

7 WATER – HYDROLOGY & HYDROGEOLOGY

The Study Area, for the purposes of this Chapter, covers 18km of the Bandon River, extending from 4km upstream of Bandon Bridge, to 5.5km downstream of Inishannon town centre and covers an area of 18km².

This chapter describes the existing aquatic environment in the Study Area, and assesses the impact the Bandon River (Bandon) Drainage Scheme may have on the quality of both surface water and ground water along with the hydrology and hydrogeological regimes of the Study Area.

The Bandon River (Bandon) Drainage Scheme construction phase will include the following;

- detailed site investigation
- site preparation works including temporary fencing / hoarding
- dredging of approximately 150,000m³ of material from riverbed
- construction of reinforced concrete walls
- construction of earthen embankments
- replacement of an existing culvert
- services and utility diversions
- re-instatement of footpaths / roadways / green areas

7.1 SURFACE WATER QUALITY

7.1.1 Methodology

A desk study of relevant hydrological data was conducted. The following documentation and sources were reviewed:

- Environmental Protection Area (EPA) water quality data (J. Lucey, pers. comm.)
- Cork County Council Surface Water Quality Results from the Bandon River
- South West River Basin District Management Plan
- The EPA website <http://www.epa.ie/rivermap/data>
- The Water Framework Directive website www.WFD.ie

In addition, kick sampling was conducted at various locations on the Bandon River within the Study Area and water samples were taken at two locations within the Study Area on the Bandon River for physico-chemical analysis.

7.1.2 Legislation

7.1.2.1 Water Framework Directive

The Water Framework Directive (WFD) came into effect on the 22nd December 2000. It is the most significant piece of water legislation to be introduced by the European Commission in twenty years.

The Directive takes a broader approach to the protection, enhancement and restoration of all coastal waters, rivers, lakes, estuaries and groundwaters in Europe. It requires all countries to control, manage and protect their water resources from all impacts – physical, polluting or otherwise. Under the Directive, all waters within Europe must achieve at least 'Good' status by December 2015 unless otherwise agreed upon by the relevant authority and the European Commission.

7.1.2.2 The European Communities Environmental Objectives (Surface Water) Regulations, 2009

The European Communities Environmental Objectives (Surface Waters) Regulations, 2009 came into effect on the 30th July 2009. They have a significant effect on the Water Framework Directive and also the Dangerous Substances and Priority Substances Directives.

The Directive, similar to the requirements of the Water Framework Directive, requires that all waters must be maintained at or improved to at least 'Good Status' and no deterioration of status is permitted. The EPA is responsible for assigning Status. 'Status' is a descriptor term that incorporates ecological and hydrochemical data and facilitates catchment comparisons on an EU scale. The catchment scale is referred to as the 'macro-scale'. Its status cannot be used to assess the potential impacts at a micro-scale i.e. a point discharge on a river, without there first being validation by monitoring data at the source of the point discharge.

These Regulations specify the conditions and physico-chemical concentrations that should be considered in the assessment of Status.

Table 7.1 below shows the surface water quality standards applied across a range of relevant legislation.

| Parameter | Units | European Communities (Quality Of Surface Water Intended For The Abstraction Of Drinking Water) Regulations, 1989 (S.I. No. 294/1989)* | European Communities Environmental Objectives (Surface Water) Regulations (S.I. No. 272 of 2009) | European Communities Drinking Water Regulations S.I. 106 of 2007 | Salmonid Water Regulations (Mandatory Level) (S.I. No. 293 of 1988) |
|-------------------------------------|-----------------------------|---|--|--|---|
| BOD | mg/l | 5 – A1 & A2 7 – A3 | High status ≤ 1.3 (mean) or ≤ 2.2 (95%ile) Good status ≤ 1.5 (mean) or ≤ 2.6 (95%ile) | N/A | ≤ 5 |
| Suspended Solids | mg/l | 50 | N/A | N/A | ≤ 25 |
| pH | - | 5.5-8.5 – A1 5.5-9.0 – A2 & A3 | 4.5-9.5 (Soft Water) 6.0-9.0 (Hard Water) | ≥ 6.5 & ≤ 9.5 | ≥ 6 & ≤ 9 |
| Conductivity | $\mu\text{S}/\text{cm}$ | 1,000 | N/A | 2,500 | N/A |
| Phosphates | mg/l P_2O_5 | 0.5 – A1 & A2 0.7 A3 | N/A | N/A | N/A |
| Molybdate Reactive Phosphorus (MRP) | mg/l P | N/A | High status ≤ 0.025 (mean) or ≤ 0.045 (95%ile) Good status ≤ 0.035 (mean) or ≤ 0.075 (95%ile) | N/A | N/A |
| Chloride | mg/l Cl | 250 | N/A | 250 | N/A |
| Ammonium | mg/l NH_4 | 0.2 – A1 1.5 – A2 4 – A3 | N/A | N/A | ≤ 1.0 |
| Total Ammonia | mg/l N | N/A | High status ≤ 0.040 (mean) or ≤ 0.090 (95%ile) | N/A | N/A |

