8.0 AIR QUALITY

8.1 Introduction

8.1.1 Fresh wastewater arriving at a treatment plant via a properly constructed sewer system has a slight smell, normally described as musty in character. As long as a certain level of dissolved oxygen is maintained in the sewage, anaerobic conditions will not take place. However, if the oxygen content of the sewage is used up, then gases such as hydrogen sulphide, nitrogen and sulphur based organic compounds (mercaptans, ketones, amines, indoles and skatoles) are produced and a general septic condition occurs with typical pungent, putrid and nauseating odours being emitted.

8.1.2 Sulphide compounds which have very low levels of odour detection are a major component of odours from a waste water treatment plant. For example, hydrogen sulphide has an odour detection limit in the order of about 0.2-2 $\mu g/m^3$. Its characteristic smell of rotten eggs occurs at concentrations of about 3 - 4 times higher with odour nuisance complaints likely at even higher levels.

8.1.3 A sufficient detention time is required for the formation of anaerobic conditions and warm weather conditions above about 20°C will also assist the rapid growth of anaerobic bacteria. The operation of a waste water treatment plant involves many locations during the process where anaerobic conditions can occur; from poor maintenance of the inlet works, overloaded secondary treatment through to the dumping of the dewatered sludge in open skips prior to disposal off-site. In many cases the odour problem can be solved by regular cleaning of channels and general maintenance whereas sometimes overloading or sludge treatment may necessitate more extensive mitigation measures such as covering and removing waste gases via an odour control system.

8.1.4 The majority of odour nuisance problems associated with waste water treatment plants are due to the age of the plant or where the sewage loading arriving at the plant results in regular overloading of the facility. This tends to be the public perception of waste water treatment plants. However, with the modern technology available the plants can exist close to residential areas without causing any problems of odours in the surrounding area. Sophisticated continuous monitoring of the effluent flow through the plant to ensure an adequate flow and to prevent clogging, measurement of oxygen content and pH levels as well as the containment of the sludge in enclosed sludge digestors have greatly helped to reduce community nuisance.

8.1.5 The rate of emissions of potentially odorous inorganic and organic compounds from waste water treatment tanks depend on the tank surface area, organic concentrations and BOD of the tank liquor, volatility of the compounds and the evaporation rate from the tank. The rate of evaporation is lower from a quiescent liquid surface than from a turbulent surface with higher air temperatures and/or wind speeds increasing the evaporation rate. The rate of anaerobic activity within the effluent is also affected by weather conditions such as air temperature and humidity so that odours tend to be greatest during dry warm weather conditions. These conditions may also be associated with periods of low effluent flow through the plant which can significantly affect the efficiency of the plant.

Material left on the walls or deposited on the floor of the connecting channels can quickly become septic resulting in odorous emissions. Unless there is a strong upward movement within the tank the volume of the tank is not important compared to the surface area with respect to the emission rate since compounds near the floor of the tank will not quickly diffuse to the surface.

8.1.6 The perception of odour at some point downwind of an emission source depends on the type of odour compound and the air concentrations of the odorous gas. The measure used to quantify odour nuisance potential is the odour concentration (odour unit per cubic metre, o.u./m^3). An odour concentration of 1 o.u./m^3 is the level at which there is a 50% probability that, under laboratory conditions using a panel of qualified observers, an odour may be detected. At levels below 1 o.u./m^3 the concentration of the gaseous compound causing the odour in the air will be less than the detection level and so, although the gas is still present in the air, no odour should be detected.

8.1.7 The intensity of an odour ranges from 1 o.u./m^3 = odour detection, 2= slight odour up to 5 o.u./m^3 where the odour is strong and easily recognisable with higher levels likely to result in nuisance complaints by the neighbouring community. Since duration of the odour also determines whether or not a nuisance situation may occur an odour concentration of greater than 5 o.u./m^3 over periods of 15-30 minutes is widely used as a criteria for predicting the potential for complaints.

8.2 Receiving Environment

Existing Air Quality

8.2.1 The air quality in the locality of the Commoge is good with low levels of ambient air pollutants in the area. This site is about 1km to the SW of Kinsale and the local terrain forms a U-shaped ridge surrounding Kinsale Marsh which opens out into the Bandon estuary. The site of the wastewater treatment plant is located on the SE facing lower slope, about 5-12m O.D. and the ground rises up a relatively gentle gradient to about 50-60m along the ridge. During low tide odours from the exposed mud-flats in the River Bandon will be experienced along the coast road (R606) although it is unlikely that the odours will extend to the residential areas on the upper slopes. The fields surrounding the site are used for livestock and so there may be occasional odours generated during farming activities such as slurry spreading.

8.2.2 There are a number of detached private properties and also a number of small housing estates situated on the upper slopes of the ridge overlooking the Commoge. Atmospheric emissions from the housing estates on the outskirts of Kinsale to the and also the private dwellings overlooking the Commoge may result in elevated levels of smoke and sulphur dioxide as well as certain hydrocarbons during the winter heating period.

8.2.3 However, the ambient air concentrations in the locality of the proposed site will typically be less than a daily level of 25ug/m^3 and so well below the National Air Quality Standards (SI 244 of 1987) for smoke and sulphur dioxide.

8.3 Local Climatology

General

8.3.1 The climate of the South Co. Cork area is characterised by the passage of Atlantic low pressure weather systems and associated frontal rain belts from the south-west during much of the winter period. During the summer months the influence of anticyclonic weather conditions can result in drier air masses over this part of Ireland interspersed by the passage of Atlantic frontal systems. Occasionally, the establishment of a high pressure area over Ireland and Britain can result in calm conditions and during the winter months these are characterised by clear skies and the formation of low level temperature inversions with slack wind conditions at night-time. If anticylconic conditions become established for a few days or more during the summer months then high daytime temperatures may be recorded, especially in sheltered south-facing locations. Under anticyclonic weather conditions sea breezes would be common in Kinsale Harbour and the neighbouring estuaries during the summer. This would result in on-shore breezes during the daytime with offshore flow at nighttime when the airflow will tend to follow the downstream direction out into Kinsale Harbour.

8.3.2 The microclimate is defined as the climate within the immediate locality of the proposed development site, typically within 1-2km of the site. The microclimate may be characterised by a sheltered south facing site, surrounded by a small ridge along the north-western, northern and eastern sides. The Commoge is in a sheltered position compared to locations closer to the coast where the sea breeze will dominate the local climate. The ridge around the NW-SE sector of the site will provide some shelter from winds from these directions. During relatively low wind speeds low-level temperature inversions are likely to form, especially during anticyclonic weather conditions. This may result in calm conditions leading to fog in the Lower Bandon estuary which will restrict the dispersion of air emissions from sources situated within the Commoge. The local climate on the surrounding slopes will tend to be dominated by typical up-slope winds during the daytime and down-slope winds at nighttime during relatively calm wind conditions. However, for much of the year the local wind field (wind speed and direction) will tend to be dominated by the prevailing weather conditions in the region.

Wind Speed and Direction

8.3.3 Wind speed and wind direction will affect the magnitude of any potential odour nuisance at a specific property in the surrounding area. At high winds any odour generated at the treatment plant will be rapidly dispersed in the air and so will quickly reach a concentration below which it is not detected. Conversely, during slack winds an odour plume from the plant may drift some distance before dilution of the odour is such as to be below the odour detection limit.

8.3.4 Results from Roches Point meteorological station (25km to NW) over a 30 year period indicate that the prevailing wind direction is from a NW direction with a secondary maximum for S-SW winds (Fig 1). The incidence of winds of 5 m/s or

less is about 45% of the year with speeds of <2m/s (including calms) occurring about 10% of the time. The occasions when calm wind conditions is about 3% which is much lower than would be observed further inland, due to the dominance of on-shore and estuarine breezes. Kinsale Harbour and the Bandon estuary are slightly more sheltered than at Roches Point although these locations will also experience a relatively high number of days when sea-breeze circulation patterns dominate the local weather. The incidence of relatively slack wind conditions (< 2 m/s) in the Kinsale Harbour area is likely to be slightly higher than at Roches Point and probably in the order of 10-15% of the time. Local up-slope winds during the daytime and down-slope flows at nighttime will tend to develop during relatively light wind conditions within the Commoge area .

