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Comparative Population Health Status Study of a Semi-Rural Irish Community Before and After Licensing of a Waste Incinerator

STRIVE

Environmental Protection Agency Programme

2007-2013

SSTI
Strategy for Science, Technology and Innovation

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government

Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Heritage and Local Government.

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- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.

EPA STRIVE Programme 2007–2013

Comparative Population Health Status Study of a Semi-Rural Irish Community Before and After Licensing of a Waste Incinerator

(2007-EH-MS-51)

STRIVE Report

Prepared for the Environmental Protection Agency

by

Health Service Executive West

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The EPA STRIVE Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

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Table of Contents

Executive Summary

This report presents the results of a study commissioned by the Environmental Protection Agency (EPA) and undertaken by the Health Service Executive (HSE) West (Limerick, Clare and North Tipperary) between April 2007 and September 2008. The purpose of this study was to compare the health status of the populations of two regions of County Clare (Clarecastle and Ennistymon) with health status which was determined as part of a separate study completed in 1996[1].

At the time the baseline data were being collected, a licence to operate a waste incinerator was granted to a pharmaceutical factory in Clarecastle, amid local health concerns. This study was designed to reassess the self-reported health status of the residents of Clarecastle to determine if this has been altered in the decade that the incinerator has been operational. Ennistymon was also included in the original study and acted as a control region for this study.

This report reviews the evidence of the health effects of living in proximity to an incinerator, reports significant findings from the health status comparison and summarises routinely collected environmental data from both areas since 1996 in order to provide some 'environmental context' to the study and highlight potential explanations for findings.

Overall, the results of this study show very few differences in self-reported health status either between the two areas studied or between the original and current study, despite substantial changes in educational and fertility patterns which have taken place in the intervening period and a large increase in population in the Clarecastle area possibly as a result of economic development. Although environmental information for the overall period was viewed as limited, particularly in respect of the early years (pre-2001), the data sets available suggested that the two towns did not differ significantly in terms of environmental quality that would be likely to cause an impact on public health during the years 1996–2007.

Significant improvements were evident in two of the eight domains of the SF-36 score (reduction of bodily pain and improvement in general health) over the 11- to 12-year interval in each area; decreased vitality was the only significant negative health difference between the 1996 and current data shown in both areas while Ennistymon demonstrated a significant reduction in the mental health score. No significant decrease in health status between 1996 and the current study, which was exclusive to the Clarecastle area, could be identified. (Ennistymon was the control for both studies.)

The only two areas where data showed Clarecastle to have reduced health status compared with Ennistymon were with respect to respiratory symptoms and environmental concern; however, overall environmental concern levels reduced significantly in the Clarecastle area between 1996 and 2007. The differences in respiratory symptoms recorded did not reach significance and the differences in the median respiratory score between the two areas equate to an average symptom score difference of just one per person. This small difference is reflected in the component physical score which shows no difference between Ennistymon and Clarecastle.

1. EPA, 1998. *Investigations of Animal Health Problems at Askeaton, County Limerick*. Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

1 Purpose of Study

This study aimed to ascertain whether the health status of the populations of two areas in County Clare (Clarecastle and Ennistymon), Ireland, have been altered by environmental factors in the two areas over the preceding decade. These factors included the licensing of a waste incinerator in the Clarecastle area. The following specific objectives were used to achieve this aim:

- To collect data on the general health status of a sample of residents of Clarecastle and Ennistymon using an interview-administered self-reported health status questionnaire (Chapter 7);
- Using the same sample, to collect data on the occurrence of symptoms of a number of specific medical conditions which may be linked to exposure to environmental hazards (Chapter 8);
- To collect data on pregnancy, fertility and childbirth amongst the females of childbearing age in this sample (Chapter 9);
- To collect information on lifestyle, social and demographic factors and concerns about the environment among the individuals in the sample (Chapter 10);
- To compare all of the above collected data with the available baseline data from a comparable sample of residents which was collected in 1996 (Chapters 7–10); and
- To look at routinely collected data relating to the environment about both of the areas, and specific industrial or infrastructural developments from the last decade, in order to provide an ‘environmental context’ to the study (Chapter 4).

2 Background

The Roche incinerator at Clarecastle is one of 11 incinerators operating in Ireland under licence from the Environmental Protection Agency (EPA). There has been considerable opposition to the development of municipal solid waste incinerators in Ireland and to date none is in operation. Concerns expressed by groups opposing such developments largely centre on possible health effects of incineration. These concerns include emissions (including dioxins) and the disposal of ash and fly ash.

The communities of Clarecastle and Ennistymon were previously studied as part of a multi-agency investigation into animal health problems in Askeaton, Co. Limerick, which took place between 1995 and 1998 (EPA, 1998). One part of this study assessed the health status of a sample of the population using a number of measures. Samples of the populations of Clarecastle and Ennistymon were surveyed regarding health status as control areas for the Askeaton study.

Since 1996, the environmental profile of both areas has changed due to industrial and infrastructural developments. One major development which has raised concerns among residents of Clarecastle was the licensing of a waste incinerator at Roche.

Between June 2007 and May 2008, a follow-up survey was completed on the residents of Clarecastle and Ennistymon, the aim of which was to assess if the health status of the residents of these two communities had changed in light of changes in their environmental profiles. This report presents the findings of this study and also provides an environmental context to the changes that have occurred in the two areas during the intervening years.

3 Literature Review

The major health concern that prompted this study was the licensing of a waste incinerator in the Clarecastle area. This section of the report reviews previous epidemiological studies of the health effects of waste incineration.

Studies in this area generally include either people with occupational exposure to incineration by-products or populations living in the vicinity of an incinerator (or both); most studies test the null hypothesis that the health outcome of people living or working in proximity to an incinerator does not differ from that of the non-exposed population. As this study focuses on those living in the vicinity of an incinerator, studies looking at occupational exposure were not included in this review.

It should also be noted that studies in this area can be based on one or more of several incinerator types which are in operation. These include municipal waste incinerators, industrial toxic waste incinerators, crematoria and hospital incinerators. The type that is operational in the Clarecastle area is a liquid/vapour incinerator situated within a pharmaceutical factory. While the emissions that are generated by this type are generally more uniform and thus deemed safer than those from a municipal waste incinerator, studies which focused on other types of incinerators were also included as the overall number of studies in the area is relatively small. Similarly, the incinerator in Clarecastle is a newer-type incinerator that is associated with less dioxin and furan emissions (the emissions which cause most concern from a public health point of view); however, studies that looked at older-type incinerators were also included.

The main health outcomes that are studied in relation to public health and incinerators are reproduction, respiratory health and cancer incidence. While the current study includes sections on reproduction and respiratory health, it was deemed inappropriate to include a section on cancer because the 10-year time frame between collection of the baseline data and this study is relatively short compared with the lag time between exposure and cancer development. The national cancer register collects information on cancer incidence at small-area level and a separate study looking at cancer incidence in Clarecastle can be undertaken once an appropriate lag time has elapsed. However, previous studies that focused on cancer incidence in areas near incinerators have been included in this review for completeness.

3.1 Search Methods

This section of the report reviews previous epidemiological studies of the health effects of waste incineration. Firstly, MEDLINE was searched using the Medical Subject Headings (MeSH) terms ‘incineration’ or ‘incinerator’ to identify human studies that had been published in the last 10 years. TOXNET was also searched using the search terms ‘incinerator’ and ‘health’. Next, the resulting studies were scoped by title and abstract and those that looked at health effects or chemical level in community residents were included. References cited in studies were also checked to identify other relevant studies.

3.2 Results

Following the search and scope procedures described above, a total of 20 articles were included for review. These comprised five studies considering congenital and reproductive effects, three looking at respiratory effects, five studying cancer incidence and five studies which measured emissions; two review papers are also included. Four additional papers relating to the epidemiology of asthma and respiratory symptoms in Ireland were included.

3.3 Congenital and Reproductive Effects

A Japanese study of the association between adverse reproductive outcomes and mother living within 10 km of a municipal solid waste incinerator (Tango et al., 2004) found no significant excess within 2 km of the incinerator. However, a significant peak–decline in risk, for both infant deaths alone and all congenital abnormalities (incl. infant deaths), with distance from

incinerator up to 10 km radius was observed, with the peak being detected within a 1- to 2-km radius. This study used vital statistics and thus no attempt to adjust for confounding variables could be made.

A study based in Germany which aimed at investigating whether twinning occurs more frequently in residents living in the vicinity of a toxic waste incinerator (Obi-Osius et al., 2004) found that the incidence of twins was significantly higher in areas surrounding the toxic waste incinerator (1.4–1.6 per 100 births versus 0.8 per 100 births). However, the authors of this study noted that the study areas included other industries as well as having the incinerator and did not adjust for potential confounding factors in their analysis. Additionally, they did not make any differentiation between identical and non-identical twinning. It was concluded that multiple births should be included as an outcome in future environmental health studies.

A study from south-east France assessed the impact of an increase in particulate matter containing dioxins and metals on birth defect rates (Cordier et al., 2004); 194 communities were identified as exposed and level of exposure estimated. A reference population of 2,678 unexposed communities was used to calculate relative risk of birth defects. Overall, there was no significant increase in the exposed population compared with the unexposed. Some subgroups of abnormalities occurred more frequently in exposed groups, while other subgroups increased with road traffic density, with a linear relationship being observed between the two.

A UK study investigated the risk of stillbirth, neonatal death, and lethal congenital anomaly among babies whose mothers lived close to incinerators and crematoria between 1956 and 1993 (Drummer et al., 2003). The study used a database of births and computed a measure of distance function from exposure for each birth. Using this information, increased odds of some lethal congenital anomalies, including spina bifida and heart defects, around incinerators were calculated. However, these increases were not large (odds ratio 1.17 for spina bifida and 1.12 for heart defects) and, as it was not a case-controlled study, it would have been more appropriate to calculate risk ratios which would have resulted in a less marked difference.

A Taiwanese study investigated whether incinerator-generated dioxins affected birth outcomes of exposed infants (Lin et al., 2006). Exposure to dioxins was determined using a US EPA modelling technique and various birth outcomes were collated from a birth register in 40 districts with an estimated exposure greater than or equal to 0.03 pg toxic equivalent (TEQ)/m^3 and 40 reference districts with an estimated concentration of zero. Results showed no statistically significant increased risk of low birth weight, female or preterm births. However, a statistically significant decrease was observed in mean birth weight between the exposed and reference groups. The authors themselves noted a number of study limitations: the study used calculated rather than measured exposure levels so sites may have been misclassified and this (in the authors' own admission) would have biased results towards the null. Additionally, only air exposure was calculated in this study and dioxin exposure via food consumption was not considered.

3.4 Respiratory Effects

An American study interviewed residents of four communities with biomedical, municipal or hazardous waste incinerators and four comparison unexposed communities regarding respiratory symptoms (Mohan et al., 2000). A total of 4,200 participants were telephone interviewed and results showed the only higher prevalence of self-reported respiratory symptoms was in one community near a hazardous waste incinerator, compared with its comparison community. Additionally, in-between these groups only symptoms of long duration remained significant after adjusting for perceived air quality. An increase of 50% in self-reported, long-duration respiratory symptoms was calculated. It should be noted that comparison areas were not matched for ethnicity or level of education and no objective measurements (either symptoms or air quality) were taken.

A second study from America measured air quality, respiratory function and respiratory symptoms in populations living with waste incinerators in their neighbourhood and matched control neighbourhoods (Shy et al., 1995). The study also estimated the

contribution of incinerator emissions to overall particulate air matter in exposed areas. Results showed that emissions did not have a major or even modest impact on routinely monitored air pollutants and no differences in particulate matter among any of the three paired communities. Additionally, no consistent community differences in prevalence of chronic or acute respiratory symptoms, lung function tests or peak expiratory flow rates were found between exposed and control communities. This study represented the first year of a 3-year study; the findings after 3 years were presented by Hazucha et al. (2002). Similarly, there was no difference reported between exposed or control communities with respect to spirometric functions, lung function or air quality measurements taken during the 3 subsequent years of the study (Hazucha et al., 2002). The control areas chosen for this study were very close to the study areas and relied on wind direction to define them as unexposed (each control was 5 km or greater upwind from the study area). In addition, while information was collected on family size, chemical exposure at work and home, cooking appliances and perceived outdoor air quality from each participant, only age, sex, race and height were adjusted for in the analysis.

Reference data for incidence of respiratory symptoms are available through the International Study of Asthma and Allergies in Childhood (ISAAC) which was begun in 1991, and has been carried out in three phases. A simple standardised questionnaire was used to determine prevalence of asthma symptoms and diagnosis, among other things. The Phase One study was repeated in the third phase, to give a picture of trends over time of the prevalence of asthma and allergic conditions in children in the 6–7 years age group and in the 13–14 years age group. Phase One took place between 1992 and 1998, and Phase Three took place between 1999 and 2004. The results of some of this work were published in the *Lancet* in 2006 (Asher et al., 2006) – the authors considered trends over time internationally which included Irish results in the answer to the asthma-related question 'Have you (has your child) had wheezing or whistling in the chest in the past 12 months?'.

A second publication outlining the trends in both asthma symptoms and asthma diagnosis in a group of Irish schoolchildren was published in the *Irish Medical Journal* (Manning et al., 2007). This study used the ISAAC protocol to study trends over time in a large group of schoolchildren in the 13–14 years age group and presented the results of the answers to the questions on 'wheeze or whistling in the chest in the past 12 months', and 'ever having asthma'. They compared the results from their 2002/2003 study with those of a previously reported 1995 survey (Manning et al., 1997).

In 2008, another Irish study (Kelly, 2008), using the ISAAC protocol, examined, among other things, the epidemiology of asthma in a group of schoolchildren in the four counties of Laois, Offaly, Westmeath and Longford, mainly in the 13–14 years age group.

These results are all included in Table 3.1 and provide a basis for comparison with the results from the Clare study which included the same question format.

Table 3.1 Comparison of studies in Ireland on prevalence of asthma and asthma symptoms.

	Prevalence of diagnosed asthma	Wheeze in past 12 months
ISAAC Ireland (13-14 years)		
Phase One 1992–1998		29.1%
Phase Three 1999–2004		26.7%
Ireland (13–14 years)		
1995	15.2%	29%
1998	18.2%	29.8%
2003	21.6%	26.7%
Midlands (13–14 years) 2007	23.5%	32.6%

ISAAC, International Study of Asthma and Allergies in Childhood.

3.5 Cancer

A UK study examined 70 municipal incinerators, 307 hospital incinerators and 460 toxic-waste landfill sites for evidence of effluents causing childhood cancers (Knox, 2000). The study compared distances from sources with birth addresses and death addresses of children who had died of cancer. The results of the study showed a high significant excess of migration away from municipal and hospital incinerators among children who subsequently died of cancer, 41% having a greater than 0.1 km difference between birth address and death address. However, of the 9,224 migrating cancers identified, precise (to within 0.1 km) information on both birth and death addresses was only available in 4,385 cases. Furthermore, the study looked only at distances from pollution source, birth and death addresses – no attempt was made to adjust for individual variables.

A similar study was conducted to determine if childhood cancers are initiated by prenatal exposure and to identify specific hazards (Knox, 2005). Birth and death addresses of fatal child cancers in Britain between 1966 and 1980 were collected and linked to local atmospheric emissions of different chemicals. Among children who had migrated, distances from addresses to emission hotspots were recorded, excess of outward over inward migration was then calculated and this was used as a proxy for increased risk. The results showed a significant increased risk of migration within 1 km of hotspots for a wide range of chemicals. However, like the previous study, the author draws complex assumptions from this migration data without adjusting for other factors. Furthermore, as this study deals with a number of pollutants, it cannot show whether the increase in migration is specifically associated with incinerators.

An Italian study investigating the occurrence of soft tissue sarcomas and residence near an industrial waste incinerator found an increase in odds associated with residence within 2 km (odds ratio 31.4) (Comba et al., 2003). However, this study is based on a small sample of 37 cases with soft tissue sarcomas and 171 controls. There is also a huge confidence interval around the odds ratio (5.6–176.1) – this is a reflection of the fact that the study included only five cases residing near the incinerator (one of these cases was working in the plant). It was also assumed that the sarcomas were caused by dioxins and other exposures were not adjusted for, despite the study area being defined as an industrial region. Furthermore, control areas were selected on the basis of age and sex frequency matching but no adjustment was made for other possible confounders. It should also be noted that when distance from incinerator was examined as a continuous variable no association was found between residence and sarcomas.

A case series from France (Floret et al., 2003), which used modelled dioxin ground-level concentrations and established four exposure categories, found that the risk of developing non-Hodgkin's lymphoma was 2.3 times more likely among residents in highest concentration areas compared with those living in lowest concentration areas. However, the authors of this study did note that the incinerator in the study area had had legal guideline breaches both for having too high emissions and burning waste at too low a temperature and was closed down in 1998. Similar to the previous study, no association was found when distance from incinerator was analysed as a continuous variable.

A study in the UK looked at incidence of larynx and lung cancer near one waste solvent and oil incinerator, where there had been reports of a cluster of laryngeal cancer, and nine other similar incinerators in Britain (Elliott et al., 1992). Cases were identified from the UK cancer register and were included if complete postcodes were available at the time of registration and lag periods of 5 and 10 years from incinerator start-up date were used. Overall, the study found no decreasing risk of cancer with distance from incinerator, for either type of cancer, using both lag periods and both before and after adjustment for regional socio–economic differences. It should be noted that the study included only cases which developed 5 years or 10 years after the incinerators were set up, a relatively short lag period in environmental epidemiology terms. Although the study included regional differences in cancer rates, subregional differences may have caused bias. Additional bias may have occurred because of incompleteness or duplication in the register used and,

because the population census is completed once every 10 years, the population data used may not have reflected the true population in question.

3.6 Emission and Dioxin Levels

In a study based on the first hazardous waste incinerator licensed in Spain, dioxin and furan plasma levels were measured in a sample of 20 people residing near the incinerator directly before the incinerator started operating and again 3 years later in a sample from the same population (Agramunt et al., 2005). The results found that the mean concentration of dioxin in plasma was significantly lower in the second sample than the first and the authors concluded from this that emissions from the incinerator stack did not result in significantly higher exposure to dioxins and furans in the population living near the incinerator. However, the plasma measurements were not taken from the same individuals in the baseline and the follow-up part of the study and additionally no mention was made of demographically matching the baseline and follow-up samples. Furthermore, because of the small sample size there was wide variation in the concentrations measured (range 4.66–29.25 pg international toxic equivalent (I-TEQ)/g lipid in follow-up and 14.79–48.95 pg I-TEQ/g lipid at baseline).

An American study looked at the potential public health effects associated with exposure to metal emissions from incinerators through non-inhalation pathways (Sedman et al., 1994). They used novel techniques that involved firstly determining changes in the concentrations of a number of metals that had resulted from incinerator emissions. Next, changes in human exposure due to direct contact with soil or ingestion of water were estimated and changes in dietary metal intake due to the incinerator were projected. The results of the study showed that incinerator emissions could contribute to aggregate human exposure to lead and cadmium by two facilities (nine incinerators were examined in total), while exposure to mercury, arsenic, beryllium and chromium was not substantially altered. The authors note that the increase in exposure found would not necessarily impact on human health and that no incinerator contributed a significant proportion to the reference dose of any metal. The study is limited by the considerable uncertainty surrounding the projections that were used. The projected exposures are calculated using Food and Drug Administration (FDA) estimates on dietary intake of metal. These estimates were calculated as part of the FDA total diet studies, which were not designed to monitor intake of toxicants but rather track changes from year to year. While the study did not reach any firm conclusions, it does highlight the importance of including non-inhalation exposure pathways when evaluating the potential impacts of hazardous waste incinerators on public health.

A Japanese study investigated the correlation between mortality rates from five major disease categories and dioxin level (Fukuda et al., 2003). Five hundred and ninety municipalities were studied and each given dioxin indices based on concentration of dioxins, amount of dioxins per head of population, cumulative amount of dioxins and cumulative amount of dioxins per land area. Socio–economic status, measured by seven indicators, was also assigned to each municipality. Mortality rates for stroke, ischaemic heart disease, all-site cancer, lung cancer and stomach cancer were calculated and compared in municipalities with differing dioxin indices. The results showed significantly higher mortality from female stroke and lower mortality from male all-site and lung cancer in municipalities with higher dioxin indices. However, no statistically significant correlation was evident when results were adjusted for socio–economic status. Furthermore, this study compares mortality between large areas and it is feasible that some significant correlations may have been identified if smaller-area statistics had been employed.

