An Assessment on the Compliance of Fluoride Concentration in Water Supplies in County Cork

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By

Tarik Nazer BSc, DDS, MScPed.

Department of Oral Health and Development

University College Cork

Supervisors

Emeritus Professor D.M. O' Mullane

Dr. Máiréad Harding

To my parents, and my brother.

Abstract

Fluoridation of water supplies in Ireland commenced in Dublin in 1964 and in Cork in 1965 after the completion of the legal challenges to the Health (Fluoridation of Water Supplies) Act 1960 (McLoughlin et al, 2002). By 1977 there were one hundred and thirty five water supplies serving 1.76 million people with fluoridated water. It is estimated that approximately 2.7 million persons, representing approximately 73% of the population of the state at the time of the 2002 North South Survey of Children Oral Health, reside in dwellings that are supplied with fluoridated water (Whelton et al, 2003). The major benefit of water fluoridation is that it reduces the incidence of dental decay. Its use as a public health measure in the prevention of dental decay has been well documented over the past sixty years, and it has been widely accepted and recognised by public health authorities to be one of the most successful public health promotion measures introduced. Its safety and effectiveness have been endorsed by international bodies such as the World Health Organisation (WHO), the United States Public Health Service (USPHS), the Centre for Disease Control and Prevention (CDC) and the United States Surgeon General (Forum on Fluoridation, 2002). Studies on the efficacy of communal water fluoridation in reducing dental caries based on surveys of caries prevalence in fluoridated and non-fluoridated communities in the US, Australia, Britain, Canada, Ireland & New Zealand showed that the efficacy was greatest for deciduous dentition followed by the mixed dentition and adult teeth (O'Conner et al, 1999). Both the World Health Organisation and the York Review on public water fluoridation concluded that although water fluoridation is associated with fluorosis,

communities served with optimally fluoridated water supplies only small proportion of the population will continue to be affected by very mild fluorosis, evident as diffuse white lines and patches, which is not aesthetically damaging and which usually cannot be seen by the untrained eye (WHO, 1994), (Treasure et al. 2002).

To reach this optimal level, both the Fluoridation of water supplies Regulations 2007 (SI 42/2007) and The European Communities (Drinking Water) Regulation (SI 278/2007) in July 2007 recommended that the level of fluoride added to public piped water supplies should be in the range of 0.6ppm to 0.8ppm with a target of 0.7ppm (SI 42/2007) and a parametric value of 0.8ppm (Si 278/2007), as compared with 0.8 to 1.0ppm under the previous regulation. And that the acid as supplied shall contain 10.9 percent by weight off hydrofluosilicic acid, as compared with 14 percent under the previous regulation.

This report focuses on the compliance of Cork County public water supplies to obtain the optimal recommended fluoride levels in water.

The aim of the project was to determine the proportion of satisfactory and unsatisfactory reports and wither treatment plants in all four Areas of County Cork were compliant with current legislation.

Methods: In order to determine the compliance of Cork County Water supplies in maintaining the recommended fluoride levels data were obtained from the monthly test results on the concentration of fluoride in public piped water supplies from The Environmental Health Officer (EHO) and the Public Analyst Laboratories Reports for the period 2001-2012. These data were than tabulated using Microsoft Excel programme® and the percentages for the satisfactory and unsatisfactory results were

calculated to determine the compliance of the water plants. Series of tables for Cork County areas were also used to determine the proportion of the sample. Maps of water supplies in County Cork were also used to assist with indicating: size, spread and population density served. Finally, Information from the relevant Health Service personnel on the operation of water fluoridation was obtained.

Results: The analysis of monthly test results indicated that the majority of the fluoride levels in public water supplies in County Cork were well controlled. The majority of the results in all areas fell within the satisfactory limits for both periods i.e. from January 2001-June 2007, and July 2007-2012. Both North and West Cork Areas results showed that within the unsatisfactory results both had more low reading (below 0.6ppm) with percentages 64.7% and 80% respectively. While North and South Lee Areas results showed more exceedance (above 0.8ppm) in the unsatisfactory results with 73% and 53% respectively.

Conclusion: The systems are in place with the regulators and regulations but most important that monitoring required under the regulation is adequate to ensure consistent dosage of fluoride at optimal levels.

Declaration

The research presented in this dissertation was carried out by the undersigned. No part of the research here has been submitted in support of an application for another degree or qualification of this or any other University or institute of learning.

Tarik Nazer
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CHAPTER 1

Introduction

1.1 Background

In the mid- 1950s a visit by Dr. Trendley Dean to Dublin aided the advancement of the decision to introduce water fluoridation as a public health measure to the Republic of Ireland to decrease the prevalence of dental caries. A challenge to the constitutional validity of the Health (Fluoridation of Water Supplies) Act 1960 failed and in 1964 the water supplies of Dublin city were fluoridated and followed by Cork in 1965. In the next seven to eight years all the major urban communities in the Republic of Ireland were fluoridated (O'Mullane, 1981). It is estimated that approximately 2.7 million persons, representing approximately 73% of the population of the state at the time of the 2002 North South Survey of Children Oral Health, reside in dwellings that are supplied with fluoridated water (Whelton et al, 2002). The major benefit of water fluoridation is that it reduces the incidence of dental decay. Its use as a public health measure in the prevention of dental decay has been well documented over the past sixty years, and it has been widely accepted and recognised by public health authorities to be one of the most successful public health promotion measures introduced. Its safety and effectiveness have been endorsed by international bodies such as the World Health Organisation (WHO), the United States Public Health Service (USPHS), the Centre for Disease Control and Prevention (CDC) and the United States Surgeon General (Forum on Fluoridation, 2002). Studies on the efficacy of communal water fluoridation in reducing dental

caries based on surveys of caries prevalence in fluoridated and non-fluoridated communities in the US, Australia, Britain, Canada, Ireland & New Zealand showed that the efficacy was greatest for deciduous dentition followed by the mixed dentition and adult teeth (O'Conner et al, 1999). Furthermore, Studies conducted over the last twenty years show that residents of fluoridated communities have better dental health than those in non-fluoridated communities. Furthermore, Pre-fluoridation baseline surveys and various surveys conducted over the last thirty years in the Republic of Ireland show that in fluoridated communities, children experience lower levels of dental caries and adults retain more of their natural teeth when compared with residents of non-fluoridated communities (O'Mullane et al, 1982). Data from the 2002 national survey indicate that children and teenagers who are life-time residents of fluoridated communities in the Republic of Ireland continue to experience considerably lower levels of mean dmft and DMFT respectably (decayed, missing filled teeth) than their counterpart in Northern Ireland, where public piped water supplies are not fluoridated (Whelton et al, 2002).

Both the World Health Organisation and the York Review on public water fluoridation concluded that although water fluoridation is associated with fluorosis, communities served with optimally fluoridated water supplies only small proportion of the population will continue to be affected by very mild fluorosis, evident as diffuse white lines and patches, which is not aesthetically damaging and which usually cannot be seen by the untrained eye (WHO, 1994), (Treasure et al. 2002).

To reach this optimal level, both the Fluoridation of water supplies Regulations 2007 (SI 42/2007) and The European Communities (Drinking Water) Regulation (SI 278/2007) in April/July 2007 recommended that the level of fluoride added to public piped water

supplies should be in the range of 0.6ppm to 0.8ppm with a target of 0.7ppm (SI 42/2007) and a parametric value of 0.8ppm (Si 278/2007) (Appendix 1).

This report focuses on the evaluation of delivery and monitoring of water fluoridation in County Cork public water supply to obtain the optimal recommended level.

1.2 Aim

The aim of the project is to determine the proportion of satisfactory and unsatisfactory reports and wither treatment plants in all four areas of County Cork are compliant with current legislation, regulation and best practice.

1.3 Objective

The objective of the report is:

- To assess wither County Cork's water treatment plants are in compliance with the acceptable fluoride range by analysing the results of fluoride levels for the period 2001-2012.

CHAPTER 2
Methods

In order to meet the objectives of the project the following methods and sources of information were used:

- Monthly test results data on levels of fluoride in County Cork public piped water supplies for the period 2001-2012 will be obtained from the Environmental Health Office and the Public Analyst Laboratories. The data was sourced as part of a larger study FACCT (Fluoride and Caring for Children's Teeth).
- Series of tables for Cork County areas will be used to determine the proportion of the sample.
- Maps of water supplies in County Cork provide by Dr. Máiréad Harding and Cork County Council will be used to assist with indicating: size, spread and population density served. (CD is provided with the thesis).
- Information from the relevant Health Service personnel on the operation of water fluoridation was obtained via e-mail correspondence.
- A visit to Inniscarra water treatment plant in Cork County.
- Microsoft Excel program® was used to develop graphs, tables and in calculating the percentages for the satisfactory and unsatisfactory results.
- For the purpose of this report the monthly test data collected before July 2007 will be reported in three categories, Satisfactory, Marginal and Unsatisfactory following the Department of Health

and Children methods of categorizing the results. The monthly test data for July 2007 and after will be categorized as following: satisfactory and unsatisfactory according to the Health Service Executive categorization of the results.

CHAPTER 3

Literature Review

3.1 History of water fluoridation in the international context

Water fluoridation is the adjustment of the natural low fluoride, concentration of water to the level recommended for optimal dental health. Fluoridation of water supplies is considered the single most effective public health measure to prevent dental decay (ADA, 2005). However, the history of water fluoridation dates to 1902 when Dr. Frederick McKay a dentist working in Colorado Springs, Colorado, noticed an unusual permanent stain or "mottled enamel" (described locally as "Colorado brown stain" by residents of the area) on the teeth of many of his patients. He noted an association with a deep-well water supply, and also observed that teeth with this condition did not seem to increase the chance of developing dental caries (McKay, 1928). In 1930, H. V. Churchill, a chemist with the Aluminium Company of America, when investigating the possible causes of mottled enamel in that region, used spectrographic analysis, a new technology, to measure the concentrations of fluoride in the area of water supplies. Samples were found to contain between 2ppm to 14ppm fluoride (Churchill, 1931).

In 1931 the Dental Hygiene Unit at the National Institute of Health was established after identifying a possible causative agent for mottled enamel. Dr. H. Trendley Dean headed it. The primary responsibility of the Unit was to investigate the association between fluoride and mottled

enamel. Dean adopted the term “fluorosis” to replace “mottled enamel,” and then developed Dean's Index of Fluorosis in order to measure and classify this condition. It identifies six ascending levels of increasing fluorosis, ranging from zero (Normal) to four (severe fluorosis).

Classification	Criteria
Normal (0)	The enamel represents the usual translucent semivitriform-type of structure. The surface is smooth, glossy, and usually of pale, creamy white color
Questionable (0.5)	The enamel discloses slight aberrations from the translucency of normal enamel, ranging from a few flecks to occasional white spots
Very mild (1)	Small, opaque, paper white areas scattered irregularly over the tooth, but not involving as much as approximately 25% of tooth surface.
Mild (2)	The white opaque areas in the enamel of teeth are more extensive, but do not involve as much as 50% of tooth.
Moderate (3)	All enamel surfaces of the teeth are affected and surfaces subject to attrition show wear. Brown stain is frequently a disfiguring feature
Severe (4)	All enamel surfaces of the tooth are affected and hypoplasia is so marked that the general form of the tooth may be affected. There is discrete pitting of the affected tooth. Brown stains are widespread and teeth often present a corroded-like appearance

Table 3.1: Dean’s Index of Fluorosis (Baskaradoss et al, 2008)

Dean conducted extensive epidemiological surveys of the prevalence of

dental decay and also measured the prevalence and severity dental fluorosis in the US (Dean, 1942). When Dean compared data on dental caries in children in twenty-six states with the prevalence of fluorosis, he noted a strong inverse relationship (Dean, 1938). He demonstrated that the higher the fluoride contents the lower the prevalence of dental decay. This cross-sectional relationship was later confirmed in a series of studies (the 21 Cities Studies) in Colorado, Illinois, Indiana, and Ohio (Dean et al 1942). Caries among children were lower in cities with concentrations of approximately 1ppm of fluoride in their water supplies while at these levels the prevalence of dental fluorosis was low and mostly in the questionable and very mild categories (Dean et al 1941, Dean et al 1942). Following these investigations the United States Public Health Service decided to adjust the fluoride level of the water supplies to obtain a concentration of 1 part per million. Artificial fluoridation of domestic water supplies was first introduced in Grand Rapids, Michigan in January 1945, with Muskegon acting as the control city. The purpose of a control was to establish what would have happened if no artificial adjustment was made (O'Mullane et al, 1981).

Recommended concentrations of fluoride in water supplies currently are based on the original formula by Galagan that relates water consumption (fluid Oz/lb.) to mean daily maximum temperatures. So Dean's 1ppm recommendation changed slightly based on water consumption in different climates, to the fact that downward revision had occurred many times in different places. For example, in 1957, a 60% difference in intake of water between warmer and cooler regions of the US was demonstrated in the Galagan studies. They looked at the relationship between annual air temperatures and water intake (Galagan et al, 1957). The US Public Health Service recommended in 1962 that the fluoride

level in the water should be in the range 0.9-1.7ppm in areas with mean daily temperatures of 10.0-12.1°C and 0.6ppm-0.8ppm in areas with higher mean daily temperatures (26.3-32.5°C). In 1999, Heller and colleagues reported differences in water consumption of less than 20%, but these related to particular regions and times of the year in the US (Heller et al 1999). Fluoride levels were initially set at 0.7ppm for the warmer months and 0.9ppm for the cooler months in Hong Kong. Following the US Public Health Service guidelines of 1962, the most appropriate concentration for Hong Kong was calculated to be 0.8ppm. In 1978 the levels were set at 0.7ppm year round but it reduced in 1988 to 0.5ppm, which reduced levels of fluorosis from 64% to 47% (Evans & Stamm 1991). Also in Toronto, Canada where fluoridated water has been provided since 1963, the level was reduced from 1.2ppm to 1.0ppm initially and then to 0.8ppm in 1999. The WHO in 1994 recommended a range of 0.5ppm-1.0ppm fluoride (WHO 1994).

According to the CDC (Center for Disease Control) in 2002, it was estimated that throughout the US, 162 million residents (65.8% of the population) receive fluoridated public water supplies (CDC 2002). Twenty-six states as well as the District of Columbia have already achieved the "Healthy People 2010" national health goal for the US, of providing 75 percent of the population with fluoridated public water systems. Water fluoridation has been selected by the US Center for Disease Control as one of the 10 great public health achievements of the 20th century (CDC, 1999).

3.2 History of water fluoridation in the Irish context

In 1944, the problem of oral health was under the attention of Dr. Conn Ward, Parliamentary Secretary to the Minister for Local Government and

Public Health. He advised that the National Nutrition Survey be expanded to include an investigation of decay, with the rationale that nutrition and diet had a bearing on dental decay incidence and prevalence (Beirne, 1999).

This survey, which began in 1946, provided the basis for a subsequent study of dental health of Irish children. At that time an inverse relationship had been observed between dental decay and dietary intake by Channel Island children during the occupation of the Second World War where the poorer the nutrition the higher the incidence of decay (Forum On Fluoridation, 2002).

In July 1951, the Minister for Health, Dr. James Ryan, appointed The Dental Consultative Council to advise the Minister on 'the improvement and extension of the dental services at present provided by the local authorities'. The Council presented its report in 1953 and recommended that four groups should be provided with dental treatment on a priority basis including: Pupils of national schools, Children attending child welfare clinics and expectant and nursing mothers, adolescents (14 to 19 years) and adults eligible for treatment under the Public Assistance Act (Forum On Fluoridation, 2002).

In 1952, the Minister for Health requested the Medical Research Council (MRC) to carry out a survey 'to ascertain whether there were significant differences in dental conditions amongst schoolchildren living in different areas of the country, and whether such differences, if they existed, could be related to differences in the dietary intake of children' (Forum on Fluoridation, 2002). The MRC organised an epidemiological survey that showed that dental decay experience among schoolchildren was high in all the survey areas, and that the prevalence and severity of the condition

was independent of the environmental or domestic circumstances and dietary habits of the children. Of those examined in the 5-6, 7-8 and 12-13 year age groups only 4.3 percent, 1.4 percent and 1 percent, respectively had complete sets of teeth (dentitions) free from decay. The average number of decayed, missing and filled teeth (DMFT) per child aged 7-8 years was 6.9 (i.e. almost 7 teeth per child) (Forum on Fluoridation, 2002).

In May 1956 local authorities were informed that 'the Minister considers that where services are not sufficiently developed to provide full dental care for all persons entitled to such care, health authorities should concentrate on the making available of an adequate service for children in preference to other eligible groups'. In the Dental Consultative Council's report it was recommended that a full time dental surgeon should be appointed to the Department of Health 'in order that the Minister may be adequately advised on dental matters and in particular on those relating to local authority dental services'. Séamus MacNeill was appointed as the Department's first full time Dental Advisor in 1953, and his appointment marked a turning point in departmental policy towards tackling the problem of dental decay. In a report he outlined his proposals, marking the beginning of public health dentistry in Ireland: The prevalence of dental diseases, the problems involved and the costs of adequately controlling them appears on the face of it almost insurmountable in view of our limited resources. At the present time we are trying to move from the position where the only resort is to the mass extraction of diseased teeth due to a general state of neglect. The resort to such measures is not only incompatible with the function of public health but cannot be indefinitely tolerated by an enlightened administration (Forum on Fluoridation, 2002). In May 1958, the Council unanimously advised that:

Having considered all the information available to it on the relationship between fluorine and dental decay the Council is satisfied that an increased intake of fluorine will reduce the incidence of dental decay and that it is desirable to provide for such an increased intake. The Council is further satisfied that the increased intake of fluorine can best be provided by the fluoridation of public water supplies to the level of 1.0 part per million. In so recommending the Council is aware that not quite 50 per cent of the community would thereby benefit at present even if all public water supplies in the country were fluoridated, but the percentage will increase according as public water supplies are extended.

The Minister for Health introduced the Health (Fluoridation of Water Supplies) Act in 1960 (Health Act 1960). The legislation withstood legal challenges at both High Court and Supreme Court level before being enacted in 1964. In a High Court hearing lasting 65 days, the counsel for the plaintiff argued that the Act had overridden the inalienable rights of the individual citizen, which the State had a duty to respect and, as far as practicable, to defend by its laws. In his final judgment, delivered in 1963, Mr. Justice Kenny stated: ‘None of the personal rights of the citizen are unlimited: their exercise may be limited by the Oireachtas when the common good requires this.’ On the question of bodily integrity, Mr. Justice Kenny accepted that it would be oppressive to impose on a country's citizens any process that might be dangerous. But he also accepted arguments that fluoridation was safe and that it constituted no danger to individuals' bodily integrity. He concluded: ‘In my judgment, the fluoridation of the public water supplies in this country is not a violation of any of the plaintiff's constitutional rights and this action must be dismissed’ (Kenny, 1972).

The Supreme Court upheld the judgment of Mr. Justice Kenny in July

1964. Chief Justice O'Dalaigh commented: ‘The effect on the teeth (of fluoridation) is demonstrably beneficial. The purpose and the effect of fluoridation is to improve children's teeth and so, indirectly, their health. These benefits are to a great extent carried forward into adult life’ (Ryan v Attorney General, 1965).

3.3 Mandatory Legislation and Regulation Governing Water Fluoridation in Ireland

Under the (Fluoridation of Water Supplies) Act in 1960 certain responsibilities were appointed to the Minister for Health, the health authorities and local authorities. Prior to the commencement of water fluoridation, the Minister for Health was required to fulfill the following conditions before making any regulation: 1-‘A survey of the incidence of dental caries in a representative sample of pupils attending full-time day schools in the functional area or functional areas of the health authority or health authorities to whom the regulations relate’, 2-‘An analysis or series of analyses of the quantities of fluorine in the water supplied by sanitary authorities through pipes to the public in the functional area of the health authority’ was required (Health Act 1960).

To meet this requirement the dental decay surveys were undertaken by the Medical Research Council at the request of the Minister for Health. A team of public health dentists with their recording assistants carried out the survey examinations. The surveys began in May 1961 and ended in December 1963, when the entire state had been covered. In all, over 96,000 children were examined. The surveys disclosed high levels of decay in all areas. Although there were variations from place to place, the overall results showed uniformly poor dental health. The methods and criteria for this series of surveys were a duplication of those used in the

1952 survey. They did not take account of the early stages of the process of decay. Consequently the results have been accepted as an under-evaluation of the real levels of decay (Minster of Health, 1965). Every public piped water supply in the State was analysed and only five out of more than 660 supplies contained any significant concentrations of fluoride (Forum on Fluoridation, 2002).

Subsequent regulations made under the Act were concerned with the fluoridation of water supplies in individual local authority areas, and dealt with: 'The provision, installation and maintenance of equipment for fluoridation, the making of arrangements for the addition of fluorine to the water and the testing of the fluorine content of the water to which the fluorine has been added' (O'Hickey, 1976). With regard to testing, the fluorine content 'shall be determined daily by a colorimetric method and in addition, shall be determined by a distillation method at intervals not exceeding two weeks during the period of six months after the date on which fluorine shall have been first so added and thereafter at intervals not exceeding four weeks' (O'Hickey, 1976).

3.4 Public Water Supplies in Ireland

In Ireland drinking water originates from groundwater sources and surface water sources, including rivers, lakes and springs. Groundwater originates from under the earth's surface and its quality depends on local circumstances like geology, agricultural practices and surface water influences. Surface waters originate from a combination of sources, including rainfall on adjacent lands, direct rainfall to a river or lake and groundwater contribution to the water body (Forum on Fluoridation, 2002).

The level of treatment of water for public consumption is obligated to

meet the standards set out by the European and National Legislation. Since January first, 2004 the revised Drinking Water Directive (98/83/EC) that was transposed into Irish law by European Communities (Drinking Water) Regulations in 2000 became effective. Under its provisions:

1. All water for human consumption, whether in its original state or after treatment, regardless of origin, is covered, including water used in the food industry, but excluding natural mineral waters or medicinal waters.
2. National quality standards, the legal limits, which must not be exceeded, are fixed for over 50 parameters.
3. In particular circumstances, and only where there is no risk to public health, the Minister for the Environment and Local Government may grant 'departures' (exemptions) from the standard set for particular parameters.
4. Minimum frequencies of sampling and analysis, for defined groups of parameters, are established by the Regulations. Samples are to be taken from water at the point where it is made available to the consumer, that is, at the consumer's tap. Deficiencies in water quality confirmed by sampling and analysis are remedied according to procedures set down in the European Communities (Quality of Water Intended for Human Consumption) (Amendment) Regulations 2000.

Currently, Irish drinking water standards are fixed in Statutory Instrument S.I. No. 278 of 2007 - European Communities (Quality of Water Intended for Human Consumption) Regulations, 2007.

To capture a glimpse of the huge task to monitor water fluoridation, the

Environmental Protection Agency (EPA) listed some 300 public water supplies, each supplying 5,000 or more consumers. County Cork has the highest number of water supplies. (Figure 1). The EPA Drinking Water report on the provision and quality of drinking water in Ireland 2008-2009 , based on the results of monitoring carried out in 2007, states that there are a total of 65 Public Water Supply scheme in the Cork South, serving 209,225 consumers. In addition there are 6 Public Group Water Supply Schemes serving 500 people, and 12 private Group Water Supply Schemes serving 1,075 consumers (EPA, 2011).

The Forum on Fluoridation report stated that there are many more public water supply schemes that service less than 5,000 consumers. In addition, some 260,000 households approximately are connected to private and group water supply schemes.

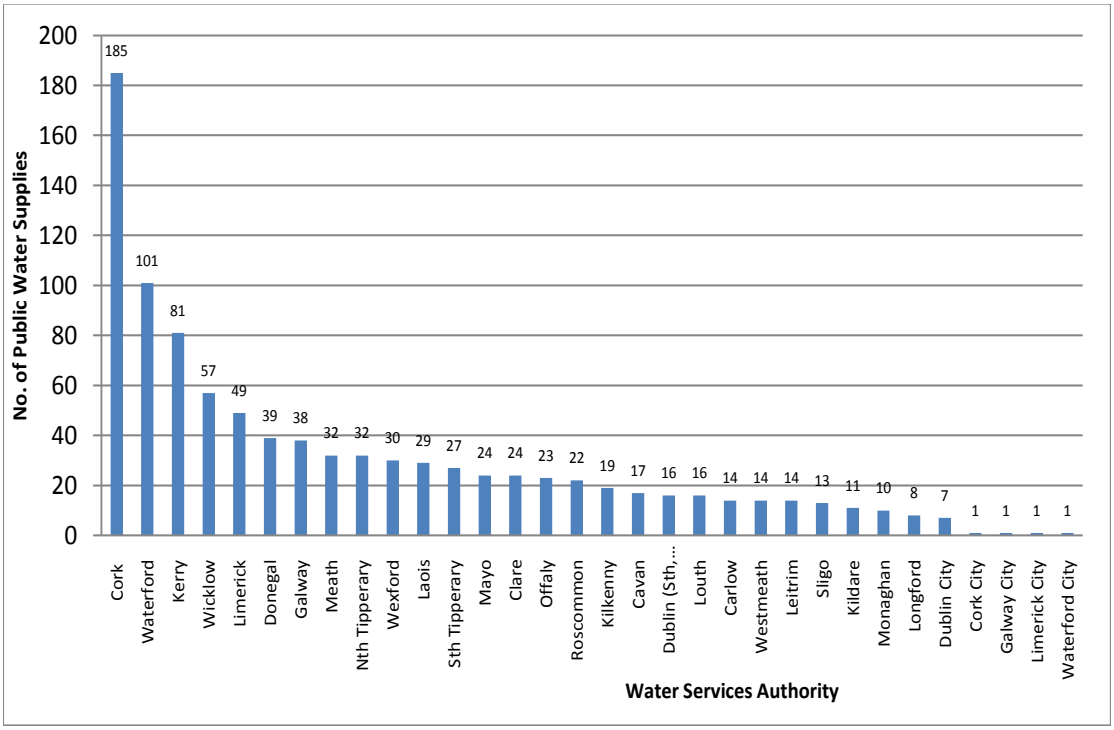


Figure 1: Number of public water supplies per Water Services Authority in Ireland.

In Ireland there are five distinct categories of water supply:

1- Public Water Supplies (PWS). These are WSA operated schemes (though these may be run by a private contractor on behalf of the WSA). They supply water to the majority of households in Ireland.
2- "Public" Group Water Schemes (PuGWS). These are schemes where the water is provided by the WSA but responsibility for distribution of the water rests with the group scheme. These schemes tend to be supplied by larger public water supplies.
3- "Private" Group Water Schemes (PrGWS). These are schemes where the owners of the scheme (usually representatives of the local community) source and distribute their own water. Combined, the "public" and "private" group water schemes supply water to around 7% of the population of Ireland.
4- Small Private Supplies (SPS). This is a group of different types of supplies (1,429) comprising industrial water supplies (such as those used in the brewing industry) to boreholes serving commercial premises (e.g. pubs, hotels etc.) and public buildings (e.g. schools, nursing homes).
5- Exempted Supplies. These are supplies serving less than 50 persons and not supplying water as part of a public or commercial activity. The majority of these supplies are private wells serving individual houses. These supplies serve approximately 12% of the population.

3.5 Fluoride additive used in water supplies in Ireland

Fluoride is a negative ion and will combine with a positive ion to produce a generally very stable compound. It comes from the element fluorine which is a gaseous halogen, a natural component of the biosphere and the thirteenth most abundant element in the earth's crust. As such, it has been found in a wide range of concentrations in virtually all inanimate and living things. Fluorine is never found in a free state in nature, but is always in combination with other elements as fluoride compounds (Reeves, 1986).

