Report on River Water Quality in County Carlow 2013

Contents

1. Overview

This report provides an assessment of river water quality in County Carlow in 2013. It should be read in conjunction with the other data and assessments provided under the South East River Basin district report.

The report is presented in the following sections:
(i) Section two of the report provides a general assessment of the state of rivers in the county, with graphs showing trends in annual average o-phosphate and nitrate concentrations in the County since 2001.
(ii) The third section identifies the river sites which require further investigation and the suspected causes of pollution. They were selected on the basis of having a Q value less than 4 (i.e. moderate or worse status), poor chemistry, or there were other significant pollution issues.
(iii) The fourth section provides a summary assessment of water quality for each river, having regard to the relevant Q values and WFD criteria for the 4 key physico-chemical parameters BOD, ammonia, o-phosphate and Nitrate.
(iv) Sections five and six include long term graphs for both o-phosphate and nitrate in Carlow Rivers. These are based on three year rolling means.
(v) Finally there are a set of maps which provide an indication of river water quality based on the 4 key physico-chemical parameters. These maps compare the annual average for each parameter at each river station against the relevant EQS.

2. General Assessment & Trends

Compared to the national picture, water quality in County Carlow remains quite poor. In terms of ecological status, just 33% of river stations in the county are at least good status compared with 65% nationally with regard to the Biological Q value.

The general physico-chemical data suggests a slight improvement in water quality in 2013 compared to 2012. As indicated in the table below, there was a significant decrease the percentage of river stations which exceeded the Good status EQS for o-phosphate and BOD levels. There were however, slight increases in the percentage of rivers which exceeded the EQS for ammonia and nitrate.

Parameter	2013 (%)	2012 (%)
Ammonia	4.7	2.4
o-Phosphate	20.9	59.5
Nitrate	86.1	81.0
BOD	20.9	40.5

Table 1. % of river stations that exceeded the EQS for Good status for each parameter in 2013 compared to 2012.

The drop in the percentage of rivers which exceeded the Good status for ortho-phosphate was matched by a decrease in the annual average ortho-phosphate concentration in 2013. The ortho-phosphate levels have fluctuated over the time period 2001 - 2013 but the trend is generally downward since 2011. Annual average ortho-phosphate is now at Good status levels.

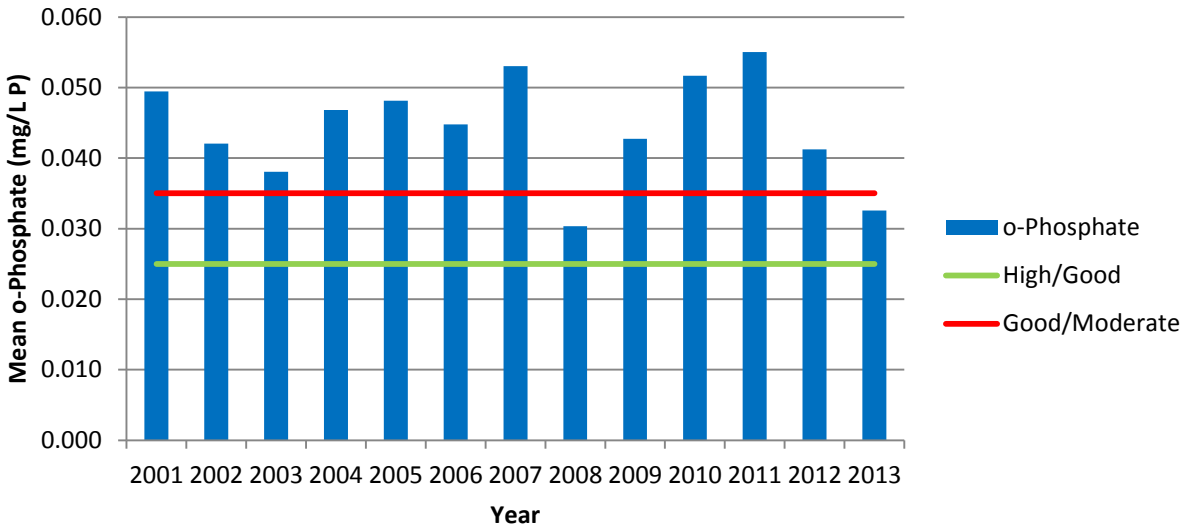


Fig. 1. Annual average ortho-phosphate levels in Carlow rivers 2001 – 2013.

There was a slight increase in the number of sites which exceeded the Good status for the surrogate EQS for nitrate. Nitrates are a significant problem in Carlow rivers. Average nitrate levels fell between 2005 and 2012. In 2013 however, there was an increase in the average concentrations. The average nitrate concentration has consistently exceeded the surrogate EQS for Good Status over the past 14 years.

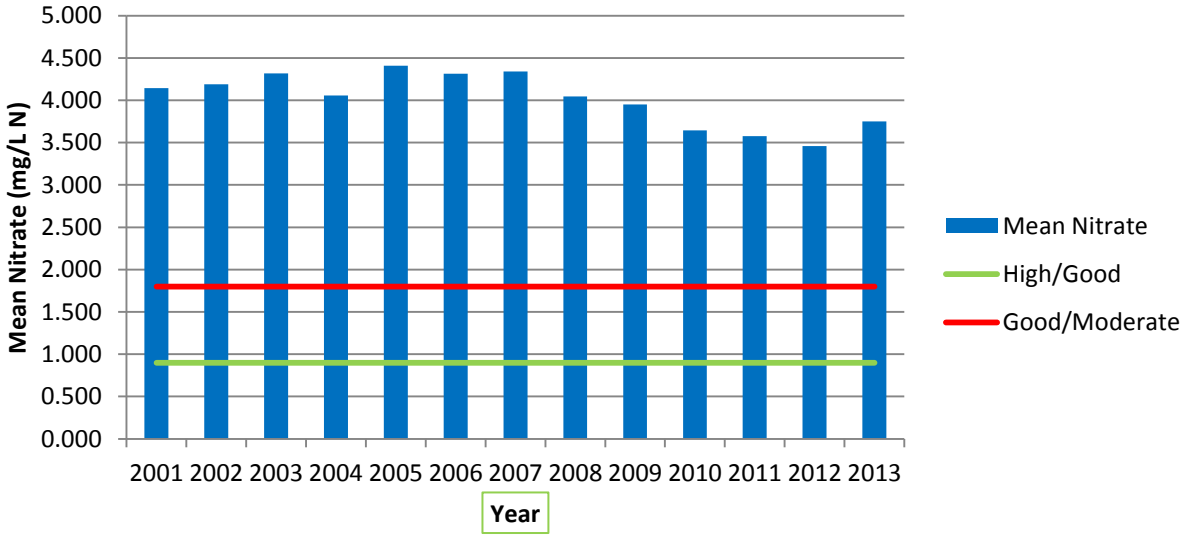


Fig. 2. Annual average nitrate levels in Carlow rivers 2001 – 2013.

With the advent of the Water Framework Directive (WFD) compliance rules for certain river chemistry determinands were applied to the data collected. Assessment is based on the four most significant contributing parameters to water quality, namely BOD, ammonium, ortho-phosphate and TON. Sites are identified as passing or failing based on an assessment of the mean and 95%ile of these parameters. Sites fail chemistry where two or more parameters fail the criteria set. While few sites fail two parameters, a significant number of sites fail a single parameter (in the majority of cases this is due to TON). Where a site fails one parameter, it is described as being of concern. The data for Carlow rivers since the start of the WFD monitoring (2007) is shown in Table 2. The percentage of sites which fall into each category is trended over 3 year rolling cycles (Figure 3).

Chemical monitoring since 2007 indicated an improving trend in all Carlow rivers. This improvement is most marked in 2013. No sites have failed chemistry in any cycle since 2007 and the number of passing sites has increased from 14 in 2007-2009 to 35 for 2011-2013.

While chemical monitoring indicates an improving trend, it is important to also remain focussed on maintaining the status of those sites that are already at good or higher status.

Year	No. of Stations	Pass	Of Concern	Fail
2007-2009	43	14	29	0
2008-2010	45	18	27	0
2009-2011	45	18	27	0
2010-2012	45	21	24	0
2011-2013	42	35	7	0

Table 2. Number of river stations by WFD compliance status

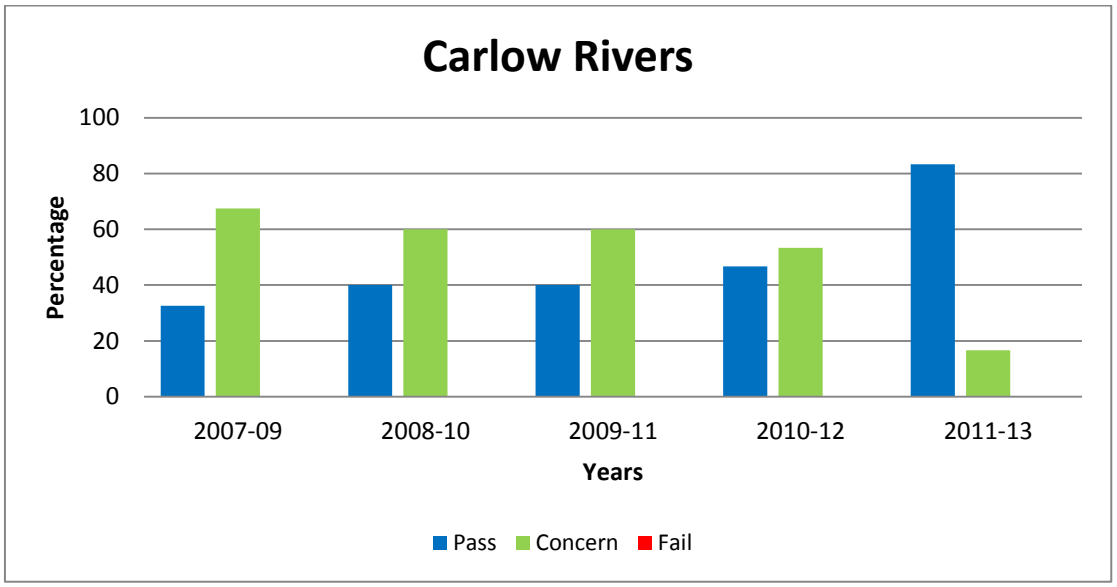


Fig. 3. % of river stations by WFD compliance status

Table 3. River stations with the highest average ammonia concentration in 2013 (in decreasing order).

River Name	River Code / Station Number
Aghalona	14A02-0100
Douglas (Kiltegan)	12D04-0700
Tully Stream	14T02-0600
Barrow	14B01-1500
Lerr	14L01-0300

Table 4. River stations with the highest average o-phosphate concentration in 2013 (in decreasing order).

River Name	River Code / Station Number
Barrow	14B01-1600
Douglas (Ballon)	12D03-0400
Douglas (Kiltegan)	12D04-0700
Aghalona	14A02-0100
Douglas (Ballon)	12D03-0100

Table 5. River stations with the highest average nitrate concentration in 2013 (in decreasing order).

River Name	River Code / Station Number
Aghalona	14A02-0200
Aghalona	14A02-0100
Lerr	14L01-0300
Douglas (Ballon)	12D03-0400
Burren	14B05-0400

Table 6. River stations with the highest average BOD concentration in 2013 (in decreasing order).

River Name	River Code / Station Number
Owenass	14O02-0700
Lerr	14L01-0300
Barrow	14B01-3100
Barrow	14B01-2900
Barrow	14B01-3300

3. WFD River Sites for further investigation

There are over 900 river sites of less than Good status across the country – that is they have a biological Q value of 3-4 or less. There are 17 river stations in County Carlow that have a Q value of 3-4 or less (that are also monitored for chemical determinands). These have been identified as sites for further investigation. Table 8 lists all these sites along with the suspected causes and any relevant additional comments.

Carlow is a predominantly rural county with agriculture being one of the main activities in the county. Diffuse pollution from agriculture as well as small point sources such as small urban wastewater treatment plants (UWWT), domestic wastewater treatment systems (DWWTS) and farmyards are significant contributory pressures. The predominant pollution sources in the more urbanised areas are discharges from wastewater treatment plants, storm water overflows and industrial discharges. It must be borne in mind that multiple pressures may impact on any given site. Further work is required also in order to better distinguish between the impacts of DWWTS and diffuse agricultural sources. The pathways by which pollutants reach water are similar for those emanating from DWWTS and from agricultural sources, whether farmyard or field.

