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See below for Submission details. Attachments are displayed on the following page(s).	

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Submission to the EPA by Atlantic Shellfish Ltd.

with reference to the

Application for an Industrial Emissions Licence

by

Dairygold Co-Operative Society Ltd. and TINE Ireland Ltd.

of Mogeely, Co. Cork P25Y996

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Relevant Inspector: Orla Harrington

Environmental Licensing Programme
Office of Environmental Sustainability

EPA Licence Application Reference No: P1103-01

Objection to the discharge of the treated wastewater from the enlarged cheese-making facility of Dairygold Co-Op and TINE Ireland Ltd. at Mogeely, Co. Cork, which is proposed to be made to the North Channel of Cork Harbour through the Midleton WWTP Primary Discharge at Rathcoursey Point in the North Channel of Cork Harbour.

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Executive Summary.

Dairygold propose laying a 14km pipeline to transport up to 4,000m3 (4 million litres) waste water daily from their new cheese factory in Mogeely and discharge it into the innermost and shallowest part of Cork Harbour behind Great Island - still 12km away from the harbour mouth and dilution with the open sea, when the open sea at Ballycotton Bay is only 10km south of the factory at Mogeely itself. Oysters have grown in the North Channel for thousands of years, precisely because their free-swimming larvae are NOT flushed away by the tides and we have been growing world-beating oysters there now for 50 years, with our production generating as much as a quarter of the value of all Irish oyster sales from 1975-1995 (see sections 1 & 2).

The most up-to-date hydrodynamic computer modelling from NUI Galway, shows that the water in the North Channel remains there with a "residence time" of a staggering 60-70 days and at Rostellan of up to 48 days. Furthermore, analysis of current meter measurements in the North Channel shows a considerable (>1km/tide) anti-clockwise movement of water around Great Island – i.e. any discharge at Rathcoursey (at the top of East Ferry) eventually travels inland, as it never ever reaches the Main Cork Channel south of Whitegate on the ebb and thus to escape to the open sea. 1977 and 1993 dye studies following both a continuous 5-day discharge at Rathcoursey and one for 3 hours made at the top of the outgoing, ebb tides only, both show a build-up of dye at the far inner, west end of the North Channel. Discharges at Rathcoursey simply accumulate in the North Channel – they do not get flushed into "~80% new water" as we are informed by the Dairygold Consultants (sections 3, 4 & 5).

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Shallow areas of warm water with little outside dilution are ideal for the growth of phytoplankton, on which the oysters feed, but, if the input of nutrients is too great, the phytoplankton is liable to bloom and when the bloom dies, the rotting cells then take all the oxygen from the water. This process is known as "eutrophication". For this reason estuarine waters have been tested for signs of this occurring and the 28 year old Urban Waste Water Treatment Directive (91/271/EEC) required in its third Article that water should be tested and, if found in danger of being "eutrophic", or "potentially eutrophic", should be classed as "sensitive" and extra precautions taken. From the first EPA sampling period in 1995-99 the North Channel, was found to be eutrophic, and since then either the North Channel, or the Owenacurra Estuary that feeds into it, have been declared either eutrophic, or potentially eutrophic, although these two waters, together with the Lee Estuary/Lough Mahon, most unfortunately, avoided being classed as "sensitive" until July 2004 (section 7).

Two earlier EPA studies of 2001 and 2002 (section 6.2.3) however, had already published their opinions. In a study of Wexford and Cork Harbours:

"The study found that point sources (outfalls) of nutrients are contributing to phytoplankton blooms in both estuaries. ***Measures to reduce waste inputs into the inner brackish-water part of the estuaries are thus required to reduce the occurrence of harmful algal blooms, especially in Cork Harbour where toxic blooms have occurred and are likely to continue to occur",*** and the authors made, as their first recommendation for "*Estuary Management*":

"Measures are required to reduce inputs of point source nutrients in both estuaries, because these are significantly contributing to the phytoplankton blooms. ***This action is especially important in inner Cork Harbour because potentially-toxic dinoflagellate phytoplankton develop blooms there during the summer."***

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These blooms are due to the warmth of the water, because of its shallowness (less than 0.5m at LW) and the solar-panel effect of the surrounding mud banks, together with the very high residence time and lack of dilution of the water in the enclosed cul-de-sac of the North Channel. Regrettably, these blooms produce some of the most serious natural nerve poisons known to man, causing Paralytic Shellfish Poisoning (PSP) to anyone gathering and eating, for instance, the freely available mussels (of greater danger) from the shore. The North Channel is the only place in Ireland to suffer such regular phytoplankton blooms every summer and has been extensively researched by boat and computer modelling (section 6).

The historical and current trophic status of the water is discussed in section 7 using the two latest EPA publications on Water Quality in Ireland (2018). Attention is drawn to the placing of Midleton WWTP on the OEE's National Priority Enforcement List of the worst 7 failing WWTP's in the country in 2013; the EPA's failing of the waste water treatment capability in Midleton in 2016; the European Court's judgement in March 2019 that the WWTP had failed on all 3 of the Directive's fundamental Articles "1.Collection", "2. Secondary Treatment" and "3.Tertiary Treatment" and the An Bord Pleanála decision of February 2019 to refuse permission for the building of a further 176 houses, until adequate steps had been taken to ensure adequate waste water treatment capacity for the town. I argue that with the very poor overflow record from the main pumping stations in the town averaging nearly 300 million litres p.a. over the last 16½ years, there is likely to be a very high load of nutrients coming from the town, which is simply not taken into account in the Dairygold Consultants' calculations on the effect of the Dairygold discharge. A detailed discussion of the addition of nitrogen, phosphorous and overflows is made in section 8.

The lack of serious alternative discharge locations for the Dairygold discharge is discussed in section 9 and attention is drawn to Cork County Council's appointment of WYG Consultants to draw up plans for the "Upgrading of the Wastewater Treatment Facilities at Midleton, Castlemartyr, Cloyne, Saleen and Ballycotton" (Nov. 2008) and the "Cost Benefit Analysis for an Alternative Outfall for Midleton WWTP" (July 2009), which was to divert the treated effluent flow from Rathcoursey to Ballycroneen on the south coast, to improve the water quality for the oyster fishery in the North Channel.

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Section 10 discusses the increasingly pro-active role of the EPA in protecting Shellfish Waters through individual Pollution Reduction Programmes, where, in particular, discharges given the status of Key Pressures on shellfish water quality, default automatically to the highest enforcement category (A1).

Section 11 notes that the North Channel is one of the largest sites of *Ostrea edulis* production in Europe today and could claim to be safeguarded by Appropriate Assessment in its own right and advises that the UK has had a Native Oyster Species Action Plan (NOSAP) under the Rio Convention since 1999 and that the OSPAR Commission also listed *Ostrea edulis* as one of its threatened species in 2003.

Section 12 refers to the ever present threat of operator error and the previous destruction of 20,000 juvenile salmon, trout and lamprey by the Dairygold discharge of insecticide to the Kiltha River at levels 50,000 times over a safe dilution and the need in section 13 for the Rio Convention Principles of Prevention and Precaution in environmental matters.

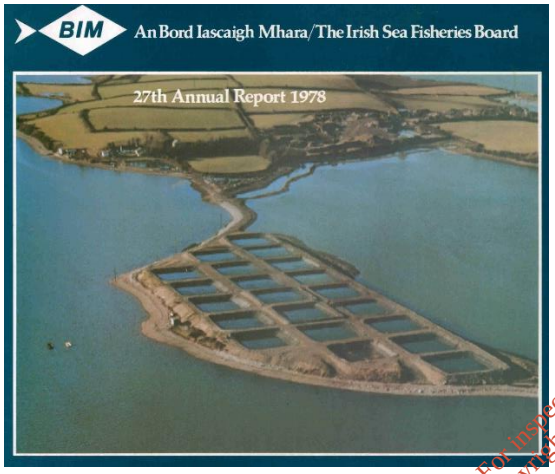
In section 14, I exhort the EPA to forbid any further nutrient discharge to our water and urge Dairygold to follow Irish Water's Option 3 to discharge to the open sea at Ballycroneen.

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1. Background of oysters in the inner Harbour.

Our concern with this IEL Application centres only with the choice of the waste water discharge location at Rathcoursey Point, to which we are very strongly opposed and which we feel could be financially disastrous for us after a lifetime of work in the area. The location of this discharge, right between our EU Designated Shellfish Water in the North Channel, shared by ourselves with Fota Oyster Farm Ltd., and our three further Designated Shellfish Waters at Rostellan, in the Lower Harbour, could not be worse, nor these waters more unsuitable for the disposal of waste water of any description.

As you may know, we have been farming oysters in Cork Harbour for very nearly 50 years. We have established a native oyster breeding complex of 22 x 1,000m3 shore-based ponds, the only successful venture of this kind in the world, producing on average 90 tonnes p.a. of market oysters (about a quarter of the current French production of *Ostrea edulis*).



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For the production of Pacific oysters (*Magellana gigas)*, we have 13 kilometres of trestles in the north-east corner of the Lower Harbour at Rostellan for holding juvenile oysters from seed to the size they can be laid safely on the sea-bed, of which we then have several hundred hectares in the Lower Harbour - all that ground east of a line from the Power Station to Cuskinny Bay on Great Island, for which we own the Oyster Fishery Order granted 56 years ago in 1963.

Both these areas have been oyster producing areas since the Iron Age, as witnessed by the kitchen middens of discarded oyster shells, which are features of the OS maps of the area. The Browne Report of 1904 lists Cork Harbour as the fourth largest oyster production area in the country at that time. Such areas are very scarce in Europe these days and are of great commercial value. With the recent emergence of an almost unlimited market for oysters in the Far East, we believe that the sales which we made over many years from 1996-2002 of about 800kg/week to Hong Kong can now be multiplied many times to several hundred tonnes p.a. with the employment of at least twice as many hands as we needed then – i.e. 40-50 men. Production by our neighbours in the North Channel is already substantial at, we believe, some 200-300 tonnes p.a.

With the encouragement of every single Government-sponsored food-producing initiative, we have grown our business from the start in 1971 on supplying all our oysters packed in retail quantities, on a daily basis, to the end of the supply chain. In the 1990's, for instance, we

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were supplying 90% of the Good Food Guide restaurants in London and "Rossmore Oysters" featured prominently on menus and Chefs' Boards of Honour all over the capital. To supply direct to consumers on a daily basis, of course, means that one cannot miss supplying a single order – for any reason, even anything out of our own control, caused by poor water quality.

2. Description of the North Channel water body.

It was the Department of Fisheries and Forestry Research Station oyster expert who suggested in 1969 that we should establish our breeding ponds and fishery in the North Channel. He knew its history of oysters and that the hydrodynamics of the area had led to it being one of those rare areas where the pelagic, free-swimming oyster larvae were retained for as much as the minimum 10 days (20 tidal cycles) necessary before their metamorphosis and settlement, without substantial loss, and had given rise to the natural beds both there and at Rostellan, over thousands of years.

Reference to the Admiralty Chart shows that depths over most of the North Channel are less than 0.5m at low water and one can easily wade down the whole length of the centre of the channel, marked on the Chart as "Shellfish Beds" at low water of spring tides. Although this description of the shallowness of the North Channel is more than adequate, this extraordinary picture, below, of the actual features on the seabed itself, taken from the 450km-high QuickBird satellite, which was published in the O'Kane Report on the hydrography of the North Channel (Chapter 1 p.7), make the point dramatically.

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Fig. 1.2 "Modelling the Norovirus in Cork Harbour". Prof. J.P. O'Kane
"Quickbird" image of the Oyster Fishery in the North Channel.



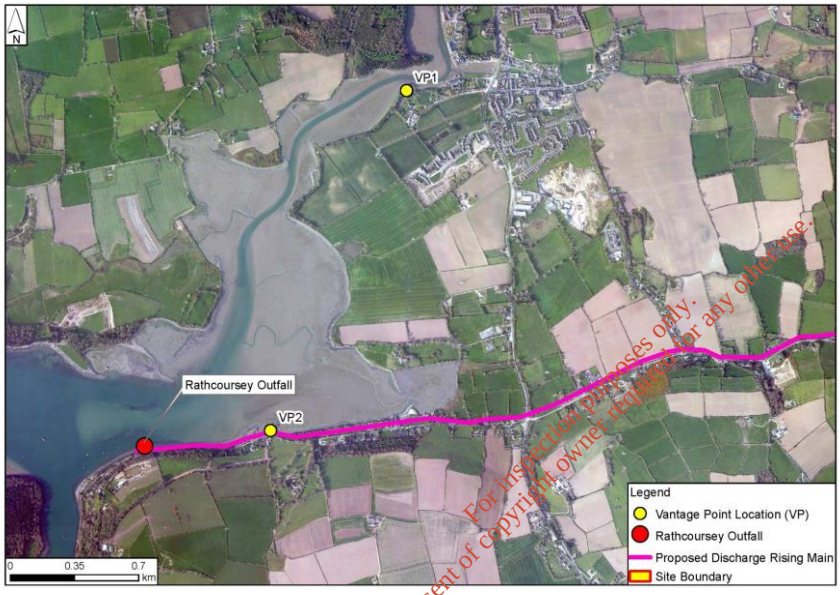
(The trestles mentioned in the caption are, in fact, only the grey area shown at the west end of the picture in water of 0.5 to 1.0m OD and at the western extremity, where the individual blocks of trestles show clearly. These are the trestles of the Fota Oyster Company, producing c. 200 t.p.a. There are no trestles in the 1.6km of seabed belonging to Atlantic Shellfish over the main part of the North Channel, east of the land-based breeding ponds, which show up

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distinctly on the north side. What is showing up as black is probably weed adhering to half-grown oysters in the well-delineated layings of 2- and 3-year old stock on the bed of the sea.)

The other end of the North Channel, which is not shown in this Quickbird photograph, can be seen in the photograph given as Figure 4 on p.11 of the Screening for Appropriate Assessment of the Dairygold application. This also shows exactly the same LW situation, but at the eastern end of the North Channel, from Rathcoursey to Midleton.

The area showing up in the middle of the channel north of what is indicated as the Rathcoursey Outfall (in fact the tidal holding tank) is at the same depth as the oyster layings in the main channel (<0.5m), and, as can be seen, the rest of the Owenacurra Estuary is shown up to be almost entirely exposed mudflats at low water, with a narrow channel, little over the depth of an outboard motor:



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Fig. Owenacurra Estuary at LW from the air.

(Figure 4 on p.11 of the Screening for Appropriate Assessment in the Dairygold application).

These two pictures make it very easy to visualise just what little volume there is in the North Channel and Owenacurra Estuary to dilute any discharges made into it. M.C. O'Sullivan in his "1981 Report on Midleton Sewage Treatment" also usefully described the water flows in the estuary above on p.4.

"In order to ascertain the effect on the estuary of releasing sewage on a falling tide, a float survey was carried out. The survey indicated clearly that material released over a 2-hour period at Ballinacurra would be swept down to the East Passage and hence to the Lower Harbour provided the release was carried out not later than 3½ hours after high tide. It further indicated that material released later than 3½ hours after high tide would be carried back up the estuary to the mouth of the Owenacurra and Dungourney Rivers."

He did not say what then happened to the water which reached the Lower Harbour, except to say that the returning flood water splits approximately 76% to the North Channel and 24% back up the Owenacurra Estuary. We will see that the Dairygold submission is equally vague.

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3. Hydrography of the North Channel

In the extraordinarily simplistic "tidal prism" method of looking at the hydrodynamics of the channel, used by M.J. O'Sullivan for the Dairygold EIS (Appendix 6E Assessment of Proposed Wastewater Discharges on the Receiving Waters at Rathcoursey Point), he has resurrected the M.C. O'Sullivan 1977 Cork Harbour Pollution Report (CHPR), Volume 1, 40 year-old basic topographical statistics, which gave the surface areas and volumes at HW and LW for various parts of the Harbour on its p.268 and, as the remaining volume in the North Channel at low water can readily be calculated as about 20% of the high water volume, he then tells us that ~80% is therefore lost from the North Channel on each tide. I quote from s.5.5.10 Habitats on p. 60 of the Dairygold EIS:

"Over the 6+ hour period between ebb tides, water will undergo an ~80% exchange so that the subsequent discharge event will occur on new water coming in rather than the column which has gone out on the preceding tide."

Again on p. 61 in s.5.5.12:

"Trade effluent will be discharged via diffuser pipe on 6+ hour ebbing tide in a 24 hour period with water undergoing an ~80% exchange so that the subsequent discharge event will occur on new water coming in." (My emphasis in the above two quotations.)

The Natura Impact Statement in the EIS Vol.3 Appendix 3 (Attachment-6-3-7-NIS-Planning-Nov-2016) gives us the CHPR tables on pp.35 & 36 which show how the tidal prisms can be calculated as varying from 47.6% – 74.4% of the HW volume at neap and spring tides and, although a figure as high as ~80% is not mentioned here, the section carries this same message on p.36 (and again on both pages 37 & 38):

"As discharges will be on an ebb tide, effluent will be carried away from the Natura 2000 designated areas of the receiving waterbody. The effluent emanating from the discharge point is lighter than sea water so it rises to the surface, spreading out as it does so, thus becoming more diluted by the friction of the seawater on the rising column. Generally it occupies the top one third of the waterbody at the surface and continues to be diluted further. As it sinks deeper as it travels, it eventually diffuses through the entire waterbody[15]. The discharge will quickly diffuse into the overall waterbody and owing to the ebb tide, will be carried away from the SAC/SPA."

NB: "Footnote 15 acknowledges this statement to *"Michael O'Sullivan Water Services Engineer"*

p.37 *"Discharging on an ebb tide only will allow the effluent to be flushed out of the receiving environment. Over the 6+ hour period between ebb tides, water will undergo an ~80% exchange so that the subsequent discharge event will occur on new water coming in rather than the column which has gone out on the preceding ebb tide".*

p.38 "Trade effluent will be discharged just south of Natura 2000 sites via diffuser pipe on 6+ hour ebbing tide in a 24 hour period with water undergoing an ~80% exchange so that the subsequent discharge event will occur on new water coming in.

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It is surprising that Dairygold's Consultant, did not given us a more sophisticated approach than that of 1977 and I hope you will agree that it is simply not good enough today, with the huge advances that have been made in hydrodynamic modelling, including the very sophisticated modelling now available on Cork Harbour by NUIG, some of which I believe has been used by Cork City Corporation in their correspondence with yourselves e.g. "*Nutrient Dynamics in Cork Harbour*", Nash S, Berry A and Hartnett M (2005), with reference to the need for nutrient removal for the Carrigrennan WWTP.

The problem with the above Dairygold synopsis, was to be recognised by Irish Hydrodata Ltd. in the further work for Irish Water, "*Rathcoursey Outfall Investigation of the Impact of Treated Wastewater Discharges Arising from the Dairygold Mogeely Plant to Cork Harbour*", which was required by Cork County Council in response possibly to our letter of objection to the Planning Permission and was dated 19th May 2017. This addendum explores the vital question of "Estuary Tidal Flushing" in Section 4.9 on p.42

However, the submission continues to pursue the fact that there is simplistically a large difference between the high water and low water volumes, and although it confronts the problem of how much of the returning water is "new", no actual figures are put forward and the argument is made at really a most unacceptably basic level, e.g.:

"*A fundamental part of flushing calculations is establishing what portion of waters that exit an area on the ebb tide will subsequently return on the following flood*", and that,

"*Mixing processes in the lower harbour will determine how much of the Great Island channel waters get replaced with "new" waters."*

After its earlier computer modelling of the Report, this section on flushing is entirely subjective and conjectural,

"Similarly waters in the lower Cork Harbour area will in turn exit past Roches Point and a portion of these will be replaced by "new" Celtic Sea waters on the incoming tide. Part of this mixing is due to turbulent motions of the water body but wind is also a very important factor in the mixing process and as a consequence, in the flushing behaviour. Shallower areas are the most responsive with enhanced mixing due to wave action and the formation of induced circulations. The lower harbour area is geographically exposed with mean monthly wind speeds of 10-12 knots and up to 15 days with gales per year. Therefore while short quiescent periods may occur when only tidal mixing prevails, on average weather conditions promote mixing."

No attempt at quantification is given in any of this. 10-12 knot winds are the same average for all the south and south-west coasts and winds of this speed, from my experience, are not going to cause particular turbulence in Cork Harbour. They will also be 30% less in the summer months, which we will be more concerned with in this discussion.

This addendum does add some figures on the next page (p.43), but then only by returning to the use of the figures of the "*simple tidal prism model"* and again quotes the findings of the M.C. O'Sullivan Cork Harbour Study of 1977 which, for the Harbour as a whole, in the first paragraph:

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"*suggested exchange factors with the open sea waters of 0.2 – 0.4 representing the amount of "new" water that enters on the flooding tide. Using the average exchange factor of 0.3 the flushing time would increase to about 6 days."*

and for the North Channel (para.4) *"a flushing time of about 8 days".*

This seems to be somewhat nearer to the mark than "*~80% exchange per tide*" or even the 19% exchange put forward by M.C. O'Sullivan, himself, in the CHPR 1977, but, as free-swimming pelagic oyster larvae take 10-14 days to metamorphose and attach to shells on the bottom, it is still difficult to equate either estimate with the depth of old oyster shells in the North Channel and even in the Harbour generally.

Waters with suitable water retention for oyster larvae lose typically < 4% per tide (c.f. the Oosterchelde in Holland, where precise water movements are so accurately known), leaving 30 - 40% of the original water with its larvae still near the parent oyster-beds after their pelagic development as I deal with in section 3.2.3 in the table on p.23 below. It can be seen how critical each single percentage point of water exchange is to the suitability of an area for oyster bed formation and it can be appreciated why such sites are so rare in nature, requiring what Prof. Korringa called in his historic oyster paper of 1941, "*an almost perfect oscillation*" of the water.

Section 4.9 of the Irish Hydrodata addendum ends on a grand finale of assumptions:

"*All of these prism calculations assume good mixing which is believed to be a reasonable assumption given the tidal volumes, shallow depths and expansive areas discussed previously."*

The addendum finally concludes (p.44):

"Discharges from the outfall are carried by the ebb tide to the south and into the lower harbour. A high proportion returns on the subsequent flood. Based on dye tests (MC O'Sullivan 1977) this fraction is about 65%. Estimates of flushing rates vary and are dependent on the method used and stage of the spring neap cycle. The tidal prism volumes are large relative to the low water volumes. Estimates range from 3-8 days for the waters upstream of Rathcoursey Point."

I have respect for Irish Hydrodata, but I am surprised that they have confined themselves to such a conjectural piece on tidal flushing, when it is of such importance to the dispersal of any more nutrients intended to be added by Dairygold, and that they are, in fact, still mainly relying on the M.C. O'Sullivan's tidal prism method of 40 years ago.

Before turning to the complexity of the newer hydrodynamic models which have come from NUI Galway from 2005 to 2012, we have the benefit of more direct observations made during the course of an important NUIG Ph.D. phytoplankton modelling exercise over three summers and literally scores of boat trips in the North Channel and Lower Harbour – often made with ourselves.

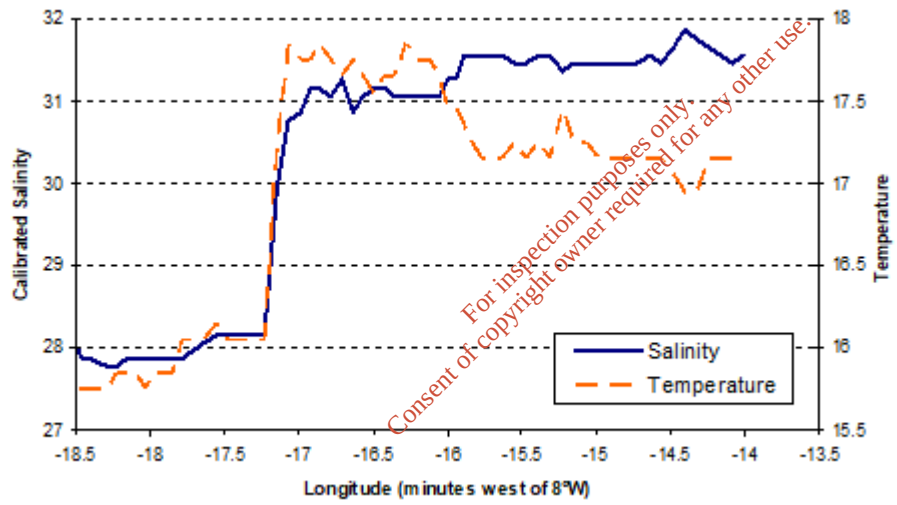
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3.1 Direct water movement measurements for the NUIG Ph.D. thesis.

The annual occurrence of serious toxic algal blooms in the North Channel, leading to bans on the harvesting of shellfish in the North Channel during nine of the 11 years between 1996 and 2006, associated with the only cases of contamination of shellfish with paralytic shellfish toxins in the Republic of Ireland, enabled funding for a 3-year Ph.D. thesis, "*Modelling Alexandrium Bloom Dynamics in Cork Harbour, Ireland"*, by Aoife Ni Rathaille, under the guidance and full-time, on-site support and assistance of Dr. Robin Raine from NUIG, with boat-time of at least 2 months each summer from 2004 to 2006.

Establishing boundaries for the hydrodynamic modelling of the North Channel and Lower Harbour was essential and many days were spent towing salinity/temperature probes to show that no water entered the North Channel from Lough Mahon through the Belvelly Channel at the west end with a null point where the two water bodies meet, varying by only 0.02 of a minute of longitude over the 27 separate tows made, which is just 20m (p.117). A very clear example of the findings of such a tow, is that made on 13.06.05, with the much lower salinity of the Lough Mahon/River Lee water showing clearly on the left (west) side of the null point:



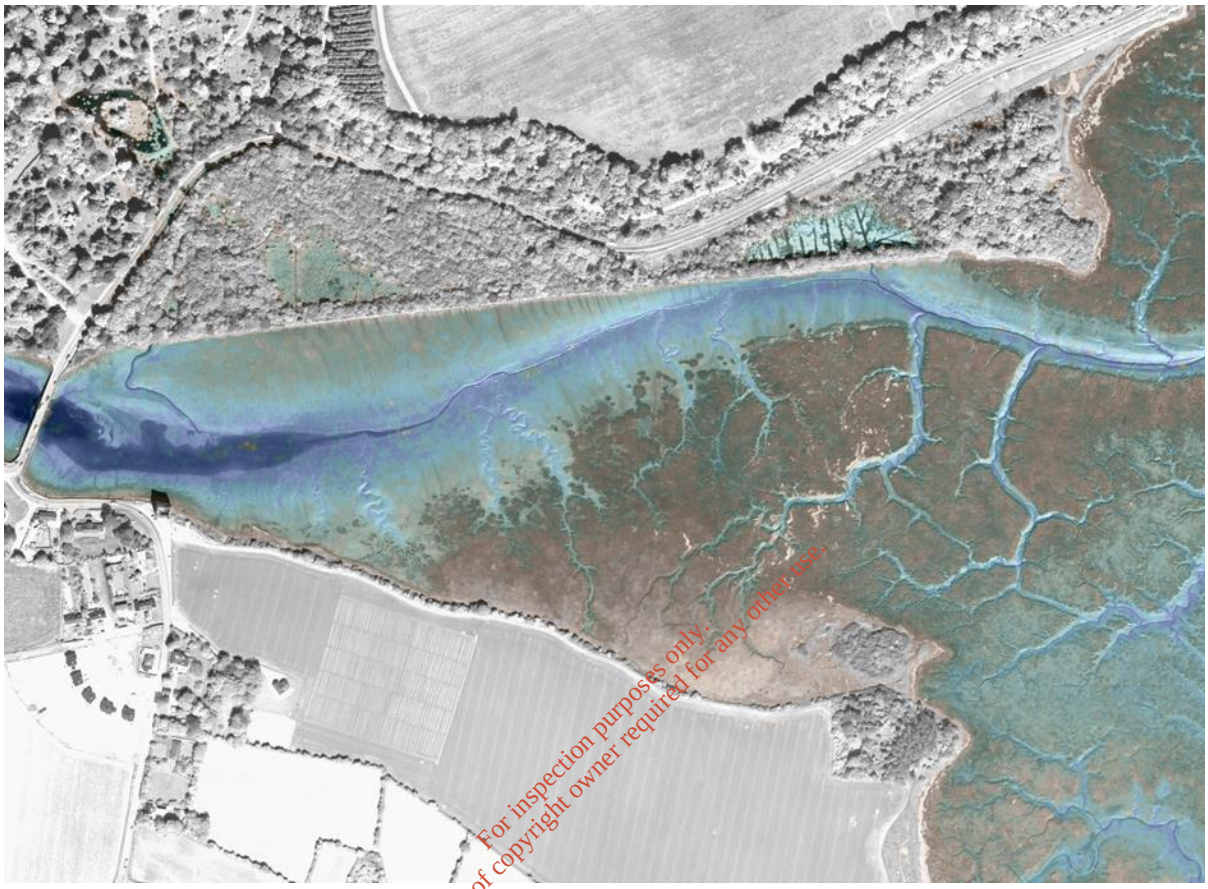
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Example of temperature/salinity tow results down the Belvelly Channel

The position of this null point, where these two different water flows meet, shows up at low water in the satellite pictures taken with the Mars QuickBird camera of the Belvelly Pool, with the null point, approximately a quarter of the way between the SE tip of Fota Island and Belvelly Bridge, where the two drainage flows can be seen dividing to east and west.

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Satellite photograph of LW at Belvelly,
(showing the dendritic patterns of flow to east and west from the null point off the SE sea-wall of Fota Island. (Photo from UCC Civil Engineering Dept.)



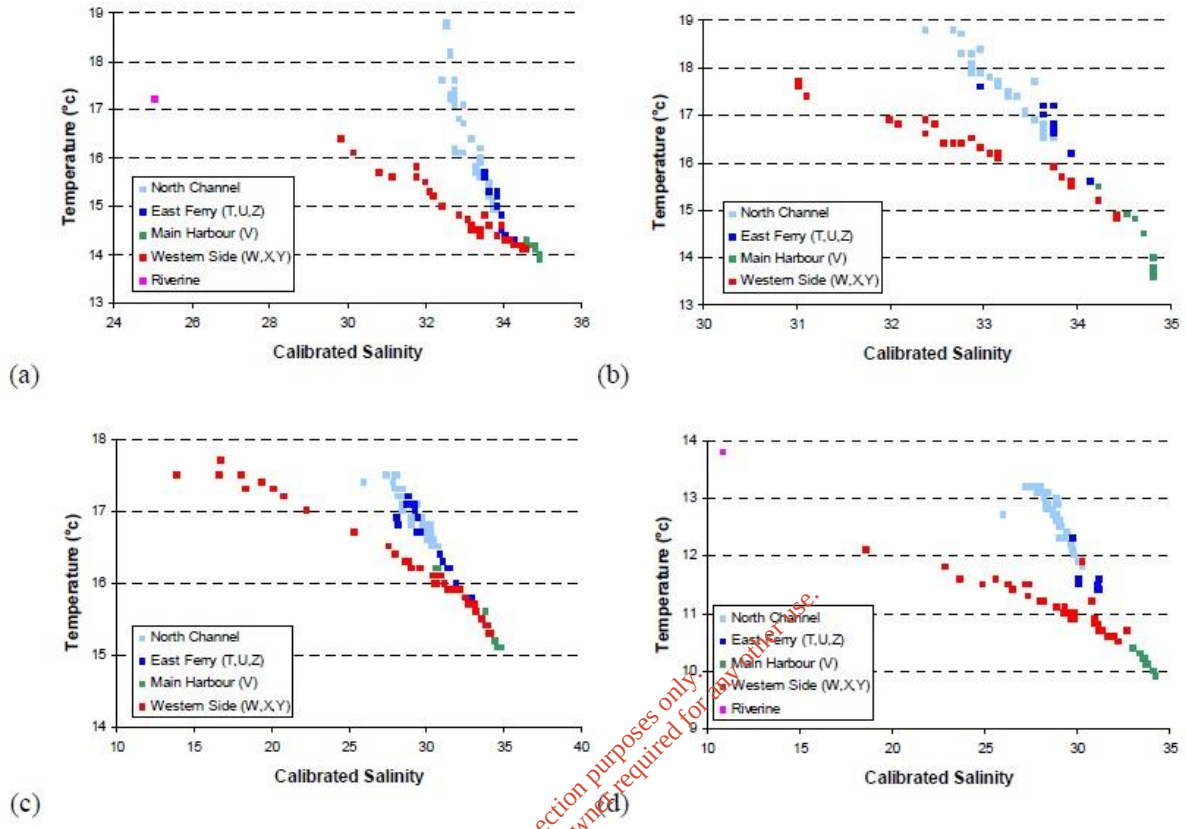
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These two different water bodies of the considerably fresher water from the River Lee side (p.116) versus the water in the North Channel, could be followed down quite clearly into the Lower Harbour (p.113), as they report:

"The waters in the North Channel and the eastern side of the harbour consistently had distinctly different temperature and salinity properties compared with those of the western side of the harbour. This indicates that these were two separate water bodies and that the only place where they met and mixed was in the main harbour area."

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Fig. 6.15 Temperature salinity plot of Cork Harbour waters on (a) May 26th 2004 (b) June 9th 2004 (c) August 24th 2004 and (d) May 5th & 6th 2005.



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Mixing of these two waters was only taking place below the confluence of the East Channel with the main shipping channel, which is something over 6km away from Rathcoursey.

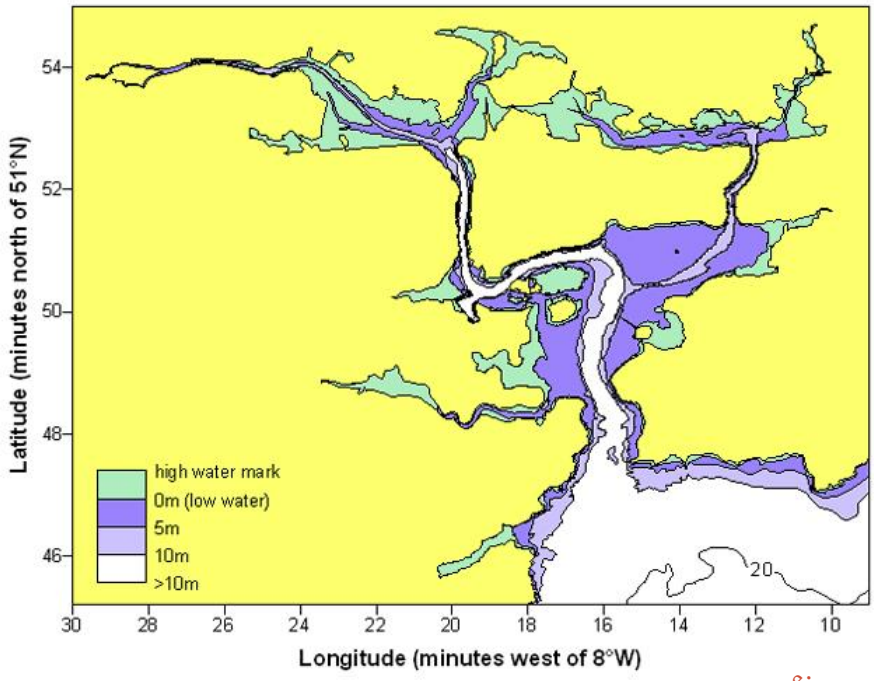
Ni Rathaille and Raine also needed to know the tidal excursion in the North Channel water to set the eastern boundary of their model and examined this in s. 6.4.1.2 Tidal Excursion. They reported:

"Having defined the western boundary of the model domain, the eastern boundary then needed to be defined. The extent of tidal excursion in the North Channel was used as a proxy to calculate the length of the model domain. Tidal excursion was found to be approximately 1.5 km at a tidal range of 2.1 m and 2.5 km at a tidal range of 3.3 m. Assuming tidal excursion is linearly proportional to tidal range, and that the two points found were representative points rather than exceptions to the rule, it can then safely be assumed that tidal excursion in the North Channel can vary between 1 km and 3.5 km depending on the tidal range."

This level of tidal excursion is well below the 6km required for a Rathcoursey discharge to reach the Cork main channel and have any chance of exchange with "new" water from the open sea. The wide expanse of the NE section of the harbour also spreads the flow out at the bottom of East Ferry. The diagram of the bathymetry of the harbour (on p.26), shown below, gives a good idea of the pattern of the two deeper channels and the large expanse of shallow water, in fact, between only 1-2m deep at LW, over most of the eastern half of the harbour.

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Bathymetry of Cork Harbour



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3.2 Up-to-date computer modelling.

Luckily, in the last few years we have been given the benefit of much more highly developed hydrodynamic studies from the NUI Galway team, of such sophistication that they tell me that the computer running time required is more or less the same as for the real time movements of the tides.

Cork Harbour has lent itself to research on eutrophication, mainly for the EPA.

Eutrophication following blooms of macro and micro-algae, is recognised world-wide as the greatest estuarine environmental problem. In Europe, measures such as the Nitrates Directive (91/676/EEC), the Urban Wastewater Treatment Directive (91/271/EEC), the Water Framework Directive (2000/60/EC) and the OSPAR Joint Assessment and Monitoring Programme (JAMP) have been introduced in an attempt to tackle eutrophication (and water quality in general), primarily through the management of nutrient inputs.

However, it has become apparent that nutrient-based systems alone are insufficient. While nutrients are the primary cause of eutrophication, there are many other factors that can influence trophic status such as tidal exchange and freshwater inflows. The NUIG team have, over as much as 15 years, developed an integrated approach to the assessment of trophic status, which combines both measurement, remote sensing, modelling and water quality classification, with papers on Cork Harbour from 2001 i.e. from 18 years ago:

Costello MJ, Hartnett M, Mills P et al. (2001) Measurement and Modelling of Nutrient Dynamics of Two Estuaries in Ireland: Wexford and Cork Harbours. Irish EPA, Wexford, Ireland.

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Hartnett, M., Nash, S., 2004. Modelling nutrients and chlorophyll-a dynamics in an Irish brackish waterbody. Environmental Modelling and Software 19 (1), 47-56.

Nash S., Berry A. and Hartnett M (2005) Nutrient Dynamics in Cork Harbour.

Dabrowski T., 2005. A flushing study analysis of selected Irish waterbodies. PhD Dissertation, Department of Civil Engineering, College of Engineering & Informatics, National University of Ireland, Galway.

Nash, S., Hartnett, M., and Dabrowski, T., 2011. Modelling phytoplankton dynamics in a complex estuarine system. Proceedings of the ICE - Water Management 164 (1), 35e54.

We thus now have the benefit of a succession of increasingly sophisticated computer-run, hydrodynamic models of Cork Harbour. Enormous advances have been made in this science since the first such models were used by the Civil Engineering Department of UCC in the 1992 Pettit's work for the Cork City Main Drainage Project and the Irish Hydrodata Ltd model in the 1993 EIS for the Midleton WWTP, with the development and fine-tuning of the myriad of constants required for such models (39 parameters and temperature correction factors are used in the nutrient model formulations and associated values alone); more sophisticated ground-truthing techniques and, not least, by the prodigious increases in computer power over the years, as the running time for such models is normally measured in days, or even weeks and with banks of computers running in series.

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Even from the first of these papers, published by the EPA in 2001, Costello, Hartnett, Nash et al, (12 authors in all) *"Measurement and Modelling of Nutrient Dynamics of Two Estuaries in Ireland: Wexford and Cork Harbours"*[1] EPA Environmental Research R&D Report Series No. 17, their Executive Summary showed where they felt their model stood at that time,

"*In this study, the distribution of phytoplankton was quantified in space and time using a two-dimensional depth integrated nutrient and hydrographic mathematical model. The model was validated using tidal elevation, current measurements, dye releases, airborne remote sensing, and field data. Water samples were collected over different years, months, and state of the tide. At a spatial resolution of 30 x 30m,* ***this was one of the most detailed water quality models conducted in Ireland,*** *and the first to integrate hydrography and nutrient dynamics with chlorophyll distribution".*

As far as the North Channel water was concerned, its characteristics were referred to only obliquely in this paper of 2001, as one must first know that it is only in the North Channel of Cork Harbour, that toxic algal blooms of PSP occur:

"*The study found that point sources (outfalls) of nutrients are contributing to phytoplankton blooms in both estuaries.* ***Measures to reduce such waste inputs into the inner brackish water part of the estuaries are thus required to reduce the occurrence of harmful algal blooms,*** *especially in Cork Harbour where toxic blooms have occurred and are likely to*

[1] Costello, Hartnett, Nash et al, "Measurement and Modelling of Nutrient Dynamics of Two Estuaries in Ireland: Wexford and Cork Harbours" (2001)

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continue to occur".

Their single recommendation for Estuary Management on p.48 repeated this:

"Measures are required to reduce inputs of point source nutrients in both estuaries, because these are significantly contributing to the phytoplankton blooms. ***This action is especially important in inner Cork Harbour because potentially-toxic dinoflagellate phytoplankton develop blooms there during the summer".***

In their next paper of 2005, Nash, Berry and Hartnett look again at "*Nutrient Dynamics in Cork Harbour*"[2] in relation to the introduction of the secondary treatment of Cork City waste water at the new Carrigrennan WWTP. They developed and further "tuned" the parameters required to develop modules for Cork Harbour for hydrodynamic solute and water quality, using the advanced DIVAST model, developed by Falconer et al in 2001, which they had used in 2001. This was to provide assurance to the EPA that the treatment options for the proposed Carigrennan WWTP would significantly improve the water quality of the Lee Estuary and Lough Mahon – which it did.

In their Introduction they spell out that,

"Lough Mahon and the Lee Estuary are currently classed as eutrophic and the Owenacurra Estuary / North Channel are classed as potentially eutrophic. These areas are, therefore, highly sensitive to any variations in nutrient input."

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3.2.1 "Modelling phytoplankton dynamics in a complex estuarine system" Nash S., Hartnett M. and Dabrowski T., 2011.

Proceedings of the Institution of Civil Engineers, Water Management 164 January 2011 Issue WM1 Pages 35–54[3]

Six years further on again, in 2011, with this latest model, a very interesting addition was made, namely, "*a flushing module was incorporated in the model and used to calculate spatial distributions of residence times. It was found that analysis of flushing results can provide valuable information on transport pathways and potentially eutrophic waters at an early stage of a water quality study and at little additional cost"* (Introduction 1 (c) p.37)

"While the average residence time for a particular waterbody is a very useful indicator of its flushing characteristics, it is a rather general parameter since flushing rates can vary quite significantly between sub-regions. In order to visualise this phenomenon, spatial

[2] Nash S, Berry and Hartnett M, "Nutrient Dynamics in Cork Harbour" (2005) River Basin Management III, WIT Press, UK, pp. 369-380

[3] Nash S., Hartnett M. and Dabrowski T., "Modelling phytoplankton dynamics in a complex estuarine system" 2011. Proceedings of the Institution of Civil Engineers,Water Management 164 January 2011 Issue WM1 Pages 35–54

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distributions of the residence time can be computed. This is done by considering each grid cell within the region of interest as a small, completely mixed reactor. Using this approach, a residence time is computed for each grid cell allowing spatial plots of residence time. ***These plots provide great insight into local variations in flushing times*** *and the identification of transport pathways"* (s.2.3 last para. p.42)

Validation and calibration of the Cork Harbour model had continued to use the novel availability of the remote sensing of chlorophyll-a from the air, first used in the 2001 paper, but the authors also acknowledge the importance of the much earlier, but comprehensive source of detailed hydrodynamic data collected in the 19 volume Cork Harbour Pollution Report (CHPR) of M.C. O'Sullivan in 1977, enabling a "*high degree of accuracy in model predictions":*

"A substantial proportion of the data used in this research for calibration and validation of the Cork Harbour model was obtained from the 1977 Cork Harbour Pollution Report (CHPR) (M.C. O'Sullivan, 1977). The report contains a detailed hydrodynamic study of the area, and includes extensive tidal elevation and current velocity measurements, results of numerous dye release surveys and a detailed salinity measurement study. The availability of such a comprehensive dataset is unusual in most modelling studies and enabled the achievement of a high degree of accuracy in model predictions. Although the CHPR was written in 1977, its results could still be used as Cork Harbour is quite stable and no appreciable variations in bathymetry occurred in the intervening period" (s.3 p.42).

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The authors explain that they had developed more of an holistic, integrated measuring and modelling method to estuarine water quality assessment. They claim that one of the unique features of this research had been the interdisciplinary approach taken with the project team including numerical modellers, geographers, physicists, and earth and marine scientists, to develop comprehensive rate constants and coefficients employed in the model's kinetic formulations. In the table for just the nutrient model, for example, as mentioned already, about 40 different constants and temperature corrections are now taken into account (Table 1 p.41).

3.2.2 The flushing study (sec. 3.3 p.47).

In this study they looked at the entire harbour and then in detail at the "*semi-enclosed shallow North Channel"* and then at what they call the Main Channel, which I have called the Lower Harbour, i.e. into which the North Channel drains (Fig. 14a).

The average residence time over the whole harbour was 22.5 days, but looking in detail at the sub-regions (as in Fig. 14(1)b below) they find:

"*The Main Channel and central section of the main harbour are well flushed with residence times in the region of 10 days; residence times elsewhere are substantially greater. Those in*

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Passage West and Lough Mahon are in the region of 20-35 days while those in Passage East are in the region of 50-60 days. ***Finally residence times in the semi-enclosed North Channel are in excess of 70 days, indicative of a poorly flushed region".***

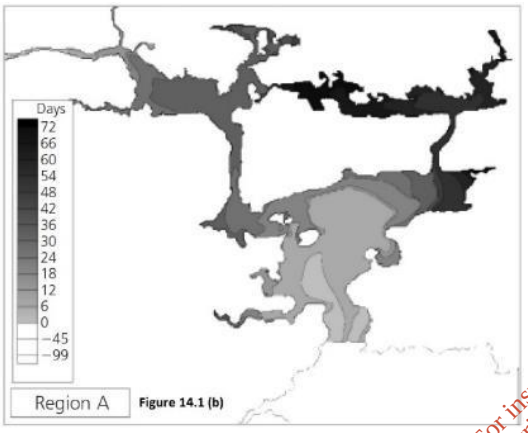
They continue,

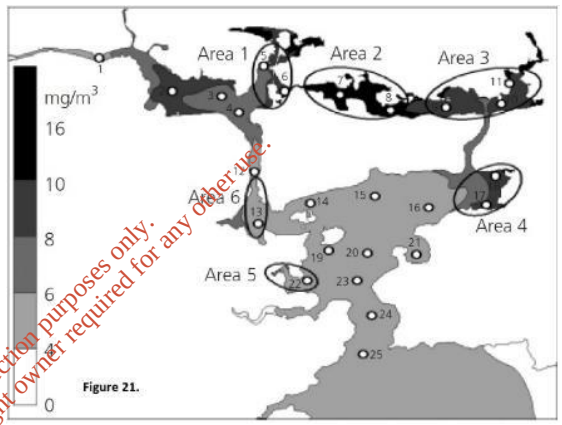
"*The results suggest that Passage East, Passage West, Lough Mahon and* ***North Channel*** *in particular are prime locations for algal growth."*

They ring these areas in Fig. 21, added below:

Fig. 14(1)b. Spatial distribution of residence times.

21. Predicted optimal areas for chlorophyll-a





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How do we decide on the merits of the NUIG papers, which show very little water exchange from the North Channel, and the M.J. O'Sullivan and Irish Hydrodata work based on physical tidal prism size, which shows enormous water exchange from the North Channel?

3.2.3 Further ground-truthing of the NUIG hydrodynamic models by reference to the position of the historic oyster beds in Cork Harbour.

The requirements for the development of algal blooms are exactly the requirements for the development of natural oyster beds – high water temperatures and minimal water exchange, leading to the retention of sufficient numbers of the drifting oyster larvae to still be present over the oyster bed after a minimum of 10 days i.e. 20 tides.

In my search for the location of our breeding ponds to seed a naturally self-propagating oyster bed, I made sure I visited one of world's great oyster experts 50 years ago. He had analysed the meticulous records of the famous oyster fishery in the Oosterchelde in Holland. Dutch scientists had kept records of the numbers of oysters of different age-groups each year in the fishery, the daily water temperatures, the quantity of collectors put out to catch the "spatfall" of young oysters and with what success – all since the 1860's. The Dutch are also

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leaders in the hydrography of their low-lying, embattled coastline and knew precisely the volume of water lost to the fishery each tide.

In Prof. Korringa's classic paper of 1941, "*Experiments and observations on swarming, pelagic life and setting in the European flat oysters*", *Ostrea edulis* L. (Arch. Neerl. Zool.), 5 p.129 he states:

"*The larvae are unable to counteract dispersion. This inability clearly shows the enormous advantage of sufficiently enclosed breeding grounds. An adequate retention of the larvae is only to be expected in places where the tides perform a more or less perfectly oscillating movement, which enables the majority to return to the grounds after each tidal cycle."*

On page 22 he quotes the Rijkwaterstaat figures for the tidal exchange in the Oosterschelde as 3.7%. This is about as high as the exchange can be. Over 14 days (28 tides) only a third of the water will still be over the oyster bed. The North Channel is very like a miniature Oosterschelde and thus it is likely that only about 4% of its water can be lost on each tide if there are to be sufficient larvae left to give rise to a spatfall on the beds.

Expressed mathematically for an exchange of ~ 4% per tide:

$\{(100-4)\ \%\}^n$ where n =20 (2 tides/day over 10 days) leaves 44% water remaining
where n =28 (2 tides/day over 14 days) leaves 32% water remaining

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The two biological criteria are:

1) the sufficient development of the larvae to reach the stage of metamorphosis, when they are sufficiently developed to grow a rudimentary eye and foot to locate a suitable shelly substrate for settlement (10-14 days in our seawater temperatures of 16-18°C) and

2) probably no more than a maximum of 14 days free-swimming life because of losses in dispersion, predation and mortality.

Ireland is towards the northern end of the range for *Ostrea edulis* and the critical importance of high levels of water retention, assuming that at least a third of the larval spawning (i.e. the values above 33.3% in yellow in the Table below) must still be present at the end of the developmental period, can be seen in the following computation:

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Table of Percentage of original water containing the release of oyster larvae, which will still be present over the oyster bed under different degrees of water-exchange.