8.4 Project Description and Impact Assessment

Plant Size

8.4.1 The wastewater treatment plant is designed to cater for sewage from the Kinsale town area with an influent capacity of about 10,000 person equivalent. The 25 year design of the plant is described in detail in section 3 and may be summarised as follows in relation to the potential of certain components to generate odours.

- Inlet works
- Storm water holding tanks
- Primary sedimentation
- Activated sludge treatment
- Final clarifiers
- Sludge thickening, mixing and de-watering

Inlet Works

8.4.2 The inlet works of a sewage treatment plant can be a major source of odours due to the collection and deposition of solid matter in the wastewater. Screening devices can clog if not cleaned regularly and this can cause anaerobic conditions to occur. Grit chambers are also another possible source of odours from the organic coatings on the finer material collected or deposited in the channel due to low flow rates, especially during low flow conditions. The material collected if stored in an open skip for a number of days can also create offensive odours. In the design of this part of the plant the potential for these odour-forming aspects to arise has been addressed to ensure that emissions of malodours are effectively controlled by covering channels and housing the screening/grit treatment indoors and ducting the foul air from the preliminary treatment to a high efficiency odour control system.

8.4.3 It is proposed to house the inlet works components including screenings and grit traps indoors in the main plant building which also houses the sludge de-watering equipment. The coarse material will be removed by comb screens to remove material down to 5 mm. Given the high potential for anaerobic conditions to

occur in the rising mains and inlet well the air within the inlet-works room will be ducted to the main odour control unit before being vented to atmosphere. Screened material will be transferred to a covered skip located within the building. Grit traps will be used to remove grit and other particulate matter from the influent and this material will be classified, washed and discharged to a covered skip located within the building.

Storm Water Holding Tanks

8.4.4 This tank will be rectangular with a surface area of about 320 m^2 and will be located on the south-west side of the site. It will only be used during periods of high inflow. The liquor in the tank will have undergone screening. Once storm conditions have abated the liquor in the tank will be returned for primary and secondary treatment at a controlled rate.

8.4.5 There is a potential for odorous emissions from material left on the floor of the tanks once the influent has been discharged. To eliminate this problem cleaning by automatic flushing will be carried out once the tanks have been emptied. Due to the limited usage of these tanks and the flushing of any material deposited on the side-walls the odour emissions will be negligible.

Primary Sedimentation Tanks

8.4.6 Two radial flow circular tanks, each with a surface diameter of 14.5 m, including peripheral overflow channel, will be installed for primary treatment of the waste water at the treatment plant. The potential for odours from these tanks depends on the BOD load of the influent, the rate of evaporation of odorous components from the surface of the influent and in particular the turbulence at the peripheral overflow weirs. The surface area of liquor in the tanks rather than the depth of the tank is important in relation to odour potential.

Activated Sludge Treatment

8.4.7 Two extended aeration basins will be installed, each with a surface area of about 253 m^2. The influent to these tanks will be mixed with the returned activated sludge from the secondary clarifier tanks. An anoxic zone will be created within the basin. Aeration of the activated sludge will be carried out using fine bubble diffused aeration from pipes located on the floor of each tank.

8.4.8 Odour emissions from activated sludge treatment tanks of this type are normally low since the aeration provides high levels of oxygen in the tank liquor so that most of the odorous compounds are oxidised and anaerobic reactions do not take place. Sub-surface aeration also significantly reduces the release of aerosols into the air compared to surface shaft propeller systems commonly found in older plants around the country.

Final Clarifiers

8.4.9 Two circular tanks for secondary settlement, each with a diameter of 18 m (area 254 m^2) are proposed and these will be located on the northern side of the plant. Due to the low BOD and relatively stable sludge from the activated sludge tanks the potential for further decay of the sludge and resulting odorous emissions is very low. In addition, the liquor in the tanks covers the secondary sludge and so this prevents odorous compounds reaching the surface. Evidence from existing waste water treatment plants around Ireland indicates that odours from final clarifiers are very low and are normally not detected beyond a few metres from the peripheral wall.

Sludge Thickeners

8.4.10 Sludge will be thickened in picket fence thickening tanks located in the southern corner of the site adjacent to the sludge dewatering building. The tanks will be covered and the head-space foul air vented to atmosphere via on odour control scrubber system. This control of odours during sludge thickening from the primary and secondary treatment will ensure that the potential for malodorous emissions from this part of the plant will be minimised.

Sludge De-watering Building

8.4.11 The sludge de-watering unit will be within the main plant building and the sludge will be pumped from the thickening tanks to the sludge dewatering plant where enclosed a sludge belt press or decanter will be used to produce a sludge cake. The final dewatered sludge cake will be discharged into covered disposal skips.

8.4.12 Ventilation air within the rooms housing the sludge dewatering equipment and also the disposal skips will be treated with a high efficiency odour control unit before being vented to the atmosphere. There will be a satisfactory number of air changes per hour (typically 6 to 8) to prevent odorous gas concentrations creating an unhealthy work environment for employees. For example, a concentration of 14 mg/m^3 for hydrogen sulphide would represent the maximum level employees should be exposed to within the building in terms of occupational exposure thresholds over a normal 8 hour working day. The proposed ventilation air exchange rate will ensure that the actual levels indoors are much lower than this threshold value.

Odour Handling System

8.4.13 It is proposed that there will an odour control system located in a separate room within the dewatering/inlet works building. The odour control system to be installed should ensure that odours are not detected beyond a few metres from the building. It will operate at a very high removal efficiency rate with values in excess of 98% removal of the malodorous compounds in the exhaust air expected. To improve dispersion of exhaust gases from the main odour control system it is proposed that the exhaust units will be located on the roof of the building. These are typically squat covered rectangular units with side grills through which the air

is exhausted. Options of odour removal for the extracted air include biofiltration and bio-scrubber systems.

8.5 Odour Dispersion Modelling

Introduction

8.5.1 Short-term odour concentrations downwind of the proposed treatment plant site were computed using the Industrial Source Complex (ISC3) air quality gaussian dispersion model developed by the U.S. Environmental Protection Agency. This model is widely used for modelling the air quality impact of a wide range of different types of emission sources, including waste water treatment plants. Calculations were carried out to predict the rate of dilution from the boundary of the plant to the property in the neighbourhood where a potential odour nuisance could arise. A total of 320 receptor locations within 1 km of the plant were used to calculate ground level odour concentrations in the prediction model. The results of the modelling study are presented as odour concentration contours showing the extent of certain ranges of odour downwind of the proposed plant.

8.5.2 Hourly climatological data from Roches Point meteorological station was used to predict the 98 and 99.5 percentile as well as the maximum short-term odour concentration values. These computations give the odour concentration at each receptor location that is predicted to be exceeded for 2% (175 hours) or 0.5% (44 hours) of the year. This type of interpretation of the pattern of odour concentration around the plant reflects the annual incidence of certain wind speeds and directions coupled with the different types of atmospheric stability.

Emission Estimates

8.5.3 Unlike emission rates for industrial sources such as boiler stacks or process vents where specific information for a range of emission characteristics is generally available estimation of emissions from wastewater treatment plants is much harder to quantify. Although measurement of emissions from wastewater plants has been extensively carried out and models to predict emission rates from the various sources produced in the U.S. these relate to volatile organic compounds (e.g. toluene, benzene, and trichloroethylene). These types of pollutants tend to be more inert in the treatment plant process and so a mass balance approach may be used. For estimating emissions of odours that are produced as a result of anaerobic activity during the treatment process, such as mercaptans and hydrogen sulphide, a mass balance approach is unsuitable. In addition many of the studies citing odour concentrations at various parts of the plant tend to be based on situations where a serious problem exists at old overloaded plants. Hence selection of suitable emission rates for a new plant needs to be made with due consideration of the operational conditions present when the study was carried out.

8.5.4 The emission rates used in the odour dispersion model were expressed in terms of the odour dilution factor rather than as a specific compound emission rate due to the mix of compounds that may be emitted. For emission sources that are either point sources such as emissions from odour control units or specific 'small area'

sources within the treatment plant the odour emission rate in terms of o.u/s were computed. In the case of larger area emission sources - sedimentation, aeration and final clarifier tanks - the emission rates were expressed in terms of the odour emission rate per unit area per second (o.u/m^2.s).

8.5.5 A uniform tank surface height of 1.5 m above ground level was used for all area source emissions and an emission temperature of 15°C was used in the calculations. Vertical exit velocities from the surface of the tanks are very low with rates of 2-6 mm/s reported in the literature and so emission rates are primarily related to the rate of evaporation from the water surfaces.