The EPA is responsible for the licensing or certification of all discharges to the aquatic environment from sewerage systems owned, managed and operated by Irish Water. The licensing and certification authorisation process was introduced on a phased basis commencing on 14th December 2007 in accordance with the requirements of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007). Up to the end of 2013 eight licences were issued in County Carlow. The eight licences issued to the end of 2013 are shown in Table 7 below.

Table 7. Wastewater discharge licences issued in Co. Carlow

Agglomeration	Licence No.	Authority	Date Issued
Carlow Town	D0028-01	Irish Water	21/9/2009
Muinebheag/Leighlinbridge	D0090-01	Irish Water	15/3/2011
Rathvilly	D0237-01	Irish Water	1/11/2011
Hacketstown	D0243-01	Irish Water	20/12/2011
Fenagh	D0246-01	Irish Water	6/1/2010
Ballon	D0247-01	Irish Water	17/12/2009
Myshall	D0390-01	Irish Water	30/6/2010
Palatine	D0391-01	Irish Water	15/5/2010

Both diffuse and point source pollution are key pressures in Co. Carlow. Many of the point sources are due directly to wastewater discharges with a number of plants requiring upgrade works. It is hoped that the licencing of these plants will show improvements over the coming years. The Kernanstown Sewerage Scheme is now connected to the Carlow

network, this should improve conditions at station 0485 on the Burren, and Fenagh WWTP no longer discharges to the Burren tributary, but is piped to the Burren immediately south of Ullard Bridge.

The focus on domestic waste water treatment systems (DWWTS) has continued to increase in recent years. In 2013, a National Inspection Plan for DWWTS was published in response to the European Court of Justice finding that Ireland had not met the legal obligation required by the 1975 Waste Framework Directive to regulate the waste water generated in our unsewered areas. Inspections commenced in 2013, starting with areas at greatest risk of damage to human health or the environment. In the period 01/07/2013 to 31/12/2013, nine inspections were carried out in Co. Carlow. Three of these inspections (33.3%) were deemed to be non-compliant.

It is apparent that diffuse agricultural pollution is a key pressure in Co. Carlow. Tillage farming is the main factor affecting the high nitrate concentrations. Carlow County Council had prioritised farm inspections (based on risk tools developed by the River Basin District office) for the Burren Lower. This catchment contains priority polluted sites on the Aghalona and Burren listed below. Two section 4 licences, discharging to the Aghalona were being finalised. They have also carried out monitoring of the feeder streams which discharge to this area in order to identify priority sub-catchments. It is hoped this work will be reflected in improved ecology at these sites in future

Table 8. Sites for further investigation in County Carlow

River	Code	Location	Q Value	Year	Key Pressures	Comments
AGHALONA	14A02-0100	Friarstown Br	3-4	2011	Agricultural	
AGHALONA	14A02-0200	Br nr Moatalusha House	3-4	2011	Agricultural and mixed rural influences.	Improved pasture and tillage u/s One off housing - Possible DWWTS
BLACKLION STREAM	12B04-0400	Br u/s Derreen R Conf	3	2013	Agricultural	
BARROW	14B01-2200	New Br u/s Carlow (d/s sugar factory)	3-4	2011	Urban Industrial	Carlow Town
BARROW	14B01-2450	2 km d/s Carlow	3-4	2011	Urban Agricultural and mixed rural influences.	Carlow WWTP located u/s
BARROW	14B01-2455	Br at Dolmen Hotel	3-4	2011	Urban Agricultural and mixed rural influences.	Carlow Town u/s
BARROW	14B01-2600	Millford Br	3-4	2011	Agricultural and mixed rural influences.	One off housing possible DWWTS
BARROW	14B01-2700	Leighlinbridge	3-4	2011	Urban Agricultural	Powerstown landfill site u/s
BURREN	14B05-0100	Ullard Br	3-4	2011	Urban Agricultural and mixed rural influences.	Fenagh WWTP discharging just south of bridge Siltation noted in river
BURREN	14B05-0200	Ballintrane Bridge	3-4	2011	Agricultural and mixed rural influences.	Siltation noted in river

River	Code	Location	Q Value	Year	Key Pressures	Comments
BURREN	14B05-0400	Staplestown Br	3-4	2011	Urban Industrial Agricultural	Rathoe WWTP u/s Section 4 discharge licence for quarry Tillage & Improved pasture Siltation noted in the river
BURREN	14B05-0485	Ring Rd Br Carlow (d/s side)	3-4	2011	Urban Industrial Agricultural	Carlow Town Increased population density Tillage & Improved pasture Siltation in the river
DEREEN	12D01-0300	Hacketstown Br	3-4	2013	Urban	Hacketstown WWTP
DEREEN	12d01-0420	Br d/s Saulsford Br	3-4	2013	Agricultural	
DEREEN	12D01-0700	Rathglass Bridge	3-4	2013	Agricultural and mixed rural influences	
DOUGLAS (BALLON)	12D03-0100	Myshall Br	3	2013	Urban Agricultural	Myshall village and WWTP
DOUGLAS (BALLON)	12D03-0200	Sragh Br	3	2013	Agricultural and mixed rural influences	
DOUGLAS (BALLON)	12D03-0400	Bang Up Br	3	2013	Urban Agricultural	Located d/s of Ballon village
LERR	14L01-0300	Lerr Br	3-4	2011	Urban Agricultural	Palatine stream confluence u/s Palatine WWTP located u/s

River	Code	Location	Q Value	Year	Key Pressures	Comments
OLD LEIGHLIN STREAM	14O02-0700	Madlin Br	3-4	2011	Urban Agricultural	Old Leighlin WWTP located u/s
SLANEY	14S02-1000	Rathvilly Br	3-4	2013	Urban Agricultural	Rathvilly village and WWTP
SLANEY	14S02-1100	Rathmore Br	3-4	2013	Agricultural and mixed rural influences	
SLANEY	14S02-1200	Moatabower Br	3-4	2013	Agricultural and mixed rural influences	
SLANEY	14S02-1300	Tullow Br	3-4	2013	Urban Industrial	Tullow village
SLANEY	14S02-1400	Ford 2km d/s of Tullow	3	2013	Urban Agricultural	Tullow WWTP located u/s
SLANEY	14S02-1600	Kilcarry Br	3-4	2013	Agricultural	

4. 2013 Summary of River Water Quality in Co. Carlow

These assessments are based on physico-chemical measurements made during 2013, and the most recent Q values and assessments of the river biologists.

River	Remarks	Change from 2012
Blacklion Stream **12B04-0400 Q3 (2013)**	This stream was first sampled in 2007 under WFD. Nitrates remain elevated and abundant weed growth was recorded. Biological monitoring in 2013 indicated a decline in quality from moderate to poor quality at this location (the quality further upstream has also declined to moderate from good).	Decline in ecological quality to poor quality from 2010.
Clody **12C03-0100** **12C03-0200 Q4-5 (2013)**	Chemical monitoring data satisfactory during 2013. Biological monitoring in 2013 indicates high ecological status at all stations assessed.	No change from 2012.
Clonmore Stream **12C05-0100**	This river is a tributary of the Derreen river and flows through agricultural land in NE Carlow. Nitrates are slightly elevated , but chemical monitoring data is generally satisfactory.	No change from 2012.
Derreen **12D01-0200** **12D01-0300 Q3-4 (2013)** **12D01-0400 Q4 (2013)** **12D01-0550 Q4 (2013)** **12D01-0700 Q3-4 (2013)**	This report deals with the Carlow stretch of the Derreen only (u/s stretches are in Co. Wicklow). The Derreen sub-catchment is protected under the Freshwater Pearl Mussel Regulations (SI 296 of 2009). Colour in this river is high (naturally occurring). Average nitrate values rose slightly in 2013 from a downward trend over the last few years. The long term trends remain positive. Q values indicate an decline to moderate status at Hacketstown (0300) although there was an improvement in ecological quality at Acaun Br (0500) and Knockeen Br (0550).	Decline in ecological quality to moderate quality at Stn 0300 but an improvement to high quality at stations 0500 and 0550 from 2010.

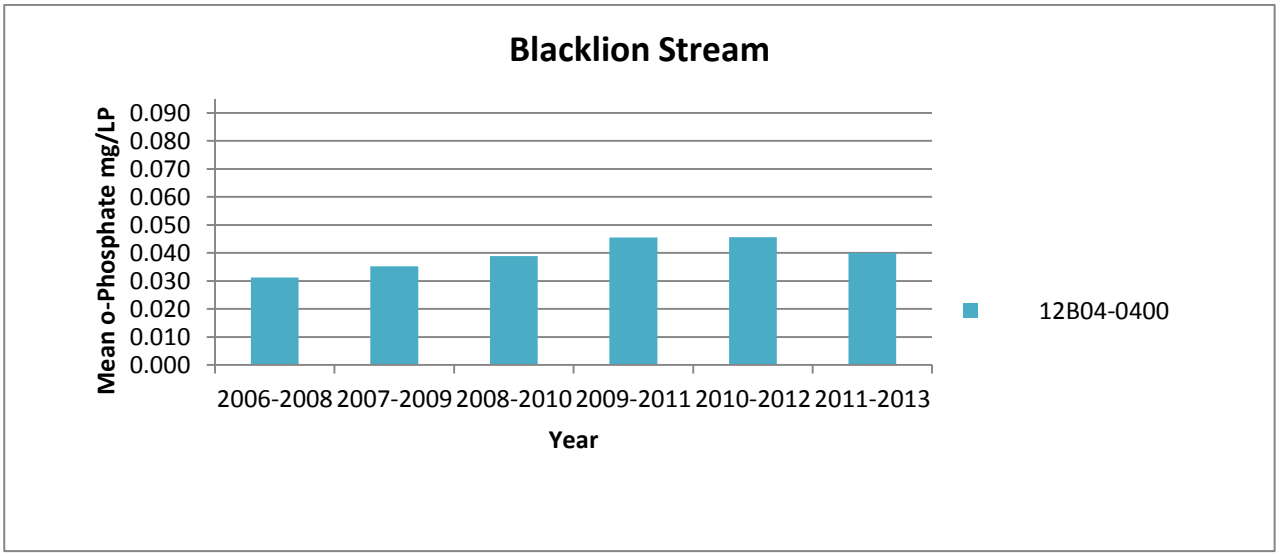
River	Remarks	Change from 2012
Derry **12D02-0900 Q3-4 (2013)**	This report only deals with the Carlow /Wexford stretch of the river. The average BOD decreased again in 2013 from a rise in 2012 however there was a slight rise in nitrate levels with the nitrate remaining at 'moderate' status relative to the surrogate EQS for nitrate. There was a decline in ecological conditions to Moderate quality a Clonegall Br (0900).	Decline in ecological quality to Moderate quality at Stn 0900.
Douglas (Ballon) **12D03-0100 Q3 (2013)** **12D03-0200 Q3 (2013)** **12D03-0400 Q3 (2013)**	This river flows through agricultural land past the villages of Myshall and Ballon. Reductions in average BOD, ammonia and ortho-phosphate seen at all 3 stations in 2013 however there was an increase in the average nitrate concentration at the 3 stations. Biological monitoring indicated over-enrichment which may have been further compromised by low flows and high temperatures during the summer months of 2013 resulting in Poor quality all stations.	Decline in ecological quality to Poor quality at all stations.
Douglas (Kiltegan) **12D04-0700 Q3-4 (2013)**	A tributary of the Derren and Slaney, this river was included in the sampling programme under WFD. Nitrates remain elevated other the chemical monitoring data was satisfactory during 2013. Biological monitoring in 2013 shows that quality remain Moderate.	No change from 2012.
Slaney **12S02-0950 -** **12S02-1100 Q3-4 (2010)** **12S02-1300 Q3-4 (2010)** **12S02-1400 Q3 (2010)** **12S02-1600 Q3-4 (2010)**	The Slaney rises in the Wicklow mountains and flows through Carlow and Wexford, before flowing into the sea at Wexford Harbour. This table deals with the freshwater stretches that flow through Carlow. Elevated BOD and ortho-phosphate concentrations in June and October at Stn 1400 d/s Tullow WWTP and elvated BOD at Stn 1600 in October, otherwise quality is satisfactory. Biological monitoring shows a drop in quality at the 4 stations monitored with them exhibiting Poor to Moderate ecological conditions.	Elevated BOD and o-phosphate concentrations in June and October at Stn 1400 d/s Tullow WWTP. A decline in ecological status at all 4 stations.