Sodium fluoride powder was first used in the early years when fluoridation started in 1960s as the source of the fluoride ion. However, many problems occurred in association with the use of a powder rather than a liquid. The sodium fluoride powder was very hygroscopic (water-absorbent) and as water treatment plants are by their nature damp places there was a tendency for the powder to become solid, resulting in major difficulties in measuring accurate amounts to add to the water. In addition, the dust from the powder was a serious health and safety hazard for water plant workers. The change to the liquid fluoride source occurred at a time when similar changes were taking place on a worldwide basis (Forum on Fluoridation, 2002).

Today, public water supplies in Ireland are fluoridated with hydrofluorosilicic acid (H_2SiF_6) that is derived from fluorspar. Since 1990, the Eastern Region Health Authority has acted as agent for the nation's health boards for the purchase of the acid. A company called Derivados Del Flúor, S.A, produces it in Spain. The acid is imported into Ireland by Albatros Fertilisers in New Ross, Co. Wexford, from where it is supplied, in a diluted form, to the water treatment plants throughout the

country. The chemicals are manufactured to exacting quality standards.

‘The hydrofluorosilicic acid (at a concentration of 37-42%) is then transported to New Ross in a 4,000 gallon sealed rubber-lined container. On arrival, laboratory personnel from Albatros Chemicals analyse the acid to confirm the concentration and to determine the amount of water required for further dilution. The acid is then diluted to a concentration of 14.0 ± 0.5% H2SiF6 using water from the New Ross public water supply. The predetermined quantities of water and acid are put into a 2,000 gallon tank. Air is supplied for mixing and agitating. After about five minutes the density is checked using a hydrometer. A reading of 1.118 denotes that the acid is within the tolerance of 13.5 to 14.5 per cent. A sample is taken to verify and certify the acid concentration. The diluted acid (14 per cent) is then stored in large storage tanks prior to distribution’ (Forum on Fluoridation, 2002).

Hydrofluorosilicic acid at a concentration of 10.9 percent is delivered to water treatment plants throughout the country. Acid is stored in large, rubber-lined tanks in these plants, the capacity of which depend on the size of the individual plant. Acid is transferred on a daily basis to a ‘day tank’ that has a capacity for approximately a 24 hours fluoride requirement. The tank is mounted on a scale and the weight before and after filling is recorded. From the day tank the acid is dosed directly into the water in proportion to the flow in the output main. The HFSA is added to water in an amount that will result in a fluoride concentration in the treated water that will conform to the limits of 0.6 to 0.8 mg/liter as laid down in the legislation. The amount added may be calculated on either a weight or a volume basis. Dosing hydrofluorosilicic acid by volume is not as accurate as doing it on a weight basis because for a given concentration of acid the specific gravity can vary from one batch

to another. Therefore dosing by weight is preferable where possible. However, the dilution required is so great that errors introduced by volume dosing will be quite small. The actual concentration of hydrofluorosilicic acid is given on the laboratory report that comes with each consignment. The Statutory Instrument also describes the specifications for the hydrofluorosilicic acid (Forum on Fluoridation, 2002).

It has been explained that hydrofluorosilicic acid is added to drinking water in order to reduce the incidence of dental decay. According to the Health Act of fluoridation of water supplies, the final concentration of hydrofluorosilicic acid in drinking water is required by legislation to 'not exceed 0.8 part by weight of fluoride per million parts of water i.e. the limit just discussed. The limit in Ireland is two-thirds of that permissible elsewhere in the EU. The acid, at 14 per cent strength, with all its constituents, is diluted appropriately when it is added to water in the water treatment plants. As a result the concentrations of trace elements such as arsenic, lead, iron and so on are diluted by the same proportion (Forum on Fluoridation, 2002).

3.6 Technical Aspects of Water Fluoridation

The Center for Disease Control (CDC) Manual Engineers and Technicians list forty-nine different chemicals that are used in the process of treating drinking water in the US, of which the addition of fluoride is only one part of the process (CDC, 1986).

There are several stages in water treatment including: clarification, filtration, disinfection, and finally fluoridation (Figure 2). This is to insure that there are no unwanted reactions with other chemicals such as alum and lime which are used in water treatment (CDC, 1986).

The concentration of fluoride is monitored daily at the water treatment plant by colorimetric testing and using calculations based on the weight of fluoride compound added to a known volume of water, the gravimetric-volumetric calculation. In some more modern water treatment plants ion specific probes or photospectrometers are used instead of colorimeters to measure fluoride concentrations (McLoughlin, 2002).

The fluoride level in the water at plant level is measured daily and that appropriate adjustments made to the dosing pumps if required. In most plants measurements are made with colorimeters, ion specific probes are used in water schemes with their own laboratory facilities (McLoughlin, 2002).

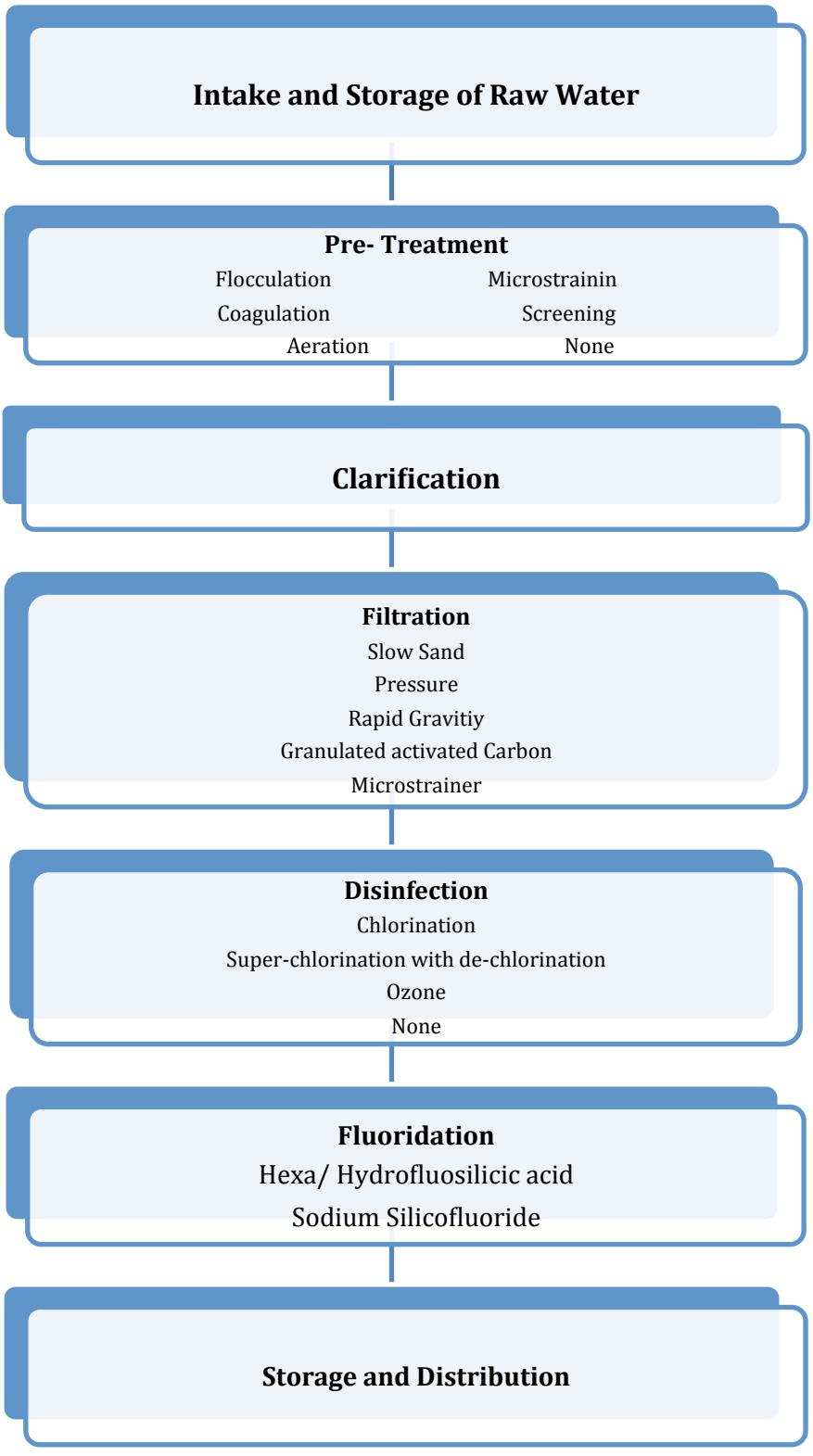


Figure 2: Water treatment process (Taken from McLoughlin, 2002)

3.7 Assessment and monitoring of the testing of fluoride levels in public water supplies and the role of different agencies involved

Fluoride levels in drinking water are monitored under the Health Act 1960 and the EU Drinking Water Quality Regulations. The Statutory Regulations which implement the Health Act 1960 require mandatory testing of fluoride levels in water supplies on a daily (colorimetric) and monthly (distillation) basis. The requirement for regular monitoring has been met from the outset, with sampling being carried out by authority personnel and analysis (Forum On Fluoridation, 2002). In the current situation local authorities are required to do daily testing, however, it varies between different schemes and generally tests done 5/7 days per week. The two main tests conducted are:

1- Colorimetric (Hak system): An ampule of test reagent is broken into a sample of water and the reagent is then drawn into the solution. The depth of colour is proportionate to fluoride concentration. A colour disc is used, to make comparison. The Environmental Health Officer also uses Hak system as an early warning method. There can be inaccuracies as a result of interference from other substances (e.g. aluminium, Iron).
2- Volumetric: based on calculation of weight of acid used. More sophisticated plants have online monitoring. No sample needed. Reagent used but automatic sampling and readings continuously.

In the Cork Area the Fluoride Ion Selective Electrode is used. The Irish National Accreditation Board accredits the results. The uncertainty of measurement that is reported is 14% (± 0.044ppm). The uncertainty of measurement is based on the classification of the results i.e. satisfactory, marginal, and unsatisfactory. This uncertainty in measurement creates a challenge in reporting the results. For example, any report of results up

to .8044 may in fact be within the upper statutory limit of 0.8ppm and not under the unsatisfactory column. This development highlights the issue of the accuracy of the testing equipment at plant level and at the Public Analyst Laboratories equipment. Since results are reported in two, three, and up to ten decimal places at each scheme, the degree of uncertainty will have an effect on the overall compliance not to exceed the recommended levels of fluoride.

The following paragraphs draw a diagram of the responsibilities and roles of different agencies involved in the assessment and monitoring of water fluoridation in Ireland (Figure 3).

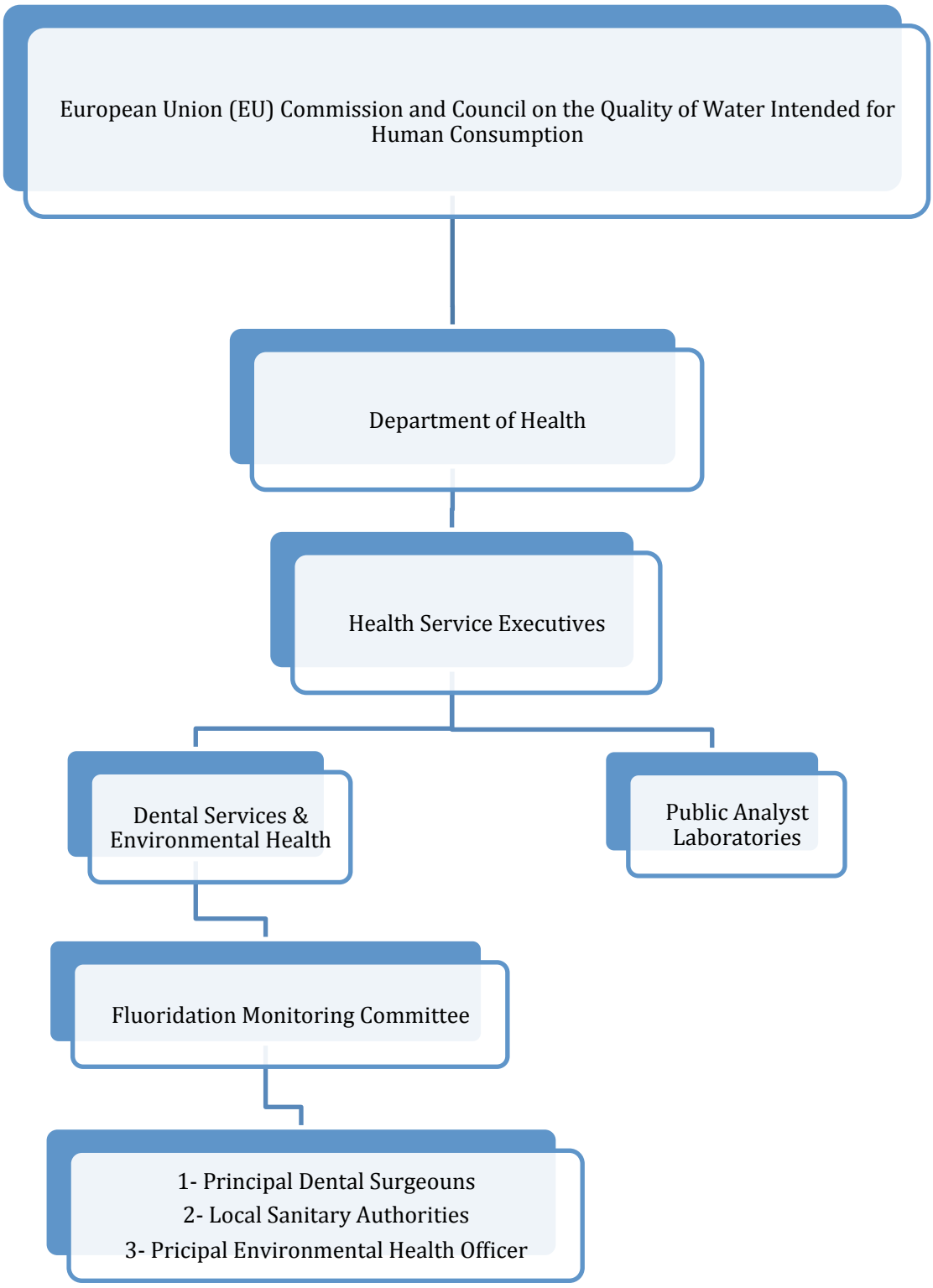


Figure 3: Diagram of the different agencies involving in the assessment and monitoring of water fluoridation in Ireland

At the top of the pyramid are the European Union (EU) Commission and Council on the Quality of Water Intended for Human Consumption. Ireland as a EU member must adhere to EU directives that are translated into practice in Ireland through Statutory Instrument (SI). Strict regulations and consideration by the EU comity's experts and scientists are legislated and adopted under the Directive 98/83/EC, of November 1998. This act had some amendments in 2009 under Regulation EC 596/2009 however the recommended fluoride concentration of 1.5 mg/L has not changed.

However, in Ireland, under the act S.I. No. 42/2007 the regulations specified "the amount of fluoride which may be added to public water supplies shall be such that the water, after the addition of the fluoride, shall contain no more than 0.8 milligrams of fluoride per litre (mg/1) of water, and not less than 0.6 milligrams of fluoride per litre (mg/1) of water". This lower figure is still in force as the national standard.

Beneath the EU commissions lay two departments that are involved in fluoridation of water supplies in Ireland. The first is the Department of Health; the second is the Environment Community and local Government.

The Department of Health includes the Health Services Executive (HSE) where all reports goes before conveying any information back to the Ministry. The HSE itself has two divisions:

1- Dental Services and Environmental Health that includes the Fluoridation Monitoring Committee. Currently the Dental Services is down from 32 a Principal Dental Surgeon (PDS) to 17 Local Sanitary

Authorities with regional responsibility for water fluoridation.

2- Public Analyst Laboratories where the actual testing of fluoride level is carried out. There are three Public Analyst Laboratories in Dublin, Cork and Galway. The monthly test report on water samples may be returned to the Principal Environmental Health Officer, the Principal Dental Surgeon or the Senior Area Medical Officer. The ISO 17025 Laboratory Accreditation Standard has now accredited the three laboratories.

In Cork city and county areas the environmental health officers take monthly samples from the distribution system (typically at a consumer's tap) i.e. not at the treatment plant, and send this sample to the Public Analyst's laboratory where the analysis is actually carried out i.e. the EH service does not itself carry out the analysis of the sample. In some areas of the country the environmental health officers take a second sample at the same time as the monthly sample for submission to the public analyst's laboratory. This second sample is analysed using the HACH colorimetric testing system.

CHAPTER 4

Results

County Cork is divided into 4 areas: West Cork, South Lee, North Lee and North Cork. Data available from 34 schemes monthly test for the period 2001-2012 are included. Data were obtained from the Environmental Health Officers Reports and the Public Analyst Laboratories.

It should be noted that raw data were reported from one decimal place up to ten decimal places. However, for the purpose of this analysis results were reported to three decimal places.

For the periods 2000- June 2007 data are reported in three categories: satisfactory, marginal, and unsatisfactory. Data reported from July 2007-2012 have two categories satisfactory and unsatisfactory. For each Scheme there are four tables, one line chart and two bar charts. Table a: Shows the results of fluoride readings from 2001 up to June 2007. Table b: Shows results of table (a) but it include all the marginal readings in the unsatisfactory column for comparisons. Table c: Shows results of fluoride readings from July 2007 up to 2012. Table d: shows the percentage of unsatisfactory results before and after July 2007. Each Chart represents a scheme. It has a red line indicating the month of July 2007 when the new regulation was established, and an orange line indicating the European maximum allowed concentration of 1.5ppm. Bar charts show the combined percentages of satisfactory and unsatisfactory results for each zone. All tables were categorized according to the following:

	Class	Range Min	Range Max
Up to June 2007	Satisfactory	0.8	1.0
	Marginal	0.7	0.8
	Marginal	1.0	1.1
	Unsatisfactory	0.1	0.7
	Unsatisfactory	1.1	9.0

	Class	Range Min	Range Max
From July 2007	Satisfactory	0.6	0.8
	Unsatisfactory	0.1	0.6
	Unsatisfactory	0.8	9.0

Table 4.1: Classification of satisfactory and unsatisfactory categories

4.1 Area #1 West Cork

4.1.1 Baltimore

Table 4.1.1.a Baltimore : Fluoride results up to June 2007 with Marginal results		
	n	**%**
Satisfactory	**68**	**78%**
Marginal	**13**	**15%**
Unsatisfactory	**1**	**1%**
No data available	**5**	**6%**
Total	**87**	**100%**

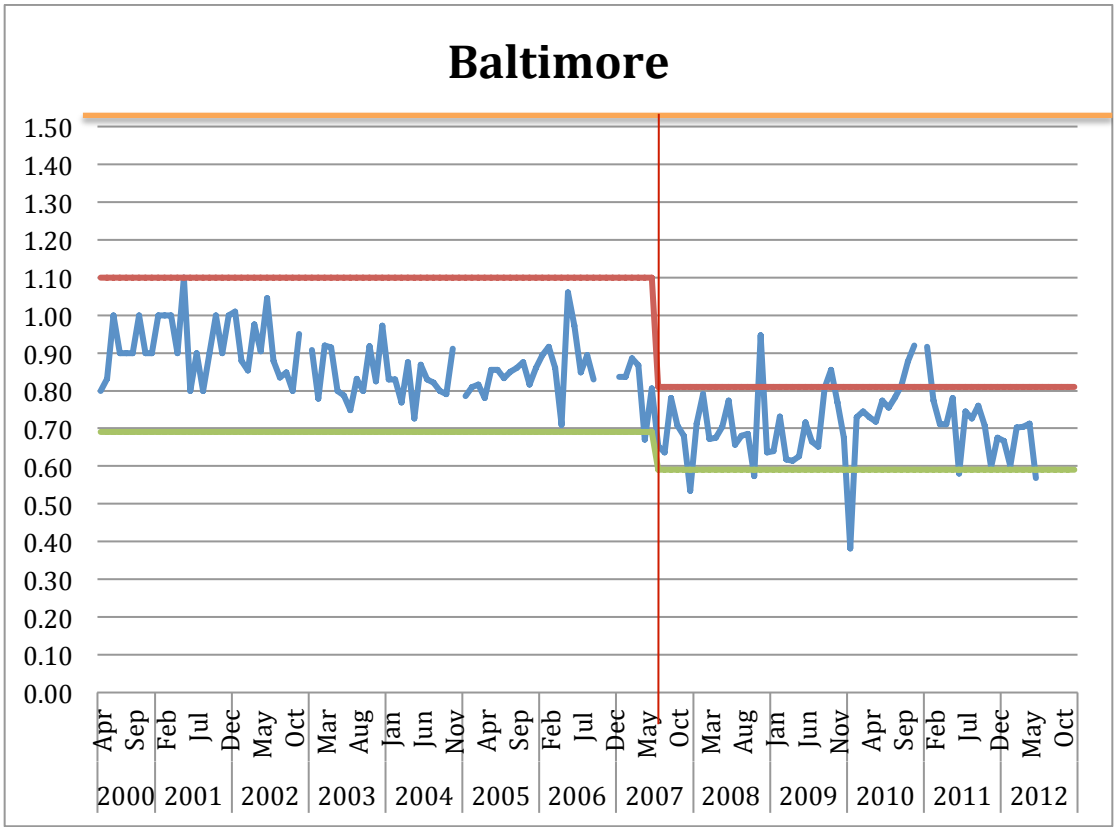
Table 4.1.1.b Baltimore: Fluoride results up to June 2007 without Marginal results		
	n	**%**
Satisfactory	**68**	**78%**
Marginal	**0**	**0%**
Unsatisfactory	**14**	**16%**
No Data Available	**5**	**6%**
Total	**87**	**100%**

Table 4.1.1.c Baltimore: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	46	70%
Marginal	0	0%
Unsatisfactory	13	20%
No data available	7	11%
Total	66	100%

Table 4.1.1.d Baltimore: The Percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	1	100%
Unsatisfactory = > 1.1	0	0%
Total	1	100%

From July 2007	n	%
Unsatisfactory = < 0.6	6	46%
Unsatisfactory = > 0.8	7	54%
Total	13	100%

Chart 4.1.1 Baltimore: fluoride results 2001-2012



4.1.2 Bantry (High) Derryginagh

Table 4.1.2.a Bantry High: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	39	45%
Marginal	19	22%
Unsatisfactory	24	28%
No data available	5	6%
Total	87	100%

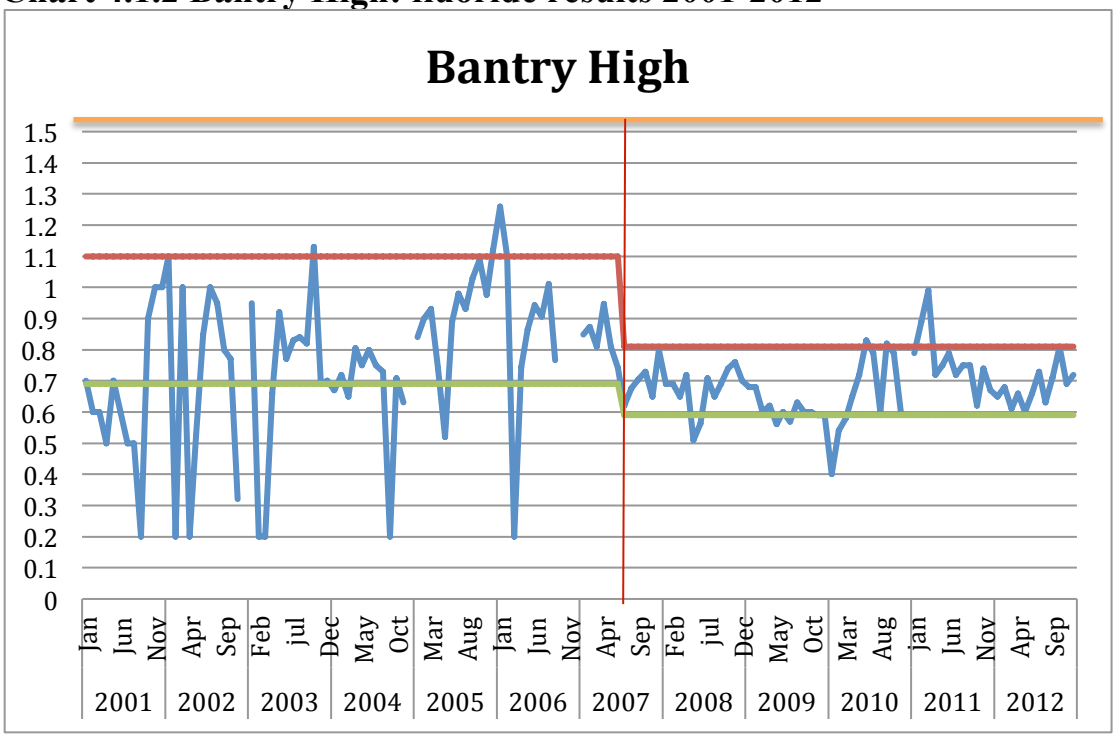
Table 4.1.2.b Bantry High: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	39	45%
Marginal	0	0%
Unsatisfactory	43	49%
No data available	5	6%
Total	87	100%

Table 4.1.2.c Bantry High: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	42	74%
Marginal	0	0%
Unsatisfactory	14	25%
No data available	1	2%
Total	57	100%

Table 4.1.2.d Bantry High: percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	21	88%
Unsatisfactory => 1.1	3	13%
Total	24	100%

From July 2007	n	%
Unsatisfactory =< 0.6	9	64%
Unsatisfactory => 0.8	5	36%
Total	14	100%

Chart 4.1.2 Bantry High: fluoride results 2001-2012



4.1.3. Bantry Low

Table 4.1.3.a Bantry Low: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	44	52%
Marginal	9	11%
Unsatisfactory	26	31%
No data available	5	6%
Total	84	100%

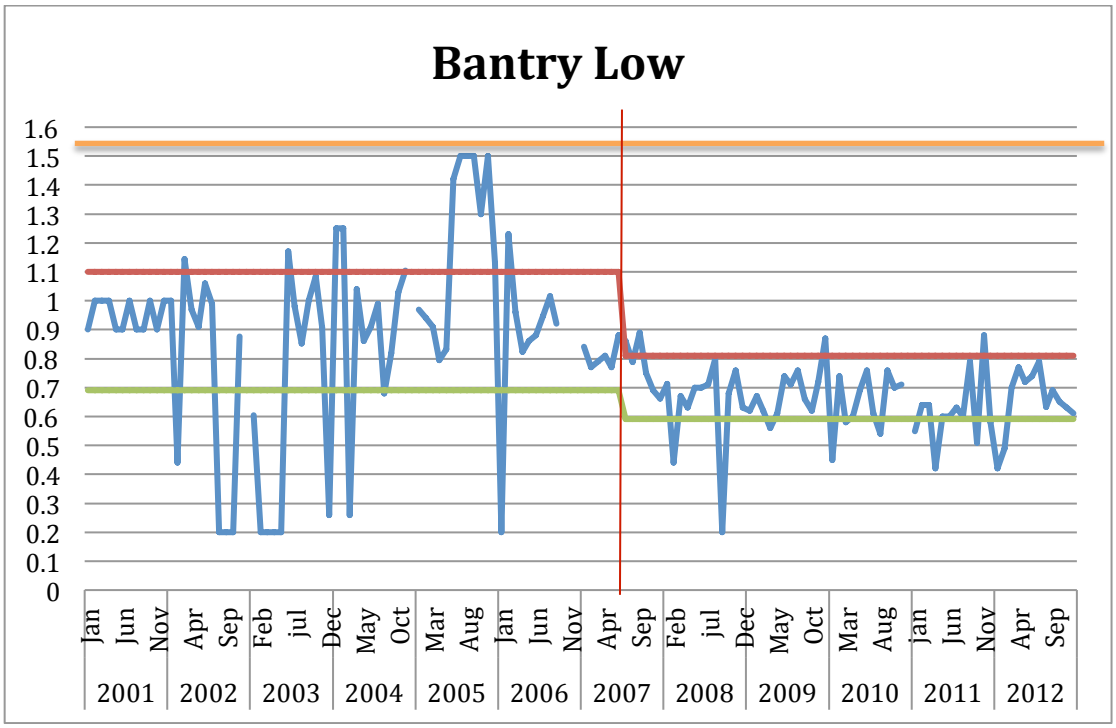
Table 4.1.3.b Bantry Low: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	44	52%
Marginal	0	0%
Unsatisfactory	35	42%
No data available	5	6%
Total	84	100%