A Belgian study examined blood dioxin concentration in subjects residing in the vicinity of an incinerator (Fierens et al., 2003). The study included subjects from one rural area with an incinerator and one urban area and compared concentrations with controls from rural areas. The results of the study showed that dioxin concentrations were 50% higher in the serum of those residing near the rural incinerator when compared with the concentration both of controls and of those living near the urban incinerator. A self-administered questionnaire on dietary habits was also completed by each subject as part of the study and further analysis

showed interaction between residing around the rural incinerator and consumption of fat from local animals. Age-adjusted dioxin levels in controls did not vary depending on local animal fat consumption, while concentrations increased proportionately with fat consumption in those living in the rural study area. However, the authors note that a significant increase in dioxin body burden due to local produce consumption is only likely to occur when dioxin levels are greater than 5 ng TEQ/Nm^3 – a figure five times greater than the emission standards currently in force in most countries.

A Spanish study calculated the concentration of dioxins and furans in air, soil and herbage from a municipal solid waste incinerator using modelling techniques (Meneses et al., 2004). These levels were calculated before and after the adaptation of the incinerator to comply with EU legislation on pollutant emissions. The authors found that only a low level of the dioxins and furans in the total air concentration could be attributed to the incinerator, with emissions at 4.25% of the total I-TEQ initially and 0.024% following installation of the new cleaning system. With respect to the total concentration of dioxins and furans, the study calculated a fall from 0.89% to 0.2% which could be attributed to the incinerator before and after the new cleaning system was installed. Similarly, the measured hazard ratio for total human dioxin and furan exposure was reduced from 1.16 to 0.38, while the cancer risk contribution of the incinerator with respect to other emissions in the area decreased from 1.93% to 0.17% and the contribution of dioxin and furans emissions from the incinerator to total health risks of dioxins and furans for the population living near the incinerator fell from 0.08% to 0.007%. However, the authors of the study do note some weaknesses in the model that was used; for instance, only a small number of stack emissions were available for the period prior to the installation of the new cleaning equipment and neither atmospheric degradation nor soil dissipation rates were taken into consideration by the model.

3.7 Review Papers

Following a review of epidemiological studies on the health effects of waste incineration, a number of recommendations for further research were made (Hu and Shy, 2001). Firstly, studies should specify the type of incinerator being studied, the pollution control mechanisms employed and the nature of the stack emissions. Exposure levels should be specified at area and individual level and for specific chemicals of interest, thus allowing dose–response analysis to be included in the study. Data on air quality in control and study areas should be collected, as well as information on other confounders including age, sex, smoking, indoor air quality and occupational exposure. Finally, the authors recommend that future studies focus on cancer, cardiovascular health, reproductive outcomes and respiratory health.

Another review looked at 46 papers, 32 of which examined the health effect on populations living near incinerators (Franchini et al., 2004). This review makes the point that the effect of bias and confounding factors needs to be considered when looking at the results of such studies and that methodological problems and insufficient exposure information can weaken study results. The authors suggest that future research should include a better definition of exposure in both qualitative and quantitative terms and that this could be achieved using biomarkers and environmental measurements.

Overall, while there is little conclusive evidence of an increased risk of negative health outcomes being associated with exposure to incinerator by-products, there are studies that support a possible link. As mentioned above, it is important that future studies collect data on possible confounding factors and that these factors are properly adjusted for.

4 Demographic Profile

This chapter describes the demographic characteristics of the study and control populations; some of the changes in the period between the original and follow-up studies which may have had an impact on results will be outlined.

4.1 Extent of Areas 1 and 2

Area 1 is situated on the southern environs of Ennis which is the county town and main urban centre in Clare – it encompasses the Electoral Divisions (EDs) of Doora and Clareabbey (within Ennis Rural District) as well as the southern half of Ennis Rural ED (made up of the townlands of Coore, Cahircalla More, Cahircalla Beg, Shantulla, Ballymacaula, Keelty and Kilnacally). Area 2 in north-west County Clare includes all of Ennistymon Rural District and more specifically the EDs of Annagh, Ballagh, Ballyea, Ballysteen, Ballyvaskin, Cloghaun, Cloonanaha, Clooney, Ennistymon, Formoyle, Kilfenora, Killaspuglanone, Killilagh, Kilshanny, Liscannor, Lurraga, Magherareagh, Miltown Malbay, Moy and Smithstown (Fig. 4.1).

4.2 Population

In common with many other Irish counties, County Clare has experienced population growth in recent decades. Figure 4.2 shows that Clarecastle had a 67% surge in population between 1991 (the census year upon which the 1996 sample was based) and 2006 compared with an increase of 12.3% over the same

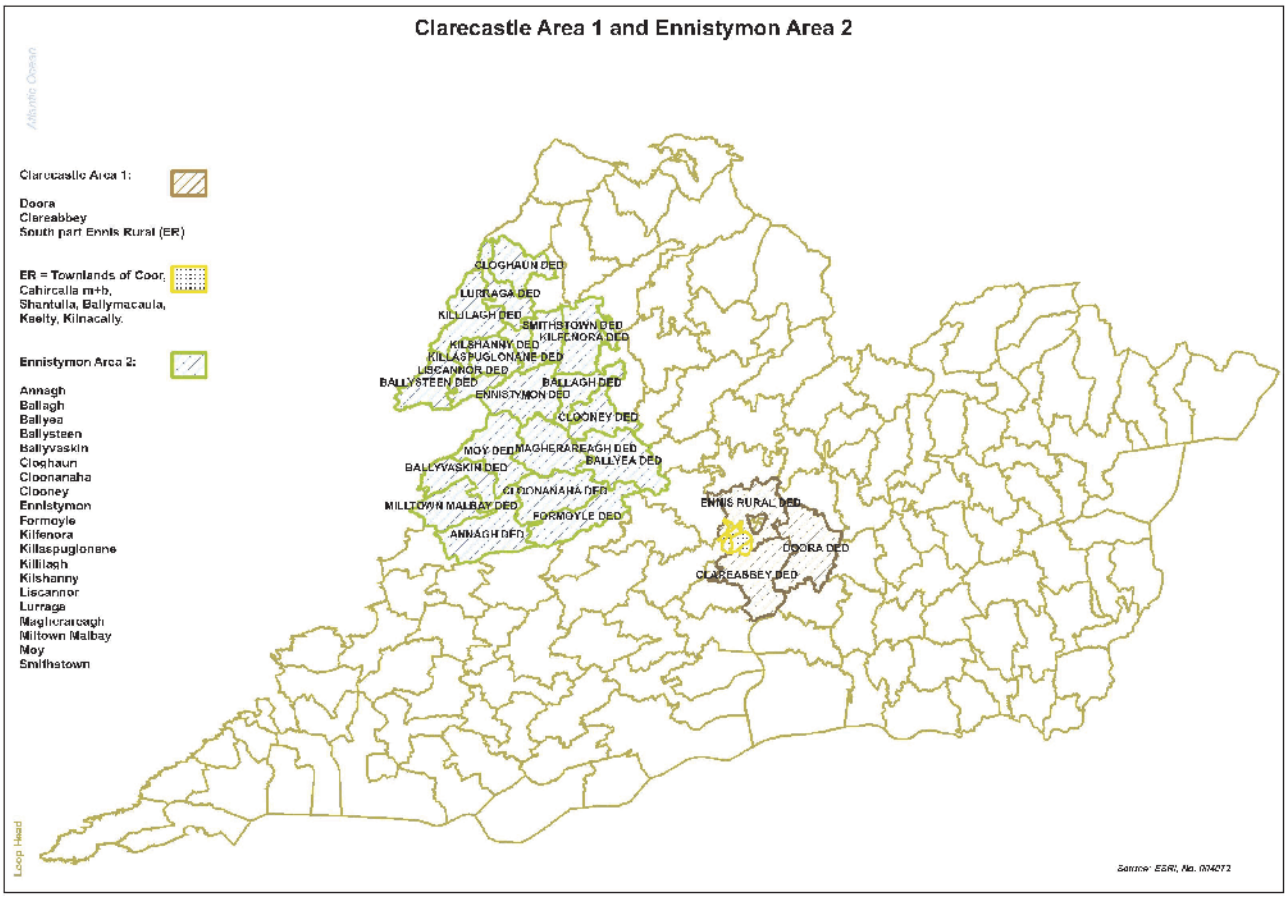

Figure 4.1. Map of County Clare with Clarecastle and Ennistymon study areas (source: Economic and Social Research Institute (ESRI) No. 004072).

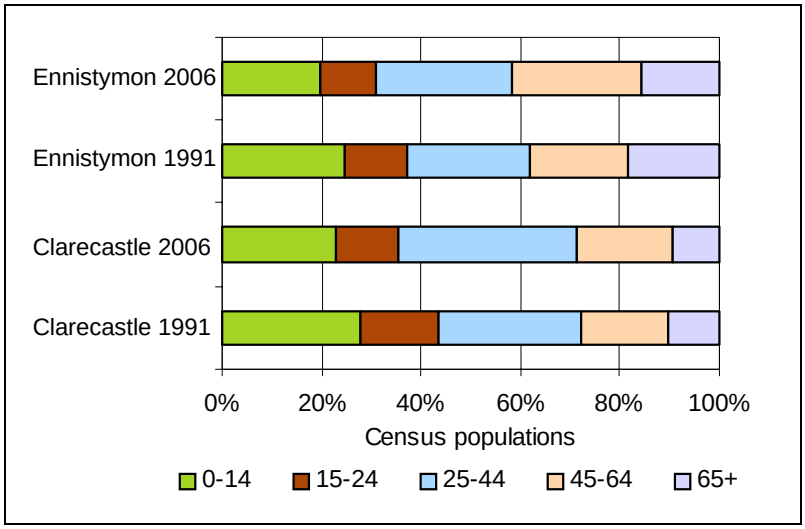

Figure 4.2. Population change by age group in Clarecastle and Ennistymon, 1991–2006.

period in Ennistymon. The growth in the overall Irish population over the same period (from 3,525,719 to 4,239,848), which was 20.25%, was fuelled by a combination of increased life expectancy and immigration to take advantage of emerging work opportunities linked to the 'Celtic Tiger' economy. Individual fertility reduced – in 1979 the total period fertility rate (TPFR) in Ireland was 3.23 but by the early 1990s it had dropped below 2, where it has remained. In 2006, it was 1.94 which is still one of the highest within the EU area. Despite this reduction in the fertility of individual women, crude numbers of births increased by almost a quarter in Ireland from approximately 53,000 in 1990 to 65, 810 in 2006 – this rise was mainly accounted for by an increasing number of women in the fertile age groups due to immigration and to reduced emigration.

The biggest increase was seen in the economically active age groups in Clarecastle – the dependency ratios for the two areas in 2006 demonstrate the younger age structure of the Clarecastle area (Table 4.1).

The rapid growth of population in Ennis and its environs in recent years has been facilitated by the increasing availability of high-skilled employment in the Ennis–Shannon–Limerick axis for which the Clarecastle locality is an ideal commuting location. The development of a new road structure, a commuter rail

Table 4.1. Dependency ratios for the Clarecastle and Ennistymon areas in 2006.

	Area 1 Clarecastle	Area 2 Ennistymon
Young	33.7	30.4
Old	13.7	24.2
Total	**47.4**	**54.6**

link and the choice of Ennis (including Clarecastle) as Ireland's Information Age Town in the late 1990s may have contributed to the dramatic surge in population especially in the economically active age groups. Tourism has also contributed to the economy of the area with a recorded increase in overseas visitors to County Clare from 597,000 in 1999 to 727,000 in 2006 (Fáilte Ireland). Ennis was designated as a hub in the National Spatial Strategy 2000–2020 and has been the fastest growing of those designated to date with a projected population of 36,000 in 2020. The planning policy of the municipal authority (Clare County Council http://www.clarecoco.ie) has identified Clarecastle as one of the three Residential Development Areas (RDAs) in Ennis under the government's Serviced Lands Initiative (SLI) where focused infrastructure has been provided; coupled with a policy of limited planning permission for individual homes in rural and seaside areas in recent years this may have

contributed to the apparent asymmetry in population growth between the two areas (Fig. 4.3). Both areas were equally balanced by gender in the 2006 census (Table 4.2).

Table 4.2. Gender balance in the 2006 census.

	Area 1 Clarecastle	Area 2 Ennistymon
Male (%)	10,087 (49.2)	4,968 (50.7)
Female (%)	10,407 (50.8)	4,824 (49.3)
Total	20,494	9,792

4.3 Health Indicators

The Clarecastle area had more than twice as many births in 2007 (308) as Ennistymon (115), which is in keeping with the population trend discussed above. Clarecastle babies were less likely to have a low birth weight; their mothers were less likely to be under 20 at the time of the birth and were more likely to breastfeed as shown in Fig. 4.4.

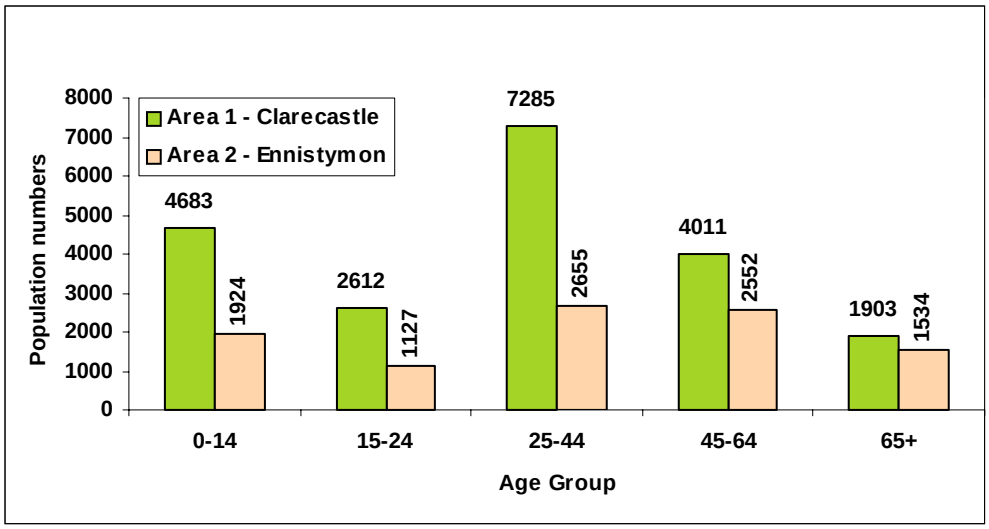

Figure 4.3. Clarecastle (Area 1) and Ennistymon (Area 2) population profiles by age group, 2006.

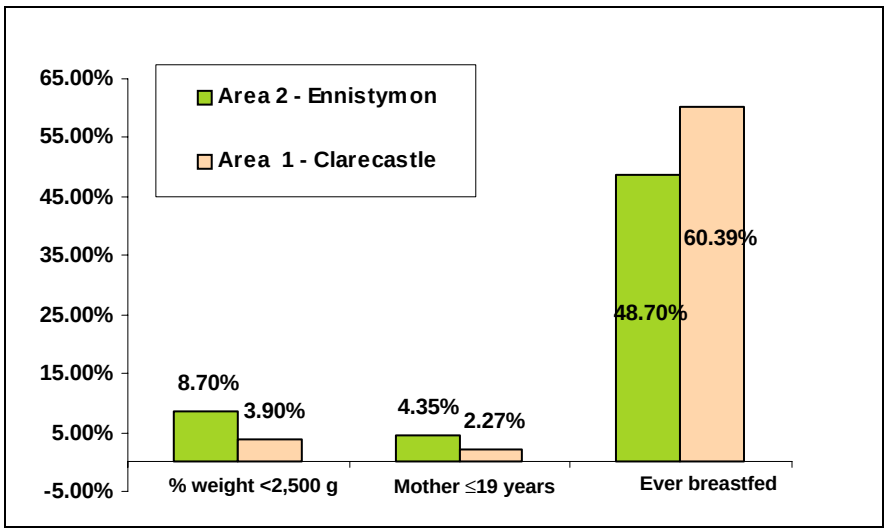

Figure 4.4. Infant health indicators for the year 2007.

Cancer incidence was measured across the Mid-West in a report issued in December 2006 by the National Cancer Registry of Ireland and the HSE. As illustrated in Fig. 4.5 only one ED in Co. Clare had significantly higher rates of cancer incidence between 1994 and 2002 than would have been expected by national rates and this ED was not in either of the study areas.

4.4 Social Class Structure

Thirty-eight per cent of the Clarecastle (Area 1) population belonged to Social Classes 1 and 2 in the 2006 census compared with a somewhat lower proportion (31.3%) in the Ennistymon area. Overall deprivation scores for Areas 1 and 2 are not available; however, Fig. 4.6 shows that Ennis Rural and Doora (which comprise over 87% of the Clarecastle Area 1) have deprivation scores of 5 or below which again suggests a greater level of affluence in Area 1 (Clareabbey, Doora and Ennis Rural (shown in red) make up the Clarecastle Study area).

4.5 Summary

These factors demonstrate an increasing divergence between the two areas since 1991 – Clarecastle has experienced a rapid population growth in the economically active age groups and in 2006 had a population with a lower dependency ratio and younger age profile than Ennistymon. This picture is supported by a pattern of lower deprivation scores in Clarecastle, by lower rates of adverse infant health indicators such as low birth weight and teen pregnancy and higher levels of positive health behaviours such as breastfeeding. Cancer incidence rates are not raised in either area.

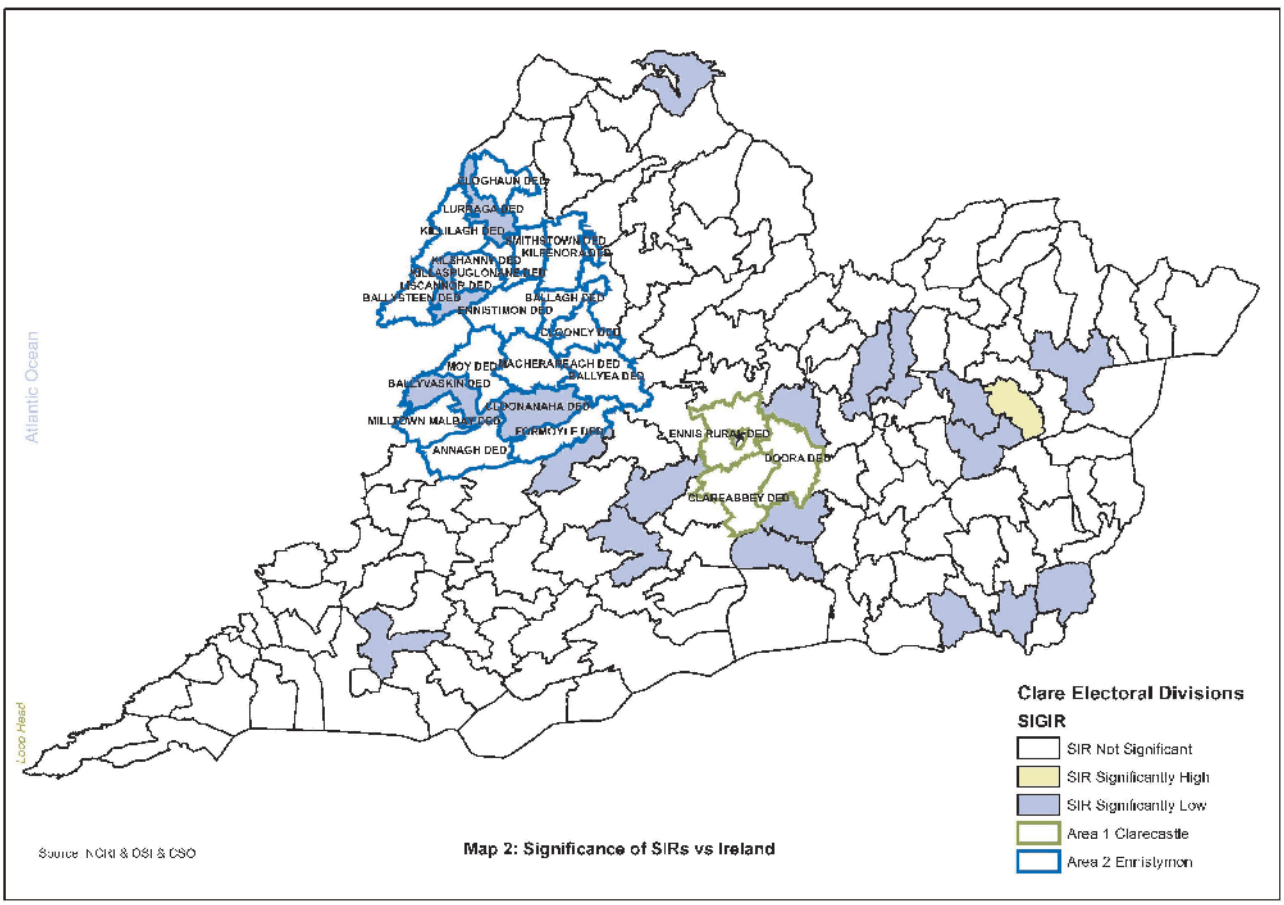

Figure 4.5. Map of all cancer standardised incidence ratios (SIRs) in the Clare Electoral Divisions (source: National Cancer Registry, Ireland (NCRI), Ordnance Survey Ireland (OSI) and Central Statistics Office (CSO)). Areas with significantly high and low SIRs compared with the national rates, 1994–2002. DED, District Electoral Division.