No. of tides	% water exchange on each tide:						
	80% Dairygold	19% MCOS 1977	3.70% Oosterschelde	4%	5%	6%	
1	20.00	81.00	96.30	96.00	95.00	94.00	
2	4.00	65.60	92.70	92.20	90.30	88.40	
3	0.80	53.10	89.30	88.50	85.70	83.10	
4	0.16	43.00	86.00	84.90	81.50	78.10	
5	0.03	34.90	82.80	81.50	77.40	73.40	
6		28.20	79.80	78.30	73.50	69.00	
7		22.90	76.80	75.10	69.80	64.80	
8		18.50	74.00	72.10	66.30	61.00	
9		15.00	71.20	69.30	63.00	57.30	
10		12.20	68.60	66.50	59.90	53.90	
11		9.80	66.10	63.80	56.90	50.60	
12		8.00	63.60	61.30	54.00	47.60	
13		6.50	61.30	58.80	51.30	44.70	
14		5.20	59.00	56.50	48.80	42.10	
15		4.20	56.80	54.20	46.30	39.50	
16		3.40	54.70	52.00	44.00	37.20	
17		2.80	52.70	50.00	41.80	34.90	
18		2.30	50.70	48.00	39.70	32.80	
19		1.80	48.90	46.00	37.70	30.90	
20		1.50	47.00	44.20	35.80	29.00	Minimum length of larval life
21			45.30	42.40	34.10	27.30	needed for development at our
22			43.60	40.70	32.40	25.60	sea-water temperatures (16-18°C)
23			42.00	39.10	30.70	24.10	
24			40.50	37.50	29.20	22.70	
25			39.00	36.00	27.70	21.30	
26			37.50	34.60	26.40	20.00	Maximum length of larval life
27			36.10	33.20	25.00	18.80	found in practice due to
28			34.80	31.90	23.80	17.70	dispersion, predation, mortality etc.

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This table illustrates how the Oosterschelde, with its tidal exchange of 3.7%, even after 14 days (28 tides), retains over a third of its initial water and oyster larvae. With faster development at 10 days only, nearly half the larvae (47%) are still over the bed.

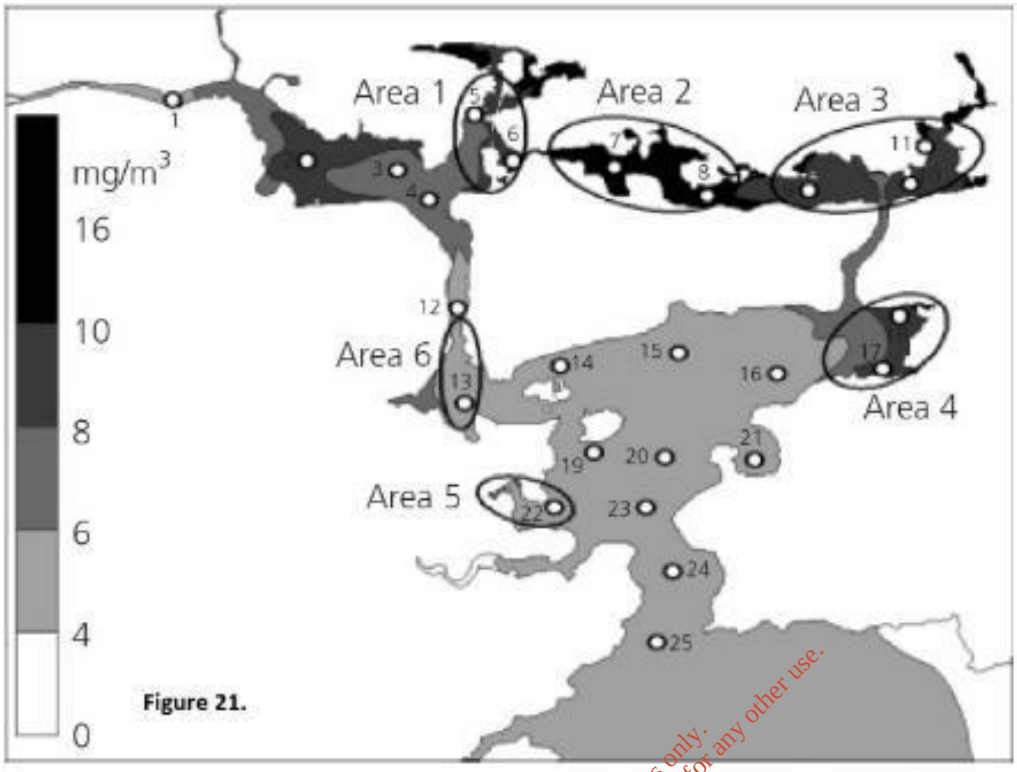
This table allows one to appreciate how in just 0.3% greater water exchange (i.e. increasing the exchange up to 4% per tide), one precious day's development must be compensated for by a higher temperature growth; at 5% exchange per tide 3½ days must be compensated for – in other words, fast development through higher sea-water temperatures for the larvae to be ready to settle after just 10 days, is now essential; at 6% tidal exchange the area has really lost its chances of a good spatfall. Even in our best national spatfall areas, such as Tralee Bay, (and with a huge broodstock available to spawn) annual spatfalls are by no means certain and the total number of such areas in Ireland are only to be counted in single figures.

Thus, to have maintained a very successful natural bed of oysters in the North Channel from the Iron Age to about 1920, when there was a Europe-wide mortality of native oysters, we have to be talking of tidal exchange rates of little more than 4%.

What becomes so striking in looking at the areas which are picked out as algal bloom hot-spots by the hydrodynamic model, i.e. areas of warm water with high water retention, circled in Fig. 21, above, and reproduced again below,

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Fig. 21 Predicted optimal areas for chlorophyll-a.



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is that it can be seen that they pinpoint precisely the position of the historical oyster beds, which, as described above, require exactly the same conditions for both larval development and retention.

The old oyster beds are recorded on the OS Map of Cork Harbour, through its inclusion of the occurrence of kitchen middens of oyster shells (circled below) which are shown to be found on both shores of the North Channel; North & South of Lough Beg and at Carrigrennan Point in Lough Mahon, thus confirming all that I have claimed, for so long, for the same water retention characteristics to be revealed by the presence of the naturally occurring oyster beds.

In fact it was only after looking at the water retention high points of Areas 1 and 5, that I found the oyster middens associated with them on the OS Map to the north and south of Lough Beg and at Carrigrennan Point. I was, of course, aware of the substantial middens at the three access points to the North Channel beds.

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OS map of Cork Harbour with kitchen "middens"
of oyster shells shown on the shores and circled here by me.

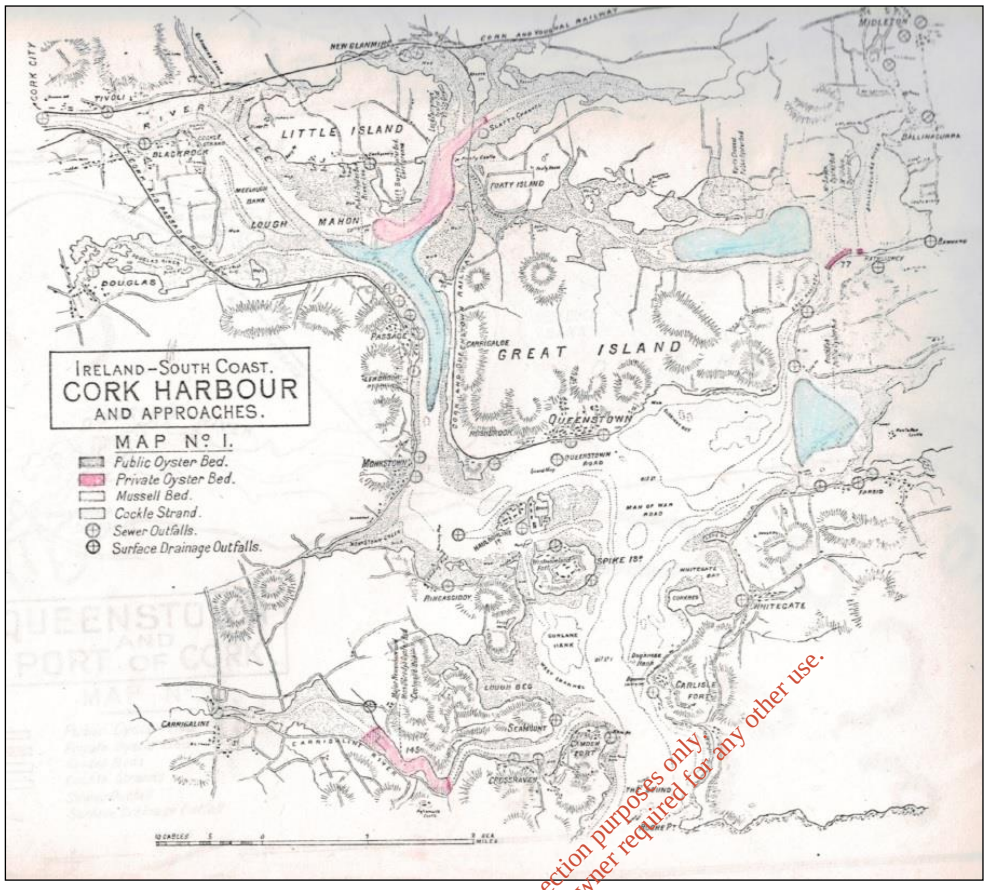


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The position of the oyster beds in Cork Harbour in 1903, including the large bed at Rostellan at the NE corner of the Lower Harbour, is shown in the Browne Report of 1904 below, where the naturally occurring "public" beds in the North Channel, Rostellan and Lough Mahon are shown in blue and the private Fota oyster bed in red.

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The oyster areas of Cork Harbour shown in the Browne Report of 1904



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I hope that the strength of the ground truthing of the NUIG hydrodynamic work by both the aerial photographic evidence of the chlorophyll-a concentrations in the Harbour waters, together with this evidence of the positioning of the harbour's natural oyster beds, can be appreciated easily, but I can, if necessary, expand on the latter with more detailed biology.

Having established the precision being obtained by this series of hydrodynamic studies, we can now look at a further paper to bring this work, focussing on the hydrodynamics of Cork Harbour, up to date, in which Prof. Hartnett takes the modelling of this complex harbour to new levels of detail and expands on the concept of "tidal flushing", which has such relevance on both where to site a natural oyster bed and where NOT to discharge commercial waste water.

As far as applying this knowledge to the matter of the Dairygold and Midleton WWTP discharges, we must also remember the declared requirement of M.C. O'Sullivan himself in the Cork Harbour Pollution Report, Vol. 1 p.102,

"(iii) Because of the presence of oyster farming in the North Channel, ***any outfall point should be such as to give <u>very substantial dilution</u>."***

I would hope that the EPA will agree with this given and we can progress to the concept of tidal flushing.

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4. Tidal flushing.

"**An integrated approach to trophic assessment of coastal waters incorporating measurement, modelling and water quality classification"** M. Hartnett, S. Nash*, I. Olbert (College of Engineering & Informatics, National University of Ireland, Galway, Ireland) 2012[4].

For the Flushing Study in this paper, which I attach, Prof. Hartnett, explains in sec. 5.2,

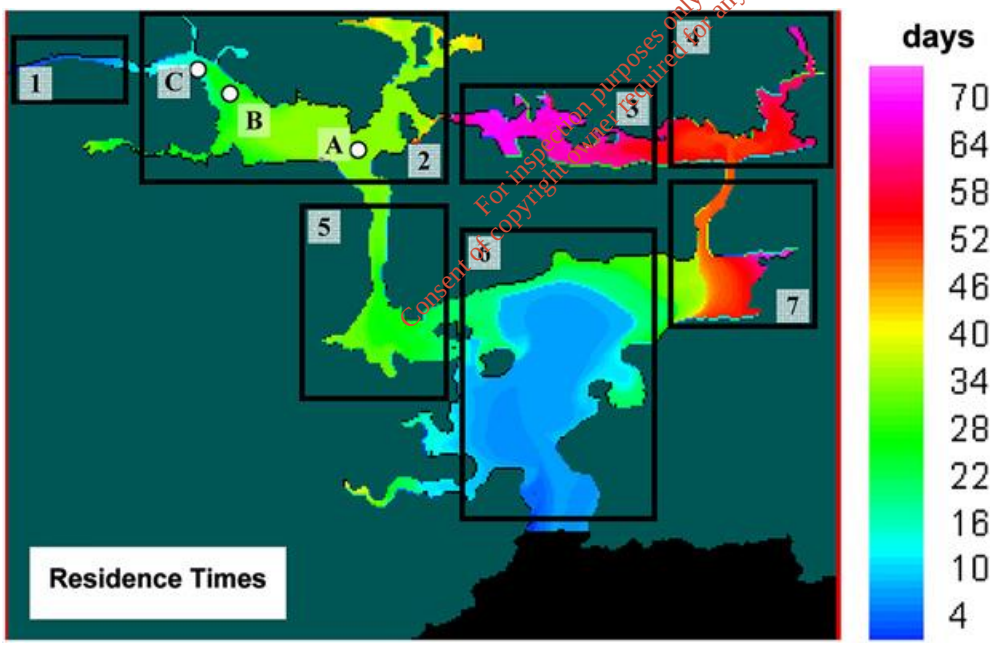
"Firstly the hydrodynamic model was run until steady state conditions were reached; at this juncture a uniform dye concentration of 35 mg/m3 was specified at each wet grid cell (30mx30m) *within the harbour. Next, the hydrodynamic and solute transport models were run for a further 3000h* (i.e. a computer run of 125 days) *for the flushing analysis.*

As it was explained to me in UCG, it was this programme that was so complex and the grids used so small and numerous, that the computer was almost running at real-time to come up with the real-time results.

The outcome of this modelled tidal flushing is expressed powerfully in this figure below:

Fig. 9. Spatial plot of residence times showing boundaries of sub-regions

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One can now see at a glance that the "new" water from the open sea is only to be found at the very mouth of the harbour and even right in the line of the entering flood tide, water as close as Whitegate has been there for several days. By the time the shallow area of the NE harbour is reached, the residence time of the water is 20-40 days, with the oyster area at Rostellan at the bottom of East Ferry showing a residence time of 40-50 days.

[4] "An integrated approach to trophic assessment of coastal waters incorporating measurement, modelling and water quality classification" M. Hartnett, S. Nash, I. Olbert (College of Engineering & Informatics, National University of Ireland, Galway, Ireland) 2012

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This is certainly not the *"~80% new water"* that Dairygold are advising will dilute their discharge on every incoming tide.

Prof. Hartnett states on p.134 that,

"The spatial variation of residence times provided a very good insight into the hydrodynamic circulation patterns of the harbour; for example they enabled easy identification of areas that are well-mixed with a high rate of tidal exchange and ***other areas such as the North Channel that are quite poorly-mixed and are thus a potential site for eutrophication.*** *A number of areas were identified within which the residence times were quite similar; it was on this basis that the harbour was divided into the seven sub-regions shown in Fig. 9. The names of the sub-regions and their spatially averaged residence times are:*

1) Lee Estuary - 3.8 days;
2) Lough Mahon - 31.4 days;
3) North Channel - 64.4 days;
4) Owenacurra Estuary - 53.1 days*;*
5) Harbour (west) - 26.2 days;
6) Harbour (central) - 10.7 days;
7) Harbour (east) - 47.1 days.

The benefits of the modelling-flushing approach used in this research are two-fold. Firstly, the spatial variations in the chosen characteristic of homogeneity, i.e. residence time, are produced for the complete estuary; this results in a more-informed decision as regards sub-division. Secondly, residence times were chosen as the characteristic of homogeneity as spatial distribution plots of this parameter capture details of both hydrodynamic circulation and solute transport processes. Solute transport is what we are so interested in with the introduction of waste materials into the system at Rathcoursey Point.

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The division of Cork Harbour into a number of smaller homogenous waterbodies, as done in this paper, for monitoring and management purposes, is now common practice. For example, the EU Water Framework Directive establishes that surface waters should be divided into waterbodies, or management units, which should then be monitored to establish ecological status.

It is quite clear from Figure 9 in this paper, above, that not only is the dilution <u>not</u> at all "substantial" as required for such a discharge by MC O'Sullivan, there is hardly any dilution at all, with the water residence times in the North Channel given as **64 days** and stretching to **70 days** at its west end and at Rostellan as **47 days.**

The Rathcoursey Point location for discharging waste products, which is actually sited centrally between these two stagnant areas, could therefore not be worse positioned. In fact there could probably not be a worse position for such a discharge in the whole of Ireland, if I think back to the famous oyster-producing areas, for all that they tell us about their own hydrography, with the oyster beds in the North Channel being over 12km away from the cleansing "new water" of the open sea.

On top of all this, there is a substantial, measured flow of water <u>anti-clockwise</u> around Great Island – i.e. the residual flow of any discharge at Rathcoursey is actually <u>inland</u> to the west, locking it into the North Channel.

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5. The residual flow in the North Channel is inland from east to west.

5.1 The everyday evidence for this is apparent to all who spend time on this bit of water.

5.1.1 Half-submerged branches and flotsam

These can be seen passing up and down the North Channel for days on end and are invariably found stranded near the HW mark there, rather than disappearing to the Lower Harbour.

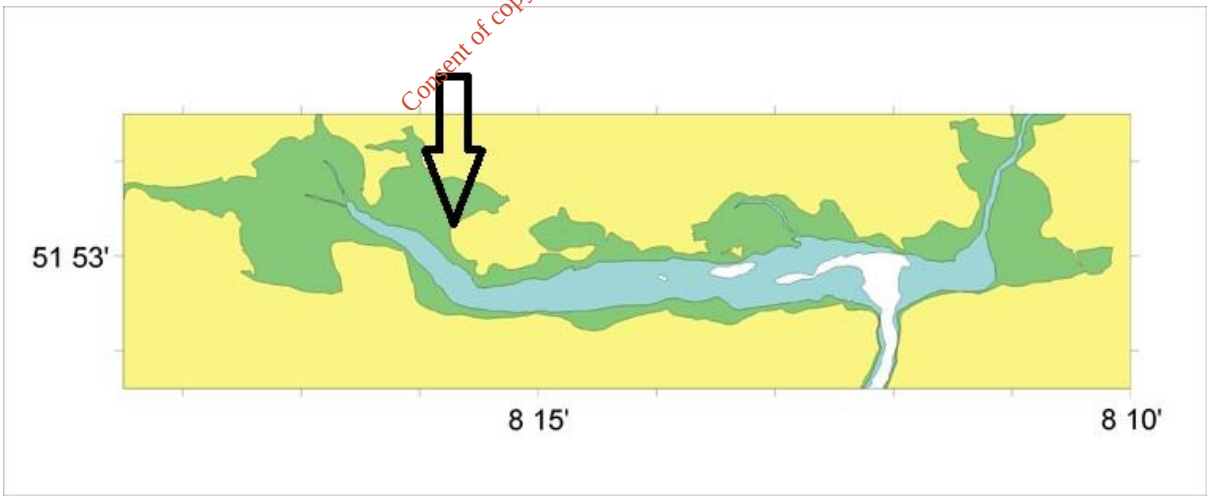
5.1.2 Boats.

If these go adrift in East Ferry, local knowledge is that they are almost always found in the North Channel and not out in the main harbour.

5.1.3 Bodies.

It is an unfortunate and quite frequently occurring fact, known to the Midleton undertaker, who is used by the Gardai for this purpose, that the bodies of people drowning in East Ferry are most often recovered in the North Channel. This undertaker found me after a talk given by M.C. O'Sullivan 30 years ago, when I had advised the audience, that the evidence of the oyster beds in the North Channel showed that there was negligible tidal water loss and therefore dilution from the North Channel, and he told me then that this was the Garda experience in recovering bodies – it was nearly always inland that they came, and, I have confirmed that his son would support this entirely today. We ourselves made the unhappy discovery of one such man in about 1986, who had fallen off the pier in East Ferry and we found his body 6 km inland from the pier, after being in the water for some weeks, certainly stopped by the reed-beds across most of the Belvelly channel, from following the flow even further westwards to Lough Mahon.

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Position of a body recovered from a drowning in 1986 in the middle of East Ferry (6km to the SE and just off this map)

This sill of reeds, which divides the pool at Belvelly Bridge from the North Channel, stretching from Belvelly Castle to the SE corner of Fota Island can be seen in the photo below. The body was found near the pylon, which can just be made out, i.e. at the furthest reach to the west of the North Channel available to a mainly submerged corpse.

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Fig. View to the north east from Belvelly Castle and Pool,
showing the reed-bed at HW stretching from the south shore across to the SE corner of Fota Island, and the shallow narrow channel, not covered by reeds. (Photo from the Ph.D thesis of Aoife Ni Rathaille June 2007 NUIG)



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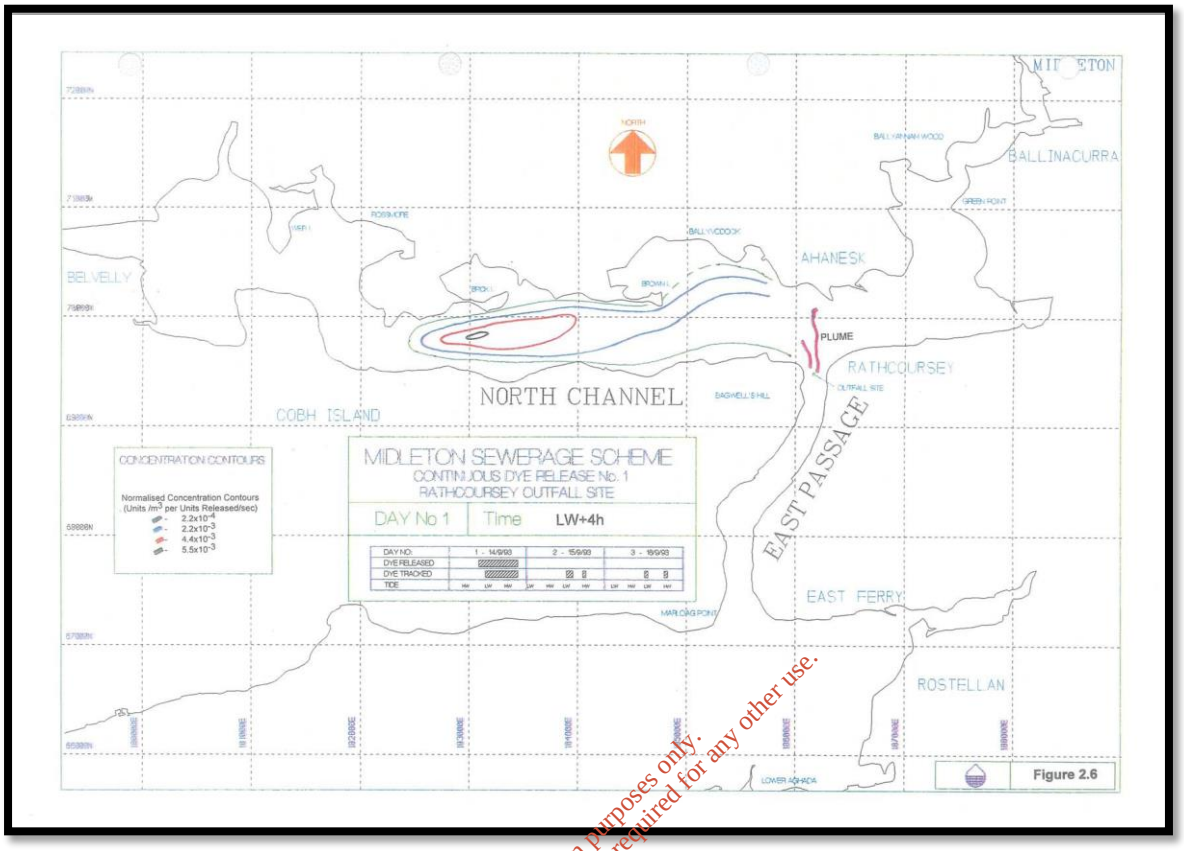
5.2 In the dye studies carried out by Irish Hydrodata in 1993.

For this study, a continuous release of Rhodamine B over a complete tidal cycle was made from Rathcoursey for 5 days.

At LW + 4h of Day 1 (Fig. 2.6), the slug of dye can be seen to have passed over all the Atlantic Shellfish oyster beds, having passed Brick Island, and to be approaching the trestle area of Fota Oyster Company, a kilometre to the west of the seabed covered by our Oyster Fishery Order.

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Fig. 2.6 LW + 4hrs on Day 1

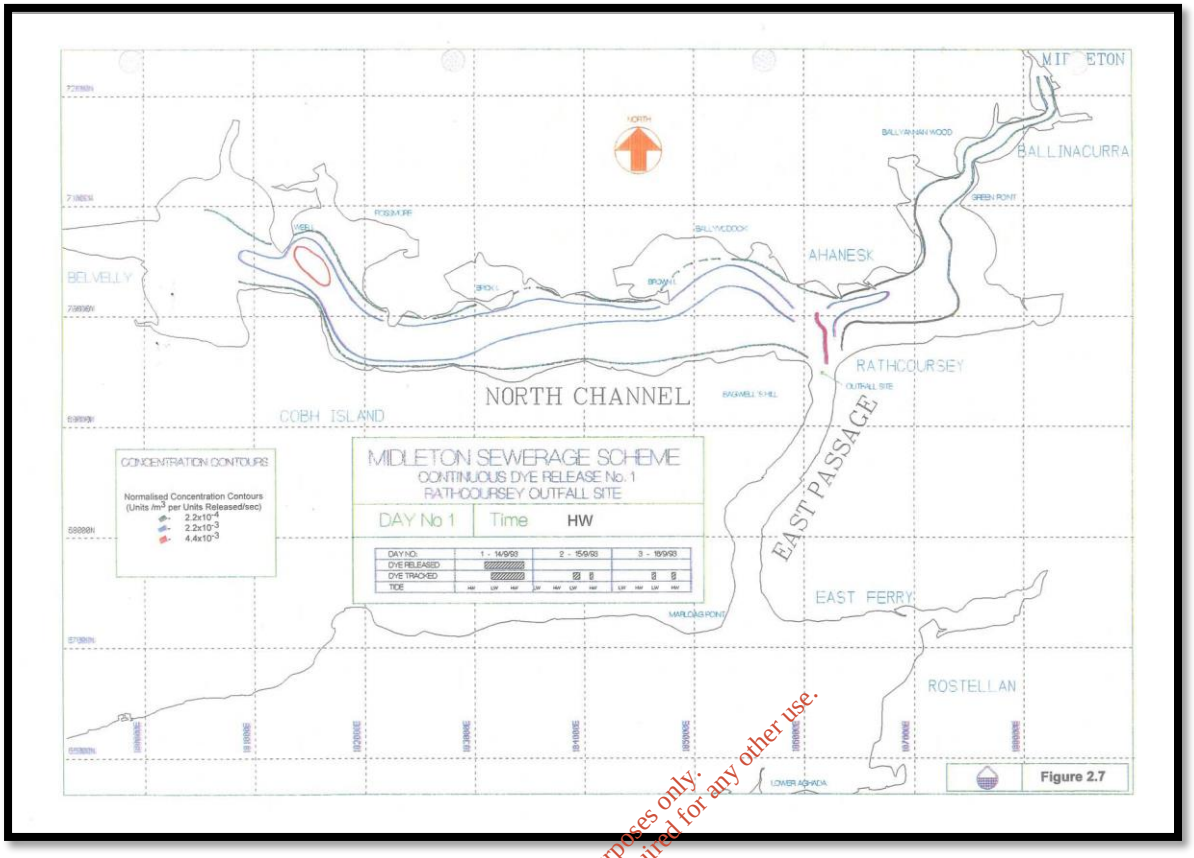


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At HW of Day 1 (fig.2.7) the slug of dye has passed Weir Island, well past all the oyster areas, with traces shown as having been recorded as high up into the reed beds around Fota Island as was possible to get the boat (c.1m draught) and the highest concentration of dye in the whole of the North Channel (shown in red) situated right up to Weir Island:

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Fig. 2.7 HW on Day 1



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Note that this figure shows the **flows from Rathcoursey are still progressing towards the null point,** approximately a quarter-way between the SE tip of Fota Island and Belvelly Bridge, where the two flows are seen to divide to the west and east in the satellite photograph shown on p.14 above.

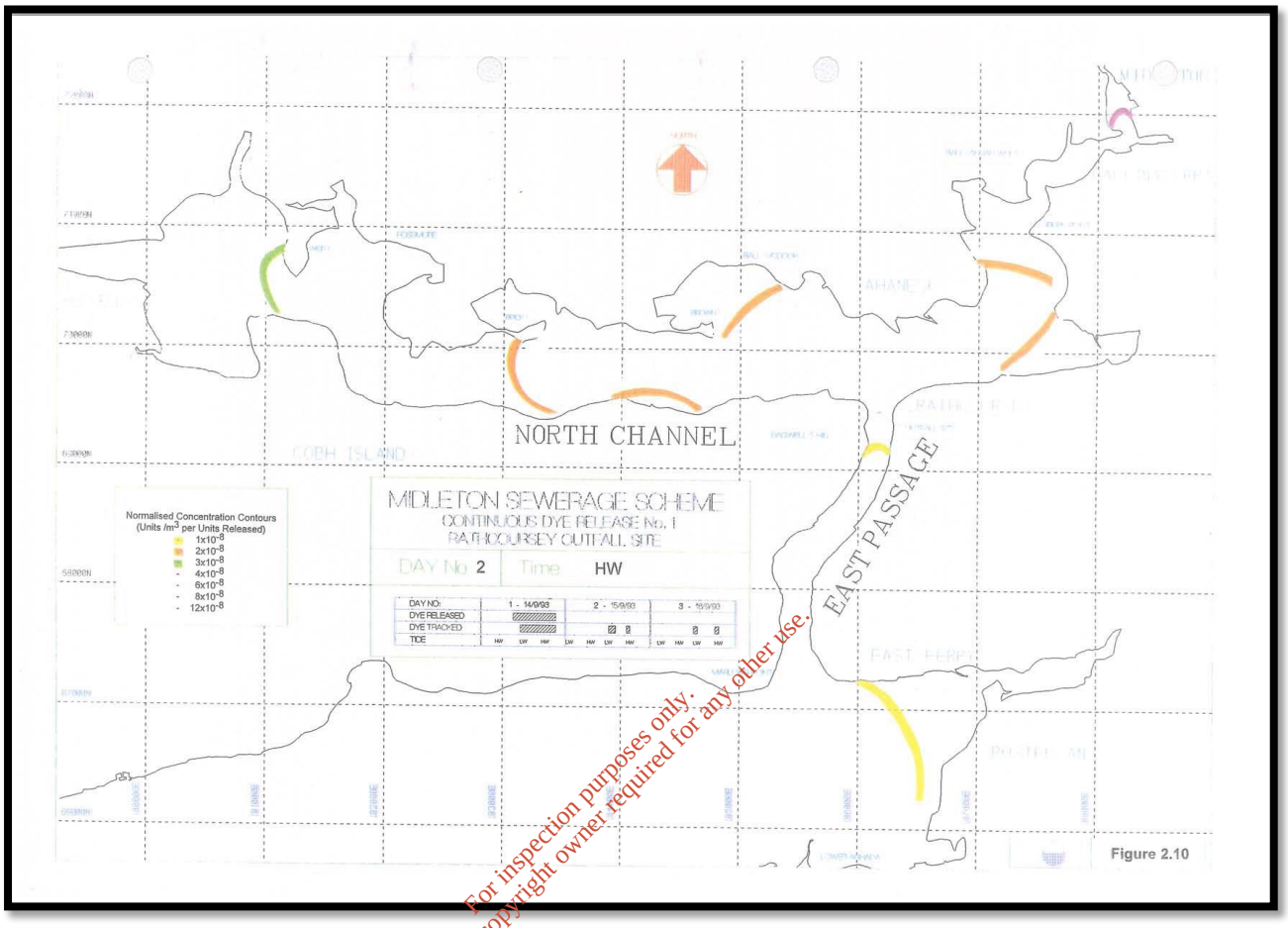
Fig. 2.7, above, certainly **shows only the dye released from Rathcoursey reaching the far west end of the North Channel and no trace of any meaningful flow coming in from the Cork side** and this was confirmed by 27 days of separate salinity/temperature tows made in the NUIG phytoplankton work in 2004 -2006, when this null point of flows from east and west was found to vary by less than 20m (see fig. 6.15 in sec. 3.1 of the temperature/salinity tow on p.15 above).

The plume was followed for the next two days.

At HW on Day 2 (Fig. 2.10), the highest concentrations of dye in the North Channel (**50% above those over the oyster beds) were now recorded <u>above</u> Weir Island** at the very far west end of the Channel.

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Fig. 2.10 HW on Day 2

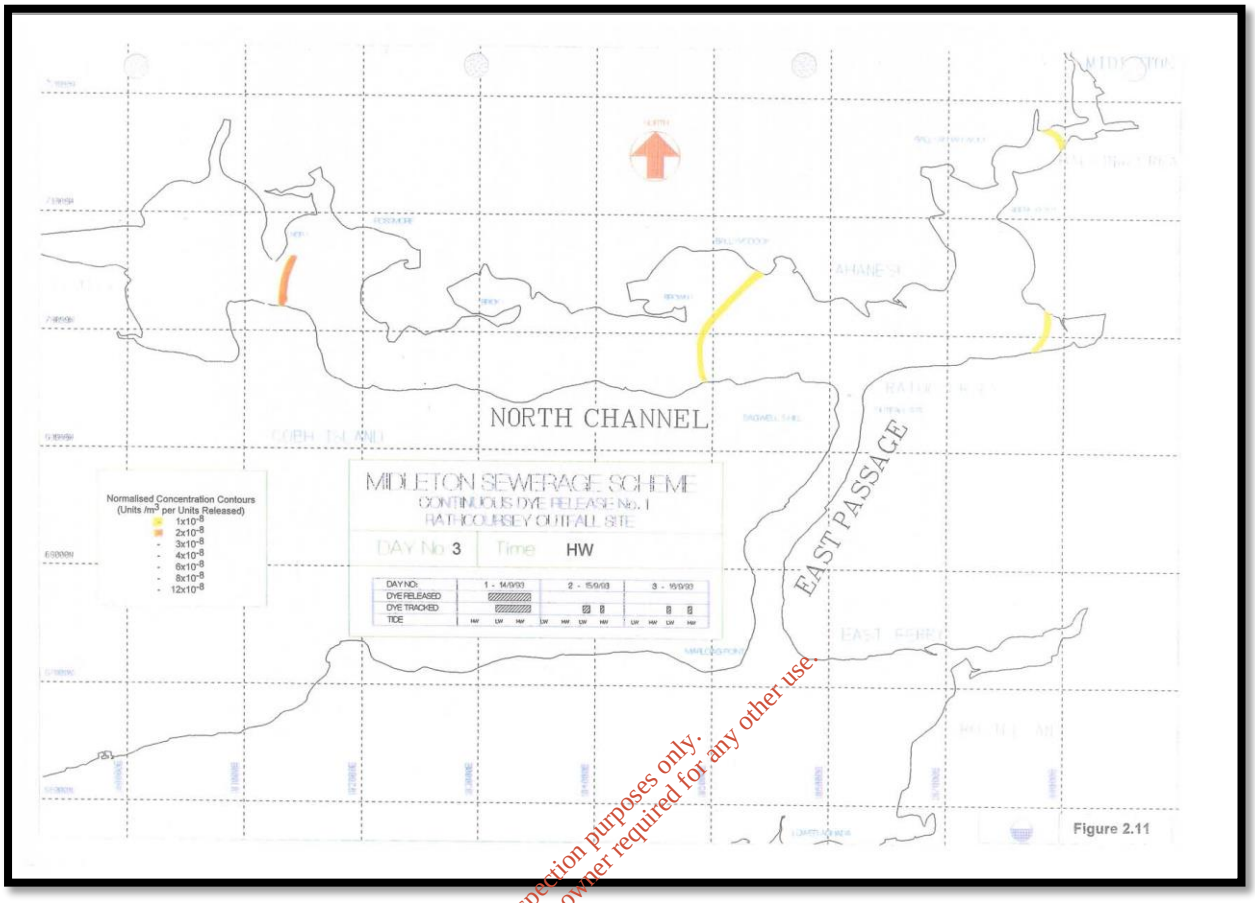


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At HW on Day 3 (Fig. 2.11 below) the concentration of dye at Weir Island was **now 100% greater than that found at Brown Island**, at the Rathcoursey end of the channel.

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Fig. 2.11 HW on Day 3



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The information in these dye studies is so important that I have added a better scan of the above figs. 2.6, 2.7, 2.10 and 2.11 in which the detail is much clearer as **Ref. 21.** See also my comments on the ABP Inspectors Report in response to her sec. 13.9.

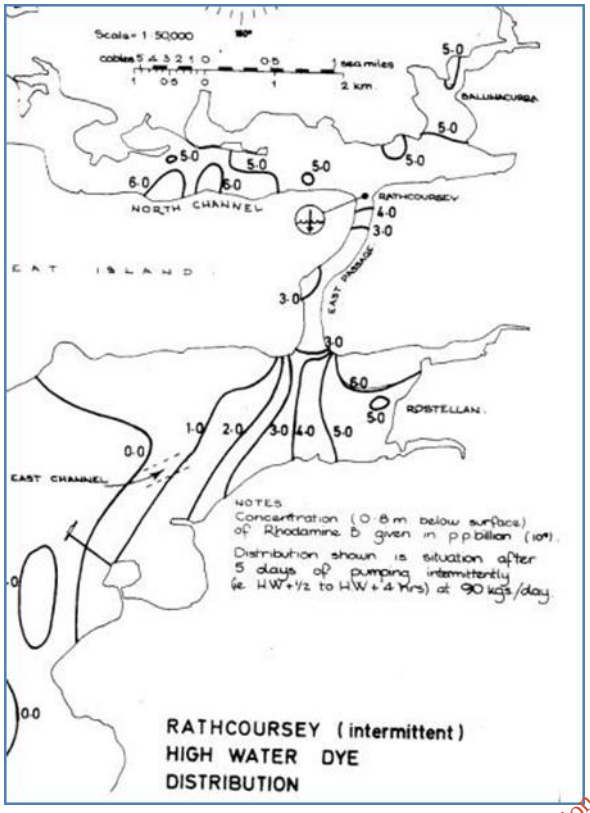
5. 3 Evidence of the MC O'Sullivan 1977 Cork Harbour Pollution Report dye studies.

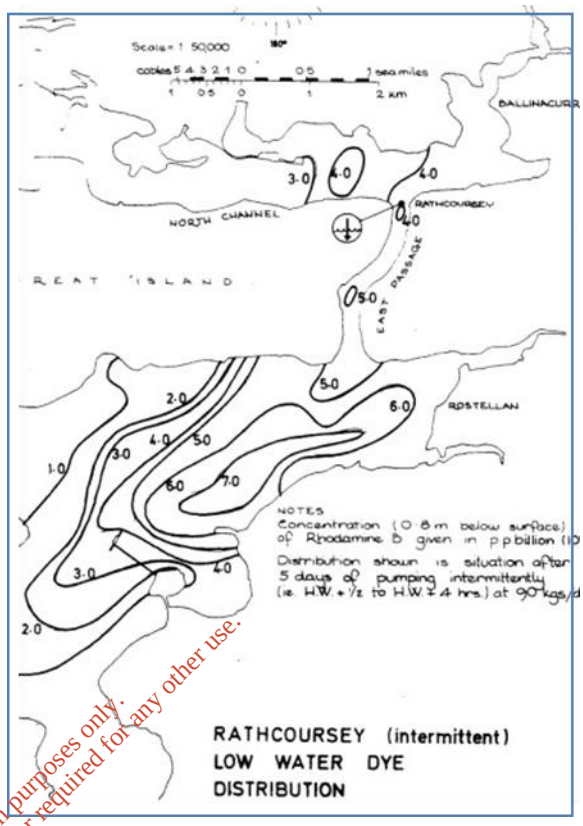
The purpose of the CHPR 1977 was to find how much untreated BOD could be discharged to Cork Harbour at Marina Point, Rathcoursey Point and at Dognose Bank at the Harbour mouth. In Vol. XIV Physical Study - Dye Survey Analysis, M.C. O'Sullivan gave us the results of dye studies over 5 days of releasing dye continuously and then compared those with an intermittent discharge made over just 3½ hrs into the fastest flowing part of the ebb tides, with the view to getting the best possible dispersion of the discharge.

The Irish Hydrodata 2017 Addendum for Irish Water and Dairygold reproduces part of this work to give us the very revealing position of the dye distributions following 5 days of pumping intermittently from Rathcoursey for 3½ hrs at the top of each ebb tide (i.e HW + ½hr to HW + 4hrs) designed to give the best possible dispersion.

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Figs. Concentrations of dye at HW and LW after 5 days of intermittent release at Rathcoursey Point at the top of each ebb tide (HW+ ½hr to HW+ 4hrs)





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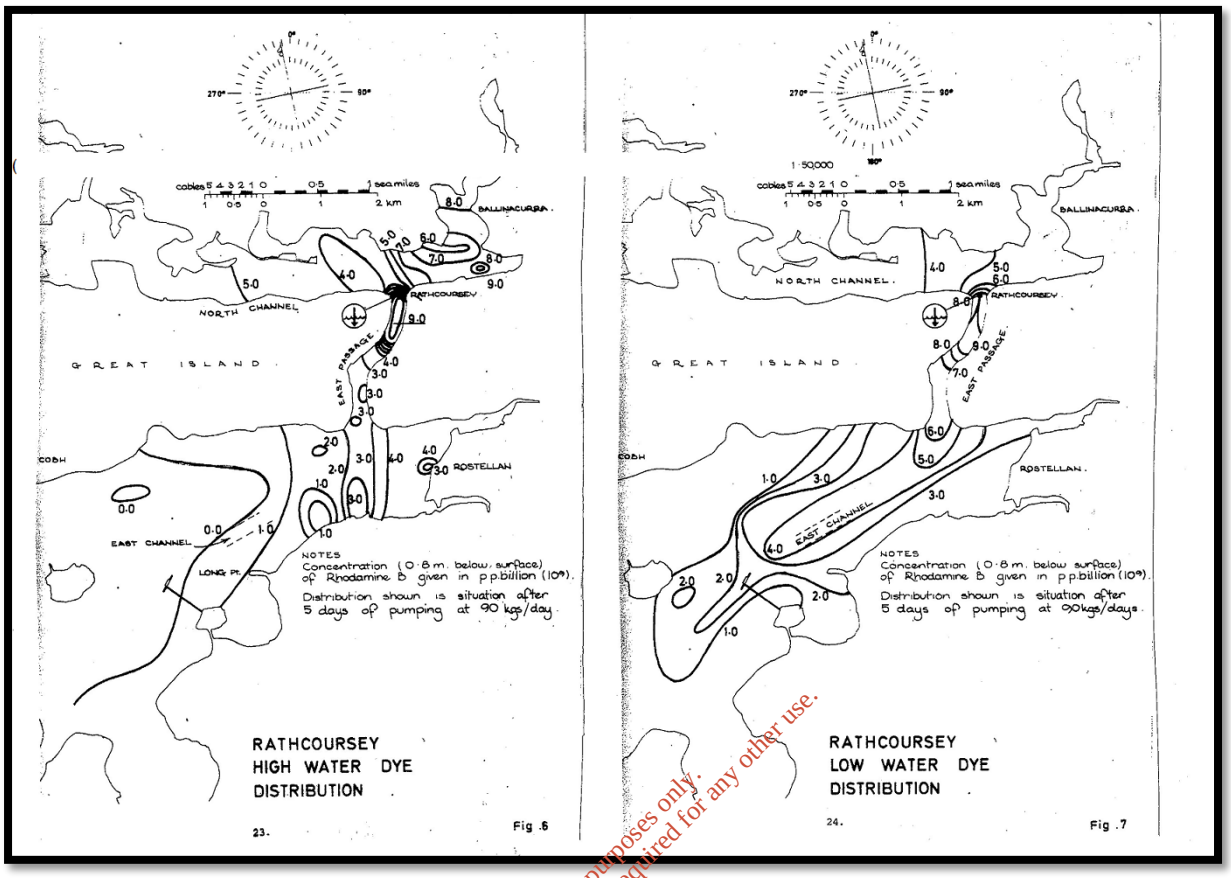
We are looking, above, at the cumulative dye position in both the LW and HW positions after the last of the dye releases – <u>following 5 days</u> of these <u>intermittent</u> ebb tide releases (i.e. after 10 tides).

Despite giving the discharge every chance to disperse by using the very best part of the ebb tide only, the bulk of the dye at 5.0 - 7.0 ppm is clearly still contained in the area between Whitegate and Marloag. The concentration of dye reaching the main River Lee channel, where it can be lost from the Harbour, can be seen to be very little at 1.0 ppm.

The HW position is equally interesting with the highest concentrations of dye again being found at the <u>west end</u> of the North Channel, not, as one might have expected close to the discharge at Rathcoursey. Thus these dye studies are following exactly what the NUIG hydrodynamic work is now predicting and what the current meter is showing.

I have a copy of Vol. XIV of the Cork Harbour Pollution Report and p.24 gives the similar Low Water situation after 5 days of <u>continuous release</u>, which I show below:

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Fig. Rathcoursey Low Water Dye Distribution after 5 days continuous release from Rathcoursey Point.

Comparison of both the continuous and intermittent discharges after 5 days pumping of dye, show that there is little to choose between them. Again the HW situation of the continuous release shows a higher concentration of dye at the west end of the North Channel, but there is also a greater backing-up of dye up the Owenacurra Estuary

On p.16 of his CHPR Volume XIV Physical Study – Dye Survey Analysis, MC O'Sullivan sums up his findings and has to admit:

"20. The hoped for benefit of an intermittent discharge over a continuous discharge would be that a large portion of the intermittent release would be carried towards the sea and not return. ***What is, in fact happening is that the intermittent release is not carried far enough by the outgoing tide to remove it permanently from the East Channel - it remains in the East Channel and is simply pushed inwards by the incoming tide****, thereby tending to build up in the Rostellan area.*

He then misrepresents this finding entirely, turning it instead to his various specious advantages:

"22. In summary, therefore, the studies done to compare the effects of intermittent and continuous discharges do not show the former method to be advantageous over the latter. Study of the topographical, etc., shape of Cork Harbour shows that the results obtained for

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the Rathcoursey area can very reasonably be taken to occur within Cork Harbour. The result of Rathcoursey dye releases is extremely important on two grounds:-

a) It shows that expensive tidal holding tanks are not necessary for the Midleton Area outfall and this saving alone in capital works covers the cost of the whole Harbour Study.

b) It shows that the introduction of holding tanks for intermittent discharge disimproved the situation in two potentially valuable shellfish areas viz. the North Channel and Rostellan Bay."

In his Vol. 1 General Report of the CHPR, M.C. O'Sullivan repeats these findings:

"12. In the case of Rathcoursey point, the intermittent discharge was compared with the continuous discharge of the same quantity in similar periods of time. It was found that, releasing the dye intermittently on an outgoing tide only, did not, in fact, significantly affect the quantities of dye at the end of the release period, as compared with the quality present in the area as a result of continuous pumping. ***More importantly, if there was any difference in the quantity of dye present in Areas 16 and 16 (North Channel and Ballinacurra Estuary), it was an increase as a result of intermittent pumping rather than continuous."***

and then he again turns these dye study results to fallacious advantage, to show that there is no benefit to be obtained from an expensive foreshore holding tank, stating:

"14. The result of the parallel dye studies at Rathcoursey Point is that expensive tidal holding tanks which form part of the Midleton Sewerage Scheme can be eliminated. ***This practical result on its own saves the whole cost of the 5 year study of Cork Harbour."***

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What has, in fact, been shown, is that even by only using the top half of the ebb tide, ***"the release is not carried far enough by the outgoing tide to remove it permanently from the East Channel - it remains in the East Channel and is simply pushed inwards by the incoming tide..."***

In other words he has proved that Rathcoursey Point is definitely NOT the place to discharge effluent in any way at all, especially having stated on p.102:

"(iii) Because of the presence of oyster farming in the North Channel, ***any outfall point should be such as to give very substantial dilution"*** and, again, on p.176,

"(v) The existence of a commercial oyster fishery in the North Channel and the potential for shellfish development in Rostellan ***calls for special caution****."*

On this same page (p.176) it is worth also noting MCOS' observation:

"(iii) The freshwater flushing of the Ballinacurra Estuary ***is well-nigh totally absent*** *in summer and in winter is very small in comparison with the Lough Mahon situation."*

We thus have MCOS' word (and he carried out float experiments for the 1972 Scheme) that nutrients coming down from Midleton overflows are just not flushed out of the Estuary. The more pumping station overflows that occur, the more nutrients will accumulate over the PSP cyst beds and, we will see in sec. 5.5, below, move on westwards down the North Channel.

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5.4 The evidence of EPA sampling of the North Channel (2015-2017)

The regular EPA sampling of stations LE 420 (Weir Island), LE 430 (Brick Island) and LE 450 (North of E. Ferry) also demonstrates the build-up of nutrients to the west in the winter sampling, when there is no nutrient uptake by the phytoplankton. The table below of the most up-to-date results, averages the surface (S) and bottom (B) samples and highlights the highest concentrations of TON, PO4 and DIN, 4 out of 6 of which are found at Weir Island (LE420) – as far west as could be sampled. Two out of the 6 are equal highest with Brick Island (LE430) which is 2 km to the west of Rathcoursey and nutrient levels at the Owenacurra/Rathcoursey east end (LE450) are the lowest on 5 out of the 6 counts.

Table of EPA recent regular winter sampling of the North Channel for nutrients at stations from north of East Ferry (LE450), Brick Island (LE430) to Weir Island (LE420).

Station No	Sample Label	Survey Date	TON mg/l N	Av. TON	PO4 µg/l P	Av. PO4	DIN	Av. DIN
LE420	**Weir Island**	21.01.15			n/a		n/a	
LE420		"			n/a		n/a	
LE430	**Brick Is.**	"			n/a		n/a	
LE430		"			n/a		n/a	
LE450	**N of E. Ferry**	"			n/a		n/a	
LE450		"			n/a		n/a	
LE420	LE420S	03.03.16	0.93		36		1.05	
LE420	LE420B	"	1.3	1.115	34	35	1.4	1.225
LE430	LE430S	"	1.4		31		1.49	
LE430	LE430B	"	0.91	1.155	30	30.5	1.001	1.246
LE450	LE450S	"	1.4		30		1.483	
LE450	LE450B	"	0.55	0.975	29	29.5	0.625	1.054
LE420	LE420S	17.01.17	0.74		30		0.87	
LE420	LE420B	"	0.55	0.645	24	27	0.635	0.753
LE430	LE430C	"	0.46		18		0.531	
LE430	LE430C	"	0.46	0.46	18	18	0.531	0.531
LE450	LE450C	"	0.41		24		0.472	
LE450	LE450C	"	0.41	0.41	24	24	0.472	0.472

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It should be noted that from the full table of the annual results (not given here), this winter sampling of phosphate in the table above is an order of magnitude greater than the summer sampling (which is at c. 2.5mg/l PO4) in this snapshot of recent years, although it is noteworthy that the only September sampling (12.09.17) carried out in these 3 years, shows equally high phosphate again, similar to the above "winter" figures, though both TON and DIN are still at summer levels.

This observation points to phosphate being a limiting factor over the summer algal bloom period – an observation also made in Nash and Hartnett (2011), who noted on p.49:

"*It was found that the ratio of available nitrogen (ammonia and nitrate) to available phosphorous (orthophosphate) was greater than 7.2 in Lough Mahon and the North Channel, suggesting that phytoplankton growth is phosphorous-limited.*

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5.5 Current meter observations at Brown Island: November 1996 (Irish Hydrodata in EIS Technical Appendices for Midleton WWTP)

The Irish Hydrodata report, prepared in response to the questions from Cork CC Planning Department to Irish Water and Dairygold, refers to the greater current speeds entering the North Channel on the flood tide rather than leaving on the ebb, in the fourth paper in this attachment to the EPA:

http://www.epa.ie/licences/lic_eDMS/090151b2806bb95b.pdf

i.e. in the,

"*Rathcoursey Outfall Investigation of the Impact of Treated Wastewater Discharges arising from the Dairygold Mogeely Plant to Cork Harbour."* prepared for Irish water by Irish Hydrodata. 19th May 2017.

