1
Neanuridae (7)	0	3	2	0	2	0	0	0	0	1	2	0
Leuctridae (10)	1	4	10	2	2	0	2	1	1	0	0	0
Perlodidae (10)	0	0	0	0	0	0	1	0	0	1	0	0
Chloroperlidae (10)	2	16	26	1	1	2	1	0	0	2	0	0
Hydrophilidae (5)	1	3	0	0	0	0	0	0	0	0	0	0
Elmidae (5)	2	4	4	20	2	5	21	24	10	27	31	27
Rhyacophilidae (7)	0	0	0	2	2	3	2	0	0	0	0	2
Polycentropodidae (7)	0	0	1	0	0	0	0	0	1	0	0	1
Hydropsychidae (5)	0	2	0	1	4	0	2	6	1	3	0	0
Odontoceridae (10)	0	0	0	0	0	0	0	0	0	0	0	1
Leptoceridae (10)	0	0	0	0	0	0	0	0	0	0	1	1
Goeridae (10)	1	1	0	0	0	0	0	0	0	0	0	0
Lepidostomatidae (10)	0	0	0	0	0	0	0	0	1	0	0	0
Sericostomatidae (10)	0	0	1	1	1	1	1	1	2	2	1	3
Tipulidae (5)	2	2	3	2	0	1	0	0	0	0	0	0
Simuliidae (5)	0	4	1	0	3	2	0	0	0	0	0	0
Ceratopogonidae (/)	0	0	0	0	0	0	0	0	0	0	1	0
Chironomidae (2)	3	6	8	20	12	9	7	9	14	31	16	16
Epididae (/)	1	0	0	1	3	0	3	0	4	3	3	5
Rhagionidae (/)	0	1	0	1	3	0	1	2	0	0	0	2

FIGURES IN PARENTHESES INDICATE THE BIOLOGICAL WORKING PARTY (BMWP) SCORE FOR THE FAMILY.
 (/)=NON-SCORING TAXON.

Appendix 7

A30 OKEHAMPTON BYPASS SCHEME MACROINVERTEBRATE SURVEY OF THE WEST AND EAST OKEMENT RIVERS.
THE MACROINVERTEBRATE FAUNA OF THE RAILWAY STREAM DOWNSTREAM AND UPSTREAM OF THE BYPASS. DECEMBER 1st.1987

D/S BYPASS
SPECIES LIST WITH No. PER SAMPLE

Lumbriculidae	1
Lumbricidae	1
Pedicia rivosa	1

TOTAL No. OF INDIVIDUALS 3

INDICES OF ENVIRONMENTAL QUALITY

TOTAL BMWP SCORE	=	6
NUMBER OF SCORING TAXA	=	2
AVERAGE SCORE PER TAXON	=	3.00

U/S BYPASS

SPECIES LIST WITH No. PER SAMPLE

Polycelis felina	120
Ancyclus fluviatilis	32
Sphaeriidae	4
Lumbricidae	8
Other Oligochaeta	32
Gammarus pulex	168
Baetis rhodani	108
Baetis muticus	4
Rhithrogena semicolorata	1
Protonemura meyeri	4
Nemoura cambrica group	4
Leuctra sp. (nigra?)	52
Chloroperia torrentium	4
Helodes sp.	12
Elmis aenea	1
Rhyacophila dorsalis	16
Agapetus sp.	140
Philopotamus montanus	72
Plectrocnemia sp. (?)	1
Lype sp.	4
Diplectrona felix	60
Potanophylax group	24
Micropterna sequax	4
Juvenile Limnephilidae	44
Beraea maurus	1
Sericostoma personatum	2
Tipula sp.	4
Dicranota sp.	4
Chironomidae	32
Simuliidae	220
(incl. Simulium cryophilum sp.	
Simulium ornatum group)	

TOTAL No. OF INDIVIDUALS 1214

INDICES OF ENVIRONMENTAL QUALITY

TOTAL BMWP SCORE	=	146
NUMBER OF SCORING TAXA	=	23
AVERAGE SCORE PER TAXON	=	6.35

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