Table 4.1.3.c Bantry Low: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	43	72%
Marginal	0	0%
Unsatisfactory	16	27%
No data available	1	2%
Total	60	100%

Table 4.1.3.d Bantry Low: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	13	50%
Unsatisfactory => 1.1	13	50%
Total	26	100%

From July 2007	n	%
Unsatisfactory =< 0.6	12	75%
Unsatisfactory => 0.8	4	25%
Total	16	100%

Chart 4.1.3 Bantry Low: fluoride results 2001-2012



4.1.4 Castletownbere

Table 4.1.4.a Castletownbere: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	62	71%
Marginal	12	14%
Unsatisfactory	8	9%
No data available	5	6%
Total	87	100%

Table 4.1.4.b Castletownbere: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	62	71%
Marginal	0	0%
Unsatisfactory	20	23%
No data available	5	6%
Total	87	100%

Table 4.1.4.c Castletownbere: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	52	79%
Marginal	0	0%
Unsatisfactory	13	20%
No data available	1	2%
Total	66	100%

Table 4.1.4.d Castletownbere: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	3	38%
Unsatisfactory => 1.1	5	63%
Total	8	100%

From July 2007	n	%
Unsatisfactory =< 0.6	11	85%
Unsatisfactory => 0.8	2	15%
Total	13	100%

Chart 4.1.4 Casteltownbere: fluoride results 2001-2012

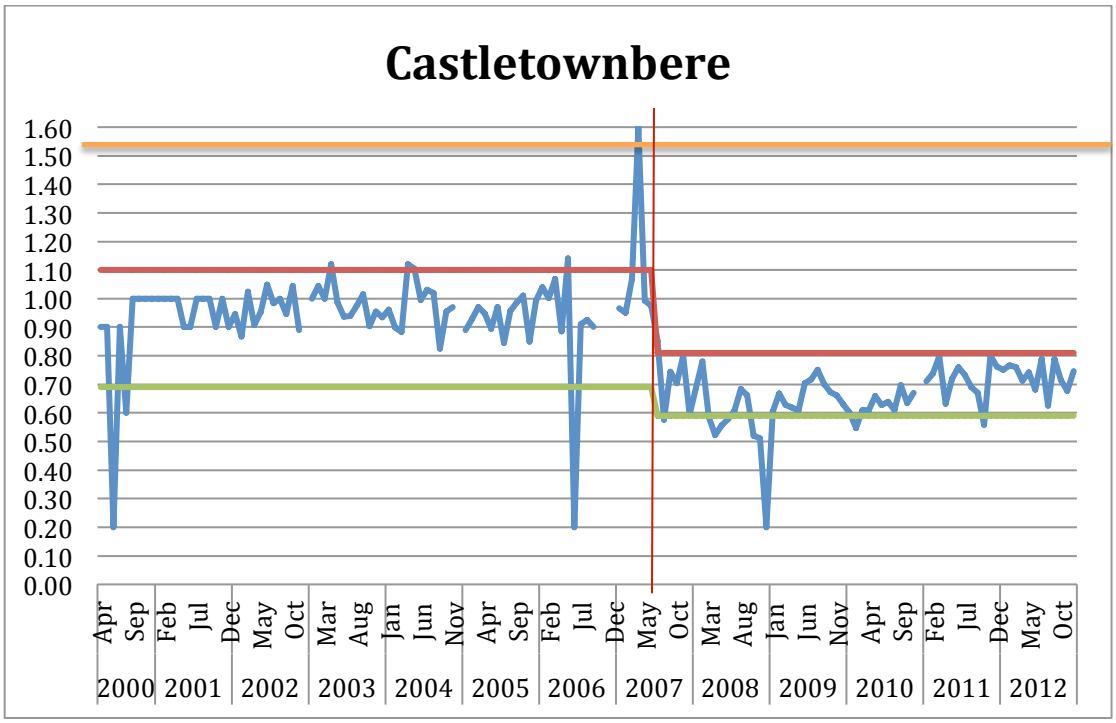


Table 4.1.5 Clonakilty

Table 4.1.5.a Clonkilty: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	73	84%
Marginal	7	8%
Unsatisfactory	2	2%
No data available	5	6%
Total	87	100%

Table 4.1.5.b Clonkilty: Fluoride results up to June 2007 without Marginal results

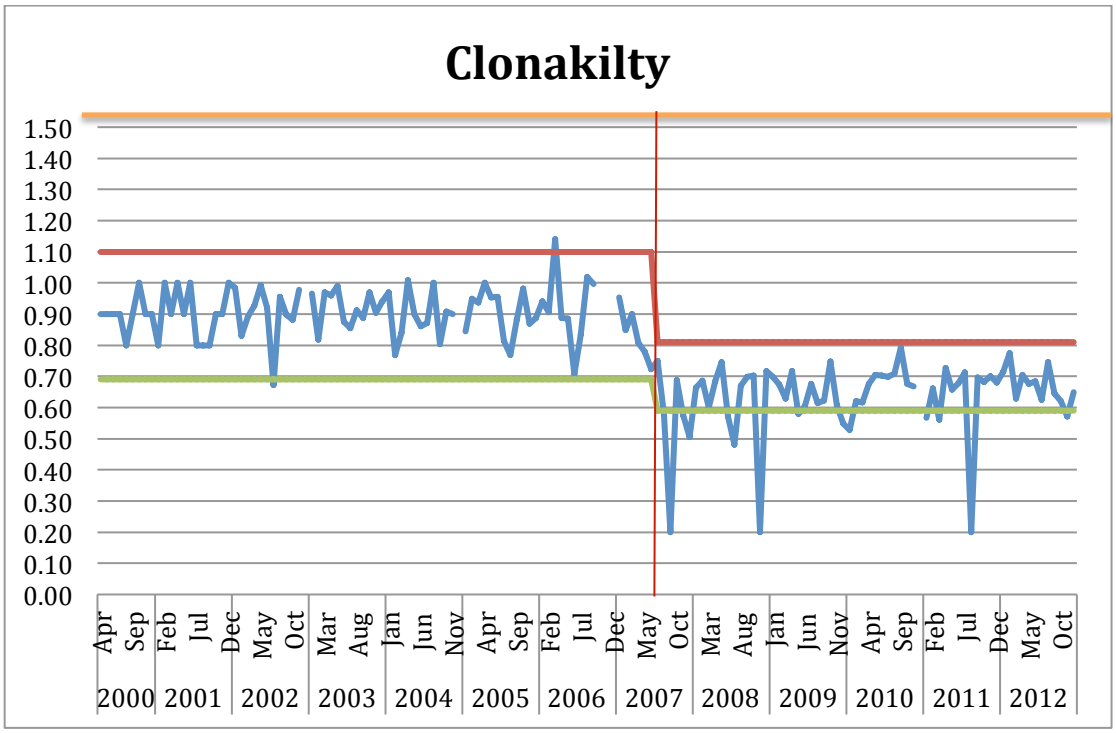
	n	%
Satisfactory	73	84%
Marginal	0	0%
Unsatisfactory	9	10%
No data available	5	6%
Total	87	100%

Table 4.1.5.c Clonkilty: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	50	76%
Marginal	0	0%
Unsatisfactory	15	23%
No data available	1	2%
Total	66	100%

Table 4.1.5.d Clonkilty: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	1	50%
Unsatisfactory => 1.1	1	50%
Total	2	100%

From July 2007	n	%
Unsatisfactory =< 0.6	15	100%
Unsatisfactory => 0.8	0	0%
Total	15	100%

Chart 4.1.5 Clonkilty: fluoride results 2001-2012



4.1.6 Dunmanway

Table 4.1.6.a Dunmanway: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	60	69%
Marginal	11	13%
Unsatisfactory	11	13%
No data available	5	6%
Total	87	100%

Table 4.1.6.b Dunmanway: Fluoride results up to June 2007 without Marginal results

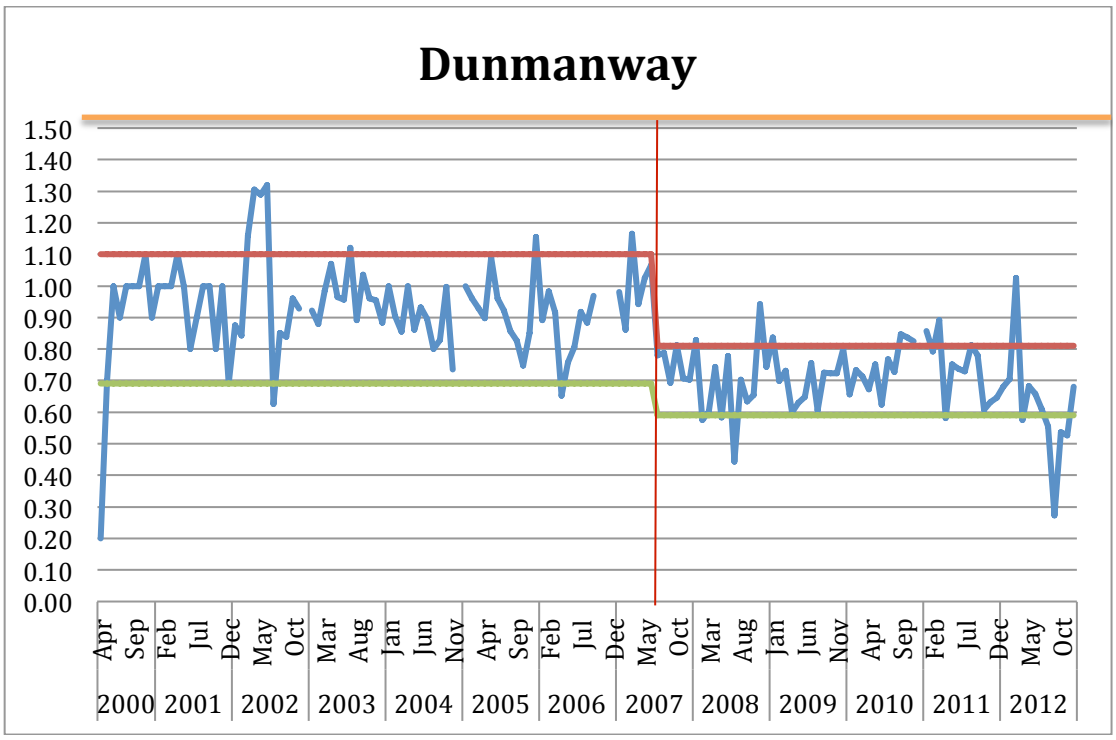
	n	%
Satisfactory	60	69%
Marginal	0	0%
Unsatisfactory	22	25%
No data available	5	6%
Total	87	100%

Table 4.1.6.c Dunmanway: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	45	68%
Marginal	0	0%
Unsatisfactory	20	30%
No data available	1	2%
Total	66	100%

Table 4.1.6.d Dunmanway: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	4	36%
Unsatisfactory => 1.1	7	64%
Total	11	100%

From July 2007	n	%
Unsatisfactory =< 0.6	9	45%
Unsatisfactory => 0.8	11	55%
Total	20	100%

Chart 4.1.6 Dunmanway: fluoride results 2001-2012



4.1.7 Skibereen

Table 4.1.7.a Skibbereen: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	76	87%
Marginal	3	3%
Unsatisfactory	2	2%
No data available	6	7%
Total	87	100%

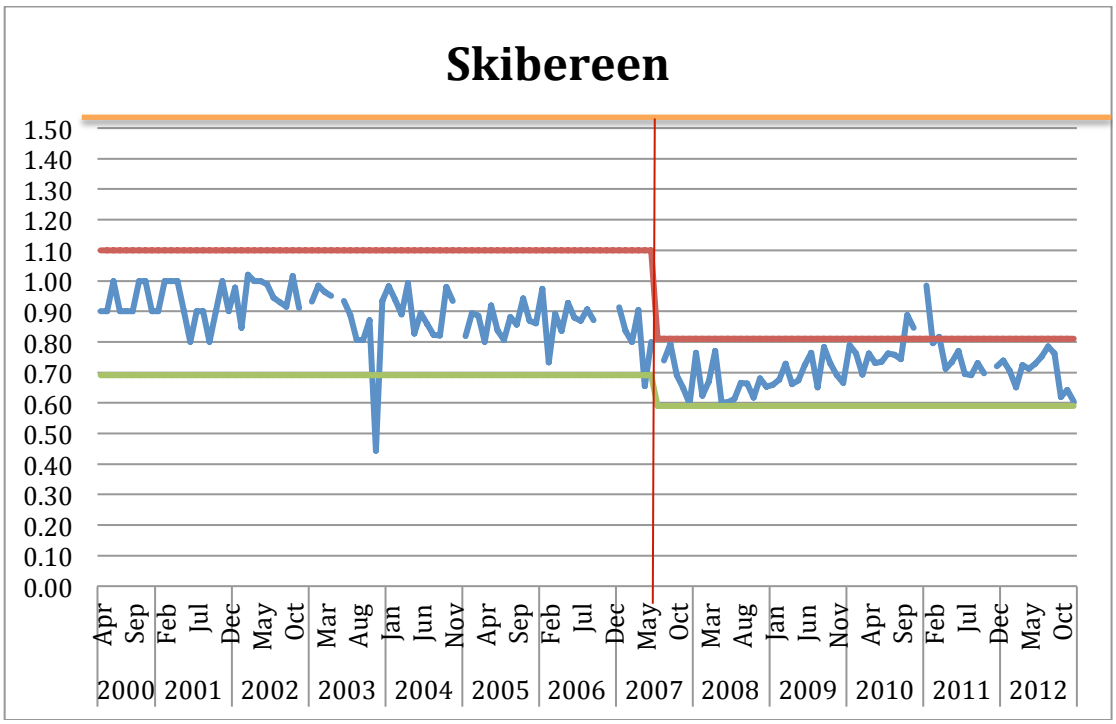
Table 4.1.7.b Skibbereen: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	76	87%
Marginal	0	0%
Unsatisfactory	5	6%
No data available	6	7%
Total	87	100%

Table 4.1.7.c Skibbereen: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	58	88%
Marginal	0	0%
Unsatisfactory	5	8%
No data available	3	5%
Total	66	100%

Table 4.1.7.d Skibbereen: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	2	100%
Unsatisfactory => 1.1	0	0%
Total	2	100%

From July 2007	n	%
Unsatisfactory =< 0.6	1	20%
Unsatisfactory => 0.8	4	80%
Total	5	100%

Chart 4.1.7 Skibbereen: fluoride results 2001-2012



4.1.8 Union Hall

Table 4.1.8.a Union Hall: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	2	50%
Unsatisfactory	2	50%
Total	4	100%

Table 4.1.8.b Union Hall: The percentage of unsatisfactory results before and after July 2007		
	n	%
Unsatisfactory =< 0.6	2	100%
Unsatisfactory => 0.8	0	0%
Total	2	100%

Chart 4.1.8 Union Hall: fluoride results 2007-2012

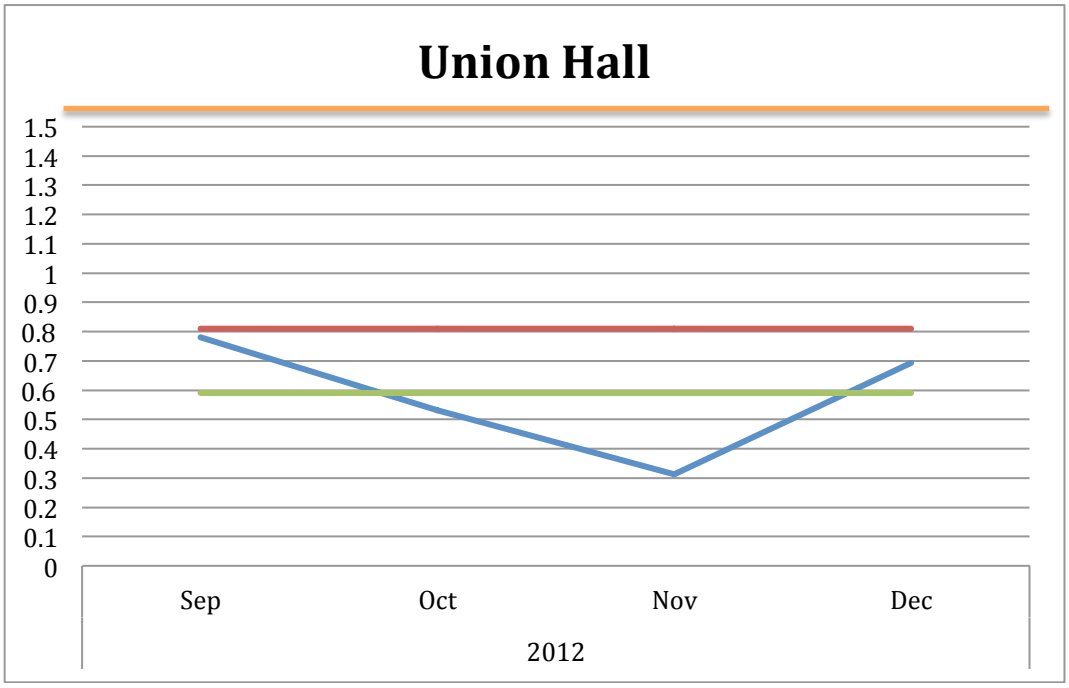


Table 4.1.9 Combined percentages of satisfactory and unsatisfactory results for West Cork

West Cork		
Up to June 2007		
	n	%
Satisfactory	422	69%
Unsatisfactory	77	13%
Marginal	74	12%
None	36	6%
Total	609	100%

From July 2007		
Satisfactory	338	75%
Unsatisfactory	95	21%
None	15	3%
Total	448	100%

Up to June 2007		
Satisfactory	422	69%
Unsatisfactory	151	25%
Marginal	0	0%
None	36	6%
Total	609	100%

Chart 4.1.9: Combined Chart for West Cork prior to July 2007

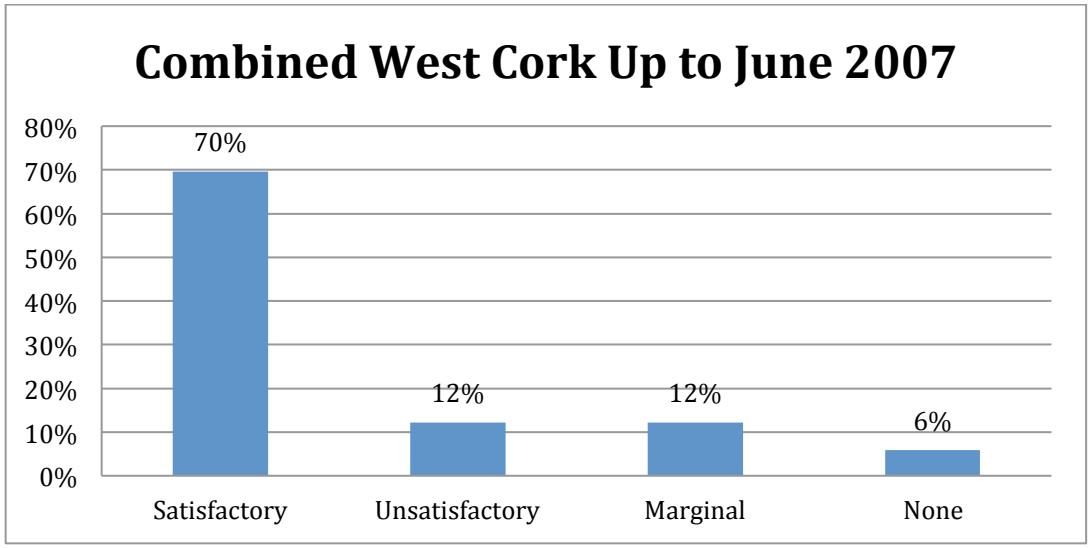
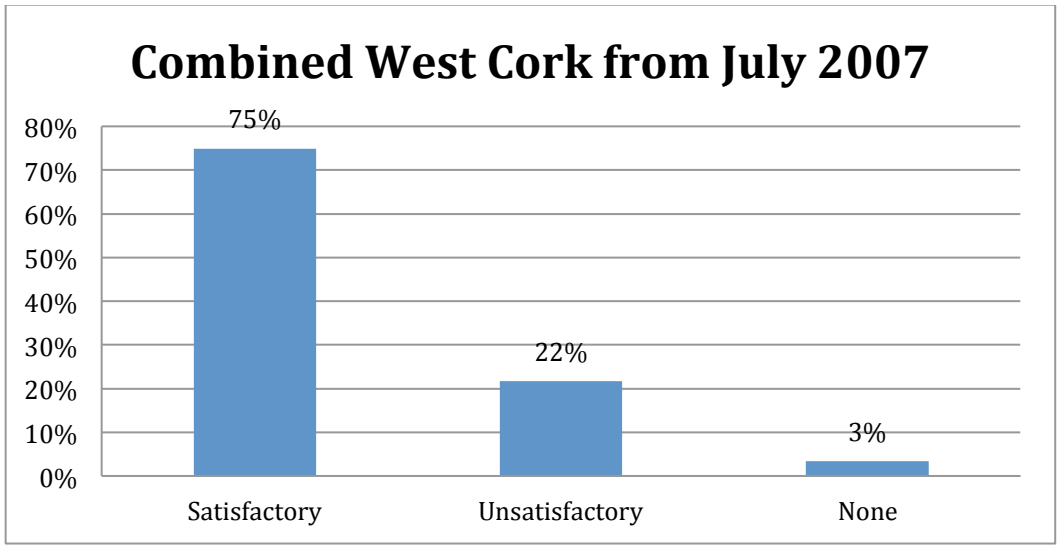


Chart 4.1.10: Combined Chart for West Cork after to July 2007



4.2 Area #2 South Lee

4.2.1 Bandon

4.2.1.a Bandon: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	58	74%
Marginal	13	17%
Unsatisfactory	3	4%
No data available	4	5%
Total	78	100%

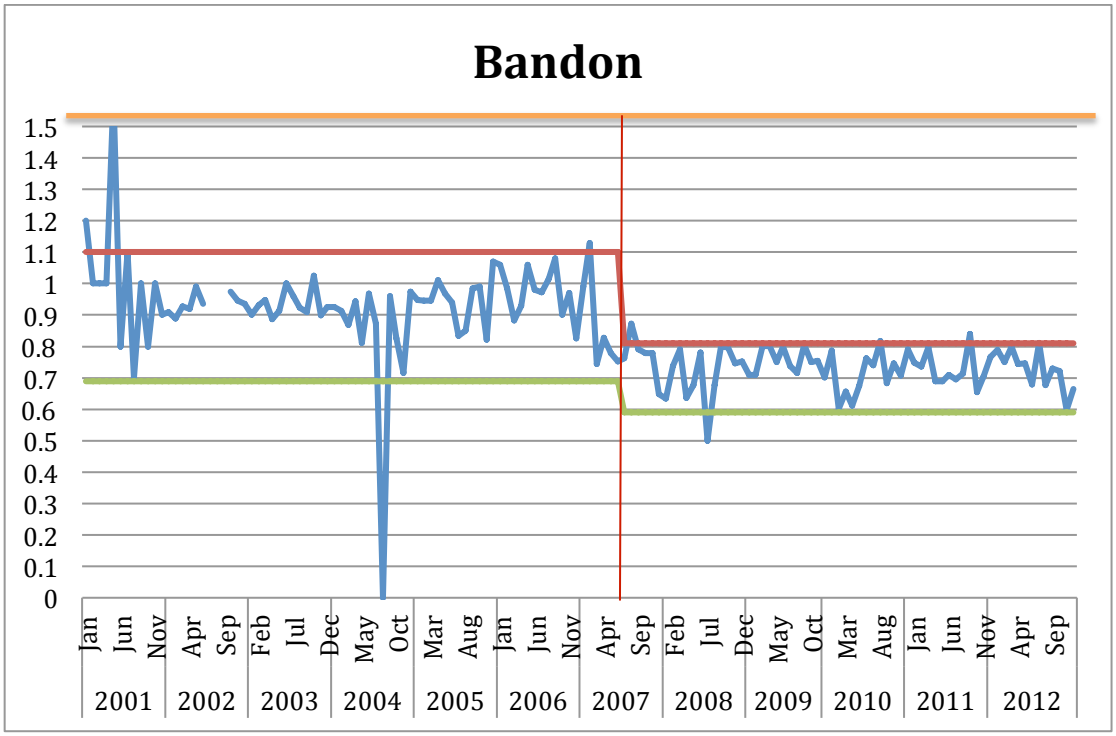
Table 4.2.1.b Bandon: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	58	74%
Marginal	0	0%
Unsatisfactory	16	21%
No data available	4	5%
Total	78	100%

Table 4.2.1.c Bandon: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	57	86%
Marginal	0	0%
Unsatisfactory	9	14%
No data available	0	0%
Total	66	100%

Table 4.2.1.d Bandon: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	**n**	**%**
Unsatisfactory =< 0.7	0	0%
Unsatisfactory => 1.1	3	100%
Total	3	100%

From July 2007	n	%
Unsatisfactory =< 0.6	2	22%
Unsatisfactory => 0.8	7	78%
Total	9	100%

Chart 4.2.1 Bandon: fluoride results 2001-2012



4.2.2 Kinsale

Table 4.2.2.a Kinsale: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	66	85%
Marginal	7	9%
Unsatisfactory	1	1%
No data available	4	5%
Total	78	100%

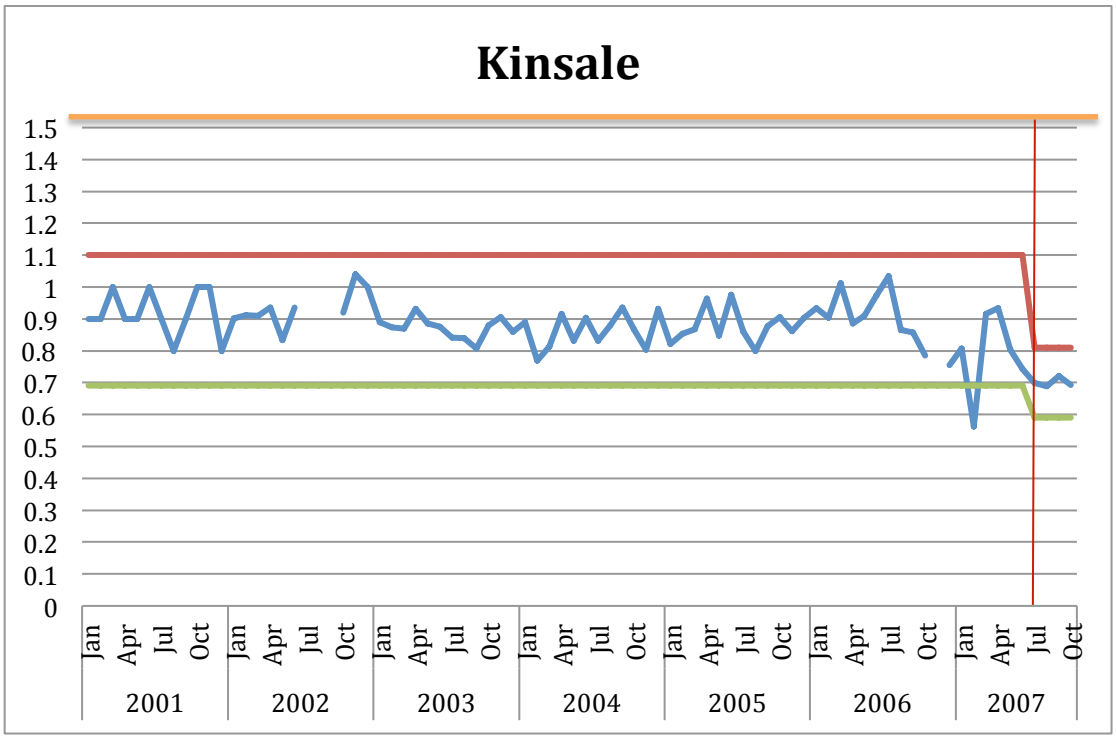
Table 4.2.2.b Kinsale: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	66	85%
Marginal	0	0%
Unsatisfactory	8	10%
No data available	0	0%
Total	74	95%