| Parameter | Units | European Communities (Quality Of Surface Water Intended For The Abstraction Of Drinking Water) Regulations, 1989 (S.I. No. 294/1989)* | European Communities Environmental Objectives (Surface Water) Regulations (S.I. No. 272 of 2009) | European Communities Drinking Water Regulations S.I. 106 of 2007 | Salmonid Water Regulations (Mandatory Level) (S.I. No. 293 of 1988) |
|------------------|------------------------|---|--|--|---|
| | | | Good status ≤ 0.065 (mean) or ≤ 0.140 (95%ile) | | |
| Nitrate | mg/l NO ₃ | 50 | N/A | 50 | N/A |
| Nitrite | mg/l NO ₂ | N/A | N/A | 0.5 | ≤ 0.05 |
| Dissolved Oxygen | - | >60% - A1 >50% - A2 >30% - A3 | Lower limit: 95%ile>80% saturation Upper limit: 95%ile<120 %saturation | N/A | 50% ≥ 9 mg/l |
| Total Hardness | mg/l CaCO ₃ | N/A | N/A | N/A | N/A |
| Copper | mg/l Cu | 0.05 – A1 0.1 – A2 1.0 – A3 | 5 - water hardness ≤ 100 mg/l CaCO ₃ 30 - water hardness >100mg/l CaCO ₃ | 2.0 | ≤ 0.005 [1, 6] ≤ 0.022 [2, 6] ≤ 0.04 [3, 6] ≤ 0.112 [4, 6] |
| Zinc | mg/l Zn | 3–A1 5- A2 & A3 | 0.008 - water hardness ≤ 10 mg/l CaCO ₃ 0.05 - water hardness >10 ≤ 100 mg/l CaCO ₃ 0.1- water hardness >100mg/l CaCO ₃ | N/A | ≤ 0.03 [1, 6] ≤ 0.2 [2, 6] ≤ 0.3 [3, 6] ≤ 0.5 [5, 6] |
| Total coliforms | no/100ml | 5,000 – A1 25,000 – A2 100,000 – A3 | N/A | N/A | N/A |
| Faecal coliforms | no/100ml | 1,000 – A1 5,000 – A2 40,000 – A3 | N/A | 0 | N/A |

Table 7.1 Mandatory levels for physiochemical parameters for specific legislation

[1] At water hardness 10 mg/l CaCO₃; [2] At water hardness 50 mg/l CaCO₃; [3] At water hardness 100 mg/l CaCO₃; [4] At water hardness 300 mg/l CaCO₃; [5] At water hardness 500 mg/l CaCO₃; [6] To be conformed with by 95% of samples over a period of 12 months where sampling is carried out at least once a month; where sampling is less frequent, to be conformed with by all samples.

*S.I. No. 294/1989 is superseded by S.I. No. 272 of 2009. If a particular parameter is not found in SI 272 of 2009 then the 1989 value applies.

7.1.3 Desk Study

7.1.3.1 Introduction

The main hydrological feature within the Study Area is the Bandon River, which flows into the Study Area from the East. The river flows through the town of Bandon before veering to the north and then looping southwards to its estuary below Inishannon. It finally reaches the sea in Kinsale Harbour.

In addition, there are two main tributaries that flow into the Bandon River within the Study Area; the Bridewell and Brinny Rivers.

7.1.3.2 EPA Water Quality Data

The EPA website, <http://www.epa.ie/rivermap/data>, contains information regarding water quality in selected Irish rivers based on surveys carried out by the EPA. Information was obtained from EPA monitoring stations on the Bandon River and the Brinny River within and upstream of the Study Area. Biological information is provided in the form of Q values. Q Values are biotic indices used to express biological water quality and are based on changes in the macro invertebrate communities of riffle areas brought about by organic pollution. Q1 indicates a seriously polluted water body and Q5 indicates unpolluted water of high quality. A value of Q3 indicates moderately polluted water. These Q value ratings are shown in Table 7.2.

| Quality Ratings | Quality Class | Pollution Status | Condition (re beneficial uses) |
|---------------------|---------------|---------------------|-----------------------------------|
| Q5, Q4-5, Q4 | Class A | Unpolluted | Satisfactory |
| Q3-4 | Class B | Slightly Polluted | Unsatisfactory |
| Q3, Q2-3 | Class C | Moderately Polluted | Unsatisfactory |
| Q2, Q1-2, Q1 | Class D | Seriously Polluted | Unsatisfactory |

Table 7.2 Q value classification

Information was gained on the Bandon River as a whole, including five monitoring points that were within or very close to the Study Area and nine that were located upstream. Baxter's Bridge is just upstream of the Study Area with the downstream monitoring points further down the table. The EPA concluded that water quality in the Bandon River was 'Mostly satisfactory, with good ecological quality, but only moderate downstream of Dunmanway, Ballineen and Enniskeen'. It should be noted that the monitoring station located 1.5 km downstream of Bandon Bridge recorded moderately polluted status during the 1997, 2000 and 2003 surveys but recovered to unpolluted status in the most recent sampling periods.

