Submission	
Submitter:	Mr David Hugh-Jones
Organisation Name:	Alantic Shellfish Ltd.
Submission Title:	Fifth Submission re Dairygold P1103-01 to dischrage at Rathcoursey Point.
Submission Reference No.:	S005964
Submission Received:	31 January 2020
Application	
Applicant:	Dairygold Co-Operative Society Ltd and TINE Ireland Ltd
Reg. No.:	P1103-01
See below for Submission details. Attachments are displayed on the following page(s).	

Atlantic Shellfish Ltd. views on the comments/observations of Dairygold TINE Ltd. on the content of the last two Submissions to the EPA made by David Hugh-Jones and Mark Bentley of JBA Consulting.

I had hoped to have inserted our views and further details etc on these comments and observations in blue, directly under or alongside the Dairygold comments, hoping that this was the most direct and easiest way to relate and group all the information concerning each point. However the formats used by the Developer make this difficult and I will have to copy in the comment we have difficulty with (in black) and continue to add our comments in blue

3.1.1 Exchange factor / Flushing.

The NIS, which was produced as part of the original Planning Application (Ref. 16/07031) to Cork County Council, did contain a number of incorrect references to "~80% exchange" which were inserted due to a misunderstanding".

(1) To make a mistake on such an important statement is astonishing: to make it 22 times in the NIS and 3 times in the EIS, is verging on the deceitful.

It is noted that Mr. Mark Bentley, JBA, for Atlantic Shellfish Ltd., in his submission (ref. S005925) gives the following analysis of the same data in the NUIG (2011) paper

"The plots show that residence times in the North Channel are at their greatest just to the east of Belvelly (22-days). Residence times to the west of Belvelly (up to 6-days) are less than the residence times at Rathcoursey (up to 9-days), the eastern end of the North Channel."

Mr. Bentley takes his figures from the 2011 NUIG paper sec. 3.3. but he has recently advised me on this that he was mainly going by the shades of grey in the Figures and he comments,

- *The 22.5-days refers to the average residence time in the North Channel.*
- *The comment about 6-days residence time at Belvelly and 9-days at Rathcoursey is based on a B&W figure which shows greater residence times in the North Channel itself of 22-days.*
- *The text of the paper does say there is a residence time of 70-days in the North Channel but it is not possible to confirm this from the figures produced in the paper.*
- *Personally I don't think it matters, the number is still much larger than the 3-days that IH mentioned.*

He refers in the last bullet-point to p.42 of the July 2019 IH Rathcoursey Outfall Study:

"Applying an exchange factor of about 0.35 (ref:17 i.e. MCOS 1977) indicates a flushing time of about 3 days during neap tides" - and on spring tides:

"Applying the tidal prism method to the average mid-tide volume would indicate a flushing time of about 8 days for the Great Island channel".

Finally, Mark Bentley also adds:

- *As mentioned above, I said the residence time in the North Channel was 22-days not 9-days. 9-days refers to the residence time at Rathcoursey at the top end of the East Passage. Residence times here are going to be less because of the effect of freshwater flow from the Owenacurra River.*

We would both point out that in the penultimate para of this very same sec 3.3 "Flushing Study", we have the following spelt out:

"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 Passage West and Lough Mahon are in the region of 25–35 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."***

I, myself, have never understood why there are two such different sets of times given in this section, but by the next 2012 paper the smaller figures are not mentioned and we get residence times given as:

-3) ***North Channel - 64.4 days****;*

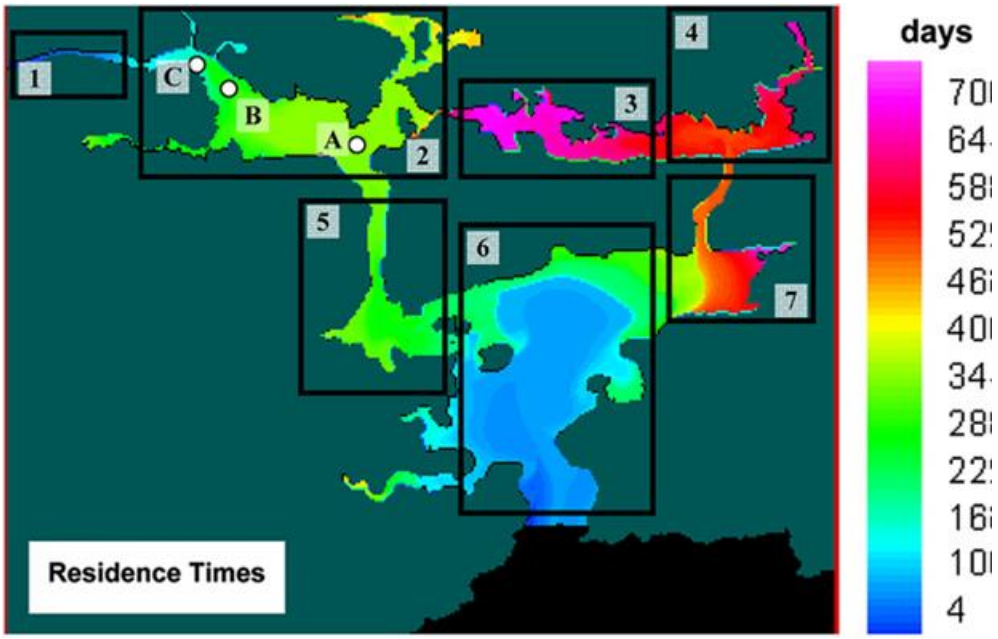
- 4) ***Owenacurra Estuary - 53.1 days****;*

- 5) Harbour (west) - 26.2 days;

- 6) Harbour (central) - 10.7 days;

- 7) ***Harbour (east) - 47.1 days***

In this Hartnett et al paper of 2012, we are also given this spatial plot of residence times:



3.1.2 Dye Studies

Mr. Hugh-Jones, in his fourth submission, and combined with his second submission, implies that the 2017 IH study is only based on limited dye study work carried out by IH in 1993. This is not correct as can be seen from Section 2.1 of the 2017 IH report which lists the data used as follows: -