Table 4.2.2.c Kinsale: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	4	5%
Marginal	0	0%
Unsatisfactory	0	0%
No data available	0	0%
Total	4	5%

Table 4.2.2.d Kinsale: the percentage of unsatisfactory results before and after July 2007		
Up to June 2007	**n**	**%**
Unsatisfactory =< 0.7	**1**	**100%**
Unsatisfactory => 1.1	**0**	**0%**
Total	**1**	**100%**

From July 2007	n	%
Unsatisfactory =< 0.6	**0**	**0**
Unsatisfactory => 0.8	**0**	**0**
Total	**0**	**0**

Chart 4.2.2 Kinsale: fluoride results 2001-2012



4.2.3 Inishannon

Table 4.2.3.a Inishannon: Fluoride results up to June 2007 with Marginal results		
Satisfactory	69	88%
Marginal	6	8%
Unsatisfactory	0	0%
No data available	3	4%
Total	78	100%

Table 4.2.3.b Inishannon: Fluoride results up to June 2007 without Marginal results		
Satisfactory	69	88%
Marginal	0	0%
Unsatisfactory	6	8%
No data available	3	4%
Total	78	100%

Table 4.2.3.c Inishannon: Fluoride results from July 2007 and up to 2012		
Satisfactory	64	97%
Marginal	0	0%
Unsatisfactory	2	3%
No data available	0	0%
Total	66	100%

Table 4.2.3.d Inishannon: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	0	0
Unsatisfactory => 1.1	0	0
Total	0	0

From July 2007		
Unsatisfactory =< 0.6	1	50%
Unsatisfactory => 0.8	1	50%
Total	2	100%

Chart 4.2.3 Innishannon: fluoride results 2001-2012

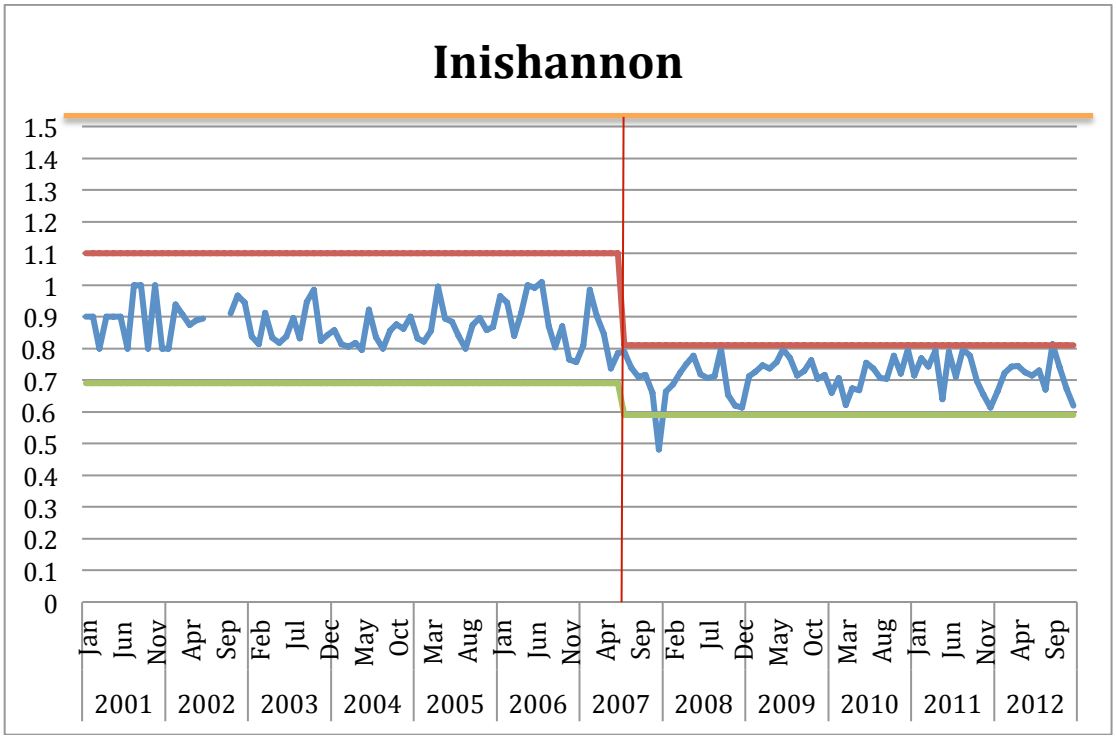


Table 4.2.4 Combined percentages of satisfactory and unsatisfactory results for South Lee

South Lee		
Up to June 2007		
	n	%
Satisfactory	127	76%
Unsatisfactory	8	5%
Marginal	26	15%
No data available	7	4%
Total	168	100%

From July 2007		
Satisfactory	125	92%
Unsatisfactory	11	8%
No data available	0	0%
Total	136	100%

Up to June 2007		
Satisfactory	127	76%
Unsatisfactory	34	20%
Marginal	0	0%
No data available	7	4%
Total	168	100%

Chart 4.2.4: Combined Chart for North Lee prior to July 2007

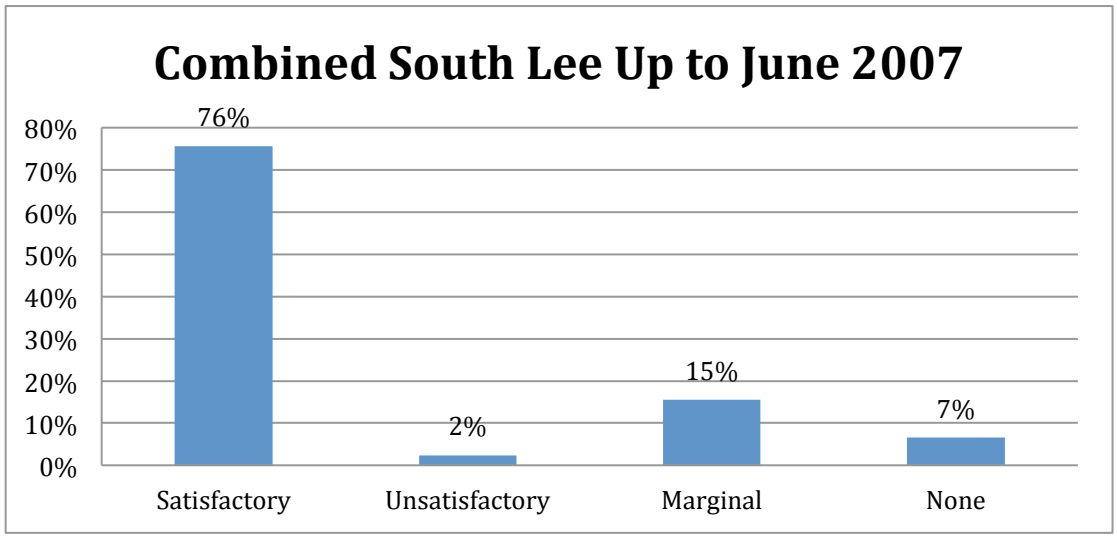
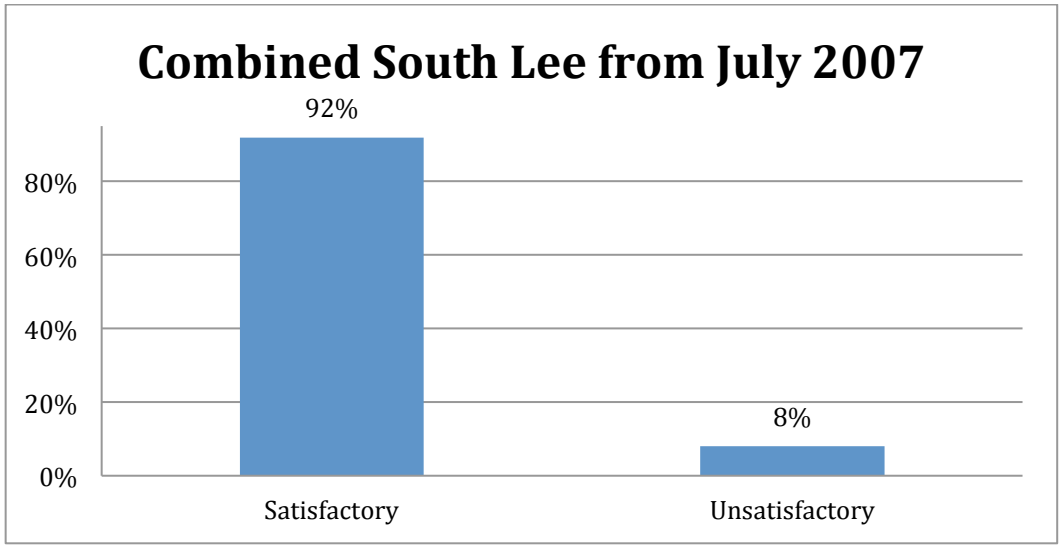


Chart 4.2.5: Combined Chart for North Lee after to July 2007



4.3 Area #3 North Lee

4.3.1 Cobh

Table 4.3.1.a Cobh: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	44	56%
Marginal	18	23%
Unsatisfactory	16	21%
Total	78	100%

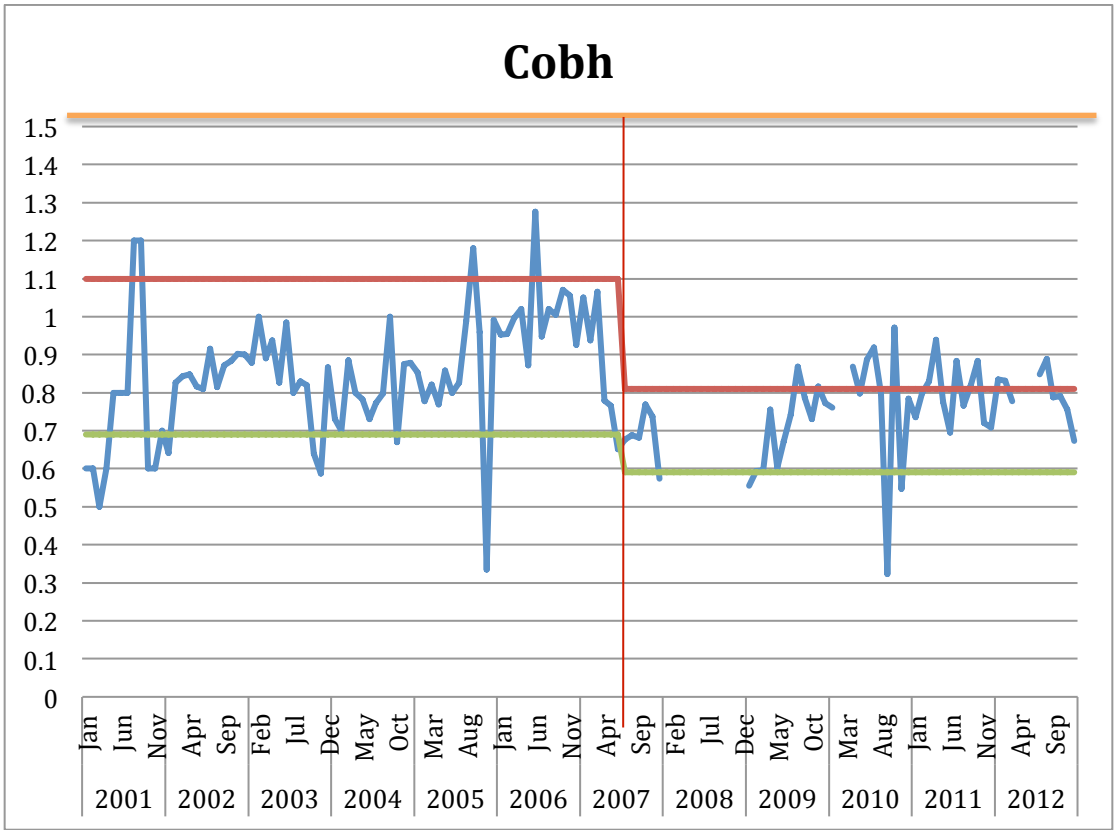
Table 4.3.1.b Cobh fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	44	56%
Marginal	0	0%
Unsatisfactory	34	44%
Total	78	100%

Table 4.3.1.c Cobh: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	28	42%
No data available	17	26%
Unsatisfactory	21	32%
Total	66	100%

Table 4.3.1.d Cobh: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	12	75%
Unsatisfactory = > 1.1	4	25%
Total	16	100%

From July 2007	n	%
Unsatisfactory = < 0.6	6	29%
Unsatisfactory = > 0.8	15	71%
Total	21	100%

Chart 4.3.1 Cobh: fluoride results 2001-2012



4.3.2 Cork City and Harbour

Table 4.3.2.a Cork City & Harbour: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	70	90%
Marginal	6	8%
Unsatisfactory	2	3%
Total	78	100%

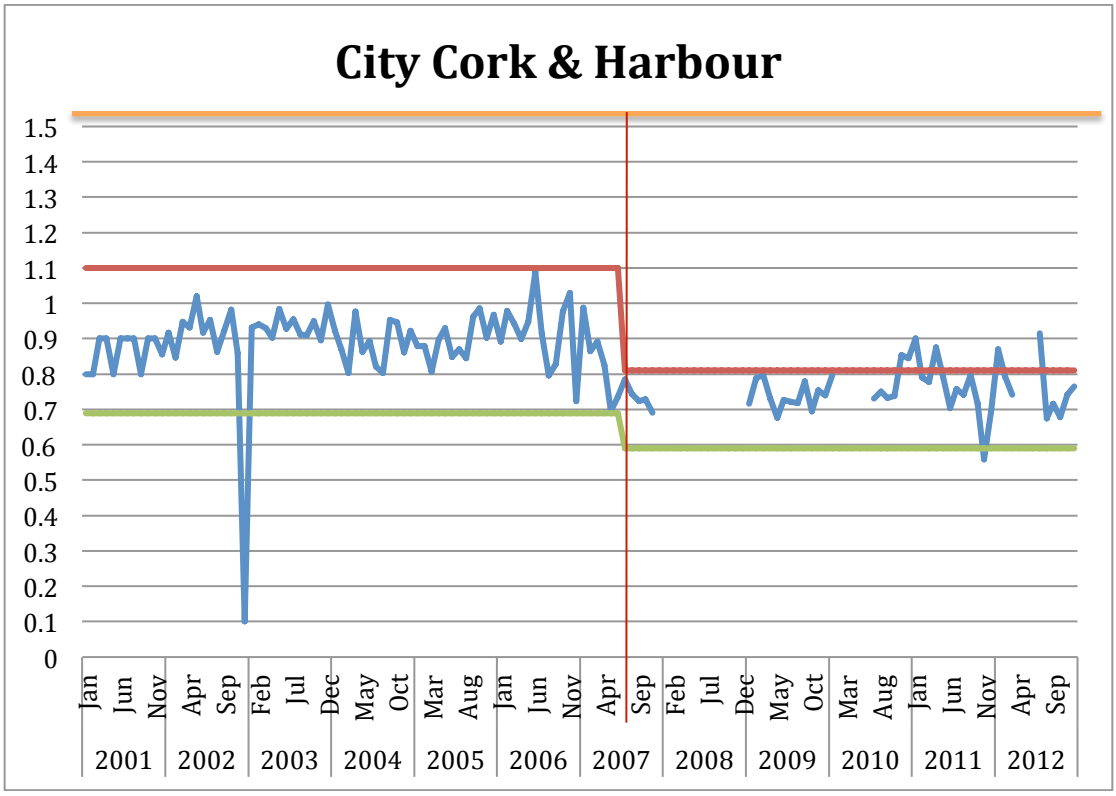
Table 4.3.2.b Cork City & Harbour: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	70	90%
Marginal	0	0%
Unsatisfactory	8	10%
Total	78	100%

Table 4.3.2.c Cork City & Harbour: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	38	58%
No data available	21	32%
Unsatisfactory	7	11%
Total	66	100%

Table 4.3.2.d Cork City & Harbour: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	100%
Unsatisfactory = > 1.1	0	0
Total	2	1

From July 2007	n	%
Unsatisfactory = < 0.6	1	14%
Unsatisfactory = > 0.8	6	86%
Total	7	100%

4.3.2 Cork City and Harbour High fluoride results 2001-2012



Note: 2008 data is missing due to data lost from the system.

4.3.3 Lee Road

Table 4.3.3.a Lee Road Waterworks: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	71	91%
Marginal	4	5%
Unsatisfactory	2	3%
No data available	1	1%
Total	78	100%

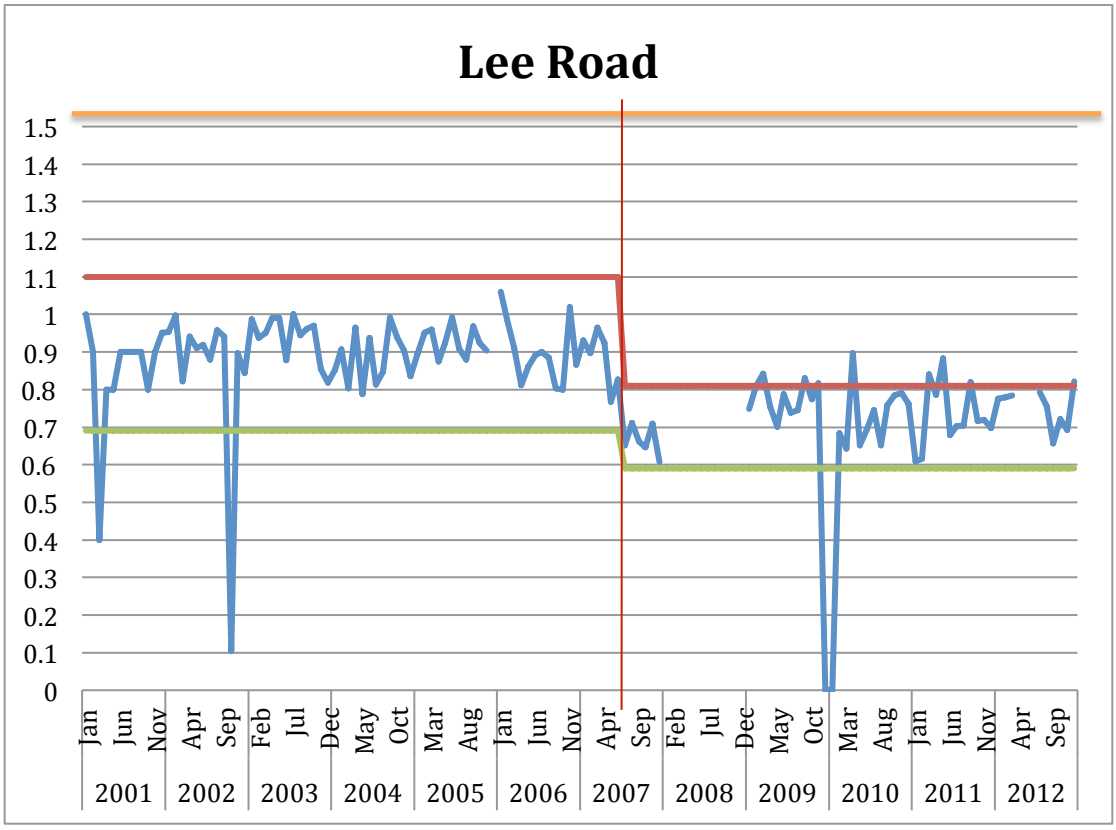
Table 4.3.3.b Lee Road Waterworks: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	71	91%
Marginal	0	0%
Unsatisfactory	6	8%
No data available	1	1%
Total	78	100%

4.3.3.c Lee Road Waterworks: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	40	61%
No data available	17	26%
Unsatisfactory	9	14%
Total	66	100%

Table 4.3.3.d Lee Road Waterworks: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	100%
Unsatisfactory = > 1.1	0	0%
Total	2	100%

From July 2007	n	%
Unsatisfactory = < 0.6	0	0%
Unsatisfactory = > 0.8	9	100%
Total	9	100%

4.3.3 Lee Road Waterworks fluoride results 2001-2012



Note: 2008 Data missing due to major flooding.

4.3.4 Cloyne Aghada

Table 4.3.4.a Cloyne/Aghada: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	59	76%
Marginal	10	13%
Unsatisfactory	2	3%
No data available	7	9%
Total	78	100%

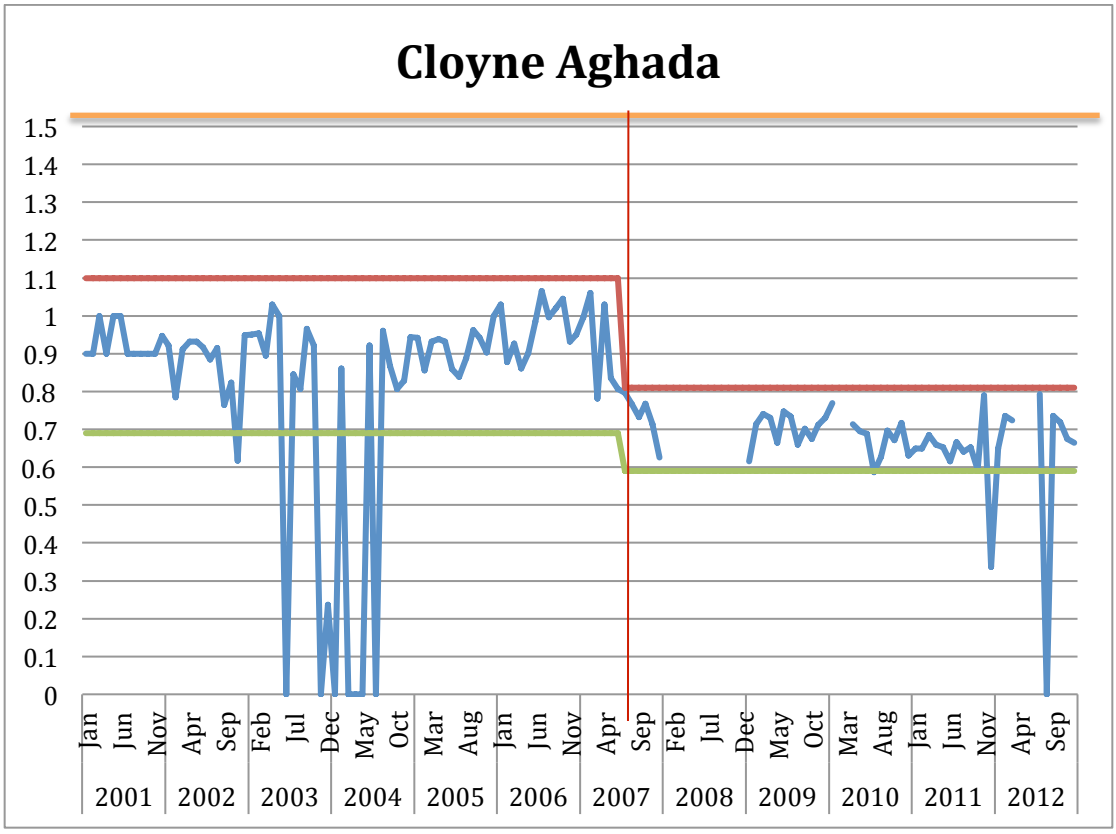
Table 4.3.4.b Cloyne/Aghada: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	59	76%
Marginal	0	0%
Unsatisfactory	12	15%
No data available	7	9%
Total	78	100%

Table 4.3.4.c Cloyne/Aghada: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	45	68%
No data available	18	27%
Unsatisfactory	3	5%
Total	66	100%

Table 4.3.4.d Cloyne/Aghada: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	100%
Unsatisfactory = > 1.1	0	0%
Total	2	100%

From July 2007	n	%
Unsatisfactory = < 0.6	3	100%
Unsatisfactory = > 0.8	0	0%
Total	3	100%

4.3.4 Cloyne/Aghada fluoride results 2001-2012



4.3.5 Glanmire

Table 4.3.5.a Glanmire: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	62	79%
Marginal	9	12%
Unsatisfactory	6	8%
No data available	1	1%
Total	78	100%

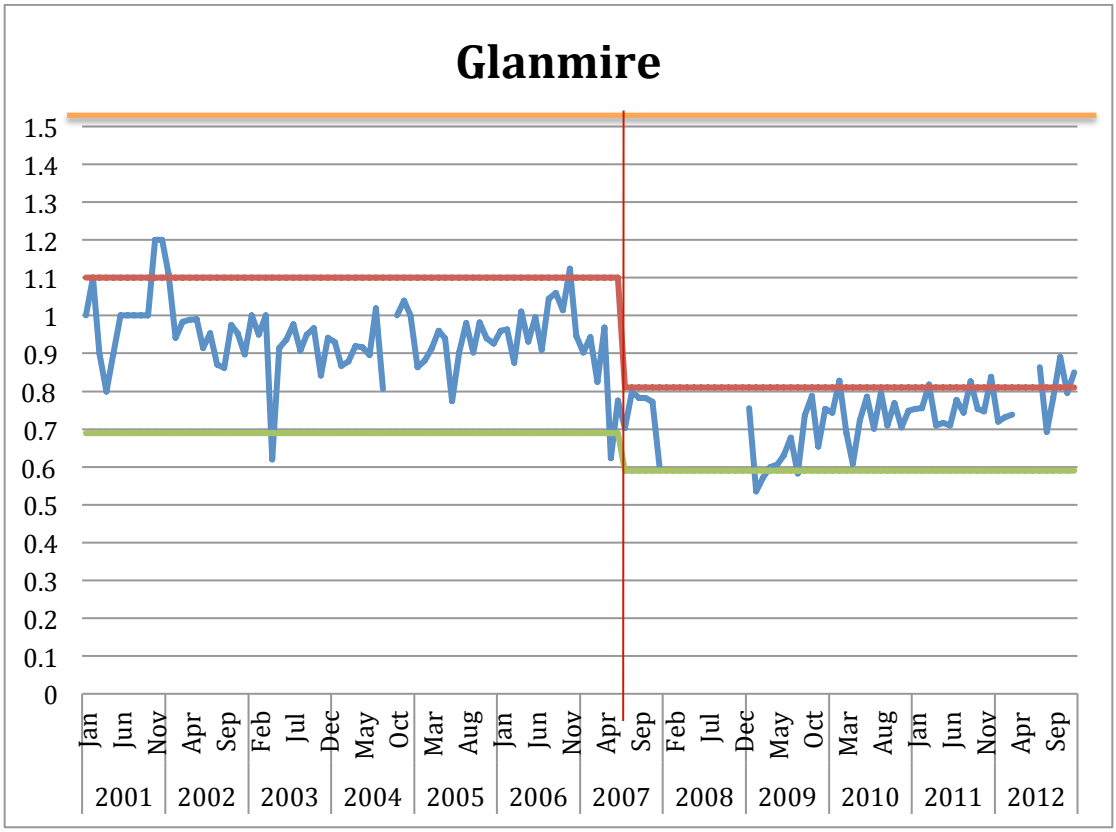
Table 4.3.5.b Glanmire: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	62	79%
Marginal	0	0%
Unsatisfactory	15	19%
No data available	1	1%
Total	78	100%