Tidal current data is given in section 2.5 on p.140. It, too, admits that the current speeds on the flooding tide in East Ferry **(NB)** at Rathcoursey are faster than those of the ebb.

"Peak current speeds are summarised in Table 2.5 and shown in Figures 2.5 & 2.6. ***The speeds on the flooding tide are stronger than on the ebb,*** *with the flood lasting for about 6 hours and the ebb for the remaining 6.42 hours. The high water slack lasts for less than 30 minutes".*

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Note that Table 2.5 and Figures 2.5, 2.6 and 4.8 all refer to flows in the North/South directions i.e. these are in East Ferry channel, as can be seen from the directions of flow at 180° (S) and 360/0° (N) and the considerably different and greater flow in the East Ferry at over 1m/s, than is found in the East/West North Channel, which is closer to 0.3m/sec. However, Fig. 2.6 shows a much greater area under the flood tide curve than the ebb tide curve, indicative of a greater volume of water entering the North Channel than leaving it.

In this 2017 investigation for Irish Water/Dairygold, we are not given the current meter records for the North Channel itself, which are by far the most instructive. It is not clear why they were omitted, as they were available to Irish Hydrodata, having been published by them in their hydrodynamic work in 1993 for the Midleton WWTP discharge and re-published by M.C. O'Sullivan in the 1996 EIS for Midleton WWTP.

In these publications we are still only given just one snapshot of 4 spring tides and 4 neap tides from the current meter off Brown Island in Fig. 3.5a as shown below:

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Fig. 3.5a Irish Hydrodata current speeds off Brown Island for spring and neap tides with direction of flow (flood tide at 270° and ebb at 90°) shown below – with modelled current speeds in red and actual, measured speeds in black. (From 1993 EIS for Midleon WWTP)

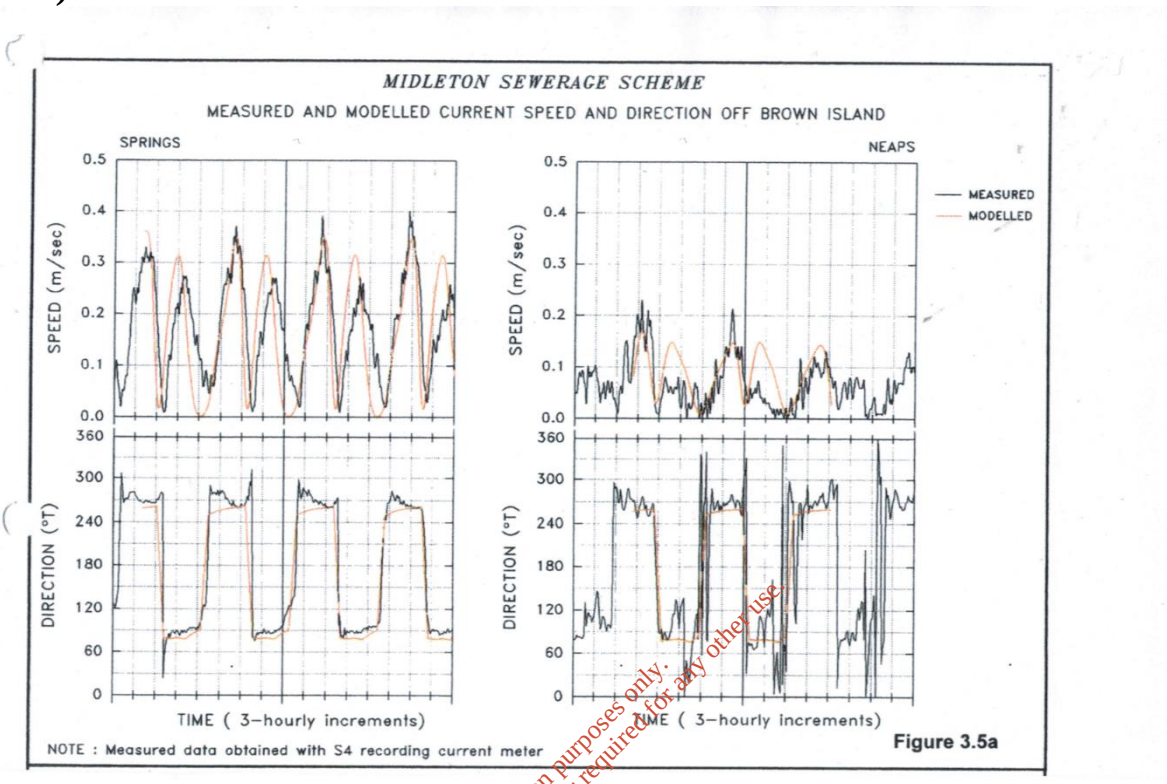


Figure 3.5a

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In this Irish Hydrodata Fig. 3.5a, the direction of flow is given beneath the current speeds, i.e. the flood tide is running due west (270°) and the ebb tide due east at 90°, and it is immediately clear that the "measured" flood current, shown in the current speed graph above it, is considerably greater flowing to the west on both spring and neap tides, than the following ebb tide flows to the east. Note also that the "measured" ebb tides shown in the black line on both spring and neap tides is also considerably less than the "modelled" line for the ebb tides, shown in red.

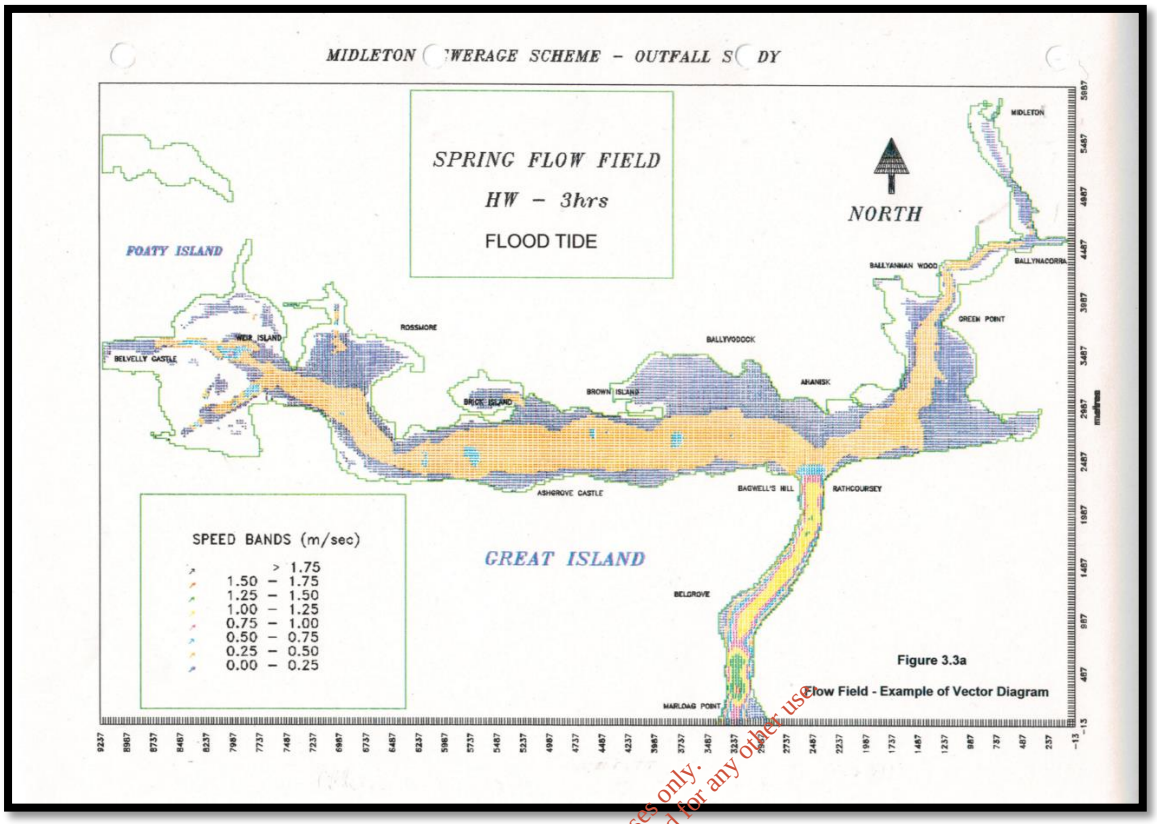
Irish Hydrodata/M.J. O'Sullivan also had the benefit of Spring Tide Flow Fields for the mid-flood tides in Fig. 3.3a and the same "Flow Fields" for the mid-ebb tides in Fig. 3b for the North Channel in the 1993 Irish Hydrodata work, which I copy below.

It is very clear here that they are showing the flood tide up to Belvelly in the far west, to be travelling at 0.25-0.50m/sec (yellow), with occasional faster flow areas of over 0.50 m/sec (pale blue), including some faster flows right up into the area between Weir Island and Belvelly in the deeper channels in the reed bed area.

In contrast, the mid-ebb tide flows are given as only 0.00-0.25m/sec (darker blue), except for the same shallower patches down the centre of the channel, where the flows were greater also on the flood tide.

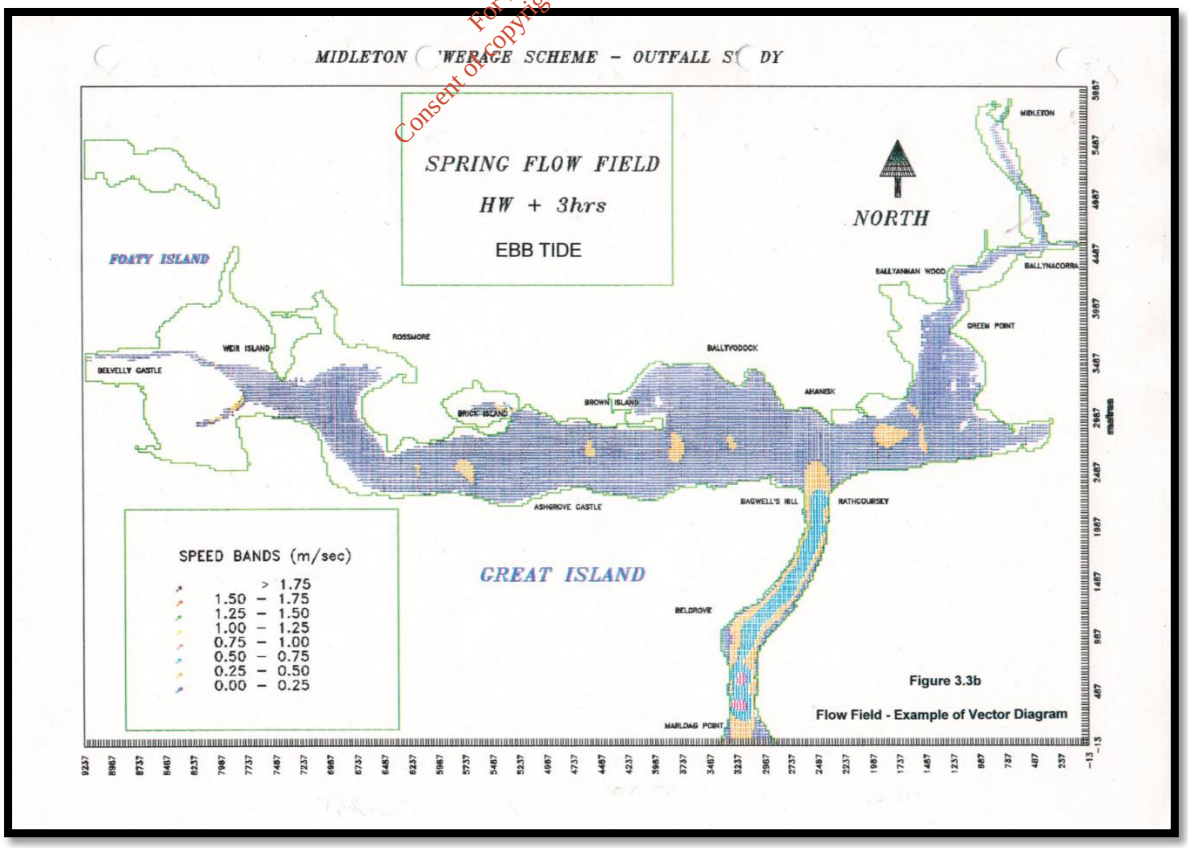
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Fig. 3a Irish Hydrodata 1993 for Midleton WWTP EIS with flood tide current speeds.



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Fig. 3b Irish Hydrodata 1993 showing the ebb tide current speeds



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However, for his work on, "*Modelling the Norovirus Contamination of an Oyster Farm in Cork Harbour"* (2007), carried out to comply with condition 7 of the 1999 Foreshore Licence issued for the discharge, Prof. O'Kane needed more than just the above 2 days' data and made use of a longer 12-day set of the Irish Hydrodata current meter records off Brown Island in his study on discharges to the North Channel and, 14 years later, he gives us the records of these 12 days flows at Brown Island (a whole spring and neap tide cycle) in which we can see quite clearly the much greater speed of the flood currents as compared to the ebbs and, even without running the programme, we can see that, on spring tides, the flood currents are approx. 50% greater than the ebbs and on neap tides the difference in the currents is over 100%. The length of the ebb tides is shown as being slightly longer overall – but only about 13%, thus, at a simple overview, it is clear that far more water comes into the North Channel via Rathcoursey, than returns the same way – in other words there is a marked residual current to the west exiting at Belvelly.

5.6 Brown Island current meter data used by Prof. O'Kane in his "Modelling the Norovirus Contamination of an Oyster Farm in Cork Harbour" (2007) Figs. 3.17-3.22.

The Brown Island current meter records are given on pp. 59, 60 and 61 of this report. These are the records we need and in the detail that we need – i.e a full spring and neap tidal cycle of the currents directly in the North Channel, which is what we are interested in.

I have copied the figures for each of the three 4-day periods in the pairs as presented in the O'Kane Report, so that the direction of flow of the current is immediately below the graph of the current speeds, so that it is obvious which current speeds refer to the flood tide (flowing to the west at 270°) and which is the ebb (flowing back to the east at 90°).

The flood tide currents are very markedly greater than the ebbs at all stages of the tidal cycle.

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First 4 days (15.09.93 – 18.09.93) Spring tides.

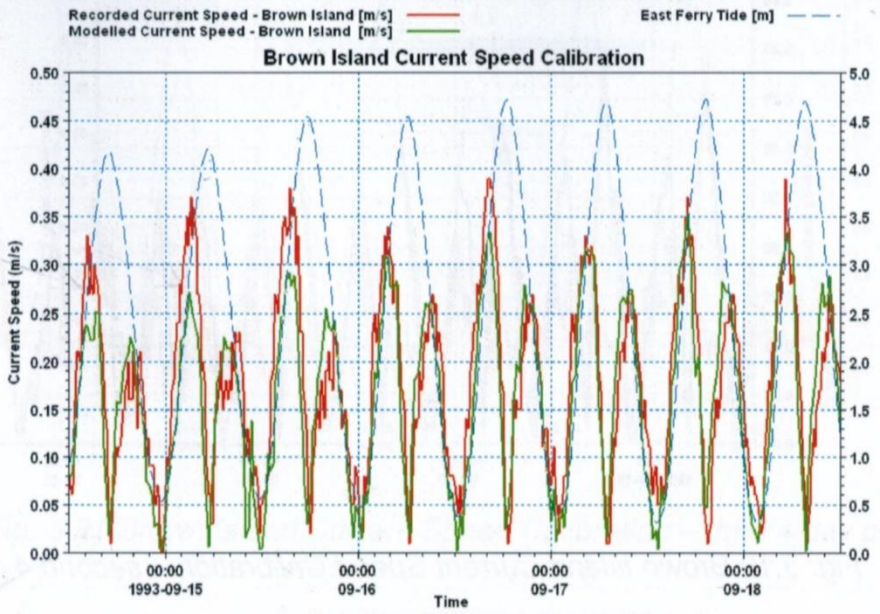


Fig. 3.17 Brown Island Current Speed – first 4 day period

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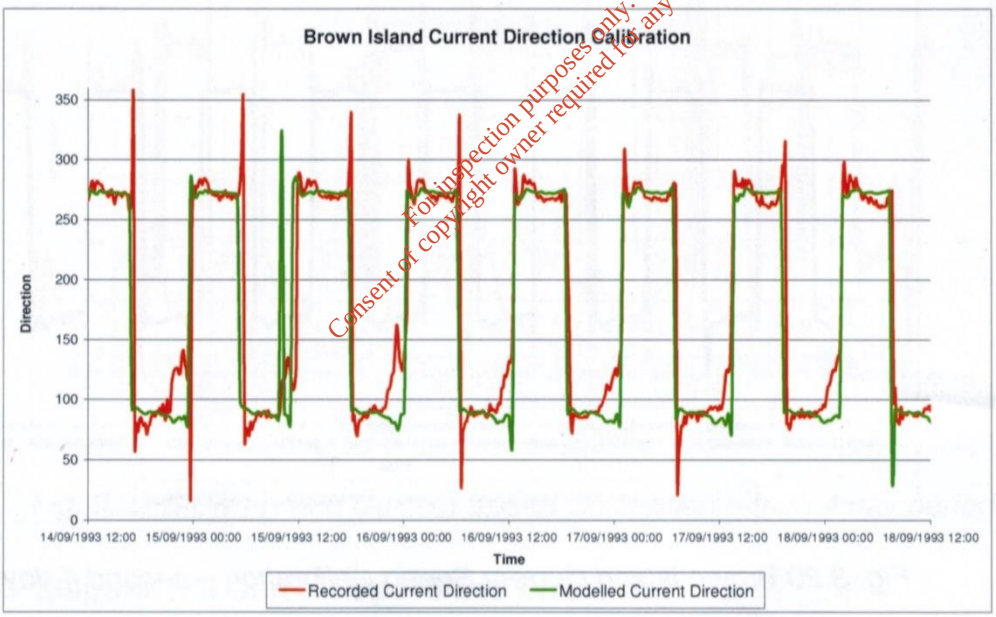


Fig. 3.18 Brown Island Current Speed Calibration – first 4 day period

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Second 4 days (19.09.93 – 22.09.93) Transition to neaps

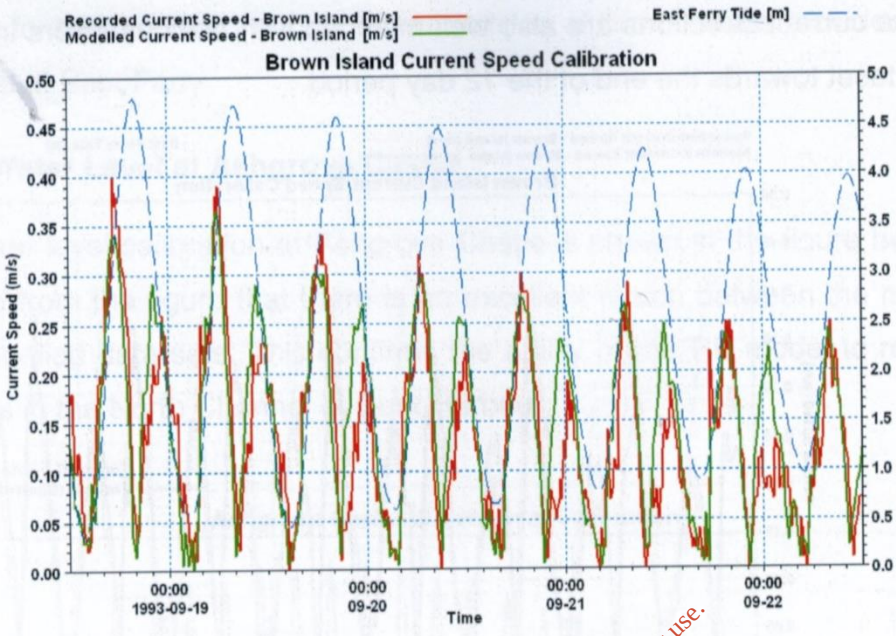


Fig. 3.19 Brown Island Current Speed Calibration – second 4 day period

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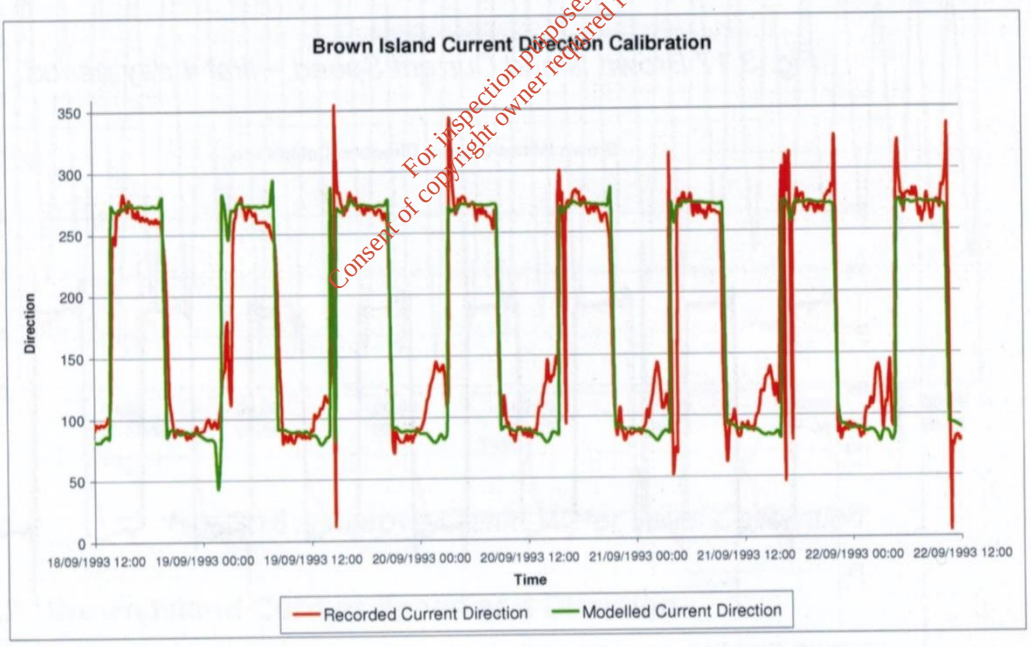


Fig. 3.20 Brown Island Current Speed Calibration – second 4 day period

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Third 4 days (23.09.93 – 26.09.93) Neap tides.

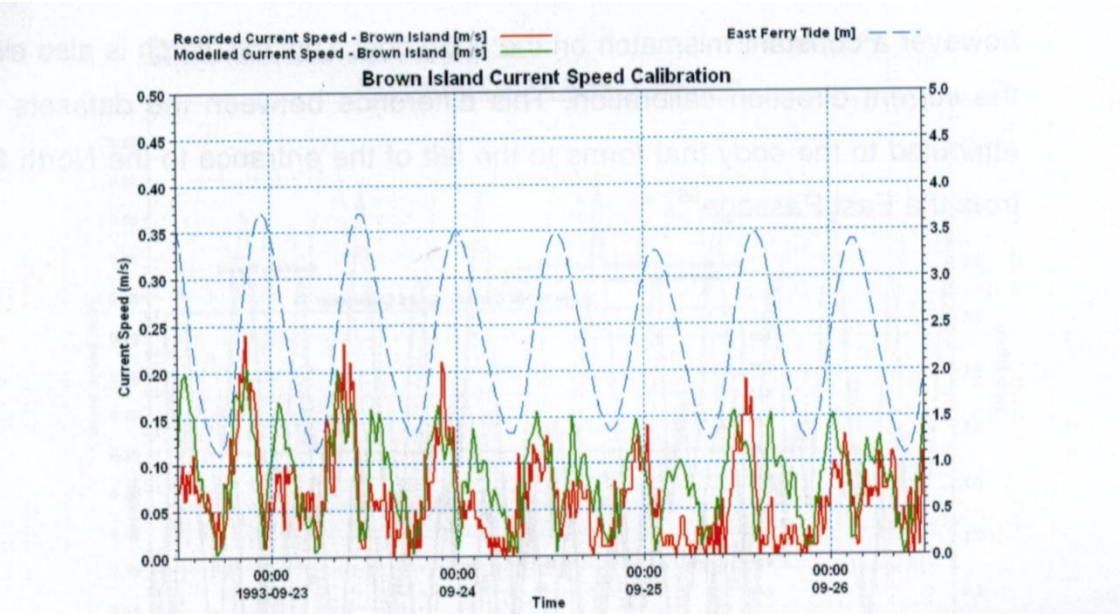
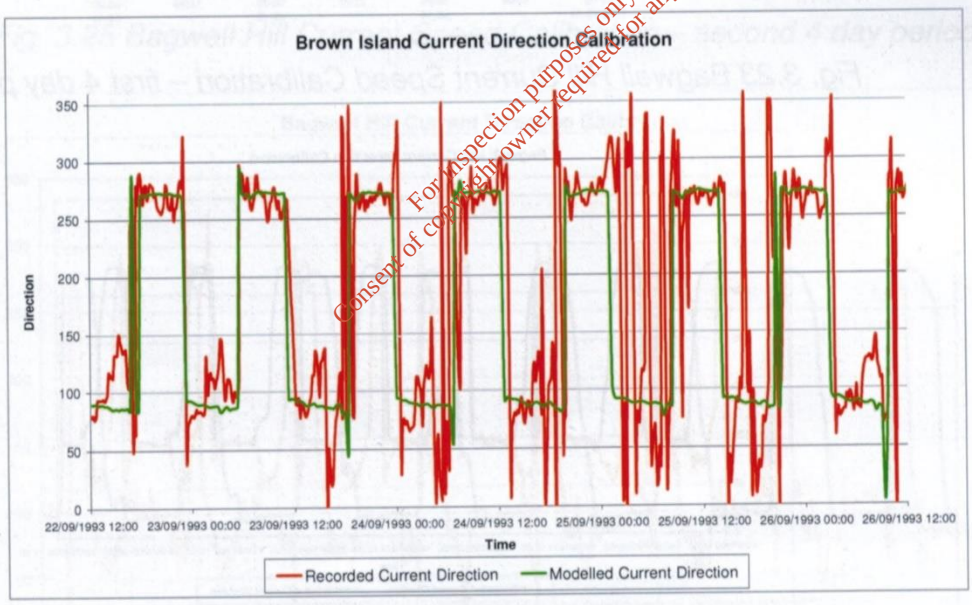


Fig. 3.21 Brown Island Current Speed Calibration – third 4 day period



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Fig. 3.22 Brown Island Current Speed Calibration – third 4 day period

These figures are so important in the argument we are making, that I reproduce them again as a pdf with my references.[5] The direction of flow is also shown on these copies with each 4 day period, confirming the due west/due east flows on the incoming and ebb tides.

[5] Brown Island current meter data collected by Irish Hydrodata in 1993, taken from "Modelling the Norovirus Contamination of an Oyster Farm in Cork Harbour" J.P O'Kane (2007)

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As with the Irish Hydrodata Fig. 3.5a, above, it can be seen, again, very clearly, that the actual (red) current velocity is very appreciably greater on the flooding tide (270°) than on the ebb at 90° - returning to the east.

I have tabulated these results as best I can by eye. The maximum current speeds are easily read. I have tabulated the maximum speeds for the flood and ebb tides and, from them, the median speed. The % difference between the two speeds is, of course, the same, but median speeds might be closer to the overall difference in speed between the flood and ebb tides, though it will take a computer and model to make the best estimate.

The duration of each phase of the tide is more difficult to measure and the report identifies difficulties in the last 2½ days, "*The current directions are also well matched with obvious errors in the recorded dataset towards the end of the 12 day period".*

Differential current speed and duration of flood and ebb tides in the North Channel

Date	Max. current speeds		Median current speeds				Duration of flow		
	Flood tide m/sec.	Ebb tide m/sec.	Flood tide m/sec.	Ebb tide m/sec.	Flood tide Difference % greater	Actual difference in speed m/s	Flood tide	Ebb tide	Ebb tide difference % longer
14.09.93	0.33	0.21	0.165	0.105	**57%**	**0.060**	n/a	6.24	
15.09.93	0.37	0.28	0.185	0.140	**32%**	**0.045**	6	6	**0%**
"	0.38	0.23	0.190	0.115	**65%**	**0.075**	6.24	6.48	**4%**
16.09.93	0.34	0.27	0.170	0.135	**26%**	**0.035**	5.76	6	**4%**
"	0.39	0.27	0.195	0.135	**44%**	**0.060**	5.76	6.24	**8%**
17.09.93	0.33	0.27	0.165	0.135	**22%**	**0.030**	6	6	**0%**
"	0.37	0.27	0.185	0.135	**37%**	**0.050**	5.76	6.48	**13%**
18.09.93	0.39	0.27	0.195	0.135	**44%**	**0.060**	5.76	6.24	**8%**
"	0.4	0.26	0.200	0.130	**54%**	**0.070**	6	6.72	**12%**
19.09.93	0.39	0.23	0.195	0.115	**70%**	**0.080**	6	6	**0%**
"	0.34	0.21	0.170	0.105	**62%**	**0.065**	6	6.48	**8%**
20.09.93	0.32	0.22	0.160	0.110	**45%**	**0.050**	5.28	7.2	**36%**
"	0.3	0.19	0.150	0.095	**58%**	**0.055**	5.76	6.48	**13%**
21.09.93	0.29	0.18	0.145	0.090	**61%**	**0.055**	5.76	6.48	**13%**
"	0.25	0.13	0.125	0.065	**92%**	**0.060**	5.28	6.72	**27%**
22.09.93	0.25	0.11	0.125	0.055	**127%**	**0.070**	6	6	**0%**
"	0.24	0.1	0.120	0.050	**140%**	**0.070**	5.76	6.72	**17%**
23.09.93	0.23	0.08	0.115	0.040	**188%**	**0.075**	5.52	n/a	
"	0.21	0.07	0.105	0.035	**200%**	**0.070**	Difficulty reading these records on the graphs - as noted in the O'Kane text.		
24.09.93	0.13	0.08	0.065	0.040	**63%**	**0.025**			
"	0.14	0.04	0.070	0.020	**250%**	**0.050**			
25.09.93	0.19	0.06	0.095	0.030	**217%**	**0.065**			
"	0.13	0.11	0.065	0.055	**18%**	**0.010**			
Average	**0.29**	**0.18**	0.146	0.090	**62%**	**0.056**	**5.80**	**6.38**	**10%**

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The table shows, however, that the speed, and hence volume, of the median incoming flood tide is approximately 60% greater than the outgoing ebb and that the difference in the duration of the tides is only some 10%. Although the ebb tide lasts a little longer, there is no way that a 60% greater volume of inflowing water will be equalled by a 10% longer lasting ebb tide and, **even on this simplistic level, it is very clear that there will be a very considerable residual tide to the west.**

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How big this really is, will only be gauged by running the model, with the start and finish at exactly the same point of the tide, and using the full tidal cycle of springs and neaps (i.e. all 12 days above). As already discussed, above, this anti-clockwise movement of water up East Ferry and westwards along the North Channel is supported by the apparent greater volume entering the North Channel from East Ferry on the flood tide, than leaving it, as shown in Fig. 2.6 (p.9) of the Irish Hydrodata Addendum.

Though the model needs to be used to get a more exact figure on this greater entering volume, even if it is, **in <u>any</u> way, showing an overall residual flow inland up the East Ferry and west towards Belvelly, it means that any extra input of nutrients at Rathcoursey Point <u>is not going to be diluted by "new" water, as stated in the Addendum and the original Dairygold documents,</u> but will simply accumulate in the North Channel, being carried to the far west end of the North Channel, as shown in the NUIG Fig. 9 in sec. 4, above, where the highest residence time of water at 70 days is shown.**

Added to the long historical evidence of the oyster beds in the North Channel, which prove the retentive nature of the hydrodynamics to have existed since the Iron Age kitchen middens were made, I believe this residual east-west flow around Great Island and exiting through the Belvelly Channel, may have been further increased by the blocking of so much of the estuary opening on to Lough Mahon by the Cork to Cobh railway line, leaving just the one small, single span bridge as the only opening over the main creek. If this does provide any restriction to flow, then there will be less of a hydraulic head to drive flow through this restriction on the flooding tide from the LW level, than on the rapidly falling tide from the HW level. This would add to the mechanism by which the flood tide from Rathcoursey appears to be so much stronger than the ebb and could also explain the discrepancy between the modelled ebb current speed back down the North Channel and those found in practice.

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6. Considerations as to nutrient dispersal from Rathcoursey.

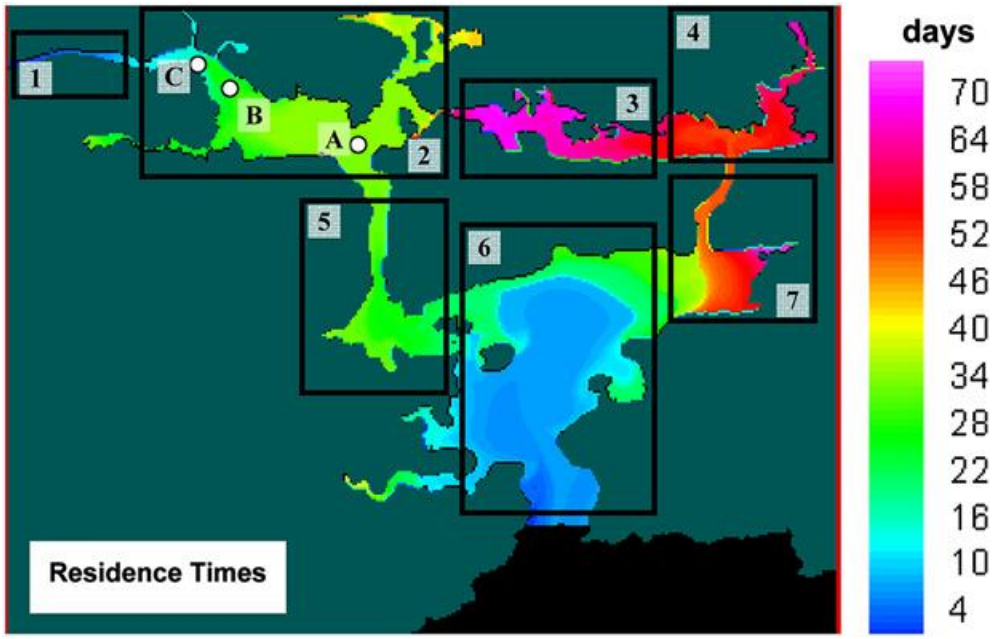
As was explained, above, residence times were chosen by the UCG hydrodynamic team as the characteristic of homogeneity for the different areas in the harbour, as spatial distribution plots of this parameter captured details of both hydrodynamic circulation <u>and solute transport processes.</u>

As can be seen here, again, the highest residence time, which includes an element of solute transport, is to be found at the far west end of the North Channel and this is due to there being this residual flow from east to west down the North Channel and the build-up of dye (sec.5.3) and winter nutrients (sec. 5.4) at the west end of the North Channel, before spilling into the Lough Mahon side for a short period at the top of the ebb tide.

It is worth reminding ourselves of the NUIG Residence Times data before considering the effect of this nutrient dispersal from Rathcoursey on the phytoplankton blooms of the North Channel:

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Fig. 9. Spatial plot of residence times (NUIG data)



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6.1 The North Channel is subject to toxic algal blooms of the most dangerous variety.

The North Channel is one of just two areas in the country (the other is Belfast Lough) where there is the risk of the most dangerous of the toxic algae reaching bloom conditions when their cells produce saxitoxins, quoted as being 1000 times more toxic than cyanide, and some of the most potent nerve poisons known to man. These biotoxins are taken up by shellfish, which feed on the *Alexandrium spp*. dinoflagellates, and these will then be passed on to consumers of the shellfish, causing Paralytic Shellfish Poisoning, or PSP.

Some shellfish can store this toxin for several weeks after a harmful algal bloom passes; ordinary cooking methods do not eliminate the toxins and PSP can be fatal in extreme cases, particularly in immuno-compromised individuals. Within 2-12 hours, in very severe cases, there is complete paralysis and death from respiratory failure in the absence of ventilatory support, leading to experience, in three large series of studies, of mortality at 8-14% and 50% in young children.

The Saxitoxin produced by blooms of *Alexandrium spp*. causing PSP is the only biotoxin specifically included in the shellfish water quality parameters of the 1979 EU Shellfish Water Directive (79/923/EEC) and it was retained, but with no further biotoxins added, in the current codified version (2006/113/EC), which set out to rationalize and improve the original Directive:

Table 1 - Parameters listed in Annex I:

Saxitoxin (produced by dinoflagellates)	**No limit given**	**No limit given**

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Needless to say Ireland has taken the risk of all the biotoxin threats such as the lesser Diarrhetic Shellfish Poisoning (DSP) very seriously, and there is both full-time surveillance of the phytoplankton around the coast as well as sampling of shellfish tissue for the toxin levels, organised by the Marine Institute, in the dangerous months. However, it must be considered both hazardous and irresponsible to stimulate such blooms by adding further nutrients to a situation, which could be, at present, on the cusp of getting out of control.

The North Channel gets blooms of *Alexandrium* every year in the summer months. I have retrieved records of the Proceedings from the past nine Irish Shellfish Safety Scientific Workshops 2000-2009 of high *Alexandrium* cell counts, and the Marine Institute have given me the toxin levels in mussels and oysters from 2011 to 2018. These notes are given in the Appendix.

This annual Cork Harbour bloom has been the subject of many studies and round-the-year monitoring. The most intensive was a 3-year PhD thesis incurring hundreds of boat-hours, continuous monitoring devices and sediment traps etc., with the aim of developing a method of predicting these blooms, in which it was assessed as being highly successful. The UCG Hydrodynamics team provided the tidal model and the thesis, was published in June 2007.

6.2 "Modelling Alexandrium bloom dynamics in Cork Harbour, Ireland" by Aoife Ni Rathaille pp.304 (2007).

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Abstract: Blooms of *Alexandrium* are an annually recurring problem in the North Channel of Cork Harbour on the south coast of Ireland. They are associated with the only cases of contamination of shellfish with paralytic shellfish toxins in the Republic of Ireland. Two species of *Alexandrium* co-exist in Cork Harbour, a toxic form of *A. minutum* and a non-toxic form of *A. tamarense*. Toxic events have led to bans on the harvesting of shellfish in the North Channel during nine of the 11 years between 1996 and 2006.

The thesis reports,

p.3 "*Cork Harbour is the only shellfish production area in the Republic of Ireland where a ban on harvesting due to the presence of the toxins responsible for paralytic shellfish poisoning (PSP) has been enforced."*

Figure 1.1 on p.4 shows 7 closure periods in June, 4 in July and 1 in September and

p.22 "*The detection of paralytic shellfish toxins in Cork Harbour has led to a ban on shellfish harvesting each summer from 1996 to the present, with the exception of 1999 and 2001". (Source Marine Institute Biotoxin Data)*

With any risk at all of PSP, we have to take the best precautions we can by buying-in stock from outside Cork Harbour and not introducing PSP water into the purification tanks. Any slip-up would be highly detrimental to the sales of all shellfish and to Ireland's image for the safety of its food products abroad.

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The Sea Fisheries Protection Agency (SFPA) are tasked with the safety of Irish shellfish and send alerts, such as this one below by e-mail, to alert us to the fact that Cork Harbour was closed by PSP levels exceeding the safe limit for mussels. Mussels accumulate the toxin to a greater extent than oysters and can give us timely warning, however, an explosive bloom could well cause (and have caused) a closure for both mussels and oysters together.

This was the e-mail, for instance, received from the SFPA on 03.07.17:

Dear All

Please note closure of production areas in the SW for DSP.

Please also note PSP levels in Cork Harbour above regulatory limits for mussels, (not classified for mussels) but also detected at significant levels (below regulatory limits) in Oysters.

Templenoe Oysters are on a closed pending biotoxin status. (No sample since April 17 and area on weekly sampling frequency)

The following areas are closed pending, Bantry Middle and Bantry South.
Please inform relevant producers in the affected areas.

Report 17-26c Date Published 30 Jun 2017

Production Area	Sample Site	Sample Date	Species	Tissue	ASP mg/kg	AZP ug/g	DSP ug/g	PSP ug/Kg STXdiHCL equivalents	PTX ug/g	YTX ug/g	Status
Kilmakilloge	KY-KE-KE	26/06/2017	Mytilus edulis	Whole	n.d.(a)	<LOD(a)	0.10(a)		<LOD(a)	<LOD(a)	Open
Tahilla	**KY-TA-TA**	**26/06/2017**	**Mytilus edulis**	**Whole**	**n.d.(a)**	**<LOD(a)**	**0.26(a)**		**<LOD(a)**	**<LOD(a)**	**Closed**
Clew Bay North	MO-CN-IL	26/06/2017	Mytilus edulis	Whole	n.d.(a)	<LOD(a)	<LOD(a)		<LOD(a)	<LOD(a)	Open
Bantry Middle	**CK-BM-NC**	**27/06/2017**	**Mytilus edulis**	**Whole**		**<LOD(a)**	**0.11(a)**		**<LOD(a)**	**<LOD(a)**	**Closed Pending**
Bantry South	**CK-BS-SC**	**27/06/2017**	**Mytilus edulis**	**Whole**		**<LOD(a)**	**0.12(a)**		**<LOD(a)**	**<LOD(a)**	**Closed Pending**
Cork Harbour	**CK-CH-NC**	**27/06/2017**	**Crassostrea gigas**	**Whole**	**n.d.(a)**	**<LOD(a)**	**<LOD(a)**	**221(a)**	**<LOD(a)**	**<LOD(a)**	**Open**
Cork Harbour	**CK-CH-NC**	**27/06/2017**	**Mytilus edulis**	**Whole**	**n.d.(a)**	**<LOD(a)**	**<LOD(a)**	**1174(a)**	**<LOD(a)**	**<LOD(a)**	**Closed**

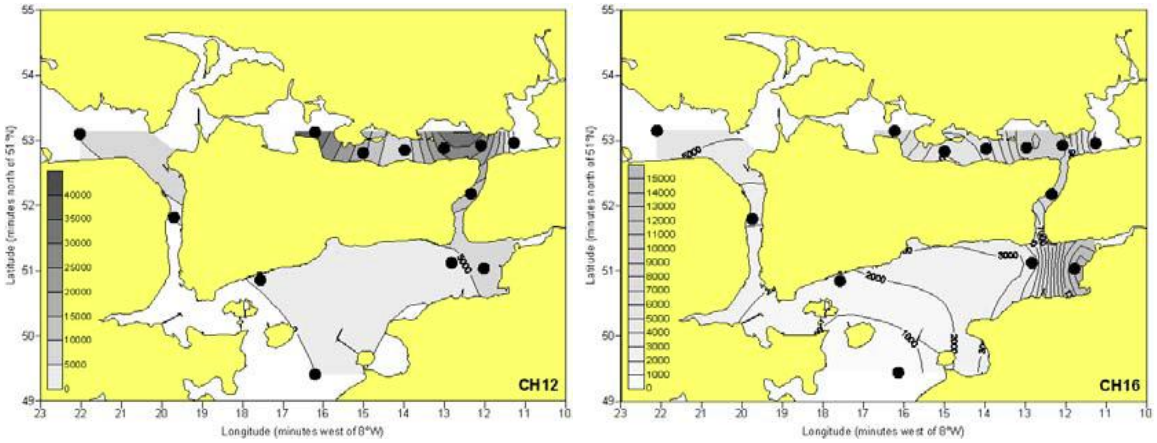
LOD = Limit of Detection, LOQ = Limit of Quantification, ULQ = Upper Limit of Quantification, N.D. = Not Detected
(a)M.I. Galway

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Three summers were spent on estimating the distribution of both the dinoflagellates in the water column, as well as densities of the over-wintering cysts in the sediments, to build up the following picture, which was to be incorporated into the very successful modelling of the initiation and development of these toxic algal blooms.

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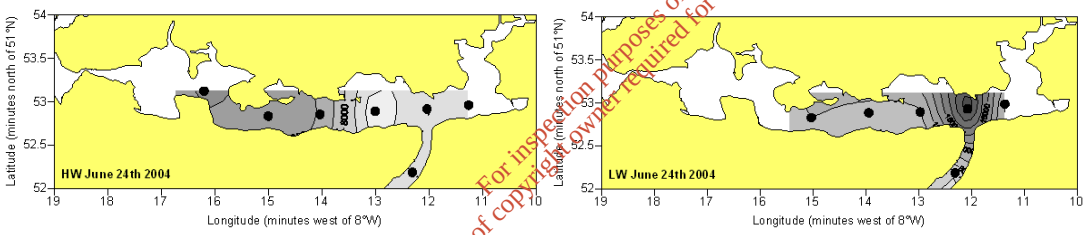
6.2.1 Typical distributions of the Alexandrium dinoflagellates in the North Channel **(PhD Thesis p.151):**



(a) (b)

Surface distributions of Alexandrium spp. vegetative cells (cells·L-1) in Cork Harbour on (a) June 9th 2004 and (b) August 5th 2004.

With surface distributions of *Alexandrium* spp. vegetative cells (cells·L-1) in the North Channel at (a) high water and (b) low water on June 9th 2004.



(a) (b)

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These distribution diagrams mirror-image the NUIG residence times given above, as is only to be expected. The drift of these organisms with the tide shows the highest concentration of cells at the top of East Ferry at LW, precisely the position of the Rathcoursey outfall, with its input of nutrients.

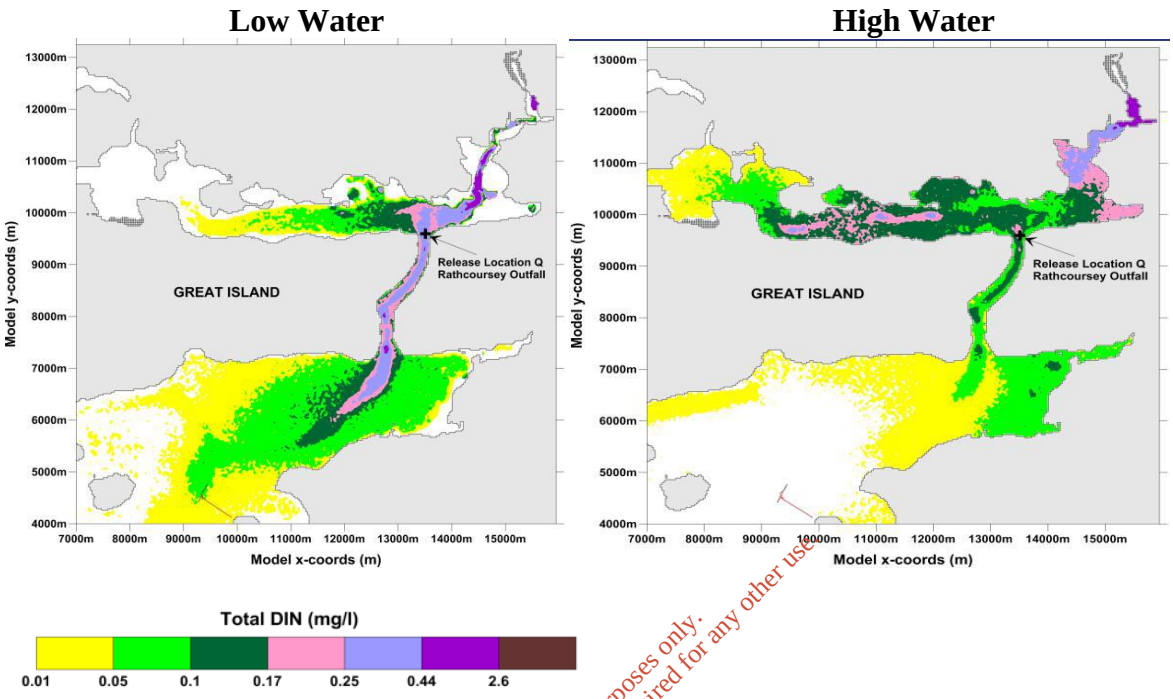
What is possibly even more worrying is that cyst densities in the sediments (the seed-beds for the following season) are also highest, by a long way, at the bottom of the Owenacurra Estuary, which is also precisely where the Rathcoursey discharge will have its maximum effect, as shown in Fig. 4.10 of the "*Rathcoursey Outfall Investigation of the Impact of Treated Wastewater Discharges arising from the Dairygold, Mogeely Plant to Cork Harbour*", prepared for Irish Water by Irish Hydrodata, 19th May 2017, which was required by Cork County Council to address their queries and to:

"*provide a quantum of the risk of adverse impact on Cork Harbour SPA (004030), Great Island Channel (001058), and of further degradation of water quality in the Owenacurra Estuary".*

Thus the two sets of diagrams should be viewed in conjunction.

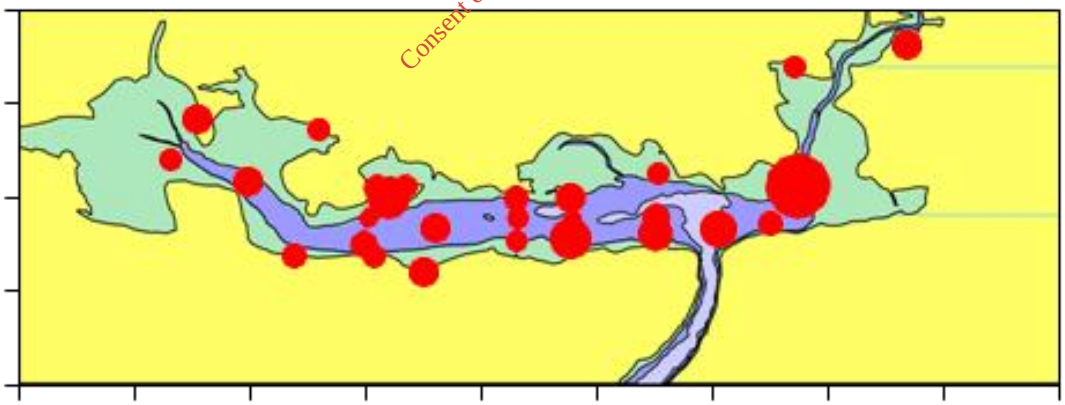
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Figure 4.10 Irish Hydrodata Addendum 19.05.17 - Simulation of DIN concentrations arising from the Rathcoursey outfall (WWTP, IDL and Dairygold) and river inputs, Future DIN load = 967 kg/day



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Figure of A. minutum cyst densities (cysts.g^{-1} dry sediment) in surface sediments of the North Channel (from Ni Rathaille Ph.D. Thesis 2007)



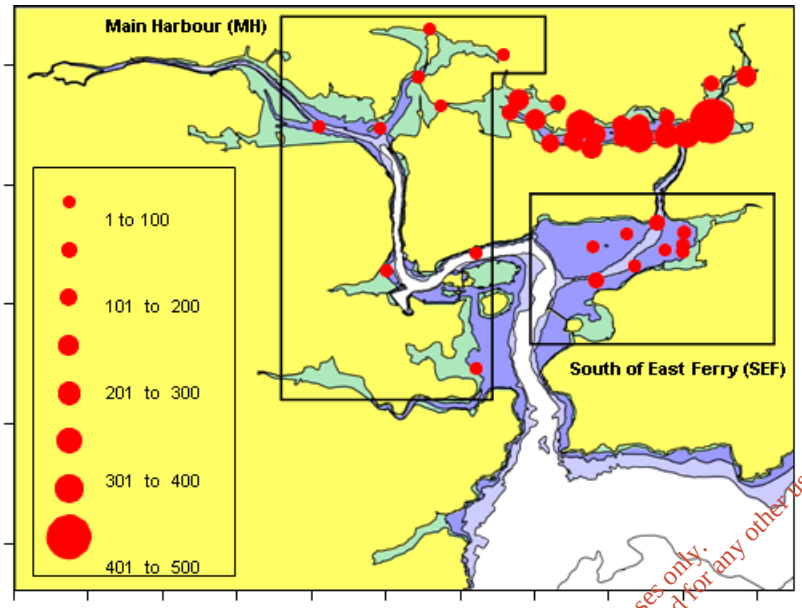
Comparison of Cork Harbour cyst densities to those reported elsewhere in the world.