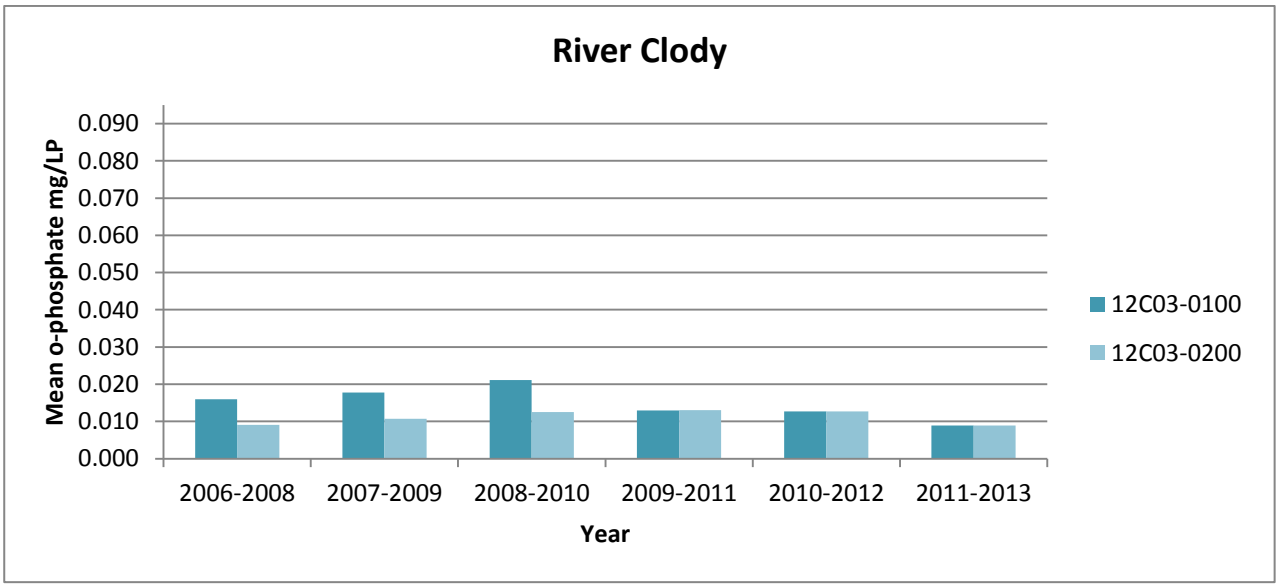
River	Remarks	Change from 2012
Aghalona **14A02-0100 Q3-4 (2011)** **14A02-0200 Q3-4 (2011)**	This river flows through a major tillage area, which explains the high nitrate levels seen once again in 2012. High ammonia observed at Friarstown bridge (stn 0100) in March. The average BOD and o-phosphate levels have decreased for both stns in 2013 from 2012 levels. Average nitrate levels have increased in 2013. Biological assessment of Q3-4 in 2011 shows the river to be of moderate ecological status.	Slight decrease in average BOD and o-phosphate levels in 2013, however an increase in average nitrate concentrations.
Aughavaud **14A04-0580 Q 4-5 (2011)**	This river was added to the sampling programme in 2009 when the sub-catchment was designated a protected habitat under the Freshwater Pearl Mussel Regulations (SI 296 of 2009). Slightly elevated nitrate levels otherwise chemical and biological monitoring indicates satisfactory conditions.	No change from 2012.
Barrow **14B01-2200 Q3-4 (2011)** **14B01-2450 -** **14B01-2600 Q3-4 (2011)** **14B01-2700 Q3-4 (2011)** **14B01-2900 Q4 (2011)** **14B01-3100 Q3-4 (2011)** **14B01-3300 Q3-4 (2011)** **14B01-3500 Q4 (2011)** **14B01-3600 -**	The Barrow rises in the Slieve Bloom mountains and flows through counties Laois, Kildare, Carlow, Carlow and Wexford. It converges with the Nore and Suir rivers before discharging to Waterford Harbour. The lowest reaches are tidal and they are dealt with under the Transitional Waters monitoring programme. BOD, ammonia and o-phosphate were elevated from Stn 2600 (Millford Bridge) through to Stn 3600 (St.Mullins) in October 2013. Biological monitoring indicates only moderate ecological conditions at five of the seven stations monitored in Carlow.	No significant change from 2012.
Burren **14B05-0020 Q4-5 (2011)** **14B05-0100 Q3-4 (2011)** **14B05-0200 Q3-4 (2011)** **14B05-0300 Q4 (2011)** **14B05-0400 Q3-4 (2011)** **14B05-0500 -**	This river flows through a tillage area in north Co. Carlow hence the elevated nitrate levels in the lower reaches. Nitrates are high in the lower reaches of this river. The average BOD, ammonia and o-phosphate levels have decreased for all stns from 2012 levels. Biological assessments indicate that quality remains only moderate.	Decrease in average BOD,ammonia and o-phosphate levels at all stations.

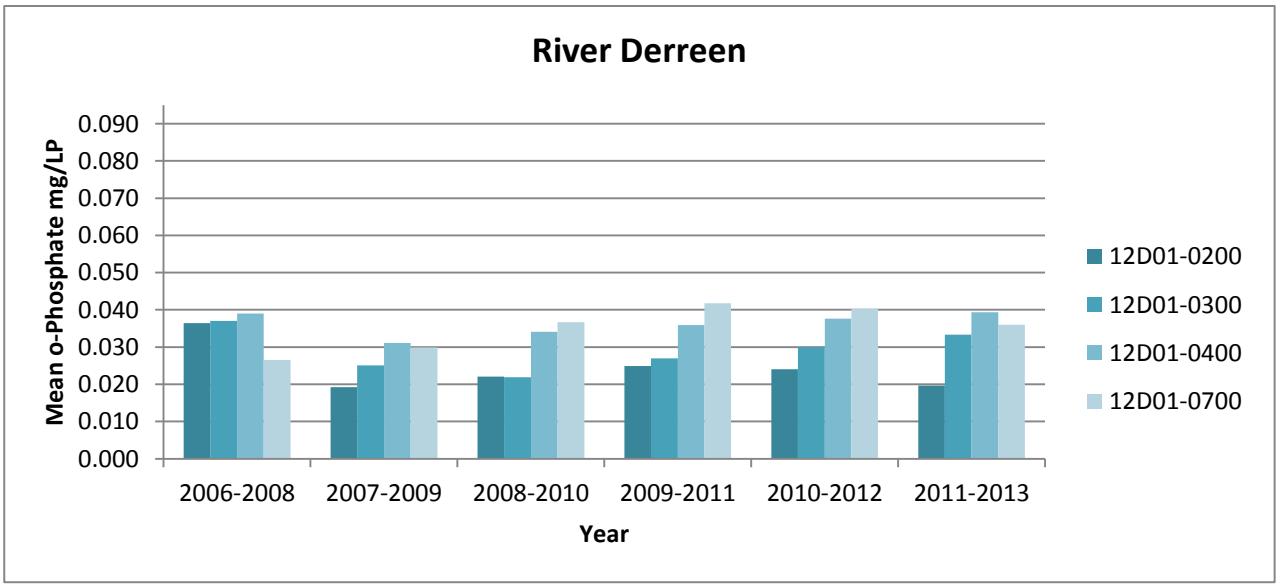
River	Remarks	Change from 2012
Black (Borris) **14B06-1380 Q4-5 (2011)**	Physico-chemical monitoring was satisfactory in 2013 and ecological conditions are high quality.	No significant change from 2012.
Ballymurphy (Barrow) **14B21-0500 Q4 (2011)**	This river was added to the sampling programme in 2009 when the sub-catchment was designated a protected habitat under the Freshwater Pearl Mussel Regulations (SI 296 of 2009). There was an elevated BOD in October otherwise physico-chemical monitoring was satisfactory in 2013 and ecological conditions are good.	No significant change from 2012.
Lerr **14L01-0300 Q3-4 (2011)**	This river flows through areas of intensive tillage farming in Co. Kildare. Only station 0300 (u/s of Barrow) in monitored here. High nitrate levels are characteristic of this river. BOD, ammonia and o-phosphate levels were high in October 2013. Ecological quality is only moderate, biological assessments indicate eutrophication and excessive siltation.	No significant change from 2012.
Mountain **14M01-0100 Q4-5 at station 0070 (2011)** **14M01-0200 Q4 (2009)**	The Mountain sub-catchment was designated a protected habitat under the Freshwater Pearl Mussel Regulations (SI 296 of 2009). Physico-chemical monitoring was satisfactory in 2013 and ecological quality is high at station 0100 (Bridge in Borris)	No significant change from 2012.
Old Leighlin Stream **14O02-0700 Q3-4 (2011)**	A tributary of the Barrow, this river flows through an agricultural area. It was added to the work programme in 2007 under WFD. High BOD, colour, ammonia and ortho-phosphate observed in October. Biological assessments indicate moderate ecological quality and eutrophic conditions.	No significant change from 2012.
Pollmounty **14P03-0300 Q4 (2011)**	Physico-chemical monitoring is generally satisfactory at station 0300 and biological assessment indicates good ecological quality here, despite ongoing signs of enrichment.	No significant change from 2012.

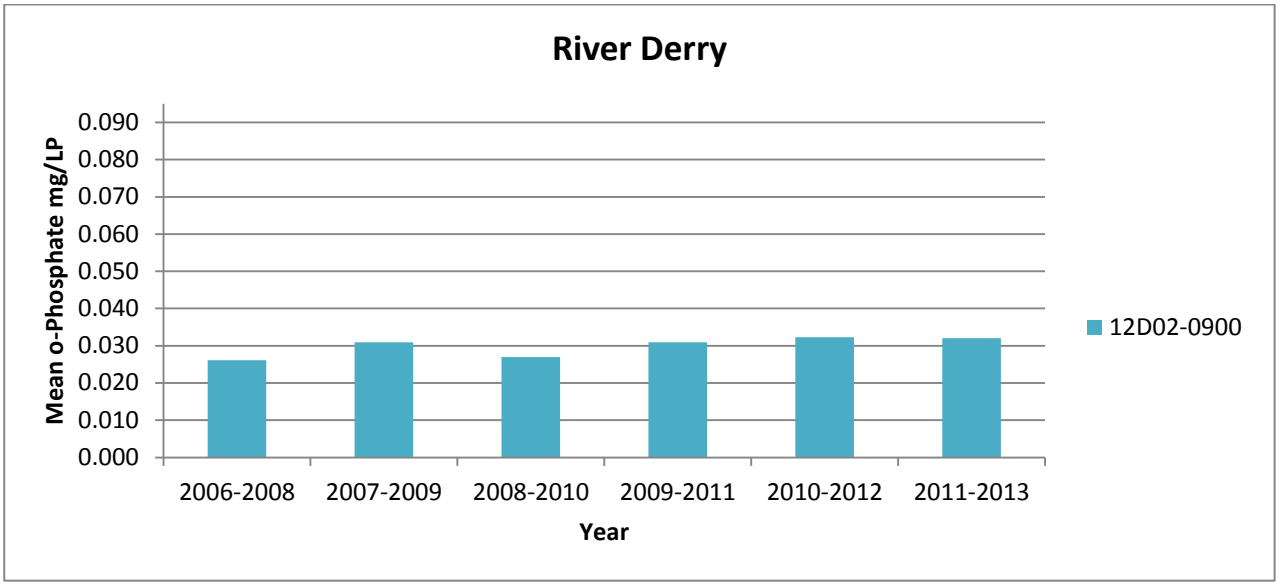
River	Remarks	Change from 2012
Dinin **15D02-0450** **Q4 (2013)**	This sampling point is located on the southern branch of the Dinin. The river can be highly coloured at times, otherwise physico-chemical monitoring is good. Biological monitoring indicated a drop in ecological quality from high to good quality since 2010.	Decline in ecological quality to Good quality from 2010.