8.5.6 The following odour emission rates were used in the dispersion model

(i) Primary Sedimentation Tanks

8.5.7 The area of each of the 2 tanks is approximately 180m^2 (including overflow channel). The central area of the tank where the liquor is flowing outwards towards the peripheral weir is relatively quiescent compared to the more turbulent state at the peripheral overflow channel. A relatively low vertical exit velocity from the surface of the liquor of 7m/hr with a near-surface concentration of 100 o.u./m^3 was used for the central area to give an estimated emission rate 0.2 o.u./m^2.s. The increased turbulence around the tank overflow weir will result in significantly higher emissions with a corresponding higher vertical velocity. The odour emission rate from the overflow weir/channel was estimated to be about 16 o.u./m^2.s based on an odour concentration of about 2000 o.u./m^3. The combined emissions from each of the primary sedimentation tanks were estimated to be 200 o.u./s, which is equivalent to an approximate emission rate of 1 o.u./m^2.s

(ii) Aeration Tanks

8.5.8 The surface area of each of the aeration basins is about 253 m^2 and based on a vertical exit velocity of about 7 m/hr and a near surface concentration of 100 o.u./m^3 the emission rate was calculated to be 0.2 o.u./m^2.s.

(iv) Final Clarifiers

8.5.9 The total area of each of these tanks is approximately 254 m^2, including peripheral overflow channels, and based on a vertical exit velocity from the surface of the tank of 7 m/hr and a near-surface concentration of 50 o.u./m^3 the emission rate was estimated to be a maximum of 0.1 o.u./m^2.s. Total emissions from each of the final clarifier tanks were estimated to be about 25-30 o.u./s.

(iii) Odour Control Unit - Inlet Works/Sludge Dewatering Building

8.5.10 The maximum emission rate used in the odour dispersion model for the odour control unit was estimated to be about 500 o.u./s. Given the modern design of the plant it is expected that the odour control system will have a substantially lower emission rate so that any odours are not detected beyond a few metres from the building. However, this allows a 'worst case emission' scenario to be employed in the odour modelling exercise.

Results of Odour Dispersion Modelling

8.5.11 The intensity of an odour from various parts of the waste water treatment plant will depend on the strength of the initial odour concentration from the surface of the tank or other emission source, and the distance downwind at which the prediction, or indeed measurement, is being made. Where the odour emission plumes from a number of sources combine downwind, then the predicted odour concentrations may be significantly higher than that resulting from an individual emission source. An odour concentration of 1 o.u./m^3 is the level at which there is a 50% probability that, under laboratory conditions using a panel of qualified observers, an odour may be detected. At levels below 1 o.u./m^3 the concentration of the gaseous compound causing the odour in the air will be less than the detection level and so although the gas is still present in the air no odour should be detected. The sensitivity of humans to an odour also depends on the location; for example an odour from agricultural related activities or exposed mud-flats will be tolerated by the community longer in a rural setting than in an urban area.

8.5.12 The odour concentrations that are predicted to be exceeded for 2% of the time, or 175 hours during the year, referred to as the 98 percentile, are shown as concentration contours in Figure 8.2. The hours when this 98 percentile odour concentrations is predicted to be exceeded will be spread throughout the year and would not be over a consecutive period. The contour pattern in Figure 8.2 indicates that the short-term odour concentrations of the treatment plant are predicted to be less than 0.5 o.u./m^3 near to the boundary of the plant for less than 2%(175 hours) of the year. At the nearest houses the predicted level is much lower with levels substantially below 0.25 o.u./m^3. In other words, the odour concentration is predicted to be below the odour detection level (1 o.u./m^3) for at least 98% of the year beyond the boundary of the plant.

8.5.13 The corresponding predicted 99.5 percentile odour concentrations is presented in Figure 8.3. This frequency of occurrence corresponds to only 44 hours during the year and so levels above this odour concentration will be very infrequent. The pattern around the plant indicates that short-term odour levels beyond the plant boundary will generally be less than 1.5 o.u./m^3 and less than 0.5 o.u./m^3 at the nearest private properties to the site.

8.5.14 The predicted odour concentrations at the nearest houses are low and, although there are no National Standards, the predicted odour concentrations would meet the Standards required in other European Countries such as the Netherlands. In the Netherlands existing facilities must meet an odour concentration of 1 o.u./m^3 as a 98 percentile at neighbouring sensitive locations, such as houses. For new

plants the Standard is even more stringent in that the concentration of 1 o.u./m^3 should be met for 99.5% of the year. This condition is satisfied in relation to the impact of odours emitted from the treatment plant at Cappagh.

8.5.15 It is evident from the analysis of the predicted air quality impact of odorous emissions from the proposed treatment plant that the potential for odours to occur at the boundary to the plant will be very low. No adverse impact in terms of concentrations of odours is therefore likely to result in a nuisance beyond the boundary to the treatment plant.

8.6 Odour Control Measures

8.6.1 Control of odorous emissions from various parts of the treatment plant by dry or wet scrubbing is an important part of the design of this plant. The methods that will be considered include biofiltration, scrubbing systems (activated carbon dry scrubbing systems, wet gas scrubbing in a packed tower) or ozone. The final method has not been agreed and may indeed incorporate a combination of scrubbing processes. However it is recommended that the approved system should achieve an odour removal efficiency in excess of 98% so that emissions from the odour control units are minimised and not detected beyond a few metres from the buildings.

8.6.2 The following measures are proposed in the design and operation of the plant.:-

- The inlet works wells, channels and screening/grit removal equipment will be covered and the screenings and grit material transferred to covered skips which will be kept within the building.
- Flushing the storm tanks will remove any deposits which could cause an odour once the tanks are emptied after the storm water conditions have abated. This operational procedure will ensure no significant odours occur from this part of the plant.
- The use of diffused aeration rather than a surface shaft propeller system in the aeration tanks is the preferred method to reduce the turbulence and hence the potential for generating malodours or aerosols from the surface of these tanks.
- The sludge thickening and mixing tanks will be covered and the air ducted to a high efficiency odour control unit.
- The dewatering plant will be incorporated into the screening/grit treatment building and the air from the room exhausted to atmosphere via the central odour control system located in this building. The de-watered sludge, which is relatively stable and hence has a low odour potential, will be discharged to a covered skip housed on the ground floor of the building.