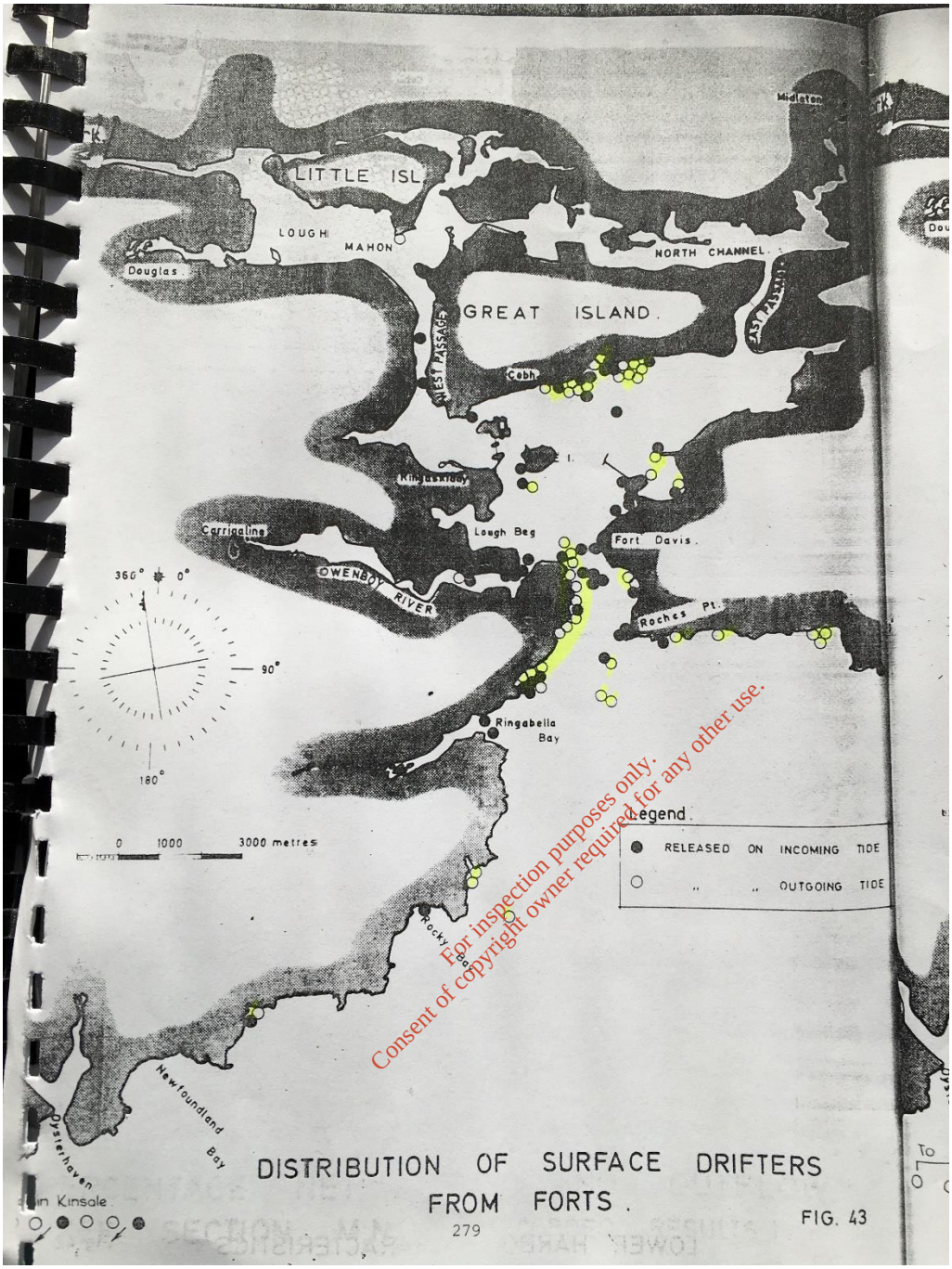
Report No	Report	Relevant Content
1	M.C. O Sullivan Ltd, Cork Harbour Pollution Report 1988	Contains results of extensive field studies in the harbour, includes dye and tracer release from Rathcoursey outfall location
2	Hydrographic Surveys Ltd, Midleton Outfall Dye Tracing Study 1992	Contains results of dye tracer releases from Rathcoursey outfall location
3	Irish Hydrodata Ltd, Cork Harbour Study 1991	Contains tide levels and current meter data
4	Irish Hydrodata Ltd, Midleton SS Marine Outfall Hydrographic Survey/Numerical Modelling Report 1993	Contains results of field studies at the Rathcoursey location, includes currents, tides, drogue and dye tracer releases.
5	Irish Hydrodata Ltd, Saleen Outfall Dispersion Study, 2005	Contains results of field studies for Saleen outfall

Table 2.1 - Information from various studies relevant to this report

The MC O'Sullivan Cork Harbour Pollution Report of 1977 ran to 19 Volumes, which provided a great deal of useful data. Certainly it provided a wonderful base for later more advanced work such as the aerial photography of chlorophyll concentrations, which must be the ultimate of dye studies, encompassing the entire harbour in a single photograph.

It should be remembered, however, that although the datasets used for the model calibration were extensive, the Irish Hydrodata model only represented the eastern end of the North Channel and O'Kane's Cork harbour model was not calibrated for conditions in the North Channel; instead he calibrated a sub-model that was closed at Belvelly.

There are, however, parts of the CHPR's work which have not shown up the Harbour flushing in such a helpful way, such as the surface drifters released in a line between the Forts (Fig. 43) at the Harbour mouth and (Fig. 44) at Roches Point in Vol. 1 of the CHPR. The open circles in the fig. below, represent release on an **outgoing tide at the harbour mouth** and yet many of them have come back into the Harbour to Cuskinny Bay and even up to Lough Mahon. They were sent off to see where floating sewage released at Dognose Bank (at the mouth of the harbour) might end up.



The result is much the same for Fig. 44, but we are back to assumptions as to the actual amount of water returning in para. 62:

"*Assuming that all drifters lost were, in fact, lost to sea, then in the case of the Forts on an outgoing tide, 70.5% was discharged to sea and on the incoming tide, 57% was discharged to sea. Taking an average over the two tides, 64% of the material would be lost to sea."*

Is this a fair assumption? Cork Harbour is claimed to be the second largest harbour in the world with an area of 180 sq. km and a shoreline to match with many inlets and islands – and the furthest drifter recovered above, reaching as far in as Carrigrennan Point in Lough Mahon.

The table added by Dairygold, the subject of this discussion, includes work done by Irish Hydrodata on tide levels and current meter data in the Cork Harbour Study of 1991. IH also then quote that more specific current meter data was collected for the North Channel in connection with the use of Rathcoursey Point as a discharge point in 1993, giving rise to Fig. 2.2a:

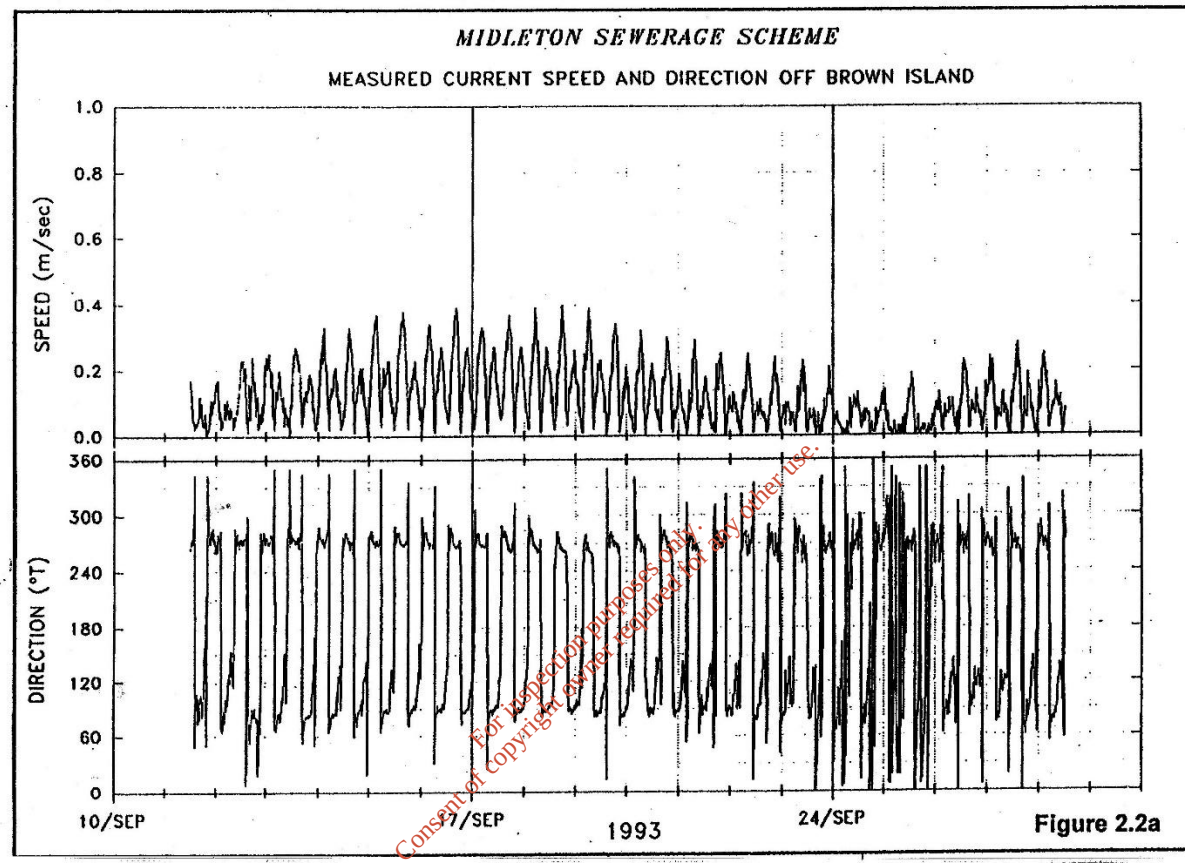


Figure 2.2a

Irish Hydrodata (IH) have all the data for this current meter deployed off the east end of Brick Island in 1993, at the far end of the oyster beds from Rathcoursey, and must therefore have the ability to tell us precisely by how much the flood tide to the west apparently so obviously exceeds the speed and hence volume of the returning ebb tide to the east. The answer will tell us where a discharge into water at Rathcoursey really drifts to. I suggested it would be helpful if Irish Hydrodata used their records from 1993 to this end, in my second submission on p.16 and in my fourth submission on p.21.