| Biological Quality Ratings (Q Values) | | | | | | | | | | | | | |
|---------------------------------------|--------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Station Nos. | 1971 | 1976 | 1978 | 1982 | 1986 | 1989 | 1994 | 1997 | 2000 | 2003 | 2006 | 2009 |
| Keenrath Br | 0050 | - | - | - | - | - | 4-5 | 4-5 | 4 | 4-5 | 4-5 | 4-5 | - |
| Br u/s Ardcahan Br | 0100 | 5 | 4-5 | 4-5 | 4-5 | 4 | 3-4 | - | - | - | - | - | - |
| Ardcahan Br | 0150 | - | - | - | - | 4-5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Br near River View | 0200 | - | - | 4-5 | 4-5 | 4-5 | 4 | - | - | - | - | - | - |
| Bealboy Br | 0300 | 5 | 4-5 | 4-5 | 4 | 4 | 4 | 4 | 4 | 3-4 | 3-4 | 4 | 3-4 |
| Manch Br | 0400 | 5 | 4-5 | 4 | 4 | 4 | 3-4 | 4 | 3-4 | 3-4 | 3-4 | 4 | 4 |
| Ballineen Br | 0500 | 5 | 4-5 | 4 | 3-4 | 3-4 | 3-4 | - | - | - | - | - | - |
| Enniskeen Br | 0550 | - | - | - | - | - | 4 | 4-5 | 4 | 3-4 | 4 | 3-4 | 3-4 |
| Murragh Br | 0600 | 5 | 5 | 5 | 3-4 | 3-4 | 4 | 4-5 | 4 | 4 | 4 | - | 3-4 |
| Baxter's Br | 0700 | 5 | 4-5 | 4 | 3-4 | 4 | 3-4 | 4-5 | 4 | 4 | 4 | 4 | 4 |
| Bandon Br | 0780 | - | - | - | - | - | 3-4 | - | - | - | - | - | - |
| 1.5km d/s Bandon Br | 0800 | 5 | 3 | 2-3 | 3 | 4 | 3 | 3-4 | 3 | 3 | 3 | 4 | 4 |
| French's Wood | 0850 | - | - | - | - | - | 3-4 | - | - | - | - | - | - |
| Inishannon Br | 0900 | 5 | 4-5 | 4 | 4 | 4 | 3-4 | 4 | 4 | 4 | 4 | 4 | 4 |

Table 7.3 Biological water quality in the Bandon River Study Area based on EPA data.

In addition, various chemical parameters are also tested by the EPA and are available for some of the monitoring points. Physico-chemical data from the 2001-2003 and 2007 to 2009 sampling periods for a number of the monitoring points within and upstream and downstream of the Study Area are shown in Tables 7.4.

| EPA Physico-chemical Data – Bandon River | | | | | | | |
|--|------------------------|--------------------------------------|--------|-------------|-----------|-------------|--------------|
| Parameter | Unit | 2001-2003 | | | 2007-2009 | | |
| | | Station No. 0600 Murragh Bridge | | | | | |
| | | Min | Median | Max | Min | Mean | Max |
| Alkalinity | mg/l CaCO ₃ | - | - | - | 23.0 | 44.8 | 66.0 |
| Chloride | mg/l Cl | - | - | - | 10.4 | 20.7 | 35.8 |
| Conductivity @25°C | (µS/cm) | - | - | - | 102.0 | 195.2 | 305.0 |
| pH | | - | - | - | 6.5 | 7.3 | 7.6 |
| Sulphate | mg/l | - | - | - | 4.3 | 8.2 | 12.6 |
| Temperature | °C | - | - | - | 3.6 | 10.6 | 16.7 |
| Total Hardness | mg/l CaCO ₃ | - | - | - | 51.9 | 74.7 | 10.9 |
| Total Organic Carbon | mg/l | - | - | - | 2.59 | 5.33 | 10.90 |
| True Colour | mg/l Hazen | - | - | - | 5.0 | 22.5 | 63.0 |
| Nitrate | mg/l NO ₃ | - | - | - | 3.79 | 9.17 | 17.20 |
| Nitrite | mg/l N | | - | - | 0.006 | 0.011 | 0.036 |
| Ortho-Phosphate | mg/l P | - | - | - | 0.006 | 0.019 | 0.042 |
| Total Oxidised Nitrogen | mg/l N | - | - | - | 0.870 | 2.115 | 3.890 |
| Ammonia – Total | mg/l N | - | - | - | 0.015 | 0.069 | 0.236 |
| B.O.D | mg/l O ₂ | - | - | - | 0.5 | 1.0 | 3.5 |
| Dissolved Oxygen | % Saturation | - | - | - | 75.0 | 91.8 | 106.0 |
| Dissolved Oxygen | mg/l | - | - | - | 7.80 | 10.10 | 12.50 |
| Parameter | Unit | Station No. 0700 Baxter's Br | | | | | |
| | | Min | Median | Max | Min | Mean | Max |
| Ortho-Phosphate | mg/l P | 0.01 | 0.03 | 0.07 | - | - | - |
| Oxidised Nitrogen | mg/l N | 1.5 | 3.0 | 4.0 | - | - | - |
| pH | | 7.3 | 7.6 | 7.9 | - | - | - |
| Temperature | °C | 6.6 | 11.0 | 19.3 | | - | - |
| Total Ammonia | mg/l N | <0.02 | 0.04 | 0.06 | - | - | - |
| B.O.D | mg/l O ₂ l | <1.0 | 1.7 | 4.0 | - | - | - |
| Dissolved Oxygen | % Saturation | 78 | 94 | 111 | - | - | - |
| Dissolved Oxygen | mg/l O ₂ | 8.7 | 10.2 | 11.6 | - | - | - |
| Parameter | Unit | Station No. 0770 – Footbridge Bandon | | | | | |
| | | Min | Median | Max | Min | Mean | Max |
| Ortho-Phosphate | mg/l P | 0.01 | 0.03 | 0.06 | - | - | - |
| Oxidised Nitrogen | mg/l N | 1.9 | 3.1 | 3.6 | - | - | - |
| pH | | 7.7 | 7.7 | 8.2 | - | - | - |
| Temperature | °C | 8.0 | 12.5 | 20.9 | - | - | - |
| Total Ammonia | mg/l N | 0.02 | 0.04 | 0.10 | - | - | - |
| B.O.D | mg/l O ₂ | 0.9 | 1.5 | 2.3 | - | - | - |