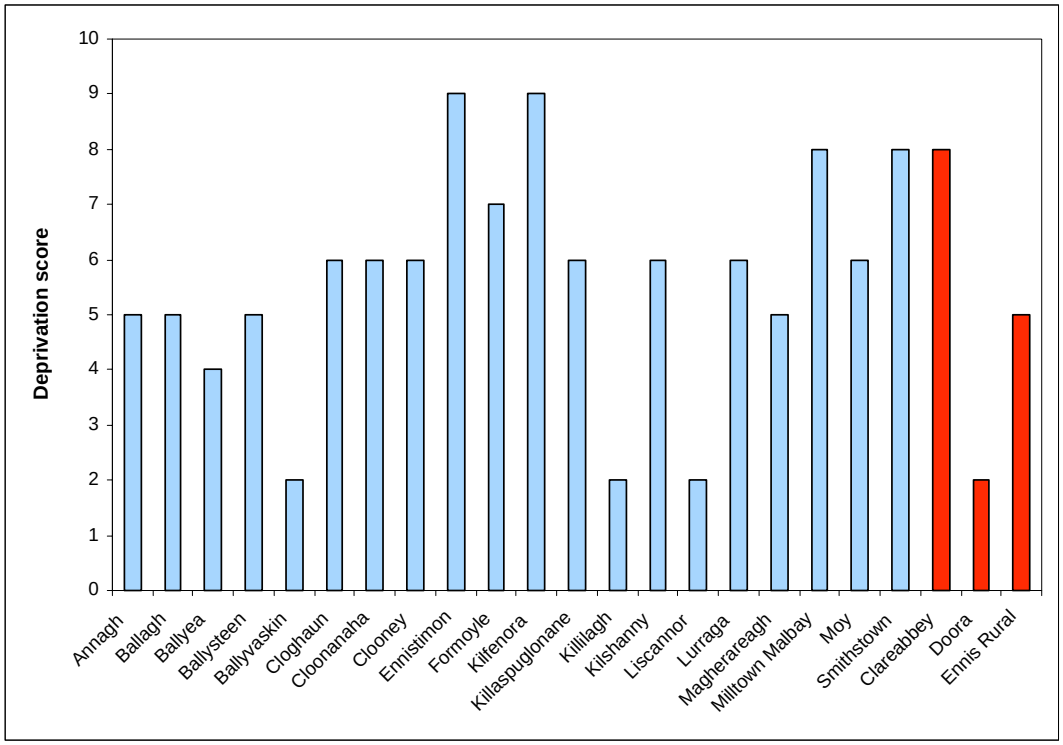

Figure 4.6. Deprivation scores by Electoral Division in Areas 1 (red) and 2 (blue), 2006 census.

5 Environmental Report

5.1 Introduction

This chapter deals with some areas of environmental concern in the context of human health. Recently published sources of information on environmental quality include the EPA's State of the Environment Report *Ireland's Environment 2004* (EPA, 2004) and the EPA *Environment in Focus 2006 – Environmental Indicators for Ireland* (EPA, 2006). In general, these publications conclude that environmental pollution is not viewed as a major threat to health in Ireland. While sources deal with national trends, they provide little location-specific information for the two County Clare towns that are the subject of this study.

Where direct impacts of environmental pollution on human health do occur, they are still likely to arise mainly from contamination of waters and air. The impact on public health of waste facilities, especially the prospect of the future introduction of municipal incineration can be of concern to some, even though there is evidence that such fears are based on international experience of the old type of municipal incinerator which is not relevant in an Irish context. In the context of this study, it is pertinent to note that a clinical waste incinerator is operated under licence at the Roche Ireland Ltd facility in Clarecastle.

The following sections summarise the information that was gathered when researching publicly available data on environmental quality in Clarecastle and Ennistymon and their immediate environs. Data were sought for the period 1996 through to December 2007, data that entered the public domain after December 2007 have not been considered. In most cases, the data sets did not provide a complete chronology for the period so any statement on the environmental quality that prevailed throughout those 11 years is incomplete.

5.2 Drinking Water

Drinking water in the Clarecastle area is supplied predominantly by the Ennis Public Water Scheme (PWS), while drinking water in Ennistymon is supplied predominantly by the Ennistymon PWS. Until recently, drinking water quality has been regulated by the European Communities (EC) (Drinking Water) Regulations, 2000 (EC, 2000) (now superseded by the 2007 Regulations). Under this legislation there are two microbiological, 26 chemical and 20 indicator standards that must be adhered to. Clare County Council monitors the drinking water quality for both public and group schemes. Monitoring is conducted at the water treatment plant and randomly from points of use (kitchen sinks). The extent of sampling in Ennis and Ennistymon for check and audit monitoring is proportional to the population(s) served by each supply.

The monitoring that was conducted prior to 2003 was for a smaller suite of parameters and the purpose was to assess compliance with EC (Quality of Water Intended for Human Consumption) Regulations, 1988 (EC, 1988).

The tables in Appendix 1 were supplied by Clare County Council and summarise the performance of two PWSs versus the regulatory limit values for the period 2001–2006.

The frequency of sampling from the Ennistymon PWS ranged from three samples per year (for parameters subject to audit monitoring) up to 27 samples per year for other parameters. The parametric levels of compliance with drinking water standards were ≥85% with two exceptions. During 2002 and 2003, almost half the samples exceeded the standard for taste/odour. In 2006 two of the three audit results for trihalomethanes exceeded the standard.

The frequency of sampling from the Ennis PWS ranged from five samples per year (for some parameters subject to audit monitoring) up to 85 samples per year for other parameters. The parametric levels of compliance with drinking water standards were ≥85% with three exceptions. In 2002, 21.7% of samples (10 of 46) exceeded the standard for colour. In 2003, 36.5% of samples (31 of 85) fell outside the concentration range for fluoride specified in the

Regulations, i.e. between 800 µg/l and 1,000 µg/l. Finally in 2005, 66% of samples (10 of 15) exceeded the standard for trihalomethanes. Noteworthy, in the context of public health, are the reports that there were three boil water notices in 2005, once due to an outbreak of cryptosporidiosis and twice due to *Escherichia coli*. There were two boil water notices in 2006 due the presence of crypto oocysts and *E. coli*. The result for *Cryptosporidium* is expressed as the number of oocysts (eggs) per 10 litres of water. There is no parametric value for the presence of crypto oocysts in the Drinking Water Regulations 2007, but in UK legislation an action limit of 1 oocyst/10 l in final water was in use during the study period.

5.3 Radon

The National Survey of Radon in Irish Dwellings was conducted between 1992 and 1999 under the auspices of the Radiological Protection Institute of Ireland (RPII) (Synnott et al., 2004). This survey quantifies comprehensively the scale of the radon problem in Irish dwellings and identifies those parts of the country where high indoor radon levels are more likely to be found.

The results were used to predict the percentage of houses in each grid square in which the radon concentration is in excess of 200 becquerels per cubic metre (Bq/m^3), the national reference level.

Radon was measured, over a 12-month period, in a random selection of houses in each 10 km × 10 km national grid square. The map in Fig. 5.1 is taken from the RPII website (http://www.rpii.ie) and displays the results for County Clare.

The nature of the grid based sampling system that was employed in the survey means that there is an absence of any collated data that are specific to Ennistymon and Clarecastle. However, data that are more location specific can be found in the radon in schools survey (RPII, 2004). The Department of Education commissioned the RPII to conduct the survey in all primary and post-primary schools. The survey took place over the years 1998–2004. The Department issues grants to schools where radon levels are between 200 and 400 Bq/m^3. Schools that exceed 400 Bq/m^3 are advised to employ the services of suitably qualified professionals and to carry out all necessary remediation work. The RPII then carries out post-remediation measurements to confirm that the necessary improvements have been achieved.

The radon in schools survey data provided by the Department of Education Planning and Building Unit are shown in Appendix 2. A summary of the data is shown in Table 5.1.

Remediation work was necessary arising from the initial survey results at St Fachnan & St Attracta's NS. Measurements conducted between October 2004 and May 2006 gave a school average of 441 Bq/m^3, post-remediation measurements conducted between September 2006 and March 2007 saw levels reduce to 53 Bq/m^3. One room at Scoil Mhuire, Ennistymon, was remediated from 214 Bq/m^3 to 51 Bq/m^3.

An examination of the schools by study area shows the two schools in Clarecastle averaging 73 Bq/m^3, while the eight schools in the Ennistymon area (post-remediation) had an average of 44 Bq/m^3. A workplace reference level of 400 Bq/m^3 is set down in national legislation. However, in the case of schools, the RPII has recommended that, wherever possible, radon concentrations should be reduced to below 200 Bq/m^3. Radon levels at St Fachnan & St Attracta's NS prior to the summer of 2006 were a notable exceedance of the reference level.

Both of the surveys mentioned have been conducted only once and there are no available data to show the variation in public exposure to radon over the years 1996 to the present day. It is important to note, however, that all houses built after July 1998 were required to install radon preventative measures (radon barrier and sump).

5.4 Air Quality

There is an acknowledged absence of data on air quality in the study areas as stated in the 2005 environmental report (Clare County Council, 2005) that was prepared to assess the impact of a proposed variation to the Ennis and Environs Development Plan. In describing the characteristics of the existing environment, the report cites the absence of information on air emissions and the lack of total traffic

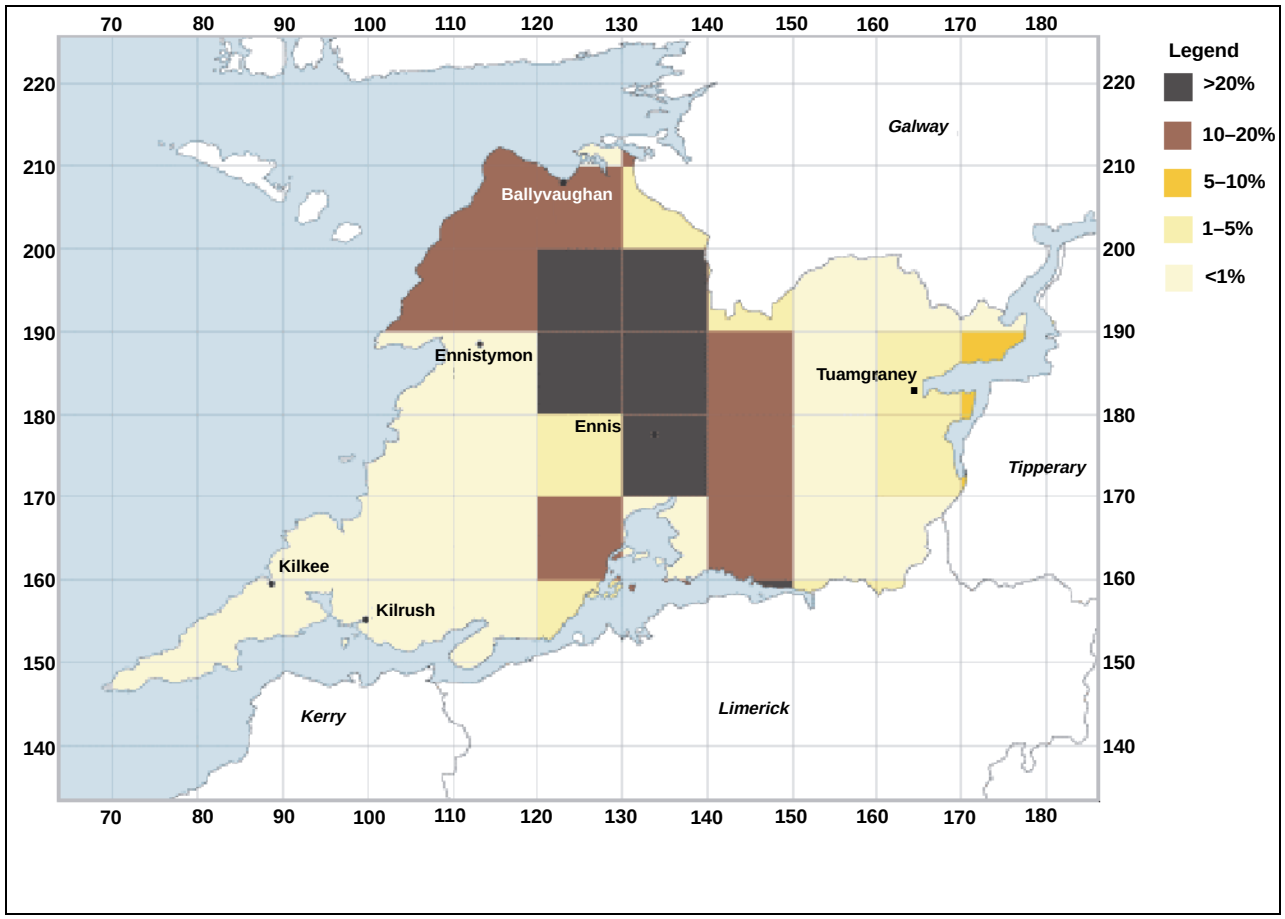

Figure 5.1. Radon map for County Clare (source: Radiological Protection Institute of Ireland).

Table 5.1. Summary of radon data in Clarecastle and Ennistymon schools.

Study region	School name	Address	Survey type	No. of sample locations	Radon concentration (school average) (Bq/m^3)
Clarecastle	Doora NS	Doora	Initial survey	5	74
Clarecastle	Coore NS	Mullach	Initial survey	5	72
Ennistymon	St Fachnan & St Attracta's NS	Kilfenora	Initial survey	6	441
Ennistymon	St Fachnan & St Attracta's NS	Kilfenora	Post-remediation survey	6	53
Ennistymon	St Michael's Furglan NS	Furglan	Initial survey	4	20
Ennistymon	Liscannor NS	Liscannor	Initial survey	4	34
Ennistymon	Scoil Mhuire	Lahinch	Initial survey	5	24
Ennistymon	Scoil an Chlochair	Ennistymon	Initial survey	7	37
Ennistymon	Ennistymon CBS (Primary)	Ballingaddy	Initial survey	5	47
Ennistymon	Meánscoil na mBraithre	Ennistymon	Initial survey	12	50
Ennistymon	Scoil Mhuire	Ennistymon	Initial survey	18	85
Ennistymon	Scoil Mhuire	Ennistymon	Post-remediation survey	1	51

counts in order to calculate emissions as an information gap and limitation.

Similarly, there is reference to the absence of air quality data for the area. The report mentions only the EPA Air Quality Monitoring Station at Askeaton, which monitors sulfur dioxide, stating that the air quality there is very good.

The EPA mobile air quality monitoring unit conducted tests in Ennis town over the period January 2006 to April 2007. Continuous monitoring was conducted for ozone, sulfur dioxide, nitrogen oxides, metals and PM_{10} (particulate matter sized less than 10 µm). The results of that monitoring led to the EPA's assessment of the air quality as being GOOD. Benzene and lead were indicated as being below their respective Statutory Air Quality Standards (see Table 5.2).

5.5 Dioxins in the Environment Based on Cow's Milk Surveys

'Dioxins' is a collective term for the category of 75 polychlorinated dibenzo-para-dioxins (PCDDs) and 135 polychlorinated dibenzofurans (PCDFs) which arise mainly as unintentional by-products of incomplete combustion and from certain chemical processes. Seventeen PCDD and PCDF compounds are likely to be of toxicological significance. The toxic responses include dermal effects, immunotoxicity and carcinogenicity, as well as reproductive and developmental toxicity.

The primary mechanism for dioxins entering the food chain is through atmospheric deposition. Cow's milk is considered to be a particularly suitable matrix for assessing their presence in the environment since cows tend to graze over relatively large areas and these compounds will, if present, concentrate in the fat content of the milk.

The EPA has conducted four cow's milk surveys in 1995, 2000, 2004 (EPA, 2005a) and 2006 (EPA, 2008). Two types of sampling stations were chosen:

1. Type A background stations covering the entire country (24 samples); and
2. Type B potential impact stations in areas of perceived potential risk (13 samples).

Two of the Type B sampling stations were located in County Clare – Clarecastle and Cooraclare; there was no station located near the town of Ennistymon. Figures 5.2 and 5.3 show the trend of the results over successive surveys for the A and the B sampling stations, respectively. Clarecastle and Cooraclare correspond to location codes B5 and B6, respectively, in Fig. 5.3.

The levels at the two County Clare stations showed little variation over successive studies. The EU limit for milk and milk products is 3.0 pg WHO-TEQ/g fat. The levels that have been recorded in Co. Clare are greater than an order of magnitude below the limit.[1]

The results from the study confirm the uniformly low levels of dioxins in the Irish environment. The results for the two County Clare stations are consistent with this overall assessment.

5.6 Industry and Commercial Activity

A number of permitting schemes are operated in Ireland for the control of pollution arising from industry and commercial activity; a summary of the permits that

1. The data in Fig. 5.3 are expressed in units of I-TEQ whereas the EU limit in milk is expressed in units of WHO-TEQ. Dioxins are complex mixtures and various systems of Toxic Equivalents have been developed to express their toxicity in the environment. Usually I-TEQ concentrations will be a little lower than WHO-TEQs but in the context of the low levels found in the Irish environment it makes little difference to the interpretation of results.

Table 5.2. Air quality data – Ennis Town 2006/2007.

Pollutant	Period of assessment	Result (average concentration)	Statutory Air Quality Standard
Benzene	1 March 2006 – 31 May 2006	0.61 µg/m^3	5 µg/m^3 (Note 1)
Lead	24 January 2006 – 18 April 2007	0.0235 µg/m^3	0.5 µg/m^3 (as an annual average)
Note 1: The Statutory Air Quality Standard for benzene is on a reducing scale that will culminate in 2010 at a level of 5 µg/m^3.			