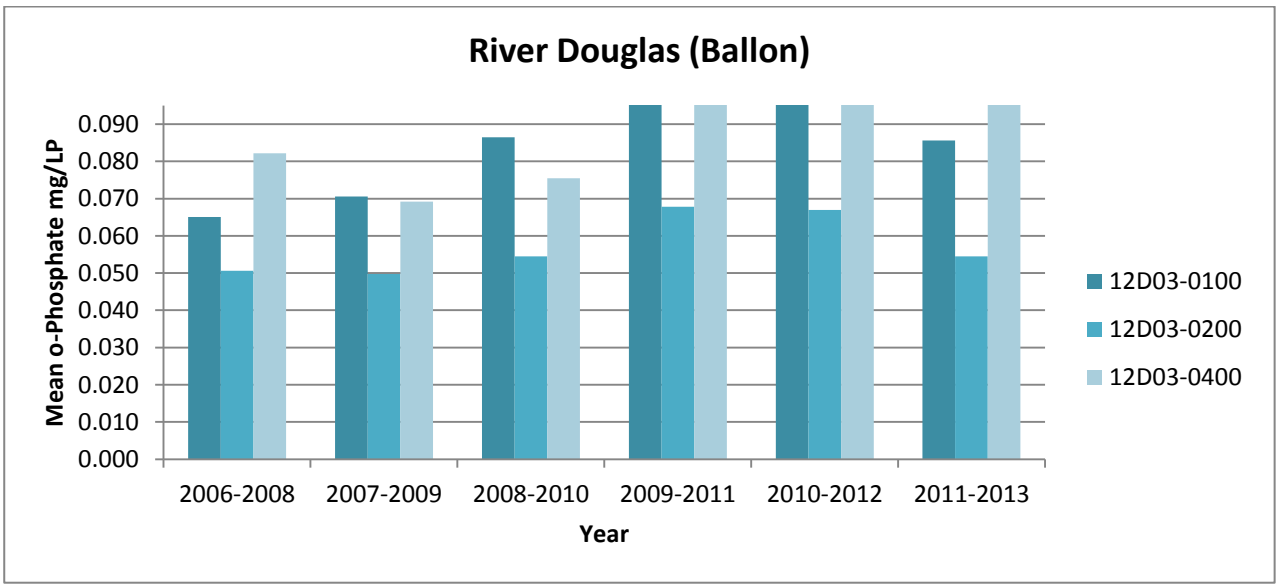
5. Long Term Trend Graphs – o-Phosphate

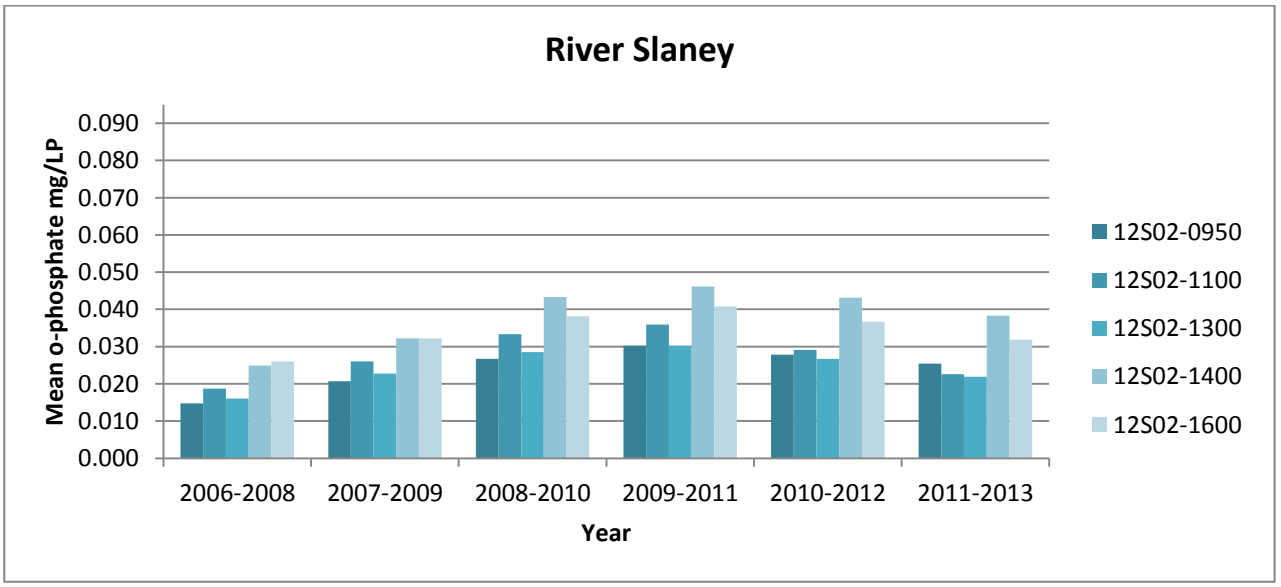







River Derry
Mean o-Phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
12D02-0900


River Douglas (Ballon)
Mean o-Phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
12D03-0100
12D03-0200
12D03-0400


River Slaney
Mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
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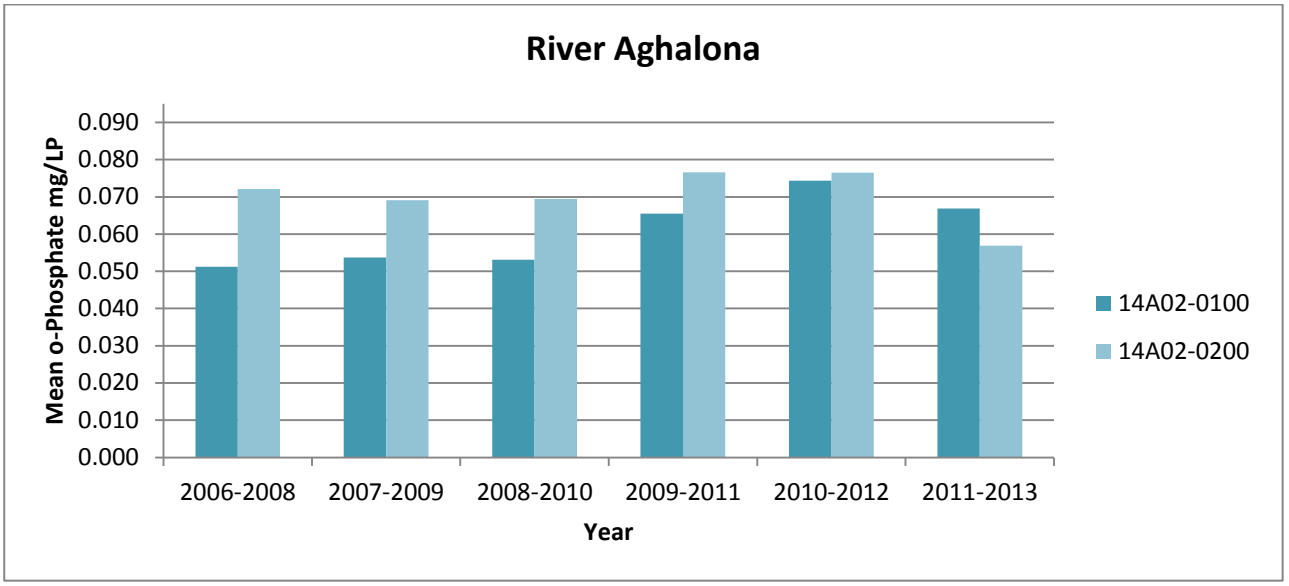
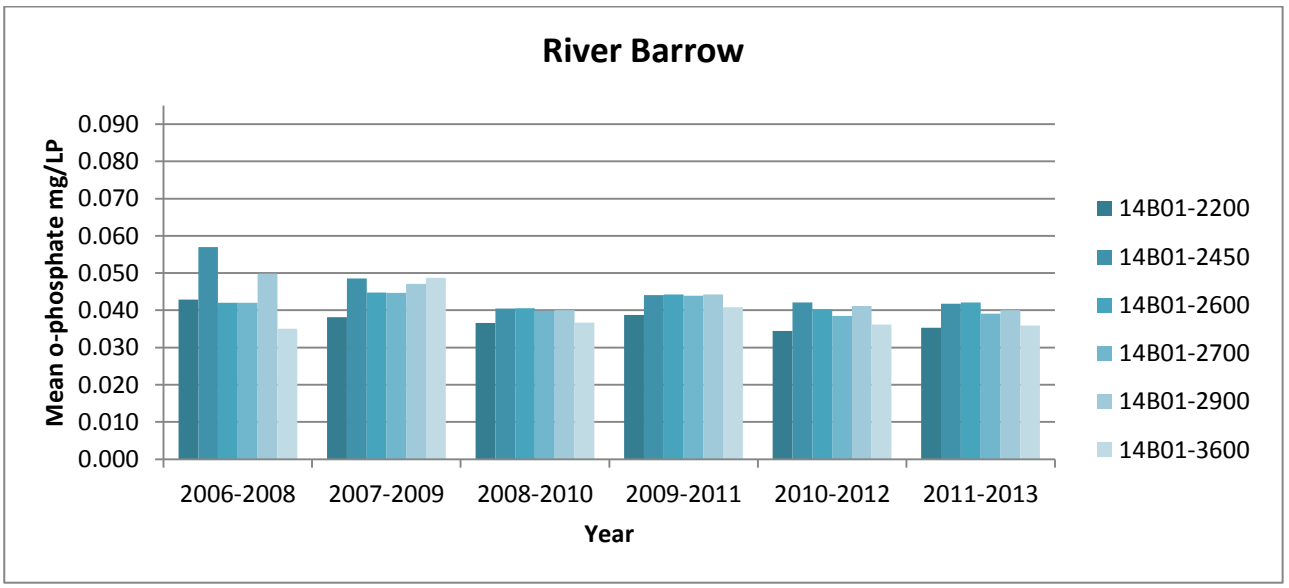

River Aghalona
Mean o-Phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14A02-0100
14A02-0200