| Dissolved Oxygen | % Saturation | 96 | 103 | 111 | - | - | - |
|----------------------|------------------------|--|-------------|-------------|-------|--------------|--------------|
| Dissolved Oxygen | mg/l O ₂ | 9.7 | 11.0 | 12.0 | - | - | - |
| Parameter | Unit | Station No. 0800 – 1.5 km d/s of Bandon Bridge | | | | | |
| | | Min | Median | Max | Min | Mean | Max |
| Ortho-Phosphate | mg/l P | 0.01 | 0.04 | 0.11 | - | - | - |
| Oxidised Nitrogen | mg/l N | 0.0 | 3.0 | 4.3 | - | - | - |
| Temperature | °C | 6.9 | 8.8 | 15.7 | - | - | - |
| Total Ammonia | mg/l N | 0.02 | 0.03 | 0.13 | - | - | - |
| B.O.D | mg/l O ₂ | 1.9 | 1.9 | 1.9 | - | - | - |
| Dissolved Oxygen | % Saturation | 85 | 90 | 106 | - | - | - |
| Dissolved Oxygen | mg/l O ₂ | 9.9 | 10.4 | 11.0 | - | - | - |
| Total Ammonia | mg/l N | <0.02 | 0.03 | 0.13 | - | - | - |
| pH | | - | - | - | - | - | - |
| Parameter | Unit | Station No. 0900 – Inishannon Bridge | | | | | |
| | | Min | Median | Max | Min | Mean | Max |
| Ortho-Phosphate | mg/l P | 0.01 | 0.04 | 0.07 | 0.003 | 6.825 | 30.00 |
| Oxidised Nitrogen | mg/l N | 2.2 | 3.5 | 4.8 | 1.250 | 2.737 | 4.360 |
| pH | | 7.6 | 7.9 | 8.7 | 7.0 | 7.5 | 7.8 |
| Temperature | °C | 6.7 | 11.9 | 20.8 | 3.6 | 10.0 | 18.2 |
| Total Ammonia | mg/l N | <0.02 | 0.02 | 0.13 | 0.005 | 0.048 | 0.092 |
| B.O.D | mg/l O ₂ | 1.8 | 1.8 | 3.1 | 0.5 | 1.7 | 5.9 |
| Dissolved Oxygen | % Saturation | 86 | 101 | 126 | 67.0 | 93.0 | 101.8 |
| Dissolved Oxygen | mg/l O ₂ | 9.7 | 10.9 | 12.0 | 8.20 | 10.47 | 12.50 |
| Suspended Solids | mg/l | - | - | - | 2.4 | 2.5 | 2.5 |
| Alkalinity | mg/l CaCO ₃ | - | - | - | 22.0 | 43.5 | 58.0 |
| Chloride | mg/l Cl | - | - | - | 9.6 | 18.0 | 26.0 |
| Conductivity @25°C | µS/cm | - | - | - | 107.0 | 189.6 | 243.0 |
| Sulphate | mg/l | - | - | - | 4.2 | 8.3 | 12.2 |
| Total Hardness | mg/l CaCO ₃ | - | - | - | 29.6 | 55.1 | 70.9 |
| Total Organic Carbon | mg/l | - | - | - | 2.400 | 5.5325 | 10.8000 |
| True Colour | Hazen | - | - | - | 4.0 | 24.8 | 69.0 |
| Nitrate | mg/l NO ₃ | - | - | - | 5.440 | 11.511 | 19.200 |
| Nitrite | mg/l N | - | - | - | 0.010 | 0.010 | 0.010 |

Table 7.4 EPA Physico-chemical data from EPA sampling points in the Bandon River (Exceedances highlighted in bold)

EPA data was also obtained from the Brinny River including three monitoring points located within or very close to the Study Area and a further five that were located upstream. The EPA report concluded that water quality in the Brinny River was '*Satisfactory with Good and High ecological quality*'. Information on this river is shown in Tables 7.5 and 7.6.