They have chosen not to make any response.

3.1.4 Results of Drogue Tracking

"In addition, there is mention, in Mr. Hugh-Jones commentary that the drogue track was interfered with on at least one occasion".

We had wasted the spring tide run of s. 2.1.1 on 14.10.19 to see how far a release in the middle of the 3hr discharge period which is allowed at present, would go, and if it would

reach the Main Cork Channel, because on this occasion the drogue got caught in the clockwise gyre to the west of the mouth of East Ferry and then stranded on the shore.

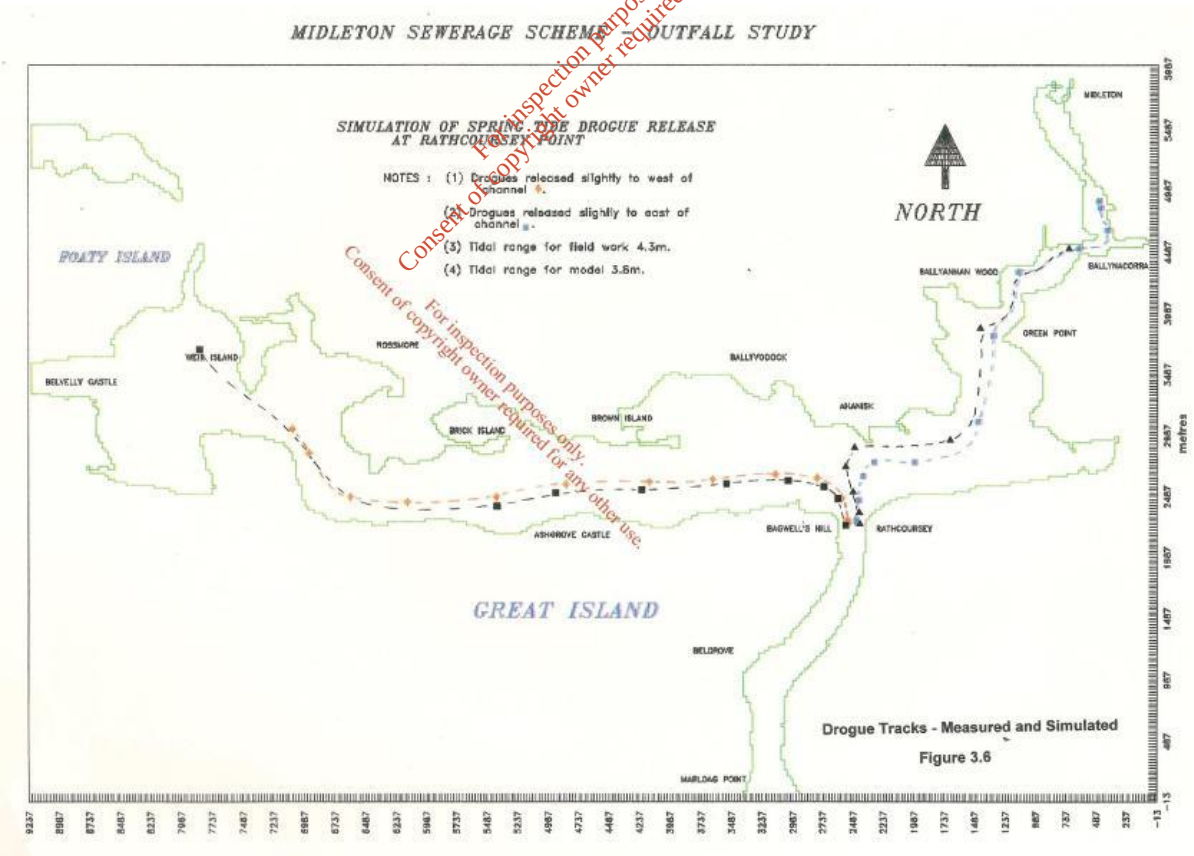
On 15.10.19 we had a good run past Whitegate, but on the next run on 16.10.19 s. 2.1.3 the drogue was moving into an anti-clockwise gyre on the east side of the mouth of East Ferry and had come out of the East Channel on to the shallow sloping bank of the Rostellan fishery wher the flow is slower. We recorded:

"12.25 Drogue probably affected by the anti-clockwise gyre to the east of the East Channel and as it drifted east out of the East Channel flow on to the Rostellan shallow shelf, we decided to try to bring it back to the Channel, with the aim of letting it maximise its tidal reach, to see how far it could possibly go".

There really was no point in letting the drogue get stranded again. We had now learnt about these two gyres, but we were coming to the end of our spring tide work and wanted to learn how far the last water of a 3hr discharge would go.

p.9 The only significant difference between these drogues and those used in earlier studies is that these are easier to trace due to the GPS tracking technology. The accuracy of the previous drogue runs is at least as good as these now presented.

We quite agree and several of our runs followed the Irish Hydrodata simulation further than Weir Island, as below, where the drogue's depth of 1.6m would have prevented it going any further unless it was precisely in the channel through to Belvelly.



p.10 Furthermore, it illustrates the variation of the track depending on which side of the East Passage that the drogue is dropped. The Rathcoursey Outfall diffuser is located in the eastern side of the passage.

This last sentence suggests that the material discharged on the ebb tide will stay on the eastern side of the passage and conveniently return on the eastern side of the passage on the flood and disappear up to Midleton. Let us be clear,by the time the discharge has travelled down the East Ferry and into the Lower Harbour and is returning on the flood tide, the water in the Ferry will be entirely mixed. It will then split approx. 72% to the west and 28% returning up to Midleton according to MCOS 1977.

p.10 cont. The point Mr Hugh-Jones appears to be trying to make is that there is a nett tidal flow from east to west in the North Channel with the excess water exiting into the West Passage through Belvelly Bridge. This is the thrust of the remainder of his fourth submission. However, other studies of Cork Harbour state the exact opposite.

Prof. O'Kane in his report on "*Modelling the Norovirus contamination of an Oyster Farm in Cork Harbour",* in 20078 , using MIKE 21 software for his numerical model, arrived at the conclusion that: -

"On the flood tide viral particles from CC_S&C (untreated Cork City) ***are advected into the Belvelly Channel area of Cork Harbour and pass through the Belvelly Bridge. As the flow to the east of Belvelly divides with the turning of the tide, some of the viral particles travel west, back through the Belvelly Channel, while some travel east into the North Channel. The number of viral particles that travel east is influenced by the spring to neap tidal variation and the magnitude and direction of the wind. A greater number of viral particles will travel east under spring tides as the higher velocities and water levels ensure a greater number are advected through the Belvelly Channel."***

To start with the hydrodynamics, we would comment that Prof. O'Kane's model of the whole of Cork Harbour was not calibrated for the North Channel.