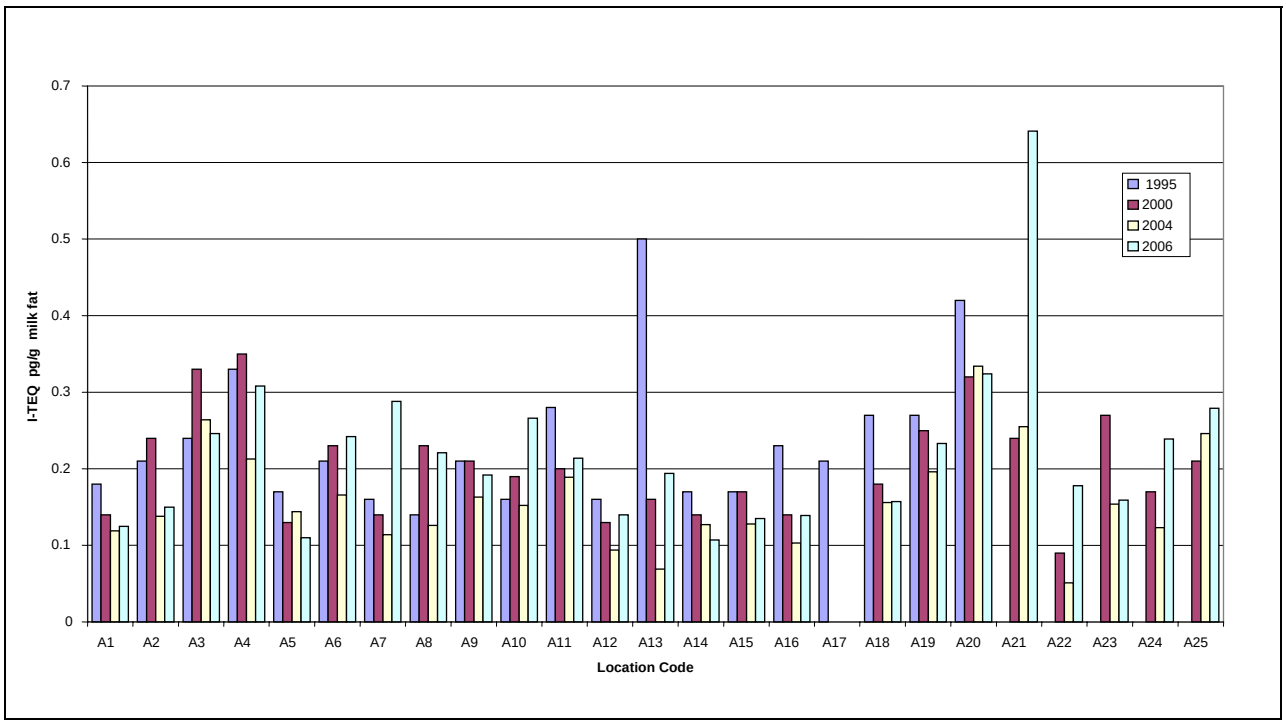

Figure 5.2. Comparison of 1995, 2000, 2004 and 2006 dioxin levels in milk – Type A samples.

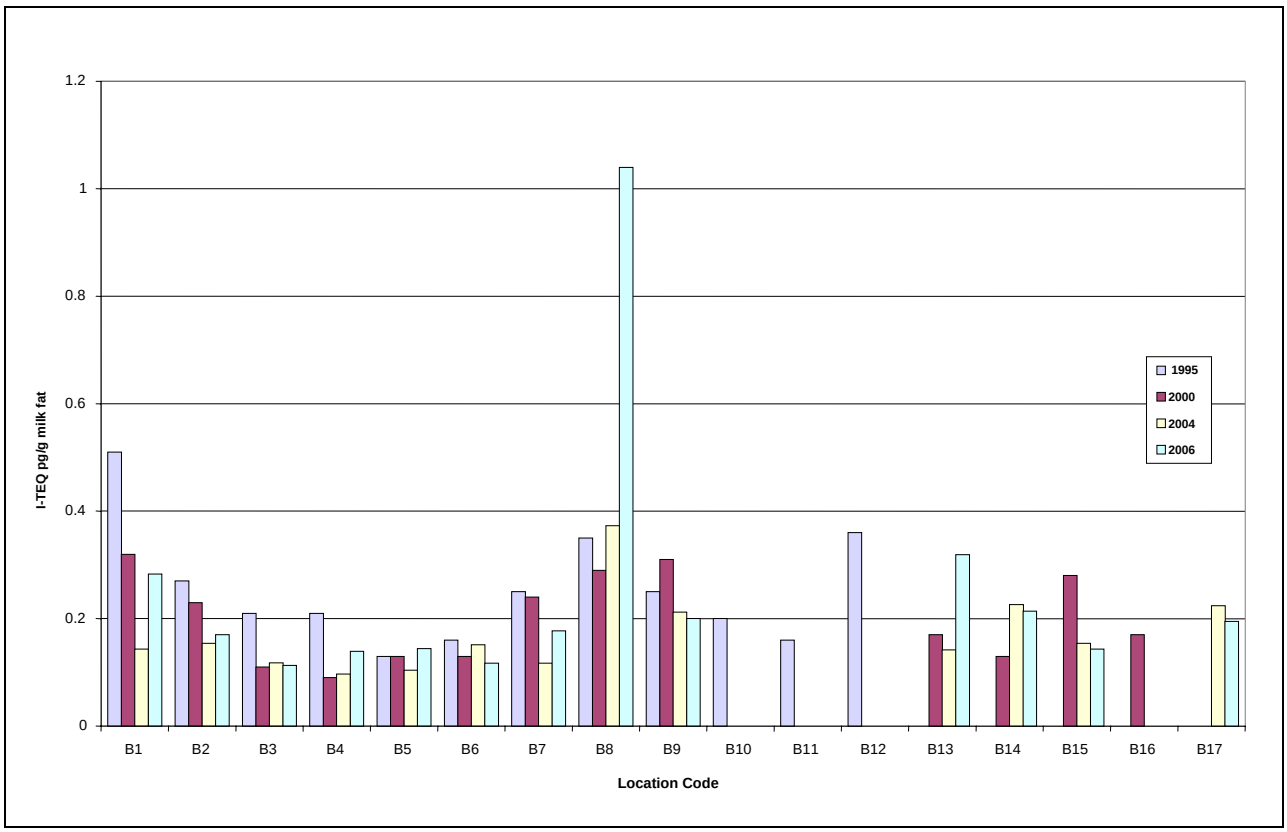

Figure 5.3. Comparison of 1995, 2000, 2004 and 2006 dioxin levels in milk – Type B samples.

are currently in force in the study towns is shown in Table 5.3.

5.7 Clare County Council Permits

Water pollution licenses are issued under Section 4 for discharge to waters and under Section 16 for discharge to sewer. One Section 4 licence is in force at the Ennistymon–Deerpark traveller accommodation. Five Section 16 licenses are in force for a variety of shops/hotels/restaurants in Ennistymon. None of the facilities have been prosecuted on the grounds of water pollution.

Waste facility sites that are currently permitted, or were in the past, in the vicinity of either town are for the deposition of soil/stones (for example, during construction of the Ennis Bypass, GAMA Construction Ireland Ltd operated a number of sites outside Clarecastle where it deposited excavated soils from along the route of the road) and would not have any public health effects. There are no reports that any of these sites have caused any difficulties for Clare County Council. There are records that refer to the an 'Ennistymon landfill' that operated between 1969 and 1997 and which was the subject of public complaints in which the complainants cited health concerns. The landfill was closed prior to the commencement of the waste permitting regulations. The County Council conducted an Environmental Risk Assessment and deemed it to be a low-risk site.

5.8 EPA Licenses

The EPA is responsible for regulating activities that have significant polluting potential. Licensed activities are required to conform to best practice and all licences and permits are routinely monitored to ensure ongoing compliance with requirements.

The EPA has implemented the integrated approach to the licensing of certain large-scale industrial and agricultural activities since 1994. The licensing system is called Integrated Pollution Prevention and Control (IPPC). An IPPC licence is a single integrated licence which covers all emissions from the facility (air, water, land, and waste) and its environmental management.

In 1996, the EPA began licensing certain activities in the waste sector. These include landfills, transfer stations, hazardous waste disposal and other significant waste disposal and recovery activities.

Clare County Council owns and operates a non-hazardous, engineered landfill near the village of Inagh in Co. Clare. The landfill is licensed to accept 56,500 t/annum of household, commercial and industrial non-hazardous waste. The licensee commenced waste acceptance in September 2002. Whilst the facility is located in a rural setting on the outskirts of Inagh village, there are 50 private residences located within a 1.5-km radius of the facility. Compliance with the conditions pertaining to odour has been the biggest issue of concern to the Agency. There were over 40 complaints in relation to the facility in 2008 primarily relating to odour nuisance.

There is one licensed IPPC activity in Clarecastle – Roche Ireland Ltd. Roche was first licensed in October 1995, and a series of licence reviews followed in December 1996, January 2001 and May 2006. Roche Ireland Ltd is engaged in the manufacture of bulk pharmaceuticals used in the treatment of arthritis, high blood pressure, severe pain, organ transplant

Table 5.3. Environmental permits currently in force.

Permit type	Clarecastle	Ennistymon
Water pollution licence (Section 4)	0	1
Water pollution licence (Section 16)	0	5
Waste facility permit	0	2
Waste licence	0	0
IPPC licence	1	0

IPPC, Integrated Pollution Prevention and Control.

rejection, ulcers, angina and anti-fungal agents. There is one liquid/vapour incinerator on-site. This incinerator handles all the gaseous emissions and most of the waste solvents generated from the processes. The amount of waste solvent generated is minimised as far as practicable through the operation of solvent recovery on-site. Further information concerning the licensing history of the plant can be obtained from http://www.epa.ie. The EPA inspectors' report to the board on the occasion of the most recent licence review states "*Roche Ireland Limited are generally in compliance with their existing licence"* (http://www.epa.ie/licences/lic_eDMS/090151 b2800b8992.pdf).

The licence currently in force lists six scheduled emissions to atmosphere, the liquid/vapour incinerator and five dust exhausts. An extract from the company's 2006 Annual Environmental Report (AER) is shown in Appendix 3, and one from the 2002 report is shown in Appendix 4. The reports provide a range of information about the environmental performance of the plant including the total annual emissions to atmosphere for a range of pollutants during the period 1999–2006. Trends that emerge include:

- Annual emissions of dioxin/furans increased steadily through the years from 1.4 mg in 1999 to a high of 4.9 mg in 2002. Thereafter, they have shown a steady reduction to the 2006 level of 2.9 mg. The high of 4.9 mg is less than 20% of the mass emission permitted in the licence.

- Sulfur dioxide emissions have shown large fluctuations from a low of 33.7 kg in 2001 to a high of 1,479 kg in 2003. There was a decreasing trend since 2003 to a level of 157 kg in 2006.

- Nitrogen oxides emissions have remained relatively constant with an annual average of 7,749 kg.

- The reports also provide annual emission data for other pollutants including particulates, halogenated volatile organic compounds (VOCs), non-halogenated VOCs, hydrogen chloride and carbon monoxide. The levels vary from year to year but in the context of the composite mass emission permitted by the licence the data for these pollutants show no significant peaks for the years 1999–2006.

Prior to the third licence (issued in 2001), there was no requirement for the company to submit an AER so information regarding the site's emissions to the environment is not so readily available. However, a view of the early licences and inspector reports demonstrates how operations at the site have changed over the period of the study. The most notable change has been the substantial reduction in solvent emissions to atmosphere. The first licence in 1996 set a combined emission limit on organic substances of 2,270 kg/day (EPA Integrated Pollution Control Licence Reg. No. 12). With the introduction of the vapour/liquid incinerator (EPA Integrated Pollution Control Licence Reg. No. 68 set a deadline for its introduction of October 1998), the licence limit on VOCs fell to just 7.2 kg/day. The level at which the plant can emit particulate from the process vents has also changed since the date of the first licence. There are approximately five such vents and a former limit for total particulates of 1 mg/Nm^3 has been replaced by a limit for particulates (active ingredient) of 0.1 mg/Nm^3.

The Roche licence set controls on noise emissions to protect the ambient environment from levels of noise likely to cause nuisance. The 2001 inspectors' report to the board stated that *"Noise emissions have been reduced since the issue of the licence [in 1996]"*. An annual noise survey is required to demonstrate compliance.

The Roche licences also set environmental controls on the company's effluent discharge to the River Fergus, the on-site landfill and on waste management. In the context of the aforementioned compliance history, the authors of the current report did not examine these other environmental aspects because they have no obvious route of impact on public health.

Since Roche was first licensed in 1995, the agency records show just one prosecution, which was for an exceedance of atmospheric discharge limits; the licensee pleaded guilty and the Probation Act was applied.

5.9 Conclusion

On the evidence of the data that are presented in the foregoing chapters, it is the authors' opinion that the populations of Clarecastle and Ennistymon have not differed significantly in terms of environmental quality that would be likely to cause an impact on public health during the years 1996–2007. This opinion is based on the limited amount of environmental data that are available, particularly in respect to the early years (pre-2001).

The public health data collated for Clarecastle and Ennistymon as part of this survey may be examined for evidence that the anomalies referred to here did indeed cause an impact. In particular:

- The boil water notices in the Clarecastle area;
- The exceedance of recommended radon levels in schools; and
- Concerns about the old Ennistymon landfill and the new landfill near Inagh.

The presence of the Roche Ireland Ltd plant in Clarecastle represents a difference between the two towns with respect to activities that have a potential to cause environmental pollution. Roche has not been the subject of any significant enforcement action on the grounds of public health. However, public health data may also be examined for evidence that Roche's significant reduction in solvent emissions to atmosphere has had an impact.

6 How the Study was Undertaken

In order to ensure comparability, this study followed the same randomised, cross-sectional survey design as the original 1996 health status survey (EPA, 1998). Ethical approval was granted by the HSE Mid-Western Regional Hospital's Ethics Committee. Participants were invited to take part in the study via a mailshot to all households on the electoral register, with a random sample being chosen from those who agreed to take part. Like the original study, the target was to recruit 450 participants in each area with the target demographics given in Table 6.1.

Table 6.1. Target recruitment numbers.

Age	Males	Females	Total
1–4	50	50	100
5–14	50	50	100
15–44	50	100	150
45–69	50	50	100
Total	**200**	**250**	**450**

These numbers were chosen partly to reflect the demographics of the population, but oversampled children and women of childbearing age in order to have sufficient numbers to test for statistically significant differences.

Response to the recruitment mailshot was low for people in certain demographics (including children and younger male adults) and therefore further recruitment was carried out by contacting houses in both areas door to door.

The numbers who were recruited and interviewed are presented in Table 6.2.

While most of the samples are close to the intended age and sex distribution, there are deficiencies in the under-4 age group representation in both Ennistymon and Clarecastle. Older people, those aged 45–69, were over-represented in the final sample, particularly in the Ennistymon area; this had also been a feature of the 1996 survey as shown by the figures in parentheses. A small number of participants had reached their 70th birthday by the time of interview and are included in the analysis.

Once recruited, participants were interviewed in their own homes by a nurse interviewer, at a mutually convenient time. The interview was structured around the same questionnaire that was used in the 1996 study. This questionnaire is primarily based on SF-36, a well-validated and widely used questionnaire that measures eight health concepts in order to give a summary of physical and mental health, and additionally included extra questions specifically looking at conditions frequently associated with environmental hazards, including respiratory, skin and general health, along with pregnancy and fertility. The full questionnaire is presented at the end of this report in Appendix 8.

Table 6.2. Age/gender profile of those interviewed in 2007–2008 study (1996 numbers in parentheses).

Age	Clarecastle males	Clarecastle females	Ennistymon males	Ennistymon females	Clarecastle total	Ennistymon total
1–4	23 (53)	20 (50)	26 (23)	20 (33)	43 (103)	46 (56)
5–14	45 (41)	36 (52)	43 (41)	33 (43)	81 (93)	76 (86)
15–44	61 (59)	88 (101)	40 (41)	80 (106)	149 (160)	120 (147)
45–69	47 (65)	64 (50)	56 (55)	86 (56)	111 (115)	142 (111)
70+	2 (0)	1 (0)	0 (0)	1 (0)	3 (0)	1 (0)
Total	**178 (218)**	**209 (253)**	**165 (160)**	**220 (238)**	**387 (471)**	**385[1] (398)**

[1]Age group value missing in two cases.

7 SF-36 Results

Data were collected on 387 participants in Clarecastle (compared with 471 in the 1996 study) and 387 participants in Ennistymon (compared with 398 in the 1996 study). Distribution of gender was not significantly different between the two times in either area, or between the two areas. However, the mean age of participants from Ennistymon was 31.3, significantly higher than that for Clarecastle (28.6). Likewise, median age was significantly higher in both areas in the current study compared with the 1996 study. Therefore, analyses which looked at differences between areas and times were adjusted for age.

7.1 SF-36 Comparisons

The main part of the questionnaire was based on SF-36. The SF-36 (originally the Short-Form 36) is a general-purpose health survey, giving rise to ten results. These are eight 'subscale' scores, and two summary scores called the Physical and Mental Health Component Summary (PCS and MCS) measures. The subscale scores measure different aspects of physical, psychological and emotional well-being: the Physical Functioning score, the Role Physical score, the Bodily Pain score, the General Health score, the Vitality score, the Social Functioning score, the Role Emotional score and the Mental Health score. The summary scores have been found to account for 81.5% of the reliable variance in SF-36 scales in the general population and have gained acceptance as a comparison standard across populations and patient groups. For each score, a higher result is better than a lower result.

Table 7.1 illustrates which health concept is measured by each scale score. Table 7.2 shows the SF-36 subscale scores for each area in 1996 and in 2007–2008.

The median values, which are more appropriate for data that do not have a normal distribution are presented in Table 7.3.

Physical Functioning: data from the Clarecastle area showed that between 1996 and the current study there was a slight, non-significant reduction in median physical functioning score, while in Ennistymon there was no difference.

Role Physical: comparing current data with data from 1996 showed no difference in role physical score in either area.

Bodily Pain: data showed that between 1996 and the current study there was a significant reduction in bodily pain in both Clarecastle and Ennistymon.

General Health: data showed that between 1996 and the current study there was a significant increase in general health score in both Clarecastle and Ennistymon.

Table 7.1. Health concepts measured by each subscale score.

Measurement	Health concept
Physical Functioning	Limitations in physical activities because of health problems
Role Physical	Limitations in usual role activities because of physical health problems
Bodily Pain	Bodily pain
General Health	General health perceptions
Vitality	Vitality (energy and fatigue)
Social Functioning	Limitations in social activities because of physical or emotional problems
Role Emotional	Limitations in usual role activities because of emotional problems
Mental Health	General mental health (psychological distress and well-being)

Table 7.2. SF-36 mean subscale and summary scores.

Measurement	Clarecastle 1996	Clarecastle 2007–2008	Ennistymon 1996	Ennistymon 2007–2008
Physical Functioning	90.4	90.7	92	88.04
Role Physical	84.0	86.31	86.3	87.26
Bodily Pain	85.0	77.33	89.7	79.95
General Health	73.7	78.56	76.1	77.13
Vitality	73.8	68.3	79	68.13
Social Functioning	89.5	90.21	91.9	93.1
Role Emotional	91.0	92.9	94	92.2
Mental Health	85.9	84.39	89.7	83.67
PCS[1]	*	52.59	*	52.58
MCS[1]	*	54.48	*	54.6

[1]PCS, Physical Component Summary; MCS, and Mental Health Component Summary.
*Not calculated in 1996 study.

Table 7.3. Summary differences between median SF-36 values in Clarecastle and Ennistymon in 1996 and 2007–2008.

Measurement	Area	Median value 1996	Median value 2007–2008	Significant difference
Physical Functioning	Clarecastle	100	95	No
	Ennistymon	95	95	No
Role Physical	Clarecastle	100	100	No
	Ennistymon	100	100	No
Bodily Pain	Clarecastle	100	84	Yes
	Ennistymon	100	100	Yes
General Health	Clarecastle	80	85	Yes
	Ennistymon	80	85	Yes
Vitality	Clarecastle	80	70	Yes
	Ennistymon	85	70	Yes
Social Functioning	Clarecastle	100	100	No
	Ennistymon	100	100	No
Role Emotional	Clarecastle	100	100	No
	Ennistymon	100	100	No
Mental Health	Clarecastle	92	88	No
	Ennistymon	92	88	Yes
PCS[1]	Clarecastle	*	55.39	
	Ennistymon	*	55.34	
MCS[1]	Clarecastle	*	56.69	
	Ennistymon	*	56.5	

[1]PCS, Physical Component Summary; MCS, and Mental Health Component Summary.

Vitality: data showed that between 1996 and the current study there was a significant reduction in vitality in both Clarecastle and Ennistymon.

Social Functioning: comparing current data with data from 1996 showed no significant difference in social functioning in either area.

Role Emotional: comparing current data with data from 1996 showed no significant difference in role emotional in either area.

Mental Health: Data from the Clarecastle area showed that between 1996 and the current study there was a slight, non-significant reduction in median mental health. In Ennistymon, there was a significant reduction in mental health scores between the 1996 and current study.

Overall, the current data collected showed that the SF-36 mental and physical component scores *were not significantly different* between Clarecastle and Ennistymon.