| Biological Quality Ratings (Q Values) | | | | | | | | | | | | |
|---------------------------------------|--------------|------|------|------|------|------|------|------|------|------|------|------|
| | Station Nos. | 1976 | 1978 | 1982 | 1986 | 1989 | 1994 | 1997 | 2000 | 2003 | 2006 | 2009 |
| Br N of Templemartin | 0010 | - | - | - | - | 4 | - | - | - | - | - | - |
| Br S of Aghnamorroge Cross Roads | 0030 | - | - | - | - | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Tuough Br | 0700 | - | - | - | - | 4-5 | 4 | 3-4 | 4 | 3-4 | 4 | 4 |
| Br nr Ballinacurra Ho | 0090 | - | - | - | - | 4 | - | - | - | - | - | - |
| Brinny Br | 0100 | - | 5 | 5 | 4-5 | 4-5 | 4-5 | 4 | 4 | 4-5 | 4-5 | 4-5 |
| Down Daniel Br | 0200 | 4-5 | 4 | 4 | 4 | 4-5 | 4-5 | 4-5 | 4 | 4 | - | - |

Table 7.5 Biological water quality in the River Brinny Study Area based on EPA data.

| Parameter | Unit | Criteria | Station No. 0700 Tuough Br | | |
|-------------------|--------|----------|----------------------------|--------|-------------|
| | | | Minimum | Median | Maximum |
| Ortho-Phosphate | mg/l P | 0.03* | 0.01 | 0.01 | 0.03 |
| Oxidised Nitrogen | mg/l N | 50* | 3.6 | 5.0 | 5.4 |
| Temperature | °C | 25* | 10.9 | 10.9 | 11.0 |
| Total Ammonia | mg/l N | 0.2* | 0.02 | 0.02 | 0.02 |

Table 7.6 EPA Physiochemical Water Quality Monitoring Results 2001 to 2003

* Limits from The European Communities Quality of Surface Water Intended for the Abstraction of Drinking Water Regulations (S.I. 293 of 1989) for A1 Waters

** Limits from the European Communities (Quality of Salmonid Waters Regulations) (S.I. 293 of 1988)

7.1.3.3 Water Framework Directive Operational Monitoring Data

Water quality monitoring, as required under the terms of the Water Framework Directive (WFD), is one of the functions of the Environment Section of Cork County Council. The most recent physico-chemical data from monitoring points within and close to the Study Area taken by Cork County Council are presented in Table 7.7 overleaf. Exceedances of the maximum admissible limit under the relevant legislation are highlighted in bold. Exceedances occurred in relation to the following parameters: Molybdate Reactive Phosphorus (MRP) and Nitrite.

| WFD Bandon River Surface Water Operational Monitoring Data, 2011 | | | | | |
|--|------------------------|-------------------------------------|--------------|--------------|--------------|
| Parameter | Unit | Baxters Bridge | | | |
| | | 02/02/2011 | 06/04/2011 | 06/07/2011 | 02/11/2011 |
| Colour | Hazen | 21 | 45 | 29 | 77 |
| Conductivity@20 °C | µS/cm | 166 | 124 | 198 | 123 |
| pH | pH units | 7.2 | 7.2 | 7.6 | 7.4 |
| Temperature | °C | 8.1 | 11.3 | 15.4 | 13.1 |
| B.O.D. | mg/l O ₂ | 0.5 | 1.1 | 0.6 | 3.5 |
| Hardness | mg/l O ₂ | 63 | 25 | 59 | 44 |
| MRP | mg/l P | 0.035 | 0.021 | 0.01 | 0.068 |
| Alkalinity | mg/l CaCO ₃ | 50 | 30 | 58 | 32 |
| Chloride | mg/l Cl | 17.7 | - | - | - |
| Ammonium | mg/l | 0.045 | 0.025 | <0.006 | 0.087 |
| Dissolved Oxygen | % Sat. | 101 | 95 | 96 | 93 |
| Dissolved Oxygen | mg/l O ₂ | 12.4 | 10.5 | 9.4 | 9.5 |
| Nitrate | mg/l NO ₃ | 13 | - | 7.5 | 6.6 |
| Nitrite | mg/l N | 0.027 | 0.025 | 0.032 | 0.036 |
| Parameter | Unit | Br. D/S Bandon (O'Driscolls Bridge) | | | |
| | | 02/02/2011 | 04/05/2011 | 04/08/2011 | 08/09/2011 |
| Colour | Hazen | 19 | 53 | 16 | 37 |
| Conductivity@20 °C | µS/cm | 176 | 160 | 339 | 189 |
| pH | pH units | 7.4 | 7.4 | 7.8 | 7.6 |
| Temperature | °C | 8.1 | 13.2 | 17.7 | 16.2 |
| B.O.D. | mg/l O ₂ | 0.8 | 1.3 | 1.4 | 0.7 |
| Hardness | mg/l O ₂ | 53 | 51 | 68 | 50 |
| MRP | mg/l P | 0.03 | 0.026 | 0.031 | 0.04 |
| Alkalinity | mg/l CaCO ₃ | 34 | 48 | 82 | 68 |
| Chloride | mg/l Cl | 19.1 | 20.2 | 56.7 | - |
| Ammonium | mg/l | 0.069 | 0.129 | 0.036 | 0.049 |
| Dissolved Oxygen | % Sat. | 102 | 102 | 108 | 102.2 |
| Dissolved Oxygen | mg/l O ₂ | 12 | 10.7 | 10.2 | 10 |
| Nitrate | mg/l NO ₃ | 14.7 | 8.5 | 11.7 | 6.2 |
| Nitrite | mg/l N | 0.037 | 0.057 | 0.06 | 0.057 |
| Parameter | Unit | Innishannon | | | |
| | | 02/02/2011 | 06/04/2011 | 06/07/2011 | 02/11/2011 |
| Colour | Hazen | 15 | 49 | 31 | 81 |
| Conductivity@20 °C | µS/cm | 181 | 131 | 216 | 143 |
| pH | pH units | 7.4 | 7.4 | 7.8 | 7.6 |
| Temperature | °C | 7.9 | 11.3 | 16.6 | 13.4 |
| B.O.D. | mg/l O ₂ | 0.9 | <1 | 1.1 | 2.7 |
| Hardness | mg/l O ₂ | 63 | 40 | 60 | 47 |
| MRP | mg/l P | 0.117 | 0.024 | 0.047 | 0.073 |
| Alkalinity | mg/l CaCO ₃ | 52 | 34 | 60 | 28 |
| Chloride | mg/l Cl | 18.9 | - | - | - |
| Ammonium | mg/l | 0.093 | 0.045 | 0.125 | 0.113 |
| Dissolved Oxygen | % Sat. | 100 | 99 | 107 | 95 |
| Dissolved Oxygen | mg/l O ₂ | 12.2 | 10.9 | 10.2 | 9.6 |
| Nitrate | mg/l NO ₃ | 16.9 | - | 10.8 | 8 |
| Nitrite | mg/l N | 0.038 | 0.028 | 0.091 | 0.047 |