River Barrow
Mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
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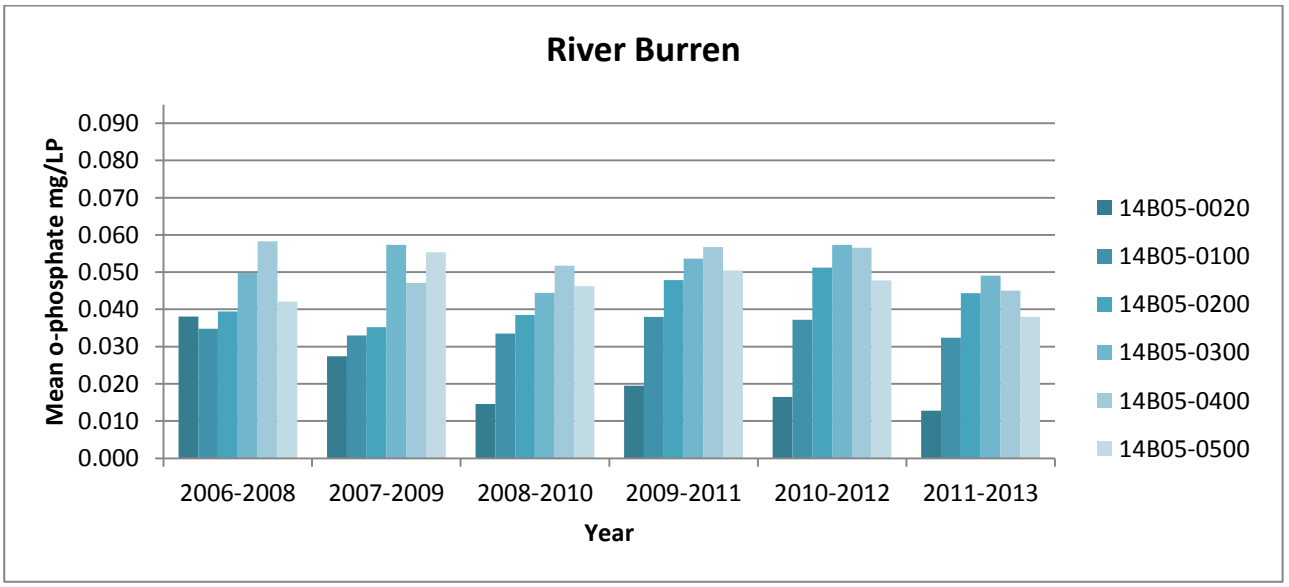
River Burren
Mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
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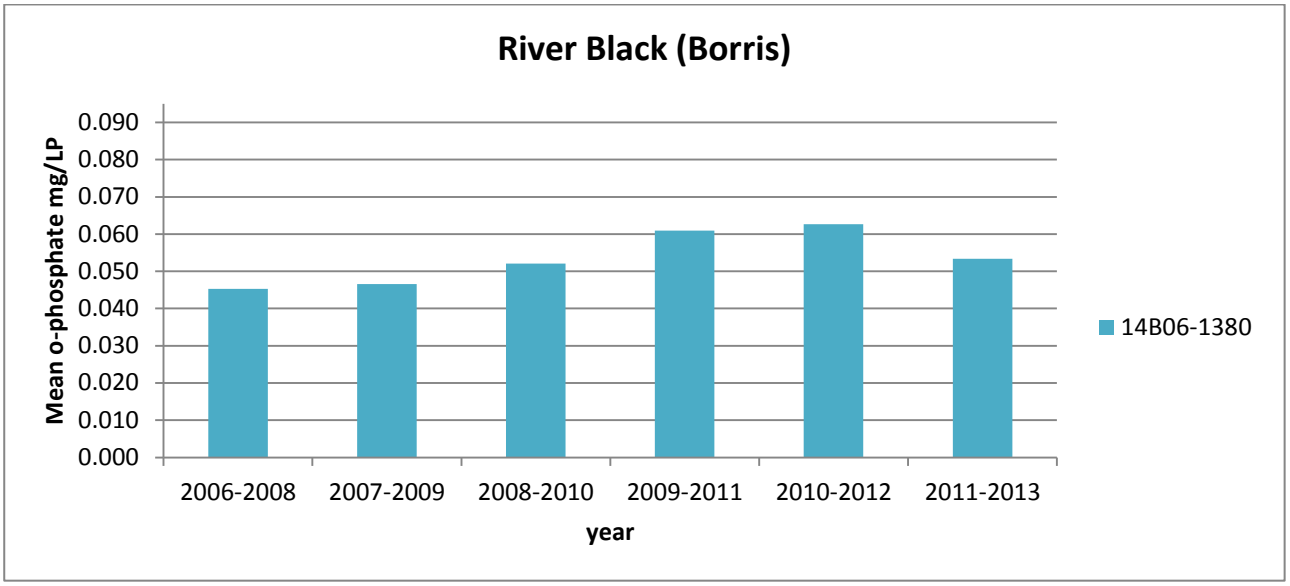
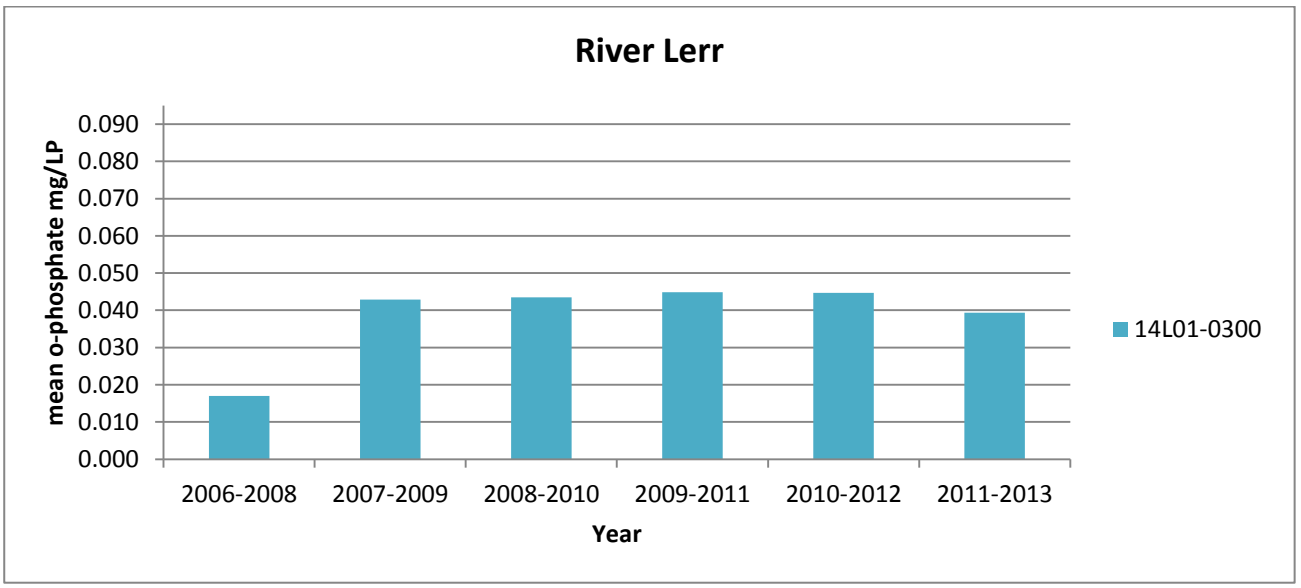
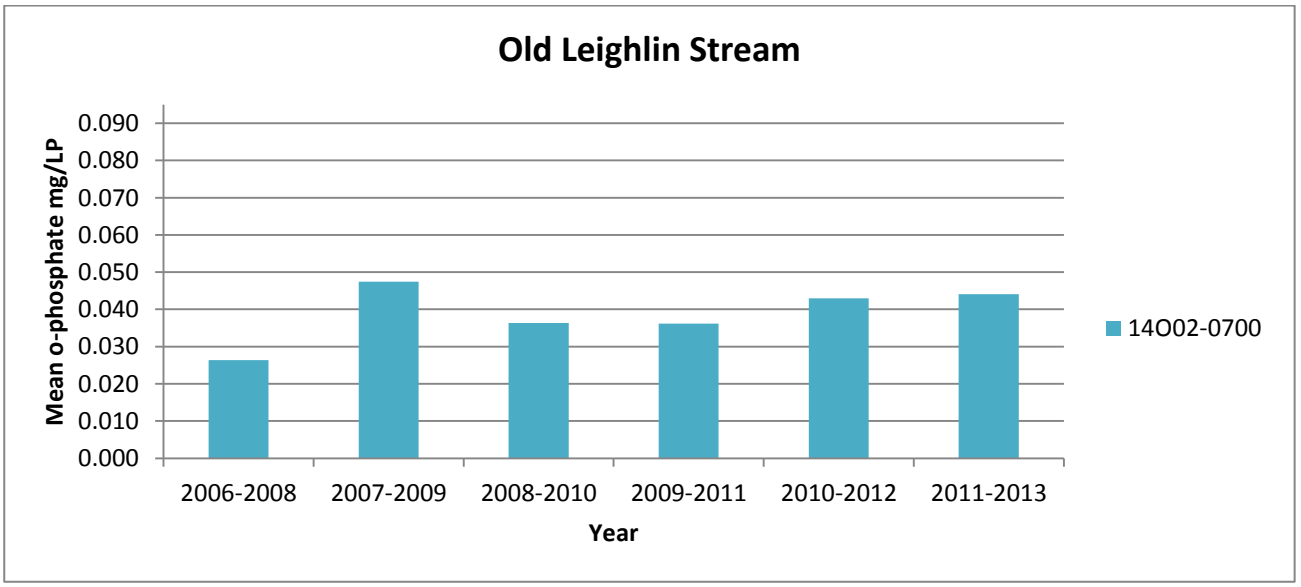
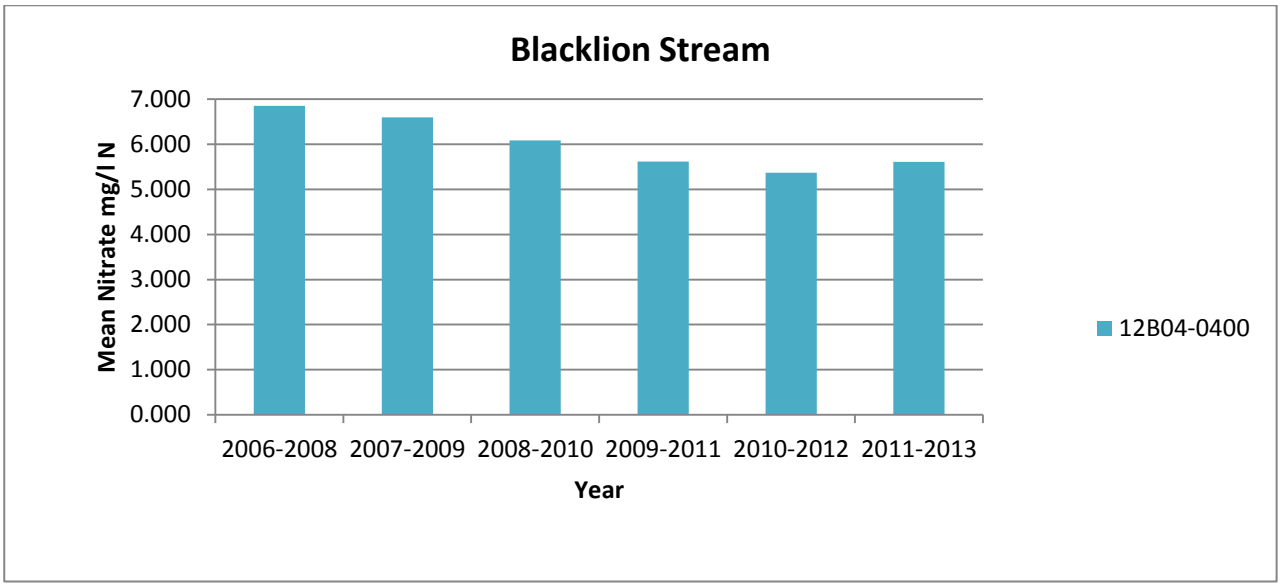
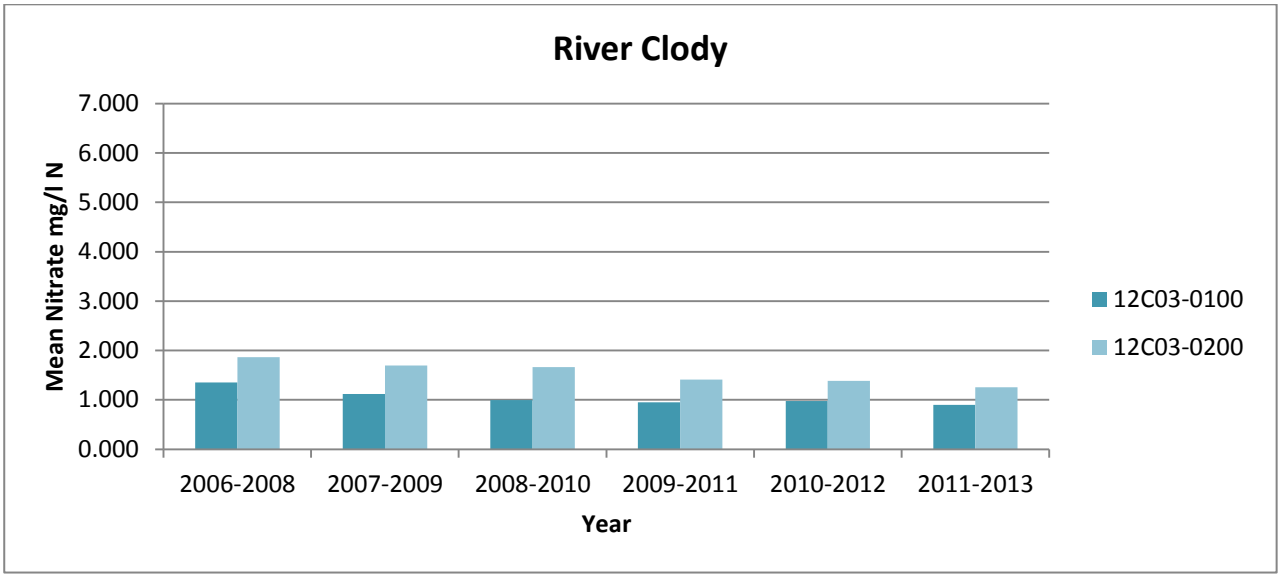