8 Occurrence of Symptoms

8.1 Respiratory, Skin and General Health

With respect to the respiratory, skin and general health sections of the questionnaire, the following summarises the significant differences that were noted between the data from Clarecastle and those from Ennistymon. Analysis was completed using either chi-squared or Fisher's exact test, as appropriate. Appendices 5–7 document the responses to the individual symptom questions.

The 1996 study had shown a significant difference between the respiratory symptom scores for Clarecastle and Ennistymon using a combination of all respiratory symptoms so this area was reviewed by comparing the data across the two areas for each study (1996 and 2007–2008) and then by comparing the results over time.

8.1.1 1996 study results

Wheezing was significantly more frequent in the Clarecastle sample in 1996 (p = 0.039, Fisher's exact test). The incidence of chest tightness was significantly higher in Clarecastle (p = 0.005, Fisher's exact test) than in Ennistymon; this was also true of hay fever (p = 0.005, Fisher's exact test).

8.1.2 2007–2008 study results

The section on respiratory symptoms showed significantly higher numbers of people experiencing attacks of shortness of breath and significantly higher numbers of people experiencing hay fever in Clarecastle than in Ennistymon. Similarly, numbers experiencing chest tightness, wheezing with exercise, wheezing with no cold and wheezing in general were higher in Clarecastle, with all differences almost reaching significance. Overall, differences in the median number of respiratory symptom scores between Clarecastle and Ennistymon were almost significant, with a median score being 1 in Clarecastle and 0 in Ennistymon.

8.1.3 Comparison over time

Significant increases in diagnosed asthma and the use of asthma medications occurred in Clarecastle against a background of small increases (which were not significant) in the incidence of wheezing in both Clarecastle and Ennistymon between the two studies. The proportion of people who had been diagnosed with asthma increased significantly between 1996 and 2007–2008 for Clarecastle (p = 0.014, Fisher's exact test) from 12.8% to 19.1%. The percentage of people taking prescribed inhalers also increased significantly between 1996 and 2007–2008 for Clarecastle (p = 0.001, Fisher's exact test) from 11.2% to 19.1%. Differences in the incidence of wheezing or wheezing over the last 12 months were not significant over the years for either area although these had increased in both Clarecastle and Ennistymon as shown in Fig. 8.1. When these results are considered together, they reflect a significant increase in diagnosed asthma and its effective treatment in Clarecastle over the years.

Of those who had experienced wheezing symptoms, further questions were asked on breathlessness, the presence of wheezing without having a cold, wheezing after exercise and a dry cough at night. Only the first (breathlessness when wheezing) was significant between the times for both areas – the level changed in Clarecastle from 40.2% to 55.6% (p = 0.017, Fisher's exact test) and in Ennistymon from 40.0% to 58.4% (p = 0.017, Fisher's exact test).

Comparing these results with other Irish studies using the ISAAC questions is helpful in providing an overall context, although this study covers a broader age group. The prevalence of diagnosed asthma and wheeze in the last 12 months for the two areas combined is broadly similar to most of the studies as shown in Table 8.1 – the higher prevalence of wheezing in the last 12 months in Clarecastle is in the range of the 2007 Midlands study (Kelly, 2008). (The results presented for Clarecastle/Ennistymon include all ages. These results are presented as a combined

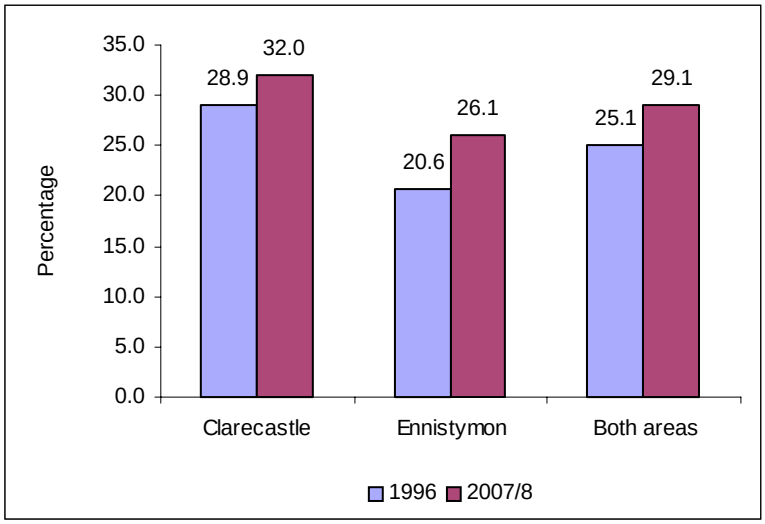

Figure 8.1. Comparison of proportion with wheezing symptoms in last 12 months.

Table 8.1. Comparison of studies in Ireland on the prevalence of asthma and asthma symptoms.

	Prevalence of diagnosed asthma	Wheeze in past 12 months
ISAAC[1] Ireland (13–14 years)		
Phase One 1992–1998		29.1%
Phase Three 1999–2004		26.7%
Ireland (13–14 years)		
1995	15.2%	29%
1998	18.2%	29.8%
2003	21.6%	26.7%
Midlands (13–14 years) 2007	23.5%	32.6%
Combined Clarecastle/Ennistymon group all ages 1996	12.4	25.1
Clarecastle	12.8	28.9
Ennistymon	11.8	20.6
Combined Clarecastle/Ennistymon group all ages 2007–2008	17.1%	29.1%
Clarecastle	19.1%	32%
Ennistymon	15.0%	26.1%

[1]ISAAC, International Study of Asthma and Allergies in Childhood.

result for both areas together, and also separately for each area.)

Using linear regression models, respiratory scores (total number of symptoms) were explained significantly by possession of a medical card (where the score went up by 0.79 on average when one was possessed), ever smoked where the score went up by 0.45 if they had, and by area where the score went up by 0.43 on average if they lived in Clarecastle. These results are shown in Table 8.2.

8.2 General Health

In this section, there was evidence of a significant but weak association with both experiencing a blocked or

Table 8.2. Respiratory scores.

Variable	Coefficient	p Value
Constant	0.94	<0.001
Medical card	0.79	<0.001
Ever smoked	0.45	0.017
Area	0.43	0.026

runny nose and a headache in the last year and residence in Clarecastle. However, there was no significant difference in the overall median number of general health symptoms between the Clarecastle and Ennistymon areas.

8.3 Skin

One in five of those interviewed for the 2007–2008 study had experienced skin symptoms in the previous year, with marginally higher rates in Clarecastle (21.4%) than in Ennistymon (18.6%) which were not significant. For 1996, the only significant difference had been the incidence of skin symptoms affecting the lips, which was higher than expected in Clarecastle ($p = 0.025$, Fisher's exact test). However, this had decreased significantly between the two studies with the incidence of lip symptoms dropping from 3% to 0.5% ($p = 0.009$, Fisher's exact test).

9 Pregnancy, Fertility and Childbirth

One hundred and sixty-eight women aged between 15 and 44 inclusive participated in the study – only these women were eligible for the questionnaire on pregnancy, fertility and birth (Table 9.1). Of these women, 122 reported ever being pregnant but for one of these women no pregnancy details were recorded. Of the 168 women, 21 (12.6%) reported trying to conceive for more than 1 year without success compared with 5.6% in the 1996 study.

The 122 women who had at least one pregnancy (Table 9.2) had between them 275 pregnancies (range 1–4); the rate of pregnancy per woman was higher in 1996 (2.8 per woman) than in 2007–2008 (2.3 per woman). Of these pregnancies, there were 244 live births, no stillbirths, 27 miscarriages and four outcomes coded as 'other'. Forty-four pregnancies finished before 37 weeks of gestation but of these 27 were miscarriages, zero were stillbirths, and two were births coded as 'other', leaving only 15 (5.5%) live-born premature infants.

An alteration in fertility patterns was demonstrated overall by the smaller family sizes of the women in the current study, none of whom had had more than four pregnancies compared with the 1996 range of 0–7 pregnancies; women in the sample were more likely to have had at least one pregnancy and also to report difficulty in conceiving than those in 1996. The rate of reported miscarriage was similar to 1996 (9.8%), although this was higher in Ennistymon than in Clarecastle.

Table 9.1. Pregnancy profile[1].

Area	Total women in each area 15–44 years	Women never pregnant	Women with at least one pregnancy
Clarecastle 2007–2008	88	24	64
Clarecastle 1996	101	59	42
Ennistymon 2007–2008	80	21	58
Ennistymon 1996	106	74	32
Total 2007–2008	**168**	**45**	**122**
Total 1996	**207**	**133**	**74**

[1]One missing value – one woman from Ennistymon within the 15–44 age range did not answer the question on pregnancy; 20 women outside this age range answered these questions by mistake.

Table 9.2. Profile of pregnancy outcome.

Area	Total pregnancies	Live births	Stillbirth	Miscarriage (%)	Other
Clarecastle 2007–2008	134	122	0	11 (8.2)	1
Clarecastle 1996	110	102	0	7 (6.3)	1
Ennistymon 2007–2008	141	122	0	16 (11.3)	3
Ennistymon 1996	97	84	0	13 (13.4)	0
Total 2007–2008	**275**	**244**	**0**	**27 (9.8)**	**4**
Total 1996	**207**	**186**	**0**	**20 (9.7)**	**1**

The changing pattern demonstrated is consistent with the national pattern as outlined in Section 4.2, showing a reduction in individual fertility which is compensated for by inward migration of women in fertile age groups.

This study showed no evidence of changing environmental effects on fertility; however, due to the small sample numbers detecting a statistically significant association would be difficult.

10 Lifestyle, Socio–Economic and Environmental Concerns

10.1 Lifestyle

A number of changes in lifestyle values have taken place between 1996 and 2007–2008, as indicated in Table 10.1, which broadly follow the trends of reduced physical activity, moderate reduction in tobacco intake and steady alcohol consumption shown in the three national surveys (1998, 2002 and 2007) of lifestyle, attitudes and nutrition in Ireland over the period (Friel et al., 1999; Kelleher et al., 2003; Morgan et al., 2008).

The overall prevalence of alcohol consumption had remained broadly similar, with a small increase in Clarecastle. The mean number of units of alcohol per week had increased from 6.2 to 7 in Clarecastle and had reduced from 7 to 5.9 in Ennistymon.

Daily numbers of cigarettes smoked had reduced in both areas although an increase in proportions who were current or past smokers was noted in Ennistymon and less effort towards change was evident in both areas prior to the current study.

Work activity scores showed that both areas had a trend towards less physically active work profiles although Ennistymon retained greater work-related activity levels, which may reflect the greater proportion of farms associated with the Ennistymon sample. Clarecastle leisure activity scores had increased over the period while those in Ennistymon remained at the same levels.

Dietary change was more complex, as participants were asked whether they had made changes in salt, fibre, fat, sugar and vegetable consumption; they were also asked whether they had tried to lose weight. Figures 10.1 and 10.2 show that, although both areas showed similar patterns of dietary change, most effort was directed towards increasing fibre and fruit/ vegetable intake and reducing fat consumption – 62% of people overall had made no effort to reduce salt consumption and 57% had not tried to reduce sugar intake.

The lifestyle questions showed that residents of Ennistymon were significantly more likely to be involved in heavy physical work, whilst those in Clarecastle had more sedentary employment; however, significantly more participants from Ennistymon read, walked or cycled, whilst more in Clarecastle ran or did aerobics. Nevertheless, all these associations were weak.

10.2 Socio–Economic

Social characteristics that were considered by the 1996 study as indicators of wealth (including educational level, housing tenure, landholdings (for

Table 10.1. Lifestyle profile.

	Clarecastle 2007–2008	Clarecastle 1996	Ennistymon 2007–2008	Ennistymon 1996
Current drinkers	77.9%	72%	77.5%	76%
Units of alcohol per week	7	6.2	5.9	7
Ever smoked	47.9%	47%	51%	39%
Cigarettes per day	14.13	18	16.56	19
Change in smoking[1]	0.47	1.22	0.34	1.35
Work activity	0.66	0.91	0.93	1.11
Leisure activity	1.18	1.05	1.04	1.05
Change in activity[1]	1.13	1.20	0.97	1.03

[1]A high score signifies a change in a healthy direction.

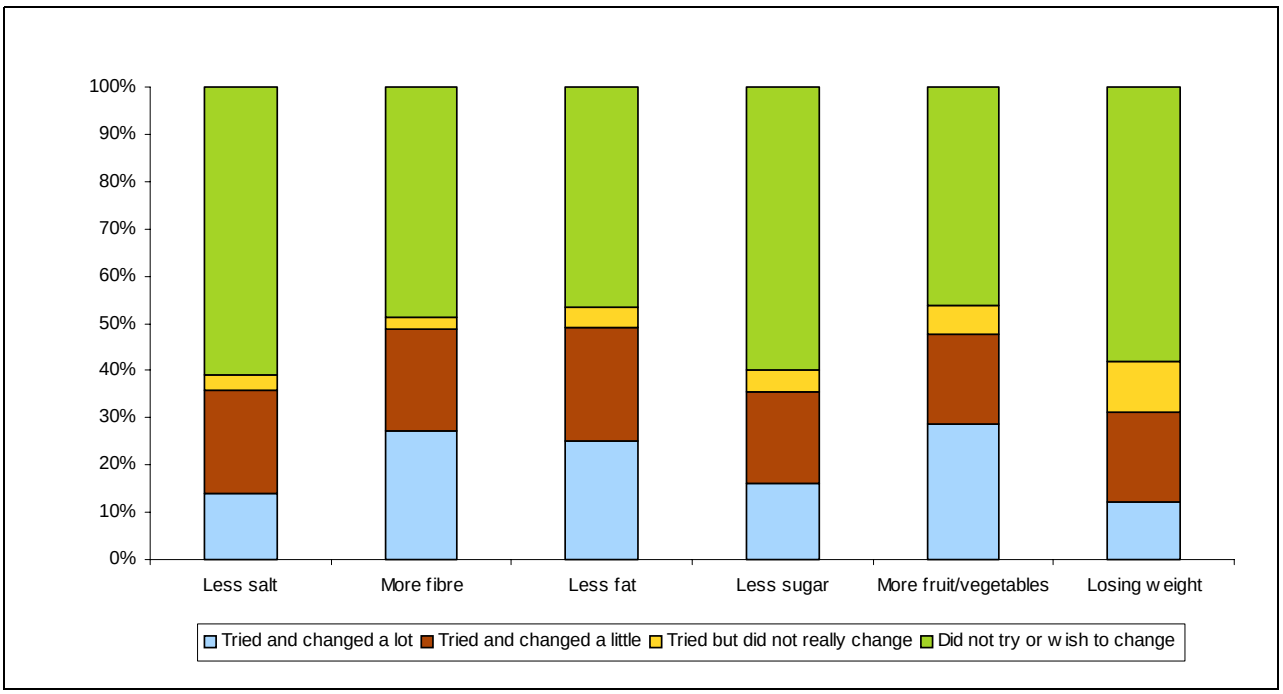

Figure 10.1. Dietary change pattern in Clarecastle during previous year.

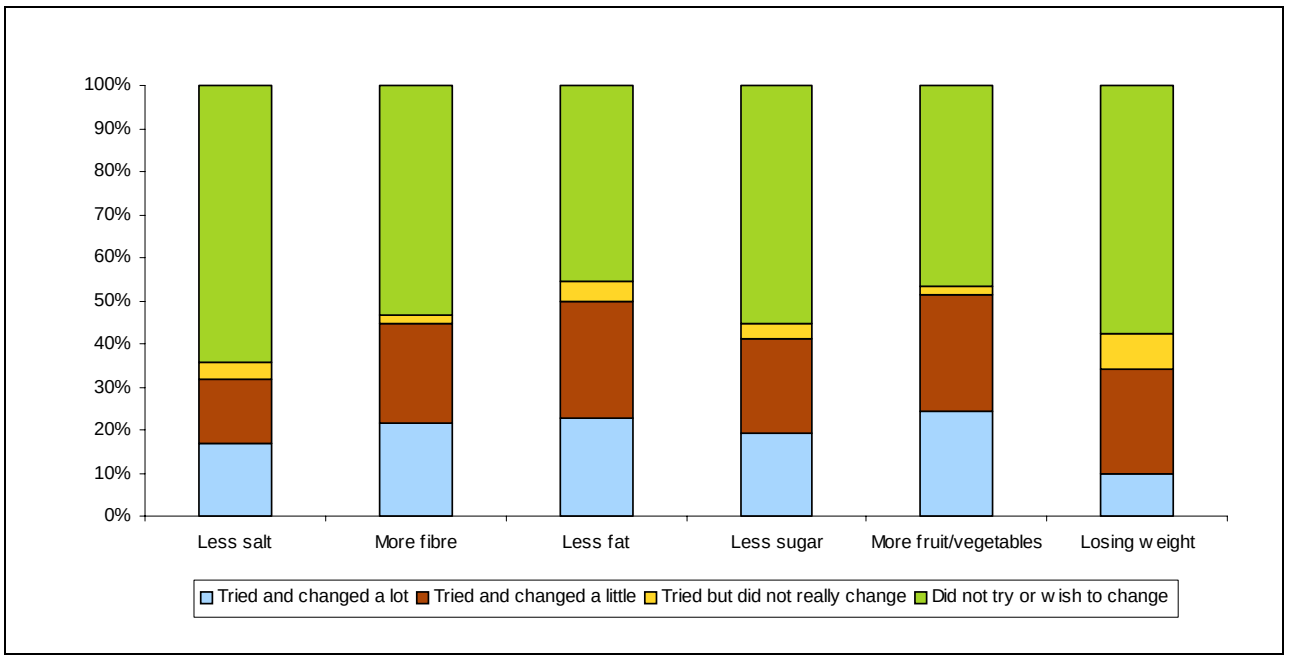

Figure 10.2. Dietary change pattern in Ennistymon during previous year.

farmers), employment status and medical insurance status) were examined. A number of socio–economic differences between residents of the two areas were noted. There were significantly more residents of Ennistymon who were single or widowed and more in Clarecastle who were married. Significantly more Ennistymon residents were educated to primary or secondary level only, with more Clarecastle residents completing third-level education. There were also significantly more in Ennistymon who were semi-skilled or unemployed and more in Clarecastle who were skilled, managerial or professional. Finally, there

were significantly more medical-card holders in Ennistymon and significantly more people with private health insurance in Clarecastle.

The principal results are shown in Tables 10.2 and 10.3 – although the level of General Medical Services (GMS) card eligibility had remained stable, private health insurance coverage had increased substantially in both areas while unemployment levels had reduced. Homeownership had remained at very high levels in Clarecastle, while a decrease was evident in Ennistymon with a shift towards the private rental (9.6%) and local authority (19.4%) sectors; more than twice as many Ennistymon participants (47 compared with 20 in Clarecastle) had farm holdings with a higher than average acreage.

One important consideration is the average length of time that people had lived in their current homes. The median length of stay was 13 years, and this varied from 11 years in Clarecastle to 14 years in Ennistymon. These differences are statistically significant, but overall the figures suggest that the populations living in these areas are quite stable.

A strong trend towards third-level educational qualifications was evident in both areas, with proportions doubling over the period between 1996 and 2007–2008 – this was most evident in Clarecastle where over 50% had availed of higher education.

Height and weight were also recorded where available. Although self-reported height and weight are not considered to be very reliable, it is interesting that the distribution of body mass indices (weight divided by height squared) is broadly similar between the two areas and in both studies and has changed very little over time (Table 10.4).

Table 10.2. Socio–economic indicators.

Area	Private health insurance (%)	GMS card (%)	Unemployed (%)	Homeowners (%)	Average land held in acres
Clarecastle 2007–2008	81.3	17	3	91.2	74.05
Clarecastle 1996	63	18	8	91	60
Ennistymon 2007–2008	56.6	37	7	71	111.66
Ennistymon 1996	38	35	10	94	60

GMS, General Medical Services.

Table 10.3. Educational profile.

Area	Educational level				
	None	Primary	Intermediate	Leaving	Higher
Clarecastle 2007–2008	6 (2.3%)	8 (3%)	45 (17.2%)	69 (26.3%)	134 (51.2%)
Clarecastle 1996	2 (0.7%)	72 (24.6%)	83 (28.3%)	81 (27.6%)	55 (18.8%)
Ennistymon 2007–2008	2 (0.8%)	24 (9.2%)	64 (24.4%)	67 (25.6%)	105 (40%)
Ennistymon 1996	1 (0.3)	61 (20.1%)	71 (23.4%)	108 (35.5%)	63 (20.7%)

Table 10.4. Body mass profile.