Table 4.3.5.c Glanmire: Fluoride results from July 2007 and up		
	n	%
Satisfactory	41	62%
No data available	15	23%
Unsatisfactory	10	15%
Total	66	100%

Table 4.3.5.d Glanmire: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	33%
Unsatisfactory = > 1.1	4	67%
Total	6	100%

From July 2007	n	%
Unsatisfactory = < 0.6	3	30%
Unsatisfactory = > 0.8	7	70%
Total	10	100%

4.3.5 Glanmire fluoride results 2001-2012



4.3.6 Glashaboy

Table 4.3.6.a Glashaboy: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	62	79%
Marginal	12	15%
Unsatisfactory	3	4%
No data available	1	1%
Total	78	100%

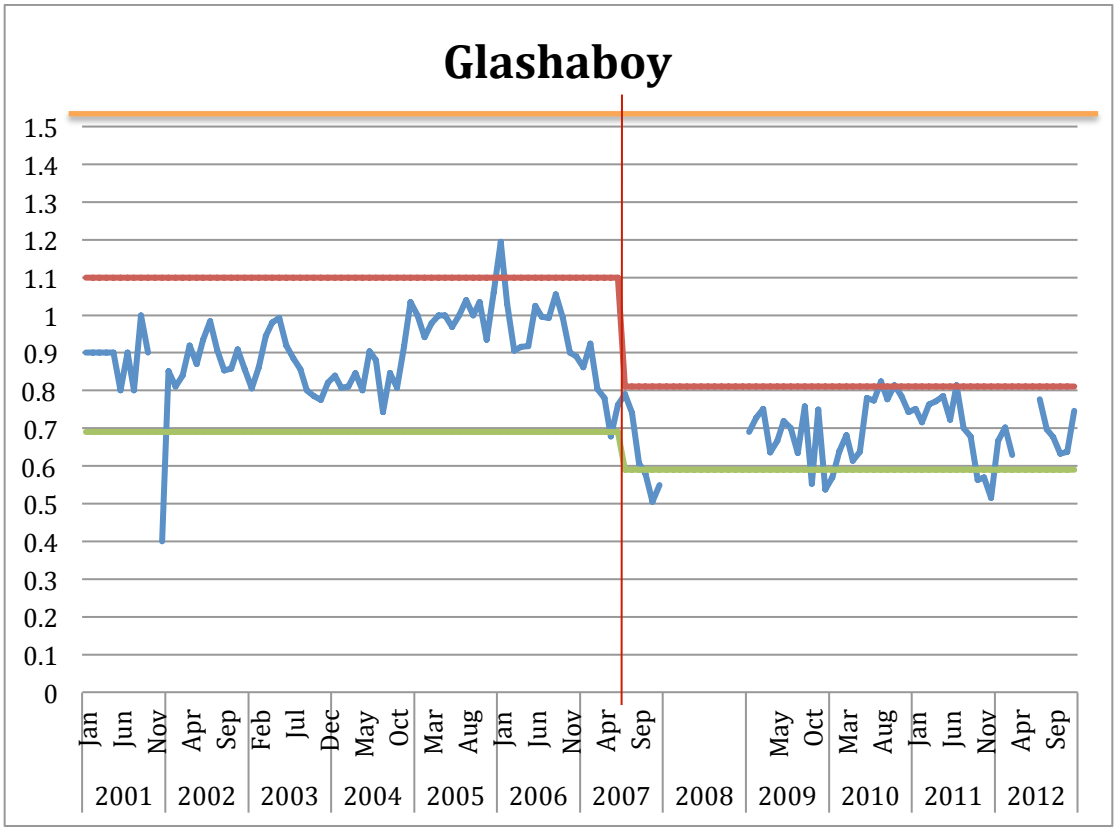
Table 4.3.6.b Glashboy: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	62	79%
Marginal	0	0%
Unsatisfactory	15	19%
No data available	1	1%
Total	78	100%

Table 4.3.6.c Glashaboy: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	39	59%
No data available	15	23%
Unsatisfactory	12	18%
Total	66	100%

Table 4.3.6.d Glashaboy: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	67%
Unsatisfactory = > 1.1	1	33%
Total	3	100%

From July 2007	n	%
Unsatisfactory = < 0.6	9	75%
Unsatisfactory = > 0.8	3	25%
Total	12	100%

4.3.6 Glashaboy fluoride results 2001-2012



4.3.7 Macroom

4.3.7.a Macroom: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	62	79%
Marginal	7	9%
Unsatisfactory	9	12%
None	0	0%
Total	78	100%

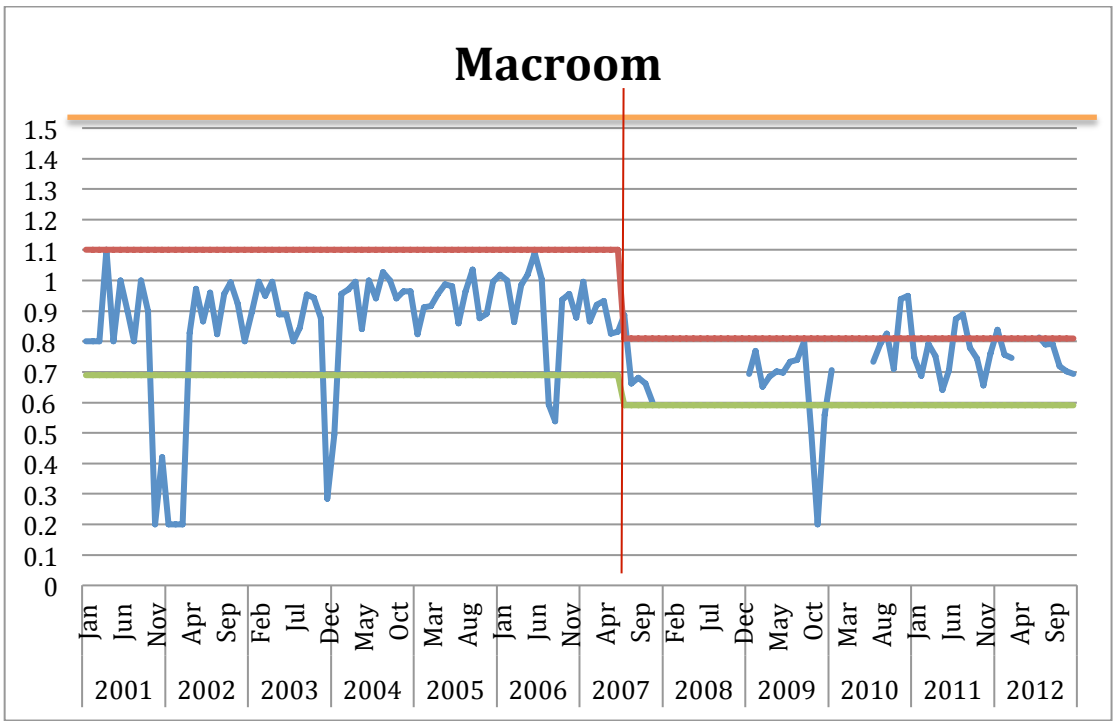
4.3.7.b Macroom: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	62	79%
Marginal	0	0%
Unsatisfactory	16	21%
None	0	0%
Total	78	100%

4.3.7.c Macroom: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	34	52%
Marginal	0	0%
Unsatisfactory	11	17%
None	21	32%
Total	66	100%

4.3.7.d Macroom: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	9	100%
Unsatisfactory = > 1.1	0	0%
Total	9	100%

From July 2007	n	%
Unsatisfactory =< 0.6	3	27%
Unsatisfactory => 0.8	8	73%
Total	11	100%

4.3.7 Macroom fluoride results 2001-2012



4.3.8 Midleton

Table 4.3.8.a Midleton: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	51	65%
Marginal	17	22%
Unsatisfactory	8	10%
No data available	2	3%
Total	78	100%

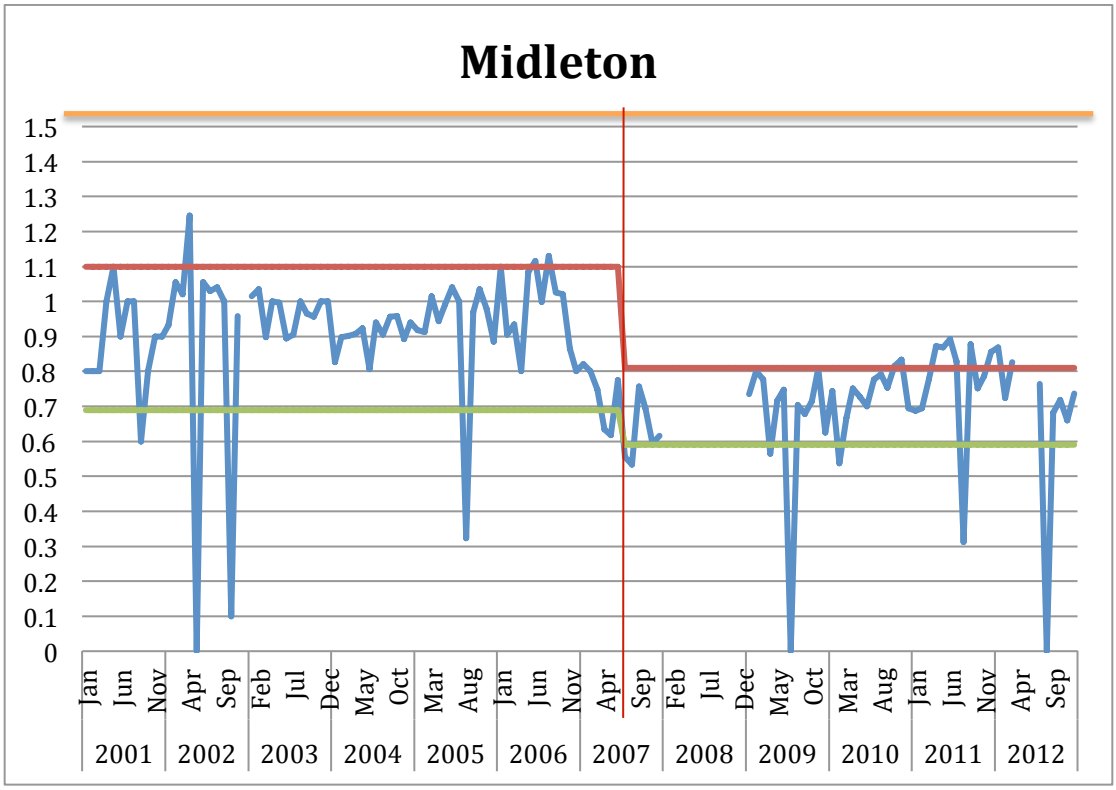
Table 4.3.8.b Midleton: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	51	65%
Marginal	0	0%
Unsatisfactory	25	32%
No data available	2	3%
Total	78	100%

Table 4.3.8.c Midleton: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	32	48%
No data available	17	26%
Unsatisfactory	17	26%
Total	66	100%

Table 4.3.8.d Midleton: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	5	63%
Unsatisfactory = > 1.1	3	38%
Total	8	100%

From July 2007	n	%
Unsatisfactory = < 0.6	6	35%
Unsatisfactory = > 0.8	11	65%
Total	17	100%

4.3.8 Midelton fluoride results 2001-2012



4.3.9 Whitegate

Table 4.3.9.a Whitegate: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	64	82%
Marginal	10	13%
Unsatisfactory	1	1%
No data available	3	4%
Total	78	100%

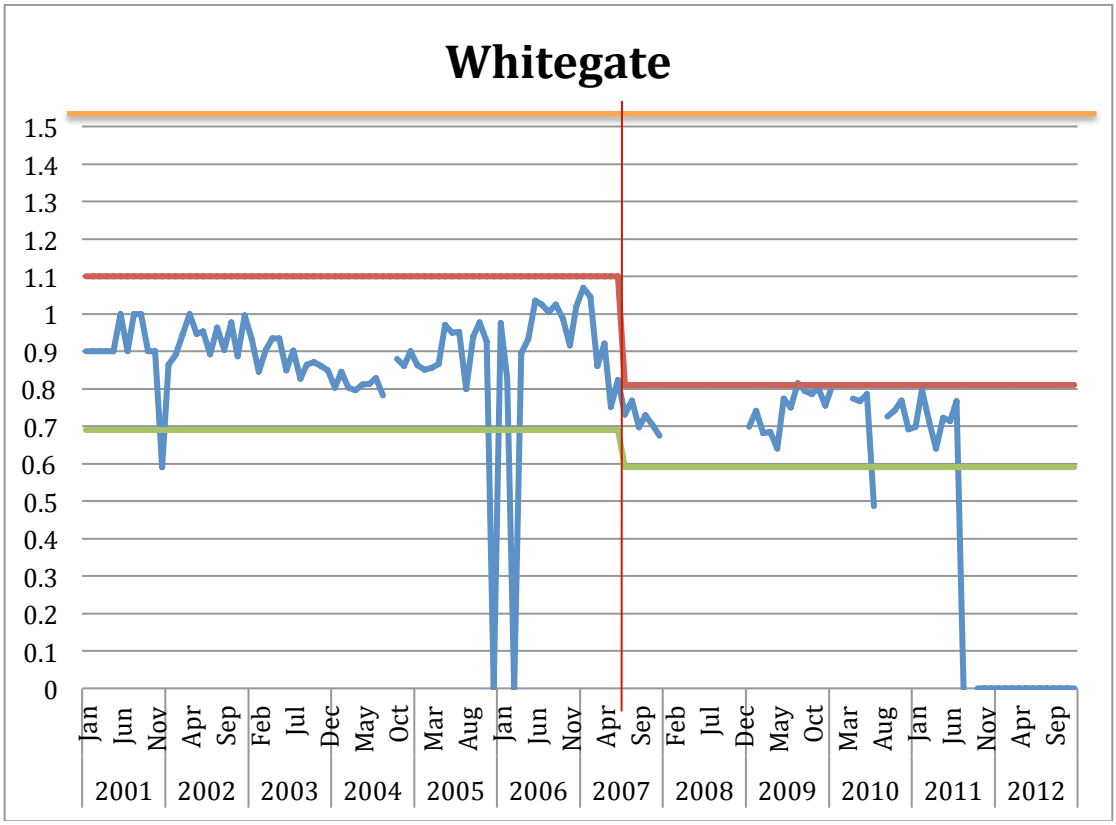
Table 4.3.9.b Whitegate: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	64	82%
Marginal	0	0%
Unsatisfactory	11	14%
No data available	3	4%
Total	78	100%

Table 4.3.9.c Whitegate: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	30	45%
No data available	32	48%
Unsatisfactory	4	6%
Total	66	100%

Table 4.3.9.d Whitegate: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	1	100%
Unsatisfactory = > 1.1	0	0%
Total	1	100%

From July 2007	n	%
Unsatisfactory = < 0.6	1	25%
Unsatisfactory = > 0.8	3	75%
Total	4	100%

4.3.9 Whitegate fluoride results 2001-2012



4.3.10 Youghal

Table 4.3.10.a Youghal: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	46	59%
Marginal	12	15%
Unsatisfactory	5	6%
No data available	15	19%
Total	78	100%

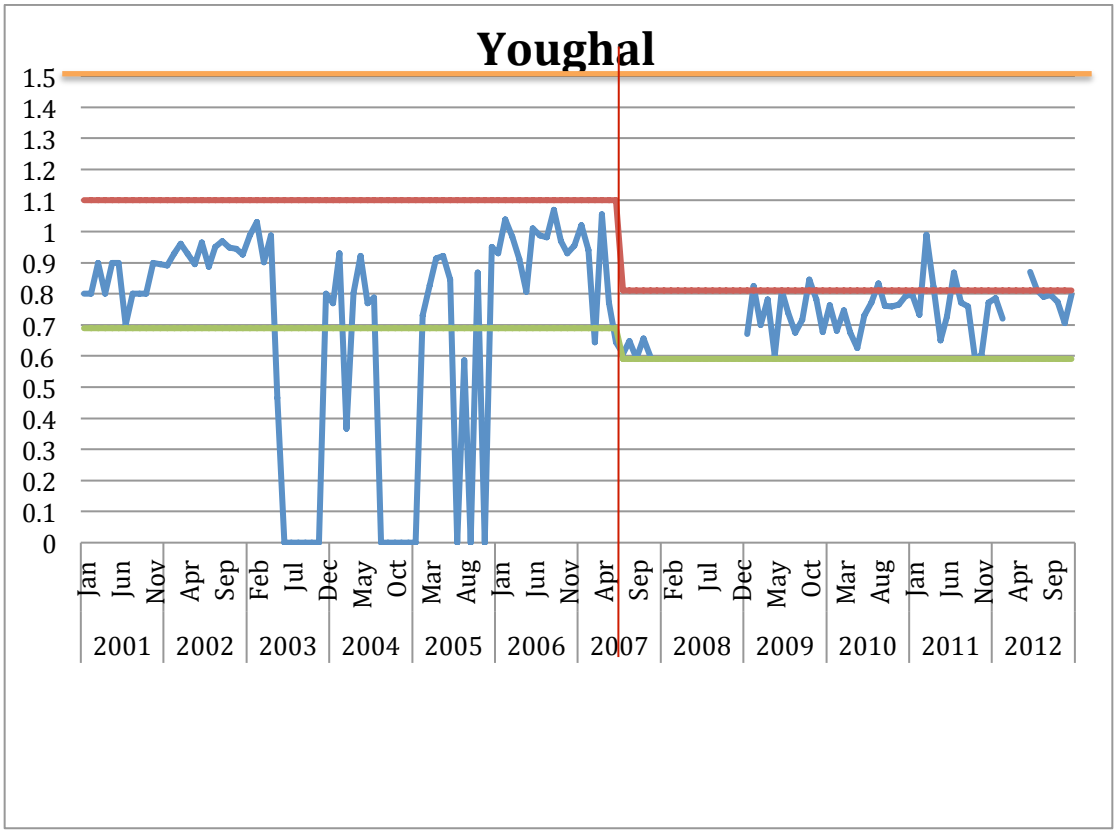
Table 4.3.10.b Youghal: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	46	59%
Marginal	0	0%
Unsatisfactory	17	22%
No data available	15	19%
Total	78	100%

Table 4.3.10.c Youghal: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	38	58%
No data available	16	24%
Unsatisfactory	12	18%
Total	66	100%

Table 4.3.10.d Youghal: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	5	100%
Unsatisfactory => 1.1	0	0%
Total	5	100%

From July 2007	n	%
Unsatisfactory =< 0.6	3	25%
Unsatisfactory => 0.8	9	75%
Total	12	100%

4.3.10 Youghal fluoride results 2001-2012



4.3.11 Castlemartyr

Table 4.3.11.a Castlemartyr: Fluoride results from July 2007 and up to 2012

	n	%
Satisfactory	14	78%
Unsatisfactory	1	6%
No data Available	3	17%
Total	18	100%

Table 4.3.11.b Castlemartyr: The percentage of unsatisfactory results before and after July 2007

From July 2007	n	%
Unsatisfactory = < 0.6	0	0%
Unsatisfactory = > 0.8	1	100%
Total	1	100%

4.3.11 Castlemartyr fluoride results 2001-2012

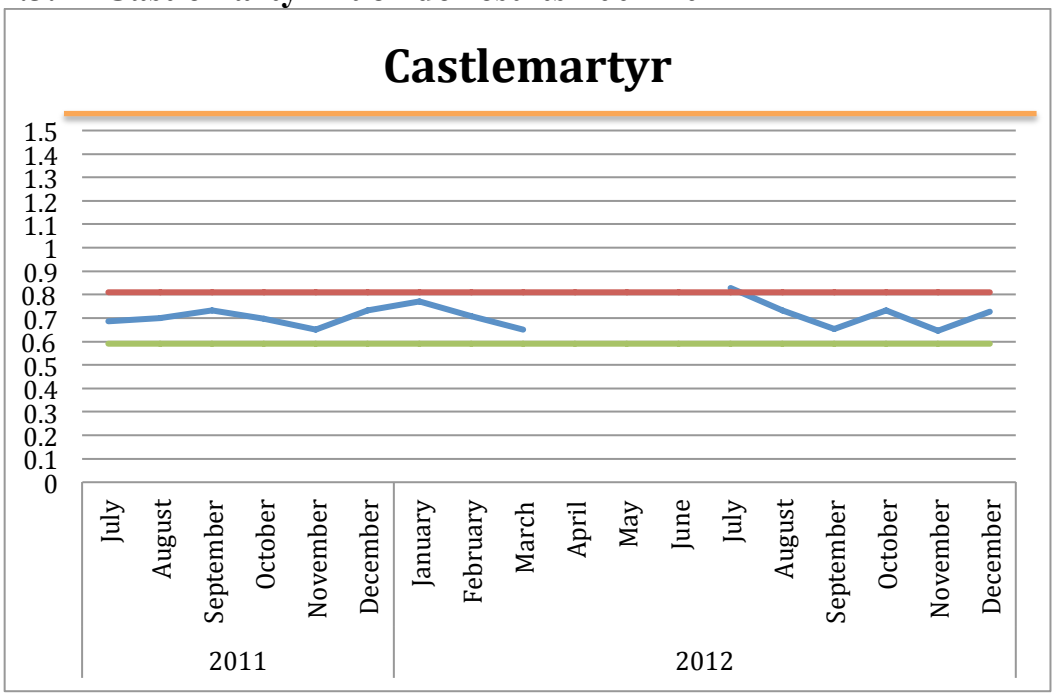


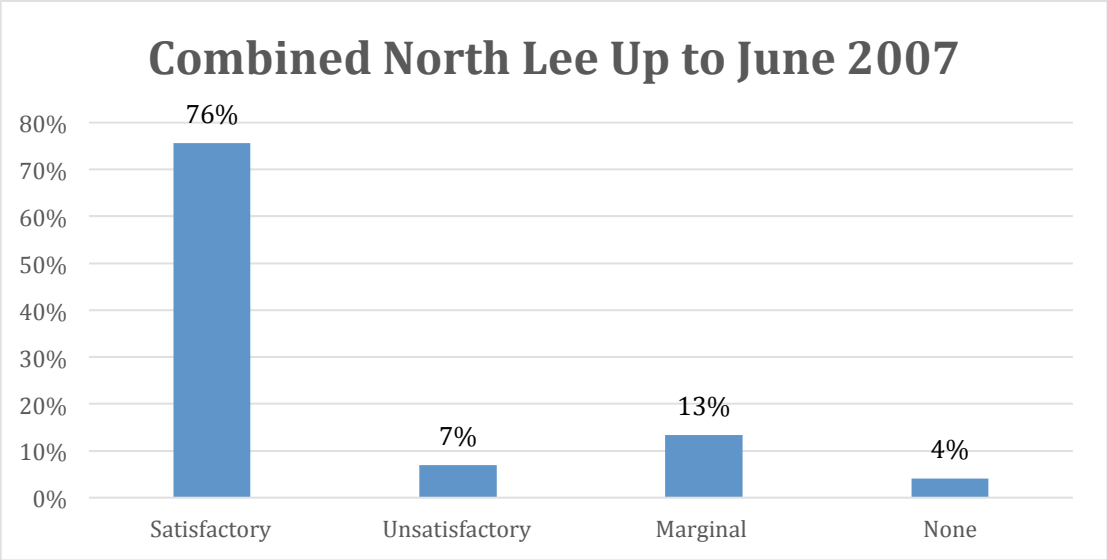
Table 4.3.12 Combined percentages of satisfactory and unsatisfactory results for North Lee

North Lee		
Up to June 2007		
	n	%
Satisfactory	591	76%
Unsatisfactory	54	7%
Marginal	105	13%
No data available	32	4%
Total	782	100%

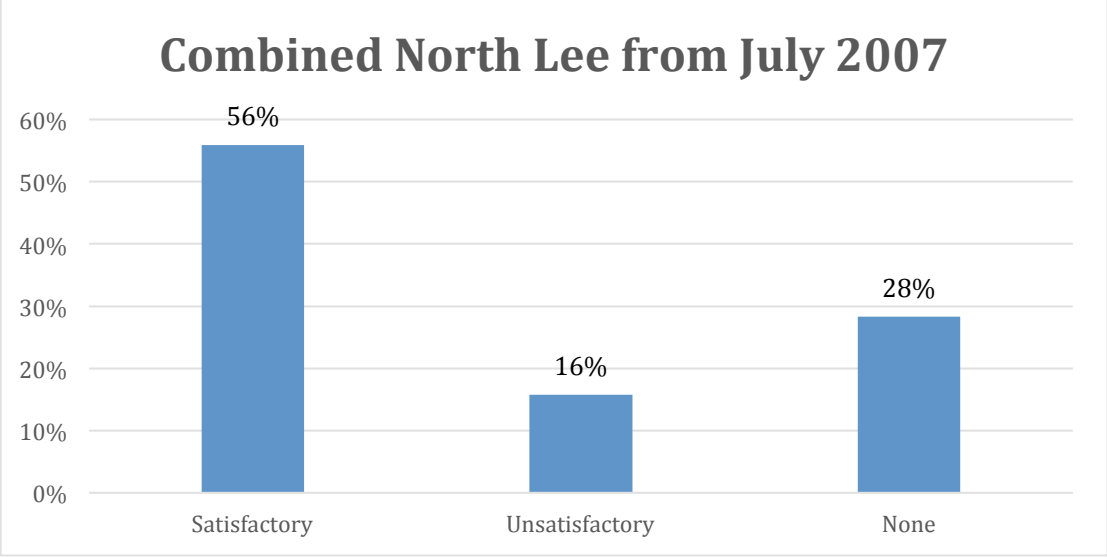
From July 2007		
Satisfactory	379	56%
Unsatisfactory	107	16%
No data available	192	28%
Total	678	100%

Up to June 2007		
Satisfactory	591	76%
Unsatisfactory	159	20%
Marginal	0	0%
No data available	32	4%
Total	782	100%

4.3.12a Combined Chart for North Lee prior to July 2007



4.3.13 Combined Chart for North Lee after to July 2007



4.4 Area #4 North Cork

4.4.1 Allow

Table 4.4.1.a Allow: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	67	86%
Marginal	5	6%
Unsatisfactory	3	4%
No data available	3	4%
Total	78	100%