On a more practical, but irrefutable level, I can advise that the sewage from Cork City was discharged untreated up until 2003 and water quality from the west of the Cobh railwaybridge to the sampling station at Belvelly did not improve until March 2004. Cork City sewage had been discharged in precisely the same way before December 1988 from the start of our operation in 1970 and yet we did not suffer from any health problems arising from the consumption of our oysters from the start of sales in 1971 to December 1988 (17 years and many millions of oysters sold direct to hotels and restaurants in London and the Continent, with our name on each and every box).

In December 1988 the sewage from Midleton was brought down to Rathcoursey Point for discharge untreated into the estuary. Immediately we had numerous reports of food poisoning and by March 1992, we had had such a catastrophic outbreak of illness that the Department of the Marine invoked a clause in their Foreshore Licence, requiring that secondary treatment of Midleton's sewage be installed "*as a priority item*".

If Cork City's untreated sewage had been able to come through the Belvelly channel in the reverse direction to the flow we believe exists and so into the North Channel and on to the

oyster beds, we would surely have been having reports of illness throughout all those first 17 years.

In my first submission I also reported the work done by NUIG in establishing a western boundary for the modelling of the toxic PSP bloom and in 27 salinity/temperature tows at Belvelly, they found a pronounced difference between low salinity, higher temperature water on the Cork side at HW, showing that two completely separate water bodies were involved, with no mixing to speak of.

"It should be noted however that even with no wind Norovirus from CC_S&C, transported through the Belvelly Channel."

In those 17 years we experienced every sort of wind from every direction including a wind of over 100mph.

3.1.5 Results of Current Metering

I understand that the on their first outing, the current meters were set to read at 10 second intervals instead of 10 minute intervals and thus ran out of battery after 2 days.

Mark Bentley, who had been consistently asking for as long a tidal period to be examined as possible – leading to our leaving the meters in for a whole month, analysed the three separate tides at Brick Island, for which we then had the data, and came up with residual differences in almost every direction except the more or less due east-west orientation of the North Channel that was obviously the direction of flow (as shown by the drogues) and it was decided to drop this unfinished work, which was of no help to anybody.

He also suggested that IH should come up with any residual flow figure from their own records which had been used in creating fig. 2.2a, above.

It appears that Mr. Hugh-Jones, as per the following statement in his submission, accepts that accuracy and believes that his current data agrees with the previous data:-

This difference of an about 10% longer ebb tide, fits with my earlier estimate from the graphs of the 12 days of current data presented in the O'Kane Hydrodynamic Survey of Norovirus in the North Channel."

I have covered this both in s. 5.6 of my first submission and on p.13 of my second submission,

"1*) The 12-day record given to us by Prof. O'Kane in 2007 in his "Modelling the Norovirus Contamination of an Oyster Farm in Cork Harbour", of the Irish Hydrodata Brown Island current meter, does NOT show greatly extended ebb tides. I go into this in detail in s. 5.6 of my earlier Submission where my table of close analysis of the daily record shows that the ebb may last as much as 10% more, but the differential between flood and ebb current speeds is more like 60%, which vastly outweighs it and points to a substantial residual westerly movement of the North Channel waterbody."*

3.3 Natura Impact Statement (NIS)

p.13 The introduction to the updated NIS clearly states that '*The updated NIS does not identify any new or additional effects which would adversely affect the integrity of Natura 2000 site. Thus the findings and outcomes of the original NIS remain unchanged*'.

No attempt was made to allow for the large and frequent overflows to the Owenacurra from Midleton pumping stations, which add greatly to the nutrient load coming down the river, by as much, I suggest as 2.5 times what has been allowed for in the NIS. (see my first submission s. 7.6.1 and s. 7.5 and on p.24 of my second submission), presumably the cause of the Owenacurra's highest DIN levels in the country and noted for the number of its exceedances)

Last para.: In addition, the NUI Galway research paper by Nash, Hartnett and Dabrowski in their assessment of the North Channel make the comment that: -

"Although a sewage treatment plant discharges to this area, its discharge is relatively low and is not sufficient to cause or sustain the elevated levels of phytoplankton growth that were recorded in this region".

The huge overflows from Midleton are not something to publicise. They are equivalent in volume to overflows on the Thames for which Thames Water was fined £20.3m in March 2017. The EU and EPA know very well the scale of the problem and have acted accordingly. Such overflows of untreated town waste, often on days without rain, are substantial sources of nutrients and must be taken into account, if and when the addition of a further source of nutrients is contemplated. This is a fundamental requirement of an EIA, such as in:

Annex III

1. Characteristics of projects

The characteristics of projects must be considered, with particular regard to:

(b) ***cumulation with other existing*** *and/or approved projects;*

(g) ***the risks to human health*** *(for example* ***due to water contamination*** *or air pollution).*

2. Location of projects

(c)(vi) areas in which there has already been a failure to meet the environmental quality standards, laid down in Union legislation have already been exceeded and relevant to the project, or in which it is considered that there is such a failure;

3. Type and characteristics of the potential impact

(g) ***the cumulation of the impact with the impact of other existing*** *and/or approved projects;*

Annex IV

(e) ***the cumulation of effects with other existing and/or approved projects****, taking into account any existing environmental problems relating to areas of particular environmental importance likely to be affected* ***or the use of natural resources;***

I have dwelt on one of the recurring themes of the re-worded EIA Directive (2014/52/EU) that I had noted in my third submission, that a **cumulation of effects** has to be taken into account. It is unfortunate for Dairygold, for instance, that the Owenacurra Estuary has one of the highest DIN levels in the country, recurring with the highest frequency. This may be due to the town overflows, which, in turn, may be being discharged into water that is already high with agricultural run-off, rich in N. However, the current state of the water will only degenerate to a potentially more disastrous level – in our case, leading to the explosion of a dangerous algal bloom – and this is the purpose of the EIA Directive – to make sure that the existing environment is not overpowered.

3.4 Discharges of Fats, Oils, Greases

"The residual concentrations of FOG (which are of milk origin) in the final treated discharged wastewater will be soluble and will not cause a build up of fatty deposits in the area."

The main milk fats of cream and butter are known to float and to adhere to moorings and boats, and to be deposited on rocks and on the shore. Most of the submissions made concern the public's fear of this degradation of a very beautiful area.

3.5 Consideration of alternatives

The issue of alternatives has been addressed in our unsolicited information submission of 27 August 2019. No further comment on this matter.

Many alternatives that have been suggested by us and in many of the other submissions, have not been acknowledged; dismissed with reasons, or, as far as we have been told, even looked into.

This is of fundamental importance to the whole of this process and there was nothing new mentioned in Dairygold's unsolicited information submission of August 2019. I went into this very fully in my third submission in September, in the light of Article 174 and the new EIA Directive, with its very instructive view of the amendments, allowing us to compare the old and new versions.

Now we are told they have no further comment – and meanwhile they have laid their pipeline to meet the existing outfall at Bawnard.

Appendix A

p. 3 It is noted that the IH Study Report makes no reference anywhere to "~80% exchange" as stated by Mr. Hugh-Jones.

I apologise. The 22 references to a "~80% exchange" were made in the NIS of Nov. 2016 with the further 3 being in the EIS Vol. 2 Chapter 5. They were given to us in one long document.

In their 2019 report IH stated *'On the basis of the dye studies the calculated exchange factor (effective amount of new water added to the tidal prism) for the waters upstream of Rathcoursey was reported (Cork Harbour Study ref:17) to be about 0.35.'*

If we check the Ref. 17 the CHPR 1977, we find that MCOS takes a tidal exchange factor of 19% on p. 172 of Vol 1, referring us to para 33 on p.148 where the "Steady State" factor was 24% and the "Die-Away" factor 19%. He doesn't appear to use a factor of 35% exchange?