River Black (Borris)
Mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
year
14B06-1380

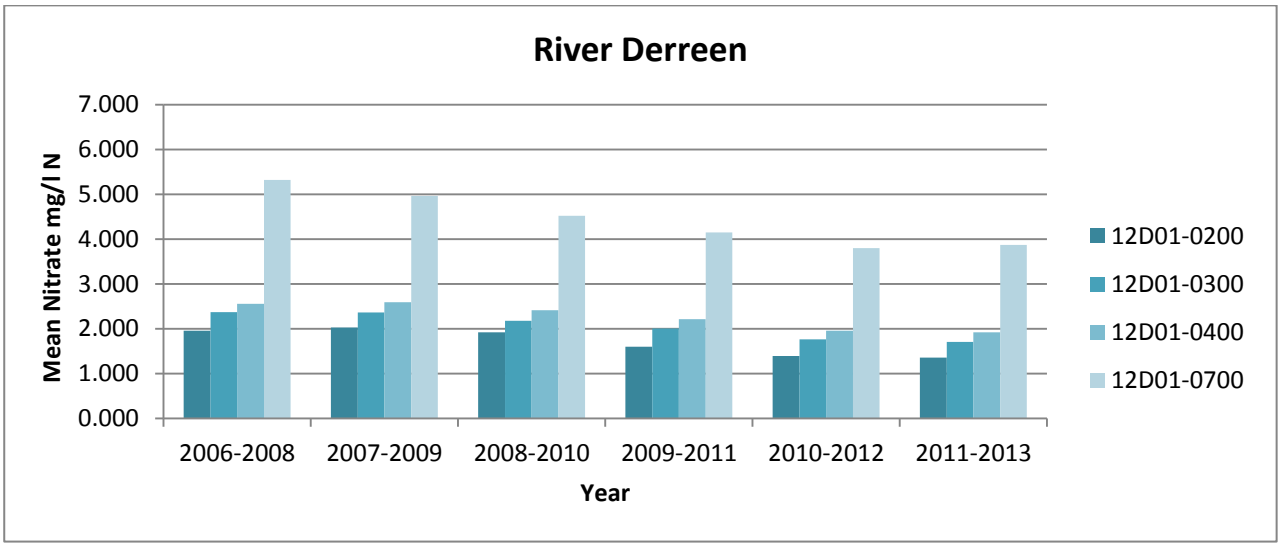

River Lerr
mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14L01-0300

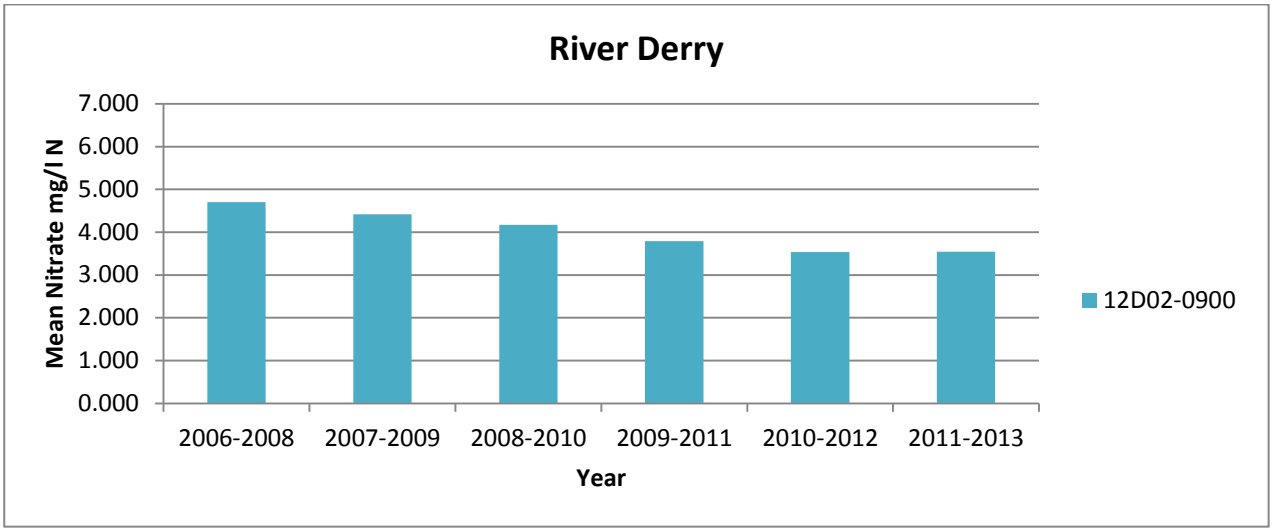

Old Leighlin Stream
Mean o-phosphate mg/LP
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14O02-0700