Area	Weight category				
	Underweight	Acceptable	Overweight	Obese	Total
Clarecastle 2007–2008	62 (16.8%)	156 (42.3%)	102 (27.6%)	49 (13.3%)	369
Clarecastle 1996	82 (19%)	169 (39%)	118 (27.4%)	63 (14.6%)	432
Ennistymon 2007–2008	55 (16.3%)	138 (40.8%)	101 (29.9%)	44 (13%)	338
Ennistymon 1996	51 (14.6%)	151 (43.3%)	101 (29%)	46 (13.1%)	349

10.3 Concern about the Environment

The final section of the questionnaire addressed concerns about the environment – this section was only completed by those over 15 years of age.

Chapter 5 provides an environmental context for both areas and describes the major factors that might have influenced the environmental concerns expressed; the existence of a large pharmaceutical plant with an associated incinerator, a busy major road (N18) and ongoing water-quality issues were identified in the Clarecastle area, while radon and landfill issues were highlighted as possible concerns in Ennistymon. The very rapid population growth (approximately 3% per year in Clarecastle) and the associated housing boom over the period was also a contributor to environmental change.

The environmental section of the study aimed to measure levels of concern about environmental hazards in the area, what the participants thought these hazards might cause, and specific problems that the participants had identified as being present in the area. The original study showed a significantly higher level of overall concern in Clarecastle than in Ennistymon (22.8% compared with 15.2%, $p \leq 0.001$, Fisher's exact test) as shown in Table 10.5. In the follow-up study, the proportion of residents who were very concerned decreased significantly in Clarecastle to 14.1% ($p = 0.036$, chi-squared test).

When asked about involvement in environmental activities, it was interesting that this had decreased significantly in both Clarecastle and Ennistymon over the period. Clarecastle had reduced from 24.7% to 11.8% ($p < 0.001$, Fisher's exact test) while Ennistymon activity levels reduced from 20.8% to 12.2% ($p = 0.009$, Fisher's exact test).

Respondents were then asked why they felt that hazards in their environment were of concern and what specific factors were causing them concern. Tables 10.6 and 10.7 show the possible causes of concern about which they were questioned and the proportion of respondents who mentioned each one as a cause for concern.

Although the percentage of participants in Ennistymon who perceived that the hazard might affect their personal health or that of a friend/family member increased significantly between 1996 and 2007–2008, the overall percentages for both remained higher in Clarecastle. Likewise, risk of future health problems increased in Ennistymon but still remained higher in Clarecastle, while the percentage perceiving a risk to the environment was higher in Clarecastle in the original study and further increased in the follow-up study.

Overall, between 1996 and 2007–2008, the gap in proportion of residents concerned generally decreased between the two areas but still remained significantly higher in Clarecastle.

With respect to specific causes of concern, more people in Ennistymon were concerned about a dump in their area – this was possibly because of the new landfill in a rural location on the periphery of the Ennistymon study area, which commenced waste acceptance in 2002, and the presence of a former landfill in Ennistymon from 1969 to 1997, which was deemed to be of low risk in an Environmental Risk Assessment undertaken by Clare County Council. However, this difference was not significant.

A significantly higher number of people in Clarecastle named bad water as a specific concern; this result is not surprising as Clarecastle is included in the Ennis

Table 10.5. Environmental concern profile.

Area/Date	No concern	A little worried or concerned	Somewhat concerned	Very concerned
Clarecastle 1996	20.3%	27.9	29%	22.8%
Clarecastle 2007–2008	26.6%	26.6	32.7%	14.1%
Ennistymon 1996	36.2%	29.6	19.1%	15.2%
Ennistymon 2007–2008	36.9%	24.3	24.3%	14.4%

Table 10.6. Causes of environmental concern to individuals.

Reason for concern	Clarecastle (%)		Significant change from 1996 to 2007	Ennistymon (%)		Significant change from 1996 to 2007	Significant difference between areas 1996	Significant difference between areas 2007
	1996	2007		1996	2007			
Personal illness	8.7	9.5	No (p = 0.766)	3.1	8.4	Yes (p = 0.013)	Yes (p = 0.01)	No (p = 0.76)
Family/Friend illness	9.1	13.7	No (p = 0.103)	3.1	7.2	Yes (p = 0.047)	Yes (p = 0.006)	Yes (p = 0.022)
Animal illness	14.1	8.4	No (p = 0.041)	3.9	4.2	No (p = 1.000)	Yes (p < 0.000)	No (p = 0.071)
Future health problems	47.5	47.9	No (p = 0.931)	25.3	38.4	Yes (p = 0.001)	Yes (p < 0.000)	Yes (p = 0.035)
Risk to environment	38.4	51.7	Yes (p = 0.002)	30	24.7	No (p = 0.201)	Yes (p = 0.045)	Yes (p < 0.000)

Table 10.7. Causes of specific environmental concern in 2006–2007.

Reason for concern	Clarecastle 2007	Ennistymon 2007	Significant difference
Dump	2%	6%	No (p = 0.072)
Bad water	61%	46%	Yes (p = 0.001)
Cars	16%	9%	Yes (p = 0.018)
Bad air	23%	10%	Yes (p < 0.000)
Local industry	17%	3%	Yes (p < 0.000)
Incinerator	27%	0%	Yes (p < 0.000)
Pylon	0%	0%	No (p = 0.35)
Radio transmitter	0%	0%	No (p = 0.106)

town water supply which has been subject to several boil water notices in recent years. Since a cryptosporidium outbreak linked to the use of unboiled tap water in May 2005, a limited boil water notice had also been in place for vulnerable groups, including children under 5 years, the immunosuppressed and visitors to the town. This notice was lifted in December 2009 following the successful commissioning of a new water treatment plant for Ennis and environs.

Cars were of concern to significantly more participants in Clarecastle than in Ennistymon; again, this result is not surprising as up to December 2006 the main road connecting Cork/Limerick with Galway (N18) passed through Clarecastle, while Ennistymon is not situated on a major national route.

Local industry, bad air and incinerators were also a concern to significantly more Clarecastle participants than in Ennistymon. Again, this is unsurprising as the Roche pharmaceutical plant, which includes a waste incinerator, is in Clarecastle, while Ennistymon has no heavy industrial sites and no licensed incinerators.

Unfortunately, the way the data were collated in the initial study means that comparisons between 1996 and 2007–2008 with respect to specific concerns are not possible. Therefore, it can only be surmised that differences between Clarecastle and Ennistymon exist, but it cannot be calculated whether reasons for specific concern or the level of concern about specific features have changed in the intervening years.

Finally, there was no mention of either pylons or radio transmitters being of concern in either area. This is perhaps surprising considering that there is public concern about mobile phone masts in other areas.

11 Discussion

11.1 Overall Results of Study

Overall, the results of this study show very few differences in health status either between the two areas studied or between the original (EPA, 1998) and current study. Comparison of SF-36 data shows decreased vitality to be the only significant negative health difference between the 1996 and the 2007–2008 data. It should also be noted that this decrease was evident in both study areas. No significant decrease in health status between 1996 (EPA, 1998) and the current study, which was exclusive to the Clarecastle area, could be identified.

The only two areas where data showed Clarecastle to have reduced health status compared with Ennistymon were with respect to respiratory symptoms and environmental concern. The differences in respiratory symptoms recorded did not reach significance and the differences in the median respiratory score between the two areas equate to an average symptom score difference of just one per person. This small difference is reflected in the component physical score which shows no difference between Ennistymon and Clarecastle. Other recent Irish studies using the ISAAC methodology reflect a broadly similar prevalence of symptoms. These data are of value in placing respiratory symptom levels for a locality in an Irish context in the absence of routinely available data at a local level, such as hospital admission rates or prescribed medication rates for asthma. Within Ireland, the lowest level at which such information is geo-coded currently is the administrative county, pending the proposed introduction of postcodes.

With respect to differences in environmental concern between the two areas, it is difficult to interpret these results with certainty. Although awareness of environmental issues remained higher in Clarecastle, overall environmental concern levels reduced significantly in the Clarecastle area between 1996 and 2007; this occurred despite a heightened awareness of possible health effects from incinerators, suggesting that concern levels were higher in the lead-up to the licensing of the incinerator and have reduced over time. This is supported by reduced levels of involvement in environmental activities over the same period. Other possible explanations for these differences may be underlying differences in the population make-up in the two areas. For example, among the sample of participants that was surveyed, those in Clarecastle were educated to a higher level and were employed in more skilled jobs. This could mean that these participants had greater awareness of environmental issues. The differences may also be a reflection of publicised concerns about the level of industry generally in the area or specifically relating to the incinerator which, whether legitimate or not, may have influenced the general public's level of concern. The paucity of data on air quality described in Chapter 5 would benefit from being addressed in this context. It is also worth noting that the Clarecastle area has experienced water quality issues manifested by boil water advisory notices over recent years, which may have increased concern about environmental issues – in addition, the opening of the Ennis Bypass in December 2007 towards the end of the study has now substantially reduced traffic flow through Clarecastle which was also recorded as an area of environmental concern. Against these factors must be placed the much greater increase in population in Clarecastle (67%) than in other urban areas of Ennis (47% in Ennis Urban District) and the national growth of 20% – this supports the conclusion that Clarecastle was generally perceived as a desirable location in which to live and raise a family since 1991.

Conversely, Ennistymon had a reduced health status score compared with Clarecastle in a number of areas, including a significantly reduced SF-36 mental health score and a significantly reduced socio–economic scoring. As the purpose of this study was to examine health status and environmental factors, further interpretation of these results is beyond its scope.

11.2 Study Limitations

The current study was undertaken as a follow-up to a baseline study in 1996 (EPA, 1998) – the constraints involved gave rise to the following limitations:

(a) The demographic patterns of the two areas had altered during the intervening period; the strong pattern of immigration into Clarecastle because of economic opportunities gave rise to differences in education and lifestyle between the two areas which means that the socio–economic circumstances of the two groups are not particularly comparable.

It is possible that people moving into Clarecastle would be generally fitter than non-migrants as they will have been drawn into the area to work. The incinerator would have had to have a very big impact on health for the effects to have been detectable in this study.

(b) There have been too few births to reliably detect the presence or absence of any excess of defects and there are too few data about air quality in Clarecastle and how air quality may have changed to be able to determine the relative importance of different pollution sources in determining exposure and potential effects.

(c) It was not possible to compare some data items directly with the original 1996 study because of the different methodology used in data analysis; however, it was possible with a few exceptions to compare directly the self-reported health status of both populations.

(d) The absence of sufficient data on air quality meant that it was not possible to adjust for other sources of respiratory exposure, including major traffic routes.

(e) Limited environmental data restrict the comparison and interpretation of variance between the two areas in terms of environmental quality that would be likely to cause an impact on public health during the period; however, the major potential differences that emerged were as follows:

- Clarecastle (as part of the Ennis Public Water Supply) was less compliant than Ennistymon with drinking water legislation and was subject to three full boil water notices during 2005.
- An excess of risk from radon was not demonstrable from the National Survey of Radon in Irish Dwellings 1992–1999 (Synnott et al., 2004); however, radon remediation was required in schools in the Ennistymon area as a result of a Department of Education-commissioned survey between 1998 and 2004 (RPII, 2004).
- A major traffic route passed through Clarecastle until December 2007 but total traffic counts were not available.
- In terms of current commercial activities with pollution potential requiring licensing by the EPA, there is one IPPC-licensed activity in Clarecastle for a bulk pharmaceutical manufacturing plant with a liquid/vapour incinerator on-site handling the gaseous emissions and most of the waste solvents generated from the process.
- A former landfill site which operated before the commencement of waste permitting regulations in Ennistymon closed in 1997.
- A new non-hazardous, engineered landfill licensed to accept 56,500 t/annum of household, commercial and industrial non-hazardous waste which opened in 2002 on the borders of the Ennistymon study area under IPPC licence has been associated with local complaints primarily relating to odour nuisance.

Although assessment of public health impact potential was limited, where comparison data were not available a number of positive trends were noted in measures that compared monitoring results from the Ennis/Clarecastle area over the time period or with external reference points as follows:

- Ennis was covered in the national EPA mobile air quality measuring unit survey 2006–2007 and was assessed as GOOD.
- Environmental dioxin biomonitoring results

from 1995–2006 covering Clarecastle and Cooraclare were consistent with uniformly low levels in the Irish environment and showed little variation over the time period.

- A substantial reduction in solvent emissions to atmosphere from Roche took place over the time period.

(f) The interval between the two studies was too short to allow for effects on cancer incidence rates to become apparent.

12 Conclusions

1. Most of the differences over the decade since the original survey and between the two regions reflect changing economic circumstances and lifestyle factors. It is only really possible to state that the influence of the incinerator, if any, on health has been smaller than that of other factors. The failure to demonstrate a clear presence or absence of an effect of the incinerator on health is unsurprising given that its influence on environmental quality is small and that the study population was relatively small. In addition the trend in emissions to atmosphere, particularly of solvents, was downwards between the two study periods.

2. Significant improvements were evident in general health over the 11- to 12-year interval in each area as measured by two of the eight domains of the SF-36 score (reduction of bodily pain and improvement in general health); decreased vitality was the only significant negative health difference over a time of unprecedented economic growth in Ireland.

3. It is notable that despite the presence of an incinerator, which was well flagged through a public licensing hearing held within the Clarecastle area, the locality experienced unprecedented growth as a predominantly residential area for young families in private housing during the subsequent decade.

4. Overall environmental concern levels reduced significantly in the Clarecastle area between 1996 and 2007 despite a heightened awareness of possible health effects from incinerators, which suggests that concern levels are higher before the introduction of a new technology and may reduce over time.

5. The proposed introduction of postcodes by COMREG should be expedited to allow for ongoing monitoring of respiratory morbidity.

6. Ongoing monitoring of cancer incidence rates should continue through the National Cancer Registry of Ireland although no excess is evident in either area to date.

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Acronyms

AER	Annual Environmental Report
DED	District Electoral Division
EC	European Community
ED	Electoral Division
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
GMS	General Medical Services
HSE	Health Service Executive
IPPC	Integrated Pollution Prevention and Control
I-TEQ	International toxic equivalent
ISAAC	International Study of Asthma and Allergies in Childhood
MCS	Mental Health Component Summary
MeSH	Medical Subject Heading
PCDD	Polychlorinated dibenzo-para-dioxin
PCDF	Polychlorinated dibenzofuran
PCS	Physical Health Component Summary
PM	Particulate matter
PM_{10}	Particulate matter sized less than 10 µm
PWS	Public water scheme
RDA	Residential development area
RPII	Radiological Protection Institute of Ireland
SIR	Standardised incidence ratio
SLI	Serviced Lands Initiative
TEQ	Toxic equivalent
THM	Trihalomethane
TPFR	Total period fertility rate
VOC	Volatile organic compound

Appendix 1 Drinking Water Data Supplied by Clare County Council

Ennistymon Public Water Scheme

Ennistymon Regional Water Supply produces approx. 4,400 m^3 daily. The water is abstracted from Lickeen Lake and treated by Clare County Council at the Ballymacraven Water Treatment Plant. During March 2002, the use of aluminium sulfate as a coagulant at the water treatment plant ceased.

Ferric sulfate is now in use as a chemical coagulant to remove non-settleable solids during flocculation of the raw water. The following locations are sampled:

- Church St., Ennistymon
- Lahinch
- Liscannor
- Kilfenora
- Lisdoonvarna
- Doolin.

Ennistymon Public Water Scheme – Summary 2002 and 2003.

Year	No. of samples	Exceedances				
		Taste/Odour	Aluminium	Iron	Manganese	Fluoride
2002	27	12[1]	4	3	4	3
2003	27	10[1]	–	3	–	–

[1]This organoleptic taste/odour problem arises from the release of certain complex chemical compounds that are by-products of the life cycle of algae. Decaying algal masses produce offensive tastes, particularly after chlorination during treatment. The early detection of the presence of algae in the raw water, combined with the addition of a low dose of activated carbon during treatment, would help to alleviate this problem.

Ennistymon Public Water Scheme – Summary 2004–2006.

Year	Audit/Check	No. of samples	Exceedances				
			Dieldrin	Turbidity	Iron	Coliform bacteria	THMs[1]
2004	Audit	3	1	–	–	–	–
	Check	19	–	1	1	1	–
2005	Audit	3	–	–	–	–	–
	Check	20	–	–	1	–	–
2006	Audit	3	–	–	–	–	2
	Check	20	–	–	–	–	–

[1]THM, trihalomethane.

Ennis Public Water Scheme: The percentage of the exceedances from the EC (Quality of Water Intended for Human Consumption) Regulations, 1988.

Year	Parameter	No. of samples analysed	No. of exceedances	% exceedance from the overall number of samples analysed
2002	Total coliforms	46	1	2.2
	Faecal coliforms	46	0	0
	Colour	46	10	21.7
	Turbidity	46	4	8.7
	Odour	46	5	10.9
	Taste	46	3	6.5
	Iron	41	5	12.2
	Fluoride	44	7 > 1,000 µg/l (1 < 800 µg/l F)	15.9 > MAC[1] (2.3 < MRC[2])
	Manganese	11	0	0
	Lead	11	0	0
	Aluminium	10	0	0
2001	Total coliforms	64	0	0
	Faecal coliforms	64	0	0
	Colour	64	8	12.5
	Turbidity	64	4	6.3
	Odour	64	0	0
	Taste	64	0	0
	Iron	64	10	15.6
	Fluoride	63	12 > 1,000 µg/l (8 < 800 µg/l F)	19 > MAC[1] (12.7 < MRC[2])
	Manganese	10	0	0
	Lead	10	0	0
	Aluminium	10	0	0

[1]MAC, maximum admissible concentration.
[2]MRC, minimum required concentration.

Ennis Public Water Scheme 2003 – Summary of percentage compliance for check and audit samples.

Parameter	No. of samples in exceedance	Total number of samples	% Compliance
Colour	1	85	98.8
Turbidity	3	85	96.4
Iron	8	85	90.5
Fluoride	31 > 1,000 µg/l (14 < 800 µg/l F)	85	83.5 > MAC[1] (93.5 < MRC[2])
Total coliforms	0	85	100
Faecal coliforms	0	85	100

[1]MAC, maximum admissible concentration.
[2]MRC, minimum required concentration.

Ennis Public Water Scheme 2004 – Summary of percentage compliance for check and audit samples.

Parameter	No. of samples in exceedance	Total number of samples	% Compliance
Fluoride	0	5	100
Coliform bacteria	3	57	95
Escherichia coli	0	57	100
Clostridium perfringens	5	57	91
Trihalomethane	1	5	80
Iron	1	5	80

Ennis Public Water Scheme 2005 – Summary of percentage compliance for check and audit samples.

Parameter	No. of samples in exceedance	Total number of samples	% Compliance
Fluoride[1]	0	5	100
Coliform bacteria	23	51	97
Escherichia coli	1	51	95
Clostridium perfringens	0	51	100
Trihalomethane[2]	10	15	33
Iron	0	5	100

[1]Fluoride analysis is only required as part of audit monitoring which is carried out five times a year.
[2]This poor compliance level is due to the high chlorine dose rate instituted during the September and October boil notices.
During 2005 there were three boil water notices issued on the Ennis PWS: one was issued due to an outbreak of cryptosporidiosis and the other two were issued due to *E. coli* contamination of the supply.

Ennis Public Water Scheme 2006 – Summary of percentage compliance for check and audit samples.

Parameter	No. of samples in exceedance	Total number of samples	% Compliance
Fluoride[1]	0	5	100
Coliform bacteria	1	51	98
Escherichia coli	0	51	100
Clostridium perfringens	0	51	100
Trihalomethane	6	51	87
Iron	1	5	80

[1]Fluoride analysis is only required as part of audit monitoring which is carried out five times a year.
During 2006 there were two boil water notices issued on the Ennis PWS: one was due to the presence of >1 crypto oocyst/10 l (UK limit). The other was due to *E. coli* contamination of the supply.
A temporary filtration unit was commissioned at Drumcliff Water Treatment Plant on the 14th of June, 2006 in order to screen out all or most of the bacteria (including crypto) present in the raw water.