I argue in s. 3.2.3 of my first submission that there would have been no oyster beds in the North Channel (the bottom is in fact feet deep in shells and there were 3 large kitchen middens on the shore) and I produce the biological data and tabulate the differences in likely recruitment on p.24 between exchange rates from oyster water bodies of 3.7%, 4%, 5% and probable failure at 6%..... at 19% exchange the necessary third of the larvae for successful recruitment would be left after only 5 of the necessary 20 tides minimum at our water temperatures. At 35% exchange, the required larval density would have vanished after 2 tides.

p.5 "Tidal prism model" versus "Numerical model"?

I asked our Consulting Hydrographer to comment on this and posted Mark Bentley's submission, which I hope was helpful.

In fact, the important issue is the dilution of the effluent and the rate at which the various nutrients and other parameters decay in the receiving waters until a "steady state" is reached.

The issue of flushing or residence times is incidental when assessing the impact of the proposed discharge.

We are particularly concerned with the residence time of the nutrients in the North Channel, where the nutrients will be being taken up directly by a potential toxic algal bloom. The longer the residence time, the greater the expansion of the bloom. We also show in our fifth submission, in a repeat of current measurements made in 1993, that the Consultants involved must have known that the residual flow of water was actually into the North Channel and not away from it. This was surely the point of the exercise?

Mr. Bentley also says, in the same section (Section 2,2), that

"The plots show that residence times in the North Channel are at their greatest just to the east of Belvelly (22-days)".

This is dealt with exhaustively in relation to 3.1.1 above.

My own references are to 50 days at the Rathcoursey end up to 70 days at the west or Fota end of the North Channel – never to 77 days.

p.7 It is clear that Mr. Bentley accepts that the best way to calculate the flushing factor is to use a numerical model. In fact, this is what IH did as stated in Section 2.5 (Dye Studies), of their 2019 report (already referenced) as follows: -

"On the basis of the dye studies the calculated exchange factor (effective amount of new water added to the tidal prism) for the waters upstream of Rathcoursey was reported (ref:17) to be about 0.35."

I have dealt with this before as the second item in Appendix A above, where I look up the reference to the MCOS CHPR of 1977. No numerical modelling appears to be used. As an

example, the "die-away" factor that MCOS favours has a very simple equation that is open to huge errors on p.147 of Vol. 1:

Total dye = High Water Volume

Dye Lost Volume of Prism Lost (P x LW vol)…. P is the exchange factor

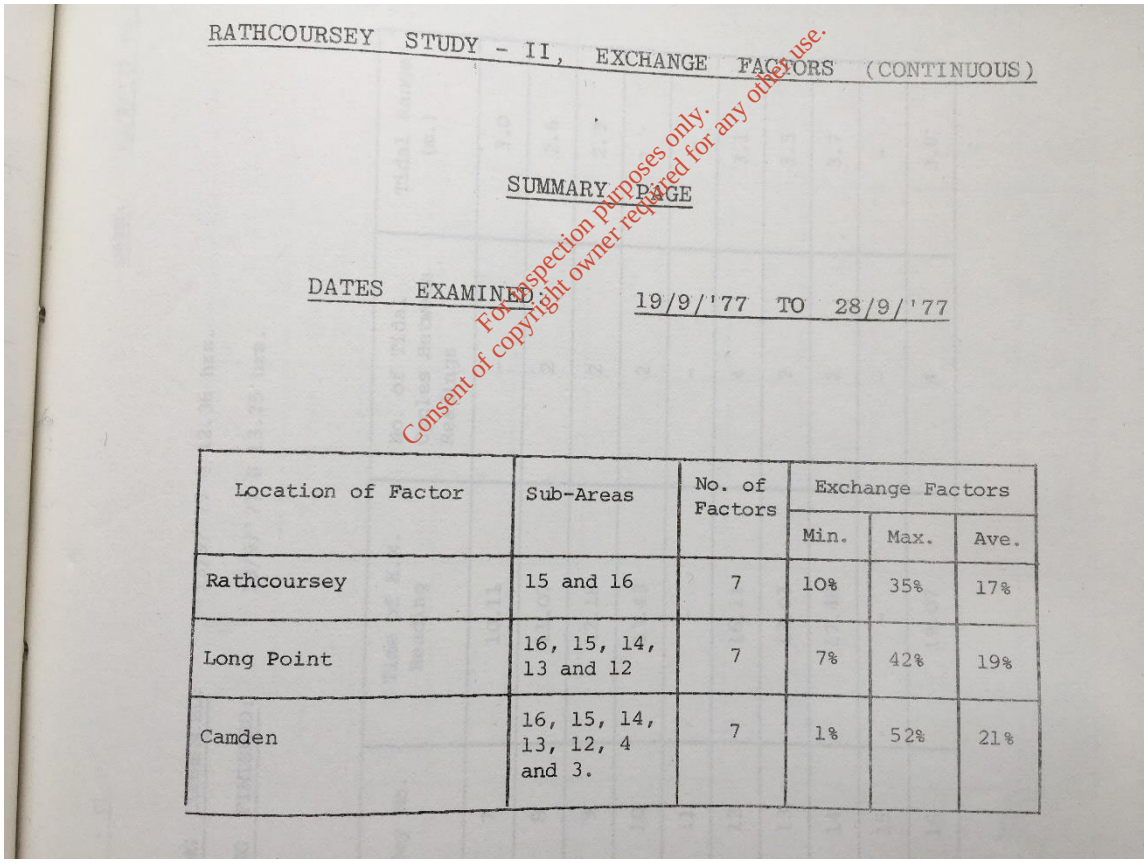
MCOS comments in para. 30, below this:

"The above example shows an exchange factor of (say 0.40 or 40% – I haven't added figs). *This is a simplified example. However, it illustrates the method which was applied."*

This really is a very elementary equation with a minute difference in say a dye level of $1x10^{-8}$ or $2x10^{-8}$ as shown on some of the dye studies, being 100%.

In Vol XIV of the CHPR 1977 p.147, MCOS gives the exchange factors during "die-away" for a continuous discharge from Rathcoursey Point :

MCOS Cork Harbour Pollution Report 1977 Vol. 1 pp.147 & 137 Exchange Factors



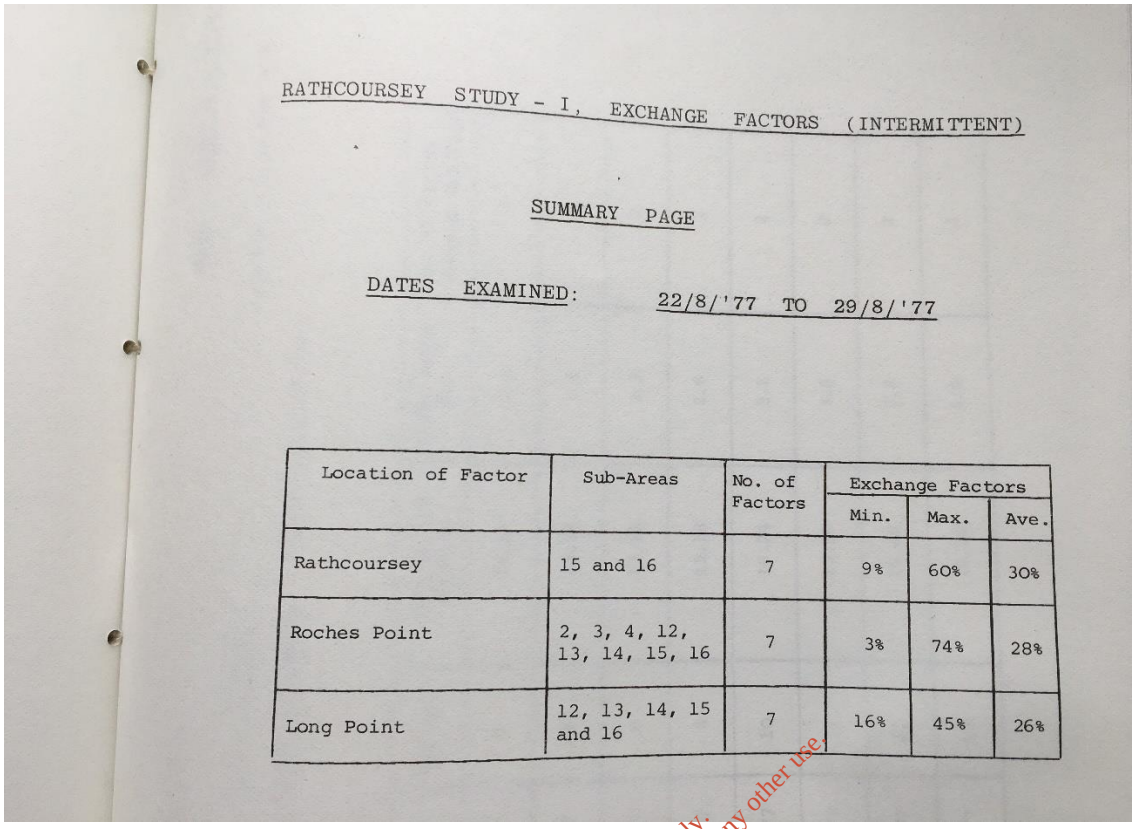
RATHCOURSEY STUDY - II, EXCHANGE FACTORS (CONTINUOUS)