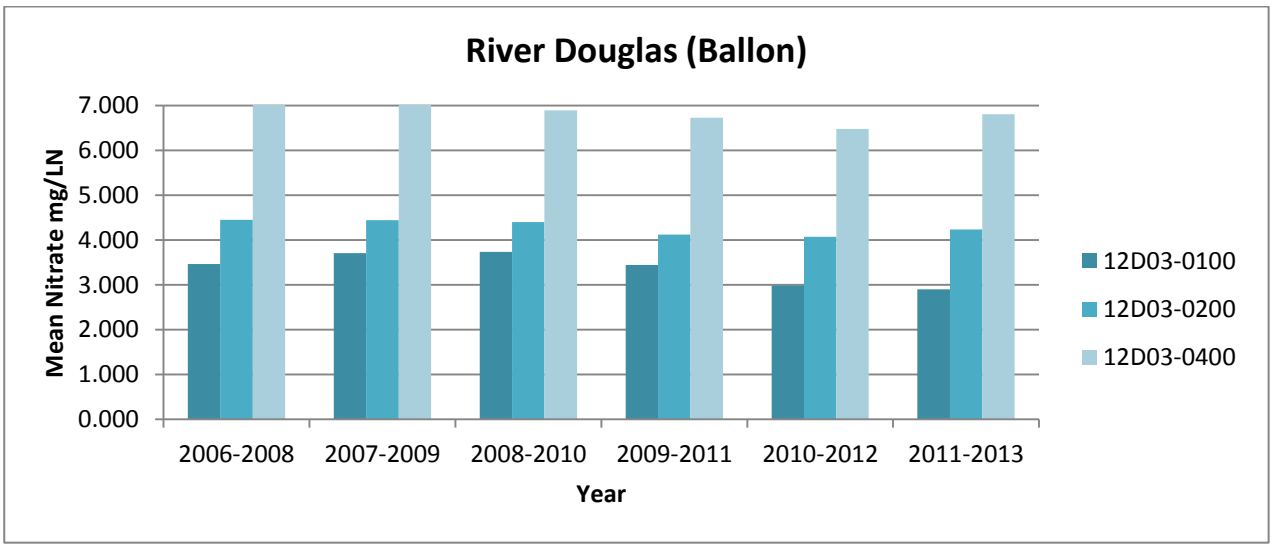
6. Long Term Trend Graphs – Nitrate

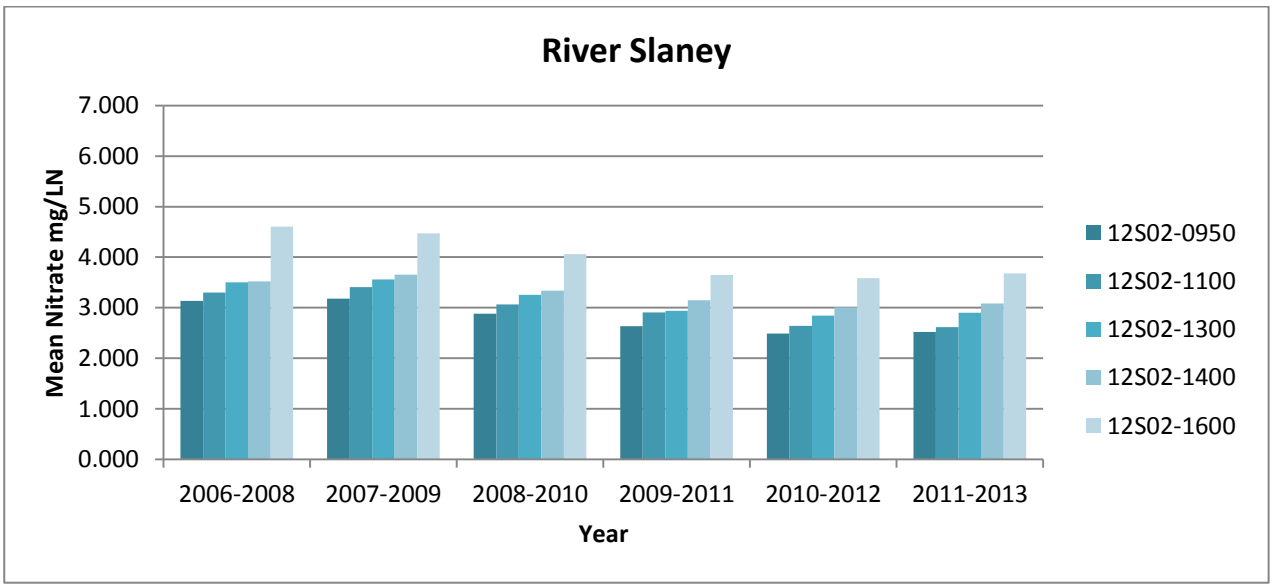


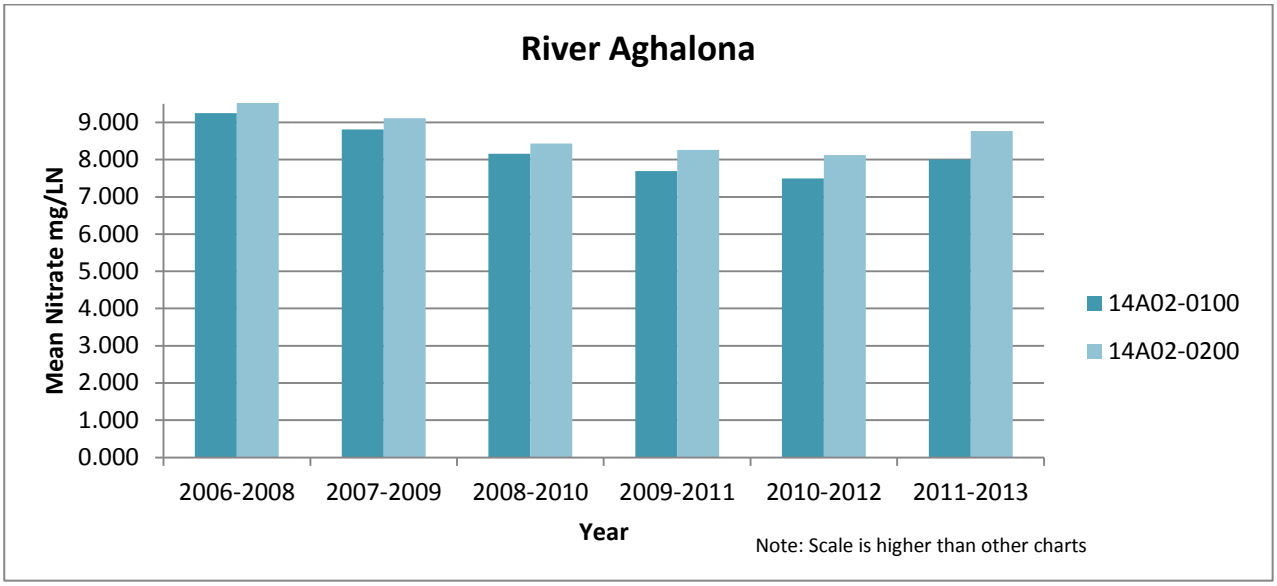


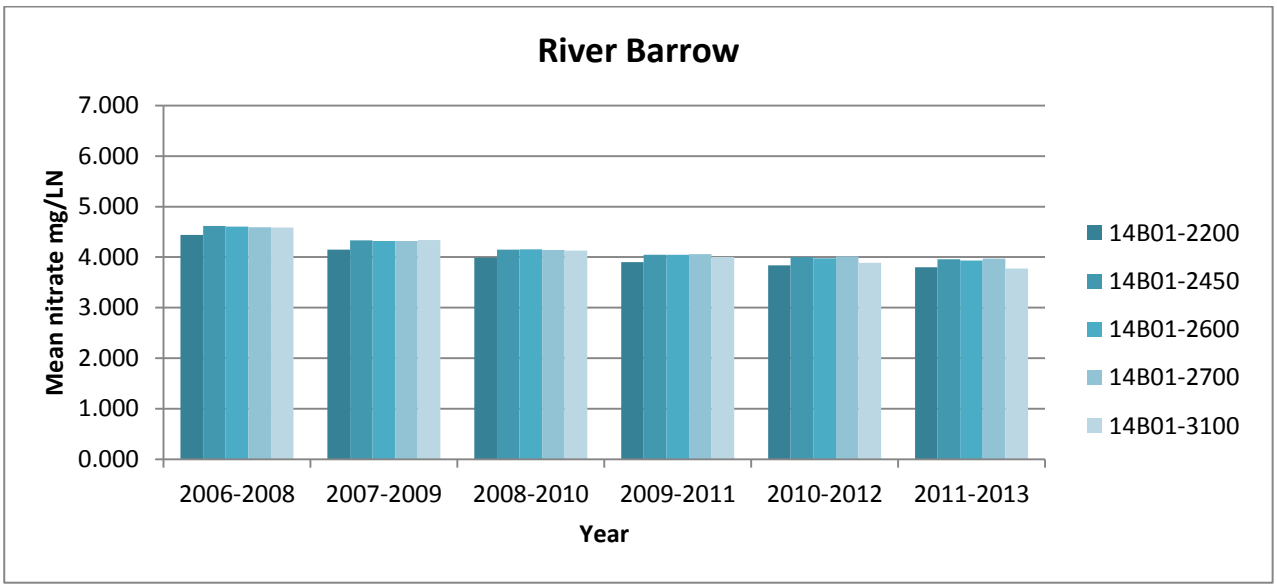


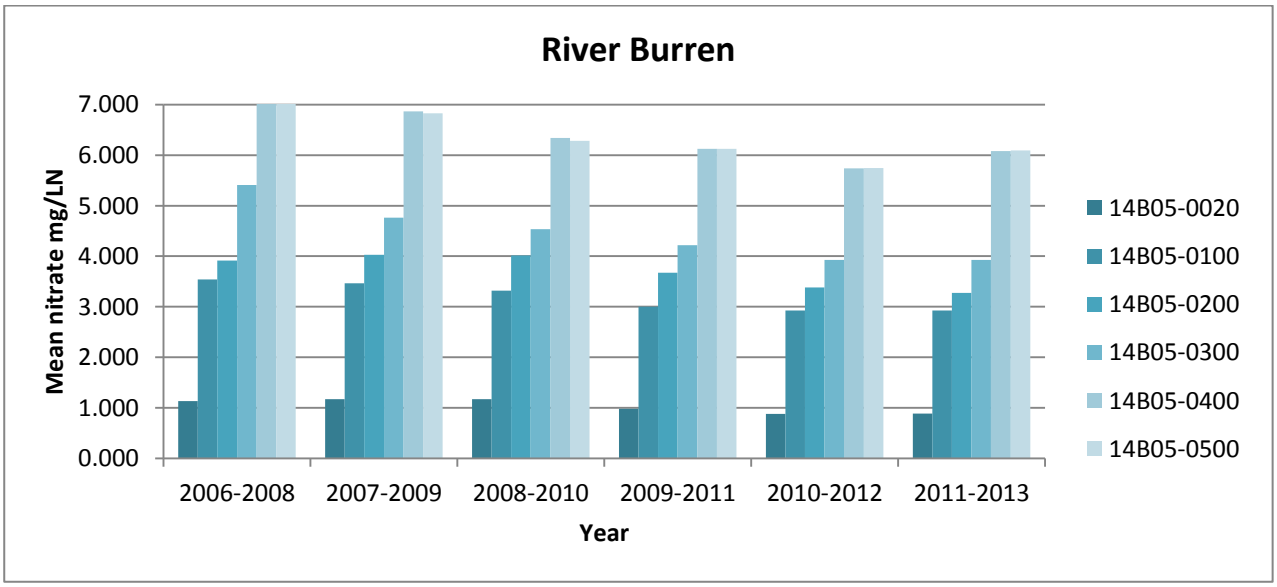

River Derry
Mean Nitrate mg/l N
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
12D02-0900

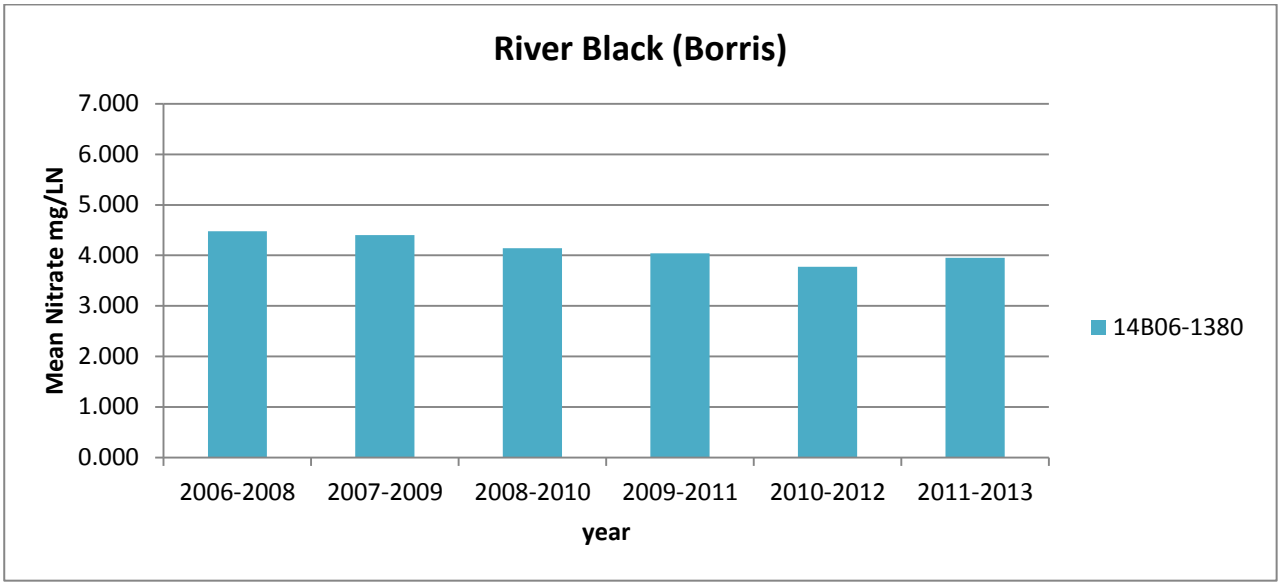

River Douglas (Ballon)
Mean Nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
12D03-0100
12D03-0200
12D03-0400

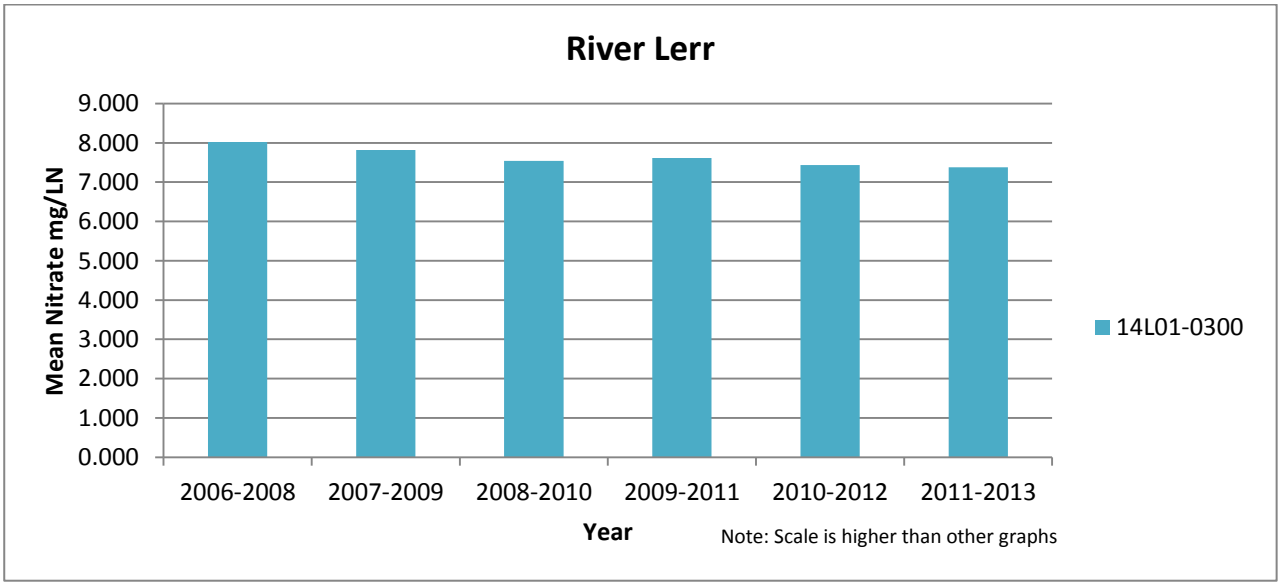

River Slaney
Mean Nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
12S02-0950
12S02-1100
12S02-1300
12S02-1400
12S02-1600

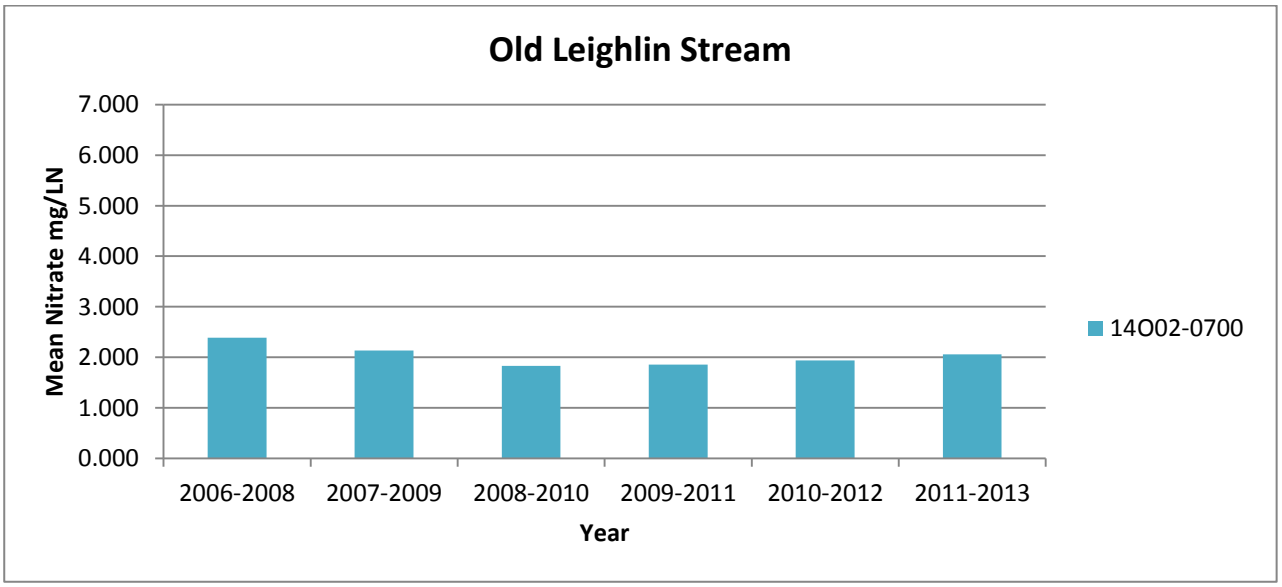

River Aghalona
Mean Nitrate mg/LN
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14A02-0100
14A02-0200
Note: Scale is higher than other charts


River Barrow
Mean nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14B01-2200
14B01-2450
14B01-2600
14B01-2700
14B01-3100


River Burren
Mean nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14B05-0020
14B05-0100
14B05-0200
14B05-0300
14B05-0400
14B05-0500