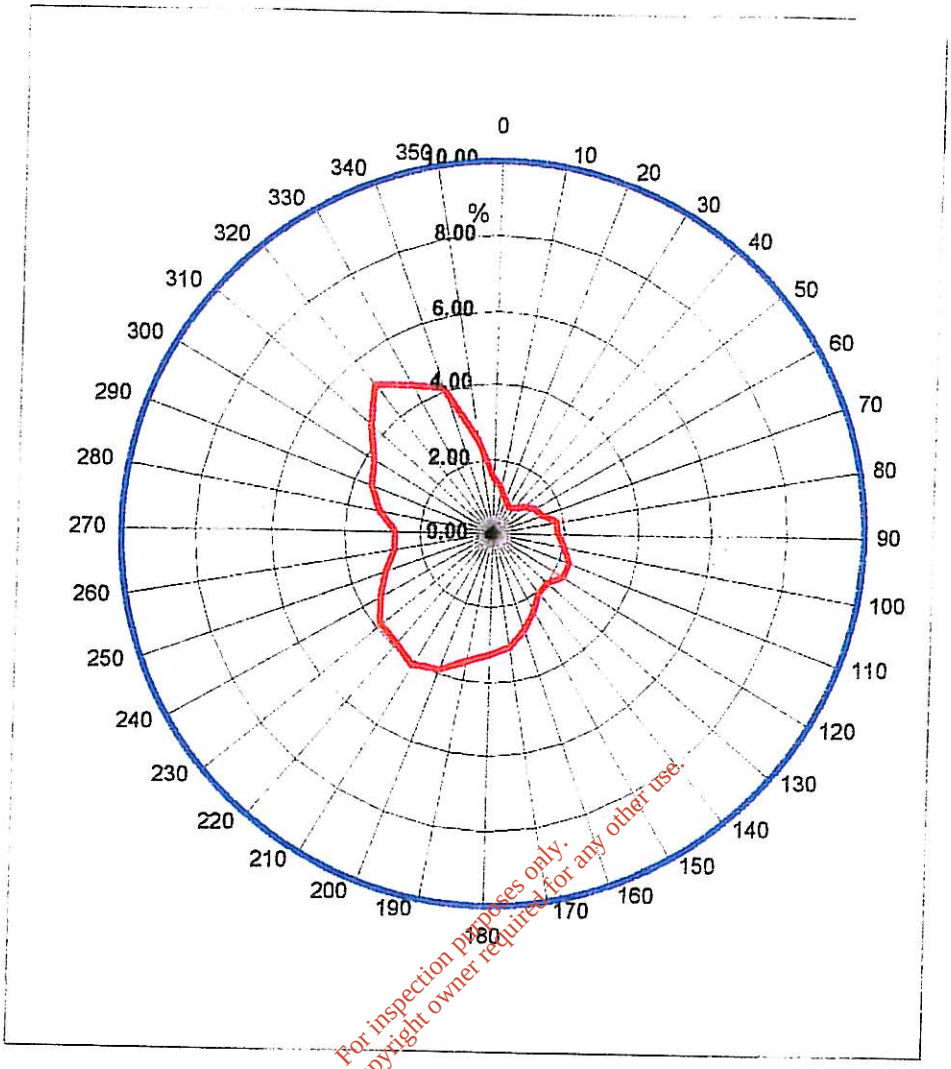
8.7 Conclusion

8.7.1 Overall, the design and operation of the proposed waste water treatment plant at Commoge, Kinsale will ensure that odorous emissions are kept to a minimum. The inlet works will be covered and will provide for a highly efficient removal

process of malodours from this part of the treatment plant. The screening/grit treatment and sludge dewatering plant will be housed in the main building with the washed screenings and grit and also dewatered sludge cake deposited into separate covered bins which will be kept in the building. This will ensure that the potential for odours from this part of the plant is low.

8.7.2 The proposed method of aeration with sub-surface diffusion will result in a low potential for malodours to form and also aerosols to be generated. The sludge thickening tanks will be covered and so this eliminates a major source of odours in this part of the treatment plant.

8.7.3 The predicted short-term maximum ground level odour concentrations are very low at the nearest private properties. The site is relatively remote, with areas where odours might be generated being over 300 m from the nearest housing. The predicted odour levels are well below the values likely to result in complaints. The prevailing weather conditions, coupled with the estuarine location, with the low incidence of low wind speed conditions will also aid rapid dilution of any odours produced from the various components in the treatment plant under normal operating conditions. No adverse impact on the ambient air quality of the area at the nearest residential properties is therefore predicted.



HOURLY WIND DIRECTION FREQUENCY - ALL WIND SPEEDS

Direction	Percentage Occurrence of Wind Speeds (m/s)						
	<2	2-3	3-5	6-8	9-11	>11	All
350-10	0.7	1.0	1.5	1.4	0.4	0.3	5.3
20-40	0.3	0.6	1.1	0.8	0.1	0.0	2.9
50-70	0.3	0.6	1.2	1.2	0.4	0.2	3.9
80-100	0.3	0.6	1.5	2.0	0.8	0.2	5.4
110-130	0.6	1.0	1.9	2.1	0.7	0.3	6.6
140-160	0.6	1.0	1.6	2.0	1.1	0.8	7.1
170-190	0.7	1.1	2.1	2.8	1.5	1.7	9.9
200-220	0.6	1.1	2.3	3.8	2.1	2.1	12.0
230-250	0.4	0.7	2.2	3.8	1.7	1.5	10.3
260-280	0.3	0.7	2.1	3.2	1.3	0.8	8.4
290-310	0.7	1.1	2.4	3.8	1.9	1.8	11.7
320-340	1.7	2.0	2.8	4.1	1.7	1.4	13.7
Calms	2.8						2.8
Total	10.0	11.5	22.7	31.0	13.7	11.1	100.0

FIGURE 8.1

FREQUENCY OF WIND DIRECTION AND WIND SPEED FOR HOURLY OBSERVATIONS AT ROCHES POINT (1962-91)

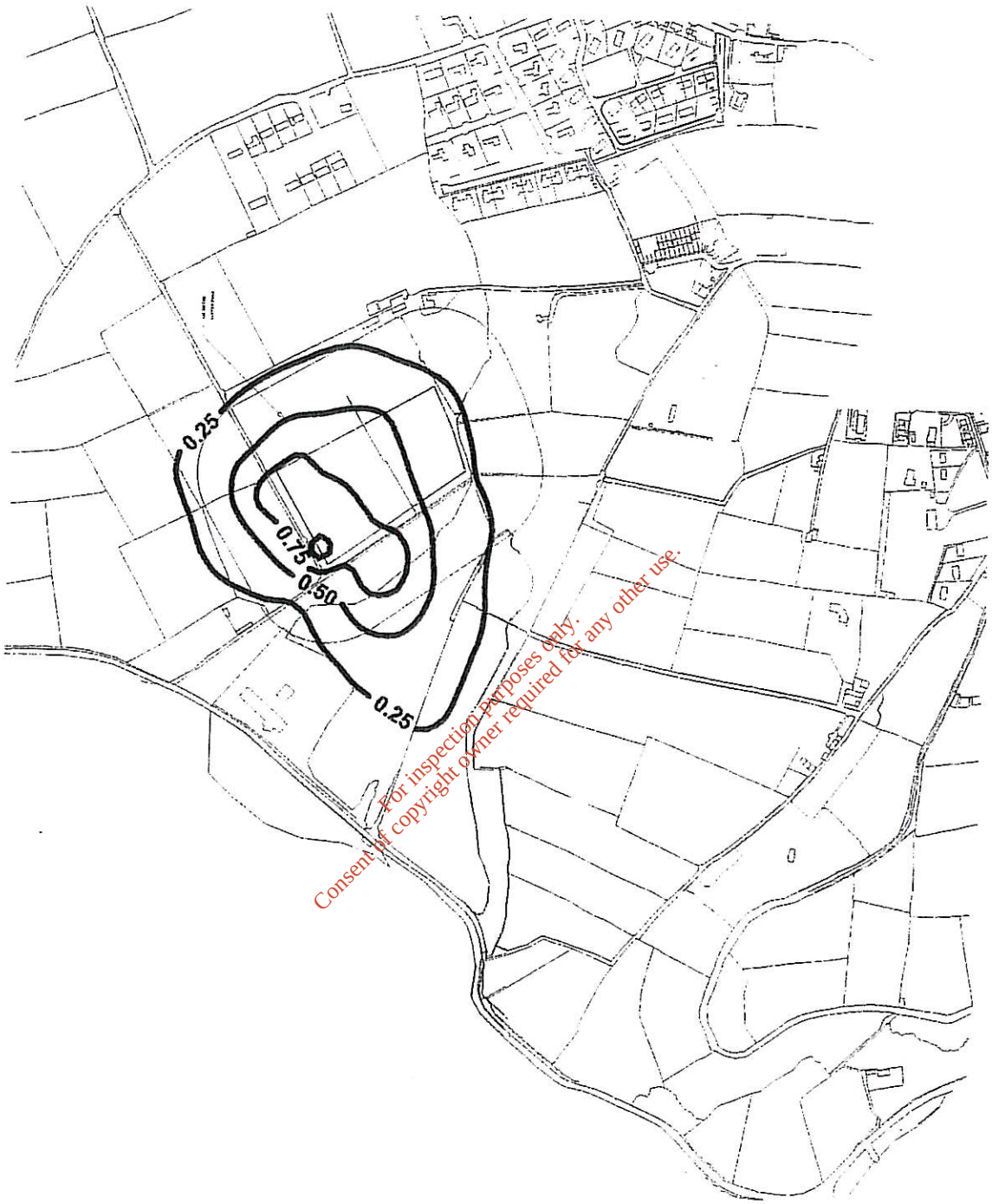


FIGURE 8.2

PREDICATED 98 PERCENTILE OF SHORT-TERM ODOUR CONCENTRATIONS OVER A YEAR (O.U./M3)