SUMMARY PAGE

DATES EXAMINED 19/9/'77 TO 28/9/'77

Location of Factor	Sub-Areas	No. of Factors	Exchange Factors		
			Min.	Max.	Ave.
Rathcoursey	15 and 16	7	10%	35%	17%
Long Point	16, 15, 14, 13 and 12	7	7%	42%	19%
Camden	16, 15, 14, 13, 12, 4 and 3.	7	1%	52%	21%

and for an intermittent (ebb tide) release of:



RATHCOURSEY STUDY - I, EXCHANGE FACTORS (INTERMITTENT)

SUMMARY PAGE

DATES EXAMINED: 22/8/'77 TO 29/8/'77

Location of Factor	Sub-Areas	No. of Factors	Exchange Factors		
			Min.	Max.	Ave.
Rathcoursey	15 and 16	7	9%	60%	30%
Roches Point	2, 3, 4, 12, 13, 14, 15, 16	7	3%	74%	28%
Long Point	12, 13, 14, 15 and 16	7	16%	45%	26%

He gives a range of Exchange Factors for Min., Max. and Average.

They are 10%, 35% and an average of 17%. **The difference between max and min is 350%**

On p.136 he gives the same exchange factors for an intermittent (ebb tide only) discharge

They are 9%; 60% and av. 30% **The difference between min and max is now 660%**

I should say this system of estimating these so important exchange factors, for which MCOS had all the dye studies &c at his command and on which Dairygold, Irish Hydrodata and M.J. O'Sullivan are still resting their case, would seem to be a bit shaky, to say the least.

I also advise above that no oyster beds would have possibly have been able to form (and so extensively) in the North Channel at this rate of water exchange, which would be below the required 30% level of retention of larvae, after 3 tides; below 5% of larvae after 7 tides and below 1% of larvae after 11 tides – when 30% is the minimum that needs to be retained for 20 tides at least at our water temperatures.

p.9 In each introduction to the state of tide, when the drogue is released, Mr. Hugh-Jones refers, variously, to a "Statutory 3 hr discharge period".

This is the "*de facto*" discharge period that has had to be observed since May 1992 since it was imposed by the Department of the Marine. It was being observed and acknowledged in the O'Kane Report as a 3-hr period and to all the Consultants reporting to Cork CC and IW.

Brendan Wall of the EPA visited the foreshore tank and reported it in his Waste Water Inspection Report of 27.04.2012, as a 3½hr period, when he also recommended that:

"*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.*"

Ref. Spring Tide drogue run of 14.10.19

The text of this section of Mr. Hugh-Jones submission, between the times of 09:25 and 14:05, appears to say that the drogue went to shore after 60 minutes and was then re-launched, a distance away, some 5.5 hours later i.e. it is not a true reflection of the drogue behaviour for this drop.

The drogue was released at R.Pt. at HW+2hrs i.e. on an ebb tide, thus the mouth of East Ferry is the mouth to the Lower Harbour – and the place where the drogue beached at Marloag is clearly shown on the drifter track which is shown on his p.10 alongside.

p.10 Spring tide 15.10.19. From the diagram provided for this the drop point appears to be to the eastern side of the East Passage at Rathcoursey Point and upstream (North) of the diffuser.

At this point in the tide the stream must be running at about 2+ knots and will take only a few minutes to reach the diffuser. It was meant to be released in mid-channel and that seems to have been achieved.

There is no comment here as to whether the drogue got fouled by the Aghada or Whitegate Jetties.

The drogue track is far to the east of Aghada pier and went between the legs of the Whitegate Jetty without hitch.

p.11 2.1.3 Spring tide on 16.10.19. From the diagram provided for this the drop point appears to be to the western side of the East Passage at Rathcoursey Point and downstream (South) of the diffuser.

It was released at the same spot at R.Pt. but the track may have been edited by BIM slightly late. If it had been released lower down the Ferry, it would only have resulted in the drogue travelling further out into the harbour. As can be seen, the end of the 3hr discharge period the drogue did not reach as far west even as Long Point and then all the discharge water, which was what would have been following the drogue, returned up East Ferry and had crossed all the oyster beds by HW.

p.12 It is noted that only a portion of the flood tide travels up North Channel with the remainder continuing up the Owenacurra estuary.

This is absolutely correct, there will be a c. 72% : 28% split, but in the return of nutrients to fertilise the PSP seed beds, both branches are equally important, with the seed bed at the bottom of the Owenacurra even more important than the bed at the west end of the North Channel.

From the diagram provided for this the drop point appears to be to the western side of the East Passage at Rathcoursey Point and downstream (South) of the diffuser.

See p.11 above – the same applies

p.13 Note that the trace was discontinued because it did not appear that the drogue would return to East Passage.

Correct, it was going nowhere and it was getting dark and we needed to save the drogue.

This appears to say that the drogue trace of 16th October 2019 was also interfered with and is not a true trace.

No the drogue seemed to get caught in a westerly gyration starting about 4hrs 20 mins after HW i.e. as the current speeds slowed. My description was not clear, my daily entry in Excel stated:

Information learnt on these two drifts. *Both these two drifts seem to have finished up in a clockwise gyre that exists on the west side of the mouth of East Ferry, which* ***would appear to mirror the anti-clockwise gyre on the east of the mouth of East Ferry, which showed up on the run on 16.10.19, which we had been quick to correct.***

p.14 3.1.1 Neap tide on 06.11.19. Release at LW The release was at Low Water so the trace does not reflect an ebb tide discharge.

Of course.

p.15. For the sake of accuracy the apportionment established by the M.C. O'Sullivan study, for the division of the flood tide, was 72% North Channel : 28% Owenacurra Estuary.

I am perfectly happy to be reminded of that. I couldn't find it. I have altered all refs. to this ratio.

p.16 It is noted that, again, this trace is on a flood tide and does not reflect the proposed discharge

If the discharge is made by Dairygold for the full 6hrs of the ebb tide, then the last of the discharge will begin to return on the start of the flood. If the discharge stops half an hour before LW as sometimes mooted, then the discharge will still be only halfway down the East Ferry. Earlier discharges which got right out into the Lower Harbour such as the spring tide run on 2.1.3 on 16.10.19 came back up the East Ferry and back right up to the far end of the oyster beds.