The thesis also reports (p.56) that the average cyst densities found for *A. tamarense* of 199 cysts/cm3 and ***A. minutum* of 280 cysts/cm3 "*fall at the top end*" and "*are closer to the upper end of the world-wide density scale*"** reported in the world-wide literature.

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The distribution of both *Alexandrium spp*. is similar in the North Channel, but it is *A. minutum* that appears to be responsible for the saxitoxin in Cork and so is the one I am showing here.

Figure of A. minutum cyst densities (cysts·g^{-1} dry sediment) in surface sediments of the whole of Cork Harbour (from Ni Rathaille Ph.D. Thesis 2007)



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When looking at the Irish Hydrodata DIN concentrations in Fig. 4.10 above, it should be remembered that although "riverine" DIN of 676kg/day (accounting for 70% of the load) is included in the total 967kg DIN/day for this modelling, from comparisons of the faecal coliform concentrations in the river, above and below the town overflows (as we will see in sec. 7.6), we need to add some further 150% of the "riverine" DIN load (~1,014kg DIN/day) for the untreated town overflows, which have not been taken into account, and the total load doubles to 1,990kg DIN/day. This will push the modelled levels in the Owenacurra Estuary in the blue 0.25-0.44 mg/l zones, to well over the target level of 0.44 mg/l, but as suggested by the authors in their Conclusions to the 2001 EPA Report in the section 6.2.3 below,

"Within estuaries, <u>eutrophication is better characterised by apparent problems</u>…."

With these North Channel and Owenacurra Estuary water-bodies there is already a substantial problem – they have been eutrophic or potentially eutrophic, without fail, since records began over 20 years ago and as these authors concluded, no more nutrients must continue to be added to this part of Cork Harbour, and

"Measures are required to <u>reduce</u> inputs of point source nutrients…..this action is especially important in inner Cork Harbour…"

If Dairygold are allowed to add their waste to this already non-compliant situation, what is to stop any other developer, within the same 14km radius, claiming the same right – and when and where will it stop?

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6.2.2 The Ph.D.'s evaluation of the effect of the addition of nutrients at Rathcoursey adds to the EPA's two studies of 2001 and 2002.

The PhD thesis on the environmental parameters, in sec. 6.2.3 on p.164 describes that,

"***Spatial distributions showed highest concentrations of nitrates and nitrites at the stations closest to the river discharges***. *This pattern would be considered typical given that rivers carry high nutrients derived from a variety of sources including natural sources, agricultural run-off and sewage effluent (Lalli and Parsons, 1993).*

"Nutrient distribution patterns in the North Channel during 2005 were also measured. ***The most prominent feature of these observations was the elevated levels of all nutrients in the eastern end of the channel on all sampling occasions. The Ballynacurra River that discharges into the north eastern corner of the North Channel was undoubtedly the source of the elevated nutrient concentrations in this area."***

On p.169 it alludes to the hydrography:

"The surface distributions of Alexandrium spp. cells at high and low tide on June 9th and June 24th 2004 respectively provide further evidence of the tidal excursion of the North Channel ***and demonstrate the retentive nature of the channel****."*

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6.2.3 The EPA studies of 2001 and 2002 and the danger of toxic algal blooms.

In the first EPA study on the "Measurement and Modelling of Nutrient Dynamics of Two Estuaries in Ireland – Wexford and Cork Harbours" by Costello et al (12 others) published in 2001 (**Ref.1**), the authors claimed in the Conclusions (p.45) that,

"*In this study, the distribution of phytoplankton was quantified in space and time using a two-dimensional integrated nutrient and hydrographic mathematical model. The model was validated using tidal elevation and current measurements, dye releases, airborne remote sensing, and field data. Water samples were collected over different years, months, and state of the tide. At a spatial resolution of 30 x 30m, this was the most detailed water quality model conducted for entire estuaries in Ireland that integrated hydrography and nutrient dynamics."*

The Executive Summary, on p.3, made the point about the algal blooms and "*a toxic dinoflagellate, Alexandrium tamarense,* (which) *has contaminated shellfish in Cork Harbour"* (Note page nos. used here are for the pdf attached to this submission, rather than the hard copy.)

and on p.4:

"*In Cork Harbour, phytoplankton blooms were more limited to the inner estuary, where they coincided with, and probably contributed to, the deoxygenation in deeper waters.*

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"*While chlorophyll levels were higher in Wexford than Cork Harbour, environmental impacts were greater in the latter. Within estuaries, eutrophication is better characterised by apparent problems than simple chlorophyll levels.* ***On this basis, the deoxygenation in Cork Harbour estuary and toxicity from dinoflagellates, indicate that the estuary is eutrophic."***

"The study found that point sources (outfalls) of nutrients are contributing to phytoplankton blooms in both estuaries. ***Measures to reduce waste inputs into the inner brackish-water part of the estuaries are thus required to reduce the occurrence of harmful algal blooms, especially in Cork Harbour where toxic blooms have occurred and are likely to continue to occur".***

In the section on Cork Harbour on p.7, 4 recent sets of reports on the Harbour were referred to,

"*The reports concluded that the water quality* ***particularly in the upper reaches of the harbour*** *has deteriorated over time"*, and again that,

"Phytoplankton causing Paralytic Shellfish Poisoning (PSP) have been recorded in Cork Harbour, namely Alexandrium tamarense in 1996 and 1997 (Marine Institute 1999)".

p.14 *"Cork Harbour has a large native oyster (Ostrea edulis) farm."*

In the Discussion on Cork Harbour on p.43

"Cork Harbour meets more of the criteria for a eutrophic system than Wexford Harbour does (notably (1), (2) (4) and (7) from the list: i.e.:

(1) nitrate concentrations enhanced above the background level;

(2) exceptional algal bloom concentrations;

(4) oxygen deficiency;

(7) occurrence of shellfish poisoning".

*"**Direct nutrient inputs to the surface layers may increase the size of toxic algal blooms when conditions are appropriate for growth of PSP-causing species.***

It is notable that nutrient loads to Cork Harbour are twelve times more for industrial and four times more for sewage than Wexford Harbour."

In the Conclusions on p.48, the authors admit:

"A limitation of this project was the absence of sufficient data on water flows and nutrient inputs from sewers, sewage outfalls, and limited information from some industrial outfalls…. It is thus not possible to point to any particular outfall as a main contributor to nutrient enrichment with confidence.

In Cork Harbour, the bloom was more limited to the inner estuary, where it led to deoxygenation in deeper waters. In both estuaries, the blooms moved up and down the estuary with the tide. The bloom was less dispersed and diluted in Cork than Wexford, due to the narrower shape of the former estuary. <u>This was reflected in the greater abundance of the slow growing dinoflagellates in Cork</u> than Wexford. These species can cause toxicity and contaminate shellfish.

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"Both estuaries receive significant sources of nutrients from catchment run-off and outfalls in the estuary. While chlorophyll levels were higher in Wexford than Cork Harbour, environmental impacts were greater in the latter. Within estuaries, eutrophication is better characterised by apparent problems than simple chlorophyll levels. ***On this basis, the deoxygenation in Cork Harbour estuary and toxicity from dinoflagellates, indicate that the estuary is eutrophic."***

And the first Recommendation (on p.46 also) is:

"Estuary Management".

*"****Measures are required to reduce inputs of point source nutrients in both estuaries, because these are significantly contributing to the phytoplankton blooms. This action is especially important in inner Cork Harbour because potentially-toxic dinoflagellate phytoplankton develop blooms there during the summer."***

"Water Quality in Ireland 1998-2000", McGarrigle et al (10 others) 128pp. plus c.100 pp. of Appendices (2002)

Perhaps the most comprehensive survey of the country's estuaries was carried out by the EPA at about the same time and published in "*Water Quality in Ireland 1998-2000*", McGarrigle et al (10 others) 128pp. plus c.100 pp. of Appendices (2002)[6]

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p.xii. Of 47 estuaries and coastal water bodies examined, 13 were "eutrophic", including the Lee Estuary and Lough Mahon. The Owenacurra Estuary/North Channel (Great Island) was classified with 3 others as "potentially eutrophic". However,

"p. xiii *"****With the exception of Greater Cork Harbour****, which was still under consideration at the time of writing, all of these waterbodies* (i.e. 12+3) *were designated as Sensitive Areas under the UWW Regulations, S.I. No. 254 of 2001)."*

p.62 *"Primarily as a result of this assessment, each of the these waterbodies, with the exception of Lee Estuary/Lough Mahon and the Owenacurra Estuary/North Channel, were classified as Sensitive Areas under the UWWT Regulations, S.,I. No. 254 of 2001****. The Lee Estuary/Lough Mahon and the Owenacurra Estuary/North Channel are currently being assessed in greater detail with a view to making a definitive decision regarding their trophic status".***

"Several estuaries and bays continued to exhibit serious pollution due to excessive organic enrichment from local waste water discharges, including the upper section of the Lee Estuary ***and Inner Cork Harbour****…."*

It was surprising, to say the least that a eutrophic water like the Lee Estuary and Lough Mahon were not declared sensitive at that stage. The Owenacurra/North Channel was said by the Minister in 1994 not to have had sufficient data collected, but it was also surprising in view of the very definite comments of the EPA in the 1998-2000 Report, such as:

[6] "*Water Quality in Ireland 1998-2000*", McGarrigle et al 128pp. plus c.100 pp. of Appendices (2002)

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p.78 "***Significant supersaturation*** (of oxygen) ***was only observed in the waters of the Ballinacurra Estuary and the North Channel above Great Island."***

"With the exception of the River Lee itself, ***very high oxidised nitrogen concentrations were typical of the tributary rivers which discharge to*** *the Upper Lee Estuary, Lough Mahon and* ***the Ballinacurra Estuary and North Channel (Owenacurra and Dungourney****)…..*
Concentrations in the outer harbour were mostly low, both in absolute terms and relative to ambient salinity, while concentrations in the Ballinacurra Estuary were moderately elevated."

p.79 *"The Lee Estuary, Lough Mahon and* ***the Ballinacurra Estuary/North Channel were all strongly phosphorous-limited, but this was particularly pronounced in the Ballinacurra Estuary.*** *Nitrogen availability was lower relative to that of phosphate in the waters of Outer Cork Harbour, though even in this high-salinity waterbody P was indicated to be the limiting nutrient in about quarter of samples from the 1998-2000 period."*

p.80 *"The Ballinacurra Estuary and the Great Island North Channel were classified as potentially, rather than formally, eutrophic owing to a lack of sufficient data on this system."*

S.I. No. 254/2001 – Urban Water Water Treatment Regulations, 2001 failed to declare the Owenacurra Estuary/Great Island North Channel "sensitive". I was advised by the EPA that the DOE was in "consultation" with the EU about this omission and S.I. No. 440 of 2004 was issued to designate just these two remaining eutrophic waters in Cork Harbour "sensitive" on 15.07.04 – presumably at the behest of the EU Commission (see section 7.1.1 below)

Thus to make it clear, the Owenacurra Estuary and the Great Island North Channel have both now been designated EU sensitive waters and this includes the East Ferry water down to Marloag at the entrance to the Lower Harbour. This means that their nutrient status has to be taken into account.

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p.121 *Discussion and Conclusions*

"It should be noted, however, that treatment plants that are overloaded or not operated correctly will cause pollution. The EPA Act defines an overseeing role for the Agency in relation to certain local authority functions, including the operation of sewage treatment works. Proper operation and maintenance of existing plant is important in ensuring the best use is made of these relatively expensive facilities. The recent increase in the extent of serious pollution is attributed in large part to the overloading of municipal sewage works as a result of recent rapid expansion of many Irish towns and a time lag in expanding treatment works to cope with additional loads. ***Thus, in some cases "storm overflows" have become continuous flows*** *allowing poorly treated effluents to reach rivers once again whereas previously the plants were capable of properly treating all effluents received."*

Of course, Midleton did not have a treatment plant until 2000, but it is no secret that the overflow situation has been very poor and can continue to be described as one of the above "cases" where storm overflows have become continuous flows, with an average of about 200 overflows per annum since 2002, of average spill size of nearly 1.5m litres (see the table in sec. 7.2 on p.50, below).

Thus there has undoubtedly been a large input of extra nutrients into a very small water-body, which, as we have seen above, is not dispersed to the Lower Harbour, but exits 60-70 days

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later from Belvelly, and this has kept the North Channel on the cusp of having PSP closures for oysters as well as the regular closures for mussels. No account at all is made of this additional and continuing source of nutrients to the North Channel in the Dairygold analysis, but clearly, as the two EPA Reports very forcefully stated nearly 20 years ago, no more nutrients should be added to this backwater of Cork Harbour, for this reason.

I have added a synopsis of our long and detailed knowledge on the formation of blooms of Paralytic Shellfish Poisoning dinoflagellates in the North Channel over the last 20 years, as an Appendix.

7. The position regarding nutrients added at Rathcoursey Point.

The alternating trophic status of the Owenacurra Estuary and the North Channel has been published by the DOE and latterly by the EPA. The data below was compiled in the AER for Cork City (D0033-01) in 2014:

7.1 Trophic Status of the Owenacurra Estuary and North Channel from EPA sampling (Cork City AER for 2014)

	95-99	99-03	2001-05	2004-06	2007-09	2010-12	2013
Owenacurra Estuary	Pot. eutrophic	Eutrophic	Eutrophic	Eutrophic	Intermediate	Pot. eutrophic	N/T
North Channel	Eutrophic	Intermediate	Intermediate	Intermediate	Pot. eutrophic	Intermediate	N/T

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There is no doubt that these two waters should have been classified as "sensitive", at least in the 2001 Statutory Instrument.

7.1.1 Designation of these waters as sensitive" under Article 5 of the UWWTD.

The criteria for identification of sensitive areas is given in Annex II of the Directive:

"(ii) Estuaries, bays and other coastal waters which are found to have a poor water exchange, or which receive large quantities of nutrients."

Despite the evidence from 1995 above, I was advised by Avril Boland, EPA, in a letter dated 6.11.02 saying,

"In relation to your second query on classification of Cork Harbour as "Sensitive" under the Urban Wastewater Regulations, 2001, I contacted the Department of Environment, Heritage and Local Government who are the responsible authority for amending these regulations. The situation at present is that Cork Harbour is currently not listed as a Sensitive Area under the Regulations but the Department and the European Commission are in consultation as to whether or not this will change."

From this advice, I believe that the Commission may have suggested that the DOEHLG list Cork Harbour as "Sensitive" under Article 5 of the UWWTD and on 15.07.04 a special S.I.

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No. 440 of 2004 was eventually issued for just the two areas of Cork Harbour, which were, at last, to be declared as sensitive. They were:

"*Lee Estuary/ Lough Mahon – from the salmon weir to Monkstown",* and

"*Owenacurra Estuary/North Channel – from North Channel (Great Island) upstream of Marloag Point, including Owenacurra Estuary upstream to Dungourney River confluence".*

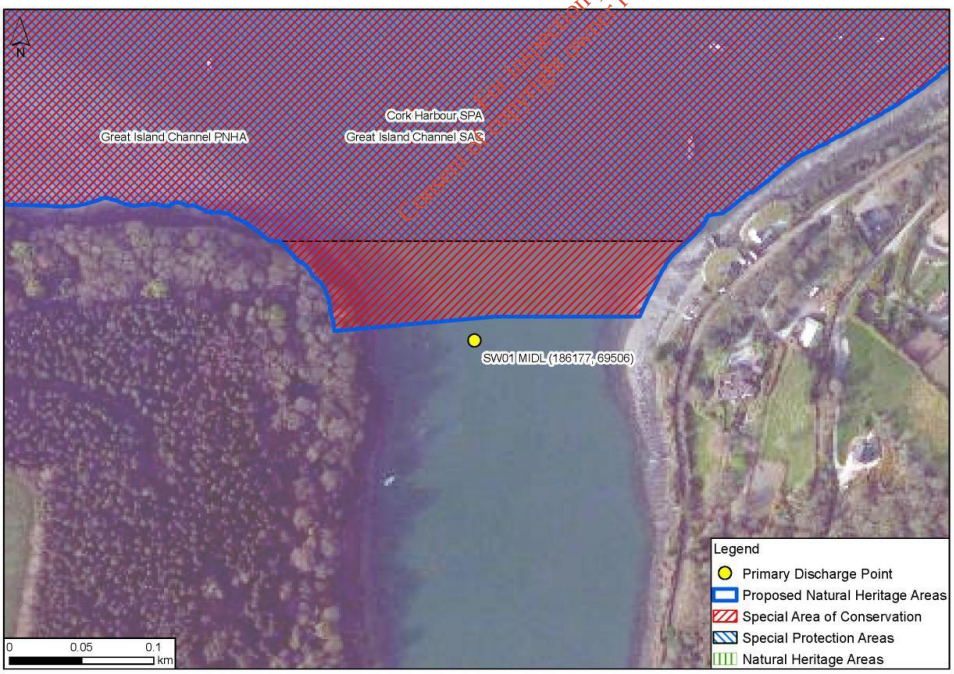
If Ireland had designated the two Cork Harbour 1963 and 1970 Oyster Fishery Orders as Shellfish Waters (responsible for earning as much as 20-30% of the country's income from oysters up to 1995), by 6th November 1981, as required by the Shellfish Waters Directive (79/923/EE) and designated these already eutrophic waters as "sensitive" under the UWWTD by 30th June 1993, as required by that Directive, there is also no doubt that no discharge of any sort could have been allowed at Rathcoursey Point.

It should be noted now, however, that although the Dairygold Application claims that the discharge is outside the Great Island SAC by 15 metres and SPA by 70 metres, it is being made directly into the centre of this "Sensitive Water", as its southern boundary is still 2 km further south at Marloag Point at the south end of East Ferry.

Dairygold NIS Fig 8

Relationship of Midleton outfall to the Position of Proposed Natural Heritage Area (pNHA); Special Area of Conservations (SAC); Special Protection Areas (SPA), with all water shown classified as "sensitive" – down to the southern end of East Ferry.

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The WWTP was put in for Midleton in June 2000. Before that, from December 1988, all the town's waste was comminuted and discharged, untreated, at the top of East Ferry at Rathcoursey Point, via the same diffuser, through which it is planned to now discharge the Dairygold waste and it would seem that this untreated discharge would have been responsible for the poor trophic status of both water bodies before 2000 and for the improvement after

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that date in the North Channel water, as untreated waste was no longer being released there directly.

From then on, as the EPA is well aware, there has been a poor record from the collection network of the town, leading to very large and regular overflows of untreated town waste water from the storm tanks associated with the pumping stations in the town into the top of the estuary in the town itself. These overflows are probably the cause of the Owenacurra Estuary being assessed as eutrophic in the 1999-2003, 2001-2005 and 2004-2006 periods in the Table above.

However, the North Channel itself was also declared "potentially eutrophic" in 2007-2009 and then again in 2013-2015 and we will discuss this further below.

7.2 The storm overflow record from the waste water collection network in Midleton

Monthly figures have been reported in the annual AERs for Midleton WWTP since their inception in 2011. However, I have also obtained the daily overflow figures from each pumping station by monthly FOI requests, from the start of them being metered in 2002.

The record, since these figures were available in 2002 has been:

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Table of total annual spillage to the Owenacurra from Midleton pumping stations

Year	Rainfall	Total days	Total overflows	Bailick 1	Bailick 2	B'curra 2	Dwyer's Rd.
	Total mm	Overflows >40m3/d	Total volume of overflows m3 (tonnes)	Volume m3 (tonnes)	Volume m3 (tonnes)	Volume m3 (tonnes)	Volume m3 (tonnes)
2002	1,264	146	333,216	315,299	17,917		
2003	908	96	117,954	110,224	7,730		
2004	1,011	212	186,640	152,643	33,997		
2005	1,014	192	314,371	259,953	54,418		
2006	1,140	259	394,796	294,380	100,416		
2007	958	246	277,409	187,690	89,719		
2008	1,076	258	323,886	260,871	63,400		
2009	1,433	225	469,140	388,774	80,366		
2010	967	222	286,911	195,175	92,038		
2011	835	281	479,943	331,744	148,595		
2012	1,055	269	430,692	181,988	234,957	13,747	
2013	1,085	103	110,031	92,130	12,842	5,059	
2014	1,108	60	312,934	226,099	44,181	33,856	8,798
2015	1,266	45	272,248	189,512	43,006	33,510	6,220
2016	1,063	107	379,745	298,421	57,045	17,743	6,536
2017	1,055	151	61,232	49,477	9,808	592	1,356
2018 (½ yr)		63	83,118	60,891	20,476	73	1,678
Average to 2017		**201**	**296,947**	**220,899**	**68,152**	**17,418**	**5,728**

over 1000m3 (tonnes) or 1 million litres/day average

Figures in red were supllied by Cork CC to the EPA in their AER, but did not agree with the monthly figures supplied to ASL under FOI.

Following the average annual spillage of untreated waste water into the Owenacurra Estuary in Midleton from 2006-2012 being recorded as over 1,000m3/day (1 million litres/day, or

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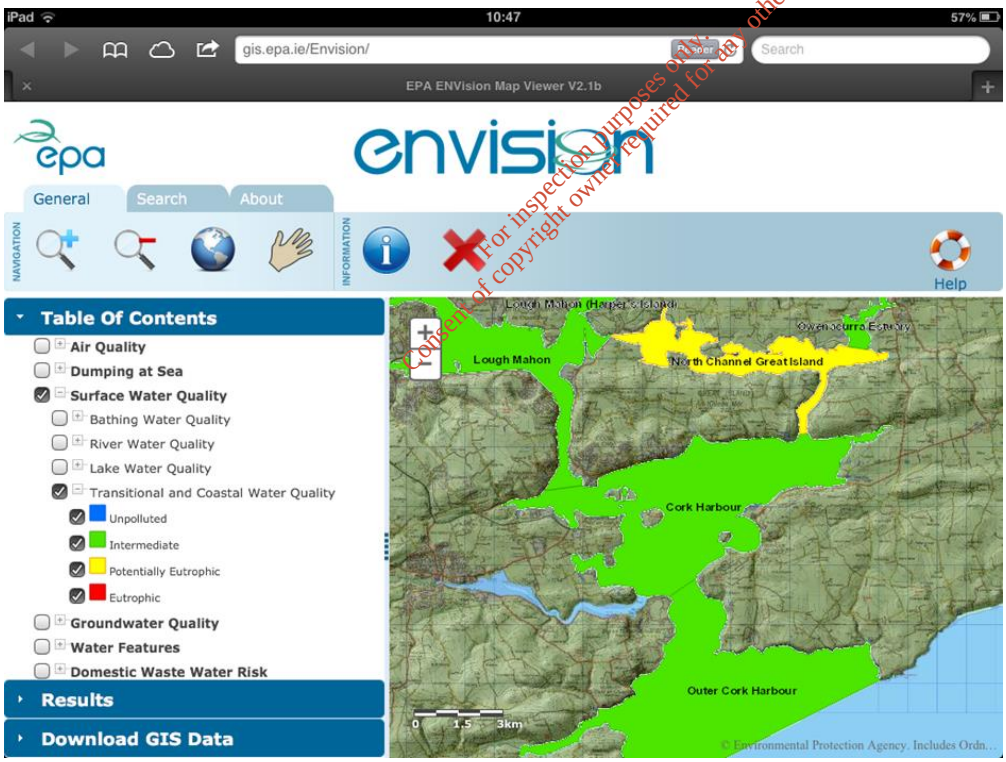
380,397m3 p.a.), the EPA advised me that the Water Services Section of Cork County Council had been informed in May 2013 that their Office of Environmental Enforcement had placed Midleton WWTP on its national priority enforcement list of the worst seven performing WWTPs in the country[7] and that the highest Enforcement Risk Category A1 had been assigned to the plant. The EPA gave their reasons for this as:

"The overflows located at Bailick 1 and 2 are specifically named in the Pilot Infringement received from the European Commission. In the infringement the Commission specifically requests details on whether these excessive storm overflows have now ceased."

As can be seen in the table above, the EPA notice was followed by a dramatic reduction in the storm overflows from the pumping stations in Midleton in 2013 to less than a quarter of what they had risen to in the previous two years.

For the following 2-year period of 2013 to 2015 the only Envision Trophic Status that I could find on the EPA website seemed to show a return to the situation which also pertained from 2007-2009, where the "eutrophic", or the later "potentially eutrophic" water, switched from being in the Owenacurra Estuary to the North Channel:

Fig. of EPA Envision Trophic Status of Cork Harbour water bodies 2013-2015



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This situation is of significant interest in the context of the present discussion. The fact that the North Channel water quality has been shown here to be of a lesser quality than the water flowing into it from the Owenacurra Estuary to the north, or from the main harbour to the

[7] 10.05.13 Report of meeting between the EPA and Cork County Council on Storm Water Overflows for the Midleton Waste Water Discharge Licence (D0056-01) dated 22.07.13 and Summary Assessments of OEE Priority Sites

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south, can only mean that the source of the nutrients causing the downgrading of the trophic status, is being discharged directly into the North Channel waterbody between them both.

There are then only two possible sources:

(1) houses with septic tanks around the water's edge and

(2) the Rathcoursey discharge.

7.3 Discharges from septic tanks.

The two sets of reports into the degree of risk from septic tanks carried out by Cork County Council to comply with the Pollution Reduction Plans for the four Cork Harbour Shellfish Water designations, governing septic tanks and other treatment systems, on the risk to water quality from houses with septic tanks around the North Channel and Lower Harbour, have discounted this source as being of any significance.

This must leave the only source of nutrients into the North Channel as being the Midleton WWTP/town sewer discharge at Rathcoursey.

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7.4 The quality of water currently discharged from the Rathcoursey outfall

Fortnightly data of the chemical analysis of the Midleton WWTP discharge is collected for the EPA and has been supplied from January 2011 onwards under the requirements of the EPA's WWDL. The EPA requires the quality of the discharge to be measured both at the outlet to the WWTP and also at the Ballinacurra 1 final pumping station, which is designated to be the sampling point for the "Primary Discharge". This flow originally contained a further 75 - 120% volume of "other" water, falling to about 40% extra from 2011 onwards.

Both sets of analyses report that the water being discharged from the town at Rathcoursey, has an extremely low nutrient content:

The content of the Primary Discharge effluent of Midleton WWTP for the last two years has been so low, in fact, that many of the effluent levels are described by the analysts and are reported to the EPA as being of,

"*Half the LOD* (Limit of Detection) *for statistical purposes"*.

The analytical levels accepted as being less than "*Half the Limit of Detection*" for the following are as little as this:

SS	1.25 mg/l
BOD	0.5 mg/l
COD	10.5 mg/l
O-P04-P	0.025 mg/l
NH3	0.05 mg/l

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Sampling of the Midleton "WWTP Discharge" for the WWDL Reports to the EPA over 2015-2016, with levels of less than half the LOD shown in brown. Levels of BOD less than a tenth of the ELV are shown in blue.

Date	SS mg/l	BOD mg/l	COD mg/l	O-PO4-P mg/l	TN-N mg/l	NH3 mg/l	TON-N mg/l
ELV	30 mg/l	20 mg/l	125 mg/l	2 mg/l	15 mg/l	no value	
15.01.15	1.25	1.4	10.5	0.060	5.90	0.05	5.53
30.01.15	3	2.2	10.5	0.025	7.54	26.90	11.6
11.02.15	1.25	1.4	10.5	0.050	6.20	0.20	4.51
27.02.15	5	2.5	23	0.025	7.00	0.90	5.47
10.03.15	1.25	1.2	10.5	0.110	5.30	0.60	4.19
27.03.15	1.25	1.7	10.5	0.350	3.70	0.30	2.78
09.04.15	1.25	0.5	10.5	0.090	5.90	0.05	3.39
24.04.15	3	0.5	10.5	0.190	5.00	0.05	1.59
07.05.15	10.00	3.2	25.0	0.330	4.30	0.50	2.43
22.05.15	1.25	1.4	10.5	0.160	2.80	0.05	
04.06.15	1.25	0.5	10.5	0.120	3.80	0.05	2.14
19.06.15	1.25	1.1	22.0	0.180	2.34	0.05	1.63
02.07.15	1.25	1.5	10.5	0.520	4.50	0.05	2.14
17.07.15	13.00	1.9	29.0	0.720	3.01	0.05	2.02
29.07.15	1.25	1.1	10.5	0.640	3.03	0.05	3.63
14.08.15	1.25	1.9	28.0	0.460	3.88	0.05	1.82
26.08.15	1.25	1.5	10.5	0.025	5.52	0.30	3.26
11.09.15	6.00	0.5	30.0	0.250	4.70	0.05	3.13
23.09.15	7.00	1.7	10.5	0.100	4.70	0.05	3.67
09.10.15	4.00	1.3	10.5	0.160	4.68	0.05	3.38
21.10.15	1.25	1.0	10.5	0.200	4.82	0.05	2.68
06.11.15	57.00	5.4	42.0	0.130	4.30	0.10	2.99
18.11.15	1.25	1.5	10.5	0.025	4.20	0.05	2.34
04.12.15	6.00	2.1	10.5	0.025	3.50	0.30	3.45
15.12.15	1.25	2.3	10.5	0.060	3.65	0.05	3.21
07.01.16	1.25	1.6	10.5	0.120	4.50	0.05	4.84
20.01.16	8.00	2.1	10.5	0.300	5.20	1.10	4.04
05.02.16	28.00	8.1	10.5	0.170	5.07	0.30	4.29
17.02.16	3.00	1.9	10.5	0.090	5.28	0.60	4.13
04.03.16	1.25	1.6	10.5	0.190	4.68	0.05	4.30
15.03.16	11.00	3.9	10.5	0.270	4.85	0.70	3.06
01.04.16	1.25	2.2	10.5	0.090	4.56	0.10	3.81
13.04.16	1.25	1.6	21.0	0.150	2.56	0.06	2.26
29.04.16	1.25	1.5	10.5	0.150	5.33	0.06	5.04
12.05.16	7.00	3.0	10.5	0.250		0.40	2.89
27.05.16	6.00	2.8	10.5	0.750	6.50	4.60	2.73
08.06.16	9.00	2.8	40.0	0.340	3.54	0.50	2.18
24.06.16	7.00	2.9	10.5	0.490	4.46	0.70	2.98
06.07.16	3.00	2.1	10.5	0.520	5.33	0.80	2.62
22.07.16	1.25	1.6	22.0	0.350	4.43	0.10	4.11
03.08.16	3.00	0.5	10.5	0.360	4.20	0.20	3.03
30.08.16	1.25	2.0	10.5	0.310	4.20	0.70	4.32
16.09.16	5.00	2.5	10.5	0.130	4.71	0.60	3.57
27.09.16	3.00	2.3	10.5	0.180	5.60	0.30	3.80
14.10.16	1.25	3.3	21.0	0.070	6.10	2.20	3.12
27.10.16	1.25	1.5	10.5	0.130	5.90	1.30	2.55
11.11.16	9.00	3.4	10.5	0.170	5.20	0.40	2.86
23.11.16		2.2	36.0	0.260	5.40	1.20	2.00

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These analyses show that the nutrients entering the North Channel from this discharge are a tiny fraction of the ELV allowed and yet there is no other major discharge that we know of which could cause the North Channel water to fail at the "potentially eutrophic" level, when the water flowing in from the Owenacurra is "intermediate".

The explanation is to be found in section 5, above. These very low nutrient levels are simply accumulating in the North Channel, because of the westerly residual current around Great Island and the resulting high residence time of the water there, to reach these levels of "potential eutrophication".

If this is the case, then the discharge from Dairygold at the permitted ELVs which are many, i.e. **3-10 times higher than those which appear to be being achieved by Midleton WWTP**, and of much the same volume, will ensure that the North Channel and Owenacurra Estuary stay in the state of being "potentially eutrophic" and, when Paralytic Shellfish Poisoning is a regular annual occurrence, this could obviously pose a very real danger to public health – especially to gatherers of wild mussels from the shore, who may not have seen the notices which get put into the local press.

7.5 The current trophic situation (EPA Nov. 2018)

This was reported upon as recently as November 2018 in the EPA's "*Water Quality in 2017: An Indicators Report"* Trodd W. and O'Boyle S., as a countywide overview, but the Owenacurra Estuary features prominently.

https://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%202017%20-%20an%20indicators%20report.pdf

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This paper shows on its Map 10 that our local trophic status for 2015-2017 has reversed to the situation where it is the Owenacurra Estuary which is now "potentially eutrophic" (yellow) and the North Channel "intermediate" (green).

Figure 7 shows that just 12% of waters in Ireland are "potentially eutrophic". The two eutrophic categories added together have accounted for between 14-18% of estuarine and coastal waters for every period examined for the last 20 years without improvement and, although the comment is meant for the country as a whole, the EPA note seems particularly apposite for the two areas that we are considering:

"*this means……that improvements in one area are being cancelled out by deterioration in other areas"* ("Trends" p.44).

7.5.1 Phosphate.

Map 4 on p.28 shows that average phosphate concentrations for the Owenacurra Estuary lie between 0.035 – 0.05 mg/l and the EPA comment on p.27 is that this level is,

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"indicating levels greater than those likely to lead to nutrient pollution. The north-east, south-east and south of the country have particularly high levels of phosphorus (greater than 0.035 mg/l P)".

It is possibly a pity that the EPA abandoned its sampling for phosphate at the station which they used to have at the confluence of the Owenacurra and Dungourney Rivers, which is also the site of the major overflows from the Bailick 1 storm tank, and we could all possibly have been able to make some assessment of the possible contribution of these particular town overflows, which one would expect to be a high source of phosphates.

7.5.2 Dissolved Inorganic Nitrogen

On p.46 the Owenacurra Estuary is singled out as being one of the four water bodies in the country which had the highest dissolved inorganic nitrogen concentrations:

- Glashaboy Estuary (Co. Cork),
- **Owencurra Estuary (Co. Cork),**
- Upper Barrow Estuary (Co. Kilkenny), and
- Lower and Upper Slaney Estuary (Co. Wexford).

The Owenacurra appears to have been left off the list of estuaries with the highest median winter dissolved inorganic nitrogen concentrations, which follows the above list, but it is then included on Map 11 on p.48, which shows these winter dissolved inorganic nitrogen (DIN) levels in estuarine and coastal waters for 2015 -2017, and shows that the percentage exceedances of the Owenacurra Estuary and the Glashaboy Estuary are not only the highest in the country, but the only two in in the country with a record of greater than 50% exceedances.

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7.5.3 Sources of N and P in Ireland: Mockler & Bruen Report 2018

Further work published recently in the EPA Research Report No. 249 "Catchment Management Support Tools for Characterisation and Evaluation of Programme of Measures" by E M Mockler and M Bruen (2018)

http://www.epa.ie/pubs/reports/research/water/Research_Report_249.pdf

as part of the EPA research programme 2014-2020, sets out the problems of dealing with eutrophication in its Executive Summary on p.ix:

"Nutrient enrichment and eutrophication can negatively impact on freshwater ecosystems, estuarine and coastal waters."

and again in the Introduction to "Catchment Management" on p.1:

"Identifying appropriate measures to address eutrophication remains a major challenge across Europe, where many river and lake water bodies are still failing to meet Water Framework Directive (WFD) objectives (EU, 2000)".

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The proposal of this work in "Developing Land Apportionment Models", is then set out in the Introduction to this section in 2.1 on p.3:

"Where surface waters are impacted by excess nutrients, ***understanding their sources is key to the development of effective, targeted mitigation measures****. Modelling can be used in these areas, in conjunction with knowledge from local authorities and investigative assessments, to identify significant pressures that contribute excessive nutrients to surface waters. In Ireland, nutrient emissions are the main drivers of surface waters not achieving the required Good status, as defined by the WFD. Hence, the Catchment Tools project developed a model to predict the sources of nutrients contributing to these emissions and to assess future pressures and the likely effectiveness of targeted mitigation scenarios".*

"This Source Load Apportionment Model (SLAM) (Mockler et al., 2016) supports catchment managers by providing scientifically robust evidence to back up decision making in relation to reducing nutrient pollution. The SLAM is a source-oriented model that calculates the N and P exported from each sector (e.g. pasture, forestry and wastewater discharges) that contribute to overall nutrient loads in a river. ***The model output is presented as maps and tables that show the proportions of nutrient emissions to water attributed to each sector in each sub-catchment".***

2.2 The SLAM framework incorporates multiple national spatial datasets relating to nutrient emissions to surface water, including land use and physical characteristics of the sub-catchments."

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The 17 datasets used for this work come largely from the EPA (AER Reports and LEMA on wastewater, septic tank and industrial discharges); DAFM for pasture and arable usage; the EU's CORINE Land Cover for diffuse urban sources, forestry and peatlands – and are set out in Table 2.1 on p.4.

The 583 sub-catchments of the country are summarised for the emissions of Total N and Total P to surface waters as kg/ha/yr; the percentage of these loads coming from point sources; and the percentage contributions of both nutrients from pasture, with the results being shown on the maps on pp. 17 & 18.

In these, our two local sub-catchments immediately to the north and south (i.e. Great Island) of the North Channel, stand out positively conspicuously (see the figs. below) at the highest levels of P and N:

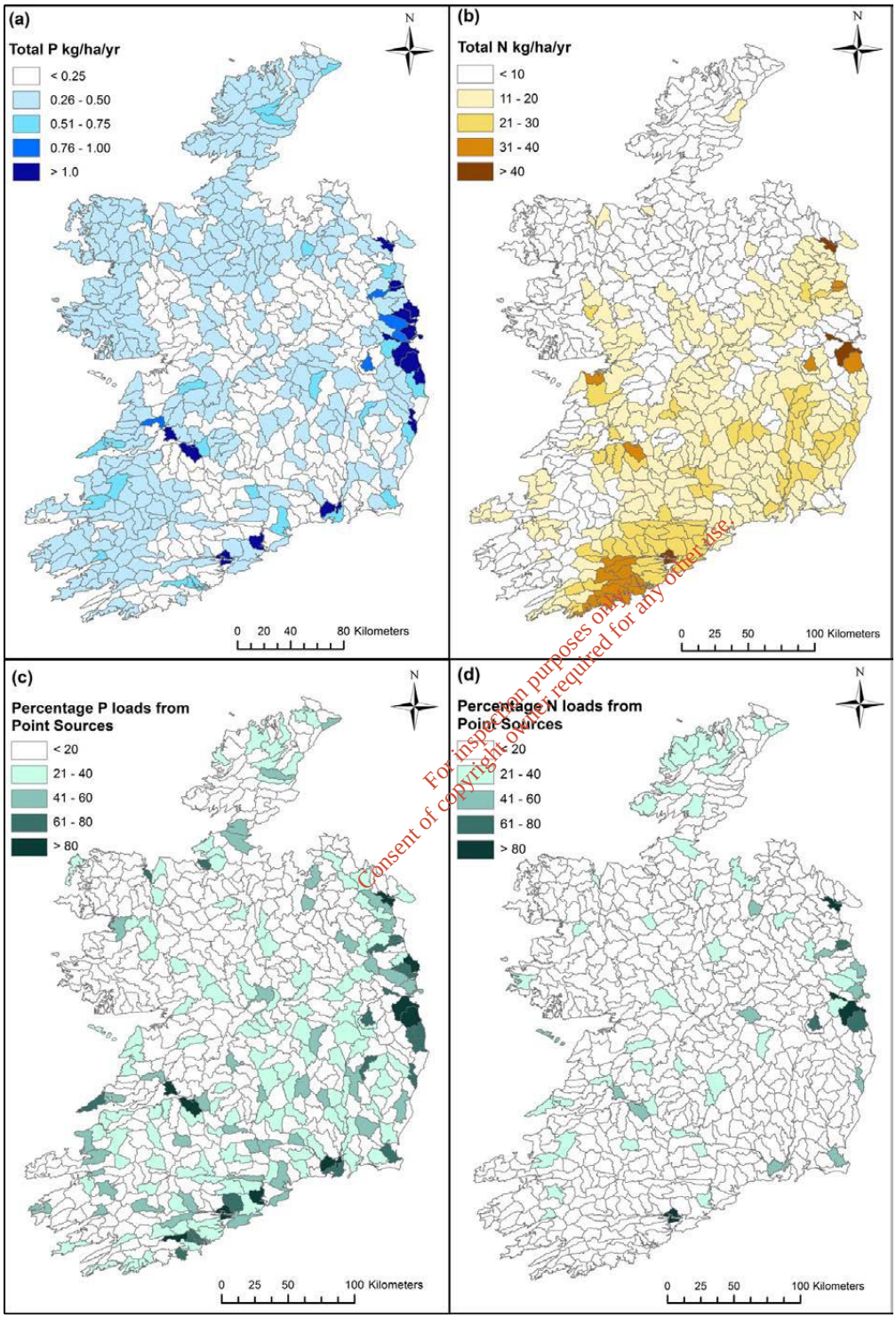
Fig. 3.2(a) Emissions of Total P are at the highest level of >1.0kg/ha/yr (being two of just 5 sub-catchments at this highest level on the south coast).

Fig. 3.2(b) Emissions of Total N are at the highest level of >40 kg/ha/yr (being two of just 5 sub-catchments at this highest level in the country)

What is of particular interest then shows up like a sore thumb on the next two maps (3.2 (c) and (d)) showing the source of both P and N to be at the highest point source levels in the country:

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Figure 3.2. Total phosphorus (a) and nitrogen (b) emissions to surface water
(kg/ha/year), and percentage contributions from point sources for phosphorus (c) and nitrogen (d).



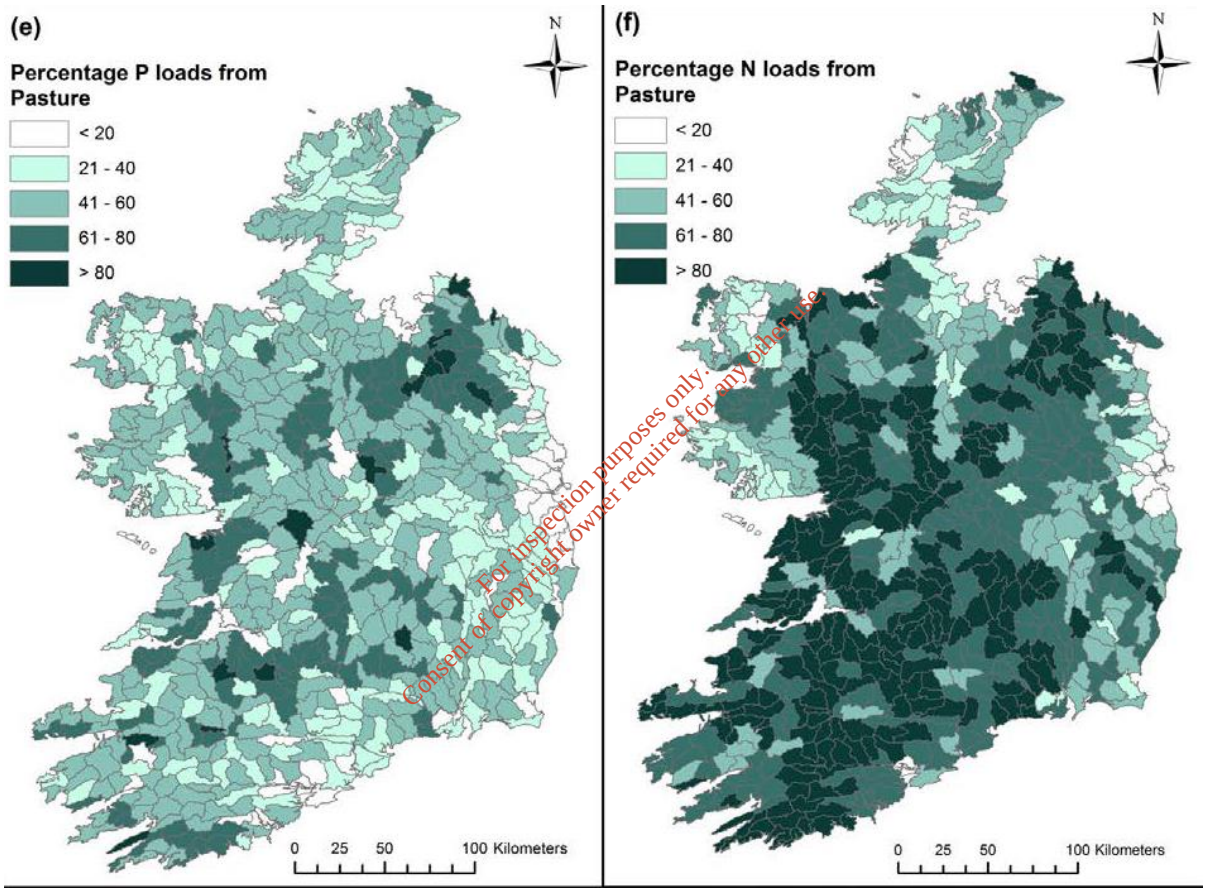
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Fig. 3.2(c) For the areas above and below the North Channel, the percentage P load coming from Point Sources is at the highest level of >80% (two of just 12 such sub-catchments at his level in the 583 total in the country) and Fig. 3.2(d) The percentage N load coming from Point Sources is at the highest level of >80% but, this time, as two of just 5 such sub-catchments at this highest level in the 583 in the country.

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Confirmation of the Point Source origin of these emissions to surface water is then given by the following maps of the percentage contributions supplied from pasture, which show the lowest levels in the country of P and N contributed by pasture around the North Channel. Thus it is NOT agricultural run-off causing the excessively high levels of P and N emissions to water to the North Channel in Fig. 3.2 (a)-(d), above.

Figure 3.2. Continued. Percentage contributions from pasture for phosphorus (e) and nitrogen (f) for 583 sub-catchments.



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Figs.3.2 (e) & (f), both of which show the percentage contributions from pasture for P and N as <20%, with these two relatively small areas, together with the catchment around Midleton for P, standing out in both, but especially for N, where the area north of the North Channel and Great Island to the south are shown equal, only in this respect, to the built-up sub-catchments around Dublin, where there is also no pastureland run-off.

I note that Prof. Hartnett was a member of this project's steering committee.

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7.6 Examination of the current Point Source origins of nutrients being discharged into the Owenacurra Estuary/North Channel.

If the SLAM work is to be believed and the alternating eutrophic/potentially eutrophic status of the Owenacurra Estuary and the North Channel is >80% due to Point Source emissions, then the EPA must be well furnished with data to determine the most likely source of the nutrients already causing these waters to fail on trophic grounds. These data sources will be:

1. The trophic data collected by the EPA themselves at the stations in these waters.

2. Data required by them under the WWDL for Midleton WWTP.

3. Overflow data from the pumping station storm tanks of the collection network in Midleton, summarised in sec. 7.2 on p.56, above, the subject of their listing of the WWTP for priority (A1) enforcement and advised in detail in the AERs.

4. The level of faecal coliforms in the rivers, as an indicator of nutrient levels, which the EPA has required to be monitored weekly from March 2007, following the Audit which they carried out on 06.12.06, dated 01.05.07, which recommended, as one of seven recommendations:

"*In view of the regular occurrence of storm water overflows, Cork County Council should develop a monitoring programme and carry out an assessment of the impact of the storm water overflows on the Owenacurra Estuary and Cork Harbour. A copy of this assessment should be submitted to the EPA."*

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From monthly FOI requests made to Cork County Council/Irish Water, I have recorded these weekly samples, expressing their averages here as geometric means:

Table of average annual geometric mean f.c levels at 3 stations in the Owenacurra, as required by the EPA with Cork Road (Bridge) above HWST added by Cork CC in 2011. (Data supplied by Cork CC/Irish Water under FOI)

Site ref.	DB02	DB03	DB04	CORK ROAD
Year	AVERAGE Bailick 1	AVERAGE By-pass	AVERAGE Estuary below B2	with high storm o'flow days discarded
2007	6,142	2,958	5,183	
2008	10,326	3,039	1,551	
2009	4,751	1,365	2,229	
2010	3,031	913	2,663	
2011	6,604	1,286	1,585	767
2012	4,163	2,113	3,979	723
2013	2,308	1,593	1,527	621
2014	3,567	777	1,442	683
2015	1,589	1,154	1,189	570
2016 (Jan-Jun)	1,570	1,049	852	1,106
2017	583	504	339	275
2018 (Jan-June)	1,466	260	242	351
Averages	**2,731**	**1,092**	**1,394**	**637**

140515 Owenacurra R. sampling (XL 2007) Tab. 4

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I have seen no record of these figures being returned to the EPA in say the AERs, but the product of f.c. concentration x river flow volume was used regularly to describe the size of the domestic "riverine load" entering the North Channel in the earlier ERU (Environmental Research Unit of the DOE) work over their 11 years of monitoring these water bodies from 1986-1996, prior to the building of the WWTP in 2000 and to the establishment of the EPA, and must give some appreciation of the nutrient load which may be coming from this source.

I have used geometric means in the Table above to reduce the obvious error of samples returned as having zero faecal coliforms. They also reduce the effect of the relatively high numbers of E.coli records ranging from 100,000 to 1,000,000 E. coli/100ml. If straight averages are used, as in the table below, the relative levels are much the same, although the figures are far higher:

Table of overall average annual mean f.c levels at 3 stations in the Owenacurra, as required by the EPA with Cork Road (Bridge) above HWST added by Cork CC in 2011. (Data supplied by Cork CC/Irish Water under FOI)

Site ref.: Date	DB02 Av. f.c./100ml at Bailick 1	DB03 Av. f.c./100ml at By-pass Bridge	DB04 Av. f.c./100ml Estuary below Bailick 2	CORK ROAD with high storm o'flow days discarded
Averages 2007-18	26,055	7,003	4,734	1,665

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Sampling of the river water itself above the furthest reach of spring tides, at the Cork Road Bridge, was added by Cork County Council in 2011. This is useful to us now, as it allows us to compare the measured "riverine" nutrient load at Cork Bridge, which is used in the Dairygold calculations, with the nutrient load after it has been added to by the town overflows, by the time it has passed them, which is below Bailick 2 at station DB04. This is the figure that is most relevant to this discussion and is assessed in the next section.