Appendix 2 Radon in Schools Data from the RPII

Table A2.1. Radon in schools data.

Roll No.	Name	Address 1	Address 2	County	Issue date	Return date	Survey type	Location	Radon concentration (Bq/m^3)
18696Q	**Doora NS**	Doora	Ennis	Clare	14 Sep 2000	20 Jun 2001	Initial survey	Junior Room	99
					14 Sep 2000	20 Jun 2001	Initial survey	Senior Room	82
					14 Sep 2000	20 Jun 2001	Initial survey	Cloakroom	72
					14 Sep 2000	20 Jun 2001	Initial survey	Staffroom	64
					14 Sep 2000	20 Jun 2001	Initial survey	Hallway	54
10191P	**Coore NS**	Mullach	Ennis	Clare	14 Sep 2000	20 Jun 2001	Initial survey	Location unknown	112
					14 Sep 2000	20 Jun 2001	Initial survey	Location unknown	75
					14 Sep 2000	20 Jun 2001	Initial survey	Location unknown	60
					14 Sep 2000	20 Jun 2001	Initial survey	Location unknown	57
					14 Sep 2000	20 Jun 2001	Initial survey	Location unknown	56
20149W	**St Fachnan & St Attracta's NS**	Kilfenora		Clare	07 Oct 2004	21 Apr 2005	Initial survey	Mrs Clancey's Room	281
					07 Oct 2004	21 Apr 2005	Initial survey	Mrs Morgan's Room	403
					07 Oct 2004	21 Apr 2005	Initial survey	Resource Room	541
					07 Oct 2004	21 Apr 2005	Initial survey	Mrs Collins's Room	450
					07 Oct 2004	21 Apr 2005	Initial survey	Staffroom	413
					30 Nov 2005	12 May 2006	Initial survey	Computer Room	559
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Mrs Clancy's Room	81
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Mrs Collins's Room	30
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Mrs McNamara's Room (Resource)	43
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Mrs Morgan's Room	38
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Staffroom	47
					13 Sep 2006	26 Mar 2007	Post-remediation survey	Computer Room	76

Table A2.1 *contd.*

Roll No.	Name	Address 1	Address 2	County	Issue date	Return date	Survey type	Location	Radon concentration (Bq/m^3)
18768P	**St Michael's Furglan NS**	Furglan	Lahinch	Clare	14 Sep 2000	30 Oct 2001	Initial survey	Strong Room	33
					14 Sep 2000	30 Oct 2001	Initial survey	Clare Yellow/Blue Room	16
					14 Sep 2000	30 Oct 2001	Initial survey	Red Middle Room	16
					14 Sep 2000	30 Oct 2001	Initial survey	Yellow Room	14
18410S	**Liscannor NS**	Liscannor		Clare	14 Sep 2000	25 May 2001	Initial survey	Mrs Blake's Room	42
					14 Sep 2000	25 May 2001	Initial survey	Staffroom	42
					14 Sep 2000	25 May 2001	Initial survey	Mrs Reynolds's Room	32
					14 Sep 2000	25 May 2001	Initial survey	Mr Reynolds's Room	20
18753C	**Scoil Mhuire**	Lahinch		Clare	14 Sep 2000	24 May 2001	Initial survey	Classroom 4	43
					14 Sep 2000	24 May 2001	Initial survey	Resource room	24
					14 Sep 2000	24 May 2001	Initial survey	Classroom 1	22
					14 Sep 2000	24 May 2001	Initial survey	Classroom 2	17
					14 Sep 2000	24 May 2001	Initial survey	Classroom 3	14
16359L	**Scoil an Chlochair**	Ennistymon		Clare	14 Sep 2000	15 Jun 2001	Initial survey	Mary Hall	49
					14 Sep 2000	15 Jun 2001	Initial survey	Catriona's Room 4	46
					14 Sep 2000	15 Jun 2001	Initial survey	Sr. Madeline's Room	37
					14 Sep 2000	15 Jun 2001	Initial survey	Helen Fitzgerald's Room	35
					14 Sep 2000	15 Jun 2001	Initial survey	Frances's Room	34
					14 Sep 2000	15 Jun 2001	Initial survey	Ann O'Looney's Room	32
					14 Sep 2000	15 Jun 2001	Initial survey	Aiden Malone's Room	28

Table A2.1 *contd.*

Roll No.	Name	Address 1	Address 2	County	Issue date	Return date	Survey type	Location	Radon concentration (Bq/m^3)
16870T	**Ennistymon CBS (Primary)**	Ballingaddy	Ennistymon	Clare	08 Jan 2004	11 Jun 2004	Initial survey	Miss McMahon's Room	83
					08 Jan 2004	11 Jun 2004	Initial survey	Miss Flaherty's Room	51
					08 Jan 2004	11 Jun 2004	Initial survey	Miss Sheridan's Room	45
					08 Jan 2004	11 Jun 2004	Initial survey	Mr Crowe's Room	31
					08 Jan 2004	11 Jun 2004	Initial survey	Staffroom	24
61940T	**Meánscoil na mBraithre**	Ennistymon		Clare	14 Sep 2000	08 May 2001	Initial survey	Science Prep. Room	123
					14 Sep 2000	08 May 2001	Initial survey	Science Room	98
					14 Sep 2000	08 May 2001	Initial survey	Staffroom	87
					14 Sep 2000	08 May 2001	Initial survey	1a Classroom	66
					14 Sep 2000	08 May 2001	Initial survey	2nd Year Classroom	46
					14 Sep 2000	08 May 2001	Initial survey	Office	36
					14 Sep 2000	08 May 2001	Initial survey	Transition Year Room	32
					14 Sep 2000	08 May 2001	Initial survey	1b Classroom	29
					14 Sep 2000	08 May 2001	Initial survey	3 B Inner	23
					14 Sep 2000	08 May 2001	Initial survey	3a Outer	22
					14 Sep 2000	08 May 2001	Initial survey	6th Year Classroom	20
					14 Sep 2000	08 May 2001	Initial survey	5th Year Classroom	16
61950W	**Scoil Mhuire**	Ennistymon		Clare	14 Sep 2000	21 May 2001	Initial survey	Room 15	214
					14 Sep 2000	21 May 2001	Initial survey	Prayer Room	193
					14 Sep 2000	21 May 2001	Initial survey	Room 16	155
					14 Sep 2000	21 May 2001	Initial survey	Room 3	111
					14 Sep 2000	21 May 2001	Initial survey	Computer Room 10	110

Table A2.1 *contd.*

Roll No.	Name	Address 1	Address 2	County	Issue date	Return date	Survey type	Location	Radon concentration (Bq/m^3)
61950W	**Scoil Mhuire**	Ennistymon		Clare	14 Sep 2000	21 May 2001	Initial survey	Room 8	95
					14 Sep 2000	21 May 2001	Initial survey	Room 5#	69
					14 Sep 2000	21 May 2001	Initial survey	Lab Room 7	69
					14 Sep 2000	21 May 2001	Initial survey	Room 2	66
					14 Sep 2000	21 May 2001	Initial survey	Room 9	63
					14 Sep 2000	21 May 2001	Initial survey	Home Economics Room 4	62
					14 Sep 2000	21 May 2001	Initial survey	Room 6	62
					14 Sep 2000	21 May 2001	Initial survey	Room 14	56
					14 Sep 2000	21 May 2001	Initial survey	Room 1	51
					14 Sep 2000	21 May 2001	Initial survey	Principal's Office	47
					14 Sep 2000	21 May 2001	Initial survey	Deputy Principal's Office	40
					14 Sep 2000	21 May 2001	Initial survey	Careers Room	37
					14 Sep 2000	21 May 2001	Initial survey	Staffroom	22
					30 Jan 2002	29 May 2002	Post-remediation survey	Room 15	51

Appendix 3 Extract from Roche Annual Environmental Report 2006

Table 7: Compliance level – Incinerator scrubber water, 2006: 100% compliant however sam were missed on 4 occasions (see below)

Date	Non-compliance	Cause	Corrective Action
June July, August & September	Monthly heavy metals data not available	Monthly samples not taken	System put in place

3.2. *Emissions to atmosphere through the Incinerator Stack and Boilers.*

Emission point: 16

Data for 2000 - 2005 are included for comparison purposes. The full monthly data set for emissions to atmosphere from the liquid vapour incinerator is included as Annex 2.

Compliance level: 100%

Table 8: Summary of the measured emissions to atmosphere from the liquid vapour incinerator for 2006.

Parameter	Licensed Mass Emissions (kg)	Total Mass emissions (kg) 2001	Total Mass emissions (kg) 2002	Total Mass emissions (kg) 2003	Total Mass emissions (kg) 2004	Total Mass emissions (kg) 2005	Total Mass emissions (kg) 2006
Average hourly stack flow m^3/hour	30,000 m^3	10,085	11,213	7,806	8,491	9,007	9,875
Sulphur dioxide	13,140	33.7	834	1,479	633	616	157
Nitrogen Oxides	26,280	9,153	5,846	6,623	7,716	7,891	10,025
Particulates	2,628	86	77	105	84	49	130
Carbon dioxide	-	19,279,000	14,251,000	12,897,000	33,026,000	12,946,676	24,269,275*
VOC halogenated	-	-	-	-	-	-	-
VOC Non-halogenated	2,628	55.7	39	44	78	67	47.99
Hydrogen Chloride	2,628	90	54	56	61	59	66
Carbon monoxide	13,140	58.24	30	22	39	70	97
Annual Dioxins/Furans (Averaged) mg	26.3 mg	4.4	4.9	4.1	0.58 (Max measured 0.79 mg)	3.3 mg (max)	2.9 mg

Note * this CO_2 figure is calculated from the CO_2 emissions attributable to waste gas and waste liquid sent to the incinerator, plus the CO_2 attributable to natural gas, less the natural gas used in the boiler.

Appendix 4 Extract from Roche Annual Environmental Report 2002

During 2002 we had 15 reportable licence exceedances to the estuary, three in effluent ammonia, one in high suspended solids and 11 on bromides. The bromides issue has now been resolved: we are now recovering some bromine from this waste stream

Table 2: Compliance level 2002: 99.40%.

Date	Non-compliance	Cause	Corrective Action
Jan 1st, 2nd and 3rd.	Ammonia	Lack of appropriate nutrients.	Ensure that nutrient supply is adequate to maintain nitrifiers at the appropriate level.
Feb 02	Bromides	Production increase	Some bromides are being recycled
May 3rd, June 7th, 8th ,10th, 18th, 19th,	Bromides	Production increase and lack of smoothing in bromide discharges	Some bromides are being recycled
December 02	Suspended solids	Accumulation of solids in the EPO tanks.	Regimen for cleaning these tanks is in place.

3.1.2 Emissions to Atmosphere through the Incinerator Stack

Table 3: Summarises the measured emissions to atmosphere for 2002. Data for 1999- 2001 are included for comparison purposes.

Compliance level: 100%

Parameter	Total Mass emissions (kg) 1999	Total Mass emissions (kg) 2000	Total Mass emissions (kg) 2001	Total Mass emissions (kg) 2002	Licensed Mass Emissions (kg)
Average hourly stack flow	16 035 m^3	11 714 m^3	10 085 m^3	11213 m^3	30 000 m^3
Sulphur dioxide	89	38.81	33.7	834	13 140
Nitrogen Oxides	8888	5852	9153	5846	26 280
Particulates	0	141	86	77	2 628
Carbon dioxide	1 3773 000	1 564 7000	19 279 000	14 2510 00	-
VOC halogenated	-	-	-	-	-
VOC Non-halogenated	40.2	40.6	55.7	39	2 628
Hydrogen Chloride	317	380	90	54	2 628
Carbon monoxide	161	173.3	58.24	30	13 140
Dioxins/Furans (Averaged)	1.4 mg	3.5 mg	4.4 mg	4.9	26.3 mg

3.1.3 Waste Management Report - Summary

Two waste disposal routes are used by Roche Ireland: off-site and on-site for both hazardous and non-hazardous wastes. A significant quantity of our waste is recycled or reused. No hazardous waste solids are disposed of on site.

Appendix 5 Respiratory Symptom Results

Table A5.1. Respiratory symptom results.

	Clarecastle		Ennistymon		Both areas	
	No.	%	No.	%	No.	%
1996 sample	470		398		869	
Ever wheezed	182	38.7	127	31.9	309	35.6
Wheezing in last 12 months	136	28.9	82	20.6	218	25.1
a) breathless when wheezing	53		32		85	
b) wheezing when did not have a cold	70		34		104	
c) wheezing during or after exercise	68		30		98	
d) dry cough at night	60		28		88	
Woken up with feeling of tightness in chest in last 12 months	45		18		63	
Woken up with attack of shortness of breath in last 12 months	30		22		52	
Woken up coughing in last 12 months	113		76		189	
Ever had asthma	60		47		107	
Ever prescribed inhalers for asthma/wheeze	52		41		93	
Ever prescribed other meds for asthma/wheeze	37		33		70	
Suffer from hay fever	84		44		128	
2007–2008 sample	387		387		774	
Ever wheezed	159	41.1	150	38.8	309	39.9
Wheezing in last 12 months	124	32.0	101	26.1	225	29.1
a) breathless when wheezing	69		59		128	
b) wheezing when did not have a cold	69		43		112	
c) wheezing during or after exercise	55		38		93	
d) dry cough at night	56		43		99	
Woken up with feeling of tightness in chest in last 12 months	38		24		62	
Woken up with attack of shortness of breath in last 12 months	28		14		42	
Woken up coughing in last 12 months	85		76		161	
Ever had asthma	74		58		132	
Ever prescribed inhalers for asthma/wheeze	74		58		132	
Ever prescribed other meds for asthma/wheeze	24		21		45	
Suffer from hay fever	72		46		118	

Appendix 6 Skin Symptom Results

Table A6.1. Skin symptom results.

Have you had any skin symptoms or signs in the last 12 months? If Yes, Where?	YES		NO	
	Clarecastle	Ennistymon	Clarecastle	Ennistymon
Any skin symptoms	83	72	304	315
Hand	19	22	368	365
Face	31	18	356	369
Lips	2	3	385	384
Arms	21	16	366	371
Legs	19	26	368	361
Body	17	16	370	371
Elsewhere	8	15	379	372

Appendix 7 General Health Symptom Results

Table A7.1. General health symptom results.

During the past year:	A few times a week		About every week		A few times a month		About every month		A few times a year		Never	
	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]	C[1]	E[2]
Have you had a runny or blocked nose?	19	11	14	5	14	20	23	17	236	227	81	107
Have you had irritated or sore eyes (not related to a cold)?	6	13	5	1	10	7	10	6	63	60	293	300
Have you had sinus congestion involving facial pain (not related to a cold)?	6	6	3	4	9	6	9	7	68	51	292	313
Have you had a headache?	9	7	4	12	15	23	30	18	136	113	193	214
Have you had allergies?	10	7	4	0	5	6	8	1	59	52	301	321
Have you felt unusually tired?	14	10	13	11	14	13	14	8	63	69	269	276
Have you had difficulty sleeping?	28	19	15	14	16	20	19	17	48	58	261	259
Have you had numbness or tingling (pins and needles) in (your arms or legs) limbs?	14	11	8	8	8	12	11	4	46	36	300	316
Have you had a chest infection?	0	1	0	0	1	0	0	2	96	86	291	298
Have you had muscle aches or pains?	23	19	5	6	10	14	13	12	83	71	253	265
Have you had dizzy spells?	5	5	4	1	4	9	7	0	34	42	333	330
Have you had a sore throat (not related to a cold)?	4	1	1	2	4	0	4	2	63	34	311	348
Have you had earaches, loss of hearing or other ear problems?	9	11	3	1	1	6	2	4	42	53	330	312
Have you lost your appetite?	4	3	1	1	2	2	2	4	25	34	353	343
Have you had nausea, vomiting or gastro-enteritis (other than pregnancy)	2	0	3	2	3	2	1	1	7	87	331	295
Have you had a blister on your lip excluding cold sores?	0	0	0	1	1	1	1	0	7	9	378	376

[1]Clarecastle
[2]Ennistymon

Appendix 8 HSE West (Mid-West Area – Limerick, Clare, Tipp NR) Health Status Survey

CONFIDENTIAL

INSTRUCTIONS FOR INTERVIEWER GIVEN IN (ITALICS)

RECORD ONE

☐☐1-2

☐☐☐☐6

Survey No.: _____ ☐☐☐☐☐☐12

Respondent Name: _____

Respondent Sex: _____ ☐13

Age: _____ ☐☐15

Area: _____ ☐16

Interviewer No.: _____ ☐☐18

District Electoral Division (DED): _____ ☐☐☐21

Date: _____ ☐☐☐☐☐☐27

END OF RECORD ONE

I certify that I have interviewed the above named respondent in accordance with survey instructions.

SIGNED: _____ **DATED: _____**

SECTION 1

TO BE ADMINISTERED TO ALL RESPONDENTS AGED 15 AND OVER

SF-36 HEALTH SURVEY

The first part of the Questionnaire asks for your views about your health. This information will help us understand how you feel and how well you are able to do your usual activities. The following questions are about your health now and your current daily activities. Please try to answer each question as accurately as you can.

1. In general, would you say your health is: **RECORD TWO**

(Read out categories and circle one) ☐☐1-2

Excellent	1	☐☐☐☐6
Very Good	2	
Good	3	
Fair	4	☐7
Poor	5	

2. <u>Compared to one year ago</u>, how would you rate your health in general? Read out answers that best suit your situation.

(Give Card Question 2 and circle one)

Much better than one year ago	1	
Somewhat better now than one year ago	2	☐8
About the same as one year ago	3	
Somewhat worse now than one year ago	4	
Much worse now than one year ago	5	

3. The following questions are about activities you might do during a typical day. Does <u>your health limit</u> you in these activities? If so, how much?

(Give Card Question 3 and read out activities, circle 1, 2, 3 on each line)

ACTIVITIES **Does your health limit you in:**	**Yes,** **Limited A Lot**	**Yes,** **Limited A Little**	**No,** **Not Limited At All**
a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	1	2	3
b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling or playing golf	1	2	3
c. Lifting or carrying groceries	1	2	3
d. Climbing several flights of stairs	1	2	3
e. Climbing one flight of stairs	1	2	3
f. Bending, kneeling or stooping	1	2	3
g. Walking more than a mile	1	2	3
h. Walking half a mile	1	2	3
i. Walking one hundred yards	1	2	3
j. Bathing or dressing yourself	1	2	3

4. During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health</u>?

(Circle one number on each line)

	YES	NO
a. Cut down on the amount of time you spent on work or other activities	1	2
b. Accomplished less than you would like	1	2
c. Were limited in the kind of work or other activities	1	2
d. Had difficulty performing the work or other activities (for example, it took extra effort)	1	2

5. During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> such as feeling depressed or anxious?

(Circle one)

	YES	NO
a. Cut down on the amount of time you spent on work or other activities	1	2
b. Accomplished less than you would like	1	2
c. Didn't do work or other activities as carefully as usual	1	2

6. During the <u>past 4 weeks</u>, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or group?

(Give Card Question 6 and circle one)

Not at all	1	
Slightly	2	
Moderately	3	
Quite a bit	4	☐26
Extremely	5	

7. How much <u>bodily</u> pain have you had during the <u>past 4 weeks</u>?

(Give Care Question 7 and circle one)

None	1	
Very mild	2	
Mild	3	
Moderate	4	☐27
Severe	5	
Very severe	6	

8. During the <u>past 4 weeks</u>, how much did <u>pain</u> interfere with your normal work including both work outside the home and housework? Has it interfered:

(Give Card Question 8 and circle one)

Not at all	1	
A little bit	2	
Moderately	3	
Quite a bit	4	☐28
Extremely	5	

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

(Give Card Question 9 and read out the questions from "a to i" – Circle one number on each line).

How much of the time during the past 4 weeks:	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a. Did you feel full of life?	1	2	3	4	5	6
b. Have you been a very nervous person?	1	2	3	4	5	6
c. Have you felt so down in the dumps that nothing could cheer you up?	1	2	3	4	5	6
d. Have you felt calm and peaceful?	1	2	3	4	5	6
e. Did you have a lot of energy?	1	2	3	4	5	6
f. Have you felt downhearted and low?	1	2	3	4	5	6
g. Did you feel worn out?	1	2	3	4	5	6
h. Have you been a happy person?	1	2	3	4	5	6
i. Did you feel tired?	1	2	3	4	5	6

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

(Give Card Question 10 and circle one).

