

LINDHURST
MANSFIELD

APPENDIX 6.1 WATER QUALITY SURVEY

CONTENTS

- I.1 Introduction
- I.2 Methodology
- I.3 Survey Results
- I.4 Discussion

Appendices

- I i BMWP Scores
- I ii Chemical Water Quality Data

I.1 INTRODUCTION

I.1.1 Following consultation with Natural England it was decided that a baseline assessment of the water quality of the Foulevil Brook and Rainworth Lakes SSSI should be made so that any changes in water quality resulting from the development could be identified and mitigated for. The SSSI is located 300m southeast of the development site and the Foulevil Brook, which feeds it, runs along the southern site boundary, east from Lindhurst cottages.

I.1.2 Full details on the hydrology of the site and surrounds is provided in Chapter 9 and should be read in conjunction with this Appendix.

I.2 METHODOLOGY

Macro-Invertebrates

I.2.1 It was considered that the best method of assessing macro-invertebrates were those according to the Biological Monitoring Working Party (BMWP) handbook. Although this was designed for use in relation to rivers and streams, the Predictive System for Multimetrics (PSYM) designed for use on ponds and still waters can only be used on small lakes <5ha, the larger two lakes of Rainworth Lakes west of Blidworth Lane were over this size.

I.2.2 Samples were taken and macro-invertebrates identified in the field and in the laboratory under microscope. Scores of species abundance were assigned to each of the waterbodies and compared to the BMWP score table to give quality categories of very poor to very good and impact interpretation of heavily polluted to unpolluted/unimpacted. Foulevil Brook was not sampled for macro-invertebrates.

Chemical Testing

I.2.3 Samples were taken (2 litres each) from Foulevil Brook and each of the three waterbodies of Rainworth Lakes, to the west of Blidworth Lane. The samples were independently tested for water quality by NRM Laboratories. Parameters tested were a standard suite recommended by the testing company and fitted with the majority of parameters required to assess water quality against several different classification methods. During the planning phase of the testing, consultation with the Environment Agency and NRM Laboratories yielded no one classification system against which the results could be compared; instead comparison was made against several systems, which helped to build up a picture of water quality from several different perspectives.

- I.2.4 The River Ecosystem Classification System is set out in The Surface Waters (River Ecosystem) (Classification) Regulations 1994, SI 1994 No. 1057. It consists of eight parameters that together form a ladder of increasing quality to reflect the needs of communities of plants and animals in rivers. The system allows samples to be put into one of five classes in order of decreasing quality, from RE1 (the highest) through to RE5. Obviously, this system was designed to be used to compare riverine water quality so has a limited value in this context.
- I.2.5 The trophic status classification of lakes, as defined by the Organisation for Economic Cooperation and Development, is assigned according to a best fit of three parameters; phosphate levels, Chlorophyll-*a*, and Secchi disc readings. However, phosphate levels alone can give a preliminary indication. The trophic status of the three lakes were also assessed against the JNCC's *Vegetation communities of British lakes: a revised classification* (JNCC 2006), which uses the Plant Lake Ecotype Index (PLEX) to reflect the complex response of freshwater plant assemblages to a large number of environmental variables.
- I.2.6 The total suspended solid of a water course is often indicative of water pollution (derived from silt), this parameter is recognised by The EC Freshwater Fish Directive (78/659/EEC as amended) which specifies quality standards that should enable fish (Salmonid or Cyprinid) to live or breed in the designated water. The quality of water required, particularly for Salmonid fisheries, is a good indicator of overall water quality.
- I.2.7 Finally, a suite of heavy metal tests were undertaken on all samples. The following determinants were assessed against Environmental Quality Standards (EQS) for List 1 and 2 dangerous substances, EC Dangerous Substances Directive (76/464/EEC): total cadmium, total mercury, total zinc, total nickel, total chromium, total copper, total lead, and total arsenic. These standards are thresholds which, if exceeded, could result in adverse effects on ecosystems, as such they must not be exceeded in any controlled watercourse in England and Wales (http://www.environment-agency.gov.uk/yourenv/eff/1190084/water/1182267/1182413/290939/?version=1&lang=_e). It should be noted that many of these EQS values will be subject to change in accordance with more accurate tests for ecotoxicity - such as those where Predicted No Effect Concentration values (PNEC) can be employed - with the further

development of the Water Framework Directive. Additionally, only some of the more common pollutants on the list were tested for.

I.3 RESULTS

Chemical Testing

I.3.1 Foulevil Brook: (sample A)

- Our results indicated a BOD of less than 2mg/l, and a pH of 7.5 – this places the Foulevil Brook in the absence of other data, in the highest water quality class of RE1
- Our result of <3mg/l for phosphate is unfortunately not sensitive enough to be assigned a category according to the Environment Agency Nutrient Grading for Rivers, but falls below the excessively high category. The nitrate nitrogen level is 1mg/l which is classification 1 – very low.
- Total suspended solids of <10mg/l is lower than the guideline limit of 25mg/l set by The EC Freshwater Fish Directive for healthy salmonid or cyprinid waters.
- Levels of mercury, cadmium and arsenic (List I) were all found to be comfortably below safe EQS levels (1mg/l, 5mg/l, 50ug/l respectively) by at least a factor of ten.
- Levels of Chromium, Copper, Lead, Nickel and Zinc (List II) were found to be too high to meet the criteria for salmonid water quality and may be too high for cyprinid waters.