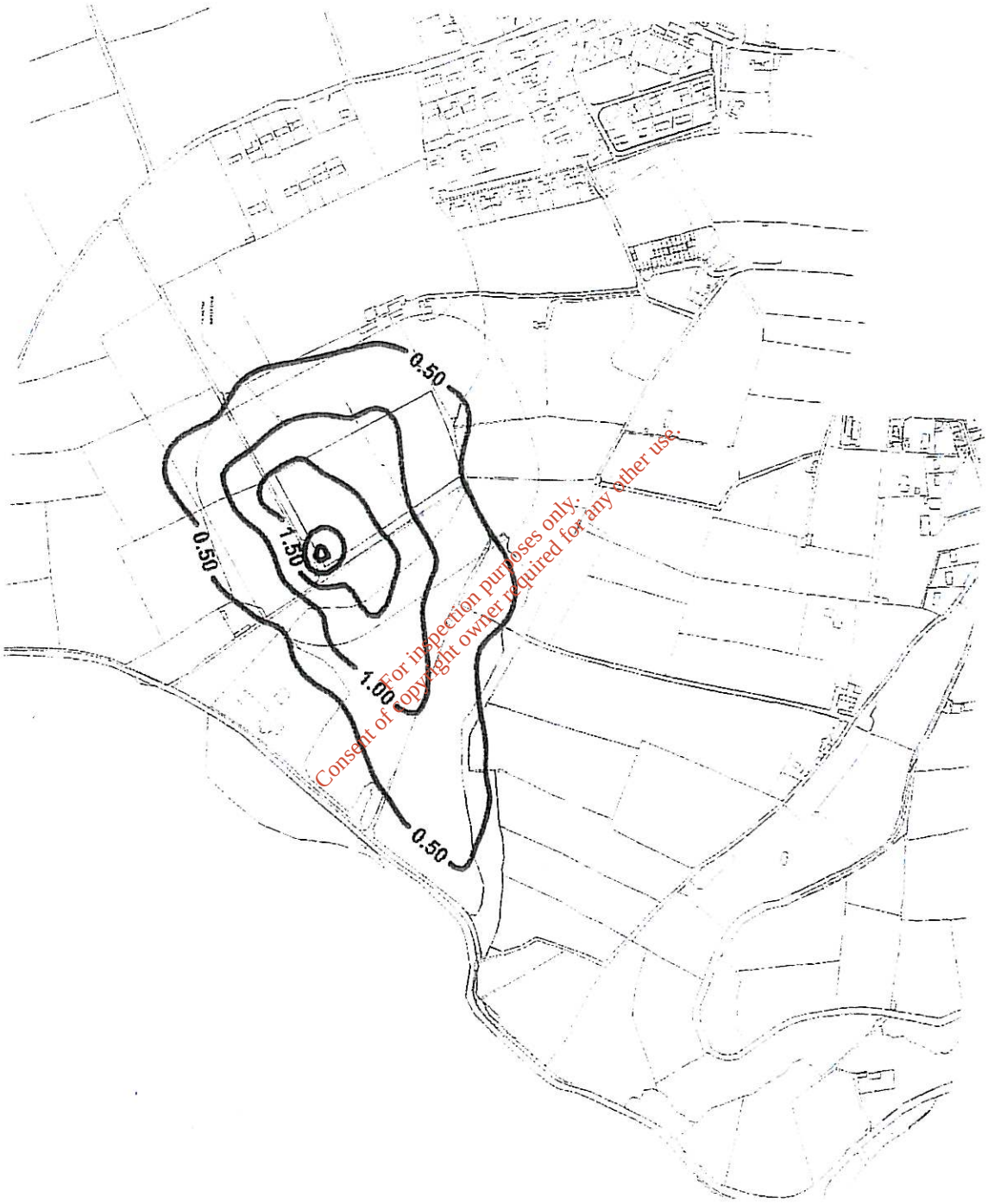


FIGURE 8.3

PREDICATED 99.5 PERCENTILE OF SHORT-TERM ODOUR CONCENTRATIONS OVER A YEAR (O.U./M3)

9.0 NOISE

9.1 Introduction

9.1.1 This section considers the ambient noise levels at locations around the proposed waste water treatment plant at Kinsale where people are likely to be affected by the operation of the proposed treatment works. It also considers predictive calculations to determine the likely affects of noise from activities at the proposed site to the nearest noise-sensitive properties.

9.1.2 All noise monitoring was carried out in accordance with BS 4142:1990 *Method of Rating Industrial Noise Affecting Mixed Residential and industrial Areas.*

9.2 Existing Environment

Details of Survey

Location of Measurement Positions(see Figure 9.1)

9.2.1 The survey was carried out on site from 22:00 hours to 01:00 hours and from 10:30 hours to 15:00 hours on Monday and Tuesday, 15-16 November 1993, at locations around the proposed site and at a similar waste water treatment plant in Bandon, Co. Cork.

9.2.2 The microphone position was at least 3.5 m from walls and at a height of approximately 1.2 m to minimise the effect of reflections.

Method of Measurement

9.2.3 Noise measurements were made in accordance with BS 7445:1991 *Description and Measurement of Environmental Noise*, and BS 4142:1990 *Method of Rating Industrial Noise Affecting Mixed Residential and Industrial Areas.*

9.2.4 Equipment used is detailed in Appendix E.

9.2.5 Measurements were carried out using a Bruel & Kjaer precision sound level meter. This is a Type 1 meter complying with BS5969, *Specification for Sound Level Meters*, as recommended in BS4142:1990.

9.2.6 The instrumentation was calibrated in accordance with the manufacturer's instructions before and after the sampling periods, to ensure accuracy of results.

Definitions

9.2.7 L_{A90}: The L_{A90} is defined in British Standard reference BS 4142:1990 as the background noise level. The L_{A90} is the level exceeded for 90% of the time. This corresponds to the "quieter" periods.

9.2.8 L_{Aeq}: A definition of L_{Aeq} is contained in The Noise Advisory Council's Guide to the Measurement and Prediction of the Equivalent Sound Level, L_{Aeq} as follows:

9.2.9 "The equivalent continuous noise level, L_{Aeq} is the level of a notional steady sound which, at a given position and over a defined period of time, would have the same A-weighted acoustic energy as the fluctuating noise. LAeq is therefore in itself a noise scale."

9.2.10 A-weighted: The A in LAeq refers to the A-weighted sound pressure level of the noise in decibels. A-weighting is a filter contained in the sound level meter which is designed to produce the relative response of the human ear to sound at different frequencies.

Weather Conditions

9.2.11 Weather conditions during measurement periods were as follows:

Wind speed:	>5 m/s, <10 m/s
Wind direction:	Southwesterly
Temperature:	5-6°C
Cloud:	100%

Background Noise Levels

9.2.12 The ambient noise-levels recorded during the survey are shown below.

TABLE 9.1. Background Noise Levels

	L_{A90} Night-Time	LA90 Day-Time
Area adjacent to causeway (MP1)	39 dB	40 dB
Harbour Heights (MP2)	42 dB	43 dB

9.3 Impact

Methodology

9.3.1 The impact of the proposed waste water treatment plant have been assessed using the guidelines contained in BS 4142:1990. These give methods of determining noise levels from factories, industrial premises or fixed installation, and sources of any industrial nature in commercial premises. It describes the methods of determining background noise levels. The method of rating in the standard depends on comparing the level of the noise source under investigation, corrected to take account of its character, with the background noise level.

9.3.2 For the assessment procedure, the likelihood of a noise-provoking complaint depends on its level relative to the background noise level and whether or not is has certain audible characteristics. A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance. At a difference below 5 dB, the lower the value the less likelihood

there is that complaints will occur. A noise source 10 dB below the background level (-10 dB) is a positive indication that complaints are unlikely.

9.3.3 Since there are no guideline figures, it is our experience that the following should apply:

TABLE 9.2. Noise Level Significance Figures

Level Difference	Significance
+13 dB or higher	Complaints very likely
+8 dB to +12 dB	Complaints likely
+5 dB to +7 dB	Marginal
0 dB to +4 dB	Little Likelihood of complaints
-9 dB to -1 dB	Very little likelihood of complaints
-10 dB or less	Positive indication that complaints are unlikely

Nuisance

9.3.4 When investigating complaints of excessive noise emanating from sources of an industrial nature in commercial premises, Local Authority Environmental Health Departments generally use the guidelines contained in BS 4142:1990 as an objective method of assessing initially whether the noise in question is likely to give rise to complaints.

9.3.5 BS 4142:1990 does not specify at what level a noise becomes a nuisance. However, from experience it is known that local authorities would generally be satisfied of the existence of a statutory nuisance where the rating level is 10 dB or more above the background noise level.