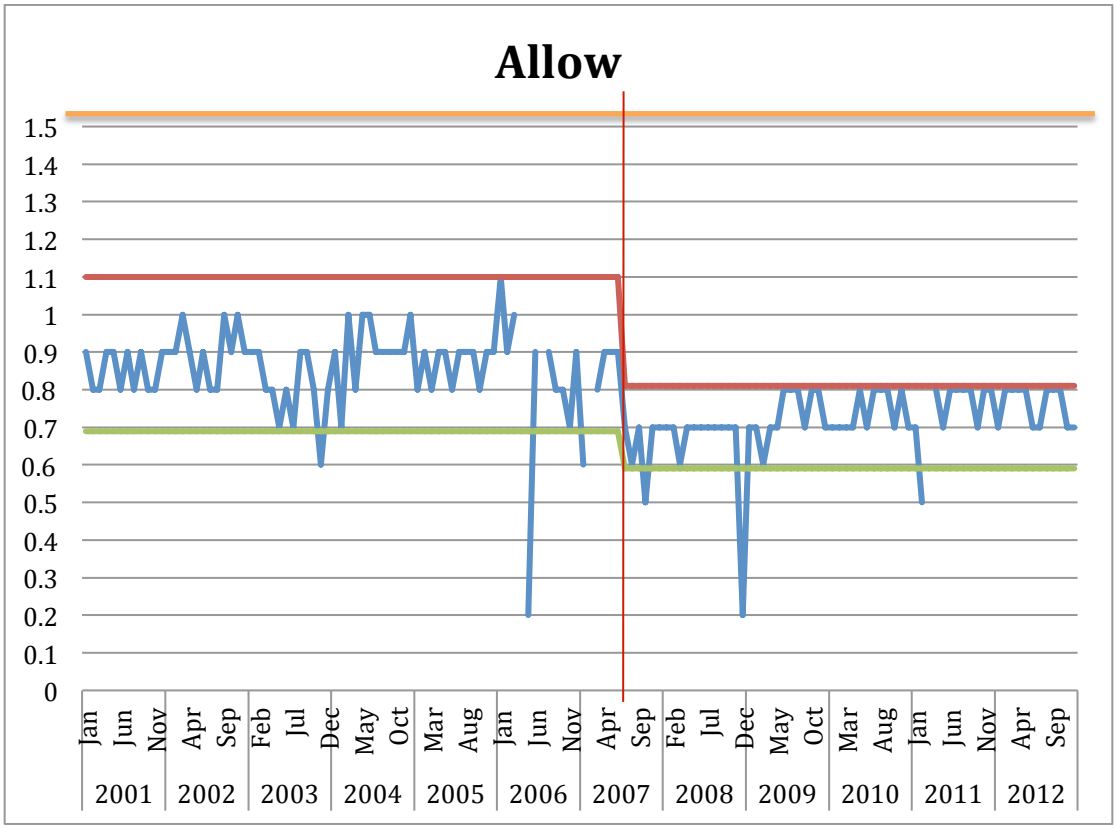
Table 4.4.1.b Allow: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	67	86%
Marginal	0	0%
Unsatisfactory	8	10%
No data available	3	4%
Total	78	100%

Table 4.4.1.c Allow: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	62	94%
Marginal	0	0%
Unsatisfactory	3	5%
No data available	1	2%
Total	66	100%

Table 4.4.1.d Allow: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	**n**	**%**
Unsatisfactory = < 0.7	**3**	**100%**
Unsatisfactory = > 1.1	**0**	**0%**
Total	**3**	**100%**

From July 2007	**n**	**%**
Unsatisfactory = < 0.6	**3**	**100%**
Unsatisfactory = > 0.8	**0**	**0%**
Total	**3**	**100%**

Chart 4.4.1 Allow: fluoride results 2001-2012



4.4.2 Castletownroche

Table 4.4.2.a Castletownroche: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	60	77%
Marginal	1	1%
Unsatisfactory	5	6%
No data available	12	15%
Total	78	100%

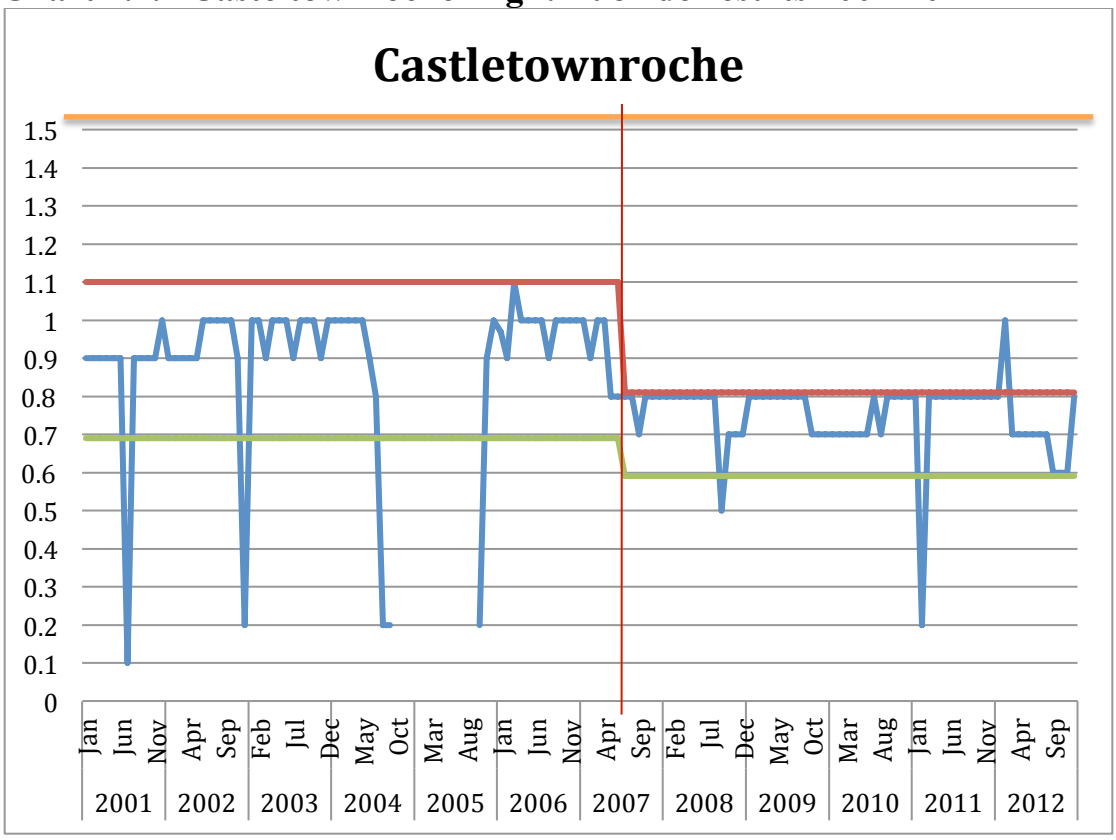
Table 4.4.2.b Castletownroche: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	60	77%
Marginal	0	0%
Unsatisfactory	6	8%
No data available	12	15%
Total	78	100%

Table 4.4.2.c Castletownroche: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	63	95%
Marginal	0	0%
Unsatisfactory	3	5%
No data available	0	0%
Total	66	100%

Table 4.4.2.d Castletownroche: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	5	100%
Unsatisfactory = > 1.1	0	0%
Total	5	100%

From July 2007	n	%
Unsatisfactory = < 0.6	2	67%
Unsatisfactory = > 0.8	1	33%
Total	3	100%

Chart 4.4.2 Casteltownroche High: fluoride results 2001-2012



4.4.3 Conna Region

Table 4.4.3.a Conna Region: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	69	88%
Marginal	4	5%
Unsatisfactory	3	4%
No data available	2	3%
Total	78	100%

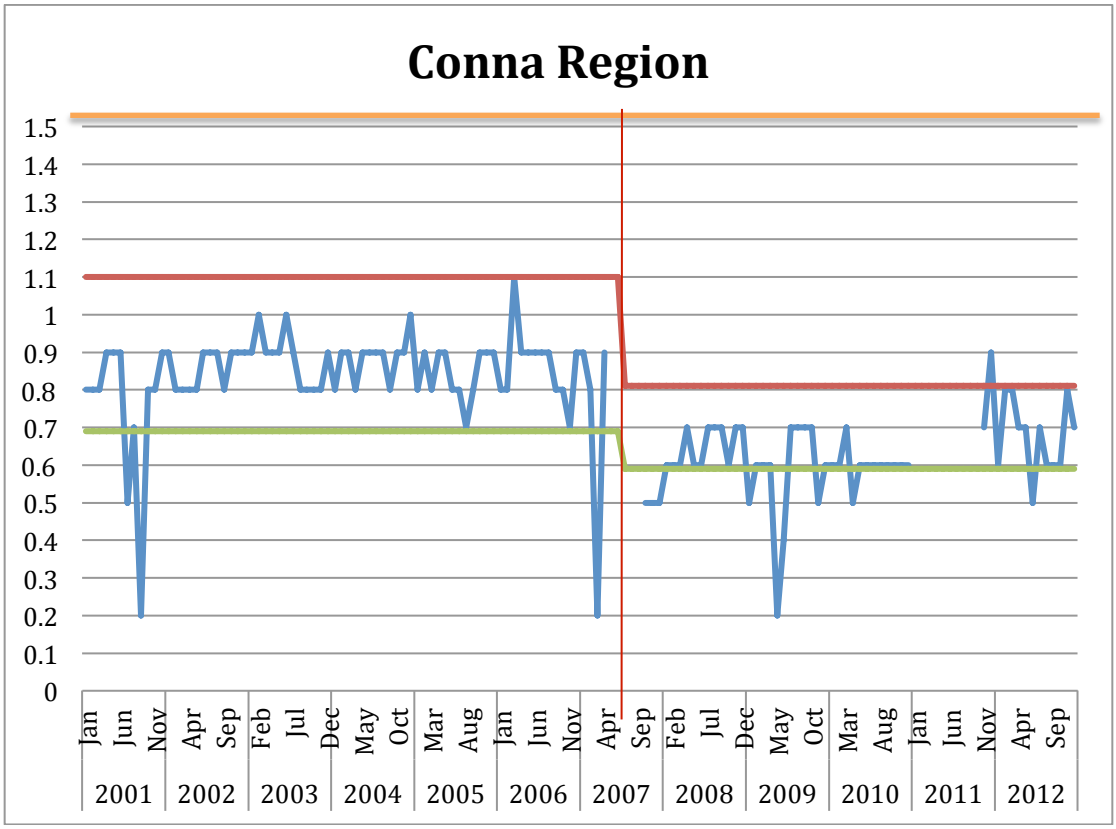
Table 4.4.3.b Conna Region: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	69	88%
Marginal	0	0%
Unsatisfactory	7	9%
No data available	2	3%
Total	78	100%

Table 4.4.3.c Conna Region: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	43	65%
Marginal	0	0%
Unsatisfactory	10	15%
No data available	13	20%
Total	66	100%

Table 4.4.3.d Conna Region: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	3	100%
Unsatisfactory => 1.1	0	0%
Total	3	100%

From July 2007	n	%
Unsatisfactory =< 0.6	9	90%
Unsatisfactory => 0.8	1	10%
Total	10	100%

Chart 4.4.3 Conna Region: Waterworks fluoride results 2001-2012



4.4.4 Fermoy

Table 4.4.4.a Fermoy: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	41	53%
Marginal	7	9%
Unsatisfactory	2	3%
No data available	28	36%
Total	78	100%

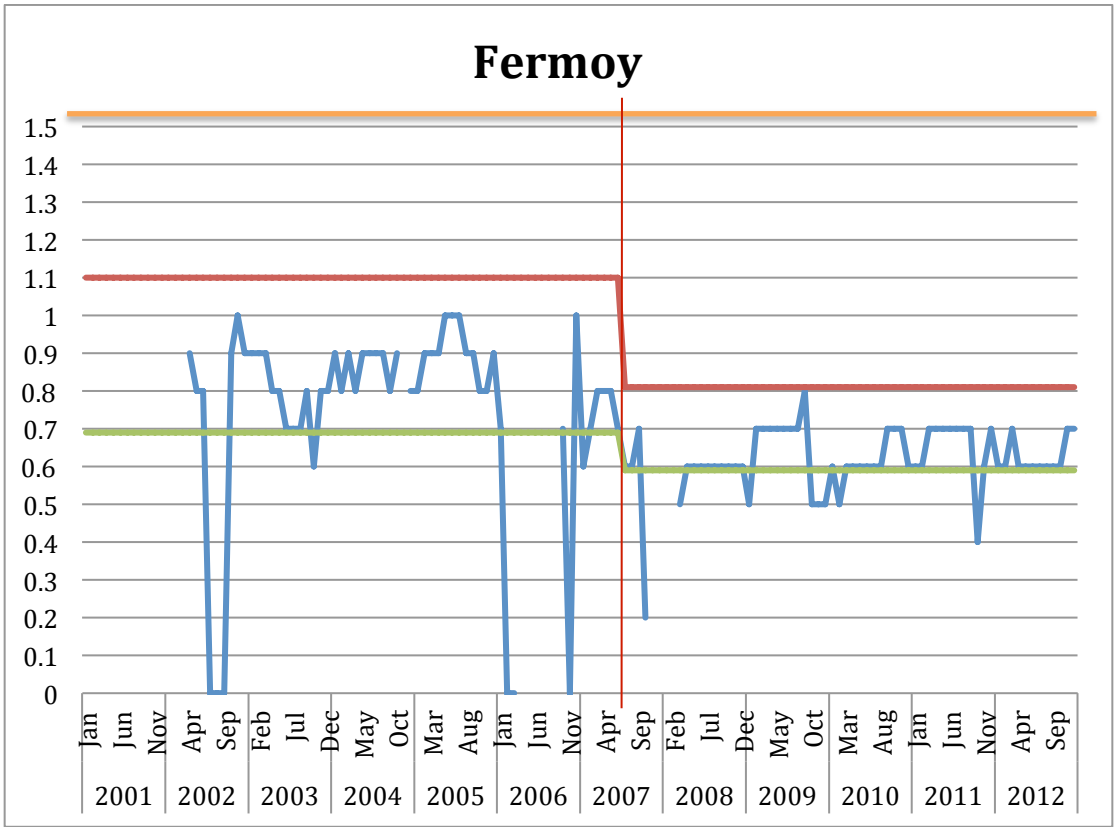
Table 4.4.4.b Fermoy: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	41	53%
Marginal	0	0%
Unsatisfactory	9	12%
No data available	28	36%
Total	78	100%

Table 4.4.4.c Fermoy: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	54	82%
Marginal	0	0%
Unsatisfactory	8	12%
No data available	4	6%
Total	66	100%

Table 4.4.4.d Fermoy: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	100%
Unsatisfactory = > 1.1	0	0%
Total	2	100%

From July 2007	n	%
Unsatisfactory = < 0.6	8	100%
Unsatisfactory = > 0.8	0	0%
Total	8	100%

Chart 4.4.4 Fermoy: fluoride results 2001-2012



4.4.5 Galtee Mitchelstown

Table 4.4.5.a Galtee Mitchelstown: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	67	86%
Marginal	1	1%
Unsatisfactory	0	0%
No data available	10	13%
Total	78	100%

Table 4.4.5.b Galtee Mitchelstown: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	67	86%
Marginal	0	0%
Unsatisfactory	1	1%
No data available	10	13%
Total	78	100%

Table 4.4.5.c Galtee Mitchelstown: Fluoride results from July 2007 and up to 2012

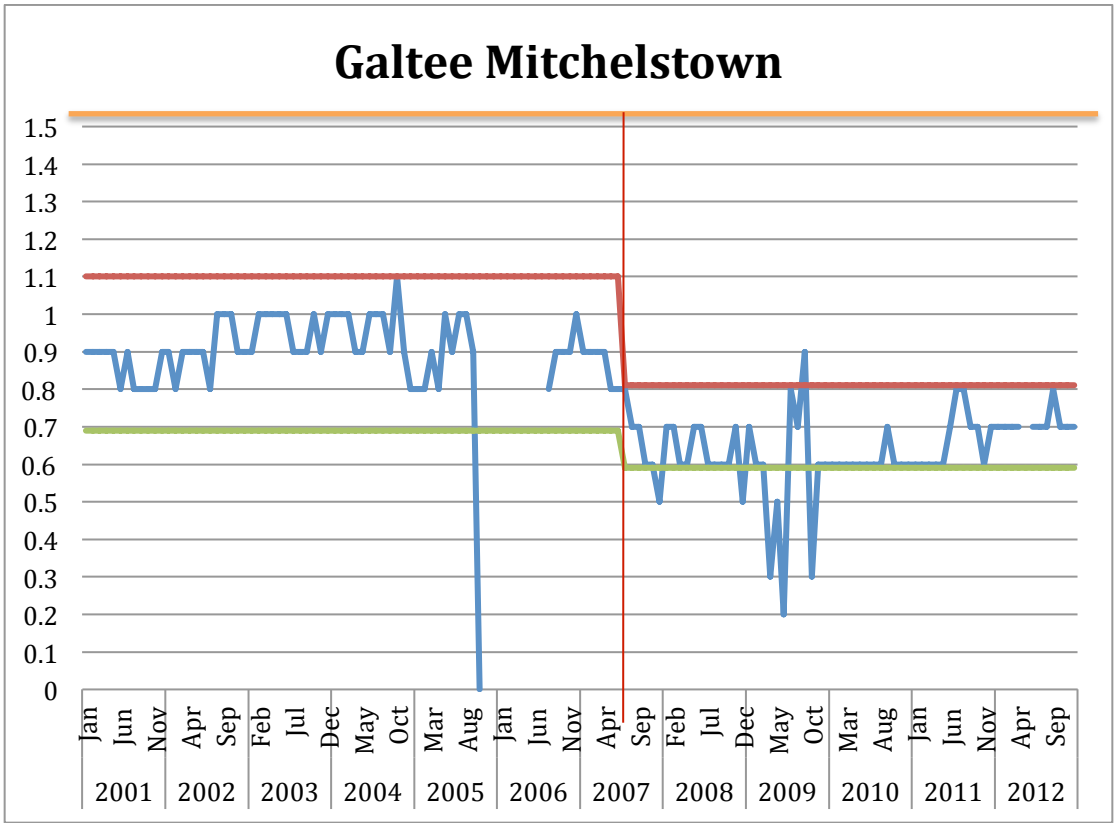
	n	%
Satisfactory	58	88%
Marginal	0	0%
Unsatisfactory	7	11%
No data available	1	2%
Total	66	100%

Table 4.4.5.d Galtee Mitchelstown: The percentage of unsatisfactory results before and after July 2007

Up to June 2007	n	%
Unsatisfactory = < 0.7	0	0
Unsatisfactory = > 1.1	0	0
Total	0	0

From July 2007	n	%
Unsatisfactory = < 0.6	6	86%
Unsatisfactory = > 0.8	1	14%
Total	7	100%

Chart 4.4.5 Galtee Mitchelstown: fluoride results 2001-2012



4.4.6 Glanworth

Table 4.4.6.a Glanworth: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	56	72%
Marginal	1	1%
Unsatisfactory	4	5%
No data available	17	22%
Total	78	100%

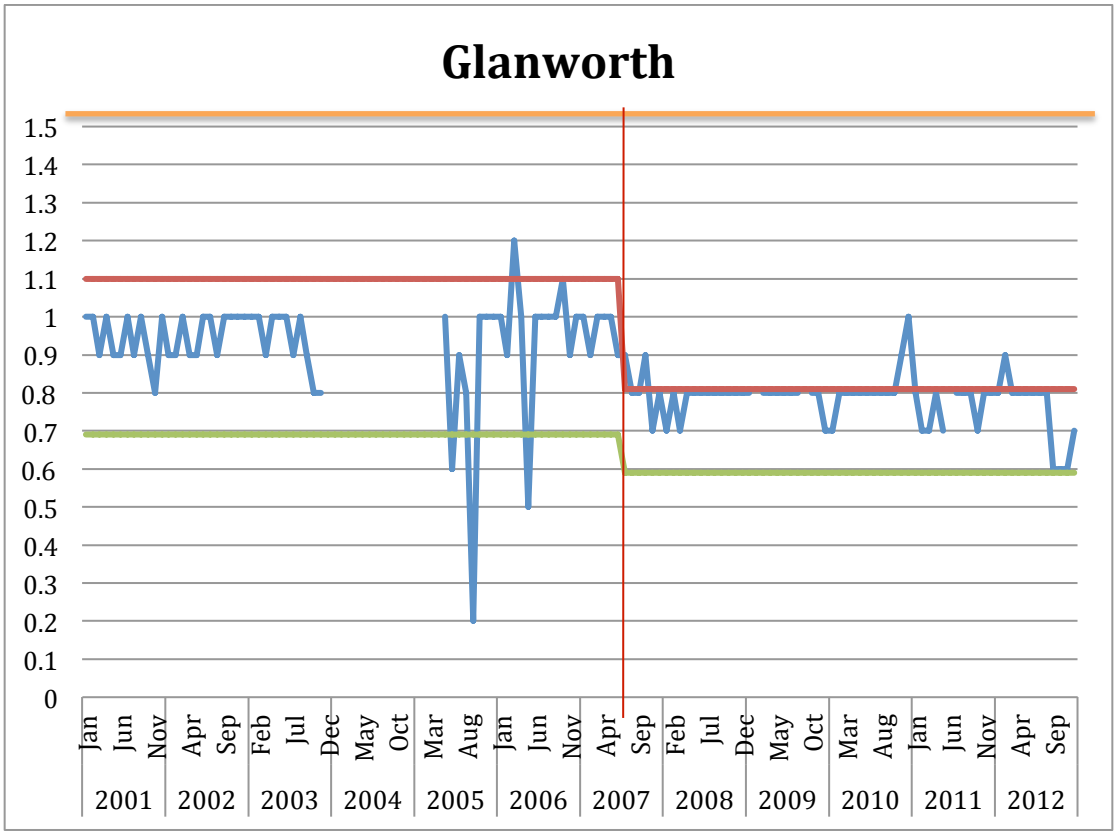
Table 4.4.6.b Glanworth: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	56	72%
Marginal	0	0%
Unsatisfactory	5	6%
No data available	17	22%
Total	78	100%

Table 4.4.6.c Glanworth: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	58	88%
Marginal	0	0%
Unsatisfactory	5	8%
No data available	3	5%
Total	66	100%

Table 4.4.6.d Glanworth: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	3	75%
Unsatisfactory = > 1.1	1	25%
Total	4	100%

From July 2007	n	%
Unsatisfactory = < 0.6	0	0%
Unsatisfactory = > 0.8	5	100%
Total	5	100%

Chart 4.4.6 Glanworth: fluoride results 2001-2012



4.4.7 Kanturk Ball

Table 4.4.7.a Kanturk Ball: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	74	95%
Marginal	1	1%
Unsatisfactory	2	3%
No data available	1	1%
Total	78	100%

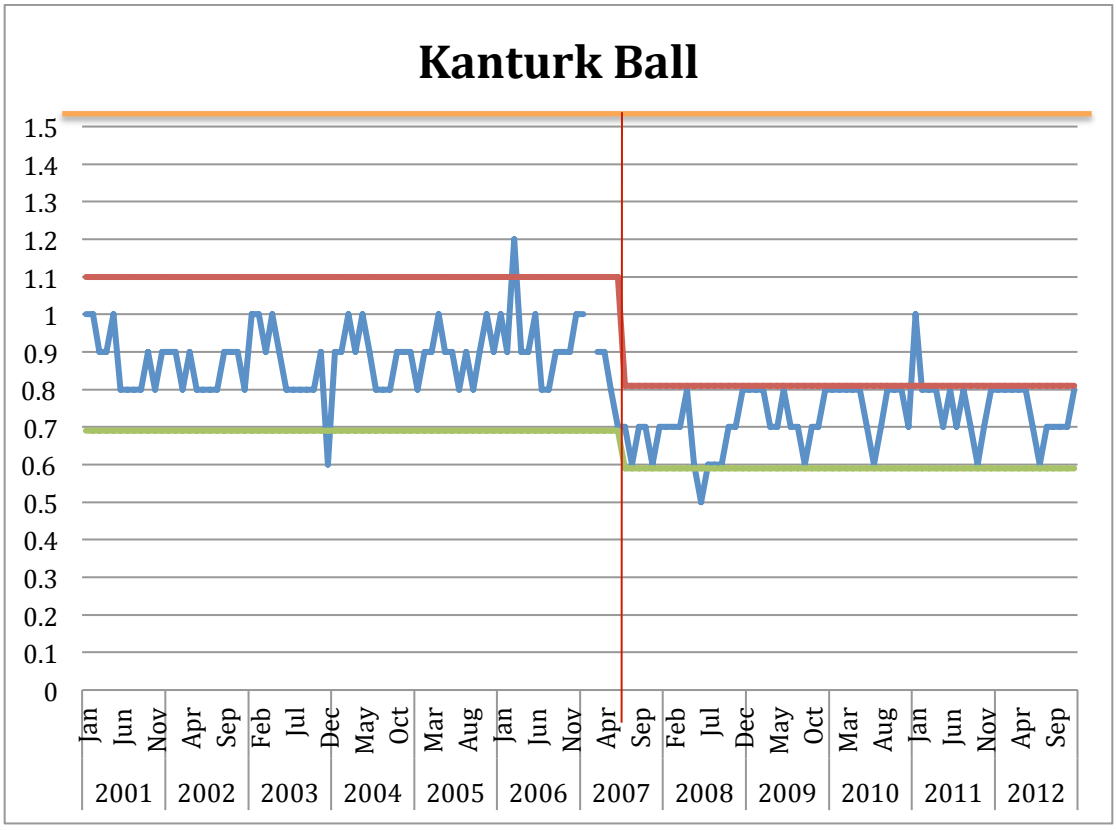
Table 4.4.7.b Kanturk Ball: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	74	95%
Marginal	0	0%
Unsatisfactory	3	4%
No data available	1	1%
Total	78	100%

Table 4.4.7.c Kanturk Ball: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	64	97%
Marginal	0	0%
Unsatisfactory	2	3%
No data available	0	0%
Total	66	100%

Table 4.4.7.d Kanturk Ball: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	1	50%
Unsatisfactory => 1.1	1	50%
Total	2	100%

From July 2007	n	%
Unsatisfactory =< 0.6	1	50%
Unsatisfactory => 0.8	1	50%
Total	2	100%

Chart 4.4.7 Kanturk Ball: fluoride results 2001-2012



4.4.8 Mallow

Table 4.4.8.a Mallow: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	60	77%
Marginal	13	17%
Unsatisfactory	5	6%
No data available	0	0%
Total	78	100%

Table 4.4.8.b Mallow: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	60	77%
Marginal	0	0%
Unsatisfactory	18	23%
No data available	0	0%

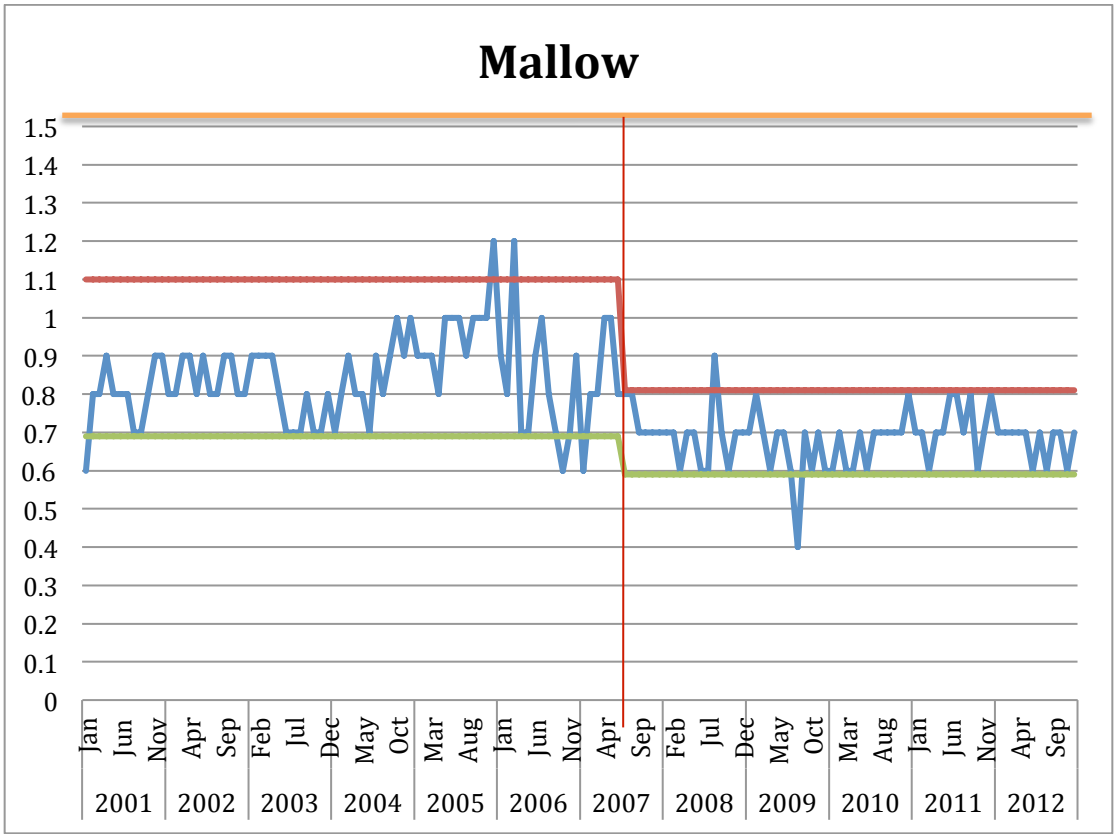
Total	78	100%

Table 4.4.8.c Mallow: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	64	97%
Marginal	0	0%
Unsatisfactory	2	3%
No data available	0	0%
Total	66	100%