7.6.1 Discharges of nutrients in the town overflows from Midleton demonstrated by high E. coli/f.c. and norovirus levels in the North Channel and Owenacurra Estuary.

These indicate commensurately high nutrient inputs into the Owenacurra River, for which no allowance is made for the nutrient load in the overflows from the pumping stations in the town in the Dairygold nutrient calculations, which simply take the declared effluent levels of the town's waste water which actually goes through the WWTP and is then measured at the Primary Discharge Point (Ballinacurra 1 pumphouse sump), and levels of nutrients in the river above the town, leaving the untreated overflows from the pumping stations in the tidal reaches, out of the equation.

Some idea of the nutrient level in the overflows of untreated waste water from the Midleton pumping stations can, however, be gained from the recorded levels of the pathogens which they carry, with which there must clearly be a close relationship.

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As mentioned in 7.6 para. 4 above, the EPA required Cork County Council to measure weekly the f.c. levels in the Owenacurra River weekly to "*carry out an assessment of the impact of the storm water overflows on the Owenacurra Estuary and Cork Harbour"* from March 2007.

It should be realised that the Table in sec. 7.6 shows average geometric mean f.c. levels in the Owenacurra River several hundred percent in excess of what the EPA permits for the Primary Discharge from Midleton WWTP whose ELV is < 250 f.c./100ml. With the average geomeans from 2007-2018 at 2,731 f.c./100ml at Bailick 1; 1,092 f.c./100ml at By-Pass Bridge and 1,394 f.c./100ml below Bailick 2, they are thus 4-11 times higher than the limit set in the WWDL for treated effluent.

On top of this, the combined Owenacurra and Dungourney River flows average 2.64 m3/sec, which is about 30 times the volume of the town's effluent at the maximum 90 l/s currently being sent out of the plant to Rathcoursey. **Thus we could estimate that the river is carrying a nutrient load (4 to 11) x 30 or 120-330 times larger than the nutrient load pumped to Rathcoursey and used in the Dairygold calculations for the contribution of the WWTP.**

What is important to see in the table above, is that the riverine faecal coliform load at Cork Bridge (whether it comes from town overflows in the north part of the town or from livestock) has more than doubled by the time it has passed the Bailick 1 & 2 pumping station overflows in terms of f.c. The two Tables above show that this varies from 2.2 times using geometric means to 2.8 times using straight average values - perhaps 2.5 times.

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If we assume that these untreated f.cs. are in proportion to the untreated nutrient load which carried them, then the riverine nutrient load, taken in the Dairygold Irish Hydrodata Report of 19 May 2017 from the EPA (2013-2015 figs.) in Sec. 4.3 and Table 4.2 as, "*background river water quality for the Owenacurra and Dungourney",* and taken by Dairygold as 676 kg DIN (N)/day in 151,200m3/day "***freshwater*"** (see Table 4.3 and note av. 1.8 ppt salinity stated in Table 4.2) in Table 4.3, could therefore be much larger, possibly as much as 2.5 times greater, by the time the river leaves Midleton **in the tidal estuary** (av. salinity at EPA Station LE520 "Ballynacurra PS" over 2015-2017 which is av. 22ppt)), after the input of overflows from the town's pumping station storm tanks.

7.6.2 The importance of the correct estimation of the "riverine load"

It is worth making this point quite clear. The background river level water quality which is taken for Tables 4.2 and 4.3 of the Irish Hydrodata Report makes up 676kg out of a total of 806kg DIN/day or 84% of the DIN load in Table 4.3 and, after allowing for the addition of 60kg DIN/day from Dairygold and slightly increased loadings up to licensed levels for the WWTP and IDL in Table 4.4, still accounts for 70% of the load.

This "riverine load" is assessed in sec. 4.3 Table 4.2 and it is very clear from the salinity record given as averaging 1.8 ppt, that this record is from above the tidal reaches of the river and below the town's pumping stations stormwater holding tanks, where some 17% of the town's collection network overflows in winter and 6% in summer (average figures from 2000-2014 overflow records).

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The EPA have a station "LE520 Ballynacurra PS" below the 4 pumping stations that have overflows and the 14 salinity figures recorded for the 2016-2017 period which the EPA suggested work should be updated to, show an average salinity at this station of 22.3 ppt – completely different water to the 1.8 ppt "riverine water" taken as being representative of the DIN load of the river reaching the North Channel and used by Irish Hydrodata.

Depending on how much of the nutrient load has a faecal origin, it becomes possible to estimate the riverine load being as much as 676 x 2.5 times = 1,690kg DIN/day and this being closer to the true load being delivered to the North Channel via the Owenacurra Estuary. Adding the licensed discharges of Table 4.4 WWTP (156 kg/day), IDL (75 kg/day), we get a figure of 1,921 kg DIN/day, double the DIN figure used by Irish Hydrodata for the Dairygold modelling in Fig. 4.10, and before the addition of any more from the Dairygold waste water.

Even at the levels shown in Fig. 4.10, the water would no longer be classed as "good" for DIN and the addition of the nutrients from the storm overflows to double the Irish Hydrodata baseline used here, provides the explanation of continual poor water quality in the Owenacurra Estuary and shows that there is absolutely no leeway to consider adding further nutrients at any level.

To get an idea of the seasonal nutrient quality of effluent pumped out of the Primary Discharge sampling point at Ballinacurra 1 pumphouse, using f.cs. as indicator, I made an examination of the number of exceedances of the WWDL maximum level of 1,000 f.c./100ml. These very poor water quality periods occurred on average 2.75 times in each of the last 4 summer periods, for which I have the results, and 4.5 times in the last 4 winter periods. Thus summer water quality fails in an approx. 40:60 ratio with winter water quality from this source of nutrients, and although these spikes of poor water quality occur less often in summer, they are quite regular enough to add to the danger of increased summer toxic algal blooms. Looking at the overflow records from 2000-2014, summer spills (April to September) are still about a third the volume of the winter spills, and are, therefore, a substantial source of nutrients for algal growth.

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We can also compare these f.c. figures temporally with the DOE's ERU regular sampling at By-Pass Bridge over the 11-year period from 1986 to 1996, when all of Midleton's domestic waste was flowing untreated into the river in Midleton. The ERU's figures for By-Pass Bridge averaged 7,298 f.c./100ml – a figure which is actually only half the level of the last 18 months figures, which I have (Jan. 2017 to Jun. 2018), which averaged 15,865 f.c./100ml.

Although faecal coliforms only provide an indirect measurement of nutrient load, the relationship between f.c. and the nutrient load derived from untreated overflows must bear a very close relationship and thus we can get indications from this river sampling data that:

(1) The nutrient load carried by the Owenacurra appears to be greater, possibly double that carried in the 11 years before the treatment plant was put in and when the whole of the town's waste load was discharged untreated to the river.

(2) It provides a reason for the fact that, despite incorporation of the treatment plant in Midleton since June 2000, one or other of these two water bodies have continued to be designated by the EPA as "eutrophic", or "potentially eutrophic".

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(3) But, the important point for the purpose of this discussion, is that no allowance has been made for this important additional source of nutrient input from the town overflows in the Dairygold modelling calculations.

Another source of regular records are those compiled monthly by the Sea Fisheries Protection Agency (SFPA) from analysis of shellfish tissue taken from the North Channel. As well as taking E. coli samples, the SFPA have been taking samples for analysis of norovirus, which is specific to pollution of human origin, most especially over the winter months.

This winter (2018/19) levels of norovirus in the North Channel reached some of their highest levels yet.

December	11,398 genome copies/g
January	12,820 genome copies/g
February	5,336 genome copies/g
April	2,637 genome copies/g

These levels should be seen in the context of an acceptable level for shellfish producing waters of 500 genome copies/g, suggested by the FSAI, some twenty times lower than we are finding in the key winter months, and the Marine Institute have advised us that the above levels are as high as any ever seen by them in the country.

This evidence would thus also point to very high levels of untreated effluent reaching the North Channel and add confirmation to the earlier f.c. data that the associated nutrient load coming down the Owenacurra is also already very high.

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Confirmation of this has already been given by me in the latest EPA monitoring data on the most current trophic situation in the North Channel and Owenacurra Estuary, which I dealt with above in sec. 7.5 (EPA's "*Water Quality in 2017: An Indicators Report"* Trodd W. and O'Boyle S.). In this paper, in the section on DIN (see sec. 7.5.2 above), the Owenacurra Estuary is singled out as being one of the four water bodies in the country, which had the highest dissolved inorganic nitrogen concentrations, and one of only two estuaries in the country with a record of greater than 50% exceedances.

Further confirmation can be gained from decisions of the EPA, European Court of Justice and An Bord Pleanála and these are given in the next three sections.

7.7 The EPA OEE puts Midleton WWTP on their national priority enforcement list of the 7 worst performing WWTPs in the country.

On 10.05.13 Brendan Kissane and John Feehan held a meeting with Cork County Council to advise them that *"the waste water discharge licence for the Midleton agglomeration was on a national priority enforcement list*" of the seven worst performing WWTPs in the country (EPA Report of Meeting, dated 22.07.13 – see **Ref. 7** and sec. 7.2 above).

The EPA's Summary Assessment of these 7 Priority Sites cited for Midleton:

"*Excessive Storm Water Overflows. Open complaints in LEMA. The overflows located at Bailick 1 and 2 are specifically named in the Pilot Infringement received from the European*

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Commission. In the Infringement the Commission specifically requests details on whether these excessive storm water overflows have now ceased. Enforcement Risk category assigned as A1 for 2013."

7.8 The EPA has now designated the performance of the Midleton WWTP as failing "*to meet the EU's legally binding standards for the collection, treatment and discharge of urban waste water".*

The EPA has long recognised that compliance with the UWWTD effluent standards do not necessarily mean that a WWTP is compliant overall. In its "Urban Waste Water Discharges in Ireland for Population Equivalents Greater than 500 Persons" for the years 2006-2007,

http://www.epa.ie/pubs/reports/water/wastewater/web%20version(low).pdf

the EPA noted in para. 2.3.1,

"*While the effluent quality from secondary treatment plants may demonstrate compliance with the requirements of the Urban Waste Water Treatment Regulations, storm overflows upstream of the plant may not be in compliance with requirements of the Regulations",*

However, it was not until "*Urban Waste Water Treatment in 2016*" was published in 2017,

http://www.epa.ie/pubs/reports/water/wastewater/Urban%20waste%20water%20report%20for%202016%20Final%20Version.pdf

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that the Table in Appendix B showed Midleton WWTP to be one of the "*50 large urban areas that failed to meet the EU's legally binding standards for the collection, treatment and discharge of urban waste water"*, with Note 1 explaining for the purpose of the Table and for this discussion:

"*The effluent discharged from the treatment plant met the relevant effluent quality standards. However, the collection system failed to meet the Directive's requirements. This means that some of the waste water is not conveyed to the treatment plant. As all waste water is not treated, the area is deemed to fail the Directive's secondary treatment requirements and, where applicable, the more stringent treatment requirements.*

Thus we have a failed treatment plant which, over the last 18 years has released on average a hundred times more storm overflows than were assured to us all in the EIS for the plant, approximately every other day, and is now having to cope with a population that has doubled from the design size and, although the third stream was added in 2012, the WYG 2008 Report on the upgrade required for Midleton (see Ref.16) advised that this capacity would be exceeded by 2011.

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7.9 The European Court of Justice also found that Midleton WWTP had failed on the three Articles 3, 4 and 5 of the Urban Waste Water Treatment Directive (91/271/EEC of 21 May 1991)

The Case, C-427/17, came before the Court on 14 July 2017. There was a hearing on 19th September 2018 and judgement was made on 28 March 2019.

http://curia.europa.eu/juris/document/document.jsf;jsessionid=4E0315CF8C0E93CE208633A8B9220F33?text=&docid=212353&pageIndex=0&doclang=en&mode=lst&dir=&occ=first&part=1&cid=5891787

No less than 17 paragraphs of the judgement were devoted to Midleton, with only 2 for Cork City. This appears to have been because it was claimed that the Midleton WWTP had had

"only eight spills recorded for 2015" with "*BOD and COD standards prescribed in Article 4 of Directive 91/271, read in conjunction with Table 1 of Annex I thereto, met for 2013 to 2016*"

The Court however dismissed this plea in para. 86:

"The Commission moreover relied on the 2016 EPA Report, which refers to the information contained in the annual environmental report for the agglomeration, from which it is apparent that four storm water overflows were active in 2016 and that there were 158 spills from them, equivalent to a volume of 561 679 m³ of untreated urban waste water".

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and in para.88 agrees with the EPA:

"Second, as Article 3 of Directive 91/271 lays down an obligation to collect all urban waste water, the fact that the prescribed water treatment standards in Article 4 of Directive 91/271, read in conjunction with Table 1 of Annex I thereto, were met for 2013 to 2016, has no bearing on whether the collecting system for urban waste water complies with Article 3 of the directive".

and found that Midleton WWTP failed on all three Articles 3, 4 and 5 of the UWWTD.

7.10 ABP have turned down further development in Midleton because the town's waste water treatment infrastructure is inadequate.

An application to build 176 new dwellings at Ballinacurra, which was appealed to An Bord Pleanála (ABP-302780-18), was refused in February 2019

http://www.pleanala.ie/documents/orders/302/D302780.pdf

on the grounds that:

*"**There is a lack** (of) **wastewater treatment capacity at Midleton Wastewater Treatment Plant**. There is a lack of certainty around the delivery of a pump station and rising main to divert wastewater from Midleton Wastewater Treatment Plant to Carrigtohill Wastewater*

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Treatment Plant and reduce the loading at Midleton Wastewater Treatment Plant. ***Having regard to the existing deficiency in the provision of adequate sewerage treatment infrastructure serving the subject site, it is considered that the proposed development would be premature by reference to the existing deficiencies in the provision of sewerage treatment facilities and the period within which this constraint may reasonably be expected to cease and, in the absence of this improved wastewater treatment capacity, would be prejudicial to public health.*** *The proposed development would, therefore, be contrary to the proper planning and sustainable development of the area."*

This building application appears to be making a start towards the requirement in the East Cork Municipal District Local Area Plan, 2017, which, in Policy Objective 3.4.8 envisages that an additional 5,243 housing units (c. 15,000 PE) will be required in Midleton on 180 hectares of land. Already a Pre-Connection Enquiry from Cork County Council has been made to Irish Water in August 2018 for a 2,460 house development at Waterock (ABP Inspector's Report of 23.01.19 s. 10.4.4).

The Inspector's report:

http://www.pleanala.ie/documents/reports/302/R302780.pdf

advises that the current under-capacity of Midleton WWTP is well known and states in Sec. 10.4.5:

"*However, wastewater services are problematic for a variety of reasons.* ***The existing WwTP at Midleton is at capacity and in order to alleviate this issue it is proposed to divert wastewater to the Carrigtohill WwTP via a new pump station and rising main***. *This is well known by the planning authority and Irish Water; accordingly steps have been taken to address the issue. To date however, there are no planning consents, either Part 8 or section 34 of the Planning and Development Act 2000 (as amended) in place. I acknowledge, that the proposed pump station comprises a current and yet undecided Part 8, published on the 9 November 2018. In addition, land is yet to be acquired for the pump station, though a site has been identified by a Foul Pumping Station Site Selection Report, that I have not seen. Finally, responsibility for the laying of the rising main falls to Irish Water, though provision has been made by the planning authority to accommodate same within the road network of the Urban Expansion Area."*

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Sec. 8.2 told us that the relevant elected members of the East Cork Municipal District, at their meeting of the 5 November 2018, called for upgrades to be made to their own WWTP at Midleton rather than pumping the excess load to Carrigtohill WWTP, however, it is noted in s. 5.2 that although Irish Water has a project underway for Midleton, which will provide the necessary upgrade works for providing additional capacity, **the timeframe involved would be 7 years**.

However, the Inspector was not convinced even of the timeframe of the short-term solution to move the overload from Midleton WWTP to Carrigtohill WWTP and in s. 10.4.9 he continued:

"*However, I cannot ignore relevant documentation before me that clearly points to an existing deficiency in the provision of foul water services at Midleton WwTP and the irrefutable need for a pump station and rising main to divert and convey waste to*

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Carrigtohill WwTP. ***It is the lack of certainty in the delivery of key infrastructure in a timely manner, that I recommend that permission be refused*** *on the basis that the development would be premature* ***by reference to an existing deficiency in the provision of sewerage facilities."***

This open admission by all the responsible authorities of the currently deficient and proposed, explosive overloading of Midleton WWTP, must be bad news both for the quality of the effluent from the WWTP discharged at Rathcoursey, as well as for the overflow situation from the town pumping stations – neither of which has been taken into account by the Dairygold Consultants when considering the addition of a further large input of nutrients from the cheese factory.

To put this proposed discharge of 4,000m3/day into perspective, relative to the present, enlarged 15,000 PE design of Midleton WWTP, the J.B. Barry and Partners Serviced Land Initiative Report for the Midleton Sewerage Scheme – WWTP Upgrade[8], prepared for Cork County Council in June 2006, used a design hydraulic loading rate of 225 litres/head/ day for Table A.9 in Appendix A, giving the 1 DWF volume of domestic effluent to be treated for 15,000 PE as 3,375m3 – about 20% less than the volume of the proposed discharge by Dairygold.

Thus, if we ignore the excess infiltration in the town, the actual discharge of society's waste products, domestic and commercial, into the inner harbour at Rathcoursey, will be more than doubled in volume by the addition of the Dairygold creamery waste, before any account is taken of Midleton's further rapid growth.

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7.11 In summary:

- With the trophic record of the Owenacurra Estuary/North Channel being already as poor as it is;

- With the Midleton Electoral Local Area Plan (second edition) of January 2015 identifying a target population of 23,735 people – an almost doubling of the population recorded in the 2011 Census of 12,001 by 2020 – and adding the normal 16% for commercial waste, means that the PE to be treated and discharged at Rathcoursey will shortly be 27,533 PE with the current plant designed for 15,000PE.

- With the flushing characteristics of the water being so different from those required for an oyster producing area, as stated by M.C. O'Sullivan himself in Volume 1 of his Cork Harbour Pollution Report of 1977 p.102:

  "(iii) Because of the presence of oyster farming in the North Channel, ***any outfall point should be such as to give very substantial dilution****."*

- In fact suffering **accumulation** of all discharges made at Rathcoursey in the >1km/tide westerly residual current in the North Channel, leading to residence times of 60-70 days, rather than any dilution at all on each tide;

[8] Midleton Sewerage Scheme – WWTP Upgrade, Serviced Land Initiative Report. J.B. Barry and Partners 2006

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- With the particular algal bloom that will take advantage of any increase in nutrients in this warmest of all waters in Ireland and which occurs in the summer months every year, without fail, being the cause of the most serious of the algal toxin poisonings – PSP and hence a very real danger to human health in the area;

- With the North Channel being known to be specifically the most dangerous area of all in the country for PSP and in the face of the widely recognised knowledge that these blooms have been so fully studied, documented and warned about:

- With a production of oysters from two farms that can feed more than 1 million people p.a. and supplied to markets all around the world,

……it would be difficult to find a worse place – especially in areas of equally major shellfish production - anywhere in the country, to discharge further nutrients on a substantial volume, compared to the current nutrient loads that we are advised are being discharged at Rathcoursey, many of which are reported to the EPA as being less than "*Half of LOD* (Limit of Detection) *for statistical purposes",* but which are already causing the receiving water to be classed as potentially eutrophic.

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8. The addition of Nitrogen (N) and Phosphorous (P) from the Dairygold discharge

8.1 Nitrogen.

The Consultant's Rathcoursey Outfall Investigation of May 2017 prepared for Irish Water, tells us in Sec. 4.3 on p.15 that the background river water quality taken, was for the Owenacurra and Dungourney (Rivers) and the DIN load is quoted as being in 151,200m3/day freshwater. As these two rivers meet above the town overflows we are not the full picture of the load currently coming down the Owenacurra Estuary. With only riverine N taken into account, the Investigation tells us, on p.24, that,

"*Figure 4.9 shows the predicted concentrations* (of DIN) *when all present day potential sources of DIN including riverine inputs are included. Concentrations in the Great Island Channel are generally below 0.4mg/l N* (the EQS target level being 0.44mg/l N)*",* and, *"with higher values predicted for the Ballinacurra Estuary".*

In other words, the eutrophic limit is already being exceeded for 32 psu salinity water, without the addition of any further nutrients from the town overflows, or, indeed the extra input of DIN from Dairygold in Fig. 4.10:

"Figure 4.10 shows that…… concentrations in the Great Island channel are still generally below 0.4mg/l"

Do such comments as these from the Consultants really give us good enough assurance that all will be well to add the Dairygold discharge to the theoretical discharge of a WWTP, which is assumed to be operating always inside its design parameters and under good management, when we are told by the EPA, ECJ and ABP that it is deficient?

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I would hope that the EPA will take into account that this is also a WWTP that was designed for 5/6 overflows p.a,, with a total spillage calculated at 2,973m3 p.a., which, over the last 16½ years, has averaged over 200 spills p.a. of a total average annual volume of 296,945m3 (see table of overflows in sec. 7.2 above). To spill exactly one hundred times (10,000%) more than was assured to all of us in the Application to the Minister for the Marine for the 1999 Foreshore Licence and also from the WWTP, that had also been designed by the very same person, who is now giving us his assurance that the Dairygold performance will *"generally"* be alright, and especially as WWTP overflows are recognised so widely to be the most important source of the environmental problems downstream of them, must surely be stretching beyond belief the bounds of confidence in any of us?

The HW/LW DIN simulations mirror what we have seen for the distribution patterns of both the *Alexandrium* vegetative cells and cysts, shown above, with the LW situation in Fig. 4.10, showing the highest levels of DIN above 0.4mg/l over the densest cyst beds in the area at the bottom of the Owenacurra Estuary.

Figs. 4.11 and 4.12 only go to show just how important the "riverine" input of nutrients is – but that is a pointless exercise as that, together with all the unaccounted-for overflows in the town, is the situation to which they wish to add their own 4,000m3/day load.

In this case the Owenacurra Estuary is not only "*potentially eutrophic"* at the moment, it has actually been singled out, in the latest November 2018 EPA Report, as being one of just four water bodies, which have the highest dissolved inorganic nitrogen concentrations in the country (see s. 7.5.2 et seq. above) and with phosphate levels which the Report says are, "*indicating levels likely to lead to nutrient pollution"* (see s. 7.5.1).

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8.2 Phosphorous

The opinion of the EPA's Water Quality in Ireland Report 1998-2000 (2002) was that,

"…. the Ballinacurra Estuary/North Channel were all strongly phosphorous-limited, but this was particularly pronounced in the Ballinacurra Estuary", and that this effect was even carried down to the Lower Harbour waters:

"Nitrogen availability was lower relative to that of phosphate in the waters of Outer Cork Harbour, though even in this high-salinity waterbody P was indicated to be the limiting nutrient in about quarter of samples from the 1998-2000 period."

The Consultant's (Dixon-Brosnan) Report on the effluent from Cloyne and Saleen impacting the north east corner of the Lower Harbour, included in the Application to the EPA for the WWDL for Cloyne (D0298-01) mentions this finding that phosphorous is limiting on p.17 of his "*Assessment of a wastewater discharge at Saleen, Co. Cork*" (April 2003):

http://www.epa.ie/licences/lic_eDMS/090151b28035463e.pdf (see Appendix 5 on pp. 45-101)

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"*8.2.5 While the dynamics at this estuary do not directly apply to the Saleen Creek area, it is reasonable to assume that the East Channel area may also be phosphorous limited. This assumption is supported by the EPA's observation that outer harbour samples indicated limited phosphorous levels on occasion."*

These earlier assessments appear to persist, with the EPA's "*Water Quality in 2017: An Indicators Report" (*Trodd W. and O'Boyle S.) whose findings are mentioned in sec. 7.5.1 above, but also in:

Nash and Hartnett (2011) also finding on p.49:

"*It was found that the ratio of available nitrogen (ammonia and nitrate) to available phosphorous (orthophosphate) was greater than 7.2 in Lough Mahon and the North Channel, suggesting that phytoplankton growth is phosphorous-limited."*

The EPA's own figures in my sec. 5.4, above, would also seem to confirm that PO4 is limiting in the summer months in the North Channel, with low levels of c. 2.5 mg/l PO4 compared to 25-30 mg/l PO4 after September and before the spring blooms.

The two phosphate simulations in Figure 4.13 show the present PO_4 concentrations, without Dairygold, having an input of 21.8kg PO_4/day, compared to Figure 4.14 with the Dairygold input and a full input of 43.1kg PO_4/day, show a striking difference, with the doubling of the level of PO_4 due to the Dairygold additional load. This is shown spreading evenly throughout both the North Channel, to the far west side of the oyster beds and also right up the Ballinacurra Estuary virtually to the top, with the potential to unlock access to nitrogen and certainly to stimulate the growth of cysts of the highest density Ballynacurra PSP seed-bed, as well as the vegetative cells that are shown to accumulate off Rathcoursey Point at LW (see figs. in section 6.2.1 on pp. 48 & 49).

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The difference between the total theoretical input of phosphate and that without the riverine input, shows the latter to be just 4.4kg/day, only half of the proposed Dairygold discharge, but, again, all of these model simulations assume that the figures given to Irish Hydrodata represent the actual performance of the Midleton WWTP, on which the EPA will have the benefit of continuing WWDL and AER information, The untreated town overflows could be expected to be rich in P from detergents etc.

The EPA also have the benefit of having the supplementary reports that they have requested in relation to the performance of the WWTP, information that may not have been available to Irish Hydrodata.

These reports with a response from the EPA and a further bit of investigative work on the Owenacurra which will be new to the EPA are given in the next 4 sections.

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8.3 Reports required of Cork CC by the EPA in relation to the Midleton WWDL

8.3.1 The Mott MacDonald Report "Assessment of Pump Station Overflows". 2011[9]

This Report finds that the infiltration problem is so large in Midleton, and the flows that need treating are so much greater than the capacity of the plant, which was actually built in 2000, that, in order to comply with the assertion in the 1993 Preliminary Report and the EIS, put forward for the Application for a foreshore licence to discharge at Rathcoursey Point in 1996, that there would be no more than 5/6 spills p.a. and the total annual overflow volume would be no more than 2,973m3, a 5m high holding tank of 5.25 hectares would be needed. This is 130-140 times the capacity of the present storm overflow storage - in lay terms, a 5m high tank covering an area of about 5 football pitches! As stated above, the actual annual volume of untreated, nutrient-rich spills from Midleton is thus running at 100 times more than what had been advised, permitted and, we were told, had been designed for.

I believe that this must be a factor which should be taken into account when we are concerned about the nutrient status of the Owenacurra and North Channel, and where these overflows will then accumulate rather than disperse, as shown above.

I also believe that, if it is still the very same consultants, who were responsible for the design of Midleton WWTP and jointly for the EIS in 1993, who are both now involved in making the case that the Dairygold outfall at Rathcoursey will do no harm – and by using the same 1993 data - and who must have known then that the circulation of water around Great Island was anti-clockwise and inland and NOT "flushing out" to the open sea (see the 1993 current meter data in Fig. 3.5a in sec 5.5 above), and can also be shown to have got the WWTP design sums wrong by a factor of over 100 times, it is only fair to suggest that their current opinion for Dairygold should be viewed with some caution.

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Even though the volumes of the town overflows in Midleton are published from 2011 in the AER's, Dairygold/Irish Water might not be expected to know of the enormity of the situation as regards these overflows of nutrients to the river, and I suppose it is possible that M J O'Sullivan who has worked closely with Irish Hydrodata on the Dairygold submissions, just might not have seen this revelation above in the Mott MacDonald Report?

One further collaborative work between M J O'Sullivan and Irish Hydrodata, which appears only to throw more light on the retentive nature of the Owenacurra Estuary, which was undertaken in 1997, was to look into and model the dispersion of the WWTP discharge over neap and spring tides, if it was made instead at the top of the Estuary at Ballinacurra. For this study, M J O'Sullivan provided the discharge and river flow data to Irish Hydrodata and I now add this further evidence in this submission:

[9] Midleton Sewerage Scheme: "Assessment of Pump Station Overflows". August 2011. Mott MacDonald

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8.3.2 The WYG "Assessment of Storm Water Overflows". October 2011

This study suggested that the Technical Amendment of the number of overflows might be allowed to be raised to 10 p.a and the limit on the volume of storm water allowed to be spilt untreated, to be raised from 1.5% *"of total storm water collected in the relevant section of waste water works on the discharge volume for a storm water event, to 20%".*

8.3.3 The Technical Amendment request to the EPA by Cork County Council re Midleton WWDL Licence Reg. No. D0056-01, dated 11.11.13 **(on the EPA website):**

http://www.epa.ie/licences/lic_eDMS/090151b280531704.pdf

"*With regard to the designated storm water overflows, a proposed increase in the Control Limit Value (CLV) from a frequency of six spills/annum to 10 spills/annum".*

"W*ith regard to the designated storm water overflows, a proposed increase in the 1.5% limit, of total storm water collected in the relevant section of waste water works on the discharge volume for a storm overflow event, to 20%",*

The EPA did not allow either of these requests in this Technical Amendment Request.

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8.3.4 Midleton Sewerage Scheme Proposed Temporary Outfall At Ballinacurra. 1997 Irish Hydrodata for M.C. O'Sullivan & Co. & Cork County Council [10]

This work was carried out at our request in 1997, following Cork County Council's undertaking to install secondary treatment for Midleton's sewage by June 2000 and we had requested the possibility of an interim reversion of the outfall location to Ballinacurra, from which we had had no health problems for 17 years. This was the hydrodynamic work offered. It gives another insight specifically to the Owenacurra Estuary. The river flow data etc. was supplied to Irish Hydrodata by M J O'Sullivan.

I have added the legend of BOD concentrations in the estuary to Fig. 1 of the following set of model simulations after between 9.75 to 10.5 tidal cycles (of 5 days' release).

Figs 1 & 2 show the situation at HW and LW after a continuous release from the WWTP on a neap tide.

Figs. 3 & 4 show the situation at HW and LW after a continuous release from the WWTP on a spring tide.

Figs 4 & 5 show the situation at HW and LW after an intermittent release from the WWTP on a neap tides.

None of the simulations show the BOD even reaching the top of East Ferry and the slug of nutrients is shown simply oscillating up and down the estuary – right on top of the highest density PSP cyst beds that are found there – and some of the highest recorded in the world.

[10] Midleton Sewerage Scheme Proposed Temporary Outfall Adjacent to Ballinacurra. 1997. Irish Hydrodata for M.C. O'Sullivan & Co. & Cork County Council.

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I remind you of the similar conclusion of M C O'Sullivan in his 1977 Cork Harbour Pollution Report, quoted already in sec. 5.3 above,

"(iii) The freshwater flushing of the Ballinacurra Estuary ***is well-nigh totally absent*** *in summer and in winter is very small in comparison with the Lough Mahon situation."*

Should there now be a further release of nutrients from Dairygold, just to the south of these cyst beds, with the addition of a large volume of yet more nutrients to the area, the situation can surely only become more dangerous for PSP blooms?

9. Alternative discharge locations for the Dairygold creamery waste water.

We had hoped very much that further attention would have been given to the County Council Planning Department's request for more information in item No. 9 in their registered letter to Dairygold dated 09.02.17 for:

"A report on the options considered for effluent disposal and the basis for the decision to discharge at Rathcoursey. Consideration of alternatives in the EIS should consider this proposal compared to other potential options for the discharge of process waste."

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Meanwhile in anticipation of this letter, it would seem, Malachy Walsh and Partners wrote to Cork CC Planning Department dated 27.01.17 on behalf of Dairygold and on p.4 discussed the Location of the discharge point:

"The Kilta River does not have the capacity to accommodate the increased future discharges of treated water from the Dairygold Food ingredients facility. Dairygold therefore consulted with Irish water as the utility service provider to establish the feasibility of a connection to public wastewater infrastructure for the disposal of treated wastewater discharges from the Mogeely Cheese Plant.

"In April 2016 Irish Water issued a Public Works Service Agreement (PWSA) to Dairygold directing Dairygold to connect to their existing outfall downstream of the tidal tank at Rathcoursey. This would be subject to compliance with the required planning permission and IPPC for the proposed development and subject to the conditions of the existing Midleton WWDL i.e. the emission limit values of the proposed wastewater discharges are below the WWDL ELVs".

In the actual Response to Further Information made on behalf of Dairygold and dated May 2017, Dairygold said that they had examined the possibility of either discharge to the local rivers, or infiltration to groundwater.

Neither of these could in any way be considered as the serious seeking of alternative options, as the volume of their eventual discharge at 46.3 l/s in a total river catchment volume of both the Kiltha and Womanagh catchments of only 160-180 l/s (about a fifteenth of the average flow of the Owenacurra River at 2,640 l/s!), i.e. cheese waste would make up about a third of their combined flow. Nor, obviously, could a soak-away solution be used in grounds which are liable to flooding.

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The Dairygold Response continued:

"*The next option was to consult with Irish Water, being the statutory provider.* ***Irish Water undertook their own review*** *and advised that there was capacity at Rathcoursey and agreed to accept an intermittent discharge (on the ebb tide as per their WWDA) at the outlet of Rathcoursey tank.*

"As part of the preliminary assessment of the discharge on the receiving water in Cork Harbour and the predicted changes in background concentration, it was considered that the option to discharge at Rathcoursey was viable on environmental grounds. ***Therefore further consideration of an alternative outfall location was not warranted.*** *This discharge point was progressed as part of the Environmental Impact Assessment and subsequently proposed in the application."*

With as much as a 14km discharge pipeline planned to reach Rathcoursey (which is still 12km from the open sea), surely other options, which should have been considered, must have been to reach the open sea at other locations, some of which are little more than half this distance away – see Table 2 in sec. 4.3.2 Identification of Natura 2000 Sites in the Screening for Appropriate Assessment of November 2016, i.e.:

Ballycotton Bay SPA is given in the AA as 8.6km S, and
Ballymacoda Bay SPA is given as 8.7km SE,
Blackwater River SAC and SPA is given as 12.7km E,
and the same distance as Rathcoursey to reach the current outfall for Ballycotton sewage, which will soon be extended with the building of the new WWTP there.

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Not one of these alternative discharge locations, **which are all in at least the same catchment area,** was investigated by Dairygold, nor was our request that they should, be either mentioned, or investigated in the An Bord Pleanála Inspector's examination (see Appendix 2).

Who else will now be allowed to discharge at Rathcoursey? Why should 14km necessarily be the limit? As far as I can see the only alternative given was in EIS Vol. 2 s. 3.3.2

"New treated effluent discharge pipeline. The Kiltha River does not have the capacity to accept the increased volumes of treated wastewater. Therefore a new discharge point is required. As part of this development proposal it is being proposed to discharge treated process effluent into Cork Harbour at Rathcoursey".

Is this really enough for the EIS to comply with EIA Directive 22011/92 Art. 5.3(d) and Article 94 of the Planning and Development Regulations 2001, as amended, where para 1(d) calls for main alternatives (in the plural) to have been studied by the developer?

Instead Dairygold apparently put their reliance on Irish Water as, "*the statutory provider to identify a suitable connection location"* (Cork CC Senior Engineer). Irish Water then came up with the Rathcoursey discharge location, a location within literally a few metres of Cork Harbour SPA; Great Island Channel SAC and pNHA; into the very centre of an EU designated "Sensitive Area" and in between four EU Designated Shellfish Waters, with the established capacity to supply more than a million people each year with oysters.

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Did Irish Water themselves pursue any alternative discharge locations? The answer is that they did, but, as I show below, Rathcoursey Point was chosen, **not on environmental grounds, but because of time constraints for the Dairygold development**, with the preferred solution to be to connect the Dairygold waste directly to the diffuser, downstream of the tidal holding tank and put in for technical amendments to dispense with not only the 3-hours current discharge regime, but the ebb tide regime also and *"request permission to discharge a portion of the flows over all stages of the tide".*

9.1 Irish Water undertook their own review of where and how to discharge the Dairygold waste water.

From an FOI enquiry made to Irish Water (IW), the course of events, as shown in Irish Water Report No.1 of December 2015[11], appears to have been that Irish Water received a Pre-Connection Enquiry from Dairygold in June 2015:

"*The Customer has requested to discharge to the inner Cork Harbour via Irish Water's infrastructure downstream of the Midleton WWTP"*

As the Customer is proposing to discharge treated process wastewater from the proposed development into the existing Ballinacurra Treated Effluent Pumping Station, additional storage volume would be needed over and above the existing volume of the Rathcoursey tidal holding tank….."

"In November 2015, Dairygold entered into a Project Works Services Agreement, under which Irish Water propose to carry out the conceptual design of the upgrade works that would be required to cater for the treated wastewater discharges from the customer's proposed development."

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The Engineering Consultant, Mott MacDonald Ireland Ltd. (MM) was appointed by IW in December 2015 with the first meeting between IW and MM on 16.12.15.

Two Reports were prepared by MM, both dated March 2016 – a Site Selection Report, followed by a Preliminary Options Report [12].

These two reports are nearly identical and I just attach the latest. Both report the basic information under the following sections:

Sec. 2 Existing infrastructure

"The potential connection for the new customer would be at or downstream of the Ballinacurra Treated Effluent Pump Station"

2.3 The 598m long 600mm pressure pipeline to the header manhole can take 2,545m3 flow/hr

[11] Irish Water Report Dairygold Progress Report No.1. December 2015
[12] Preliminary Options Report, Midleton Sewerage Scheme, Rathcoursey Tidal Holding Tank, Mott MacDonald, March 2016 for Irish Water.

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2.3.2 The 1,812m 750mm gravity line to intermediate high point (near Bawnard Cross) can take max. **2,691m3** flow/hr

2.3.3 The last 1,671m 750mm gravity line to Tidal Holding Tank can take max **2,762m3** flow/hr.
2.4.1 Tidal Holding Tank and some pipeline has total capacity 2,175m3

2.4.3 Current discharge regime is from HW+½ to HW+3½ i.e. **3 hours/tidal cycle**

2.5 Capacity of the last 110m of 610mm outfall pipe to the 21m diffuser is **4,670m3/hr** = 14,000m3/tide, or 28,000m3/day.

It is possibly difficult to understand why a pipe of 610mm dia. (4,670m3/hr), whose cross-section is only 66% of the 750mm dia. pipe (up to 2,762m3/hr) to the foreshore tank, can take a 69% greater flow? The headloss at 3.07m to the diffuser is also less than the 4.82m over the last section of pipeline to the tidal tank. This is important if the EPA continue to support the need for the current 3 hour discharge regime, demanded by the Department of Marine, and the pipeline cannot take it.

Mott MacDonald, who call elsewhere for a proper survey of this line to the diffuser, cover themselves in this s. 2.5 with,

"*It is not possible to carry out a detailed assessment of the outfall capacity without detailed information on e.g. water levels, pipework details, level of the diffuser, flow velocities etc. Nevertheless an approximate assessment of the peak discharge can be made based on the level at the tidal holding tank and the tide levels.*"

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Sec. 3. Flows

3.2.1 **WWTP : *"during wet weather the (15,000 PE) plant often operates at the peak capacity of 120 l/s for 24 hours day"*** = 10,368m3/day

"*The Midleton LAP – Second Edition – January 2015 sec. 3.2.1 identifies a target population of Midleton in 2020 of 23,735 people……. this would increase the max. flow through the plant to 240 l/s (twice the current capacity). This is equivalent to 20,736m3/day."*

3.2.2 "*An infiltration flow of 2,100m3/day has been adopted".*

3.2.3 The IDL flow is taken as c. 2,400m3/d, "*but could reach 5,000m3/day in the short to medium term."*

3.2.5 *"It is assumed that the infiltration into the Bailick Road Gravity Sewer will be addressed in the short term….. and, as such, is not included…."* NB the last 811m of the sewer before the final Ballinacurra PS was relined in January 2012, but infiltration still clearly exists. Allow 2,000m3/day as for infiltration going to the WWTP?

3.2.6 The Consultants estimate the **total future flow, including the Dairygold 4,000m3/day, to be 32,000m3/day by 2025.**

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What is difficult to understand in the table in this paragraph is why the anticipated contribution of the town to the total flow should be kept at the 2016 level of 10,368m3/day for the next 8 years before jumping to 20,736 in a single year in 2025?

Sec. 4 Required Infrastructure

4. "While the WWDL for Midleton requires that flows are discharged on the ebb tide only, the current operating procedure is compliant, but more restrictive, discharging for just three hours per tidal cycle. ***Given the location of the outfall at the northern end of the East Passage, it is understandable that the discharge from the holding tank would be completed some time before the tide turns, to prevent the treated effluent being washed back into the tidal reaches of the Ballinacurra River and North Channel on the incoming tide.***

*"****A hydrodynamic model of the harbour would be required to determine at what stage of the tide the discharge from the holding tank should be stopped to prevent effluent being washed back into the Ballinacurra River and the North Channel****. **The modelling is outside the scope of this report and would be completed at a later stage in the project."***

4.3 Table 1 gives the storage shortfall for the relevant flows in 2021 as 6,546m3 and for the 2025 flow of 32,000m3/day as 10,825m3.

(To put this in perspective of what is available at present, the WYG Draft "Alternative Outfall" Report[13] in sec. 5.4 p.17 actually admits that the present foreshore holding tank is sufficient only for the licensed discharge of IDL:

"The total daily licensed discharge from IDL is 5,000m3/day with a peak discharge of 270m3/hour. On the basis of these figures the required storage volume at Rathcoursey tidal holding tank to accommodate discharges from IDL only is 1,667 – 2,160m3. As a result the existing Rathcoursey tidal holding tank has sufficient capacity to provide the required storage retention time to cater for treated effluent discharges from IDL only".)

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MM continue:

*"****It would be unwise to alter the current regime of discharging over three hours without completing the necessary studies and hydrodynamic modelling to demonstrate that an increase in the discharge duration will not result in an unacceptable deterioration in receiving water quality",***

and although the Consultant's add,

"*It is unlikely that such modelling would be completed in time to allow the proposed storage to be designed and constructed prior to 2018,"*

it is clear that even the capacity of the 610mm pipeline and diffuser at 2 x 14,000m3/3-hour discharge (i.e. 28,000m3) may not be sufficient to handle 32,000m3/day in 2025 – with no allowance made for the continuing, but ignored, infiltration into the town sewer (in sec. 3.2.5

[13] Upgrading of Wastewater Treatment Facilities at Midleton, Castlemartyr, Cloyne, Saleen & Ballycotton. **Cost Benefit Analysis for Alternative Outfall for Midleton WWTP**. WYG Engineering (Ireland) Limited July 2009

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above); no allowance being made for commercial water usage (normally added as 16% of domestic usage); no extra flows in times of heavy rainfall, or, indeed, making any allowance for the already persistent overflows from the town's pumping stations, which very often exceed the total annual spill volume planned for by M. C. O'Sullivan's EIS in 1996 of 2,973m3 p.a. – in just a single day, and which have averaged up to 1,000m3/day since records began in 2002.

It is fair to presume that it was the same M. O'Sullivan, who wrote the Dairygold EIS Appendix 6E "Assessment of Proposed Wastewater Discharges on the Receiving Waters at Rathcoursey Point", who was the M.J. O'Sullivan who calculated this maximum annual spill figure for the 1993 MCOS EIS for Cork CC and again for the 1996 Application for the 1999 foreshore licence, and to make it clear, here, that not only can this annual spill figure be exceeded in a single day, but it is often been exceeded by 2-3 times in a single day. Over Christmas and the New Year of 2015/16, the daily spills were up to 15 times this annual spill size, that had been forecast, reaching as much as 44,995m3 on one day. Nor was this a flash event: in the 3 months of December, January and February, there were no less than 54 days with spills greater than the M.J. O'Sullivans' annual design estimate of 2,973m3/day. (See more on this in sec. 3, above)

M.J. O'Sullivan was also responsible for the design of Midleton WWTP and the town's waste water collection network, from the installation of the earlier 1988 Scheme onwards.

It would appear, anyhow, that this lack of capacity under a 3hr/tide regime is clear to the proposers of this scheme and the following passage makes its way into the Option 5 details in final Concept Design Report of April 2016:

"As the proposed discharge is not expected to contain any coliforms, ***there will be no benefit in limiting the discharge to the ebb tide".***

before cautioning,

"A technical amendment to allow a portion of the discharge to occur over all stages of the tide *would be a more fundamental change to the existing licence, and would be likely to take significantly longer to complete."* (See sec. 9.2 below).

Presumably this is also why the Natura Impact Statement keeps using a 6+ hour ebbing tide discharge, as in sections on pp. 36, 37, 38 (see sec. 3, above) and finally in sec.7.7 of the NIS on p.50:

"Trade effluent will be discharged via diffuser pipe on 6+ hour ebbing tide in a 24 hour period with water undergoing an ~80% exchange so that the subsequent discharge event will occur on new water coming in. ***Thus, considering the water exchange within Cork harbour it is unlikely that significant cumulative water quality will arise."***

This final sentence makes little sense, but if the Consultants are requiring good water exchange (i.e.~80% per tide) for their proposals to be acceptable, the NUIG hydrodynamic work (sec. 3.2 above) must provide very strong evidence that that is plain wishful thinking and simply has no support from their computer modelling, or all that we see in practice in this water body (sec. 5.1 above).

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The EPA's letter of 13 March 2019 to Dairygold also notes that the NIS then states in sec. 8.1 on Residual Impacts:

"*Provided that the mitigation measures (**from section 7.8**) are implemented in full, it is not expected that significant impacts will result to the features of interest identified for appraisal in this NIS and thus it is not expected that the proposal will have an adverse impact on Natura 2000 sites",*

but that this section on mitigation measures has not been put in.

Sec. 5 Licensing Considerations

The Consultants point out that neither the foreshore licence, nor the EPA's WWDL specify that the discharge at Rathcoursey has to be restricted to only 3 hours at the top of the ebb tide, so it might be as well to explain here how this came about.

The 1986 Foreshore Licence, issued by the Department of Communications, was only made after the adjudication of An Foras Forbartha (AFF), after a serious difference of opinion between the DOE and the Department of Fisheries and Forestry, who put forward repeatedly in their 80pp 1984 "Submission on Midleton Sewage Scheme", that Rathcoursey Point was not a suitable location, as the discharge point for this scheme.

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In the end, AFF determined that there could be a compromise solution, and there must be a "*cessation of discharge of sewage at Rathcoursey for at least an hour at low water by discharging through a tidal holding tank constructed on the foreshore."*

It was difficult to understand the purpose of this instruction and DOFF were proved correct in their assessment of the danger of the use of Rathcoursey as the discharge location for untreated sewage, by the subsequent frequent reports of illness associated with the consumption of oysters from the North Channel, when there had been virtually no reports in the 17-year period before the Rathcoursey discharge was made in December 1988.

This came to a head after a particularly large outbreak of illness in November 1991 and the Department of the Marine invoked a Condition of the foreshore licence for the discharge, which they had insisted on being put in, and on 25.03.92, required secondary treatment for Midleton's sewage to be provided by the County Council "*as a priority item*".

In the interval before this could be provided, the DOM decided that everything that could be done to minimise the effect of the Rathcoursey discharge on human health must be undertaken and, in May 1992, the end of the diffuser pipe and several ports closest to the oyster beds were required to be closed off and the tidal holding tank was hence-forward to be used as such, so that the discharge would be made only at the top of the ebb tide – from HW+½hr to HW+3½hrs, in the best attempt to get the discharge carried as far away as possible from the main North Channel oyster beds before the returning flood. As long as reports of illness from the consumption of oysters from the North Channel continued, this restriction has remained in place. With this winter's norovirus sampling in the North Channel returning some of the highest levels of contamination results ever seen in the country (see sec. 7.6.1 above), every possible ameliorative step that can be taken to improve the situation needs to be maintained, rather than scrapped.

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Although there is some ambiguity with the terms of the EPA's WWDL, this 3-hour discharge regime has been acknowledged and accepted and was the regime that was advised to be in place to Prof. O'Kane for his hydrodynamic work on the Rathcoursey outfall from 2005-2007. It was advised to be the discharge regime to Brendan Wall, EPA Inspector, as recently as his Waste Water Inspection Report of the Rathcoursey Tank, dated 27.04.12. The importance that he too attached to the Council's adherence to this discharge regime can be appreciated by his requirement in his Investigation Recommendations: 1. Control and Monitoring, that:

"b. A record should be kept of the daily discharge times from the holding tank at Rathcoursey along with details of the tidal state during these times."

I understand from an FOI request made to Cork CC for these tidal discharge records, that this EPA's requirement was never complied with, very possibly because the discharge was not, in fact, being controlled at all. The Irish Water Report by MM of December 2015, under "Areas of Concern", advised on p.6:

"Difficulty gaining access to the existing Rathcoursey Tidal Holding Tank due to scheduling with Cork County Council Staff and/or poor weather may affect the programme completion date."

And the next Report of January 2016 advised:

"IW approved the installation of an ultra-sonic level monitor in the Rathcoursey Tidal Holding Tank. However, this proposal was cancelled due to delays in gaining access to the existing tank associated with the LA staff being fully occupied with serious flooding in Midleton Town and ***the subsequent discovery of a faulty valve in the tank*** *which would result in any monitoring of water levels in the tank as not being representative of the normal operation of the outfall."*

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Sec. 6 Six Scheme Options are shown

By March 2016 the Consultants would appear to have chosen only two possible discharge locations,

1) Rathcoursey - using the Midleton WWTP diffuser, and

2) An Open-Sea outfall - by extending the pipeline to Ballycroneen on the south coast, outside the Harbour.

These were presented as "Six options", but 4 of these "options" concerned only where and how to convey and control the flow of the waste to Rathcoursey with storage tanks of different sizes at different locations, with Option 5 for no storage tanks but a "*Direct connection to existing outfall"*, and Option 3, for a new outfall to Ballycroneen, somewhat lost in the middle of the list.

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These Options are shown on p.18 of the March 2016 Preliminary Options Report of Mott MacDonald and were transferred to, what I believe is, the final "Concept Design Report" dated April 2016[14] - also on p.18 :

- Option 1 – Storage at existing Rathcoursey site
- Option 2 – Storage at Greenfield site
- Option 3 - New outfall to Ballycroneen
- Option 4 – Storage at Loughcarrig
- Option 4a – Buried storage at Loughcarrig
- Option 5 – Direct connection to existing outfall

We are fortunate, however, to have an important separate 2pp. "Irish Water Report"[15] put forward at the very same time i.e April 2016, which gives us insight into the thought process that went into the choice of these alternatives, but especially in including the late addition of Option No. 5, which is to be the straight connection of the Dairygold waste directly to the pipe to the diffuser, downstream of the foreshore holding tank.