Noise Emissions from Existing Waste Water Treatment Plant

9.3.6 A noise survey was undertaken at various locations around the waste water treatment plant at Bandon, Co. Cork, the purpose being to determine the level of noise emissions from a working site.

9.3.7 The site at Bandon is similar to that proposed at Kinsale. The results obtained are considered representative of noise emissions from this type of activity.

9.3.8 The measurements obtained were used to assess the likely noise impact at the proposed site.

Results

9.3.9 Full details of the results, predictive calculations and assessments are contained in Appendix D. A summary of the results and conclusions is given overleaf.

Predicted Noise levels from Waste Water Treatment Plant

TABLE 9.3. Predicted Noise Levels

Location	Distance from Proposed Site (m)	Predicted L_{Aeq}
Farm west of site (MP1)	400	32 dB
Harbour Heights (MP2)	400	32 dB
Farm North of site (MP3)	125	42 dB

Assessment

9.3.10 The conclusions of the assessments are:

TABLE 9.4. Noise Level Conclusions

Source	Level Difference	Conclusion
Farm West of Proposed Site (MP1)		
Day-time pumps	-3 dB	Very little likelihood of complaints
Night-time pumps	-2 dB	Very little likelihood of complaints
Harbour Heights (MP2)		
Day-time pumps	-6 dB	Very little Likelihood of complaints
Night-time pumps	-5 dB	Very little likelihood of complaints
Farm North of Proposed Site (MP3)		
Day-time pumps	+7 dB	Marginal significance
Night-time pumps	+8 dB	Marginal significance

Discussion

Farm West of Proposed Waste Water Treatment Plant (MP1) - Operational Noise

9.3.11 Ambient noise levels at this location during the measurement periods comprised mainly wind noise.

9.3.12 The L_{A10} measurement is used in the measurement of traffic noise. The low L_{A10} levels recorded during the survey at this location show that there is very little traffic movement on nearby roads.

9.3.13 Predictions of site noise to this location show that during normal operations at the proposed site, noise attributable to the site will be a total of 32 dB L_{Aeq}.

9.3.14 The existing background noise level is measured at 40 dB L_{A90} day-time and 39 dB L_{A90} night-time.

9.3.15 An assessment in terms of BS 4142, and based on "worst case condition", i.e. night-time, shows that there is little likelihood of complaints.

Harbour Heights (MP2) - Operational Noise

9.3.16 As at measurement position 1, ambient noise levels at this location comprised mainly of wind noise.

9.3.17 The L_{A90} levels are marginally higher than those recorded at measurement position 1, showing slightly increased traffic movement at this location.

9.3.18 Predictions of site noise to this location show that during normal operations at the proposed site, noise attributable to the site will be a total of 32 dB Laeq.

9.3.19 The existing background noise level is measured at 43 dB L_{A90} day-time and 42 dB L_{A90} night-time.

9.3.20 An assessment in terms of BS4142, and based on "worst case conditions", i.e. night-time, shows that there is very little likelihood of complaints.

Farm North of Proposed Waste Water Treatment Plant (MP3) - Operations Noise

9.3.21 The background/ambient noise levels at this location are determined to be the same as for MP1.

9.3.22 Predictions of site noise to this location show that during normal operations at the proposed site, noise attributable to the site will a total of 42 dB Laeq.

9.3.23 The existing background noise level is measured at 40 dB L_{A90} day-time and 39 L_{A90} night-time.

9.3.24 An assessment in terms of BS4142 and based on "worst case condition", i.e. night-time, shows that the likely impact is of marginal significance.

9.4 Mitigation

9.4.1 No mitigation measures are required.

9.5 Residual Impact

9.5.1 Noise emissions from activities related to the proposed waste water treatment plant will not have a significant effect on the existing noise environment in the surrounding area, apart from a marginally significant impact on the farm to the north (MP3)

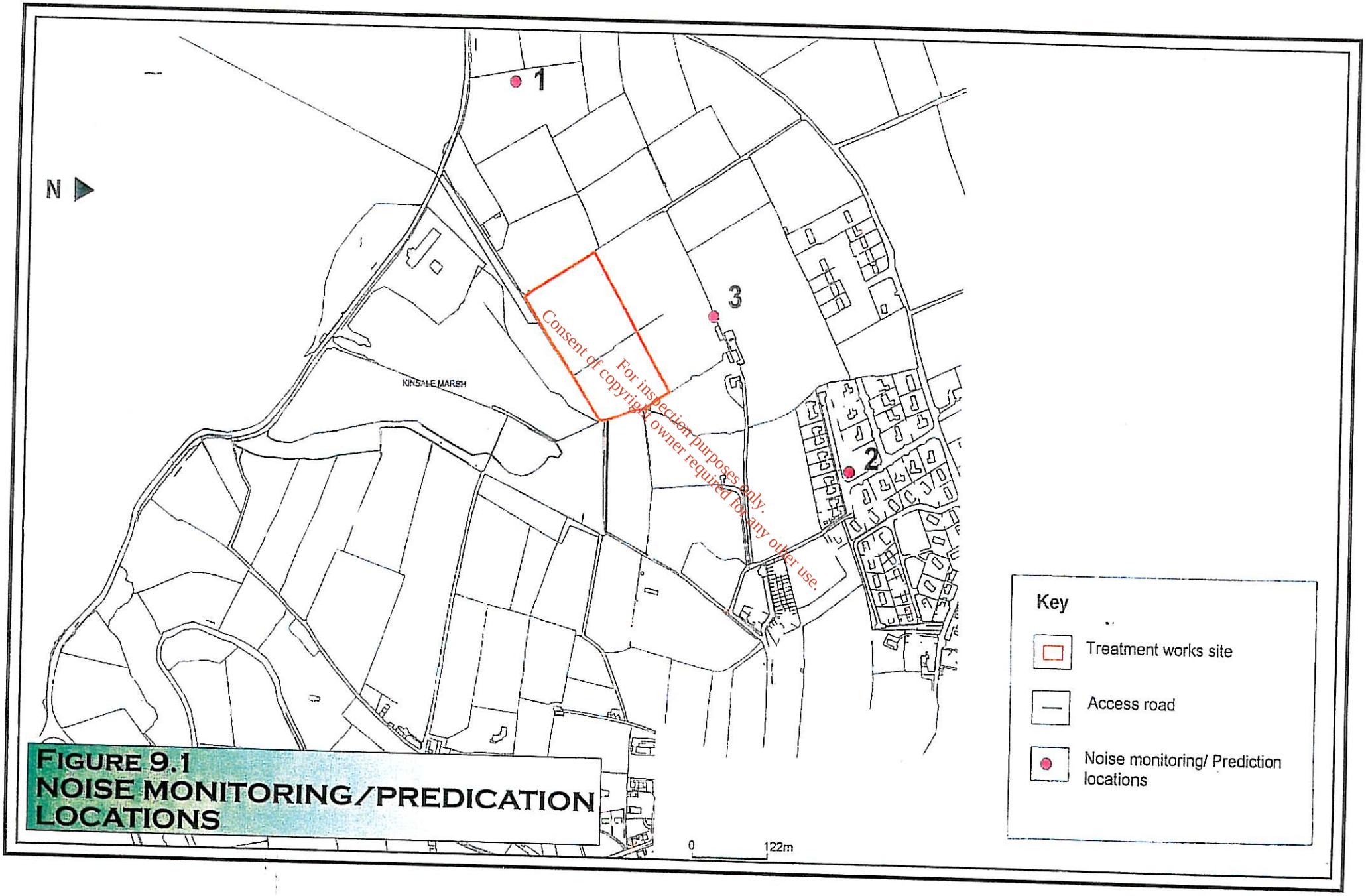


FIGURE 9.1
NOISE MONITORING/PREDICATION LOCATIONS

10.0 CULTURAL HERITAGE

10.1 Introduction

10.1.1 A study of the archaeological environment in the vicinity of Kinsale Town was carried out in order to assess the archaeological status of the proposed development site.

10.1.2 The proposed treatment plant site is located to the west of the town of Kinsale, just to the north of the Bandon River estuary. The site is a green-field site in pasture.

10.1.3 This section assesses the archaeological potential of the area and the impact of the proposed development on archaeology (see Figure 10.1). Individual site descriptions are included in Appendix E.