Table 4.4.8.d Mallow: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	3	60%
Unsatisfactory = > 1.1	2	40%
Total	5	100%

From July 2007	n	%
Unsatisfactory = < 0.6	1	50%
Unsatisfactory = > 0.8	1	50%
Total	2	100%

Chart 4.4.8 Mallow: fluoride results 2001-2012



4.4.9 Millstreet

Table 4.4.9.a Millstreet: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	60	77%
Marginal	0	0%
Unsatisfactory	7	9%
No data available	11	14%
Total	78	100%

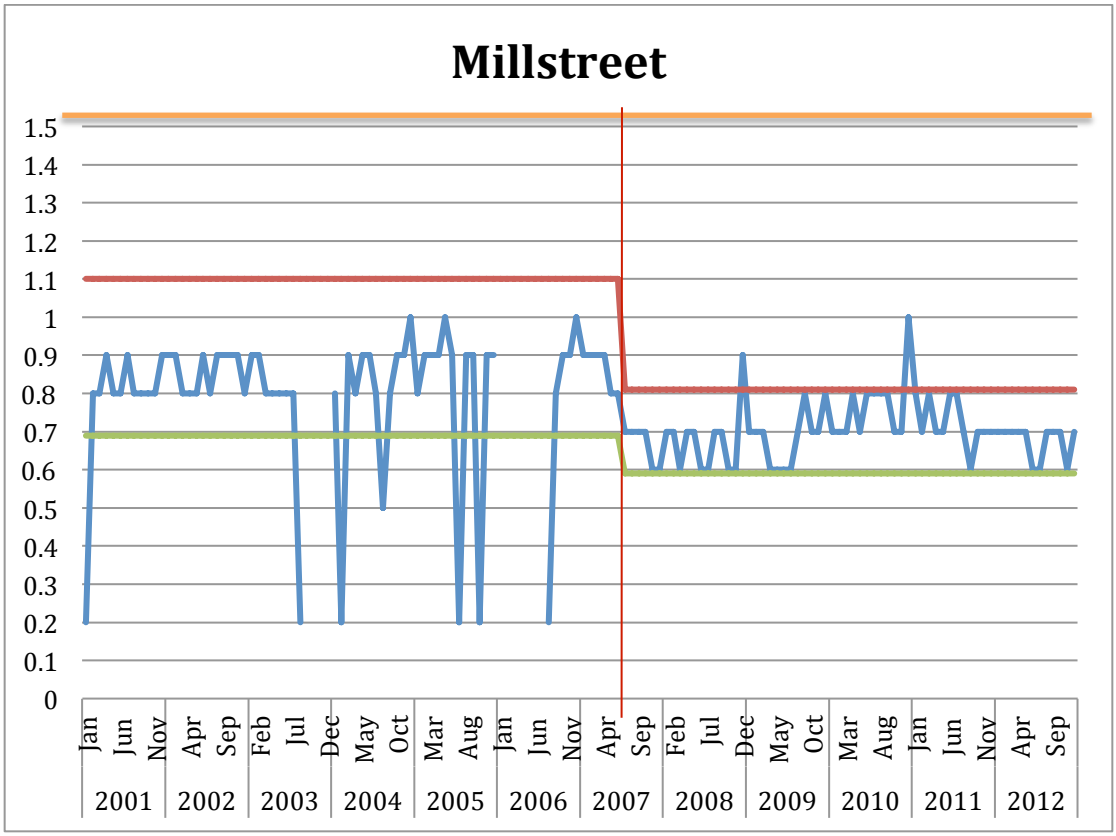
Table 4.4.9.b Milstreet: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	60	77%
Marginal	0	0%
Unsatisfactory	7	9%
No data available	11	14%
Total	78	100%

Table 4.4.9.c Milstreet: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	64	97%
Marginal	0	0%
Unsatisfactory	2	3%
No data available	0	0%
Total	66	100%

Table 4.4.9.d Milstreet: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	7	100%
Unsatisfactory = > 1.1	0	0%
Total	7	100%

From July 2007	n	%
Unsatisfactory = < 0.6	0	0%
Unsatisfactory = > 0.8	2	100%
Total	2	100%

4.4.9 Millstreet fluoride results 2001-2012



4.4.10 Mitchlestown South

Table 4.4.10.a Mitchelstown South: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	76	97%
Marginal	2	3%
Unsatisfactory	0	0%
No data available	0	0%
Total	78	100%

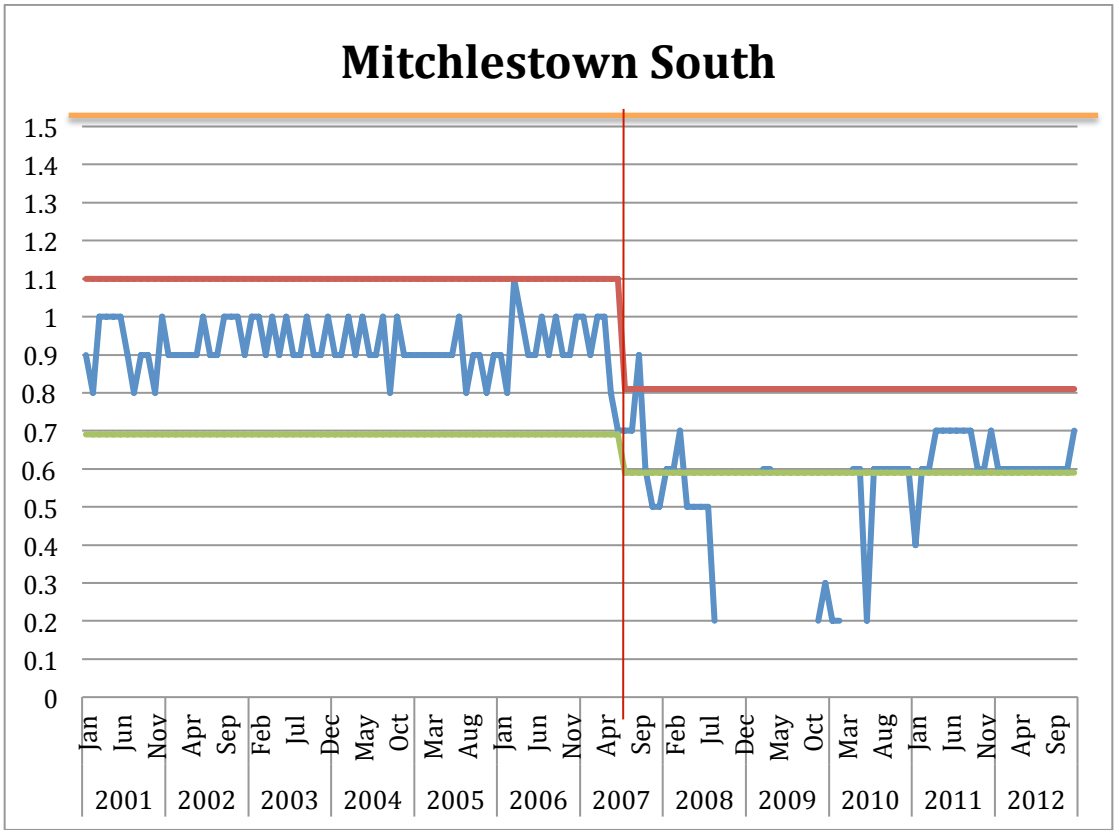
Table 4.4.10.b Mitchelstown South: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	76	97%
Marginal	0	0%
Unsatisfactory	2	3%
No data available	0	0%
Total	78	100%

Table 4.4.10.c Mitchlestown South: Fluoride results from July 2007 and up		
	n	%
Satisfactory	39	59%
Marginal	0	0%
Unsatisfactory	14	21%
No data available	13	20%
Total	66	100%

Table 4.4.10.d Mitchelstown South: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	0	0
Unsatisfactory = > 1.1	0	0
Total	0	0

From July 2007	n	%
Unsatisfactory = < 0.6	13	93%
Unsatisfactory = > 0.8	1	7%
Total	14	100%

3.4.10 Mitchelstown South fluoride results 2001-2012



4.4.11 Mitchlestown North

Table 4.4.11.a Mitchelstown North: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	54	69%
Marginal	0	0%
Unsatisfactory	5	6%
No data available	19	24%
Total	78	100%

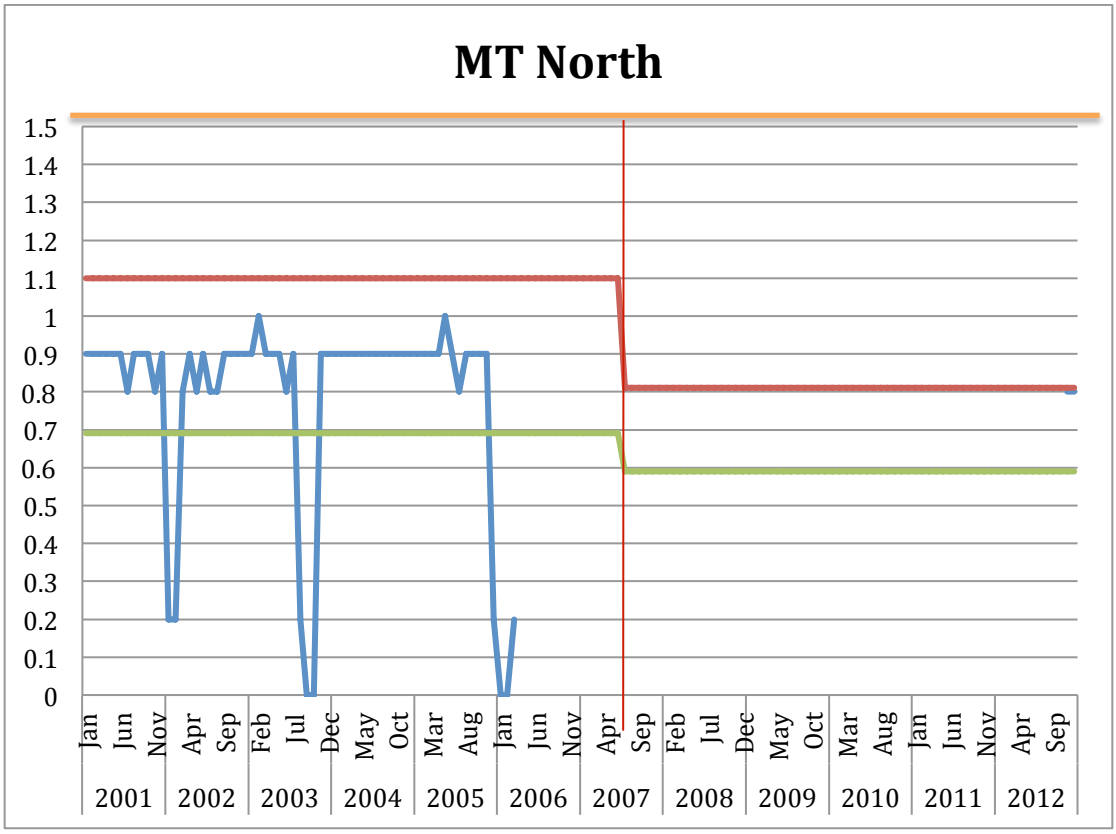
Table 4.4.11.b Mitchelstown North: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	54	69%
Marginal	0	0%
Unsatisfactory	5	6%
None	19	24%
Total	78	100%

Table 4.4.11.c Mitchelstown North: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	2	3%
Marginal	0	0%
Unsatisfactory	0	0%
No data available	64	97%
Total	66	100%

Table 4.4.11.d Mitchelstown North: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	5	100%
Unsatisfactory => 1.1	0	0%
Total	5	100%

From July 2007	n	%
Unsatisfactory =< 0.6	0	0
Unsatisfactory => 0.8	0	0
Total	0	0

3.4.11 Mitchelstown North fluoride results 2001-2012



4.4.12 Rathluric

Table 4.4.12.a Rathluric: Fluoride results up to June 2007 with Marginal results		
	n	%
Satisfactory	62	79%
Marginal	10	13%
Unsatisfactory	5	6%
No data available	1	1%
Total	78	100%

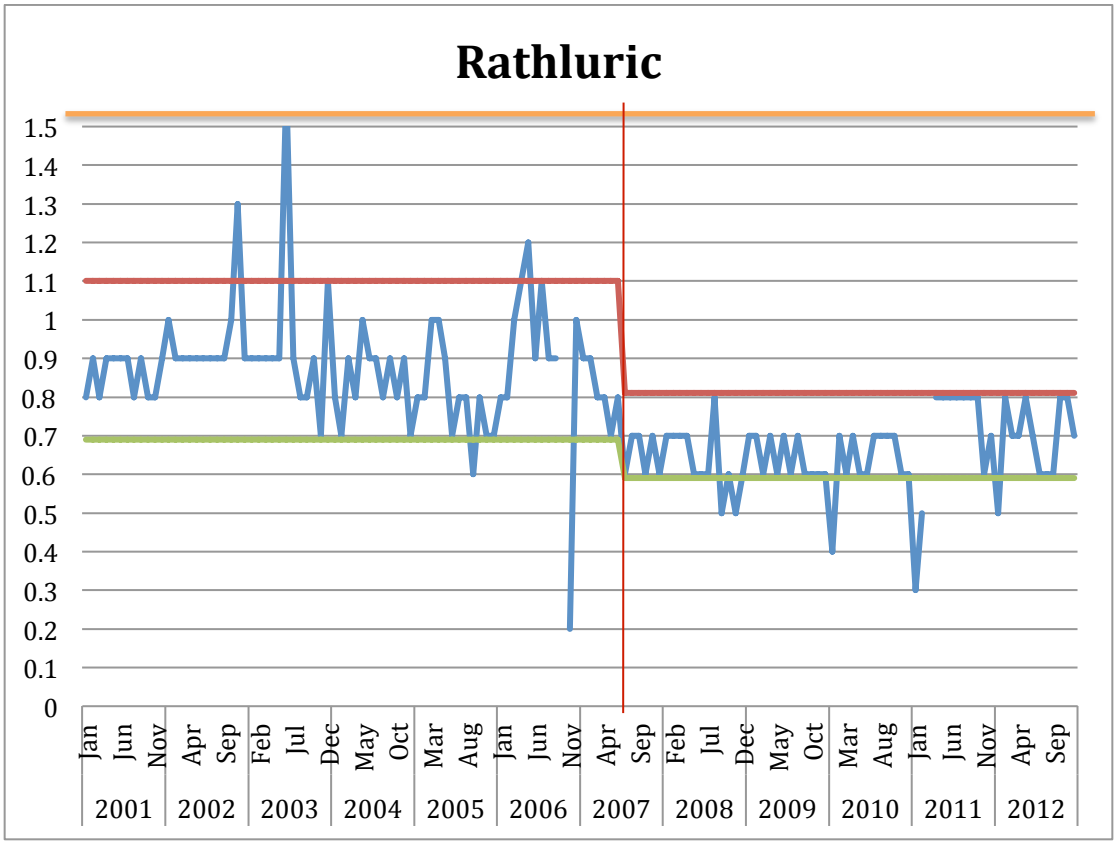
Table 4.4.12.b Rathluric: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	62	79%
Marginal	0	0%
Unsatisfactory	15	19%
No data available	1	1%
Total	78	100%

Table 4.4.12.c Rathluric: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	59	89%
Marginal	0	0%
Unsatisfactory	6	9%
No data available	1	2%
Total	66	100%

Table 4.4.12.d Rathluric: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory = < 0.7	2	40%
Unsatisfactory = > 1.1	3	60%
Total	5	1

From July 2007	n	%
Unsatisfactory = < 0.6	6	100%
Unsatisfactory = > 0.8	0	0%
Total	6	100%

Chart 3.4.12 Rathluric: fluoride results 2001-2012



4.4.13 Shanballymore

Table 4.4.13.a Shanballymore: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	71	91%
Marginal	4	5%
Unsatisfactory	3	4%
No data was available	0	0%
Total	78	100%

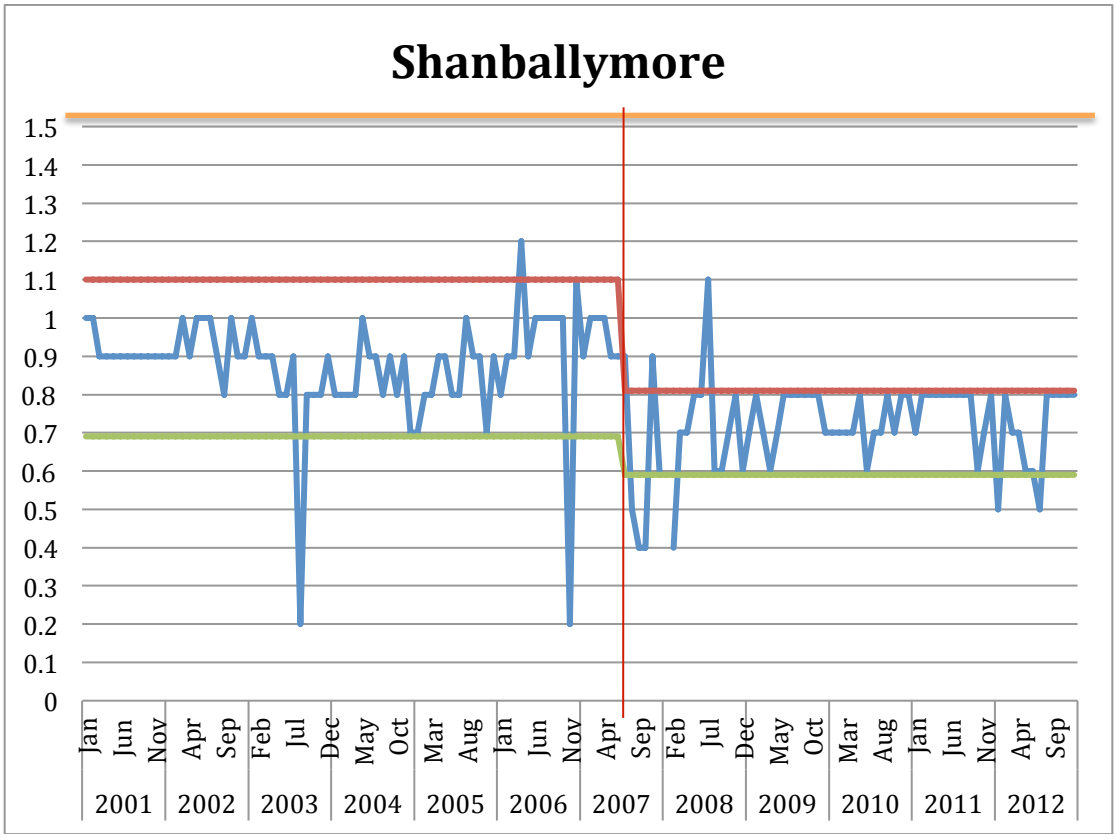
Table 4.4.13.b Shanballymore: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	71	91%
Marginal	0	0%
Unsatisfactory	7	9%
No data was available	0	0%
Total	78	100%

Table 4.4.13.c Shanballymore: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	56	85%
Marginal	0	0%
Unsatisfactory	9	14%
No data was available	1	2%
Total	66	100%

Table 4.4.13.d Shanballymore: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	2	67%
Unsatisfactory => 1.1	1	33%
Total	3	100%

From July 2007	n	%
Unsatisfactory =< 0.6	6	67%
Unsatisfactory => 0.8	3	33%
Total	9	100%

Chart 3.4.13: Shanballymore fluoride results 2001-2012



4.4.14 Ballyenihan

Table 4.4.14.a Ballyenihan: Fluoride results up to June 2007 with Marginal results

	n	%
Satisfactory	74	95%
Marginal	0	0%
Unsatisfactory	4	5%
No data available	0	0%
Total	78	100%

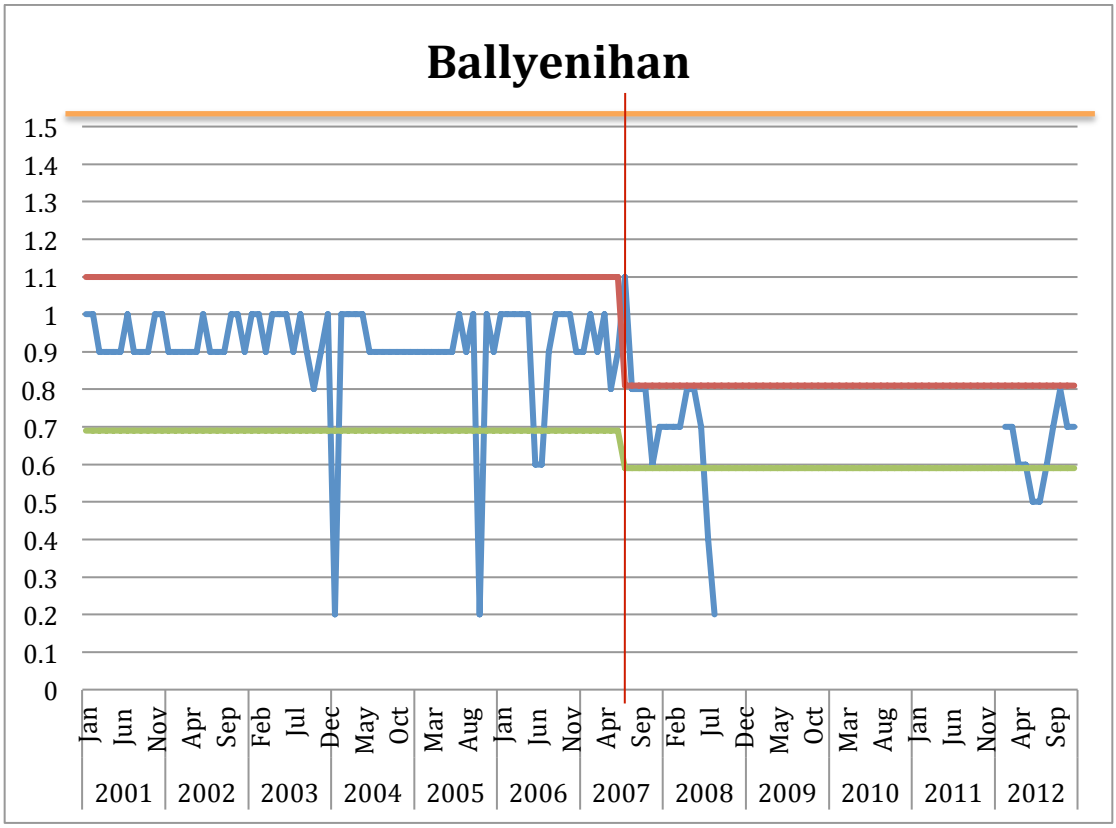
Table 4.4.14.b Ballyenihan: Fluoride results up to June 2007 without Marginal results		
	n	%
Satisfactory	74	95%
Marginal	0	0%
Unsatisfactory	4	5%
No data available	0	0%
Total	78	100%

Table 4.4.14.c Ballyenihan: Fluoride results from July 2007 and up to 2012		
	n	%
Satisfactory	20	30%
Marginal	0	0%
Unsatisfactory	5	8%
No data available	41	62%
Total	66	100%

Table 4.4.14.d Ballyenihan: The percentage of unsatisfactory results before and after July 2007		
Up to June 2007	n	%
Unsatisfactory =< 0.7	4	100%
Unsatisfactory => 1.1	0	0%
Total	4	100%

From July 2007	n	%
Unsatisfactory =< 0.6	4	80%
Unsatisfactory => 0.8	1	20%
Total	5	100%

Chart 3.4.14 Ballyenthian: fluoride results 2001-2012

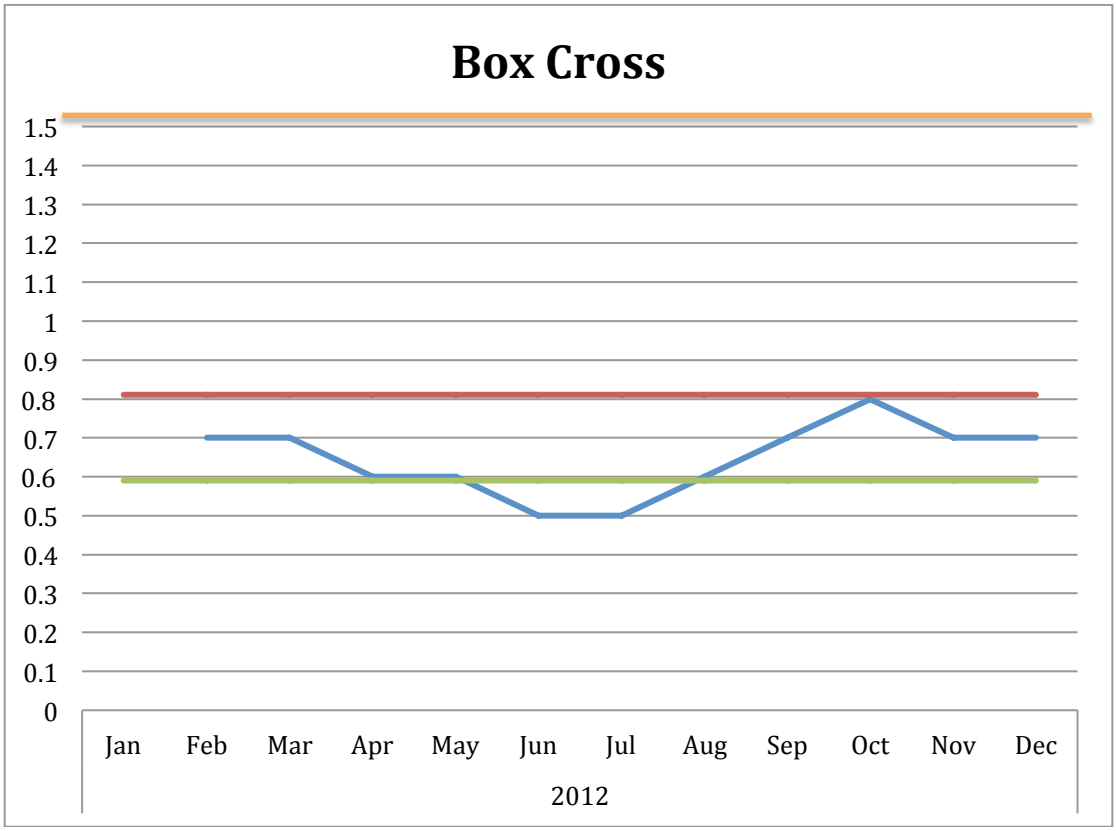


4.4.15 Box Cross

Table 4.4.15.a Box Cross: Fluoride results from 2012		
	n	%
Satisfactory	9	75%
Marginal	0	0%
Unsatisfactory	2	17%
No data available	1	8%
Total	12	100%