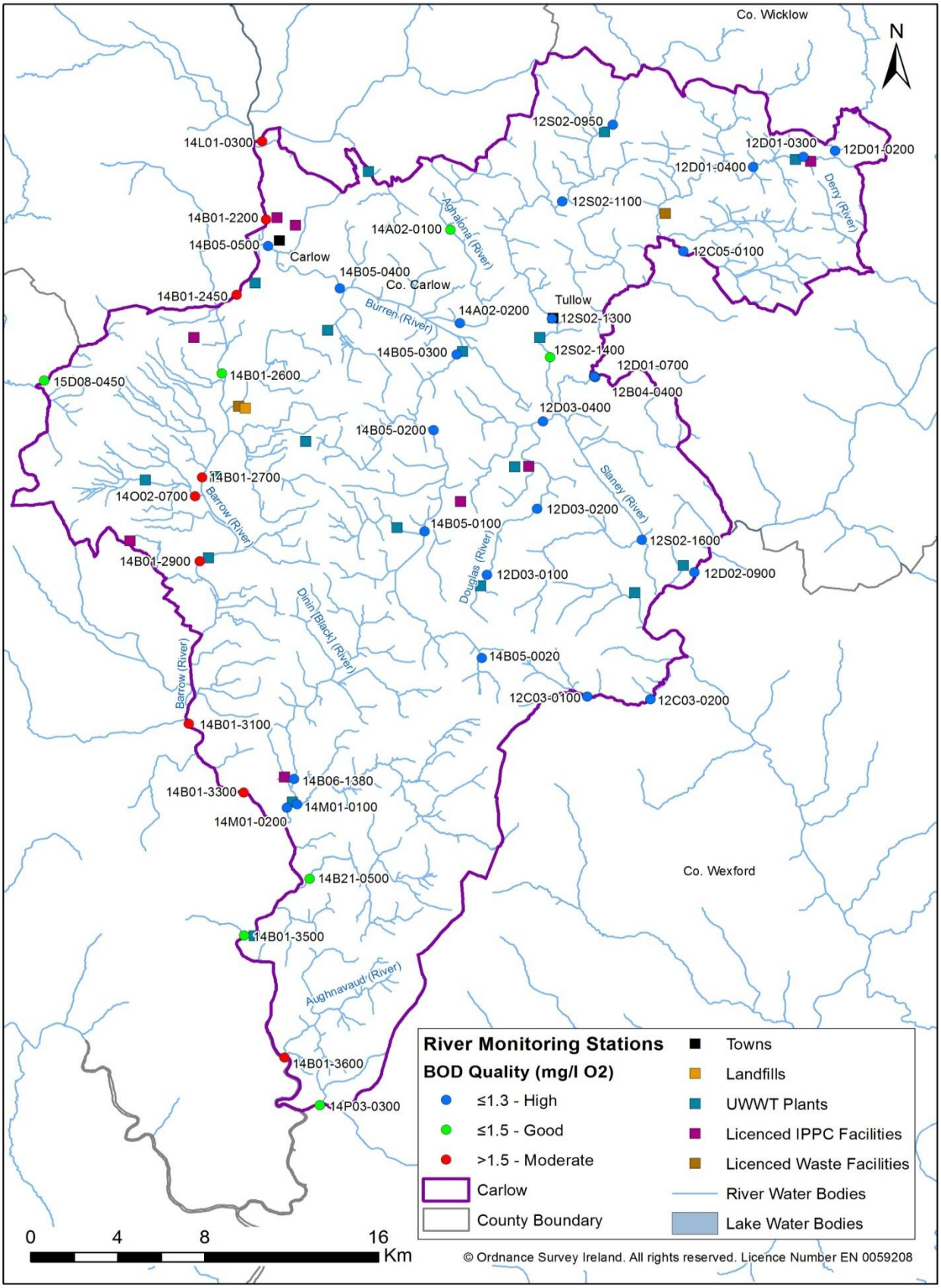

River Black (Borris)
Mean Nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
year
14B06-1380


River Lerr
Mean Nitrate mg/LN
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
Note: Scale is higher than other graphs
14L01-0300

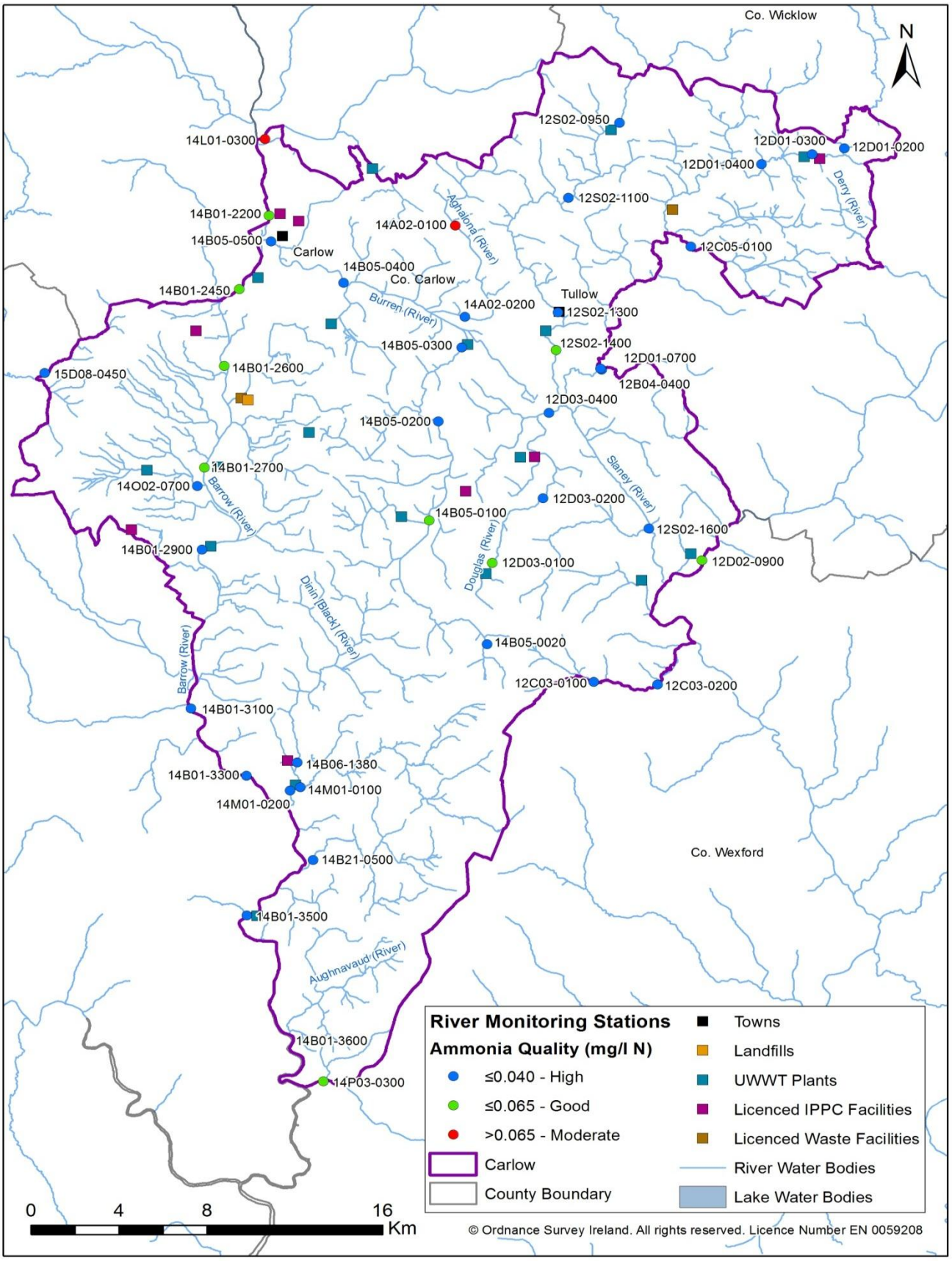

Old Leighlin Stream
Mean Nitrate mg/LN
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
2006-2008
2007-2009
2008-2010
2009-2011
2010-2012
2011-2013
Year
14O02-0700

7. River Water Quality Maps

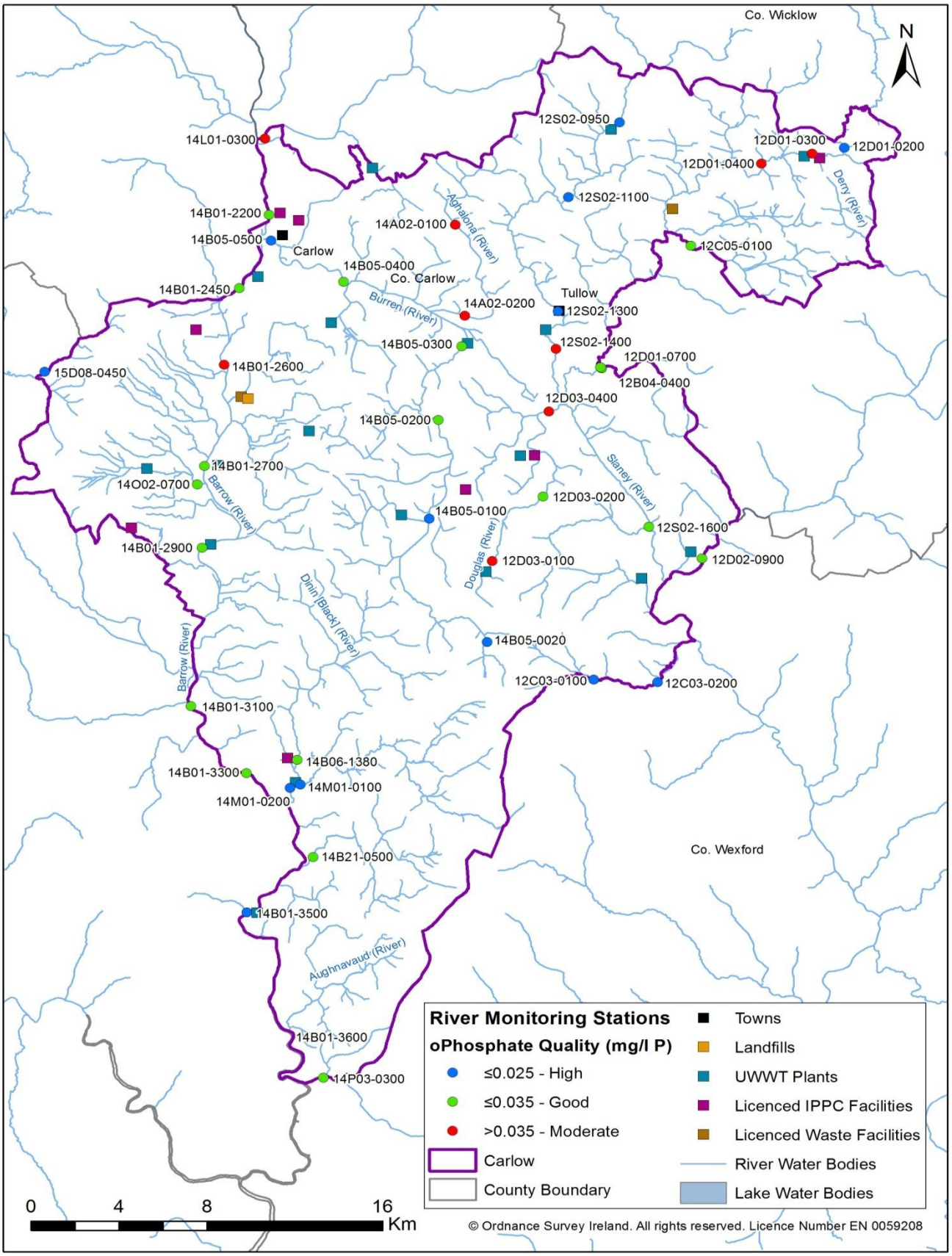
Map 1. River Water Quality: Carlow BOD Assessment 2013



Map 2. River Water Quality: Carlow Ammonia Assessment 2013



Map 3. River Water Quality: Carlow Ortho-Phosphate Assessment 2013



Map 4. River Water Quality: Carlow Total Oxidised Nitrogen (TON) Assessment 2013