This Irish Water Report makes it quite clear that this 5th Option of theirs was not considered out of any regard to minimising the effect of the Dairygold discharge on the receiving waters, but simply because **none of the other options could be provided in time to meet Dairygold's deadline:**

"*While four options were initially examined as part of the study, it became evident at an early review stage of the process that the works required under any of these options could not likely be provided in time to meet Dairygold's requirements. Therefore, an alternative* ***fifth option*** *was considered, whereby Dairygold's proposed discharge, consisting of treated wastewater only, could connect directly to the existing Midleton Sewerage Scheme primary discharge outfall at Rathcoursey.*

"This option is deemed to be the most favourable and is therefore, the recommended solution for providing a connection for the process wastewater from Dairygold's development."

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Thus the final MM Concept Design Report "Introduction" makes it clear that:

"An initial assessment of the potential options for accommodating the Customer's proposed discharge is included in the Site Selection Report. This was further developed in the Preliminary Options Report. The purpose of this Concept Design Report is to develop a Concept Design ***for the preferred option as identified in the Preliminary Options Paper****."*

9.2 The single preferred option now investigated by Mott MacDonald for Irish Water in the Concept Design Report : Option 5.

By April 2016, it is clear that an analysis of all the possible options had been reduced to a single discharge location - Rathcoursey, to make use of the WWTP discharge, BUT with a

[14] Midleton Sewerage Scheme Rathcoursey Tidal Holding Tank. Concept Design Report. Mott MacDonald. April 2016
[15] Irish Water Report. Rathcoursey Tidal Holding Tank. April 2016

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direct connection to the pipe downstream of the holding tank. No further storage tanks for a 3hr ebb-tide release were to be put in.

The following paragraphs were now added to the earlier Option 5 in the MM "Preliminary Options Report" to make the final *"***Concept Design Report of April 2016"** (Ref. 11),

Sec. 6.6 p.37 "*Having investigated the previous options in detail* ***it was clear that the timeframe for delivering any of these options was not going to meet the Customers requirement to commence discharging in early 2018.*** *Therefore, in consultation with Irish Waters Asset Strategy Department, a direct connection to the outfall downstream of the tidal holding tank was allowed to be considered as a potential option. Allowing this option would result in a reduction of the existing capacity of the outfall which has been accepted by IW Asset Strategy."*

"*Description. New Customer to provide a new pipeline to the existing tidal holding tank and connect into the outlet chamber of the holding tank."*

"Details. It is understood that the effluent to be discharged from the potential new customer will be process wastewater only and will not contain any constituents that would have potential to have a negative impact on the receiving water. ***It is therefore unlikely to be necessary for the discharge from the new connection to be restricted to three hours per tidal cycle as with the existing arrangement."***

"The proposed new connection is outside this agglomeration boundary and while it is limited to pumped treated process wastewater from one specific industry a Technical Amendment to the licence may still be required."

"This however would require that all discharges from the new customer be limited to the ebb tide as per the existing licence conditions. ***As the proposed discharge is not expected to contain any coliforms, there will be no benefit in limiting the discharge to the ebb tide****. A technical amendment to allow a portion of the discharge to occur over all stages of the tide would be a more fundamental change to the existing licence, and would be likely to take significantly longer to complete. It is possible that a response to the Technical Amendment to include this provision would not be received in time for the proposed commencement of flows in 2018."*

MM then realise that two Technical Amendments to the Discharge Licence will be needed to make this Option 5 work, as, currently, the WWDL, *"would require that all discharges from the new customer be limited to the ebb tide as per the existing licence conditions":*

They therefore propose:

1. "*As the proposed discharge is not expected to contain any coliforms, there will be no benefit in limiting the discharges to the ebb tide"*

And in the flows given under "Operating Costs" to Irish Water for this option (p.39) it would appear that Irish Water too are planning to pump at all stages of the tide as the costs are based on pumping 28,000m3/day (4,000m3 to be pumped by Dairygold) with the pumps running for 18 hours of the day and 24 hours/day during storm events - "*when the WWTP is operating at peak capacity".*

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(The WWTP is operating at peak capacity when it cannot prevent storm overflows occurring and this is, on average, on 200 days a year – rather more than every other day).

"The first Technical Amendment would be simply for the increase in flows."

2. *"A second technical amendment to request permission to discharge a portion of the flows over all stages of the tide".*

MM then caution that,

"In order to accept the proposed flow from the Customer directly to the existing outfall immediately downstream of the tidal holding tank, the existing capacity and condition of the outfall pipe and diffuse would need to be investigated." (See my own doubts on the real capacity needed in sec. 9.1 sec. 4)

This is now therefore the "recommended solution" for the Dairygold discharge, not on any environmental grounds, but because no other solution could "*be provided in time to meet Dairygold's requirements",* and with fundamental changes made to the discharge regime required by the Licence.

This cannot be good enough.

What is encouraging is that Mott MacDonald have slipped just one real alternative to a Rathcoursey discharge into the list of Options at No. 3.

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9.4 Option 3 – A new outfall to the open sea at Ballycroneen.

This is not a new idea, being one that was put forward by Cork County Council for a *"Cost Benefit Analysis for an Alternative Outfall for Midleton WWTP"* (**Ref. 13)** as much as 10 years ago and was reported on by the Consultants WYG Ireland Ltd. in July 2009, as an addition to their study on the required *"Upgrading of Wastewater Treatment Facilities at Midleton, Castlemartyr, Cloyne, Saleen & Ballycotton. Design Report"* of November 2008[16]:

http://www.epa.ie/licences/lic_eDMS/090151b2802a665a.pdf (see pages 15-85, after the drawings, on this EPA posting for this Nov. 2008 Report). I am not enclosing my copy of this report as it is too bulky to attach to this Submission at 8.3MB and it is available on the website above.

The last paragraph of the Introduction to the "Alternative Outfall Report" of July 2009 sets out the purpose of this further follow-up WYG Report:

[16] *"Upgrading of Wastewater Treatment Facilities at Midleton, Castlemartyr, Cloyne, Saleen & Ballycotton. Design Report. WYG Engineering (Ireland) Ltd., November 2008. p.15 et seq. of EPA Export 26-07-2013:13:23:14 http://www.epa.ie/licences/lic_eDMS/090151b2802a665a.pdf*

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"In November 2008, Cork County Council requested WYG Engineering to carry out a review of the viability of re-routing the treated effluent from Midleton wastewater treatment plant (WWTP) from its current discharge point at Rathcoursey to the proposed marine outfall at Ballycotton. This review was to be carried out in conjunction with formulation of an overall strategy for effluent disposal in the South East Cork Area. This report details the findings of the review undertaken and sets outs the capital and operation costs associated with the various effluent disposal routes examined.

and in sec. 2.3:

"*Having regard to this proximity to Cloyne WWTP and the proposal to lay a treated effluent rising main from Cloyne to Ballycotton, Cork County Council requested that* ***the possibility of diverting treated effluent from the existing outfall location at Rathcoursey to the new outfall at Ballycotton be examined.*** *The benefits of this proposal include a reduction in treated effluent to Cork Harbour with a corresponding reduction in risk of contamination of shellfish in the North Channel and utilisation of the greater assimilative capacity of sea through the proposed outfall at Ballycotton.*

This last paragraph from these Consultants on "*the benefits of this proposal*" is most welcome and would, we hope, find resonance with the EPA for:

1) *a reduction in treated effluent to Cork Harbour with a corresponding reduction in risk of contamination of shellfish in the North Channel and*

2) *utilisation of the greater assimilative capacity of sea through the proposed outfall at Ballycotton.*

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Table 3.1 on p.7 of the draft "Alternative Outfall" Report shows that in 2008 the treated effluent flows from Midleton WWTP accounted for approximately 85% of the total existing treated effluent flows, with the treated industrial effluent flows from IDL forming the balance of the discharge at Rathcoursey.

Three options were explored and costed in comparison to continuing the WWTP/IDL discharge at Rathcoursey in s.5.0 on p. 12:

"2. Abandon the existing outfall at Rathcoursey and pump all treated effluent from Ballinacurra 1 PS to the new proposed outfall at Ballycotton;

3. Pump all Midleton WWTP treated effluent to proposed new outfall at Ballycotton and continue to pump IDL treated effluent to the existing Rathcoursey outfall;

4. Pump all Midleton WWTP treated effluent to proposed new outfall at ***Ballycroneen*** *and continue to pump IDL treated effluent to the existing Rathcoursey outfall."*

All these schemes have the benefit of picking up the treated effluent from Cloyne and Saleen as we learn of from the Introduction and Description passages of the Scheme, pp.1-12 in the

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"*Brief for the Engagement of a Consulting Engineer/Client's Representative"*, dated August 2007[17]

The first 12 pages of this document describe the needs for upgrading all these WWTPs, which must now be part of Irish Water's pledge to all of us in Cork that, "*No more untreated sewage will enter Cork Harbour by 2021".*

9.4.1 Cloyne WWTP

In this Cork CC's Consultant's Brief:

p.9 "*This Scheme proposes that Cloyne WWTP's existing capacity of 1,400PE be augmented with an additional 2,500PE. This will increase the Plant's overall capacity to 3,900PE and will cater for development up to the year 2016."*

"*The increase in population from the 2002 Census to the 2006 estimate equates to a compound growth of 14.3%".*

And in the WYG Upgrading of WWTPs Report (Ref. 13) s. 7.2:

"*The catchment area of the stream at the outfall is small (c. 2km2), indicating a DWF of less than 2 l/s and a 95% ile flow of less than 4 l/s. This compares to a current average daily throughput for the plant of c. 290m3 (1450 PE) or 3.3 l/s. Thus, at present, dilution at the 95% ile flow is only just over 1:1. The desirable dilution factor of 1:8 is not being achieved and* ***a new discharge point is thus urgently required".***

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It is this water that discharges into the Saleen Stream and thence into the Lower Harbour at Rostellan, immediately on to 13 kilometres of oyster trestles and 30ha of sub-tidal, marked-out native oyster beds – both probably some of the finest oyster-growing areas in Europe.

9.4.2 Saleen WWTP

The WYG Upgrading of WWTPs Report s. 12.4

*"**Existing treatment at Saleen is a totally inadequate septic tank** which discharges to the adjacent "Saleen Stream". It is proposed that the untreated wastewater from Saleen be pumped to Cloyne for treatment".*

It is proposed to replace the present septic tank with its capacity for just 12 houses (40 PE) with a WWTP with a capacity of 1,000PE to meet the medium term needs of the settlement to 2013 and so as to ensure a sustainable discharge. There will be no nutrient reduction from this septic tank for 1,000 - 40 = 960 people, before it overflows to the Saleen stream and down the short estuary to the NE corner of Cork Harbour at Rostellan. As seen in Figure 9 in

[17] WSIP. East Cork WWTPs Upgrade. Brief for the Engagement of a Consulting Engineer/Client's Representative.

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sec. 4 on p.28, above, the NUIG hydrodynamic team calculate a residence time for the discharge here as 47 days.

Again this is not an area which gets the "*substantial dilution*" called for by M.C. O'Sullivan in 1977, into which to make such a discharge.

With Irish water's promise in such videos as, "*We're half-way to a sewage-free Cork Harbour"* in:

https://www.water.ie/projects-plans/cork-lower-harbour/#

promising "*Zero sewage in Cork Harbour by 2021*", with its concomitant reduction in nutrient input, and publicising this good news in every announcement, including the Cork City buses, a discharge line to the open sea for all the smaller discharges on the east side of the Harbour, which are not catered for by the Shanbally WWTP on the west side, would complete their promise to the people of Cork.

We would like to draw attention to the very obvious fact that Irish Water's two promotional videos about the beauty of Cork Harbour, which IW are helping to preserve, which are included in this link, above, both make full use of these two specific east-side water bodies, which we, too, are so keen to preserve:

"*Derek's Harbour Story*" tells us that his "showcase" is Rostellan and the film is shot almost entirely in East Ferry. He tells us enthusiastically that water quality affects us all and is crucial to the survival of the whole area.

"*Pat's Harbour Story*" tells of the wildlife in the Harbour and that,

"*My favourite places are actually in the East side of Cork Harbour, Saleen, Rostellan and East Ferry areas – those are beautiful."*

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9.4.3 Whitegate and Aghada

Such a pipeline would also be available for the currently untreated waste discharges of Whitegate and Aghada.

This route to the open sea for the east-side and as-yet-untreated waste water was also proposed in sec. 8.3 of the 2008 WYG "Upgrading" Study, though, at that time, sending it for treatment at the long-proposed and long-overdue new WWTP and 330m long sea-outfall at Ballycotton:

"A further option has now emerged however, with the proposal to pump the treated effluent from Cloyne to the sea outfall at Ballycotton. ***This means that the effluent from Saleen, and potentially also from Whitegate / Aghada / Rostellan could be pumped to Cloyne for onward transmission to Ballycotton, thus significantly reducing discharge to the Lower Harbour.***

I have attached the above Consultants' Brief and the two WYG Reports, with this submission to show you that the need for upgrading all these plants has now existed for many years and

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that a progressive plan has been drawn up and costed over 10 years ago to get these East Cork discharges channelled via a network to the open sea at either Ballycotton, or Ballycroneen (Option 4), which is now the Dairygold Option 3. An outfall to the open sea is essential for all these East Cork towns with nowhere else to discharge their treated effluent safely and will be of huge benefit to the Kiltha/ Womanagh river catchment (for the Castlemartyr and Ladysbridge effluent) and essential to Cork Harbour.

They are a necessary complement to the present good work of cleaning up the untreated waste water inputs on the western side of the harbour and they are the ha'porth of tar needed to properly complete this work. We should look at the detailed WYG proposal for Irish Water/Dairygold closely.

9.4.4 Option 4 WYG Alternative Outfall Report

(Ref. 10) sec. 5.5 p.19 – a pipeline to Ballycroneen

This option examined the costs associated with disposing of the treated effluent flows from Midleton WWTP and Cloyne WWTP (and very easily Saleen) to a new outfall at Ballycroneen. They have allowed the 15% of the discharge apportioned to IDL (Table 3.1 p.7 with a breakdown given on p.8 of 750m3/d process flows and 350m3 cooling water) to continue to be discharged at Rathcoursey via a new 300mm rising main to Bawnard Cross.

The treated Midleton effluent and remaining untreated town sewer effluent will be pumped to Bawnard Cross and then on to Cloyne in a 500mm rising main. From Cloyne a 400mm rising main outfall to Ballycroneen is deemed sufficient.

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The additional construction costs are given on p.20 as €5.5m and the pumping costs as:

"*Over a 20 year period with a rate of an annual interest rate of 5% the net present value (NPV) the additional costs to the proposed East Cork scheme arising from the additional pumping associated with Option 4 amounts to €3,649,966 including VAT".*

Dividing this figure by 20 years and again by 365days, we get €499.995/day (€500/day) as the additional daily cost of pumping to Ballycroneen, from which MM then observe that this figure can be reduced in 6 ways by:

1) The running costs of the UV at the WWTP can be taken off, as the discharge will be to the open sea and far from designated shellfish waters.

Unlike the new Dublin WWTP at Clonshaugh, where UV treatment has been promised by Irish Water for a discharge 2.5km away from the nearest shoreline, I do not feel that there is enough swimming at Ballycroneen beach to raise the same sort of outcry and we, ourselves, certainly would not be looking for UV treatment to safeguard our oyster fisheries far inside Cork Harbour. The same might not be said for the swimming at Garryvoe in Ballycotton Bay, which is presumably why this obvious, very close, discharge option was not even mentioned.

To which saving can be added:

2) The cost of providing a proper discharge for Cloyne WWTP, which still has not been upgraded, and is therefore even more urgently required 11 years later, and is included in this figure.

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As stated above, the WYG conclusion on the outflow from Cloyne WWTP into the local stream to the Saleen Creek and Rostellan was,

"At present, dilution at the 95% ile flow is only just over 1:1. The desirable dilution factor of 1:8 is not being achieved and a new discharge point is thus ***urgently required".***

3) Making use of this pipeline to the open sea might also allow Irish Water to use the Midleton WWTP as a conventional activated sludge plant rather than continue in its present extended aeration format as a Modified Ludzac-Ettinger (MLE) plant, with a 5:1 recycle to obtain denitrification,

MCOS/Cork CC Preliminary Report Book 1, sec.5.9.1

"From the outlet channel of the bio reactors, a submersible axial flow pump will return mixed liquor at a rate of 4 DWF into a channel which returns the mixed liquor to the inlet of the bio reactor. This 4 DWF volume will be joined by a further 1 DWF of returned, settled, activated sludge from the sedimentation tanks. These two comprise the recirculation of 5DWF mentioned above (in his sec. 5.7.3) *for denitrification."*

There would be more sludge to treat if extended aeration was dispensed with, but denitrification would no longer be necessary for a discharge out to open sea.

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4) If enough success was also gained in reducing infiltration in Midleton, so that the concentration of phosphate became a problem, that too would be of no consequence for a sea outfall and that would be a very considerable saving in the costs of chemical precipitation.

5) The pipeline would be available for the discharges of treated effluent from Whitegate and Aghada.

6) Irish Water currently faces enormous problems with infiltration in the town of Midleton, with a study that is underway, which will not be completed for some years and will be complex and almost certainly disruptive to install. Midleton also has An Bord Pleanála refusing permission for any more building in the town until the capacity of the WWTP has been very substantially increased and with a new pumping station and new pipeline to Carrigtwohill's WWTP temporary surplus capacity, foreseen as the only short-term solution.

These short-term, wasted costs and the substantial gain of a greater flow through the WWTP with disposal of a treated, nutrient-rich discharge, but made in safety to the open sea, with infinite assimilative capacity, as a permanent solution, can also be put into the equation.

From the MM Preliminary Options Report, Option 4a with storage tanks partially buried at Loughcarrig, required a 290.67 kW pump at 18 hrs/day at € 0.15/kWh and this still costs €785/day for the total flow of 32,000m3 by 2025. It is the most environmentally friendly of the Options on land, but is no better than any other with dealing with the risks to the water quality, with the discharge being simply in the wrong place.

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9.4.5 The Dairygold pressing requirement for an outfall

The urgent need to dispose of the Dairygold cheese waste from Mogeely, must give Irish Water the chance to get a most valuable - and probably grant-aided – contribution to a pipeline for either the 10km to the open sea at Ballycotton Bay, or slightly longer route to the new long sea-outfall planned for Ballycotton WWTP (c.13km). However, the already researched solution for Dairygold, which would also solve all the remaining problems caused by the huge infiltration problem in Midleton, could be to establish this Mott MacDonald 2016 Option 3 pipeline to take the Midleton and Dairygold discharges out of Cork Harbour altogether to Ballycroneen. By 2021 this outfall could then be used to complete the treatment of Saleen, Cloyne, Whitegate and Aghada to accomplish Irish Water's pledge to the people of Cork.

It would be highly retrograde to add more waste at this juncture to the North Channel, innermost cul-de-sac of Cork Harbour, where the water is:

(1) One of the four water bodies in the country, which have the highest dissolved inorganic nitrogen concentrations in the country;

(2) Is already classed as potentially eutrophic;

(3) Where all the most up-to-date hydrodynamic work, shows it simply accumulates for up to 70 days, and

(4) Where regular dinoflagellate blooms can lead to one of the most dangerous of human nerve poisons to be passed on from the consumption of contaminated shellfish – particularly mussels, which accumulate the toxin most readily and which are gathered freely and frequently by the general public along the shore.

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9.5 A new alternative pipeline to the open sea

could now be waiting for such a use as this in the Kinsale Energy Decommissioning Project (12 November 2018).

The Draft Environmental Management Plan is found on:

https://www.kinsale-energy.ie/files/pdf/RFI-253993-00_Draft_EMP_Final_2018-11-12.pdf

This is a most exciting prospect as the 24" (600mm) gas export pipeline actually crosses the proposed Dairygold pipeline to Rathcoursey near the Loughcarrig site, where Gas Network Ireland already has two AGIs (Above Ground Installations) and if no other re-use options can be found, it would provide a no-cost route for Dairygold and the treated waste water disposal for all of the East Harbour towns detailed in this section – to be taken as far off-shore as thought necessary.

Irish Water, of course, are in an excellent position to make a case to re-use this gas pipeline, being themselves created as a subsidiary of Bord Gáis Éireann, now Ervia, with Gas Networks Ireland being their partner since 2014.

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"Re-use" of the Kinsale Gas Field facilities that have come to the end of their productive life is seen as the most desirable approach to waste management in the European Union (EU Waste Framework Directive 2008/98/EC) - a Directive which became obligatory in Ireland in 2011 through the European Communities (Waste Directive) Regulations 2011.

Sec. 3.3 of the Environmental Impact Assessment Report Vol. 2 p.41 (to be found on the link above) gives a Consideration of Potential Re-Uses:

"*Three potential re-uses have been considered at a high level. These are hydrocarbon production, carbon capture and storage (CCS) and offshore wind energy production".*

Hydrocarbon Production. "*The Kinsale Area facilities are not designed for liquid hydrocarbon or wet gas production and are unlikely to be suitable for such use".*

Offshore Wind Energy Production. "*The main 24" export pipeline and landfall could possibly have a use as a cable conduit, for either fibre optic or high-voltage direct current (HVDC) cables (for example as part of a windfarm). Kinsale Energy is not aware of any wind farm development being considered for the vicinity of any of the Kinsale Area facilities, so no proposal currently exists at this time.*

Carbon Capture and Storage. *"Kinsale Energy has carried out technical studies which would indicate that the main Kinsale Head reservoir may be suitable for CCS and also that some of the Kinsale Area facilities may be suitable for CO_2 transportation, particularly the 24" export pipeline and the jackets.* ***There is currently no commercial case for a merchant CCS service as CO_2 prices are too low to justify the required investment,*** *however, this may change in the coming years. There is a proposal in Ireland's current National Mitigation Plan (July 2017) for DCCAE to explore the feasibility of utilising suitable reservoirs for CO_2 storage within the next 5 years. A feasibility study into the use of the Kinsale Head reservoir for CCS is being undertaken by Ervia.*

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Conclusion. "*No other re-use options have been identified at present".*

Consideration of the comparative assessments of the decommissioning options for the Kinsale Area onshore pipeline is that the best scoring option would be to fill it with inhibited water, which also maximises the potential for an alternative re-use of this pipeline in the future.

Not only does this pipeline cross the proposed Dairygold and Midleton WWTP discharge pipelines, but there is an umbilical pipeline already in situ to Whitegate, which could take the treated waste water of 2,500 - 3,000 people from the south east agglomerations of Whitegate, Aghada, Farsid and Rostellan, if the pipeline could be put to this new use.

The pipeline could be taken as far out to sea as was required presumably to satisfy any objectors and can be cut at many points along the seabed. Sec. 3.4 Decommissioning Activities forsee:

- *"The decommissioning of all pipelines, control cables and their protection materials involving rock placement of freespans and/or remaining exposed sections of pipe and all remaining in situ protection materials;*

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- *"The filling of the export pipeline onshore section with grout (if a viable reuse option is not identified before decommissioning);*

If Ervia was able to agree this re-use of the pipeline, and not keep it for potential CCS, then having this very useful re-use available almost immediately, would provide a huge saving on much of the decommissioning costs, even to the extent of maintaining the Inch Terminal for possible UV treatment etc. in the future.

The WYG Alternative outfall suggested proposed a 500mm pipeline to Ballycroneen for the Midleton WWTP, IDL and town discharge. The 600mm pipeline that is available should take at least a 40% greater flow with less than half the friction losses.

10. The EPA's role in protecting Designated Shellfish Waters through the Pollution Reduction Programmes (PRPs) required by the Directive.

There are now 4 EU Designated Shellfish Waters in Cork Harbour, which were designated in 2009:

Cork Great Island North Channel (under S.I. No. 55 of 2009 of 10th February 2009)
Rostellan North "
Rostellan South, and "
Rostellan West (under S.I. No. 464 of 2009 of 26th November 2009)

These can all be found on the Department of Housing, Planning and Local Government

https://www.housing.gov.ie/water/water-quality/shellfish-waters/cork

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Of fundamental importance to the establishment of these areas is the protection that is to be afforded them by the Shellfish Pollution Reduction Programmes (PRPs) that have to be drawn up for each of them, as required by Article 5 of the Shellfish Water Directive 2006/113/EC and Section 6 of the Quality of Shellfish Waters Regulations, 2006 (S.I. No. 268 of 2006).

The EPA was given a pivotal role in this protection, which it has further enhanced by itself requiring:

10.1 The presence of viruses to be taken into account.

A requirement by Technical Amendment(s) A of about June 2014 that viruses (norovirus) should be added to the monitoring of the microbiological quality of the receiving waters of municipal discharges (Conditions approx. 5.6 and 5.7 of WWDLs), e.g.:

"*The licensee shall carry out an assessment of the impact of the discharge(s) from the waste water works on the microbiological quality* ***(including viruses)*** *of the shellfish in the adjacent designated shellfish waters in consultation with the Sea Fisheries Protection Authority (SFPA), the Marine Institute and Bord Iascaigh Mhara (BIM). The assessment, including a timeframe for installation of UV or other appropriate*

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disinfection as considered necessary, shall be submitted to the Agency within 18 months of the date of grant of the licence where it is identified in the assessment that UV or other appropriate disinfection is required."

10.2 "Key Pressures" in a PRP must be given the top (A1) priority in the EPA Enforcement Programmes (DREAM).

As a tool to prioritising enforcement of Waste Water Discharge Licences, the EPA's Office of Environmental Enforcement (OEE) developed a Dynamic Risk Enforcement Assessment Methodology (DREAM) to allow it to best allocate and deploy resources with a view to improving compliance with its regulation of WWDLs.

"The principles underlying the methodology reflect those of the OEE's enforcement policy, i.e. proportionality in the application of environmental law and in securing compliance, consistency of approach, transparency about how the OEE operates, targeting of enforcement action ***and implementation of the polluter pays principle****".*

"*The DREAM model is a further evolution of the Risk Based Enforcement Methodology (RBEM) developed by the OEE in 2007 to prioritise enforcement of IPPC and Waste licences"*, based on a review which revealed that, "*environmental considerations are key in developing enforcement strategies, in prioritising enforcement activities and allocating resources."*

"Similar to the methodology developed for IPPC and Waste licences the DREAM allocates an enforcement category to waste water agglomerations on the basis of five environment based attributes."

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There are 4 categories of Enforcement Score based on these five environmentally based attributes, but the EPA has decided that,

"Where a waste water agglomeration is listed in a Pollution Reduction Programme (PRP) for shellfish waters..... this will cause the agglomeration to default to the highest enforcement category."

If the EPA has pushed the Key Pressures on a Shellfish Water PRP to the highest enforcement category, which they define as "*A1 Very High Enforcement Category*", that sends a powerful message to the Shellfish Industry of the EPA's commitment to the preservation and improvement of the country's Shellfish Waters.

In this case, with the particular IED being applied for by Dairygold being for:

1. A cumulative discharge of nutrients, due to the hydrodynamics of the area,

2. Into receiving water that is of "moderate" and therefore of "unsatisfactory" quality by the WFD, into which the Directive is now subsumed, and which is

3. Already potentially eutrophic – and always has been eutrophic or potentially eutrophic since records started over 20 years ago,

4. Which has been designated as a "sensitive water" for 15 years, and

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5. Is right in the middle of both a cSAC and SAC, all the Harbour SPAs, and a pNHA.

6. Where all scientific advice (EPA, Marine Institute, NUIG Hydrography and Ph.D.) points to the danger of fuelling, to full-blown levels, the locally occurring toxic algal blooms,

7. Of the most dangerous kind to consumers of oysters – Paralytic Shellfish Poisoning,

8. In one of the densest production areas for oysters in the country,

9. With the value of our own Cork production being as much as 25-30% of national sales od oysters from 1980-1995, and with a new, apparently unlimited market emerging in Asia for Pacific Oysters,

10. Where these Oyster Fishery Orders, granted by the State, have preceded this IED application by 49 years in the North Channel and 56 years in the Lower Harbour,

We would hope very much that the EPA will regard this new, substantial discharge as a Key Pressure, that the polluter pays principle should hold, and that the discharge should be sent all the way to the open sea, giving Irish Water the chance to clean up the east side of the Harbour at the same time.

It is now worth considering the strength of the environmental case contained in the Pollution Reduction Programmes for the oyster fisheries, now that they are designated, together with all the essential environmental pre-requisite information, worked out in the Characterisation Report for our area, from which the likelihood of the pressures to impact on the shellfish water quality parameter values in the shellfish areas of Cork have been estimated.

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The EPA is charged with fully integrating the requirements of the European Communities (Quality of Shellfish Waters) Regulations, 2006 (as amended) into the EPA licensing process, for which they will then be the enforcing agency, as stated in PRP 5.1 Key Pressures, Overview:

"*The requirements of the European Communities (Quality of Shellfish Waters) Regulations, 2006 (as amended) have been fully integrated into the EPA licensing process. In addition this process takes into account the effect of viruses on the quality of shellfish waters. The licence will require detailed actions including infrastructural works, if required, by the licensee within specified time-frames if the discharge does not comply with the above Regulations.* ***Each licence granted will be subject to enforcement by the EPA.*** *Full details of each application and licence decision can be viewed online at www.epa.ie."*

These PRPs stem from the precursor Characterisation Report (sec. 10.3 below), defining the waters, and the PRPs are then scrutinised with a Strategic Environmental Assessment (sec. 10.4 below), before publication as PRPs (sec. 10.5 below). These first two documents contain many points that are relevant in considering this discharge application and are worthy of scrutiny first.

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10.3 Characterisation Report No. 39 Cork Great Island North Channel Area.

https://www.housing.gov.ie/sites/default/files/migratedfiles/en/Publications/Environment/Water/PublicConsultations-ShellfishWatersDirective2/FileDownLoad%2C22121%2Cen.pdf

This lays out the development and purpose of the PRPs.

In s. 1.2 **Shellfish water quality parameters**

We are told that,

"Compliance with the directive is measured against achievement of shellfish water quality parameter values outlined in Annex I of the Shellfish Waters Directive (2006/113/EC)"

This includes, as the last parameter of the Shellfish Waters Directive:

TABLE 1 - Parameters listed in Annex I of the Shellfish Water Directive (SWD)

Saxitoxin (produced by dinoflagellates)	No limit given	No limit given

Note that it is only the Saxitoxins, which give rise to Paralytic Shellfish Poisoning, of all the many different harmful algal blooms (HABs), that are mentioned specifically in the Directive.

s. 1.4 "The Directive and Regulations require that any non-compliances with the shellfish water quality parameters are identified. The Directive and Regulations further require that the factors responsible for such non-compliances are identified."

Information on impacts and pressures has therefore been collated in an individual characterisation report for each shellfish site from available inventories. The likelihood of the pressures to impact on shellfish water quality parameter values in the shellfish areas has been estimated.

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Section 2.0 describes the area and its catchment and s. 2.1 advises that the North Channel is a Protected Area under a cSAC and SPA and Cork Harbour is both an SAC and an SPA, with the North Channel being a proposed NHA (pNHA-1058), and together with the Owenacurra Estuary being also designated as a combined nutrient sensitive area.

3.0 Water Quality in the Shellfish Area

The EPA Marine Monitoring and WFD Monitoring Programmes are referred to on p.16 of the Characterisation Report.

The WFD paragraph refers on p.17 to the state of the transitional water body within which the oyster fishery is situated:

"The WFD status of the transitional water body, within which the shellfish area is situated, is "moderate" and therefore ***unsatisfactory,*** *reflecting the results of dissolved inorganic nitrogen and dissolved oxygen analysis in some of the samples. The two main transitional*

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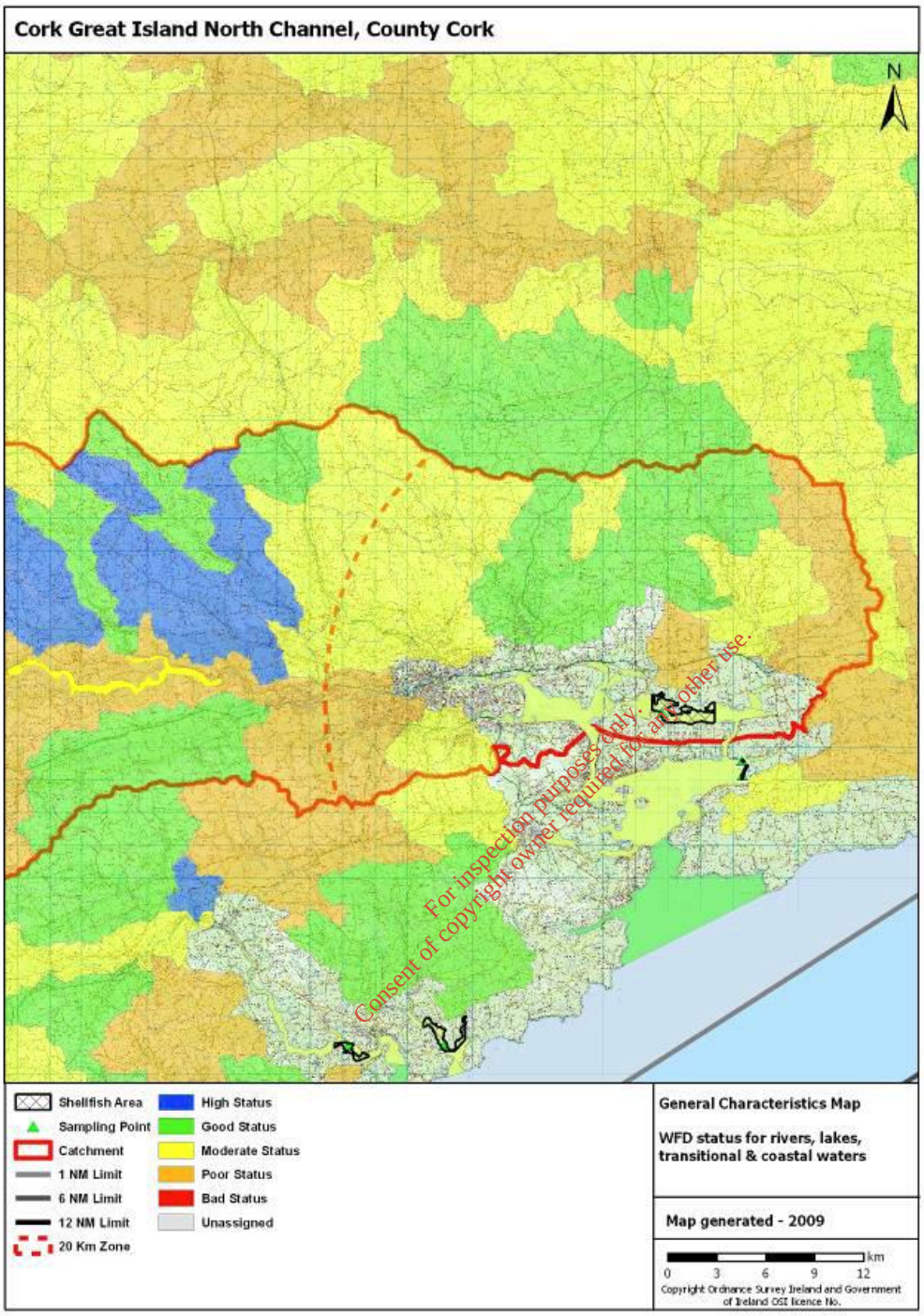
waters which discharge into the designated shellfish area are the Owenacurra Estuary and Lough Mahon. Both are considered 'moderate', and therefore ***unsatisfactory****, also reflecting the results of dissolved inorganic nitrogen and dissolved oxygen analysis and, in the case of the Owenacurra Estuary, the results of biological oxygen demand analysis and the status of fish populations.*

Thus the unsatisfactory nature of the Owenacurra Estuary is flagged up again as failing on the four counts of DIN, DO, BOD and the status of fish populations. Map 12 of the Characterisation Report also shows that the North Channel and Lower Harbour are both only of "moderate status", and **therefore of unsatisfactory quality**, as shown in yellow, below,

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MAP 12 - WFD surface water status



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The next EPA Envision map produced, showing the status of Coastal and Estuarine Waters in 2010-2012 gives the Lower Harbour as “Good” status, but shows both the North Channel and Owenacurra Estuary continuing to be of only “moderate” water quality and therefore deemed unsatisfactory.

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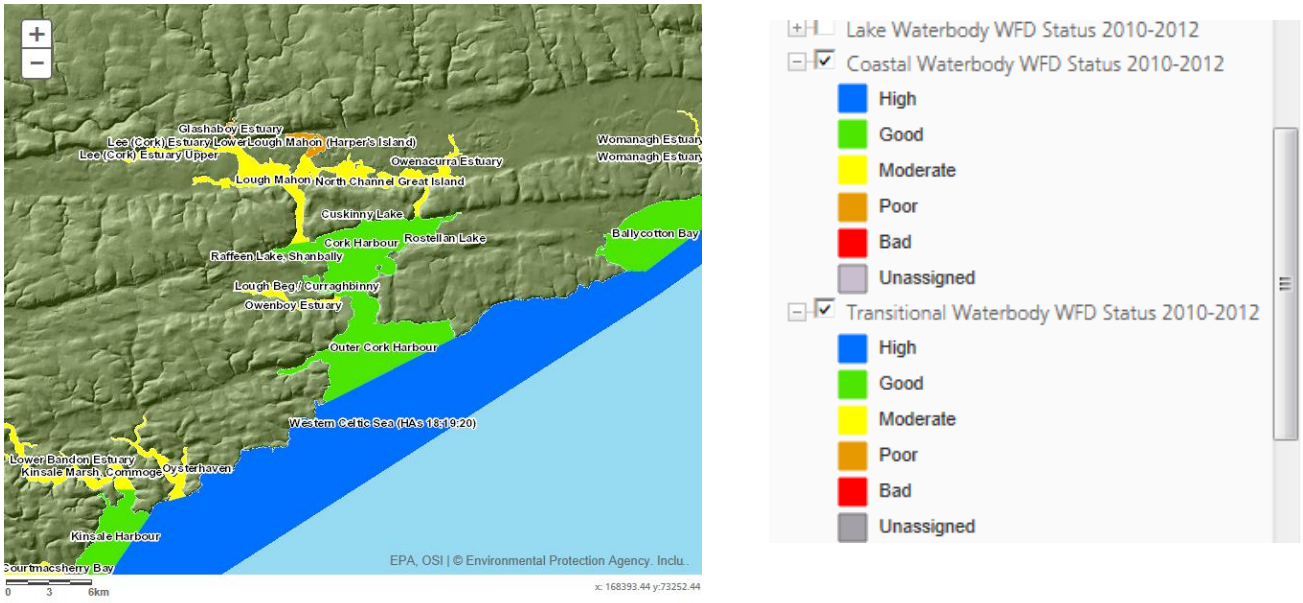


Figure 4.4 Status of Coastal and Estuarine Waters 2010-2012
Source: EPA Data from 2009-2011, downloaded from http://gis.epa.ie/Envision/

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10.3.1 Shellfish Flesh Monitoring Programme (Characterisation Report p.17)

"The licensed area is classified as Class B meaning that shellfish may be placed on the market for human consumption only after treatment in a purification centre or after relaying so as to meet the health standards for live bivalve molluscs laid down in the EC Regulation on food safety (Regulation (EC) No 853/2004). This indicates faecal contamination in this shellfish area.

A Prohibition Order has been in effect since 15th of October 2002 under the amended Regulations in relation to the harvesting and placing on the market of oysters from the North Channel area of Cork Harbour. This is due to viral contamination of the oysters. The Oyster production beds and depuration plant of the North Channel remain closed and viral monitoring in this area is ongoing. The latest Norovirus monitoring results show that this virus continues to be detected in the shellfish sampled in this area ***and no discernible change has been seen****. The levels show a strong seasonal trend and are at their highest during the winter months and may be absent during some of the summer months.*

As quoted above in s.10.1, the EPA has taken a pro-active stand, ahead of the rest of the EU, towards eliminating the scourge of norovirus in shellfish waters, which has now closed oyster fisheries in Cork, Waterford and Donegal (in particular, from the blossoming and very lucrative markets in Asia), by requiring that the "*effect of viruses on the quality of shellfish waters",* be taken into account.

To this end, in 2011 the EPA put out a paper on,

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10.3.2 "Guidance on Conducting an Assessment of the Impact of Discharges from a Waste Water Works on the Microbiological Quality of Shellfish in Adjacent Designated Shellfish Waters" [18]

This has now reached version 4 in 2016

In this last version, the EPA adds a footnote on p.1 to the effect that although the Shellfish Waters Directive had been subsumed into the WFD, its standards should still be applied:

"*The EPA notes that while the Shellfish Directive is repealed the wider obligation to protect and improve Protected Areas under the Water Framework Directive applies. In this regard the EPA considers that the standards specified in the shellfish regulations are the most appropriate for use at present and advise that impacts of waste water discharges are assessed against these".*

After setting out the process to assess any impact of a Waste Water Work on a Shellfish Water, important new wording has been added to Sec. 4 on "Assessment Reporting":

"*A report on the assessment and findings should be compiled including details of consultation with the consultees. Any comments and recommendations received from the consultees should be addressed in the final report,"*

and continues that even if an assessment does not satisfactorily conclude whether discharges are impacting on the shellfish water, the EPA have adopted a precautionary approach to the protection of these waters:

"***It is noted that the EPA have adopted a precautionary approach to the protection of shellfish waters*** *and may require that appropriate disinfection or other suitable measures are implemented in the event that an assessment does not satisfactorily conclude whether discharges are impacting on the shellfish water. The EPA will decide on such cases on an individual basis and following assessment of the report and where necessary consultation with the consultees".*

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This Guidance Document is aimed at the much more frequently met microbiological danger to human health from human sewage, for which the Characterisation Report (see above) and the final PRP advise that the latest Norovirus monitoring results show that this virus continues to be detected in the shellfish sampled in this area and no discernible change has been seen, but in objective severity to human health, PSP which can more often end in death, must be considered as being more dangerous.

Only the North Channel of Cork Harbour, in the whole country, suffers every summer from significant blooms causing PSP of differing severity.

[18] Guidance on Conducting an Assessment of the Impact of Discharges from a Waste Water Works on the Microbiological Quality of Shellfish in Adjacent Designated Shellfish Waters" EPA September 2016

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10.3.3 Harvesting of oysters allowed in Cork Harbour as from October 2018.

Despite the information in the paragraph 10.3.1, above, we can report that the oyster fisheries of the North Channel and Lower Harbour have recently been allowed to apply to resume production, after drawing up a HACCP to cover our procedures to guard against all risks to human health, which might arise from the consumption of our oysters, and it is our intention to quickly get back to the level of production we reached 20 years ago of 200-300 tonnes p.a. and the employment of 20 full and part-time staff.

With the improving water quality in the Harbour and the development of strong markets in Asia, especially for high-quality Irish oysters, we believe we can increase our pre-2002 shipments of 500-800kg weekly to those markets up to ten-fold, (5-8 tonnes p.w), with employment for 50 men.

10.3.4 Other discharges to this Shellfish Water.

Table 15 Section 4 Licences on p.67/8 of the Characterisation Report shows those IPPC industries at present discharging to waters in the catchment and assessed by the WFD as potentially putting the waters at risk.

We note that Irish Distillers Ltd. are described as discharging at 10-20km away from the Shellfish Water, but, of course, they have long had a licence to discharge up to 5,000m3 through the Rathcoursey diffuser. The potential growth of this already permitted discharge does not appear to have been taken fully into account in the Irish Water and now Dairygold applications and it was the WYG "Alternative Outfall" Report in sec. 5.4, which reports that the present foreshore holding tank is sufficient really only for the licensed discharge of IDL (see sec. 9.1 re sec.4):

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"The total daily licensed discharge from IDL is 5,000m3/day with a peak discharge of 270m3/hour. On the basis of these figures the required storage volume at Rathcoursey tidal holding tank to accommodate discharges from IDL only is 1,667 – 2,160m3. As a result the existing Rathcoursey tidal holding tank has sufficient capacity to provide the required storage retention time to cater for treated effluent discharges from IDL only"

Another discharge into the North Channel Shellfish Water comes from Irish Asphalt Ltd. which is situated on the edge of the North Channel to the west of our beds in Rossmore Bay and it is of significance, in this context of safeguarding the receiving water quality, or in the strategic planning advice of:

"*Having regard to the site's history and locational context including potential impacts on the adjoining Great Island Channel SAC and Cork Harbour SPA as well as other cumulative impacts",*

that the Company has had to install "*a new infiltration pond system to manage groundwater"* in the form of a 2 hectare lagoon lined with 3mm HDPE membrane, at a cost of €1-2 million, to allow just suspended solids, in the form of nutrient-free limestone dust, to sediment out before discharge to the waters of the North Channel.
http://www.tpa.ie/projects/rossmore-quarry/

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We are certainly very grateful for this, as these “fines” only cause oyster-beds to silt up with the risk of smothering stock and especially the 2-3mm spat, which we produce in the breeding ponds and then scatter at that size on the beds. However, the addition of extra nutrients to the North Channel is of danger to human health via PSP blooms and an order of magnitude more serious, and it is only right that the precautions insisted upon should be commensurately more onerous even than this lined lagoon below:

Fig. Settlement lagoon required of Irish Asphalt Ltd.
through which to dispose of quarry groundwater to the North Channel at Rossmore.


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10.4 Strategic Environmental Assessment (SEA) of the proposed Pollution Reduction Programmes for Waters Designated under the EU Shellfish Waters Directive.

SEA Statement - Cork Region January 2010

https://www.housing.gov.ie/sites/default/files/migratedfiles/en/Publications/Environment/Water/PublicConsultations-ShellfishWatersDirective2/FileDownLoad%2C22706%2Cen.pdf

p.4 “*The SEA Statement includes the following information:*

• *Summary of how environmental considerations have been integrated into the PRPs;*

p.7 “*The PRPs will be reviewed at intervals not exceeding three years and, where necessary, at lesser intervals if the monitoring data, either from the Marine Institute monitoring*

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programme or other sources such as monitoring carried out under the WFD, indicates deterioration in water quality status ***or a risk that the objectives or standards laid down in the EU Shellfish Waters Directive*** *(and its associated Regulations) will not be achieved.*

p.8 last line, "*It should also be noted that the PRPs and their accompanying Characterisation Reports will be dynamic documents reflecting up-to-date legislation, current monitoring and the* ***outputs from further investigations. It is anticipated at this time that further sources of baseline information will be consulted and incorporated, where relevant.***

I imagine that if the NUIG hydrodynamic papers had been available in 1984, M C O'Sullivan could not have claimed that the lack of any material difference between continuous and intermittent discharges in his 1977 dye studies (see sec. 5.3) just meant that the tidal holding tank was not needed – when it really showed that neither discharge was exiting the harbour to any marked extent and even without the advanced computers now available, by 1993 Irish Hyrdrodata could have run the Brown Island current meter results for a complete cycle of several days to check that the very obvious flood tide current being so much stronger than the ebbs, actually led to the true result of a residual westerly, inland water movement.

Hopefully, this has to be taken into account now as a "*further source of baseline information that can be incorporated"* and, as in sec. 4.4 in the next paragraphs, *"results of further investigations become available".*

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p.10 s. 4.3 "*The functions of particular importance, in light of the objectives of Directive 2006/113/EC and of this PRP, include effluent discharge licences and planning and development, among others.*

s. 4.4 *"As the monitoring database grows,* ***results of further investigations become available*** *and programmes are implemented, incremental changes will be made to the PRPs to ensure compliance with the standards and objectives established. As such, the PRPs and their accompanying Characterisation Reports will be dynamic*

p.12 s. 4.6 "***Recommendation:*** *When the PRPs are reviewed prior to their incorporation in the second cycle RBMPS, it is recommended that review of the Strategic Environmental Objective for Water be carried out,* ***including consideration of broadening the Objective to assess the extent to which the PRPs will support meeting the relevant wider objectives of the WFD,*** *e.g.* ***support achievement of Good Chemical Status.***

5.2 SUMMARY OF THE SEA ASSESSMENT

5.2.1 *Assessment methodology.*

"The approach used for the assessment in the SEA is termed an 'objectives led assessment'. In this case, each of the alternatives considered was tested against defined SEA Environmental Objectives (Box 6.1), which are separate to the PRP objectives and cover each of the SEA environmental topic issues from the legislation".

Box 6.1 of Environmental Objectives lists as

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"Objective 3 "

"Protect and reduce risks to human health related to consumption of shellfish."

5.2.4 Summary of Cumulative and Synergistic Impacts

The primary cumulative/synergistic impacts that have been identified include cumulative improvements in water quality leading to positive cumulative impacts to aquatic biodiversity, flora and fauna, both within the designated shellfish areas in the Cork region as well as across the coastal areas of the country as a whole due to the implementation of PRPs for all designated shellfish areas. ***Also, a cumulative positive impact to human health would result from implementation of the PRPs due to an improvement in water quality in the designated shellfish areas.***

*"****A number of alternatives call for the construction of new or upgraded infrastructure****. These would contribute to sustainable development in the region….."*

*"****A number of the physical modifications alternatives have considerable potential to improve the environment individually or cumulatively if implemented correctly****:"*

"The cost associated with implementation of many of the alternatives could result in potential cumulative negative impacts to both individuals and local authorities, for which no mitigation may be available. ***However, cumulative positive impacts would be experienced by those economic sectors reliant on good water quality including the commercial aquaculture industry."***

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10.5 Shellfish Pollution Reduction Programmes for Cork Harbour (2010 & 2012)

There are three of these. This is for Rostellan North PRP:

https://www.housing.gov.ie/sites/default/files/migratedfiles/en/Publications/Environment/Water/PublicConsultations-ShellfishWatersDirective2/FileDownLoad%2C22136%2Cen.pdf

These PRPs were drawn up by the Department of the Environment and are monitored by the SFPA and Marine Institute in consultation with the EPA under S.I. No. 268 of 2006 EC (Quality of Shellfish Waters) Regulations 2006 Sec. 5 (3) – "*The object of these Regulations is to give effect in the State to Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters".*

The PRPs are then enforced by the EPA under sec. 5 Action Programme, below.

1.1 Programme Objective

"Compliance with the standards and objectives established by the Quality of Shellfish Waters Regulations 2006 (S.I. No. 268 of 2006) (as amended) for the designated shellfish growing

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waters at Cork Great Island North Channel and with Article 5 of Directive 2006/113/EC of the European parliament and of the Council on the quality required for shellfish waters.

1.2 Pollution Reduction Programme

"This pollution reduction programme for the shellfish growing waters at Cork Great Island North Channel has been established by the Minister for the Environment, Community and Local Government in order to protect and improve water quality in the designated shellfish growing areas in the North Channel, Cork Harbour and in particular, to ensure compliance with the standards and objectives for these waters established by the 2006 Quality of Shellfish Waters Regulations (S.I. No. 268 of 2006) and with Article 5 of Directive 2006/113/EC of the European parliament and of the Council on the quality required for shellfish waters.

1.3 Supporting Characterisation Report and Toolkit of Measures

"The characterisation report thus provides a prioritised list of pressures/impacts/effects on water quality. The pollution reduction programme or action plan takes this prioritised list and addresses each issue with actions to help ensure that compliance with the relevant water quality standards is achieved or ensured.