Table 4.4.15.b Box Cross: The percentage of unsatisfactory results in 2012		
From July 2007	n	%
Unsatisfactory = < 0.6	2	100%
Unsatisfactory = > 0.8	0	0%
Total	2	100%

Chart 3.4.15 Box Cross: fluoride results 2012



4.4.16 Buttevant Region

4.4.16.a Buttevant Region: Fluoride results up to June 2004 with Marginal results

	n	%
Satisfactory	38	88%
Marginal	2	5%
Unsatisfactory	0	0%
None	3	7%
Total	43	100%

4.4.16 Buttevant Registration fluoride results 2001-2004

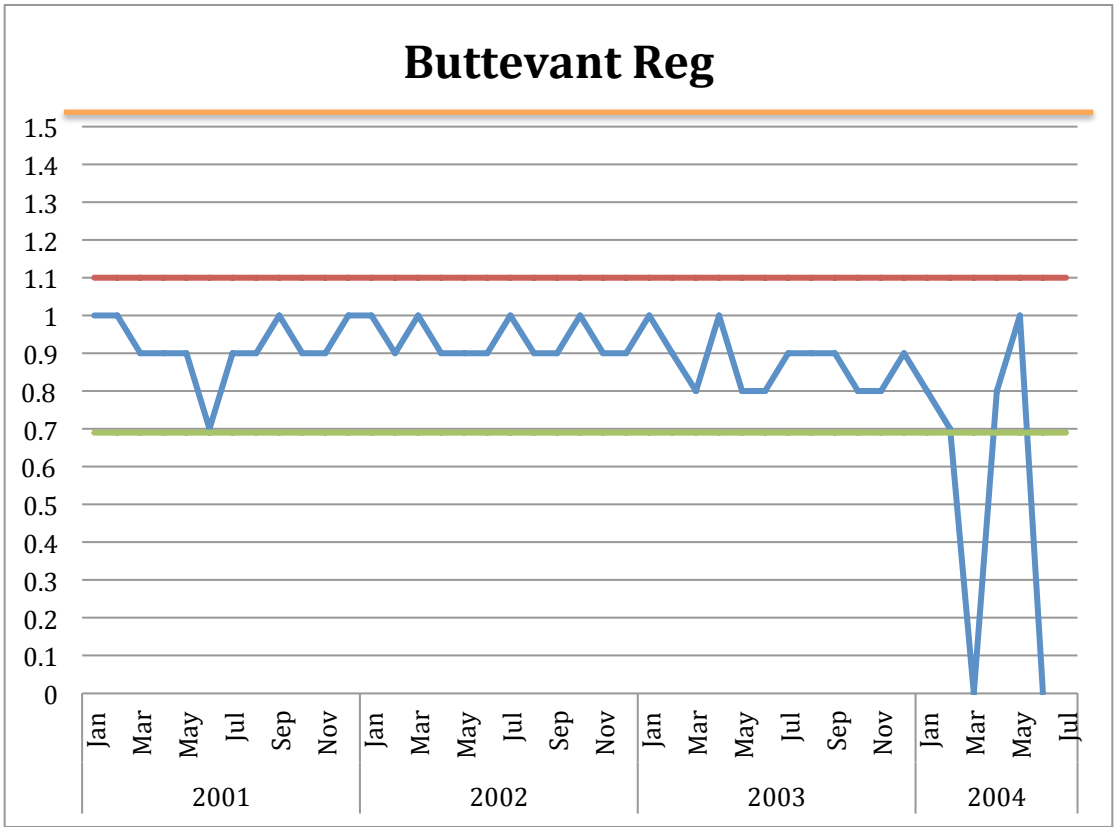


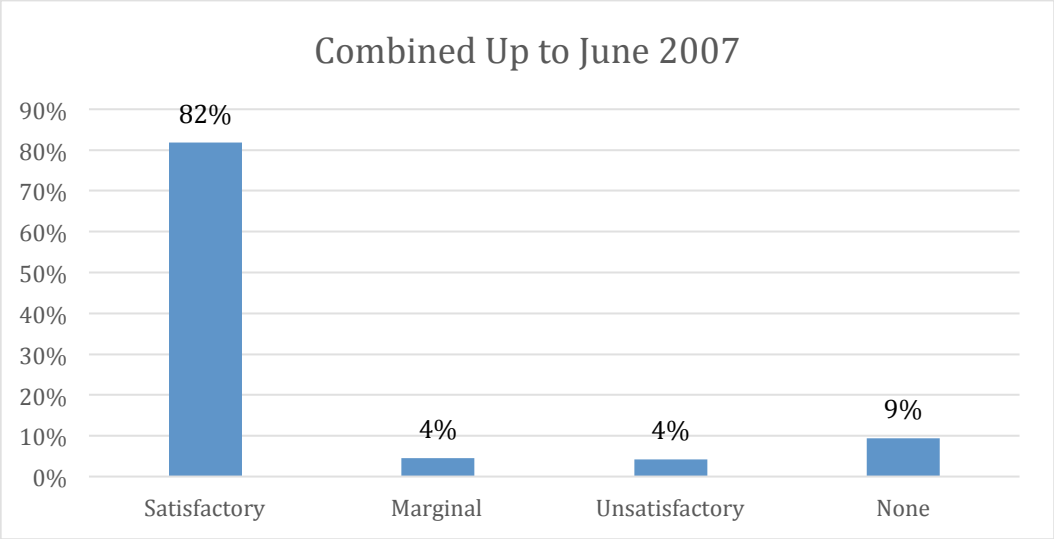
Table 4.4.17: Combined percentages of satisfactory and unsatisfactory results for North Cork

North Cork		
Up to June 2007		
Satisfactory	929	82%
Marginal	51	4%
Unsatisfactory	48	4%
No data available	107	9%
Total	1135	100%

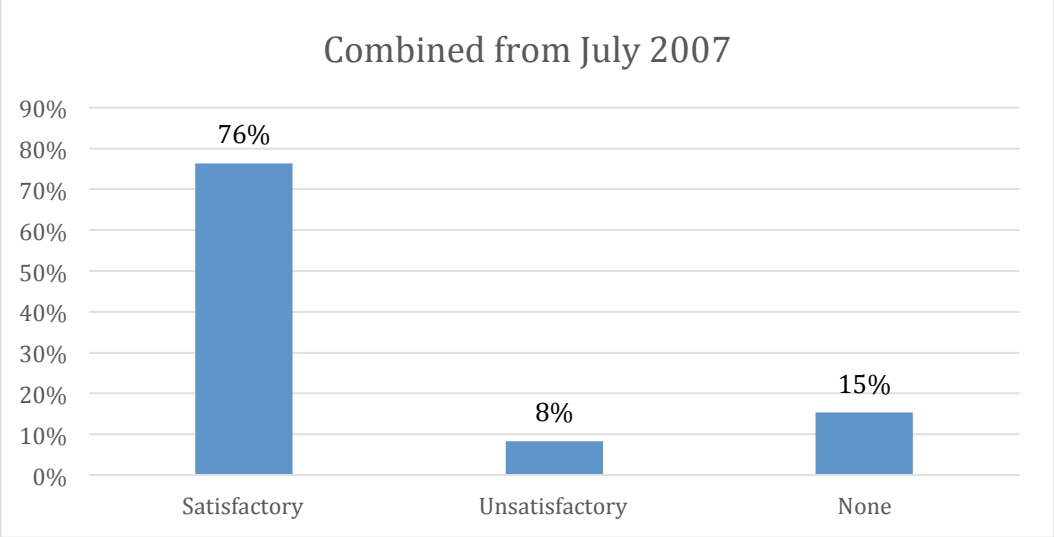
From July 2007		
Satisfactory	715	76%
Unsatisfactory	78	8%
No data available	143	15%
Total	936	100%

Up to June 2007		
Satisfactory	929	82%
Marginal	0	0%
Unsatisfactory	99	9%
No data available	107	9%
Total	1135	100%

3.4.17a Combined Chart for North Cork prior to July 2007



3.4.18 Combined Chart for North Cork after July 2007



CHAPTER 5

Discussion

5.1 Discussion of the results

The key changes introduced by the Fluoridation of Water Supplies Regulation, 2007 are: The amount of fluoride in public water supplies after the addition of the fluoride, shall be in the range 0.6 to 0.8mg/l, as compared with 0.8 to 1.0mg/l under the previous regulation, and the acid as supplied shall contain 10.9 percent by weight of hydrofluosilicic acid, as compared with 14 percent under the previous regulation. This level of fluoride is deemed optimal for protecting the oral health of all age groups. And provides the ideal, constant "repair kit" for teeth, making them more resistant to tooth decay in people of all ages, including the young and the elderly (Irish Expert Body on Fluorides and Health, 2010).

In order to assess wither County Cork's water treatment plants are in compliance with this fluoride range an analysis of fluoride levels results for the period 2001-2012 was done. This period contained the date of July 2007 were the regulation had changed. However, it must be noted that for a number of reasons, 2007 was not a representative year with respect to fluoride exceedances in Ireland. Number of changes took place to the fluoride parametric value in the three versions of the Drinking Water Regulation that were in force at different time over that 12 month period was one of the major reasons. In addition the change in the concentration of the hydrofluosilicic acid led to a degree of confusion in relation to the operation of fluoridation plant across Ireland during 2007 (TOBIN, 2008). The results of the fluoride readings in this report are than compared to the results of the 2002 Evaluation of the Delivery and Monitoring of Water Fluoridation in Ireland commissioned by what was

called the Department of Health and Children (Department of Health today) for the period between 1990-2000.

Since data in the Evaluation report from 1990-2000 was reported with a satisfactory, marginal and unsatisfactory categories, and data in this report divided into two periods before 2007 (with marginal category) and after 2007 (without marginal category) the marginal results for the period 2001-July 2007 were combined under the unsatisfactory column. This will make the comparison to like with like.

As mentioned earlier, the raw data in both reports were reported from 1 decimal place up to 10 decimal places. For the purpose of my discussion data are reported in 3 decimal places. This has a significant in the uncertainty of measurement that is reported to be 14% (± 0.044ppm). Any result up to 0.8044ppm after July 2007 is reported within the upper statutory limit of 0.8ppm and not under the unsatisfactory column. This development highlights the issue of the accuracy of the testing equipment at plant level and at the Public Analyst Laboratories equipment.

5.2 West Cork Area

The average daily volume of water produced is estimated to be 16,783 m3/day. There are 5 Regional Water Supply Schemes (Clonakilty, Skibbereen, Castletownbere, Baltimore, & Leap) and 30 smaller public schemes. The total length of watermains (including Group Schemes attached to the public main) is estimated to be 1,600 km (Cork County Council Water Services, 2007). In West Cork a high discrepancies between the schemes were noted. During the period 2001-2012, the percentages of tests in the satisfactory category ranged from 75% (after July 2007) and 70% (prior to July 2007). The highest satisfactory reading was 88% in Skibereen (after July 2007) and the lowest was 45% in

Bantry High (prior to July 2007). The percentage of tests in the unsatisfactory category dropped from 29% prior to July 2007 to 22% after July 2007. The highest unsatisfactory results were in Bantry High with a percentage of 49%. The lowest unsatisfactory readings were in Skibereen with only 6%. During this period there were 110 (64.7%) 'low' unsatisfactory fluoride readings (i.e. <0.7 prior to July 2007, and <0.6 after July 2007), while 60 readings (35.2%) were 'high' unsatisfactory fluoride readings (i.e. >1.1 prior to July 2007, and >0.8 after July 2007). These results suggest that personnel responsible for the fluoride addition were cautious. According to The York Review, the prevalence of fluorosis at a water fluoride level of 1.0 ppm was estimated to be 48% and for fluorosis of aesthetic concern it was 12.5%. At 0.1 ppm the prevalence of fluorosis was found to be 15% and with fluorosis of aesthetic concern 6% (McDonagh, 2000). This result indicates that 35.2% high unsatisfactory results (exceedance in Fluoride) will pose a side effect that could be controlled with cautious addition of fluoride to the water supplies. There were no data available in 6% of the reading prior to July 2007, and 3% after July 2007. In the period between 1990-2000, an average 74% of the readings of fluoride were in the satisfactory category and an average of 14% of the reading were in the unsatisfactory category. However, during that time the marginal category was almost 10% (Mc Loughlin, 2000). Comparing the two periods a drop from 74% satisfactory reading in 1990-2000 to an average of 72% in 2001-2012 (including prior and after July 2007 data). Although the difference in very small for the amount of readings taken. New equipment's, tests, and engineering techniques should have resulted in a higher percentage of satisfactory readings.

5.3 South Lee Area

South Cork division includes both South and North Lee. There are 3 Regional Water Supply Schemes (Inniscarra, Glashaboy, Innishannon) and 32 smaller public schemes in Cork City Hinterland Region and the average daily volume of water produced is estimated to be 82,000 m3/day a substantial proportion of these are supplied to Cork City. There are also 9 Town / Regional Water Supply Schemes (Bandon, Kinsale, Macroom, Midleton, Youghal, Whitegate, Cloyne / Aghada & Carrigtohill and Cobh) and 39 smaller public schemes and the average daily volume of water produced in these areas is estimated to be 29,376 m3/day (Cork County Council Water Services, 2007).

In the South Lee zone the percentages of test in the satisfactory category were 76% prior to July 2007, and 92% after July 2007. The range of satisfactory results ranged from 97% to 76% Inishannon and Bandon respectively. These data showed a high compliance of the South Lee area. The percentages of tests in the unsatisfactory category were 18% prior to July 2007, and 8% after July 2007 ranging from 21% in Bandon prior to July 2007 to a low 3% in Inishannon in data after July 2007. There were no data avialable in 4% of the data prior to July 2007, and 28% in the data after July 2007. The ‘low’ unsatisfactory results (i.e. <0.7 prior to July 2007, and <0.6 after July 2007) were 26%, while the ‘high’ unsatisfactory results (i.e. >1.1 prior to July 2007, and >0.8 after July 2007) were 73%. Unlike the West Cork Area the data showed that although the unsatisfactory reading in combined is low the ‘high’ unsatisfactory reading is high. According to the EPA annual reports this could be due to the background fluoride levels as a possible explanation for the exceedances. The National Water Study also

makes this point although no reference is made to supporting data. This issue needs to be clarified by regular testing of the source water. It is known that where alum is used in pre-treatment then this may remove up to 30% of naturally occurring fluoride that would eliminate background fluoride as a cause for the exceedances (CDC 1986). During the period 1990-2000 the percentage of tests in the satisfactory category ranged from 60.7% to an exceptional 100%. The percentage of tests in the unsatisfactory category ranged from 2.7% to 62.1% (McLoughlin, 2002). In comparing both periods, South Lee scored the highest scores in both the period 1990-2000, and in the period after July 2007. This result could be contributed to the fact that South Lee zone has the lowest number of schemes with only three schemes.

5.4 North Lee Area

In the North Lee zone the percentages of test in the satisfactory category were 76% prior to July 2007 and 56% after July 2007. The highest satisfactory result reported in Lee Road Waterworks at 91%. The lowest satisfactory result was reported in Cobh at 42%. The percentages of test in the unsatisfactory category were 20% prior to July 2007 and 16% after July 2007. The highest unsatisfactory results reported in Cobh at 44% prior to July 2007. A large drop in North Lee zone satisfactory results percentages between 76% prior to July 2007, and 56% after July 2007. This shows that further work should be done in order to increase the satisfactory reading percentage. The ‘low’ unsatisfactory results (i.e. <0.7ppm prior to July 2007, and <0.6ppm after July 2007) were 47%, while the ‘high’ unsatisfactory results (i.e. >1.1ppm prior to July 2007, and >0.8ppm after July 2007) were 53%. These results show a tight reading between the two categories. In the period 1990-2000 the

percentage of tests in the satisfactory category ranged from 55% to 92.5%. The percentage of tests in the unsatisfactory category ranged from 3.3% to 13.5%, with between 1.7% and 4.6% of the unsatisfactory results above 1.10ppm (McLoughlin, 2002). Again results from the period 1990-2000 showed a higher satisfying reading than the period 2001-2012.

5.5 North Cork Area

The average daily volume of water produced is estimated to be 40,465 m3/day. There are a total of 67 Public Water Supply Schemes in the North Cork Division. 7 of these deliver over 2,300 m3/day, a further 12 deliver between 450 m3/day and 2,300 m3/day each and a further 48 smaller public schemes supplying less than 450 m3/day each. The total length of water mains in these 67 Public Water Supply Schemes is estimated to be 1,289 Km (Cork County Council Water Services, 2007).

In the North Cork Area the percentages of test in the satisfactory category were 82% prior to July 2007 and 76% after July 2007. The highest satisfactory results reported in Millstreet at 97%. The lowest satisfactory result reported in Ballyenthihan at 30%. The percentages of test in the unsatisfactory category were 20% prior to July 2007 and 16% after July 2007. The highest unsatisfactory result reported in Mallow at 23%. The 'low' unsatisfactory results (i.e. <0.7 prior to July 2007, and <0.6 after July 2007) were 80%, while the 'high' unsatisfactory results (i.e. >1.1 prior to July 2007, and >0.8 after July 2007) were 20%. These results suggest that the personnel responsible for the fluoride addition were very cautious. During the period 1990-2000 the percentage of tests in the satisfactory category ranged from 75.0 % to 91.1%. The percentage of tests in the unsatisfactory category ranged from 4.1% to 15.9%, between 0.58% and 3.2% of the unsatisfactory results were above 1.10ppm

(McLoughlin, 2002). Comparing both period, North Cork zone is one zone that had the closet readings between 1990-2000 and 2001-2012.

For all four Areas during the period 2001-2012, prior to July 2007 North Cork zone had the highest percentage of satisfactory readings at 82% while West Cork Area had highest unsatisfactory readings at 25%. After July 2007, South Lee Area had the highest percentage of satisfactory readings at 92% while North Lee Area had the highest unsatisfactory reading at 56%.

Chapter 6

Conclusion

The overall conclusions from the analysis of monthly test results indicated that in general the fluoride levels in public water supplies in County Cork were well controlled. The systems are in place with the regulators and regulations but most important that monitoring required under the regulation is, providing it is followed, adequate to ensure consistent dosage of fluoride at optimal levels and to provide early and timely warning of any system malfunctions that could results in a serious overdose of fluoride. To advance monitoring, there is a need to ensure that the Fluoridation Monitoring Committees are working effectively. This need to be done by clarifying the composition, role and remit of these committees and enhancing their performance to ensure that overall responsibility is identified.

Most of the results in the four Areas fell within the satisfactory limits in both periods i.e. from January 2001-June 2007, and July 2007-2012. However, all four Areas results showed lower number of satisfactory results from these collected in the period 1990-2000. This could be due to the use of more sensitive test equipment. Both North and West Cork Areas results showed that within the unsatisfactory results, both had more low reading (below 0.6ppm) with percentages 64.7% and 80% respectively. While North and South Lee Areas results showed more exceedance (above 0.8ppm) in the unsatisfactory results with 73% and 53% respectively.

However, Naturally elevated levels of fluoride are quite rare in Ireland

thus any exceedances reported by the EPA are due almost entirely to public water supplies being dosed with fluoride at levels which exceed the legally permitted dose. According to The Irish Expert Body on Fluorides and Health compliance with the fluoride standard in 2007 was 91.4%, which was a decrease from 96.7% in 2006. The majority of fluoride non-compliances were marginally above the parametric value. They explained, that the primary reason for the drop in compliance with the fluoride standard was the confusion caused by the discrepancy between the fluoride parametric value in the Drinking Water Regulations and the required level of fluoride to be dosed under the Fluoride Regulations. Currently the EPA does not consider that low levels of fluoride in drinking water i.e. below 0.6ppm as a non-compliance. The Expert Body is of the opinion that this is non-compliance as it is not complying with the drinking water regulations and that the EPA Review Group should give consideration to the matter (Irish Expert Body on Fluoride, 2010).

As a pediatric dentist I am concerned with the prevention and control of dental caries. The best available evidence suggests that having fluoride at an optimal level would benefit the oral health of the vast majority of people by reducing caries prevalence, both as measured by the proportion of children who are caries free and by the mean dmft/DMFT score. Although Fluorosis is a major concern of the exceedance of fluoride in water, the impact on public health of lowering the fluoride dosage under the optimal level would be greater. The cost of treating dental caries has much greater effect on the public health than treating the aesthetical problem of fluorosis.

Thus monitoring the fluoride levels to ensure the maintenance of its optimal level is of a great importance.

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Appendix 1

S.I. No. 42/2007 - Fluoridation of Water Supplies Regulations 2007

S.I. No. 42 of 2007

Fluoridation of Water Supplies Regulations 2007

I, Mary Harney, Minister for Health and Children, in exercise of the powers conferred on me by section 2(3)(a) and section 4(1)(a) of the Health (Fluoridation of Water Supplies) Act 1960 (No. 46 of 1960), as adapted by the Health Order 1997 (S.I. No. 308 of 1997) and having complied with section 2(4) of the Health (Fluoridation of Water Supplies) Act 1960 and after consultation with the Minister for the Environment, Heritage and Local Government (as adapted by the Environment and Local Government Order 2003 (S.I. No. 233 of 2003), hereby make the following regulations:-

PART 1 - PRELIMINARY

1. These Regulations may be cited as the Fluoridation of Water Supplies Regulations 2007.

2. These Regulations shall apply to all water supplied to the public by a sanitary authority through pipes, hereinafter referred to as "public water supplies".

3. In these Regulations:

"Minister" means the Minister for Health and Children;

"sanitary authority" means a county or city council as defined in section 2 of the Local Government Act 2001 (No. 37 of 2001);

"health authority" means the Health Service Executive established under section 6 of the Health Act 2004 (No. 42 of 2004).

4. These Regulations shall have effect on and from 1 July 2007.

PART 2 -GENERAL PROVISIONS

5. A sanitary authority shall perform the following acts in relation to the fluoridation of public water supplies:

(a) the provision, installation and maintenance of equipment for fluoridation,

(b) the making of arrangements for the addition of fluoride to the water, and

(c) the testing of the fluoride content of the water to which fluoride has been added.

6. The amount of fluoride which may be added to public water supplies shall be such that the water, after the addition of the fluoride, shall contain not more than 0.8 milligrams of fluoride per litre (mg/1) of water, and not less than 0.6 milligrams of fluoride per litre (mg/1) of water.

7. Fluoride may be added to public water supplies either in the form of hydrofluosilicic acid complying with the specification for that substance in Schedule 1 to these Regulations, or in such other form as may be approved by the Minister.

8. Equipment used for the fluoridation of public water supplies shall be such as may be specified or approved by the sanitary authority in consultation with the health authority.

9. The fluoride content of public water supplies, to which fluoride has been added shall be determined daily at the water treatment plant. In addition, the fluoride content of public water supplies shall be determined by a method complying with the performance characteristics specified

for fluoride in section 2 of part 3 of the Schedule to the European Communities (Drinking Water) Regulations 2000 (S.I. No. 439 of 2000) or any enactment amending or replacing those Regulations, at intervals not exceeding 2 weeks during the period of 6 months after the date on which fluoride shall have been first so added and thereafter at intervals not exceeding one calendar month.

10. A sanitary authority shall arrange for:-

(a) the provision, installation and maintenance of equipment for fluoridation,

(b) the making of arrangements for the addition of fluoride to the water, and

(c) the testing of the fluoride content of the water to which fluoride has been added,

as agent for the health authority.

PART 3 - REVOCATIONS

11. (1) The Regulations listed in Schedule 2 to these Regulations are revoked.

(2) References in any other instrument to the Regulations revoked under paragraph (1) shall be construed as references to these Regulations as appropriate.

Schedule 1

Specification for Hydrofluosilicic acid of 10.9 per cent strength.

The acid as supplied shall contain 10.9 per cent by weight of fluosilicic acid (H_2SiF_6) subject to a tolerance of 0.3 per cent above or below that strength, and shall contain not more than the limits for "heavy metals" as specified in the appropriate European Standard (IS.EN 12175:2001) and no other soluble mineral or organic substance in quantities capable of a deleterious or injurious effect upon health.

Appendix 2

Department of Health letters on Fluoridation Monitoring Committees

Department of Health An Roinn Sláinte Hawkins House, Dublin 2 Teach Haicin, Baile Átha Cliath 2

18 August 1992Chief Executive Officer Each Health Board

Fluoridation Monitoring Committees

Dear Chief Executive Officer,

As you know the satisfactory implementation of the national fluoridation programme requires a high level of co0ordination between health boards and local authorities.

The Department's circular of 14/1977 and the memorandum enclosed therewith outlined for health boards and sanitary authorities their responsibilities in relation to the fluoridation of public water supplies and it appears that there is currently a good understanding between health boards and local authorities of their responsibilities.

However, it would appear that the exchange of information and co-ordination between the boards and the local authorities is sometimes unsatisfactory, with the result that the best possible use of the available resources under the fluoridation programme may not always be made and the most satisfactory results may not always be achieved.

Having regard to the overall responsibility of health boards for fluoridation programme under the health (Fluoridation of Water Supplies) Act, 1960, I am now to request you to be good enough to establish jointly with the local authorities concerned a Fluoridation Monitoring Committee in respect of each community care area to ensure a full exchange of information and a high degree of co-ordination under local programme. A specific task of the Committee would be to review test results and ensure that remedial follow-up action is taken where necessary.

It is envisaged that health board representation on the Committee would include the Director of Community Care and the Principal Dental Surgeon and might also include, as appropriate, the Supervising Environmental Health Officer and the Technical Services Officer. The Committee might meet on a quarterly basis under the chairmanship of the Chief Executive Officer or the Programme Manager Community Care.

It is envisaged that the local authority representation on the Committee would include the County Engineer and would also include such other representatives, as the local authority considered appropriate.

Please be good enough to report, in due course, progress on the setting up of Fluoridation Monitoring Committee in your area.

This letter has been prepared in co-operation with the Department of the Environment who will also be contacting local authorities in the matter.

Appendix 3

Dear Mr. Parle,

I am completing a Masters in Dental Public Health at UCC, with Professor Denis O'Mullane and Dr. Mairead Harding.

My research is focused on the Cork City and County Area, and I will also contact Mr. Fred Davidson.

Before I speak with Mr. Davidson, I would be very grateful if you could advise the methods which are used in / for Environmental Health Offices to determine the concentration of fluoride in public piped water supplies.

Please could you tell me the type of instruments that are used to measure fluoride concentration and the margin of error associated with the instruments, and the calibration of the instruments.

The second query that I have relates to from whom the samples are received?

Are they remote from water treatment plants from treatment plants Samples sent from the Environmental Protection agency (EPA).

Please could you also advise whether samples are analysed at the National Laboratories.

I would appreciate any further information you feel may be of assistance.

Yours sincerely

Tarik Nazer

Dear Mr. Nazer,

In answer to your queries, in the Cork city and county area the environmental health officers take monthly samples from the distribution system (typically at a consumer's tap) i.e. not at the treatment plant, and send this sample to

the Public Analyst's laboratory where the analysis is actually carried out i.e. the EH service does not itself carry out the analysis of the sample.
In some areas of the country (including my own) the environmental health officers take a second sample at the same time as the monthly sample for submission to the public analyst's laboratory. This second sample is analysed by ourselves back at our offices using the HACH colorimetric testing system. This method would not be nearly as accurate as the test carried out at the public analyst's laboratory. However it is useful in giving an early warning as to a possible non-compliant result enabling us to contact the water service authority to check the system.

Regards,

Ray Parle