Table 7.7 WFD Bandon River Surface Water Operational Monitoring Data, 2011

7.1.3.4 Water Framework Directive

The Study Areas located within the Water Framework Directive (WFD) South Western River Basin District and the management plan for this area was consulted. The main objectives of this management plan were to prevent deterioration, restore good status, reduce chemical pollution in surface waters and to achieve protected areas objectives. The programme of measures designed to achieve these objectives include the following:

- Control of urban waste water discharges
- Control of unsewered waste water discharges
- Control of agricultural sources of pollution
- Water pricing policy
- Sub-basin management plans and programmes of measures for the purpose of achieving environmental water quality objectives for Natura 2000 sites designated for the protection of Freshwater Pearl Mussel populations
- Pollution reduction programmes for the purpose of achieving water quality standards for designated shellfish waters
- Control of environmental impacts from forestry

The management plan identified the Bandon Estuary as being subject to eutrophication and has described it as a nutrient sensitive area. It also describes Freshwater Pearl Mussel populations in the Upper Bandon and Caha (upstream and outside the Study Area) and finds that this population is not likely to be in favourable condition, based on most recent available information from surveys in 2005 and on habitat surveys in 2009.

Information on status, objectives and measures in the South Western RBD has been compiled for smaller, more manageable geographical areas than river basin districts, termed water management unit action plans. There are twenty-eight water management units (WMUs) in the South Western RBD. These units represent smaller river and lake basins where management of the pressures, investigations and measures will be focussed and refined during implementation of this plan. In addition, action plans focusing on groundwater and a transitional and coastal water management have been prepared for the South Western RBD. WMU action plans are a key background document to the plan.

The Study Area is within the Bandon Stick Water Management Unit (WMU). There are 36 river water bodies in this WMU - 2 High, 11 Good, 8 Moderate, 15 Poor Status. The status of the various waterbodies in this area is calculated using EPA data. The identified pressures/risks in this area include wastewater treatment works with the works at Bandon being non-compliant in terms of effluent standard when capacity is available and the plant at Inishannon having insufficient capacity. Other pressures/risks include IPCC licensed activities, quarries and landfills. The WMU action plan states that nutrient sources within the area can be broken down as follows: 90% of Total Phosphorus comes from unsewered industry, 2% from WWTP and 7% from Agriculture.

In relation to Future Pressures and Developments the WMU Action Plan states:

'Throughout the river basin management cycle future pressures and developments will need to be managed to ensure compliance with the objectives of the Water Framework Directive and the Programme of Measures will need to be developed to ensure issues associated with these new pressures are addressed.'

The Bandon Stick WMU is downstream of the Upper Bandon WMU, within which the Bandon River cSAC is situated, and from which, large populations of Freshwater Pearl Mussel are known. On the basis of this, a Sub Basin Management Plan has been drafted.

7.1.4 Results of Water Sampling

7.1.4.1 Kick Sampling

Kick samples of aquatic macro-invertebrates were taken in representative amounts of differing habitats within the river. Some were taken in riffle areas, others in glides and pools.

Kick sampling was carried out by staff from McCarthy Keville O'Sullivan in August 2011 at 23 locations in the Bandon River. A full description of the sampling locations and the results of each sample taken are presented in Appendix 5E to this EIS. Kick sampling was performed for two minutes on an area of one square metre of the watercourse substrate at each site. The method used was based on that set out in Irish Standard EN 27828:1994 (NSAI, 1994). The aquatic macroinvertebrates collected were identified in the field according to the level required to estimate a Q value so that the specimens could be returned alive to the watercourse immediately.

Using Appendix 1 of the Environmental Protection Agency publication *Water Quality in Ireland*, Q values were determined for all sites sampled, based on the faunal assemblage found at each sampling location. In general, the invertebrate communities that were recorded indicated water of a high quality with samples taken in riffle areas ranging from unpolluted status (Q5) to slightly polluted (Q3) and the majority of the samples registering Q4 and Q3/4. This corresponds well with Q value results published by the EPA for all monitoring points within and just upstream and downstream of the Study Area from 1997 to 2009. However it should be noted that the results may not be directly comparable given that the samples may have been taken in different habitats within the river.