I commented: *"Thus all the water following the drogue would have been contaminated water, discharged that day at Rathcoursey."*

p.17 This first statement is redundant since there is no discharge proposed for the Dairygold effluent at the start of the flood tide. Rather the proposal is for discharge to commence just (15 minutes) after high tide i.e. at the start of the ebb and this gives time for the effluent to be diffused into the entire water column as the tide ebbs out into the Lower Harbour and for dilution and decay to reduce any contaminants to an acceptable level which does not impact the status of the waters.

See my answer above

The point Mr Hugh-Jones appears to be trying to make here is that there is a nett tidal flow from east to west in the North Channel with the excess water exiting into the West Passage through Belvelly Bridge. This is the thrust of the remainder of his fourth submission.

This could so easily be settled by Irish Hydrodata using their own 1993 Brick Island (labelled as Brown Island) current meter data. We have suggested that they do it on three or four occasions, but so far thay have refused. Why?

In my fifth submission I can now give the results of the current meter data we collected with the help of BIM and analysed by Dr. McCoy of BIM and Mark Bentley of JBA Consulting, so that this question can now be answered.

In this regard it is noted that he is using the tide times for Cobh

I have spent 50 years running my life and up to 20 men, on the Cobh tide table, which I have found to be accurate. In the drogue track for the turn of tide on 12.11.19, on p.25, I give a detail of just 2 hours of track, on the turn of the tide, to show that when the drogue is not in the actual run of freshwater coming down from the Owenacurra, the turn is immediate.

p.18 The average length of a tide according to the Cobh Tide tables is 12 hrs. 25.4 mins. with a maximum length of 12 hrs. 47 mins. and a minimum length of 12 hrs 9 minutes.

I took the length of the preceding tide and halved it. Using the average of the drogue speeds we had been measuring I could calculate when the drogue should have been re-passing, for instance, the far end of the bed at Brick Island. It in fact reached there 44 mins earlier that the computed time, indicating a drift of the whole waterbody westwards, which I calculated as 900m.

The length of slack water period and ebb tide compared to flood varies.

All this is taken care of by running the data for a full tidal cycle (at best) on a computer.

Mr. Mark Bentley, JBA consulting, 11 (Submission Reference No.S005924)

"Although the first tide illustrates the typical behaviour observed in 1993, it is unfortunate that only two tides worth of data was collected to check whether the residual current would be maintained over several tidal cycles. It is understood that further measurements will be taken in the coming weeks to establish whether a westward residual current is maintained in the North Channel."

I deal with this whole question re 3.1.5 on p.8 above.

On the basis of these submissions, by Mr. Bentley, it appears that either Mr. Hugh-Jones current metering has established a West – East residual flow through North Channel or that the survey is faulty and should not be used by Mr. Hugh-Jones in his fourth submission.

I did my best to extract as much useful data as I could from this 30-day deployment, from which we got data for a handful of tides at the extreme accuracy of data every 10 secs.

I got some data on just these 3 tides on the lengths of slack water, ebb and flood tides; similarity to the Cobh tide tables; with something salved from the Rathcoursey meter, which only recorded up to half the depth. I agree it was unfortunately very limited – also tidal data can be so variable that at least one 14 day cycle is needed – we planned for 2 full cycles.

p.19 re Prof. O'Kane's "*Modelling the Norovirus contamination of an Oyster Farm in Cork Harbour" 2007.*

These 2 passages were raised on p.10 above and I have dealt with them very fully there.

With Prof. O'Kanes prediction of the long term circulation around Great Island in his Supplementary Report of 2009, he has predicted in his s. 8.6 "Discussion/conclusion" that, "*the magnitude of the net residual circulation is roughly ten times the discharge in the River Lee"*,

and that,

"*wind with an easterly component drives the residual circulation in an anti-clockwise direction."*

He ends by saying that,

"*The magnitude of the net residual circulation is roughly ten times the discharge in the River Lee, which in turn is roughly ten times that in the Owenacurra River at Midleton. We would expect these ratios to change when the model is run with the new bathymetry.* ***This work remains to be carried out.***

I would expect so too. Prof. O'Kane altered the earlier established bathymetry at Belvelly, obtained by lead-line, citing information he said came from the Mars camera photos of the Belvelly area. Any small adjustments to the bathymetry of this area might well account for a west-east clockwise flow turning into an east-west (anti-clockwise) residual flow, if that can be reversed simply by wind, as he explains in the Supplementary report above:

"*wind with an easterly component drives the residual circulation in an anti-clockwise direction."*

I say again, that if these dire predictions of flows of sewage coming from the City of Cork directly into the North Channel via Belvelly Bridge and circulating in a clockwise direction over the oyster beds were correct, we would have been reporting hundreds of people being made ill in the period from 1971-Dec. 1988. Cork was always there and discharging crude sewage into the Lee, with raw sewage being discharged from Cobh and every other town in Passage West. All of this could have been coming through to the oyster beds if there had been the clockwise circulation predicted by him.

In fact we had 17 years of no health problems whatsoever (4 unconfirmed reports in 17 years is exceptional when any sickness is always blamed on the oysters).

This only changed in precisely the month of December 1988 when the Midleton discharge was brought down from the town itself to Rathcoursey Point and we had the rash of reports and dealings with UK EHO's etc. leading to the Department of the Marine instructing that secondary treatment for Midleton be installed as a priority item.

p.20 It is noted that, again, this trace is on a flood tide and does not reflect the proposed discharge.

See my comment re p.16

p.22. We have earlier given a full answer to the question of residual flow in North Channel.

My question to which this was the response, was:

"*We have suggested that Irish Hydrodata, with the figures for the entire neap/spring cycle in 1993, advise us what the situation is with their computer, rather than us saying that with the current speed on the flood appearing to be some 60% greater on the flood than on the ebb, and, from our observations above, that the ebb tide lasts no more than about 10% longer than the flood, there must be a residual water movement to the west via Belvelly and thus discharges from Rathcoursey are moving overall into the North Channel, rather than taking the more obvious route via Marloag to the Lower Harbour and to the open sea at Roches Point".*

Maybe they could yet be asked to come up with their answer? Let us have their computation of any residual flow that showed up on their 1993 Fig. 2.2a, which is reproduced at the bottom of this p.20.

Mr. Hugh-Jones current metering at Brick Island, which he says here gives "the truest picture" has been shown, by Mr. Bentley to show a west- east residual flow.

The author of this reply ought to know more about currents and tides than this and to know that there is little point in looking at single tides. Prof. O'Kane talked above in his Supplementary Report of the the whole residual clockwise circulation around Great Island being reversed by a strong easterly wind.

p.23 A drogue, on the surface (top metre of water), is affected by wind as well as current

This is a picture of the Microstar Drifter with an overall depth of 1.61m. This could not cross the top of the seagrass meadows, when 1.5m of water can.

p.24 In the case of water in North Channel, east of Belvelly Bridge, the bridge presents an impediment to the discharge of water in that direction.

Actually I would argue that a greater head at HW would drive more water through the arches and the restriction of the railway bridge to the west, than it would impede a rising tide with very little head coming east.

p.26 There are always gyres or eddies in complex water bodies such as East Passage and North Channel.

This is a good reason why discharges are made from long sea-outfalls.

I deal with the float tests carried out by MC O'Sullivan in 1972 from Midleton (not referred to by IH) and in the 1976 Sworn Enquiry for the CPO in my fifth submission in s. 1.1.