10.2 Methods and Resources

10.2.1 The following resources and methods were used:

- The files of the Cork Archaeological Survey.
- Various editions of the OS maps.
- The Sites and Monuments Record (SMR) for Cork[1].
- The Archaeological Inventory for County Cork – Volume 2, East and South Cork
- The Journals of the Cork Historical and Archaeological Society.
- A site inspection of the proposed development site.

10.3 Archaeological Overview

10.3.1 The area contains archaeological sites and monuments ranging in date from the Bronze Age to the 19th century. The development of the town of Kinsale, however, has had the most impact on the landscape, including its archaeology.

10.3.2 The earliest archaeological sites in the area are fulachta fiadh. The fulacht fiadh or cooking place was used to boil meat. A hole was lined with stone or timber and filled with water. Then roasting stones from a nearby fire were immersed in the water to bring it to the boil and the meat/animal was cooked in the boiling water. The heat-shattered stones were removed from the trough after cooking and thrown nearby. These diagnostic stones can still be seen in the ground when it is ploughed or topsoil is removed. There are five fulachta fiadh in the study area. The closest one to the site is in the same townland (CO111-076---) c. 1 km to the west on the east bank of the Bandon River. It survives as a spread of burnt material. Further to the west, on the other bank of the Bandon River there are three more fulachta fiadh, two in Tisaxon More (CO111-07301- and CO111-

[1] The SMR numbering system is used in this report. It consists of two parts: the first part is the county code (CO for Cork) followed by the Ordnance Survey map number (6" to the mile scale); the second part is the number of a circle surrounding the site on the SMR map, e.g. CO112-060--- refers to circle 60 on OS sheet 112 for Co. Cork.

07302-) and one in Tisaxon Beg (CO111-074----). The fourth fulacht fiadh (CO125-005---) in the study area was found during the construction of the housing estate at Castlepark, near James Fort (CO111-036---), c. 1.7 km to the southeast.

10.3.3 The only surviving ringfort in the study area is at Kilnacloona (CO124-019---) c. 1.5 km to the southwest. The site stands on a north-facing slope on the north bank of the Bandon River. This was originally a bi-vallate fort but the outer bank was removed c. 1978. These structures of the early Christian period were the homesteads of farmers. There is one circular enclosure (CO112-032---) c. 1 km north-northwest of the proposed development site at Rathbeg and one enclosure (CO112-035---) c.1.5 km to the northwest at Waters-Land South. These sites were so classified as the exact nature of the site was unclear when they were inspected by the Cork Archaeological Survey. It is quite possible that these also were ringforts. It was during the early christian period that Kinsale's origins as an urban area began. St Multose founded an early ecclesiastical site in the area in the 6th century. The suspected site of his early ecclesiastical enclosure is at Abbey Lands (CO112-085---) c. 0.6 km to the northeast of the proposed development site. No evidence for the Early Ecclesiastical Enclosure was found here, however, during trial trenching in advance of a housing development. A holy well at Abbeylands (CO112-03301-) is thought to be associated with the St Multose foundation. Holy wells, Bullan Stones and Burial Grounds are often regarded as the only remaining indication of Early Ecclestiacal activity in an area. The holy well at Castlelands (CO125-003--), c. 1.5 m to the south, has no known associated saint and the burials (CO112-082---) found during housing development in 1978, c. 600 m to the east-northeast at Ballynacubby Urban, were dated to the 16th/17th centuries. The Bullan Stone (CO111-072---) at Tisaxon More could not be located.

10.3.4 Following the Early Christian Period, the town of Kinsale was established as a Viking trading post. It was settled by the Anglo-Normans c. 1200 and was walled sometime after that. A Carmelite Friary (CO112-033---) was established at the northwest corner of the town in 1334. This lies c. 1 km northeast of the proposed development site. The town came to prominence during the Battle of Kinsale in 1601. Its defences were strengthened in the 17th and 18th centuries by the construction of James Fort (CO112-036---) and Charles Fort (CO115-007---). The town thrived in the 18th and 19th centuries mainly because of the fishing industry. The only surviving legacy of this industry recorded by the Cork Archaeological Survey is the Fish Palace (CO112-061---) at Scilly. The surviving buildings of this period are what give the town its unique charm and character. Many of these are listed in the Inventory for County Cork and in the Urban Survey for County Cork. Many others are recorded in the files of the Cork Archaeological Survey. Some are given in the appendix to this report.

10.3.5 Outside the town, Country Houses and Demesnes were established during this period. At Cappagh, near the proposed development site a house is marked on the 1842 OS map although not named. The walled garden of the house is shown in the field to the north of the eastern side of the proposed development site and bee-boles (CO112-079---) are marked in the west wall in the SMR. An ornamental tower (CO112-084---), now ruined, is marked to the northeast. On the 1842 OS

map a quay is marked outside the southern corner of the proposed development site and an open area to the southeast is named 'Ballynacubby Beach'. The 'Beach' is c. 450 m x 250 m and is bounded on its southwest side by the 'Bandon and Inishannon New Road', suggesting that the area may well have been a beach not long before that. In fact the presence of a quay suggests that boats could dock in the area. On the 1934 OS map the quay is marked on the south side of the Inishannon road and only a small area to the east is shown as being water.

10.3.6 The SMR for Cork encircles the south wall of the walled garden as a site of potential archaeological importance, based on information from an old map in the Department of Archaeology, UCC. An almost illegible hand-written note pointing to the area reads 'Thade Flynn....stones...' The site has been excluded from The Inventory for County Cork following a site visit by the Cork Archaeological Survey which concluded that there were no archaeological features visible above ground there.

10.4 Waste Water Treatment Plant Site

10.4.1 The site was inspected on 20 September 1998.

10.4.2 The site is located to the southwest of the town of Kinsale within a short distance of a number of modern housing developments. It is situated in pasture at the base of a southeast-facing slope, overlooking a marsh in the adjoining area to the southeast. It consists of the southern portion of two fields in pasture. The site is defined to the south, east and west by overgrown field fences. A north-northwest/south-southeast field fence divides the site in approximately two even halves. The northern extension of this field fence forms the west wall of the walled garden (with bee boles (CO112-078---)) shown on the 1842 OS map. The south wall of the garden has been removed although the line of this wall defines the northern perimeter of the proposed development site. Two gate piers survive in the southeastern-most corner of the site. They are built of random rubble each measuring 1.3 m x 0.72 m x 2 m high. A portion of a rusted gate is thrown to one side. The area is now heavily overgrown and a stream flows through the gate ope.

10.4.3 Both fields were walked and nothing of an archaeological nature was noted. There was no evidence for the stones recorded in the SMR although some evidence for them may still remain below ground level.

10.4.4 The 'Ballynacubby Beach' area to the south of the site has been infilled and now survives as a marsh. This area was not inspected.