All of the time 1
Most of the time 2
Some of the time 3 ☐38
A little of the time 4
None of the time 5

11. How True or False is each of the following statements for you?

(Give Card Question 11 with categories – Read out the statements and circle one number on each line).

	Definitely True	Mostly True	Not Sure	Mostly False	Definitely False
a. I seem to get ill more easily than other people	1	2	3	4	5
b. I am as healthy as anybody I know	1	2	3	4	5
c. I expect my health to get worse	1	2	3	4	5
d. My health is excellent	1	2	3	4	5

END OF RECORD TWO

SECTION 2

TO BE ADMINISTERED TO ALL RESPONDENTS

RECORD THREE
☐☐1-2
☐☐☐☐6

RESPIRATORY

These questions are to do with your chest.

(Circle 1 for Yes – 2 for No)

	YES	NO
12. Have you ever had wheezing or whistling in the chest at any time in the past? *(If "NO" please skip to Question 14)*	1	2
13. Have you had wheezing or whistling in your chest at any time in the last 12 months? *(If "NO" please go straight to Question 14)*	1	2
a. Have you been at all breathless when the wheezing noise was present?	1	2
b. Have you had this wheezing or whistling when you did not have a cold?	1	2
c. Has your chest sounded wheezy during or after exercise?	1	2
d. Have you had a dry cough at night, apart from a cough associated with a cold or chest infection?	1	2
14. Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?	1	2
15. Have you been woken by an attack of shortness of breath at any time in the last 12 months?	1	2
16. Have you been woken by an attack of coughing at any time in the last 12 months?	1	2
17. Have you ever had asthma?	1	2
18. Has any doctor prescribed any inhalers or aerosols for asthma or a wheeze?	1	2
19. In the past 12 months has any doctor prescribed any other medication for asthma or a wheeze?	1	2
20. Do you suffer from hay fever?	1	2

END OF RECORD THREE

SECTION 3

TO BE ADMINISTERED TO ALL RESPONDENTS **RECORD FOUR**

☐☐ 1-2

SKIN ☐☐☐☐6

The following question is about your skin and whether you have noticed anything specifically concerning your skin during the past year. *(If No, go on to Question 23. If Yes, code site, frequency and symptoms.)*

	YES	NO
21. Have you had any skin symptoms or signs in the last 12 months? If Yes, Where?	1	2
Hand	1	2
Face	1	2
Lips	1	2
Arms	1	2
Legs	1	2
Body	1	2
Elsewhere	1	2

22. *(Code skin problem in the last year by site, type, frequency and symptoms.)*

WHERE	TYPE	FREQUENCY	SYMPTOMS
1 = Hand 2 = Face 3 = Lips 4 = Arms 5 = Legs 6 = Body 7 = Elsewhere Specify	1 = Papules 2 = Redness 3 = Eczema 4 = Dry skin 5 = Pimples 6 = Blisters 7 = No type only symptoms 8 = Others	1 = A few times a week 2 = About every week 3 = A few times a month 4 = About every month 5 = A few times a year	1 = Itching 2 = Pain 3 = Burning 4 = Itching and burning 5 = Pain and burning 6 = Pain and itching 7 = None 8 = Others

END OF RECORD FOUR

SECTION 4

RECORD FIVE

TO BE ADMINISTERED TO ALL RESPONDENTS ☐☐1-2

☐☐☐☐6

GENERAL HEALTH

These questions are about physical symptoms you might have had **during the past year**. For each question, please give the one answer that comes closest to what you have experienced *(give Question Card 23–38, read each question and circle number in each line).*

During the past year	A few times a week	About every week	A few times a month	About every month	A few times a year	Never
23. Have you had a runny or blocked nose?	1	2	3	4	5	6
24. Have you had irritated or sore eyes (not related to a cold)?	1	2	3	4	5	6
25. Have you had sinus congestion involving facial pain (not related to a cold)?	1	2	3	4	5	6
26. Have you had a headache?	1	2	3	4	5	6
27. Have you had allergies?	1	2	3	4	5	6
28. Have you felt unusually tired?	1	2	3	4	5	6
29. Have you had difficulty sleeping?	1	2	3	4	5	6
30. Have you had numbness or tingling (pins and needles) in your limbs (arms or legs)?	1	2	3	4	5	6
31. Have you had a chest infection?	1	2	3	4	5	6
32. Have you had muscle aches or pains?	1	2	3	4	5	6
33. Have you had dizzy spells?	1	2	3	4	5	6
34. Have you had a sore throat (not related to a cold)?	1	2	3	4	5	6
35. Have you had earaches, loss of hearing or other ear problems?	1	2	3	4	5	6
36. Have you lost your appetite?	1	2	3	4	5	6
37. Have you had nausea, vomiting or gastro-enteritis (other than pregnancy)?						
38. Have you had a blister on your lip excluding cold sores?	1	2	3	4	5	6

Thank you for your answers so far. Now I would like to ask you if there are any other relevant details regarding your health situation. _____ ☐☐☐25

_____

_____

END OF RECORD FIVE

SECTION 5

RECORD SIX

TO BE ADMINISTERED ONLY TO WOMEN AGED BETWEEN 15–44 ☐☐ 1-2

☐☐☐☐6

39. While you have been living here, have you consistently tried to get pregnant for a period of at least 1 year and failed to do so during that time?

☐7

Yes	No
1	2

40. Have you ever been pregnant?

☐8

Yes	No
1	2

(If NO please skip to Question 42.
If YES, fill in table on following page.)

41. *Record all pregnancies and start with the first and continue to present with details of pregnancy outcome whether living here or not at the time. Interviewer to obtain details and fill in form below. For Multiple births allocate same pregnancy number. Congenital Anomalies refers to Structural defects including congenital malformation, inborn errors of metabolism and hereditary diseases.*

Preg No.	**Residence here during pregnancy 1 = Yes 2 = No**	**Outcome Codes 1 = live birth 2 = stillbirth 3 = miscarriage 4 = other 8 = don't know 9 = refuse**	**Day/Mth/Year End of Pregnancy**	**Gestation**	**Defect 1 = Yes 2 = No**	**If yes, please Give details**
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		

END OF RECORD SIX

RECORD SEVEN ☐☐1-2
☐☐☐☐6

				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		
				____ wks		

END OF RECORD SEVEN

SECTION 6

RECORD EIGHT

TO BE ADMINISTERED TO ALL RESPONDENTS AGED 15 AND OVER ☐☐ 1-2
☐☐☐☐6

Lifestyle

Now, I would like to ask you some questions regarding your lifestyle including diet and exercise.

DIET

42. In the last years did you make any dietary changes in the following?
(Show Card Question 42 and circle one per section.)

	Tried and changed a lot	Tried and changed a little	Tried but did not really change	Did not try or wish to change
Eating less salt	1	2	3	4
Eating more fibre	1	2	3	4
Eating less fat	1	2	3	4
Eating less sugar	1	2	3	4
Eating more fruit/vegetables	1	2	3	4
Losing weight	1	2	3	4

ALCOHOL

43. Do you or did you ever drink alcohol?
(Do not read out but circle the one closest response.)
Now drink alcohol 1 ☐13
Never drank alcohol 2
Used to but not now 3
(If never drank alcohol skip to Question 47.)

44. How often in the past year did you have alcoholic drinks? ☐☐☐16
(Fill in number of times. Circle week, month or year.)

_____ per wk/month/year

45. How many standard drinks would you have at a sitting? _____ standard drinks ☐☐☐18
(Define Standard Drink) =1/2 pint Beer
Or ½ pint Lager
Or ½ pint Guinness
Or 1 glass Wine
Or one bar measure spirit (half one – Whiskey, Gin, etc.)
Or schooner of Sherry

46. During the past year, did you try to change your drinking habits?
(Do not read out but circle the one closest response) ☐19
Stopped drinking during the past year 1
Tried and cut down a little on amount drunk 2
Tried but did not really reduce alcohol 3
Did not try or did not wish to change drinking habits 4

Started or increased drinking during past year	5
Was a non-drinker one year ago and stayed a non-drinker	6
Missing/Unknown	7

SMOKING

(Circle one category for each question, and fill in further information as appropriate.)

47. (a) Did you ever smoke tobacco regularly? ☐20

YES	NO
1	2

If NO go to Question 50.

48. (a) Which of the following do you/did you smoke?
(b) How much do you/did you smoke?

(Do not read out but circle the one closest response.)

	Amount smoked
Cigarettes	_____ no./day
Pipe/hand-rolled cigarettes	_____ oz./week
Cheroots	_____ no./day
Large cigars	_____ no./day

49. During the past year did you try to change your smoking habits?
In what way? *(Do not read out but circle the one closest response)*

☐30

Stopped smoking during the year	1
Tried and cut down a little on amount smoked	2
Tried but did not change amount smoked	3
Stopped smoking cigarettes but changed to pipe/cigar	4
Did not try or wish to change	5
Started or increased smoking during the past year	6
Was not a regular smoker one year ago	7

EXERCISE

50. How much physical activity do you have at work during an average day?
(Show Card Question 50 and circle one)

☐31

Work mainly sitting, (e.g. computer programme, office work at a desk, sitting at a production line)	1
Quite a lot at work, but do not have to lift or carry heavy things (e.g. shop assistant, light industrial work, office work where one has to move, domestic duties, etc.)	2
Walk at work and carry a lot, or climb staircases or go uphill (e.g. carpenter, farmhand, engine-shop, heavy industrial work, etc.)	3
Heavy physical work, carry or lift things, digging, shovelling, cutting (e.g. forestry, heavy farm work, heavy construction and industrial work, etc.)	4
Not employed	5
Unable to exercise	6
Don't know	7

51. How much exercise have you had during leisure time in the past month?
(Do not read out but circle the one closest response.)

☐32

Reading, watching TV, and hobbies which do not require physical activity	1
Walking, cycling, fishing, light gardening for at least four hours per week	2
Running, aerobics, swimming, ball games, heavy gardening for at least three hours per week	3
Training for competitive sports several days per week, running, orienteering, ball games or other physical heavy sports	4
Unable to exercise	5
Don't know	6

52. How many hours per day do you usually watch TV, video or play computer games?
(Record to the nearest ½ hour: 0 for less than or about 15 minutes)
_____ hours ☐☐☐35

53. Did you try to take more exercise during the past year?
(Do not read out but circle the one closest response)

☐36

Take a lot more exercise now	1
Tried and take a little more exercise now	2
Tried but do not take more exercise now	3
Take less exercise now	4
Did not try or did not wish to change exercise habits	5

END OF RECORD EIGHT

SECTION 7

RECORD NINE

TO BE ADMINISTERED TO ALL RESPONDENTS ☐☐1-2

SOCIO-DEMOGRAPHIC – (*About the person being surveyed*) ☐☐☐☐6

54. Sex: Male = 1 Female = 2 ☐7

55. Marital Status: Single = 1 Widowed = 3
Married/Cohabiting = 2 Divorced/Separated = 4 ☐8
Aged under 15 = 3

☐☐☐11

56. How tall are you? _____ft _____ inches _____(cm)

57. What weight are you? _____ stone _____lbs _____ (kg)

☐☐☐14

58. Number of persons living in household including children _____

☐☐16

EDUCATION

59. What is the highest level of education (full-time or part-time) actually completed to date?
(Do not read out but circle the one closest response.)

No formal education	1
Primary education	2

☐17

Lower secondary education (Junior/Inter Cert./Group Cert.)	3
Upper secondary	4
Third level (professional/ non-degree/degree/diploma)	5
Aged under 15 years	6

60. Present Status – Are you currently: *(Do not read out but circle the one closest response.)*

At work	1
Seeking work for the first time	2
Unemployed	3

☐18

At school, student	4
Home domestic duties	5
Retired	6
Unable to work due to permanent sickness or disability	7
Child under 5	8
Other	9

OCCUPATION

61. What is your usual main occupation?

(If child under 15 years, ask parent present.) ☐☐☐☐22

Respondent _____ Parent's occupation _____

62. What is your spouse's main occupation (if relevant)?

Respondent spouse _____ Parent's spouse occupation _____ ☐☐☐☐26

63. If employed or retired, record main occupation previously held _____ ☐☐28

If housewife, record husband's occupation: _____ ☐☐30

64. If a farmer or farmer's wife, how many acres of land do you farm?

_____ acres farmed ☐☐☐33

65. Is any of that land rented from someone else? ☐34

YES	NO
1	2

_____ rented acres. _____acres owned.

☐☐☐☐☐☐40

ACCOMMODATION

66. Accommodation in which you live: Is it?

(Circle one)

Owned/mortgaged by you or your family 1 ☐41

Rented from Council/Local Authority 2

Privately rented 3

67. Number of rooms (bedrooms, reception, kitchen)? _____rooms ☐☐43

	Yes	No
69. Do you have a Medical Card?	1	2
70. Do you have a long-term illness card?	1	2
71. Do you have private health insurance?	1	2

68. How long have you lived at this address? _____ years ☐☐48

69. Previous locations in the last ten years?

(Record area if within Clare, county if within & country if outside Ireland.)

_____

_____

_____

END OF RECORD NINE

SECTION 8

TO BE ADMINISTERED TO ALL RESPONDENTS AGED 15 AND OVER **RECORD TEN**

☐☐1-2

ENVIRONMENT ☐☐☐☐6

Now, I would like to ask you some questions regarding your opinion of environmental conditions in your neighbourhood. By this, I mean anything that might harm the air, the water, the land or place we live in.

70. How worried or concerned are you about environmental hazards in your neighbourhood?
(Circle one.)

Would you say you are:

Not at all worried or concerned	1	
(Go to Question 75)		☐7
A little worried or concerned	2	
Somewhat worried or concerned	3	
Very worried or concerned	4	

71. What makes you worried or concerned about environmental hazards in your neighbourhood?
(Only applies if answered 2, 3 or 4 above. Do not read but circle all the items mentioned.)

A personal illness	1	☐8
An illness in a family member or friend	2	☐9
Illness in animals	3	☐10
Risk of future health problems	4	☐11
Risk of the environment	5	☐12
Others	6	☐13
Describe _____		☐☐☐☐☐☐19
Interviewer comments _____		☐☐21

72. What, if any environmental hazards (problems with environment) would you say are present in your neighbourhood? Please mention the most important ones first. *(Do not read but number all that are mentioned. Write 1 opposite item mentioned first and 2 in item mentioned second and so on.)*

	Rank No.	
Dumpsite _____		☐22
Bad Water _____		☐23
Cars _____		☐24
Bad Air _____		☐25
Local Industry (s) _____		☐26
Incinerator _____		☐27
Electric Pylon _____		☐28
Radio Transmitter _____		☐29
Other _____		☐30
(List) _____		☐☐☐☐☐☐36

73. People often involve themselves in efforts to improve environmental conditions in their community. Have you been involved in any such activities in your community? *(Circle one)* ☐37

YES	NO
1	2

What is your main area of concern?

(Record) ☐☐39

_____

_____

	YES	NO
74. (a) Were you involved in organising community meetings about environmental problems?	1	2
(b) Did you contact other community members by phone, mail or in person about the environmental problems?	1	2
(c) Did you attend community meetings about the environmental problems?	1	2
(d) Were you contacted by other community members by phone, mail or in person about the environmental problems?	1	2
(e) Did you contact your public representatives/TDs/HSE members/staff?	1	2
(f) Others – describe	1	2

75. On a scale from zero to ten, where zero means least upsetting and ten means most upsetting, please rate how upsetting each of these things would be to you:

(Show card with scales questions 75 and circle one.)

	Least _____ Most	
Hospitalisation to have your appendix removed	0 1 2 3 4 5 6 7 8 9 10	☐☐49
A death in the family	0 1 2 3 4 5 6 7 8 9 10	☐☐51
Redundancy	0 1 2 3 4 5 6 7 8 9 10	☐☐53
Being late for an appointment	0 1 2 3 4 5 6 7 8 9 10	☐☐ 55
Bad weather spoiling sporting fixtures or an outing	0 1 2 3 4 5 6 7 8 9 10	☐☐ 57
Living in an area with environmental problems	0 1 2 3 4 5 6 7 8 9 10	☐☐ 59

END OF RECORD TEN

THANK YOU FOR TAKING PART IN THIS SURVEY

Appendix 9

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Valerie de Souza
Department of Public Health, Health Service Executive
West (Limerick, Clare & N. Tipp)
31-33 Catherine Street
Limerick
Tel: 00353 (0) 61 483337
Fax: 00353 (0) 61 464205
valerie.desouza@mailh.hse.ie

10th June 2007

Dear {mail merge}

Re:Clare Area Comparative Health Status Study

You and the other members of your household are invited to participate in an important health study. What is involved and how to take part is detailed in the participant information sheet which accompanies this letter.

The Public Health Department at the HSE West-Limerick, Clare & North Tipperary (former Mid-Western Health Board) is conducting a study looking at the health of the residents of two regions of Co. Clare. A similar study was conducted about ten years ago and the current study aims to collect the same information and compare the results of the two.

This study focuses on the whole population from young to old. Therefore, it is important that individuals of all ages are included (in case of very young children the questions will be answered on their behalf by a parent or guardian). After reading the enclosed information sheet, please decide who in your household wishes to participate (any number or all members of the household are invited to take part) and complete a consent form for **each participant** (in the case of minors this form should also be signed by a parent or guardian). Five consent forms have been included with this letter-please contact me if more than five members of your household wish to take part and more consent forms are required.

Please return completed consent forms in the pre-paid envelope provided.

From those who consent to take part in the study a number will be randomly chosen and you will be contacted to let you know if you are part of this sample. While everyone who consents to participate in this study will be contacted, because of the size of this study, it may be several months before you hear from us.

Please contact me if you require any further information on the study (contact details above)

Yours Sincerely,

Valerie de Souza (Senior Research Officer)
Department of Public Health
Health Service Executive West (Limerick, Clare and North Tipperary)

An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Gníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaol do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaol na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

ÁR bhFREAGRACHTAÍ

CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaol i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistrithe dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreail.
- Scardadh dramhuisce

FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhuisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaol mar thoradh ar a ngníomhaíochtaí.

MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOL

- Monatóireacht ar chaighdeán aeir agus caighdeáin aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéil agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntí a dhéanamh.

RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdéan aeir agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaol na hÉireann (cosúil le pleananna bainistíochta dramhaíola agus forbartha).

PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaol a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

STRUCHTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaol na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstiúrthóir agus ceithre Stiúrthóir.

Tá obair na Gníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.

Science, Technology, Research and Innovation for the Environment (STRIVE) 2007-2013

The Science, Technology, Research and Innovation for the Environment (STRIVE) programme covers the period 2007 to 2013.

The programme comprises three key measures: Sustainable Development, Cleaner Production and Environmental Technologies, and A Healthy Environment; together with two supporting measures: EPA Environmental Research Centre (ERC) and Capacity & Capability Building. The seven principal thematic areas for the programme are Climate Change; Waste, Resource Management and Chemicals; Water Quality and the Aquatic Environment; Air Quality, Atmospheric Deposition and Noise; Impacts on Biodiversity; Soils and Land-use; and Socio-economic Considerations. In addition, other emerging issues will be addressed as the need arises.

The funding for the programme (approximately €100 million) comes from the Environmental Research Sub-Programme of the National Development Plan (NDP), the Inter-Departmental Committee for the Strategy for Science, Technology and Innovation (IDC-SSTI); and EPA core funding and co-funding by economic sectors.

The EPA has a statutory role to co-ordinate environmental research in Ireland and is organising and administering the STRIVE programme on behalf of the Department of the Environment, Heritage and Local Government.

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

ENVIRONMENTAL PROTECTION AGENCY
PO Box 3000, Johnstown Castle Estate, Co. Wexford, Ireland
t 053 916 0600 f 053 916 0699
LoCall 1890 33 55 99
e info@epa.ie w http://www.epa.ie

SSTI
Strategy for Science, Technology and Innovation

Comhshaol, Oidhreacht agus Rialtas Áitiúil
Environment, Heritage and Local Government