On p.4 I quote from MCOS in the latter, with my emphasis added (and I give a copy of these pages with my submission):

p.17 (10) *A release of floats at Rathcoursey Point (head of the East Passage) indicated that* ***not all materials released here would get down to the southern end of the East passage before the tide turned*** *and in fact* ***the floats were inclined to ebb in towards the side of the passage and lodge on the shore."***

*Hence the **large volume of water contained in the North Channel**, behind Gt. Island, becomes available for mixing and dispersion. Also the main body of the discharge is carried into the Lower Harbour, where **hopefully** the increased mixing and dispersion ensures a minimum return of effluent on the flood tide".*

Having thus raised our hopes, MCOS still allows the next paragraph to remain:

*"The feasibility study centres around the efficiency of the design procedure selected, and the environmental impact that the discharge is liable to have **on the semi-enclosed water body of the East Passage and North Channel."***

It would seem to be difficult to have a "*large volume of water contained"* which is "*available for mixing and dispersion"* and then admit that both North Channel and East Passage are a "*semi-enclosed waterbody*".

p.28 Therefore, again, Mr. Hugh-Jones appears to accept the current metering data used to calibrate the numerical models and, as pointed out by both IH and Prof. O'Kane, the simulations produced by their models closely match the observed data.

The current metering data that would shed most light for the EPA and all those who have now been alerted to the possibility that there is, in fact, an anti-clockwise circulation pattern around Great Island, is the original current data that IH have at their disposal for the water at the very centre of the disputed waterbody of the North Channel.

If the Belvelly Channel was accepting a flow from the west, as Prof. O'Kane and IH insist, then there would not be a build up of water with the highest residence time in the harbour just to the east, this water would be flushed down towards Rathcoursey.

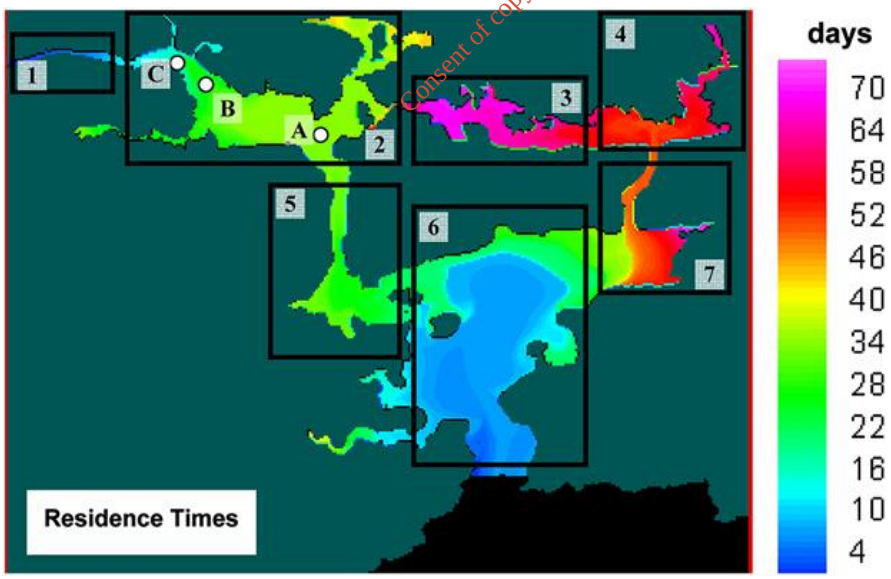


Fig. 9. Spatial plot of residence times (Dabrowski, 2005) showing boundaries of subregions and monitoring locations (white dots). From Hartnett et al, 2012.

p.29 It appears from this statement that Mr. Hugh-Jones accepts the data and analysis presented in the 2007 O'Kane report with ref. to my comment that "*This difference of an about 10% longer ebb tide, fits with my earlier estimate from the graphs of the 12 days of current data presented in the O'Kane Hydrodynamic Survey of Norovirus in the North Channel".*

Yes, I do. I believe the same current data as shown in Fig 2.2a of the 1993 IH Report is shown as a much more usefully spread-out presentation of 3 pages of 4 day results, which I had some chance to measure with a magnifying glass and a ruler to try to determine the relative length of the ebbs and floods and the difference in current speeds on both.

But why should we all go to these primitive lengths when this data is readily available to IH and they have all the software and expertise to give us their view on any residual flow that might exist in the North Channel?

p.35 We refer, again, to the NUIG team (Nash, Stephen; Hartnett, Michael; Dabrowski, Tomasz, 2011) and their assessment of the North Channel. While they make no assessment about the residual flow in North Channel they do make the comment that: -

"Although a sewage treatment plant discharges to this area, its discharge is relatively low and is not sufficient to cause or sustain the elevated levels of phytoplankton growth that were recorded in this region".

I go into this in considerable detail in considering s. 3.3, above. However, it comes up again in the next criticism on

p.36 where I state:

"*In fact in the latest piece of work, in the November 2018 EPA's "Water Quality in 2017: An Indicators Report" by Trodd W. and O'Boyle S., the Owenacurra Estuary is singled out as being one of the four water bodies in the country, which have the highest dissolved inorganic nitrogen concentrations. Not only does inner Cork Harbour (specifically the Owenacurra and Glashaboy Estuaries) have two of the highest DIN levels in the country, but they are the only two in in the country with a record of greater than 50% exceedances".*

This is noted. This refers to the Owenacurra Estuary proper and one of the issue there are the SWOs from the Bailick Road pumping stations in Midleton. It is understood this issue is being addressed by IW. Other sources contributing to the problem may be diffuse agricultural sources.

Thus Dairygold themselves understand about the very high volumes and hence levels of nutrients already being discharged from the town SWOs – the figures are given freely in the AERs for the town each year. Unfortunately it is unlikely that IW will do anything in the near future about this state of affairs and Dairygold may have looked for their permission to discharge a few years too early to accommodate all these discharges to the river.

p.37 (4) The situation with to regard to overflows, at the Bailick Road pumping stations in Midleton, is being addressed by Irish Water and has nothing to do with the Rathcoursey outfall. They are two different issues.

Unfortunately these two issues meet in the same water as is required to dilute and take away the Dairygold discharge. It is yet another very significant source of nutrients that may well

take a knife-edge situation, where significant blooms of PSP occur every year, closing the fishery for mussels, but generally not crossing the threshold very often due to high levels in oysters, to a situation where we get regular closures of the oyster business in the summer.

The matter of the Midleton overflows is not a matter for the Tine/Dairygold discharge.

This seems a trifle naïve. I am afraid that it does affect their choice of discharge area.The water is NOT pristine. It is already one of the highest recorded DIN rivers in the country.

p.38 (The placing of Midleton WWTP on the EPA's National Priority Enforcement List) relates to the SWOs and not the Rathcoursey outfall.

Unfortunately they all add to the cumulation of nutrients, in this case, one which Dairygold is asking to be allowed to join, when it is acknowledged that winter DIN levels will be exceeded on their own reckoning and the Owenacurra is continually potentially eutrophic, even without taking the huge Midleton overflows into account.

The refusal by Bord Pleanala for further houses in Midleon because of the deficiency "*in the provision of adequate sewerage treatment infrastructure serving the subject site……. The proposed development would, therefore, be contrary to the proper planning and sustainable development of the area."*

This is not relevant to the Tine/Dairygold application.

It is not only the WWTP capacity which is overloaded, but the estuary is also - as were the Kiltha and Womanagh Rivers in Dairygold's own catchment area.

The ECJ ruling against Midleton specifically for failure of all 3 Articles 3, 4 & 5 of the UWWTD and Ireland's very poor rating in comparison to other Member States with regard to care for sensitive waters and tertiary treatment (Art.5). These are the fault of the SWOs not the Rathcoursey outfall.

It is indeed very sad indeed that Ireland lags so far behind other Member States, but from the number of submissions from the public and the interest now being shown in cutting down the use of plastic to prevent it getting into the sea, public beach cleanings and outcries in Dublin over bathing closures, all go to show that maybe at long last, in the words of MCOS himself in his CHPR of 1977,

"*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".*

It is now over 40 years since he wrote those words.

The people of East Ferry have done their very best to show their displeasure at the thought of more industrial waste being poured into their beauty spot, full of protected areas and wildlife, yachting, kayaking, fishing and just walking. One day swimming will be added.