The samples taken in glides and pools recorded invertebrate communities that were more typical of the less well oxygenated habitats. Overall, species diversity was good with approximately 40 genera recorded and an average of eight genera recorded in each sample. In some samples the density of species was high and dominated by a small number of genera, whilst in others it was lower and often more diverse. In many of the deeper glides and pools, a heavy cover of algae was evident on the occasion of the kick sampling survey. This is often an indicator of organic pollution. However the samples were taken at the end of the summer when water levels were low. During river surveys in early January 2012, there was considerably less algae in the river, as it had presumably been washed away by higher flows in the winter period.

7.1.4.2 Physico-chemical Testing Results

Water samples were also taken by staff from McCarthy Keville O'Sullivan on the 11th and 16th of May specifically for the purposes of this EIS. One sample was taken upstream of the proposed works above the Fisheries Weir in Bandon Town, while the other sample was taken at Curranure gauging station downstream of the proposed working area. The Samples taken on the 11th May were tested for a suite of physical and chemical parameters, while those taken on the 16th May were tested for a number of bacteriological parameters. The results of the laboratory analyses of these samples is presented in Table 7.8 below.

| Parameter | Units | Upstream Results | Downstream Results |
|------------------|------------------------|------------------|--------------------|
| BOD | mg/l | 7.41 | <2 |
| Suspended Solids | mg/l | 5 | 7 |
| pH | - | 7.57 | 7.68 |
| Conductivity | µS/cm | 174 | 189 |
| Ortho-phosphate | mg/l P | <0.03 | <0.03 |
| Chloride | mg/l Cl | 7.6 | 21.6 |
| Sulphate | mg/l SO ₄ | <2 | 6.6 |
| Nitrate | mg/l NO ₃ | 1.96 | 9.36 |
| Nitrite | mg/l NO ₂ | <0.05 | <0.05 |
| Dissolved Oxygen | mg/l O ₂ | 10.4 | 10.9 |
| Total Hardness | mg/l CaCO ₃ | 50.6 | 59 |
| Copper | mg/l Cu | 1.12 | 1.35 |
| Zinc | mg/l Zn | <0.41 | <0.41 |
| E.coli. | cfu/100ml | 180est | 144est |
| Total coliforms | cfu/100ml | 180est | 160est |

| Parameter | Units | Upstream Results | Downstream Results |
|------------------|-----------|------------------|--------------------|
| Faecal coliforms | cfu/100ml | 180est | 160est |

Table 7.8 Results of Water Sampling, Bandon River, May 2012.

7.1.4.3 Surface Water Abstraction

Inishannon Regional Water Supply Scheme (RWSS) is supplied with water from the Bandon River, from a location on the North bank of the Bandon River 800m upstream of Inishannon Bridge. Inishannon RWSS supplies a large population, which includes the town of Kinsale and the Western side of Carrigaline. It also supplements the water supply of Rafeen and Monkstown, which are otherwise fed from the Cork Harbour Water Supply Scheme. Inishannon RWSS currently has an abstraction rate of 1,120 m³/day from the Bandon River at Inishannon.

It is expected that much of the coarser sediment and fines will settle before reaching the water intake at Inishannon, particularly as flows will be low during the works. During short periods of intense rainfall there may be a flushing effect and suspended sediment levels will increase but are not expected to increase beyond the natural range in the river which has been observed previously. However, if suspended sediment concentrations are deemed to be higher than the desired intake concentration, then measures will be implemented to reduce the suspended sediment levels locally by means of gabion walls, straw bales or other appropriate measures.

7.1.5 Impacts on Water Quality

7.1.5.1 Generation of Silt-Laden Run-off & Increase in Suspended Solids

Short-term Significant Negative Impact

During the preparation phase, site clearance and preparatory groundworks including site compound set-up etc. will lead to exposure of bare ground and the potential for the generation of silt-laden run-off. The potential for the generation of silt-laden surface run-off on the adjacent banks and along access and egress routes is likely to continue through the construction phase of the works and until the ground has consolidated. The dredging works proposed as part of the preferred scheme option will involve large-scale, major removal of substrate from the river bed, which will result in a significant increase in suspended solids in the river within and downstream of the working area for the duration of this aspect of the proposed works. Stockpiled excavated material also poses a increased threat of increased siltation in the watercourse. Damage to the river-bank during in-stream works may cause persistent scouring and siltation of the watercourse over time if left unconsolidated.

Excessive suspended sediment in the water column can clog and cause abrasions to fish gills, interfere with fish navigation and feeding, affect egg and fry development, while also affecting populations of aquatic invertebrates, on which the fishes' diet is based. Once deposited, excessive amounts of silt may damage fish habitat by clogging interstices between gravels in spawning grounds, resulting in diminished flow of oxygenated water to eggs and rendering these gravels unsuitable for egg incubation. Deposited sediment may also impact on the habitat of bottom dwelling aquatic invertebrates and damage nursery habitat for young fish.