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2.0 Status/Impacts

"The results of Shellfish Water monitoring do not indicate any water quality issues within/in the vicinity of this shellfish area. ***However due to the previous water quality issues with dissolved oxygen and dissolved inorganic nitrogen within/in the vicinity of this shellfish area it is prudent to continue with the actions outlined in this Pollution Reduction Programme.***

3.0 Key pressures are identified as WWTPs

5.0 *Action Programme – Measures*

5.1 Key Pressures – UWWTPs, with Potential Secondary Pressures listed in s. 5.2:

"Overview:

A system for the licensing or certification by the EPA of waste water discharges from areas served by local authority sewer networks was established in accordance with the requirements of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007).

"In accordance with these Regulations the EPA is not allowed to grant an authorisation for a waste water discharge, which, in the opinion of the EPA, would:

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• ***cause a deterioration in the chemical status or ecological status (or ecological potential as the case may be) in the receiving body of surface water,***

• ***exclude or compromise the achievement of the objectives*** *established for protected species and natural habitats in the case of European sites where the maintenance* ***or improvement of the status of water is an important factor in their protection or which is inconsistent with the achievement of environmental quality standards established under national Regulations in relation*** *to designated bathing waters,* ***designated shellfish waters****, areas designated for the protection of freshwater fish and areas designated for the abstraction of water intended for human consumption.*

"The requirements of the European Communities (Quality of Shellfish Waters) Regulations, 2006 (as amended) have been fully integrated into the EPA licensing process In addition this process takes into account the effect of viruses on the quality of shellfish waters….. ***Each licence granted will be subject to enforcement by the EPA.***

5.2 Potential Secondary Pressures.

"Future Development.

Under Article 4 of the European Communities (Quality of Shellfish Waters) Regulations 2006 (S.I. No. 286 of 2006) (as amended), every public authority that has functions the performance of which may affect shellfish waters shall perform those functions in a manner that will promote compliance with the objectives of this pollution reduction programme and with the objectives of the Shellfish Waters Directive.

The functions of particular importance – in light of the objectives of Directive 2006/113/EC and of this PRP – include waste water treatment (licensing and operations),……effluent discharge licences……..

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"p.14 Annex 2 - Mitigation Recommendations from the SEA process

*"The Strategic Environmental Assessment carried out for the Shellfish PRPs has highlighted potential positive and negative environmental impacts (****including cumulative impacts****) associated with implementation of the range of measures outlined in the National Toolkit of Measures, all of which are aimed at controlling pressures which impact on shellfish water quality.*

"In most cases, the PRPs identify the need for further investigation to supplement existing information on the types and extent of the pressures which are currently affecting shellfish water quality.

National Toolkit Measure

WW10 Waste Water Treatment Plants	***Associated Mitigation Measure***
Relocate the point of discharge.	*A Habitats Directive Assessment will be required to demonstrate that the relocation will not negatively impact on protected areas.*

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11. An updated Appropriate Assessment under the Habitat's Directive may be required

I am very grateful to the EPA for requiring an Appropriate Assessment in respect of this Dairygold Licence request, by their letter of 28 March 2019, but hope that these comments, which follow, are still worth adding.

Great Island Channel SAC covers the whole of the North Channel. Although the main land use is stated as being for the production of oysters, the Atlantic salt meadows are included in the qualifying interests for the SAC:

p.1 Introduction:

While the main land use within the site is aquaculture (Oyster farming), the greatest threats to its conservation significance comes from road works, infilling, sewage outflows and possible marina developments.

The following coastal habitat is included in the qualifying interests for the SAC (denotes a priority habitat):*

• *Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (ASM) (1330)*

The Rathcoursey discharge is said to be 10-15 metres south of the southern boundary of the SAC, but that clearly is of very little consequence, as when the tide turns, the water in East Ferry floods back into the North Channel (74%) and Owenacurra Estuary (26%) at speeds up to 3 knots (Admiralty Chart).

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An important ruling on the recent proposed €500m liquefied natural gas terminal on the River Shannon was made in the High Court on 15th February 2019 on an Appropriate Assessment, because it was held that *"new scientific information leading to the site being declared a 'critical area' for the bottle nosed dolphin",* had been put forward.

The Irish High Court Judge cited various ECJ (Court of Justice of the EU) rulings in s.35,

"The CJEU has considered what is required by an "appropriate assessment" in a number of judgments. In Mechanical Cockle Fishing case (Case C-127/02 Waddenzee), the CJEU stated that an "appropriate assessment" implies that all the aspects of the plan or project which can, by themselves or in combination with other plans or projects, affect the site's conservation objectives must be identified in the light of the best scientific knowledge in the field. In Case C 404/09 Commission v. Spain, ***the CJEU held that an assessment cannot be regarded as "appropriate" if it contains gaps and lacks complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the proposed works on the site concerned****. This requirement has been restated in more recent judgments, including Case C 258/11 Sweetman, [44] and Case C 521/12 Briels".*

but decided that there were still questions that need decisions from the EU and sent these back to the ECJ. It was reported by the Friends of the Irish Environment that:

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"Ireland's failure to first transpose the E.U. Directive properly and then to implement it correctly affects many cases. ***The terms of the Irish Courts' questions give the ECJ the first opportunity to consider if extensions of planning permission require reassessment because of the passage of time and developments of scientific knowledge about the environment.****"*

In the case of the North Channel SAC and the Appropriate Assessment (AA) made by Dairygold, no mention at all was made of the EPA advice that no further nutrients should be added to this inner part of Cork Harbour (Costello et al 2001; McGarrigle et al 2002 – see sec. 6.2.3 above) because of encouraging significant blooms of PSP dinoflagellates, with, in fact, no mention at all of this threat to the main land use of the North Channel in the AA.

Nor is there any assessment of the new scientific work of the highly sophisticated NUIG Hydrodynamic team published in 2005, 2011 and 2012 on the enormously high residence times of 48-70 days, calculated for the waters of the NE Harbour at Rostellan and in the North Channel. Nor in the AA, or indeed at the time of their collection in 1973, were the Brown Island current meter records run on the computer to quantify the obvious-to-the-eye residual inland flow of the water from Rathcoursey to Belvelly, rather than out to the Lower Harbour and open sea.

Although the Habitats Directive does not list the Native Oyster (*Ostrea edulis*) in its 1992 Annexes, I believe that this species has some claims to be considered in its own right, under Appropriate Assessment, as, since the Directive was issued, it has been classed as endangered by both the Rio 1992 Earth Summit and its Convention on Biological Diversity and then, in 2003, the OSPAR Commission added *O. edulis* to its list of threatened species.

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11.1 The Habitats Directive

It is important to understand that the original list of endangered species contains many species other than birds and that they have all been specifically included to ensure that the species listed in the Habitats Directive reach a favourable conservation status within the EU.

The European Commission introduces the point of the Directive on its website:

http://ec.europa.eu/environment/nature/conservation/species/habitats_dir_en.htm)

*"In order to ensure the survival of Europe's most endangered and vulnerable species, EU governments adopted the Habitats Directive in 1992 (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora**). Together with the Birds Directive, it sets the standard for nature conservation across the EU and enables all 27 Member States to work together within the same strong legislative framework in order to protect the most vulnerable species and habitat types across their entire natural range within the EU.*

The Habitats Directive protects around 1200 European species other than birds which are considered to be endangered, *vulnerable, rare and/or endemic. Included in the Directive are mammals, reptiles, fish, crustaceans, insects,* ***molluscs****, bivalves and plants. The protection provisions for these species are similar to those in the Birds Directive. They are designed to*

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ensure that the species listed in the Habitats Directive reach a favourable conservation status within the EU".

In the *"Guidance document on the strict protection of animal species of Community interest under the Habitats Directive 92/43/EEC*", produced as the Final Version by the Commission in February 2007

http://ec.europa.eu/environment/nature/conservation/species/guidance/pdf/guidance_en.pdf

Section (35) envisages changes to the original Annexes:

" Since the development of these annexes, however, research and monitoring have developed further and the conservation status of a number of species may have changed, so that the picture today might be different from the one in the late 1980s/early 1990s when the Directive was prepared."

Only this week, May 2019, 450 scientists met in Paris to come up with a 1,500-page report for the United Nations suggesting that 1 million of the planet's 8 million species of plants and animals are now at risk of going extinct because of human activities. The summary from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPEBS) was unanimously approved by more than 130 nations, including the United States.

It was reported that many of the worst effects can be prevented by changing the way we grow food, produce energy, deal with climate change and dispose of waste.

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In 2008 the EU Commission began to support the development of Species Action Plans for selected species listed in the Habitats Directive. The plans are intended to be used as a tool for identifying and prioritising measures to restore the populations of these species across their range within the EU. They provide information about the status, ecology, threats and current conservation measures for each species and list the key actions that are required to improve their conservation status in Europe. Each Plan is the result of an extensive process of consultation with individual experts in Europe.

11.2 Native Oyster Species Action Plan (NOSAP)

Thus, although the Native Oyster *(Ostrea edulis)* was not listed in the Annexes to the 1992 Directive, it has been classed as an "endangered species" in the UK for the past 20 years, with its own Biodiversity Action Plan (Native Oyster Species Action Plan (NOSAP) of 1999, under the Convention on Biological Diversity of the1992 Rio Earth Summit.

There were no less than three European Conferences held last year dealing with the plight of the Native Oyster in Europe and a fourth is being held at the Royal Society, Edinburgh, as I write this (7th May 2019), with 29 papers on Native Oyster Restoration in Europe and 10 Poster Sessions. One of the largest of the trials reported on is by the University of Portsmouth, which starts its abstract with,

"The UK's native oyster, Ostrea edulis, has been identified as one of the most threatened species in the UK, requiring conservation action. The decline of the native oyster population

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over the last 25 years was critical in its priority species classification in the UK's Biodiversity Action Plan, also resulting in ecosystem services associated with oyster beds."

11.3 The OSPAR Commission adds "*Ostrea edulis* and *Ostrea edulis* beds" to its list of threatened species in 2003.

In 2003 the survival situation for *O. edulis* around Europe was so bad that the OSPAR Commission added *O. edulis* to its list of threatened species and produced a Background Document for the conservation of *Ostrea edulis* and *Ostrea edulis* beds in 2009:

https://qsr2010.ospar.org/media/assessments/Species/P00428_ostrea_edulis_and_beds.pdf

This document explains in the Executive Summary:

"This background document on Ostrea edulis and Ostrea edulis beds has been developed by OSPAR following their inclusion on the OSPAR List of threatened and/or declining species and habitats (OSPAR agreement 2008-6). The document provides a compilation of the reviews and assessments that have been prepared concerning ***Ostrea edulis and Ostrea edulis beds since the agreement to include them in the OSPAR List in 2003****. The original evaluation used to justify their inclusion in the OSPAR List is followed by an assessment of the most recent information on status (distribution, population/extent, condition) and key threats prepared during 2008-2009. Chapter 7 provides recommendations for the actions and measures that could be taken to improve their conservation status. On the basis of these recommendations, OSPAR will continue its work to ensure the protection of Ostrea edulis and Ostrea edulis beds, where necessary in cooperation with other organisations. This document may be updated to reflect further developments.*

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p.6 ***"Original Evaluation against the Texel-Faial criteria for which the feature was included on the OSPAR List"***

O.edulis was nominated for inclusion on the OSPAR List with particular reference to global/regional/importance, rarity, decline, role as a keystone species, sensitivity and threat, and as a priority for OSPAR Region II. Additionally, O.edulis beds have been nominated as a habitat.

The North Channel *O.edulis* beds are mentioned in this document on p.6:

"Until recently Cork harbour produced between 30 and 60 tonnes annually within an oyster growing area. It has been closed for harvest due to virus problems".

In the Preliminary Map (Fig. 1) on p.9 the current distribution of *O.edulis* beds in Europe are shown. Our production from the ponds in Cork was considerably greater than those beds shown in England, Scotland and the Netherlands and, as mentioned in sec. 1 above, we can produce as much as 25% of the entire current French production. This has been due to our uniquely successful breeding for disease-resistance over 27 years using the ponds.

We cannot continue to keep this up, however, if we are unable to sell our produce in winter, because of the current closure, but it will be very difficult to develop the Asian market for

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pacific oysters *(Magellana gigas)*, which can be sold throughout the summer, if we are in constant danger of encountering higher levels of PSP due to larger *Alexandrium* blooms.

Table 1 on p.12 lists in the summary of key threats to *O. edulis*, the threat of pollution from:

"Land-based and marine industrial or commercial sources", noting the specific threat that:

"*Eutrophication may lead to excessive algal blooms, leading to low oxygen levels",*

though in our rare scenario, they will be toxic algal blooms leading to serious human health problems.

12. Danger from operator error etc.

In April 2013 Dairygold was convicted at Midleton District Court by Judge Brian Sheridan of three charges under the 1959 Fisheries Consolidation Act and the Local Water Pollution Act. Dairygold was fined the maximum possible under the legislation which was €12,000.

It was thought that 20,000 juvenile salmon, trout and lamprey eel had been killed in the River Kiltha, because an operator accidentally let 150 litres of insecticide run into the river. The Inland Fisheries Inspector is reported as advising the judge that it would have required 50,000 dilutions "*to bring it down to a safe level*".

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Some of these biocides can work at extremely low levels especially on the planktonic, larval forms, such as we breed in our 20,000m3 pond-breeding complex on Brick Island. Tri-butyl tin, for instance, was banned world-wide as a boat anti-fouling because it was found to affect the larval forms of sea-life at parts per billion. For instance, shipping in the English Channel using TBT on their hulls, was found to have been responsible for the elimination of dog-whelks along much of the length of the English and French channel coasts. In Cork Harbour the effect of TBT on shell deformation in Pacific Oysters is still measurable.

It would be extremely difficult for us ever to detect or prove such transient effects on our planktonic oyster larvae, but it could have devastating consequences to producing crops of shellfish worth millions of euros. As well as our own earlier production of 200 tons p.a. of oysters, Fota Oyster Farm, now under French ownership, continues to produce more than that in the North Channel.

13. Environmental safety - a belt and braces approach is required.

In the USA, the public has, for a long time, been protected from receiving contaminated oysters by placing a buffer zone around a point of discharge and the EU is expected to shortly follow suit to protect shellfish waters from municipal discharges. The size of buffer zone depends on the dilutions available at the discharge point and on the degree of contamination that might come down the pipe. For municipal discharges, unless, for instance, a WWTP can be guaranteed to be operating all the time within its design parameters, without exceptions that have not been agreed in advance, a dilution of 100,000:1 is required, see pp.292-303 on

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the FDA's "National Shellfish Sanitation Programme (NSSP) - Guide for the Control of Molluscan Shellfish. 2015 Revision":

https://www.fda.gov/downloads/food/guidanceregulation/federalstatefoodprograms/ucm505093.pdf

This is therefore now putting a figure on M.C. O'Sullivan's Cork Harbour Pollution Report of 1977's "*substantial dilution*" required for municipal and other discharges.

Such dilutions are simply not available at Rathcoursey.

Although the Dairygold discharge should not be immediately dangerous either to the oysters or members of the public, who consume them, adequate dilution is quite definitely needed as insurance against mishaps and the very real possibility of tipping the balance towards serious blooms of PSP in the North Channel.

I have quoted the mishap that occurred at the Dairygold creamery. The judge is quoted as wondering, "*if the penalties match the offence, but that is not a matter for me"* – and, indeed that was the maximum fine he could impose under the law.

It is worth noting that since then, in the UK, there has been a new Environmental Offences Definitive Guideline produced by the Sentencing Council in 2014

https://www.sentencingcouncil.org.uk/wp-content/uploads/Final_Environmental_Offences_Definitive_Guideline_web1.pdf

and that this has now been tested by the UK Court of Appeal in February 2015

http://www.hse.gov.uk/enforce/documents/thames-water-utilities-ewca-crim960.pdf

which has stepped up markedly the seriousness with which negligence over environmental matters is being held.

The Court of Appeal stated, in upholding the fine of £250,000, that, "*but for mitigating factors and a prompt plea of guilty at first opportunity",* the fine would have been not less than £500,000 and, more importantly, added:

39. *"…to bring the message home to the directors and shareholders of organisations which have offended negligently once or more than once before, a substantial increase in the level of fines, sufficient to have a material impact on the finances of the company as a whole, will ordinarily be appropriate. This may therefore result* ***in fines measured in millions of pounds.***

40. "*…the objectives of punishment, deterrence and the removal of gain (for example the decision of management not to expend sufficient resources in modernisation and improvement) must be achieved by the level of penalty imposed.* ***This may well result in a fine equal to a substantial percentage, up to 100% of the company's pre-tax net profit for the year in question….even if this results in fines in excess of £100 million."***

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Fines in the UK have now moved forward from the situation up till April 2010, when the maximum fine that could be imposed for a single environmental offence by a Magistrate's Court was £20,000, with fines now being imposed of six and seven figures, up to the maximum to date when Thames Water was fined £20.3m in March 2017 for polluting the Thames with 1.4 billion litres of untreated sewage, (1.4 million m3) from 3 sources over two years – on the basis of awarding fines commensurate with the size of the Company, as stated in the Court of Appeal decision.

13.1 The Rio Declaration on Environment and Development: Principles of Prevention and Precaution.

The Principle of Prevention in the Rio Declaration on Environment and Development is Principle No. 2. It is enshrined in numerous Conventions on the marine environment, climate, waste, biodiversity etc. It finds expression in primary and secondary EU law in Art. 192 (2) Treaty of the Functioning of the EU (TFEU) and is implemented through secondary legislation such as the Industrial Emissions Directive, Environmental Impact Assessment Directive and the Waste and Water Framework Directives.

The Precautionary Principle (Rio Principle No. 15) which should surely have been followed here is:

"*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."*

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14. Overview

I hope very much that the EPA will agree with me that Ireland has now realised in the following declarations,

14.1 Ireland's "green, clean, marine" credentials are of real value.

e.g. "*Harnessing Our Ocean Wealth - An Integrated Marine Plan for Ireland"* - July 2012 (a whole-of-Government initiative under the Minister for Agriculture, Food and the Marine)

Foreword by An Taoiseach :

"*As Taoiseach, I want to see us reconnect to the sea in a way that harnesses the ideas, innovation and knowledge of all our people, at home and abroad. I want to see us setting out to secure for ourselves and our children the social, cultural and economic benefits that our marine assets can deliver."*

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"I want to send out the strongest signal that government is going to back this dynamic report all the way. There will be a strong focus on the State getting the conditions right so that we can promote investment and enable growth."

p.*26 Enablers - "Clean - Green - Marine"*

"Healthy marine ecosystems, including a clean, green environment, are not only an essential goal for achieving our vision; they are also an important enabler for harnessing our ocean wealth. Ireland's clean green image plays a critically important role in the promotion of marine products and services (e.g. in our food and tourism sectors). ***The future growth of our marine industries depends on protecting our clean, green image, e.g. through implementation and compliance with environmental legislation****. Equally, we need to promote and raise awareness amongst the public, investors and entrepreneurs that Ireland is open for, and a good place to do marine business."*

14.1.2 Complying with EU Directives gives the country "competitive advantage";

p.36 "*We enjoy a reputation for a clean, green marine environment, which benefits many of our marine enterprises (e.g. seafood, tourism and leisure) and this plays a critical role in the promotion of marine products and services. The future sustainability and growth of our marine industries depends on protecting the credibility of this clean, green image.* ***The protection of our marine ecosystems and compliance with national and international environmental legislation are essential components of our sustainable future - compliance is a competitive advantage."***

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14.2 Complying with the many EU Directives dealing with the priority of safeguarding human health.

As, of course, in the two Shellfish Waters Directives (SWDs), in whose first Articles the point of the Directives is laid down, which,

"*concerns the quality of shellfish water…..and thus to contribute to the high quality of shellfish products directly edible by man."*

The SWDs are now subsumed into the Water Framework Directive (2000/60/EC) and more specifically the Marine Strategy Framework Directive (2008/56/EC) of 17.06.08, which, though not yet transposed into Irish law, has noteworthy preamble:

(3) The marine environment is a precious heritage that must be protected, preserved and, where practicable, restored with the ultimate aim of maintaining biodiversity and providing diverse and dynamic oceans and seas which are clean, healthy and productive", and

(27) *Member States should then establish and implement programmes of measures which are designed to achieve or maintain good environmental status in the waters concerned, while accommodating existing Community and international requirements and the needs of the marine region or sub-region concerned.* ***Those measures should be devised on the basis of the precautionary principle and the principles that preventive action should be taken, that***

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environmental damage should, as a priority, be rectified at source and that the polluter should pay.

14.4 In the words of the Cork Harbour Draft Study of 2011[19]

p.149 that, "*the recent designation of shellfish waters within the harbour is a step forward in the protection of marine waters*".

14.5 In the 1977 words of M.C. O'Sullivan in the Cork Harbour Pollution Report,

that, "*standards which seem perfectly reasonable and acceptable to us at present, may not be acceptable in a more affluent and sophisticated society in 30 years' time".*

15. Summary

My hope is that this further retrograde step, now 50% later than the 30 years foreseen by M.C. O'Sullivan in his 1977 CHPR, of proposing the disposal of industrial waste to such a shallow, nearly eutrophic backwater of Cork Harbour, 12 km from the open sea, with a computed water-residence time of more than 60 days, can be re-thought. Such an area, of such rarity value for the production of some of the finest quality oysters in Europe; that helps to preserve this threatened species for posterity; and, at the same time, employs 20-50 people, must be too precious to have its future risked, in the way sought by this application.

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I very much hope that the EPA will require that Dairygold be asked, again, to come up with ideas more worthy of a forward-looking company, to cover properly the request in the County Council's letter of February 2018 that they required,

"*A report on the options considered for effluent disposal and the basis for the decision to discharge at Rathcoursey. Consideration of alternatives in the EIS should consider this proposal compared to other potential options for the discharge of process waste."*

I believe, however, that there is a real chance now, with a bit more thought, to turn this disastrous and ill-conceived plan, which is now being dictated by freely-admitted commercial time constraints, into a real opportunity for Irish Water to work with Dairygold and take the chance to clean up the whole east side of the Harbour by following Irish Water's Mott MacDonald Concept Design Report, Option No. 3,

"…to abandon the existing outfall at Rathcoursey, and develop a new sea outfall to the east of Cork Harbour at Ballycroneen. An outfall to the sea would avoid any impact on the Shellfish Waters near Rathcoursey and no tidal holding tank would be required. The required treated standards would also be less stringent and the existing UV filters at Midleton WWTP could be (de-)*commissioned."*

[19] Cork Harbour Draft Study, Cork County Council's Forward Planning Section for the Mayor and County Manager of Cork. April 2011

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by the laying of a pipeline, or making use of the soon-to-be defunct 600mm Kinsale Gas pipeline, to discharge the creamery waste, together with the effluent from an over-stretched WWTP, to the open sea at Ballycroneen.

There would be many advantages for such a co-operation with Irish Water on this:

1. It would be substantially paid for by grant-aided funds, possibly from the EU, necessary for the sought-for creamery expansion.

2. There would be no need of the new 2km pipeline from Bawnard Cross to Rathcoursey with road closures and presently wayleave difficulties from apparently six local landowners owning stretches of this road.

3. Option 3 anticipates that the pipeline route to Ballycroneen will be along public roads, where no such wayleaves will be required.

4. There would be no storage tanks to be built to comply with the current 3-hour ebb tide discharge requirement.

5. The certainty and subsequent criticism that this expense would not solve the waste dispersion problem anyhow and that valuable funds were being totally wasted, would no longer arise.

6. By switching the modus operandi of the WWTP to that of a conventional activated sludge plant, instead of extended aeration with a 5 DWF re-cycle, its capacity to receive larger volumes from the town could be substantially increased.

7. This could go some way to reducing the situation of overflows to the rivers from the pumping stations, about which the EPA tells us a report has specifically been sought by the EU Commission.

8. Midleton could also get rid of genuine storm-event overflows directly to the open sea, to alleviate the EU's concern on their current status and diverting them away from the "potentially eutrophic" Owenacurra Estuary.

9. The infrastructure for doing this is in place in Bailick 1 pumping station. Though this is not ideal, it would be very much better than keeping the Owenacurra Estuary in its "potentially eutrophic" state and the discharge would have the infinite dilution of the open sea.

10. It could enable Midleton to solve, in the short-term, its huge ground-water infiltration problem, saving enormous disruption to the town's sewers and streets to remediate that, as currently planned.

11. Total flows to the outfall are kept artificially low in the Consultants' Reports (Table 3.1), by assuming no growth from 2016 levels in the town discharge until 2025, when they leap overnight from 21,468 to 32,000m3/day. Without a pipeline to receive the annually growing excess flows and unless the 3-hour ebb tide restriction is waived, MM are saying that already:

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"In order to accept the proposed flow from the Customer directly to the existing outfall immediately downstream of the tidal holding tank, the existing capacity and condition of the outfall pipe and diffuser would need to be investigated."

12. When we look at the already attained higher levels of winter flows through Ballinacurra 1 pumping station, which are quite often recorded as 15,000-18,000m3/day, and add the storm overflows to the river on the same days, which can be 5,000-15,000m3/day, we find there is already a total town flow of 20,000-33,000m3/day. On such days the town infiltration would also be double the annual average of 2,100m3/day, say 4,000m3/day and assuming that neither the IDL or Dairygold flows increase in bad weather and remain within their consents at 5,000m3 and 4,000m3/day respectively, a winter scenario of the real total combined flow could already be 33,000-46,000m3/day. This is far in excess of what MM say is possible via the present discharge pipe in 2 x 3-hour discharge periods at 28,000m3.

13. With Option 5 and the holding capacity for the Dairygold discharge being maintained 14km away at Mogeely, controlling the discharge will be too unreliable and, on days, such as those just considered, above, there will have to be impossibly close liaison, if it was to be made with an entirely separate discharger (Irish Water) and I note that the EPA also have some doubts about the control that could be exercised from such a distance.

14. At present Irish water are considering construction of a new pumping station and pipeline to Carrigtwohill WWTP to take the overload from Midleton WWTP and allow permission for the town to continue to expand. This would not now be necessary.

15. An outfall pipeline to Ballycroneen could take the treated – and even temporarily poorly-treated effluents from the East Harbour towns.

16. There are no protected waters (Bathing or Shellfish Waters, SAC, SPA etc) at Ballycroneen, so it is anticipated that an EIS will not be required.

17. Thus, as stated in the Mott MacDonald Report, a joint outfall to Ballycroneen would save on the cost of UV disinfection at the Midleton WWTP.

18. Saleen new WWTP could discharge treated effluent and overflows to this pipe with no possible risk to the three Rostellan Designated Shellfish Waters.

19. Cloyne WWTP could discharge to it also, instead of to the present reed-bed system and Cloyne River, which discharges onto the three Rostellan Designated Shellfish Waters.

20. Whitegate and Aghada could both discharge to it when their WWTP is operational. If the gas pipeline can be used (see next item), then there is already a spur of the pipeline running in the direction of the power station, which could be re-used.

21. There is the possibility that relatively immediate re-use could be made of the defunct 600mm Kinsale Gas pipeline, which at present has to be decommissioned at great expense, if no further use for it can be found.

22. It has the advantages of outfalling at Ballycroneen. It can be taken as many kilometres as required out to sea, at no extra capital cost and actually crosses the proposed route of the

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Dairygold discharge pipe, somewhere near the Loughcarrig site, which has already been selected and proposed for holding tanks.

23. Irish Water are uniquely well-placed to discuss this possibility as they are partners with Gas Networks Ireland under the Ervia umbrella.

24. At present there are no other viable options for re-use, with only Carbon Capture and Storage being any sort of real possibility, but the EIS tells us that the low value of CO_2 storage, at present, makes this uneconomical, and possibly below all the immediate advantages seen above, to all the communities along the East side of the Harbour and especially to the continued expansion of Midleton.

25. Another very real fear about permitting this large industrial discharge now at Rathcoursey, is that it would be very difficult, if not impossible, to refuse every other industry, which promised to keep to the same effluent ELVs, which are setting up within the same 14km radius (600km^2 ?). I note that Inland Fisheries Ireland "*has significant concerns in relation to both the impact of the proposed discharge* ***and the principle behind the concept of trans catchment discharges"*** (ABP Inspector's Report 3.7.3)

26. We could build an oyster industry of huge worth and employment potential with the maximum possible reduction of human health risk to consumers of oysters - mainly abroad.

27. If Cork Harbour water was thus shown to be clean enough even to sell oysters from safely, it would dispel the currently held impression that the water is filthy, and swimming and water-sports could flourish, to the great benefit of the reputation of the City and surrounds.

28. Irish Water would also have honoured their commitment to the people of Cork that "*No more untreated sewage will enter Cork Harbour by 2021".*

29. There is local concern, supported by An Taisce, that floating slicks of fats, oils and greases (FOG) will destroy the amenity value of East Ferry and Rostellan (see Irish Water's videos, above). FOG is notoriously difficult to deal with and any FOG getting through the treatment process will foul boats etc. in the Marina. It would be a disaster if it should foul the inter-tidal oysters on trestles at Rostellan.

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Appendix 1

Notes on bloom formation of *Alexandrium sp*. of toxic dinoflagellates in the North Channel of Cork Harbour and bed closures due to Paralytic Shellfish Poisoning (PSP).

I have tried to present as much as I can find from readily available sources to show that *Alexandrium* blooms are endemic to the North Channel of Cork Harbour, almost exclusively in Ireland, and that they do occur every summer from June to September. The Paralytic Shellfish Poisoning toxin is accumulated to higher levels by mussels than oysters and so the frequent closures the North Channel has suffered have been far more for mussels than for oysters, but it is almost certain that more nutrients coming into this cul-de-sac of very warm water, with little dilution from outside giving these high water retention times, would lead to closures for oysters as well, with inherent danger to human health and serious commercial consequences for ourselves and for sales of Irish shellfish.

Closures of the bed that we have had for oysters occurred more in the late 1980's when the North Channel itself was probably eutrophic – see section 7.1 and the EPA's own take on this situation in the papers produced in 2001 and 2002 in section 6.2.3.

I am not sure how well documented the years before 2000 are, but the Marine Institute started their essential surveillance work in the 1980's. Their Harmful Algal Blooms webpage:

https://www.marine.ie/Home/site-area/areas-activity/marine-environment/toxic-species-and-their-toxins-found-irish-waters gives,

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Toxic species and their toxins found in Irish waters

"Although the majority of phytoplankton are harmless to humans, some contain toxins that can cause illness and even death in extreme cases through the consumption of contaminated shellfish.

In Ireland shellfish poisoning is presently a year round occurrence with most closures being attributed to Dinophysis species. However other toxic species that are problematic to the Irish aquaculture industry are Pseudo-nitzschia, Alexandrium and Protoperidinium species.

Alexandrium species Paralytic Shellfish Poisoning (PSP) *Caused by Saxitoxins and Gonyautoxins Headaches, dizziness, diarrhoea, nausea, vomiting, leading on to muscular paralysis. In severe cases respiratory failure may occur. Can produce toxins in relatively low no's.* ***PSP has not been observed in any other part of Ireland apart from Cork Harbour despite Alexandrium being observed along the west and south coasts".***

A useful source of quite detailed historical information appeared to be in the Proceedings for the nine Irish Shellfish Safety Scientific Workshops 2000-2009, which can be accessed at the foot of this link:

https://www.marine.ie/Home/site-area/areas-activity/seafood-safety/shellfish-biotoxins

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2000. Proceedings of the First Irish Marine Biotoxin Science Workshop: Cork 19th April 2000

PSP detected above limits in Cork Harbour mussels in 1996, 1997 and 1998

Phytoplankton species – *Alexandrium tamarense*

Marine Institute has identified cysts of *A. tamarense* in sediments in Cork Harbour

Highlighted "*Action on Industry's Concerns":*

1. *Outstanding Issues*

"Much improved water pollution protection in line with 79/923/EC"

2. *The Future*

"If all responsibility for testing/recall/destruction lies with the producer, then the State cannot walk away from its responsibilities under 79/923/EC."

"Industry and general public want cleaner inshore waters not closures and de-designations"

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Phytoplankton: Research Priorities by Dr. Robin Raine, NUIG.

p.83 **"*Phytoplankton which produce PSP are geographically limited around Ireland to inside Cork Harbour*.** *Here there exists a resident population of Alexandrium tamarense which has not spread to other locations. The lifestyle of this organism included an encystment stage whereby the cells overwinter in the sediments.* ***The appearance of the organism in summer seems to be one of the most regular and predictable features of potentially harmful phytoplankton events around Ireland."***

p.85 "As stated earlier the PSP problem around Ireland is very localised at present, restricted to Cork Harbour. It would seem logical that every effort should be made to ensure that the problem is not spread further afield."

2001. Proceedings of the Second Irish Marine Biotoxin Science Workshop: Galway 11th October 2001

Overview of current phytoplankton research in Ireland by David Clarke, Marine Institute.

"Resting cyst populations of the PSP causative species Alexandrium tamarense have been shown to be present in sediments from Cork Harbour. ***Hence intoxification of shellfish due to the hatching of these cysts have led to periodic closures of shellfish from being harvested from this area for the last few years during the summer months."***

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The Ecology and Oceanography of Toxin Alexandrium Blooms in the Gulf of Maine: Insights from Model Simulations by Donald M. Anderson and Dennis McGillicuddy (USA)

Figure 1 explains the life cycle of Alexandrium in response to temperature and light stimulation to "***When nutrients are gone, growth stops and gametes are formed***", followed by encystment for germination the following year.

2002. Proceedings of the Third Irish Marine Biotoxin Science Workshop: Galway 14th November 2002

p.15 "***PSP toxicity was observed to be present above regulatory threshold levels in both mussels and oysters from Cork Harbour during a 3-week period in July 2002."***

2003. Proceedings of the 4th Irish Marine Biotoxin Science Workshop: Renvyle, Co. Galway 7th November 2003

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Review of Phytoplankton and Environmental Monitoring 2003. Marine Institute staff.

"*Alexandrium spp. are also potentially toxic dinoflagellates, producing Paralytic Shellfish Poisoning (PSP) toxins and are frequently recorded in the phytoplankton populations in Irish waters (Figure 2). The presence of these dinoflagellates triggers the testing of shellfish samples for PSP toxins. The PSP mouse bioassay (AOAC Official Methods of Analysis, 1995) is used to detect these toxins and to date* ***the only aquaculture area that has experienced closures as a result of PSP toxins is Cork Harbour*** *(south coast) (Figure 2). In mid-September 2003, shellfish sites in this area were closed as a result of a small bloom of Alexandrium spp. with highest cell concentrations in the order of 15 cells.mL-1."*

Fig. 2 shows cell counts and mouse bioassays in Cork Harbour in 2003.

"*Cell densities of Alexandrium spp. and positive PSP mouse bioassays recorded in Cork Harbour in 2003 plotted against time. Positive mouse bioassays were recorded on the 17th and 21st September".*

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Report: Phy03-39c

Date Published: 26 Sep 2003

Production Area	Sample Point Code	Sample Date	Harmful Species (Toxic/Nuisance)	Count	Predominant Organism	Biomass
Killala Bay	MO-KB-KB	24/09/2003	Pseudo-nitzschia sp.	14640	Asterionellopsis glacialis	Low
Galway Bay North	GY-GN-IN	23/09/2003	No harmful species observed		Scrippsiella spp.	Low
Aughinish	CE-AH-AH	22/09/2003	Alexandrium spp. Noctiluca scintillans Pseudo-nitzschia seriata complex	40 120 200		Low
Kenmare Bay(Killmakillogue)		22/09/2003	Pseudo-nitzschia sp.	6320		Low
Newtown	CK-NN-NN	23/09/2003	Dinophysis acuminata Noctiluca scintillans Pseudo-nitzschia sp.	40 200 2640		Medium
Kenmare Inner	KY-KI-TE	23/09/2003	No harmful species observed			Low
Bantry North	CK-BN-SE	23/09/2003	Noctiluca scintillans Pseudo-nitzschia sp.	160 3560		High
Castlemaine Harbour	KY-CH-BF	22/09/2003	Alexandrium spp. Pseudo-nitzschia sp.	80 1240		Low
Cork Harbour	CK-CH-NC	21/09/2003	Alexandrium spp.	15010	Alexandrium spp.	High

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A Review of Shellfish Toxicity Monitoring in Ireland for 2003. Marine Institute staff.

p.8 "***Two samples (M. edulis & C. gigas) from Cork Harbour in mid-September tested positive for the presence of PSP toxicity above the regulatory level. High concentrations of Alexandrium sp. (>15,000 cells/litre) were also observed at this time in the area.***

Morphology, Molecular Taxonomy and Toxin Composition of Alexandrium spp. Isolated from Irish Coastal Waters. NUIG staff.

p.24 Introduction.

"*The work presented below has been carried out in the Martin Ryan Institute since September 2002. Research initially focused on Alexandrium due to an ongoing PhD program sponsored by the Marine Institute that has the objective of developing a bio-physical coupled model for the occurrence of Alexandrium in Cork Harbour.* ***Alexandrium is known to be involved in toxic events and has been responsible for the closure of fishery activities in the south of Ireland;*** *our latest results regarding this harmful micro-algae are presented.*

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p.28 Conclusion.

"There is a history of PSP contamination of shellfish with PST derived from Alexandrium blooms in Irish coastal waters. It is likely that these harmful events have been due to the presence of A. minutum. ….. ***It is possible that this population may expand in its distribution to Ireland. It is essential therefore that monitoring procedures are maintained and the life cycle of the organisms are studied to allow the development of predictive models.***

2004. Proceedings of the 5th Irish Marine Biotoxin Science Workshop: **Rosscarbery Co. Cork 28th October 2004**

Foreword by Dr. John O'Brien, Chief Executive, Food Safety Authority of Ireland

"*Nor is the biotoxin research field standing still. Almost €1.3 million has been secured in Irish and European research funding for 4 research projects."*

"*The progress of recent years is evocative of Lord Kelvin's adage that "If it cannot be expressed with number, we don't know much about it". Analytical advances have provided us with the numbers and we can say with confidence that we know much more than we used to know.* ***Kelvin's related philosophy is even more important from a food safety perspective: "What gets measured, gets managed".*** *This is true also for the Irish shellfish industry and what is getting managed is not only the safety of shellfish but also the business risk for producers."*

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Review of Phytoplankton and Environmental Monitoring 2003. Marine Institute staff.

p.6 "Toxic Phytoplankton in Irish Waters 2004

The presence of toxic algae in waters can directly affect shellfish harvesting, particularly in the summer when greater levels of toxic algae are present, resulting in biotoxin contamination in the shellfish. Consequently if these toxin levels exceed a regulatory limit, closures of production areas will result. In Irish waters there are four main toxic algal groups that occur. These are the phytoplankton species that produce the toxins that cause Diarrhetic Shellfish Poisoning (DSP), Paralytic Shellfish Poisoning (PSP), Amnesic Shellfish Poisoning (ASP), and Azaspiracid Poisoning (AZP), events.

In 2004, closures in shellfish growing areas mainly resulted from DSP and PSP events. Clarke et al. (in these proceedings) provide details of closures and toxin concentrations.

Paralytic Shellfish Poisoning (PSP) toxins.

Saxitoxins are produced by the Alexandrium spp. ***Due to the potential severity of the toxin,*** *the presence of this species in water samples triggers the testing of shellfish samples for PSP toxins.*

To date the only production area that has experienced closures due to PSP toxins is Cork Harbour, North Channel on the south coast. *Alexandrium spp. was first observed on 20th Jan (Week 4) and continued until there was a small peak on 04th May (Wk 19) of 320 cells/l.*

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This dropped slightly until 08th June (Wk 24) when no's reached 3700cells/l. The following week – 15th June (Wk 25) - the highest no. of cells were observed at 75,800 cells/litre. Positive PSP results for samples of M. edulis occurred on 21st June (Wk 26) and 28th June (Wk 27).

Levels of Alexandrium sp. decreased to >12,000 cells/litre for week 26, falling to 440 cells for week 27. On 13th July (Wk 29) numbers had risen to 4000 and decreased again until 6th September when another small peak of 3700 cells/l occurred. By 11th Oct the level had dropped to 760cells/l. Samples of C.gigas from the area were below the limit of detection for the AOAC bioassay during this time period. Another smaller peak of 3760 cells/l occurred on 6th September but by 11th October numbers were at 760cells/l."

Report: Phy04-25c Date Published: 18 Jun 2004

Production Area	Sample Point Code	Sample Date	Harmful Species (Toxic/Nuisance)	Count	Predominant Organism	Biomass
Ballylongford	KY-BD-BD	14/06/2004	Alexandrium spp. Pseudo-nitzschia sp.	80 12080		Low
Kenmare Bay(Deenish Island)		14/06/2004	Dinophysis acuminata	120	Pseudo-nitzschia delicatissima	Low
Oysterhaven	CK-ON-ON	14/06/2004	Alexandrium spp. Dinophysis acuminata	680 40		Low
Kenmare Bay(KY-KI-BN)		15/06/2004	Dinophysis acuminata	40		Low
Waterford Harbour	WD-WH-WN	15/06/2004	Alexandrium spp. Dinophysis fortii	2800 40		Medium
Castlemaine Harbour	KY-CH-BF	15/06/2004#	No harmful species observed			Low
Kinsale	CK-KE-KB	14/06/2004	Alexandrium spp.	240	Cylindrotheca closterium	High
Bantry South	CK-BS-SC	17/06/2004	Dinophysis acuminata	40		Low
Cork Harbour	CK-CH-NC	15/06/2004	Alexandrium spp. Dinophysis acuminata Prorocentrum balticum/minimum	75800 80 1720	Alexandrium spp.	High

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The Dynamics of *Alexandrium* Blooms by Aoife N Rathaile and Robin Raine (NUIG)

p.35 "*Background.*

Vegetative cells of Alexandrium spp. have been identified from a large number of sites around the Irish coast (Touzet et al., 2004). ***However, just one area has a history of harvest closures due to positive PSP bioassays on shellfish. This is Cork Harbour, or more specifically the North Channel of the harbour. Marine Institute records of Alexandrium counts in Cork Harbour over the past four years show that three distinct blooms have occurred*** *(Figure 3). The first of these was in June 2000 and the following two were in September 2003 and June 2004. On each of these occasions a positive PSP bioassay was detected and closures in the area ensued. Two smaller blooms are also evident, one in June 2003 and the second in September 2004, although neither of these blooms led to positive PSP bioassays. There does, however, seem to be a temporal pattern in the history of Alexandrium in the region, with blooms forming in early (June) and late (September) summer.*

Fig. 3 shows cells at above 10,000/litre in June 2000, September 2003and July 2004

p.37 "*A six week intensive survey was carried out in June 2004. During this period, an intensive bloom that peaked on June 16th was observed. A positive PSP bioassay was recorded by the Marine Institute Biotoxin Monitoring Program on June 21st,* ***which led to a closure of shellfish harvesting in the area.*** *The intensive survey was repeated in September. A second Alexandrium bloom was observed that appeared to last for about two weeks with a peak on September 10th. There were no positive PSP bioassays recorded this time and thus no closures.*

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2005. 6th Irish Shellfish Safety Scientific Workshop: Galway 1st December 2005

Review of phytoplankton monitoring 2005: Marine Institute staff.

p.5 Toxic phytoplankton in Irish waters in 2005.

There are four main toxic algal groups that occur in Irish waters. These are the phytoplankton species that produce the toxins that cause, Diarrhetic Shellfish Poisoning (DSP), Paralytic Shellfish Poisoning (PSP), Amnesic Shellfish Poisoning (ASP), and Azaspiracid Poisoning (AZP). In previous years closures in shellfish growing areas mainly resulted from DSP events, ***with localised closures in Cork Harbour due to PSP events***

p.7 Paralytic Shellfish Poisoning

Paralytic Shellfish Poisoning (PSP) toxins - saxitoxins - are produced by Alexandrium spp. ***Due to the potential severity of the toxin, the presence of this species in water samples triggers increased testing of shellfish samples for PSP toxins.***

To date the main production area that has experienced closures due to PSP toxins is North Channel in Cork Harbour. Paralytic Shellfish Poisoning toxicity occurred in mussels in early to mid-June in North Channel, Cork Harbour *(Clarke et al. 2006), which corresponded a rise in Alexandrium spp. levels to 1080 cells/litre. Numbers subsequently decreased and rose again to 1640 cells/litre in early July. However, no toxicity was present at that time.*

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Alexandrium in Cork Harbour…..Nicolas Touzet and Robin Raine (NUIG)

p.53 "Conclusions

"There is a history of PSP contamination of shellfish in Cork Harbour. It is now well established that the Alexandrium community is mixed in the area, with the presence of the non-toxic A. tamarense and the ***PSP toxin-producing A. minutum****.* ***The latter species has been identified as the organism responsible for the PSP events recorded in this region as the toxin profiles obtained from cultures derived from locally A. minutum isolates coincided with those obtained from contaminated shellfish samples taken in 1996.***

The tools for the quick and reliable discrimination between Alexandrium species in Cork Harbour are now available. FISH probes will prove invaluable to study the Alexandrium population dynamics at the species level in the area, and to implement bio-physical coupled models under development for the occurrence of Alexandrium in Cork Harbour.

2006. 7th Irish Shellfish Safety Workshop: Marine Institute, Galway. 30th November 2006

Micheál Ó Cinneide Director, Marine Environment & Food Safety Services, Marine Institute, Rinville, Oranmore, Galway

Key questions for research and debate

Some of the key questions that have been investigated in Irish research that will be debated at this year's workshop include:

• What are the seasonal patterns and toxicity trends in mussels & oysters?

• Can we predict the start of PSP toxicity in Cork Harbour?

• (and 3 more)

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Review of Plankton Monitoring 2006. Marine Institute staff.

p.34 Alexandrium Spp.

One of the most potentially dangerous toxin producers in Irish waters are the Paralytic Shellfish Toxin (PSP) producing Alexandrium spp. Due to the potential severity of this neurotoxin, the presence of this species in water samples triggers increased testing of shellfish samples for PSP toxins. To date the main production area that has experienced closures due to PSP toxins is North Channel in Cork Harbour. *Levels of Alexandrium spp. were generally observed at low levels in 2006 (Figure 5)* ***with the highest levels observed as usual in the summer in North Channel*** *and Oysterhaven, County Cork.* ***Toxicity levels just over the regulatory threshold of 81.4µg/100g were observed in mussels from North Channel, on 20th June (Week 25).*** *Following this, the levels and distribution of Alexandrium spp. decreased over the summer months and no other unusual events were observed.*

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Predicting *Alexandrium* Blooms in Cork Harbour. Aoife Ni Rathaile and Robin Raine (NUIG).

Abstract: Blooms of *Alexandrium* are an annually recurring problem in the North Channel of Cork Harbour on the south coast of Ireland. They are associated with the only cases of contamination of shellfish with paralytic shellfish toxins in the Republic of Ireland. Two species of *Alexandrium* co-exist in Cork Harbour, a toxic form of *A. minutum* and a non-toxic form of *A. tamarense*. **Toxic events have led to bans on the harvesting of shellfish in the North Channel during nine of the 11 years between 1996 and 2006.**

p.66 "*The genus Alexandrium comprises 28 different species, **some of which produce potent neurotoxins** which if ingested by humans, give rise to symptoms referred to as Paralytic Shellfish Poisoning (PSP). Both toxin producing and non-toxic forms of one of these species, Alexandrium minutum, have been found in Irish coastal waters (Touzet et al., 2007). The distribution of the toxic form, which produces the toxins known as GTX2 and GTX3, **appears restricted to Cork Harbour, where there has been a history of shellfish harvest closures due to positive PSP bioassays on shellfish.***

*The archive of the National Phytoplankton Monitoring Programme indicates that Alexandrium in Cork Harbour tends to proliferate, or bloom, in **June.** Smaller blooms have occurred between **July and September in some years**. Field results have shown that Alexandrium cell numbers do not increase before the end of May and achieve maximum cell densities in June. **The blooms arise in the North Channel of Cork Harbour**.*

p.68 *Observations*

Cell densities of Alexandrium in the North Channel of Cork Harbour observed in summer of 2004, 2005 and 2006 are shown in Figure 6. Blooms of cells occurred in June each year, with highest numbers observed in 2004 and lowest numbers in 2005.

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2007. Proceedings of the 8th Irish Shellfish Safety Workshop: Marine Institute, Galway. 5th December 2007

Review of Shellfish Toxicity in Ireland 2007. Marine institute staff.

Paralytic Shellfish Poisoning (PSP)

*p.29 "The number of samples analysed for PSP toxins in 2007 was 158 and included analysis of Clams, Cockles, Razor fish, mussels, Pacific oysters and Native oysters. The majority of samples received were part of the monthly sentinel site monitoring programme. Additional analysis was carried out when Alexandrium species were observed by the Phytoplankton Unit in water samples. In this eventuality, a request for flesh samples is forwarded to sea fishery protection officers through the phytoplankton reports and by the shellfish coordinator. Of the 158 samples analysed, none produced positive results, **however, 2 samples from Cork Harbour mussels sampled on the 26th June and the 2nd of July did show low levels of toxicity.** The highest level observed at 39µg/STXdiHCL100g-1 whole flesh.*

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Irish, European and International Research on Harmful Algal Blooms. Robin Rains (NUIG)

p.52 "*A large component of the project SEED focuses on the life cycle of Alexandrium. Participation in the programme* ***was enabled through knowledge of Alexandrium blooms in Cork Harbour gained through a Marine Institute NDP PhD fellowship****, and further funding through resources made available from the Higher Education Authority PRTLI (Cycle 3). Through this funding, it has been possible to ascertain the nature and population dynamics of a mixture of toxic and non-toxic species (A. minutum, A. tamarense and A. ostenfeldii have so far been identified) which are found there. This could not have been possible without molecular biological techniques (Touzet and Raine, 2007) and in addition, the toxic blooms can now be predicted well in advance with some accuracy (Figure 3; Ní Rathaille 2007).*

p.54 *"PSP. There has been recent success in modelling the occurrence of Alexandrium in Irish waters. Results have now to be converted into a management tool for industry.*

2008, 2009 and 2010 had low counts of Alexandrium sp. in Cobh and the North Channel

The picture after this for higher counts of Alexandrium was:

Sample Date	Sampling Point	Biomass	Species	Count	Report
29/06/2011	Cobh	Medium	Alexandrium spp.	59720	Phy11-26e
03/07/2011	Cobh	Medium	Alexandrium spp.	22720	Phy11-27b
24/08/2014	North Channel	Low	Alexandrium spp.	1560	Phy14-35b
10/09/2014	Cobh	High	Alexandrium spp. Dinophysis acuta	2960 560	Phy14-37f
07/06/2015	North Channel	High	Alexandrium spp.	6880	Phy15-24b
28/06/2015	Cobh	Medium	Alexandrium spp.	8240	Phy15-27e
26/07/2015	Cobh	High	Alexandrium spp.	8320	Phy15-31b
30/08/2015	Cobh	High	Alexandrium spp.	10120	Phy15-36b
12/06/2016	Cobh	High	Alexandrium spp.	2360	Phy16-24b

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Based on the amount of saxitoxin found in the shellfish, on which the fishery would be closed, we have the following figures preventing the harvesting of mussels in the Harbour in 5 out of the last 8 years. Figures specifically for the North Channel have only been provided for the last 4 years, when testing of mussels was first requested, with closures for mussels in 2015 and 2017.