I.3.2 Rainworth Lakes

- All the lakes sampled (Samples B,C and D) had a phosphate level of <3mg/l tentatively indicating ultra-oligotrophic conditions. When comparison was made to the Vegetation Communities of British Lakes documentation, the PLEX score for Rainworth Lakes was 5.85 and the lakes grouped into Group G: central and eastern, above neutral, lowland lakes, with *Lemna minor*, *Elodea canadensis*, *Potamogeton natans* and *Persica amphibian*. The lakes in this group are typically eutrophic, with circumneutral pH values and are the most frequently occurring lake ecotype in England.

W6 (Sample point B)

- A BOD of <2mg/l and pH of 6.5 places this lake tentatively in class RE1
- Phosphate levels of <3mg/l are not excessively high according to the environment agency nutrient grading for rivers. Nitrate nitrogen levels are 1.20mg/l which is classification 1 – very low.

- Total suspended solids of 52mg/l is approximately double that of the guideline limit of 25mg/l set by The EC Freshwater Fish Directive for healthy salmonid or cyprinid waters.
 - Levels of mercury, cadmium and arsenic (List I) were all found to be comfortably below safe EQS levels (1mg/l, 5mg/l, 50ug/l respectively) by at least a factor of ten.
 - Levels of Chromium, Copper, Lead, Nickel and Zinc (List II) could not be assessed against EQS values due to the absence of water hardness data, but were nevertheless too high to meet the criteria for salmonid water quality and may be too high for cyprinid waters. Levels of Nickel were found to be particularly high (651 ug/l)
- W7 (Sample point C)

- A BOD of <2mg/l and pH of 7 places the lake tentatively in class RE1.
- Phosphate levels of <3mg/l are not excessively high according to the environment agency nutrient grading for rivers. Nitrate nitrogen levels are 0.7mg/l which is classification 1 – very low.
- Total suspended solids of 99mg/l is approximately 4 times higher than the guideline limit of 25mg/l set by The EC Freshwater Fish Directive for healthy salmonid or cyprinid waters.
- Levels of mercury, cadmium and arsenic (List I) were all found to be comfortably below safe EQS levels (1mg/l, 5mg/l, 50ug/l respectively) by at least a factor of ten.
- Levels of Chromium, Copper, Lead, Nickel and Zinc (List II) could not be assessed against EQS values due to the absence of water hardness data, but were nevertheless too high to meet the criteria for salmonid water quality and may be too high for cyprinid waters.

W8 (Sample point D)

- A BOD of 8mg/l and pH of 8 places the lake tentatively in class RE1.
- Phosphate levels of <3mg/l are not excessively high according to the environment agency nutrient grading for rivers. Nitrate nitrogen levels are 1.20mg/l which is classification 1 – very low.
- Total suspended solids of <10mg/l is lower than the guideline limit set by The EC Freshwater Fish Directive for healthy salmonid or cyprinid waters.
- Levels of mercury, cadmium and arsenic (List I) were all found to be comfortably below safe EQS levels (1mg/l, 5mg/l, 50ug/l respectively) by at least a factor of ten.
- Levels of Chromium, Copper, Lead, Nickel and Zinc (List II) could not be assessed against EQS values due to the absence of water hardness data, but were nevertheless too high to meet the criteria for salmonid water quality and may be too high for cyprinid waters.

Macro-Invertebrates

- I.3.3 Results of the macro-invertebrate sampling are given in Appendix I i. In summary W6 had a BMWP score of 93; W7 scored 21 and W8 scored 55.

I.4 DISCUSSION

Chemical Testing

- I.4.1 The results provide a baseline for later comparison of the water quality in the Rainworth Lakes and Foulevil Brook. Extended monitoring and the potential analysis of additional parameters is required to be able to assign the water bodies according to RE categories or against the emerging Water Framework Directive ecological status classes of High, Good, Moderate, Poor or Bad for all waterbodies (lakes, rivers and reservoirs). It could not be said at this stage that any of the results are indicative of poor water quality, but some concern may be drawn from the suspended solid results in two of the lakes and levels of some List II Dangerous Substances. Caution is advised drawing conclusions from the single suspended solid results at this stage; the test is particularly prone to imprecision and should ideally be carried out in triplicate in future. Finally, a determination of water hardness is essential with all future analysis as this is required in many cases to assign the correct pollutant EQS value within each waterbody.

Macro-invertebrates

- I.4.2 Comparison to the table in Appendix I of this document gives the following interpretation of the results: W6 (BMWP score 93) was of 'Good' quality, being 'Clean but slightly impacted'; W7 (BMWP score 21) was of 'Poor' quality, being 'Polluted or impacted'; W8 (BMWP score 55) was of 'Moderate' quality, being 'moderately impacted'.
- I.4.3 Monitoring of the chemical parameters and BMWP scores through the course of the development should highlight any changes, positive or negative, to the water quality in Rainworth Lakes SSSI, which is considered, along with the hydrology of the area, to be the most influential factor determining its condition.