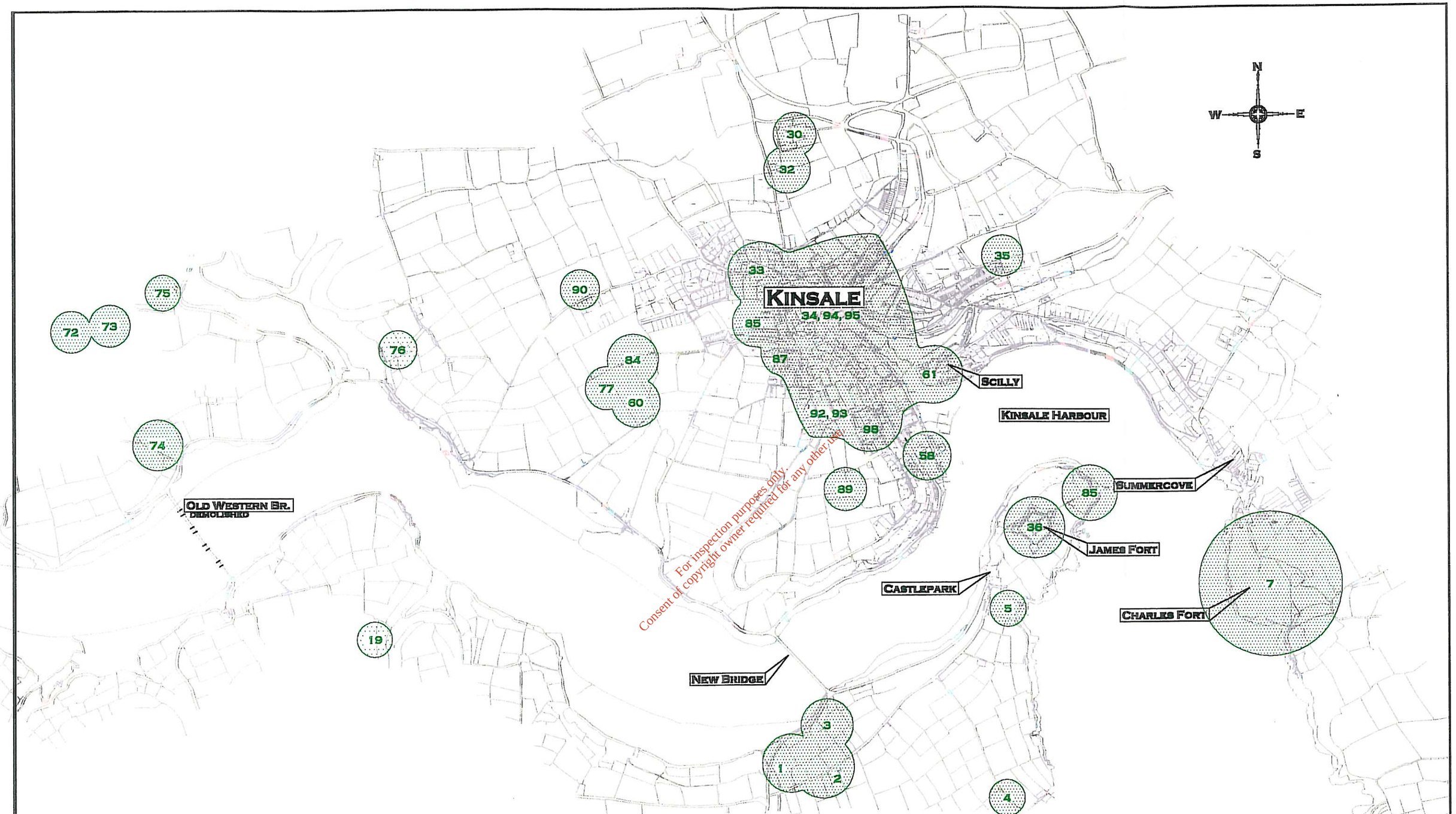
10.5 Mitigation

10.5.1 The sewerage network of the town of Kinsale is to be upgraded and linked to the treatment plant. All subsurface digging which will take place during this scheme in the town of Kinsale and its environs should be monitored. This will ensure that any archaeological features relating to the development of the town since the time of St Multose, will be noted and protected.

10.5.2 No archaeological sites were noted above ground level on the site of the proposed water treatment plant. However it is possible that some sites may remain undetected below ground level. All topsoil removal and any other subsurface disturbance on the site should be monitored by an archaeologist to mitigate impact on possible archaeological remains which may occur below ground level.

10.5.3 Where sewers or rising mains are to be laid underwater, due care should be taken to ensure the safety of the underwater archaeology. If any disturbance to the bed of the River Bandon or to Kinsale Harbour is to take place the Underwater Archaeological Survey of Ireland should be notified well in advance and any recommendations by the Survey should be followed and strictly adhered to.

10.5.4 In the event of an archaeological find being made, time and funding should be made available by the developer to facilitate an archaeological excavation, post excavation work and/or any other investigations which may be considered necessary by the archaeologist.



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Project
Kinsale Sewerage Scheme. E.I.S.
Kinsale, County Cork

Title
Cultural Heritage
Site Locations

Scales	1:15000
Drawn	
Ch'd(D.O.)	
Ch'd(Eng.)	
Approved	

Drg. No. 2328/EIS 9

Fig. 10.1

rev. A

REFERENCES

Clements, D.K. and Tofts, R.J. (1992). Hedgerow Evaluation and Grading System (HEGS): A Methodology for the Ecological Survey, Evaluation and Grading of Hedgerows (Test Draft). Countryside Planning and Management, Cirencester.

Collins, D. (1992). Birds of Kinsale Marsh. *Cork Bird Report* 1991: 63-67.

Cooke, D., Lynch, J., Nagle, T. and Shorten, M. (1995). *Kinsale Marsh: Proposals for Mitigation of Developments and Improvements of Habitat*. Unpublished submission to Cork County Council, Irish Wildbird Conservancy (Cork Branch).

Cork County Council (1996). *Cork County Development Plan: South Cork*. Cork County Council.

Curtis, T.G.F. and McGough, H.N. (1988). *The Irish Red Data Book. 1. Vascular Plants*. The Stationery Office, Dublin.

Davidson, N.C. and Evans, P.R. (1986). The role and potential of man-made and man-modified wetlands in the enhancement of the survival of over-wintering shorebirds. *Colonial Waterbirds* 9: 176-188.

EC DGXI (European Commission DGXI) (1996). *Interpretation Manual of European Union Habitats*. Version EUR15, European Commission DGXI, Brussels.

EPA (Environmental Protection Agency). (1996). *Water Quality in Ireland, 1991 – 1994*. Environmental Protection Agency

ERU (Environmental Research Unit) (1992) *Water Quality in Ireland, 1987 – 1990*. Environmental Research Unit

Galvin, P. (1992). *The ecology of brackish water lagoons of Wexford and east Cork*. Unpublished MSc Thesis, University College Dublin, National University of Ireland.

Hutchinson, C.D.H. (1994). *Where to Watch Birds in Ireland*. Christopher Helm.

JNCC (Joint Nature Conservation Committee) (1993). *Handbook for Phase 1 Habitat Survey - A Technique for Environmental Audit*. Joint Nature Conservation Committee, Peterborough.

JNCC (Joint Nature Conservation Committee) (1996). *Guidelines for selection of biological SSSIs: Intertidal Marine Habitats and Saline Lagoons*. JNCC, Peterborough.

MWP (Malachy Walsh and Partners) (1993). *Preliminary Report on Proposed Kinsale Sewerage Scheme, incorporating Hydrographic and Water Quality Reports*. Malachy Walsh and Partners, Cork

MWP (Malachy Walsh and Partners) (1997). *Addendum to Preliminary Report on Kinsale Sewerage Scheme Development in the Commoge Area: Alterations to Sewers and Treatment Works at Commoge*. Malachy Walsh and Partners, Cork.

Merritt, A. (1994). *Wetlands, Industry and Wildlife: A Manual of Principles and Practises.* The Wildfowl and Wetlands Trust, Slimbridge, Glos.

Morris, P., Thurling, D. and Shreeve, T. (1995). Terrestrial ecology. In: P. Morris and R. Therivel (eds.) *Methods of Environmental Impact Assessment* (pp. 227-254), UCL Press, London.

Reijnen, M.J.S.M., Veenbaas, G. and Foppen, R. (1995). *Predicting the Effects of Motorway Traffic on Breeding Bird Populations.* DLO - Institute for Forestry and Nature Research, The Netherlands.

RPS Cairns (1993). *Environmental Report for Proposed Sewage Works at Kinsale, County Cork.* RPS Cairns, Cork.

RPS Cairns (1996). *Ecological Impact Assessment of a Proposed Housing Development at Commogue, Kinsale.* RPS Cairns, Cork.

RPS Cairns (1997a). *Habitat Creation Proposals to Compensate for the Ecological Impact of Road Construction at Kinsale Marsh.* RPS Cairns, Cork.

RPS Cairns (1997b). *Amendments to "Ecological Impact Assessment of a Proposed Housing Development at Commogue, Kinsale".* RPS Cairns, Cork.

RPS Cairns (1997c). *Assessment of the Impact on Vegetation and Mammals of the Proposed Housing Development and Road Construction at Commogue, Kinsale.* RPS Cairns, Cork.

RPS Cairns (1998). *Ecological Assessment of a Proposed Housing Development at Eltins Wood, Commoge, Kinsale.* RPS Cairns, Cork.

RSPB (Royal Society for the Protection of Birds), English Nature and Institute of Terrestrial Ecology (1997). *The Wet Grassland Guide.* Royal Society for the Protection of Birds, Sandy, Beds., UK.

Sheppard, R. (1993). *Ireland's Wetland Wealth.* Irish Wildbird Conservancy, Dublin.

Shorten, M.G.M. (1992). *Areas of Scientific Interest for Birds in Cork.* Unpublished submission to Cork County Council, Irish Wildbird Conservancy.

Stace, C. (1991). *New Flora of the British Isles.* Cambridge University Press.