Maximum PSP concentrations in mussels and oysters observed for Cork Harbour on an annual basis from 2011 to 2018 (from the Marine Institute)

Results highlighted in Red are > Regulatory levels (> 800 µg/kg STX diHCL equivalents) which prevented sales of mussels from Cork Harbour.

location_name	location	sample_date	species_full_name	Toxin	PSP - µg/kg STX diHCL equivalents
Cobh	CK-CH-CH	23/06/2011	Mytilus edulis	PSP	**1071**
Cobh	CK-CH-CH	29/06/2011	Mytilus edulis	PSP	**1648**
Cobh	CK-CH-CH	05/07/2011	Mytilus edulis	PSP	**929**
Cobh	CK-CH-CH	05/07/2011	Magallana gigas	PSP	**537**
Cobh	CK-CH-CH	06/06/2012	Mytilus edulis	PSP	**981**
Cobh	CK-CH-CH	06/06/2012	Magallana gigas	PSP	**114**
Cobh	CK-CH-CH	10/07/2013	Mytilus edulis	PSP	**496**
Cobh	CK-CH-CH	14/08/2013	Magallana gigas	PSP	**31**
North Channel	CK-CH-NC	16/06/2014	Magallana gigas	PSP	**78**
Cobh	CK-CH-CH	22/06/2014	Mytilus edulis	PSP	**975**
North Channel	CK-CH-NC	23/06/2015	Mytilus edulis	PSP	**904**
North Channel	CK-CH-NC	01/07/2015	Magallana gigas	PSP	**323**
North Channel	CK-CH-NC	01/07/2015	Mytilus edulis	PSP	**1128**
North Channel	CK-CH-NC	14/06/2016	Mytilus edulis	PSP	**108**
North Channel	CK-CH-NC	16/08/2016	Magallana gigas	PSP	**45**
North Channel	CK-CH-NC	23/08/2016	Magallana gigas	PSP	**45**
North Channel	CK-CH-NC	27/06/2017	Mytilus edulis	PSP	**1174**
North Channel	CK-CH-NC	27/06/2017	Magallana gigas	PSP	**221**
North Channel	CK-CH-NC	06/06/2018	Mytilus edulis	PSP	**565**
North Channel	CK-CH-NC	05/09/2018	Magallana gigas	PSP	**194**

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There were low levels of Alexandrium seen in Week 17 (to April 27th) at 5,000- 10,000 cells/litre in the Marine Institute Biotoxin distribution map for PSP and the MI comment for the current Week 20 (to May 18th) is:

"Current presence and levels all low. **Toxic bloom events are strongly linked to localised suitable environmental conditions."**

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Appendix 2

Considerations of the An Bord Pleanála Inspector's Report dated 29.03.18.

http://www.epa.ie/licences/lic_eDMS/090151b2806bb956.pdf

A great deal of work has gone into this 123pp. Report and I am grateful for the full and fair transpositions of our objections in particular in s.6.1.15 to 24.

The Inspector notes that all parties object particularly to the use of the Rathcoursey outfall, which "*has generated the most contentious and contested aspects of this proposal and in particular the proposed effluent discharge solution and its perceived negative consequences to Cork Harbour"* (s. 7.8); to the absence of consideration of alternatives; into water of a high residence time and the physical build-up of FOG. A more direct route to open sea would be preferable.

3.7.3 I note that **Inland Fisheries Ireland** (IFI) in their report dated **9th January 2017,** has significant concerns in relation to both the impact of the proposed discharge and the principle behind the concept of trans-catchment discharges.

11.0 Consideration of alternatives.

We are directed to EIS Vol.2 Chapter 3. (Sec. 3.2.2).

This advises that as the Kiltha River does not have sufficient capacity, the discharge is proposed to be made at Rathcoursey. No single other alternative location for the discharge of wastewater is investigated.

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11.4 *"The applicant states that the option to discharge at Rathcoursey was viable on environmental grounds and therefore further consideration of an alternative location was not warranted"* and that,

"It is reasonable for the applicants to rely on the statutory provider to identify a suitable connection location."

"The applicant states that an existing feasible alternative outfall to the proposed outfall has not been made available to the developer by the competent authority. The ability of the developer to provide a new alternative outfall is reliant on acquisition of consents outside of the developers control and thus is potentially unrealistic and undeliverable."

No mention is made that Irish Water employed Mott MacDonald (MM) to investigate a potential alternative, or that discharge to Ballycroneen was investigated and costed. The Inspector did not mention knowing of the existence of these 3 MM Reports of 2016.

Now that the EPA have made the decision that Dairygold may not carry on licensable activities under a licence issued to another, and that the original review application (P0817-02) could not be progressed under the umbrella of Irish Water's licence, I am hopeful that the above excuses made by Dairygold are not relevant and that a proper investigation into alternative discharge locations must be made.

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11.5 The possible use of the new Ballycotton outfall was considered.

It is only 3km further than the Rathcoursey option and reaches wide open sea with good dispersive potential, although the Inspector says that it is not open sea, but Ballycotton Bay, one can at least see the horizon. The use of the Ballycotton outfall was investigated and costed as an alternative discharge location for not only the necessary and proposed Castlemartyr and Ladysbridge upgrades, but to take the Midleton outfall away from Rathcoursey, very possibly with the upgraded flows from Cloyne and Saleen. (see sec. 9 and 9.4.4 in particular). The WYG Alternative Outfall Report also costed an outfall at Ballycroneen (see sec. 9.4).

11.6 and 11.7 One suggested discharge location that wasn't even serious –

i.e. with the cheese waste making up a third of the flow of the Kiltha and Womanagh catchments – cannot be said to comply with the EIA Directive 2011/92, or the 2001 Regulations requiring alternative discharge locations to be put forward.

*"EIA Directive 2011/92 ("the 2011 Directive"), Art 5.3(d) requires the EIS prepared by the developer to contain "**an outline of the main alternatives*** (plural) ***studied by the developer and an indication of the main reasons for his choice, taking into account the environmental effects".***

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This has not been complied with and both Irish Water and Dairygold have admitted in the Mott MacDonald Reports for Irish Water that the Rathcoursey discharge location was chosen entirely for considerations of the time constraint rather than the environment, as explained in my section 9.1 re sec. 6,in our submission.

"*While four options were initially examined as part of the study, **it became evident at an early review stage of the process that the works required under any of these options could not likely be provided in time to meet Dairygold's requirements.** Therefore, an alternative fifth option was considered, whereby Dairygold's proposed discharge, consisting of treated wastewater only, could connect directly to the existing Midleton Sewerage Scheme primary discharge outfall at Rathcoursey.*

13.1 Already "at risk" status under the WFD.

It is acknowledged that the current status of this water body is already "at risk" of failing to meet good status by 2021, without adding more nutrients at low concentrations, but volumes as large as the 15,000 PE WWTP (without excessive infiltration).

13.3 The Inspector agrees that the North Channel and Owenacurra waterbodies are now classified as "at risk", with the Owenacurra "potentially eutrophic", but does not agree that this classification weighs against another large discharge of wastewater being made into it.

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13.5 Irish Hydrodata Additional Report of 2017 re. water quality "Good".

Water quality in either the North Channel or Owenacurra Estuary has always been at least "potentially eutrophic" and both contain some of the highest densities of over-wintering PSP cysts known in the world.

- No EQS for DIN? - but the percentage exceedance of the DIN in the Owenacurra Estuary is not only the highest in the country, but one of the only two estuaries in the country with a record of greater than 50% exceedances (see sec. 7.5.2 above)

- "*The "mixing zone" will not exceed recommended limits in terms of the extent of estuarine channel predicted to be likely to be affected".*

I hope that I show in sec. 3 above, that the mixing zone, with accumulating nutrients, extends as far to the west as Belvelly. All of this area is cyst-bed (sec.6.2). Water Residence time in the North Channel is 60-70 days.

13.6 Too many assumptions on allowing for compliance with EQS

"If Environmental Quality Standards (EQS) are not exceeded, it must be assumed there will be no adverse effect on Natura sites or surface water dependant environmental objectives".

These required "assumptions", which appear to actually be required to have been brought into effect first, are then listed as:

"Allowing for the expected improvement in river water in the Owenacurra and Dungourney rivers, due to network upgrades and improved pump management systems", with a:

"Planned upgrade to Saleen wastewater works, currently rudimentary primary treatment", with a:

"Programme of Measures established under the Water Framework Directive for the catchments,

before, it would seem,

"A reduction in the DIN loading to Great Island North Channel and Cork Harbour can be reasonably expected".

There are too many "assumptions" like this in this Report. In the first "Water Matters" for the WFD, we were told that from now on we could expect "joined-up thinking" - i.e. first increase the size of your WWTP, and then build more houses. In this case at least get the water to the required "good" status under the WFD, before even considering increasing the problem.

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13.9 Tidal flushing.

This is overwhelmingly important.

The Inspector states that:

"*The "new" flushing waters in this case are from the lower harbour and not from the open sea. The 2017 Irish Hydrodata Report report, which was commissioned by Irish Water in response to Cork County Councils request for Further Information, specifically addresses this issue in Sections 4.8 of their report.*

I hope I have shown from the actual measurements by boat of the salinity/temperature profiles of "North Channel/Eastern water" compared to the lower salinity flows of the Lee down the Main Cork Channel to the sea, "Western water", carried out for the PSP bloom Ph.D., that mixing only takes place where the East Channel meets the Main Channel, about 6km below Rathcoursey. They also found that the tidal excursion of North Channel water was 1.5km. Thus here is direct evidence of little mixing of these two distinct water bodies. (Fig. 6.15 in sec. 3.1)

This shows up clearly in the MCOS 1977 dye study and in his conclusions (sec. 5.3). As I say in the next section below, Irish Hydrodata carried out computer modelling for MCOS for the 1993 EIS for the Midleton WWTP discharge at Rathcoursey, but they either never ran the model for more than one day – or, if they did, as would be expected, they never published the results. **Thus we have no modelled proof or suggestion of ANY mixing/dilution of the North Channel water with different water in the Lower Harbour.**

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We do, however, have centuries of proof that mixing cannot be more than about 4% per tide, because, if it were more, there would never have been oyster beds in the North Channel (sec. 3.2.3) because of the 10 day (20 tides) minimum length of larval planktonic life.

The Inspector says that the 2017 Irish Hydrodata Report, "*specifically addresses this issue in Sections 4.8 of their report,"* but Table 4.8 does not have a single calculation made for any part of the oyster area of the North Channel or Rostellan, as can be seen in Fig. 4.21. LE610, which is not shown, is as far away as the south side of the Lower Harbour, "Adjacent to Aghada".

Thus we are not given any chance of seeing whether the Irish Hydrodata model will show up the residual anti-clockwise current to the west, which will accumulate discharges made from Rathcoursey – a point I will come back to below.

The Inspector is, however, impressed and states that:

"The report is based on a model of the Owenacurra Estuary, North Channel and Lower Harbour which is calibrated using a dye study carried out at Rathcoursey Point. The report notes that the North Channel empties to a large degree at low tides and estimates a flushing time between 3 days (Neap Tide) and 6 days (Spring Tide)."

If we check back to the Irish Hydrodata No. 1993 Report, we find in sec. 3.3.15 (p. 6/14) that the degree to which the mentioned dye study from Rathcoursey Point was used, was minimal, covering just the initial release pattern, after which it was all conjecture again, without a Day

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2 or 3 given and just" a "*tidal exchange factor of 20% at the southern boundary* (was) *assumed".*

"3.3.15 Verification of Dispersion Patterns.
"The result of the discrete release from Rathcoursey Point were used to estimate the dispersion rates of the effluent plume. The model was then used to simulate the continuous dye release from Rathcoursey (14/9/93). Results in figure 3.7 show the model predictions at HW on the day of release. A decay rate of 1% per day and tidal exchange factor of 20% at the southern boundary were assumed. The model results are in good agreement with the recorded dye distribution shown in Figure 2.7 (NB on the day or release) *and thus allow confidence in the validity of the model."*

I thus give copies from the Irish Hydrodata Report, Nov. 1993[20] of:

1) The above page
2) Figure 3.7 model of the release below at "First HW" on the day of the release
3) Figure 2.7 HW after discrete dye release on 14/9/93

Dye was released at LW-2hrs (IH sec. 2.4.3) thus the dye distribution in fig. 2.7 was made after approx. 8 hours and the Model simulation which was run to check the validity of the model was run (as quoted on the fig.) to the "First HW", **also after just 8 hours**.

The two distribution patterns are, indeed, similar – but they represent a single flood tide, without allowing for any mixing at LW in the Lower Harbour, or to check if his modelling assumption of a "*tidal exchange factor of 20% at the southern boundary"* would then give similar results to figs. 2.10 or 2.11 (**Ref. 21** – the next footnote) at HW on Days 2 and 3.

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This seems to me to be such an underwhelming validation, that I wonder if the failure of the model to allow for any mixing in the Lower Harbour, which would have showed up by running the model for 2 more days, and thus possibly disproving the choice of Rathcoursey as a good one to get MCOS' stated requirement of,

"*very substantial dilution because of the presence of oyster farming in the North Channel"*,

might have been withheld from the Report?

This then happens for all of the 9 different discharge locations/neap and spring tide combinations, that are then looked at by the Irish Hydrodata modelling, all of which cover only:

HW – 3 hours
HW
HW + 3hours
LW **i.e. for just 9 hours**.

For **not one** of these discharges (covering: Plots 1 Rathcoursey continuous neap ; Plots 2 Rathcoursey continuous spring; Plots 3 Rathcoursey tidal neap; Plots 4 Rathcoursey tidal

[20] Irish Hydrodata Midleton Sewerage Scheme. Marine Outfall. Hydrographic Survey Report. Nov. 1993 p.6/14 and figs. 2.7 and 3.7

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spring; Plots 5 Green Point continuous neap; Plots 6 Green Point continuous spring; Plots 7 Green Point tidal neap; Plots 8 Midleton continuous neap and Plots 9 Midleton continuous spring) - does Irish Hydrodata give the next day's **returning** water concentrations.

This would, at least, have given some factual, quantifiable support for the critical Lower Harbour mixing/dilution of the water which has been claimed by these authors in the 1977 CHPR; 1993 EIS and now in the Dairygold EIS, but only with such unsupported statements (see Section 3, above) as:

"*A fundamental part of flushing calculations is establishing what portion of waters that exit an area on the ebb tide will subsequently return on the following flood*".

"*Mixing processes in the lower harbour will determine how much of the Great Island channel waters get replaced with "new" waters."*

"Similarly waters in the lower Cork Harbour area will in turn exit past Roches Point and a portion of these will be replaced by "new" Celtic Sea waters on the incoming tide. Part of this mixing is due to turbulent motions of the water body but wind is also a very important factor in the mixing process and as a consequence, in the flushing behaviour. Shallower areas are the most responsive with enhanced mixing due to wave action and the formation of induced circulations. The lower harbour area is geographically exposed with mean monthly wind speeds of 10-12 knots and up to 15 days with gales per year. Therefore while short quiescent periods may occur when only tidal mixing prevails, on average weather conditions promote mixing."

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However, if Irish Hydrodata/MCOS did not give us modelled results for a single returning tide, we did get one actual dye study – following a single 12-hour release (from mid-ebb to mid-ebb) for 3 days[21], which is at last more what we need, and, as shown in section 5.2 above, finding that, rather than the dye being swept away and diluted, it was being accumulated at the west end of the North Channel (50% greater than at the east end at HW Day 2 and 100% greater at HW on Day 3). At last we have some concrete evidence to go on.

We see the initial discrete slug of dye moving up to Weir Island at 4×10^{-3} units at HW on Day 1. This slug disperses throughout the water of the North Channel and at HW on Day 2 it is $3x10^{-8}$ at Weir Island (50% more than Brown Island at the Rathcoursey end of our beds); on Day 3 it is still $2x10^{-8}$ (but now 100% more than Brown Island). This is a decrease of ⅔ (66%) over the previous day. This (very rough) estimate, is still at least a supportable estimate of the reduction in concentration of the dye over a 24-hour period, but from it we can build up a table to show the mechanics of how the dye actually accumulates at the west end of the North Channel.

The concentrations recorded over these 3 days came from one 12-hour continuous release. If we were dealing with a continuous release over the full 24 hours, it would be fair to say that these concentrations would be doubled – i.e . a starting position of $6x10^{-8}$ units at HW on Day 2. If the release was continuous like this every day, we can see that there would be a build-up (summation) of these slowly decreasing levels at the far west end of the North Channel:

[21] Irish Hydrodata Midleton Sewerage Scheme. Marine Outfall. Hydrographic Survey Report. Nov. 1993 Figs. 2.6, 2.7, 2.10 & 2.11

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Table showing accumulation of dye (nutrients) at far west end of the N. Channel.

Day of Release at Rath. Pt.	Conc. of dye at Weir Island - far west of the North Channel (in units x 10^{-8})						
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Day 1	High	6	4	2.6	1.7	1.1	0.75
Day 2		High	6	4	2.6	1.7	1.1
Day 3			High	6	4	2.6	1.7
Day 4				High	6	4	2.6
Day 5					High	6	4
Day 6						High	6
Day 7							High
Total units	Initial "high" plus:	6	10	12.6	14.3	15.4	16.15

We would submit that the evidence of the 1977 MCOS dye studies in the CHPR (see below), which show that there is no difference between a continuous (24-hr discharge), or intermittent (2 x 3½-hr ebb tide discharges) – in fact that intermittent release is slightly worse – means that the logic of the above table holds for the proposed intermittent Dairygold discharge also.

The North Channel virtually empties at LW (to wader depth), but it is pure conjecture in the Dairygold documents as to how much is lost to mixing in the Lower Harbour. I go into this in great detail above and quote the water sampling and studies made by boat for the Ph.D. thesis. (Fig. 6.15 in sec. 3.1)

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The M.C. O'Sullivan 1977 dye studies ran for 5 days. Again the highest concentrations of dye released at Rathcoursey are found at the west end and MCOS could find no difference in the final situation between continuous and intermittent discharges – because the outgoing water did not reach the Cork Main Channel, and he too gave this as the explanation:

"*What is, in fact happening is that* ***the intermittent release is not carried far enough by the outgoing tide to remove it permanently from the East Channel - it remains in the East Channel and is simply pushed inwards by the incoming tide****."* (sec. 5.3 above).

Possibly on account of the many objections to the Rathcoursey discharge, Cork County Council requested further information in point 6 of their Further Information letter dated 9/2/2017. This was prepared by Irish Hydrodata in:

"*Rathcoursey Outfall Investigation of the Impact of Treated Wastewater Discharges arising from the Dairygold Mogeely Plant to Cork Harbour"*. Prepared for Irish Water by Irish Hydrodata 19th May 2017.

Unlike the Consultants previous Natura Impact Statement which mentions no less than 11 times that, *"Over the 6+ hour period between ebb tides, water will undergo an ~80% exchange so that the subsequent discharge event will occur on new water coming in rather than the column which has gone out on the preceding ebb tide",* this new study has dropped this claim altogether.

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What is interesting, however, is that they now say in sec. 4.7, (under Fig. 4.8 which is taken straight from their Nov. 1993 Report),
"*Model runs were conducted for a recurring average tide lasting 25 days under calm conditions."*

If the model can now be run for 25 days (50 tides), why was the 1993 EIS, which was used to justify the choice of Rathcoursey as a suitable discharge location for Midleton WWTP, confined to giving all its hydrodynamic modelling to just 9 hours or less? – with not even their "*assumed 20% mixing at the southern boundary*".

13.9 (cont.) "*Modelling of Cork Harbour by NUIG".*

(1) The Inspector states, *"The data used to calibrate the NUIG model are two dye releases carried out and recorded in the 1977 Cork Harbour Pollution Report at Marino Point and Camden i.e. remote from Rathcoursey Point and the North Channel".*

This is NOT correct. As we have just seen, above and in Sec. 5.3 of my submission, MCOS carried out dye studies for both continuous and intermittent discharges from Rathcoursey Point, but I don't believe the data was ever used in the Galway work. They used a different Model to start off with, from their very first paper (see Costello et al 2001), namely the Falconer DIVAST 2-D model.

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The 2011 Nash paper describes the model as:

"The model chosen for the research was the mathematical model Divast (depth-integrated velocity and solute transport) (Falconer et al., 2001), which is a 2D, depth-integrated, time variant model based on a finite-difference solution scheme."

The first NUIG work of Costello et al "*Measurement and modelling of nutrient dynamics of two estuaries in Ireland, Wexford and Cork Harbours" 2000,* describes its validation as:

"In this study, the distribution of phytoplankton was quantified in space and time using a two-dimensional depth integrated nutrient and hydrographic mathematical model. The model was validated using tidal elevation, current measurements, dye releases, airborne remote sensing, and field data. Water samples were collected over different years, months, and state of the tide. At a spatial resolution of 30 x 30m, this was one of the most detailed water quality models conducted in Ireland, and the first to integrate hydrography and nutrient dynamics with chlorophyll distribution."

By the time of Nash et al, "*Modelling phytoplankton dynamics in a complex estuarine system"* 2011, the MCOS background is gratefully acknowledged, but I don't believe they have ever used his dye studies. I would say that they have moved on a long way from that, but copies of these hydrodynamic papers are sent with this submission. For instance, Nash tells us here on p.37:

"The hydrodynamic module is based on the solution of the depth integrated Navier–Stokes equations and incorporates local and advective accelerations, Coriolis forces, barotropic and free surface pressure gradients, wind action, bed resistance and a simple

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mixing length turbulence model. The solute transport module is based on the general depth-integrated advection–diffusion equations and includes local and advective effects, turbulent dispersion and diffusion, and wind effects. The water quality module simulates source and sink inputs and decay and kinetic transformation rates for nine water quality parameters including nitrogen, phosphorous, dissolved oxygen (DO) and phytoplankton. Details of the model formulations are presented in the following sections."

(2) The Inspector continues her paragraph on Modelling of Cork Harbour by NUIG,

"The hydrodynamic model constructed by Irish Hydrodata in their 2017 report is specific to the Rathcoursey Point and used a dye studies carried out at that location ***for calibration****".*

Irish Hydrodata described their "*Dispersion Model – Set up data*" in sec. 3.2 of their 1993 Report covering 4 pages, but do NOT mention the use of their accompanying dye studies being "*for calibration".*

The EPA will have the expertise to evaluate the merits of the two hydrodynamic models, but they are aimed at reaching different end results, with the NUIG work evaluating the residence times of water in the harbour and ground-truthing the results directly with aerial phytoplankton chlorophyll records, which are of greater relevance to our concern that the North Channel is not the place to discharge further nutrients in the presence of PSP blooms.

As I have said above, Irish Hydrodata now give the position after 25 days but all the figures show an oscillation of nutrients on the tides with the highest results at HW in the North Channel and very little going further south than Long Point, let alone the Whitegate jetty which shows up well on the plots.

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"Trophic Status".

"The status will not be changed by the proposed discharge", but it is already very bad – as bad as "potentially eutrophic" in the Owenacurra Estuary and "intermediate" in the North Channel. It does not get to reach "Good status" by making further industrial discharges into it – unless perhaps there is that "*very substantial dilution*" that MCOS said was essential in 1977 with oyster beds in the vicinity – which we now know we haven't got.

The evidence of the presence of historic oyster beds and the flushing work of NUIG show that the water does not flush away – at least for 60-70 days.

"Residual flow".

"Section 2.5 of the Irish Hydrodata Report states that the speeds on the flooding tide are stronger than on the ebb, with the flood lasting for about 6 hours and the ebb for the remaining 6.42 hours. The high water slack lasts for less than 30 minutes. ***The difference in the length of Flood and Ebb tides would account for the difference in velocities.***

The Inspector postulates that the obvious difference in the speeds of the flood and ebb currents could well be due to a difference in the length of the actual flood and ebb periods. This can only be ascertained in more detail by running the model over a complete number of cycles, but in sec. 5.6 above, the table I have made from the Brown Island current meter

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readings shows, however, that the currents speeds, and hence volume, of the median incoming flood tide is approximately 60% greater than the outgoing ebb, whilst the difference in the duration of the tides is only some 10%.

I submit that the Inspector is wrong in making her assumption above and that, although the ebb tide lasts a little longer, there is no way that a 60% greater volume of inflowing water will be equalled by a 10% longer lasting ebb tide and, **even on the simplistic level I have confined myself to here, it is very clear that there will be a very considerable residual tide to the west.**

I also cite all the practical manifestations of this in sec. 5 above: from all the dye studies, without exception, to our practical experience over 50 years of working on this water, including 3 years on the NUIG phytoplankton study, in sec.6.2.

"No Allowance for Untreated Sewage"

The Inspector states, *"All existing nutrients inputs to the Owenacurra River, whether from farming, Combined Sewer Overflows or any other source, are accounted for in the EPA monitoring data, which is based on actual sampling for the Owenacurra Estuary and North Channel and are therefore, taken into account in the 2017 Irish Hydrodata assessment of the discharge impact."*

The latest EPA monitoring data on the most current trophic situation in the North Channel and Owenacurra Estuary is dealt with above in sec. 7.5 (EPA's "*Water Quality in 2017: An Indicators Report"* Trodd W. and O'Boyle S.), with the situation described for:

Phosphate in sec. 7.5.1, showing the Owenacurra Estuary lies between 0.035 – 0.05 mg/l with the EPA comment that this level is "*indicating levels greater than those likely to lead to nutrient pollution",* and for

DIN in sec. 7.5.2 the Owenacurra Estuary is singled out as being one of the four water bodies in the country, which had the highest dissolved inorganic nitrogen concentrations, with the Owenacurra Estuary as one of only two estuaries in the country with a record of greater than 50% exceedances.

But the "riverine water" quality which Irish Hydrodata used for their modelling is, as described in their sec. 4.3, "*background river water quality*". They do not say where it was measured, but it clearly is not in the estuary below the town and 1.5km below the reach of spring tides, as the av. salinity is given as just 1.8 ppt in Table 4.2. I recently obtained the EPA sampling of their station LE510 at By-Pass Bridge and LE520 by Ballinacurra pumping station for 2015-2017 and the average salinities are 16.8ppt at By-Pass Bridge and 22.3 ppt at Ballinacurra PS. It is at this latter station that nutrients need measuring, if they are to include the nutrient discharge to the river from the average c. 1,000m3/day untreated overflows from the town.

I believe that the nutrients arising from these untreated overflows will be proportional to the f.c. content of the water and thus I calculate in sec. 7.6.1 that if the f.c. load has increased about 2.5 times from the freshwater river level by the time it has passed the Bailick 2 overflow, then the nutrient level (especially DIN) will have also increased 2.5 times.

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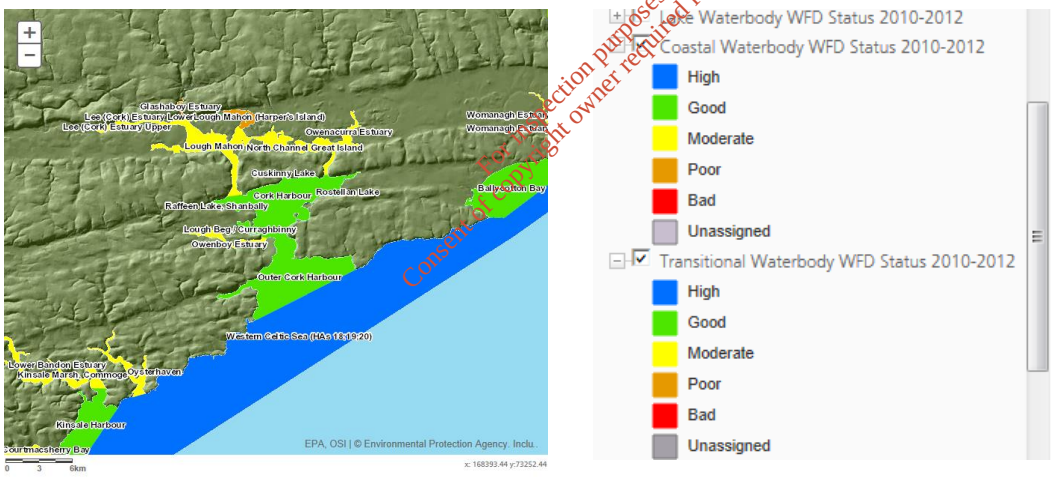
The Inspector notes that the nutrients added to the river are 3km away, but they will of course impact the North Channel, as they flow into it, and must surely be taken into account when considering adding even more nutrients at this point? See the last Hydrodynamic Study of Irish Hydrodata /MCOS carried out in 1997 in sec. 8.3.2, above, and the modelled discharges from Ballinacurra in **Ref. 10** to see how these discharges dis-improve water quality at Rathcoursey and, at low river flows, simply build up the town's nutrients over one of the most dense PSP cyst beds in the world, we are told – just north east of Rathcoursey.

We must be interested in the "cumulative impact" of all discharges – especially when there is almost no dilution – and the Dairygold EIS and Natura Impact Statement is claiming over and over again that the discharge will be made to *"~80% new water*" (see sec.3). See also that the Inspector is satisfied with the Dairygold views on this in 18.30 and 18.36 below, with which we must disagree fundamentally.

13.10 The Inspector states, *"The current WFD status was deemed "good",* under the Water Framework Directive, in the period 2010-2015, which is the latest data available from the EPA".

This is NOT correct. This is the WFD position for 2010-2012:

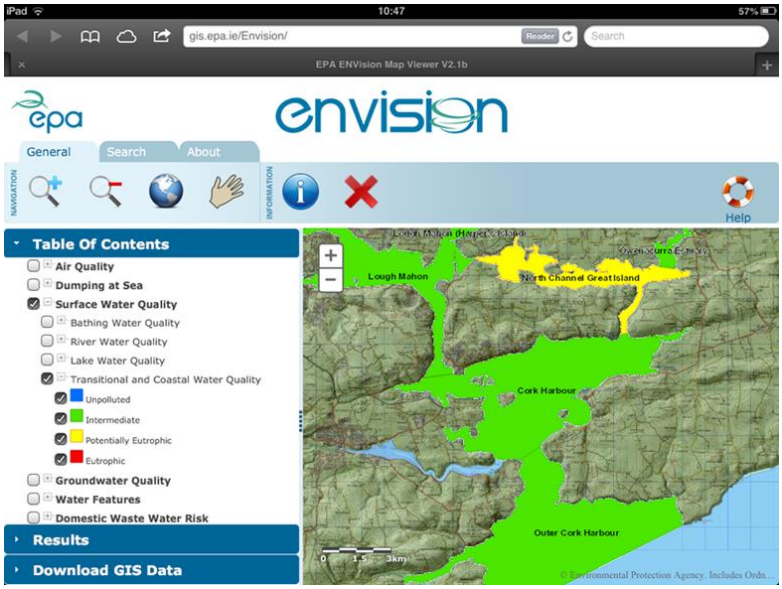
Figure 4.4 Status of Coastal and Estuarine Waters 2010-2012
Source: EPA Data from 2009-2011, downloaded from http://gis.epa.ie/Envision/



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and from 2013-2015 (see discussion in sec. 7.2 above)

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The North Channel is "potentially eutrophic".

A very large industrial discharge can surely not be allowed to be located into the middle of such a water as this?

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16.5 & 16.6 re previous Dairygold convictions for discharge of insecticides causing fish kills.

I feel quite sure that the Dairygold discharge will not be monitored for the various chemicals and biocides and that may be used around the plant. I have pointed out that biocides such as tri-butyl tin (TBT) can cause complete disruption of molluscan life in waterbodies as large as the English Channel, through their effect on larval development, which is one of our principal concerns – and for which we have the largest complex of 22 specialised breeding ponds in the world covering 3 hectares.

17.16 Ecology.

The Inspector states that, "*The cumulative effect of the Dairygold proposal with other sources of point and diffuse discharges has also been considered and it is concluded that significant cumulative impacts will not occur".*

I have answered this claim already in 13.10, above in this appendix, in "*No Allowance for Untreated Sewage"*. This huge source of nutrients from the Midleton overflows to a very small waterbody, has not been taken into account by Dairygold and is important enough to have been singled out by the EU Commission for notification as to when they will be eliminated.

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17.17.1 Human Health

"*I am satisfied, therefore, that the proposed development would not have any unacceptable direct, indirect or cumulative impacts on human health."*

I covered the danger of the annual Paralytic Shellfish Poisoning blooms in the North Channel in pp. 13-18 of my letter to An Bord Pleanála, for which shellfish harvesting is regularly prohibited. The Inspector noted my concerns in her secs. 6.1.18 and 6.1.23, but otherwise does not explore this particular threat to human health at all. The possibility of toxic blooms of PSP being augmented to really serious levels by a further discharge of nutrients directly to the North Channel is far too serious to be ignored entirely like this and this must be one of those occasions when the Precautionary Principle comes into play.

Only concerns over Human Health come before all other considerations in the Habitats Directive.

17.26 Dairygold control of the discharge from 14km away.

The Inspector feels this is possible. We are glad that the EPA's Office of Environmental Sustainability showed some doubt also in their letter of 13.03.19 in the operation of the proposed holding tank to ensure the :

"*control of wastewater discharge during ebb tide only, considering the distance from the diffuser (>12km)".*

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17.65 Material assets.

"*Material assets are defined as 'resources that are valued and that are intrinsic to specific places, they may be either human or natural origin and the value may arise for either economic or cultural reasons'. They can be economic assets of natural or human origin, or cultural assets".*

The North Channel and Lower Harbour oyster beds were the 4th largest oyster producing area in Ireland 100 years ago. Reinstated 50 years ago, the beds have shown that they are capable of producing oysters of exceptional quality (supplying 90% of the top restaurants in London for many years) and have shown the fastest growth rates of shellfish in the country. This is a huge and extremely rare, national asset for both Ireland and Europe. Both BIM and the EU have contributed significant funds to develop the oyster potential of the area, including the construction of the largest native oyster breeding complex in the world and the only one to give consistently successful results. The EU has now supported 4 multi-million € collaborative research projects using these facilities. Such an asset should not be extinguished by refusal to improve water quality, let alone planning to make it even worse and potentially tipping the balance towards higher density PSP blooms.

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17.72 Establishment of conditions can control ecological harm

- *"significant effects can be mitigated by measures set out in the EIS to prevent the pollution of water bodies……The effectiveness of mitigation measures can be controlled by condition. Monitoring of compliance with emission limit values will fall to the EPA".*

In our experience, invocation of the Precautionary Principle in the face of as much scientific evidence as can be presented, is a far safer way to proceed, when so often, just one incident, such as a death from PSP in Cork Harbour, could cause irreparable harm, from which the beds might take years to recover – if ever.

It could be remembered that the Midleton WWTP was given permission for its construction and discharge at Rathcoursey, based on the assurance in the EIS of 1993 and again for the foreshore licence of 1999, that there would be no more than 5 to 6 overflows p.a. or 1.5% of total storm water, which would total 2,973m3 p.a. The experience of the last 17 years is that this assurance has failed by a factor of 100 times and nothing has been done by any of the controlling authorities to put this right.

It should also be noted that it is the same man, Michael J. O'Sullivan, who both designed the Midleton WWTP and made those projections, with the help of Irish Hydrodata, who is now advising that the Dairygold discharge will also do no ecological harm.

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18.8 Appropriate Assessment screening

"This discharge point has been agreed with Irish Water".

It is only fair to say that this discharge point has also been vehemently opposed by the Department of Fisheries and Forestry in a detailed 80pp Submission on the Midleton Sewerage Scheme in 1984, in opposition to the eventual issue of the 1986 Foreshore Licence for the use of Rathcoursey as the proposed discharge point. The Department also opposed its use again, for the same reason, before the issue of the updated 1999 Foreshore Licence.

18.11 Trans-catchment discharge. Why should it be necessary to do this?

In s. 3.7.3 in this Appendix, I noted that Inland Fisheries Ireland (IFI) in their report dated 9th January 2017, has significant concerns in relation to both the impact of the proposed discharge and the principle behind the concept of trans-catchment discharges.

"IFI would highlight the existence of commercial shellfish production in the vicinity of Rathcoursey and recommend that any potential issues of contention arising from your clients proposed connection to the outfall may be examined within the context of the EIS. It is also anticipated that your client will in turn apply for significant modifications to their existing discharge licence arising from these proposals".

Why should we be made to suffer, when Dairygold have their own open sea so much closer to Mogeely than Rathcoursey, which is still 10 km inland?

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Table 5-4 given in Vol. 2 Chapter 5 of the EIS shows the distances to their own 2 SPAs and SAC access to open sea as 8.6, 8.7 and 8.7km – little over half the distance to Rathcoursey (13.6km).

The Rathcoursey discharge site has the added disadvantage in that it is also in the middle of 4 EU Designated Shellfish Waters, whose objective is to maintain these exceptional waters for the safe production of shellfish "*directly edible by man".*

To how many more industries will Irish Water and An Bord Pleanála offer this facility to dispose of their waste – and how much further will it be allowed to extend beyond the 13.6km under discussion here?

18.14 Conservation objective.

I argue above in sections 11.1, 11.2 and 11.3 that although the Irish Native Oyster is not at present in the Habitat's Directive list, this is open to future inclusions; it is already classed as an endangered species elsewhere, as in the UK, with its own Biodiversity Action Plan (BAP) and both the species and *Ostrea edulis* beds were added to the OSPAR list of threatened species 16 years ago.

We are the only place in the world breeding *Ostrea edulis* on a commercial scale, with enormous success and it would be a loss, far greater than just to Cork, if it became impossible to continue our work, because even the summer months became too dangerous to market our produce.

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18.28 & 18.29 Impacts on water quality.

18.28 "*There is potential for significant water quality impacts…… during the operational phase from the treated effluent discharging to the harbour.*

18.29 "*Trade effluent will be discharged just south of SPA (70m) and SAC (10m) via an existing underwater diffuser pipe from Rathcoursey an ebbing tide. As discharges will be on an ebb tide, effluent will be carried away from the Natura 2000 designated areas of the receiving waterbody. The effluent emanating from the discharge point is lighter than sea water so it rises to the surface, spreading out as it does so, thus becoming more diluted by the friction of the seawater on the rising column. Generally it occupies the top one third of the waterbody at the surface and continues to be diluted further. As it sinks deeper as it travels, it eventually diffuses through the entire waterbody. The discharge will quickly diffuse into the overall waterbody and owing to the ebb tide, will be carried out and away from the SAC/SPA."*

It is sad to see the Inspector reproducing such unsupported generalities on which to hang her backing for this desperately poor discharge location and I hope that I may have produced sounder arguments above in section 3, which will carry more scientific weight for the environmental protection we so hope for.

18.30 Water quality conclusion

"Trade effluent will be discharged just south of Natura 2000 sites via diffuser pipe on 6+ hour ebbing tide in a 24 hour period with water undergoing an ~80% exchange so that the subsequent discharge event will occur on new water coming in."

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If all that we are told here has really to be achieved in order to safeguard the receiving water from this discharge and so earn it ABP's approval, then I would have hoped that I have given the EPA enough solid data to know that:

(1) "*Just south*" of the Natura 2000 sites means 15m and 70m (in real terms, 15 seconds and 70 seconds for the 1m/s flood tide up East Ferry to carry any discharge into the protected areas).

(2) The discharge regime at present is that required by the Department of the Marine for the past 27 years, which is two periods of 3hrs at the top of each ebb tide in a 24 hour period.

(3) There would never have been oyster beds in the North Channel if the water exchange had been much more than 4% per tide. Thus all discharges are actually made into ~96% already-contaminated water.

(4) Rather than there being any dilution with outside "new" water, even M.C. O'Sullivan admitted on p.16 of his CHPR Volume XIV Physical Study – Dye Survey Analysis:

"20. The hoped for benefit of an intermittent discharge over a continuous discharge would be that a large portion of the intermittent release would be carried towards the sea and not return. ***What is, in fact happening is that the intermittent release is not carried far enough by the outgoing tide to remove it permanently from the East Channel - it remains in the East Channel and is simply pushed inwards by the incoming tide****, thereby tending to build up in the Rostellan area.*

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(5) All the nutrients released at Rathcoursey eventually flow inland and westwards anyhow, accumulating at the far west end of the North Channel, as shown in all the Irish Hydrodata and MCOS dye and modelling studies and all the NUIG hydrodynamic papers.

18.36 Assessment of In-Combination and Cumulative Effects

"Furthermore, the upgrades to the Carrigtwohill WWTP and Midleton WWTP will reduce nutrient inputs in the north east of the harbour which will benefit the Great Island Channel."

The Carrigtwohill WWTP does not impinge directly on North Channel water, as it discharges to the Fota Channel and there is no connection into the North Channel further than the null point in Belvelly pool. Proof of this is to be found in the dye released from Rathcoursey being detected right up in the reed beds to the west of Weir Island - see Fig 2.7 in sec. 5.2 in the Submission. If there was any significant water entering the North Channel from the western side, the null point, where the two flows met, would be somewhere east of Weir Island.

Midleton WWTP upgrade is not expected for many years yet and thus cannot fairly be taken into account for reducing its nutrient load for this Dairygold discharge, which is required with urgency.

However, it is noteworthy that the Inspector recognises that the Midleton nutrient load to the north east of the harbour will be reduced and will benefit the situation in the North Channel

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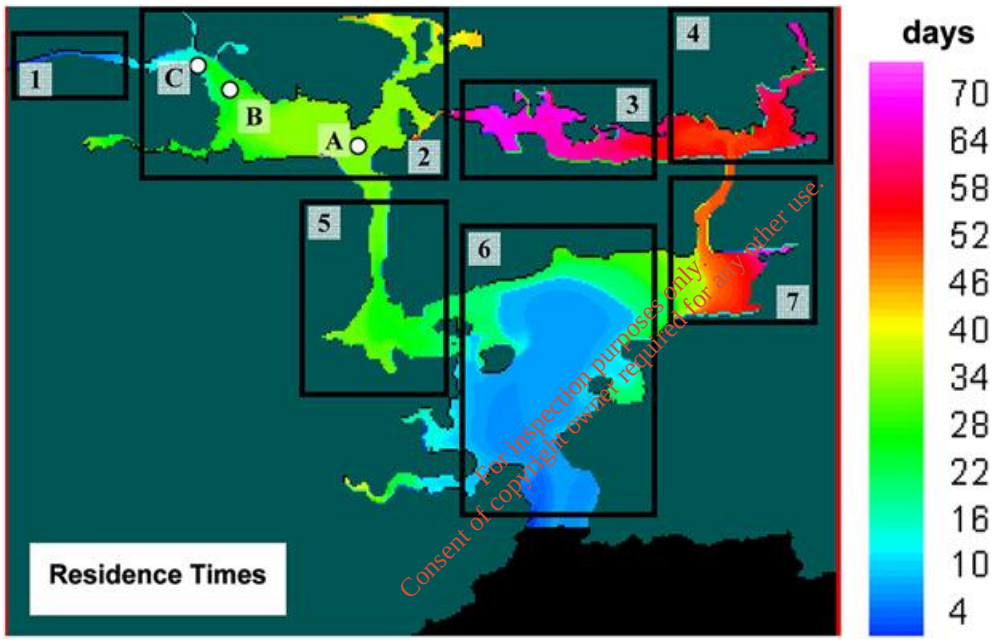
and, until that time, will also, obviously, be disimproving the situation – and thus must surely be a factor to be taken into account in considering the current situation of the current discharge licence sought.

18.37 re " *~80% water exchange available on new water coming in".*

Please see 18.30 above and with regard to this additional statement,

"*Thus, considering the water exchange within Cork harbour it is unlikely that significant cumulative water quality will arise."*

The NUIG hydrodynamic work shows that water exchange in the NE section of Cork Harbour is actually particularly limited, as I have shown in my section 4 on tidal flushing.



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Fig. 9. Spatial plot of residence times showing boundaries of sub-regions

18.40 & 18.41 Mitigation

The following Best Practice Management as per the project design will be implemented for the duration of the project:

- *WWTP upgrades will be as per planning design*
- *Construction of the wastewater discharge pipeline will be as per planning design*
- *Trench and outfall excavations will be carried out to Best Practice*
- *Detailed method statements will be prepared for water crossings, trench excavations and outfall excavations*

Provided that the mitigation measures (from section 7.8) are implemented ***in full,*** *it is not expected that significant impacts will result to the features of interest identified for appraisal*

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*in this NIS and thus it is not expected that the proposal will have an adverse impact on Natura 2000 sites. In conclusion, provided the design mitigation measures are implemented **in full** it is not expected that the Dairygold Speciality Cheese Plant Expansion will not adversely impact the integrity of the Natura 2000 sites considered in this NIS.*

There is nothing in the above two sections that give us any confidence that water quality has been safe-guarded (by "*avoiding, reducing or offsetting negative impacts"*) to protect human health from the addition of further nutrients to a critical area of high density PSP cyst beds – at the upper end of such densities found world-wide.

We also note that the mitigation measures referred to as being in section 7.8 of the NIS, as needing implementing in full, are missing, as the EPA have also observed in their letter of 13.03.19:

"Section 7.8 appears to be missing from the document. Provide a clear, concise list of mitigation measures that will be implemented on site to avoid, reduce or offset negative impacts from the operation of the installation on SPA's and SAC's".

18.44 The potential impacts have been evaluated using the best scientific knowledge

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I do not believe the ABP Inspector has taken into account fully all that we know from working 50 years on this water about the water movements, which are now supported by the NUIG hydrodynamic work and a re-evaluation of the earlier MCOS 1977 and Irish Hydrodata 1993 and 1997 dye studies and modelling.

Firstly, the Inspector dismisses the NUIG papers as drawing their data from work at Marino Point and Camden and not from the specific work at Rathcoursey. This is simply not true and I deal with this in section 3.9 (cont) above. However, this makes her believe that the work of MCOS/Irish Hydrodata in the Dairygold Submission is more relevant – even though it lacks the sophistication of all the work that has now been done in Galway 12-35 years later, with, not least, all the advances in computer technology included.

Secondly, the Inspector dismisses the evidence for the residual water movement in the North Channel being to the west and not to the Lower Harbour and to the open sea. She says that the very much greater measured flood current speeds, compared to those of the ebbs, are balanced by the slightly longer ebb tide. I look at this in sec. 5.6 and suggest that, even an analysis by eye, shows that the average flood tide (and therefore entering volume) is approx. 60% greater than the ebb tide, with the greater length of the ebb tide, at c. 10%, not possibly being able to account for such a large difference in the entering flood water volume.

With the illumination of the "flushing" work of NUIG, we can now see that all the results of the 1993 dye studies and their modelling work, have, in fact, been telling us the very same story – the story revealed by the presence of native oyster beds in the North Channel for thousands of years, that the water has a significantly long residence time – and, in fact, that this is due to an overall, or residual, water movement in the North Channel from east to west, leading to the build-up of nutrients from the Owenacurra inputs, which has supported the dense PSP cyst bed of the North Channel for so long.

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MC O'Sullivan spelled out this discovery from his 1977 dye studies in the CHPR (see sec. 5.3)

"20. The hoped for benefit of an intermittent discharge over a continuous discharge would be that a large portion of the intermittent release would be carried towards the sea and not return. ***What is, in fact happening is that the intermittent release is not carried far enough by the outgoing tide to remove it permanently from the East Channel - it remains in the East Channel and is simply pushed inwards by the incoming tide****, thereby tending to build up in the Rostellan area.*

The conclusion that he wanted to draw from this was that a foreshore holding tank was not required. The conclusion that he should have made was that it made no difference when or how you released dye, or anything else, at Rathcoursey, it simply never got far enough away to reach the open sea and get lost to the harbour, and returned with the almost perfect oscillation, that Prof. Korringa says is required for water supporting the natural recruitment of an oyster bed (see sec. 3.2.3):

"An adequate retention of the larvae is only to be expected in places where the tides perform a more or less perfectly oscillating movement, which enables the majority to return to the grounds after each tidal cycle."

Irish Hydrodata could also have allowed us to come up with this analysis, if they had given us the full spring/neap cycle of 12 full days of current meter readings at Brown Island in 1993, instead of just 2 days of springs and 2 days of neaps, with the full cycle only being made available in 2007 by Prof. O'Kane. However, Irish Hydrodata did make it quite clear in the Summary of their Report, that a discharge at Rathcoursey would not improve the situation in the North Channel.

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Irish Hydrodata could also have given us their estimate of any dilution of a Rathcoursey discharge in the Lower Harbour, if they had run their final modelled discharges for various discharge location for at least 3 days rather than just 9 hours (HW-3hrs to LW) – so that we could have seen how close their built-in estimate of 20% exchange at the southern boundary (Irish Hydrodata No. 1993 Report sec. 3.3.15 (p. 6/14) – see **Ref. 19**) came to the achieved dye study data.

If the Inspector had not dismissed these two points out of hand and had really "*analysed and evaluated them using the best scientific knowledge"*, I believe she would have had to have come to the conclusion that Rathcoursey is simply not a location at which any discharge should be made. It is such an enclosed waterbody and, however potentially small we are assured such discharges will always be, additions of any nutrients in the large volumes as required by Dairygold, simply accumulate in the North Channel, and, in the presence of one of the most dangerous nerve agents known, the risks of triggering greater blooms of PSP and endangering human health, would be an environmental risk that cannot possibly be taken.

The Inspector adds,

"*Where potential adverse effects were identified, mitigation measures are prescribed to remove risks to the integrity of the European sites. The hierarchy of mitigation was followed with avoidance measures the primary mitigation tool employed. I am satisfied based on the*

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information available that <u>if the mitigation measures are undertaken, maintained and monitored as detailed</u>, adverse effects on the integrity of Natura 2000 sites will be avoided".

These mitigation measures have been left out in sec. 7.8 of the NIS, and can they ever be monitored with enough precision to provide the safety required for human health of being "*entirely effective all of the time."* – the standard required by the Scottish EPA for the treatment of discharges to the oyster bed that we manage in Loch Ryan, which the Scottish Government then funded to take the discharge 8 km overland to the open sea.

The only effective mitigation, which was explored by Mott MacDonald for Irish Water, is in Option 3 in section 9 of our submission, above, which is to give the discharge what is required for the active, safe farming of oysters that has been practiced for 50 years in the North Channel, as stated by M.C. O'Sullivan himself:

"Because of the presence of oyster farming in the North Channel, ***any outfall point should be such as to give <u>very substantial dilution</u>."***

To achieve any such meaningful dilution for the discharge of further nutrients from the proposed pipeline, which we understand Dairygold is now already starting to install (early May 2019), the discharge has to be taken to the open sea at Ballycroneen. By an extraordinary piece of good luck, there is the possibility of making free use of the soon-to-be defunct Kinsale Gas pipeline for a discharge as far out to sea as can possibly be needed (see our Submission sec. 9.5) – at no further extra cost as 54 km of 24 inch pipe are available – and giving, at the same time, a credible solution to enable Irish Water to honour their commitment to the people on the east side of Cork Harbour that "*No more untreated sewage will enter Cork Harbour by 2021".* The agglomerations on the east side of the harbour total 2,500-3,000 people and this will complement the current, significant improvements on the west side.

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