Mitigation Measures

- The proposed works will only take place over approximately 60% of the width of the river at any one time.
- Measures to minimise the suspension and transfer of sediment downstream will be implemented. These measures are likely to include the use of silt barriers downstream of the works areas and

removal of any accumulated silt, construction of silt sumps downstream of the works areas, cofferdamming and dewatering of works areas where concrete and other building works are proposed. Any stockpiling will also be greater than 10 metres from the river bank.

- Works will only be undertaken during normal working hours (8:00 – 6:00) thus allowing the river to run clean for 14 hours per day.
- All works undertaken on the banks will be fully consolidated to prevent scour and run off of silt. Consolidation may include use of protective and biodegradable matting (coirmesh) on the banks and also the sowing of grass seed on bare soil.
- An Environmental Management Plan (EMP) will be prepared prior to the commencement of any works in order to ensure all works are carried out in a manner designed to avoid and minimise any adverse impacts on the receiving environment

Residual Impact - Temporary Moderate Negative Impact

It is likely that, with the mitigation in place this impact will constitute a **Temporary Moderate Negative Impact**. This residual impact will be fully identified as the works method statements become finalised and mitigation measures become finalised.

7.1.5.2 Use of Potential Water Contaminants

Potential Temporary Moderate to Significant Negative Impact

Construction sites, by their nature, have numerous substances, which are potentially polluting to both ground and surface water if not treated. These include fuels, lubricants, cement, mortar, silt, soil and other substances, which arise during construction. Similarly, the washing of construction lorries and equipment poses a pollution risk to watercourses. The use of vehicles and plant on the construction site gives the potential for the spillage of fuel and oil on the site either from leaks in vehicles or fuel tanks or spillages. This may lead to contamination of soils, groundwater and surface water. Such substances entering the Bandon River could damage the habitat of local populations of fish and aquatic invertebrates and also cause direct harm to aquatic fauna.

Mitigation Measures

- All concrete works will be carried out in dry conditions with no in-stream pouring of concrete. In areas where concrete is required within the river channel such as the bridge piers, a dry working area will be created or pre-cast solutions will be used.
- There will be no refuelling of machinery within the river channel. Refuelling will take place at designated locations at distances of greater than 30 metres from the watercourse.
- No vehicles will be left unattended when refuelling and a spill kit including an oil containment boom and absorbent pads will be on site at all times.
- Any fuel that is stored on the site will be in a double skinned, bunded container that will be located within a designated works compound at a location that is removed from the river. All other construction materials and plant will be stored in this compound. The compound will also house the site offices and portaloo toilets. This compound will either be located on ground that is not prone to flooding or will be surrounded by a protective earth bund to prevent inundation.
- All vehicles will be regularly maintained and checked for fuel and oil leaks.

Residual Impact - Temporary Slight Negative Impact

It is likely that, with proper implementation of the above mitigation this impact will constitute a **Temporary Slight Negative Impact**.

7.2 HYDROGEOLOGY

This section describes the existing hydrogeological environment within the Study Area and assesses the potential impacts of the Bandon River (Bandon) Drainage Scheme.

7.2.1 Methodology

A desktop study was carried out in order to ascertain a comprehensive baseline for the Study Area and give a description of the existing environment. This information was then used in assessing the potential impact the proposed works will have on the hydrogeology within the Study Area.

The following documents were consulted during the preparation of this section;

- The Geology of South Cork (Sleeman and Pracht, GSI, 1994)
- The Geological Survey of Ireland (GSI) online database

7.2.2 Hydrogeology in the Existing Environment

The Geological Survey of Ireland (GSI) online database shows the Study Area as being underlain by Locally Important bedrock aquifers. To the North of the, is a productive gravel aquifer, which runs along the Ballymahane and Brinny rivers and a second gravel aquifer exists within the Study Area at Drumkeen. An extract from the GSI Online Database is included in Appendix 7A showing the location of aquifers in the Study Area.

The Dinantian Mudstones and Sandstones (Cork Group) in the Bandon groundwater body form sequences which can be several kilometres thick (Sleeman & Pracht, 1994). Most groundwater flow in this groundwater body is expected to occur within the top 15m of the aquifer, in the layer that comprises a weathered zone of a few metres and a connected fractured zone below this. The widespread faulting and folding associated with the Variscan Orogeny in the south of Ireland has given rise to zones of enhanced permeability in the mudstones and sandstones. These can occur close to faults and near the axes of folds. Such zones are generally local. The groundwater aquifer within the Study Area is characterised by the Geological Survey of Ireland (GSI) as 'locally important', which means that it is moderately productive only in local zones.

The groundwater body is generally covered by till derived from sandstone and shale. There are also frequent sand and gravel deposits, several of which are classified as locally important sand and gravel aquifers.

The direction of groundwater flow is likely to be influenced by the topography of the surrounding area. Groundwater within the Study Area is likely to be hydraulically connected to the Bandon River and its tributaries.

7.2.2.1 Groundwater Vulnerability

Groundwater vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

The Geological Survey of Ireland (GSI) online database was referenced regarding the vulnerability of the local aquifers to contamination from ground waters. The interim vulnerability mapping indicates that the local aquifers are generally highly or extremely vulnerable within the Study Area with the sandstone

bedrock near the surface. An extract from the GSI Online Database is included in Appendix 7B showing the aquifer classifications.

7.2.2.2 Well Card

The well card data by the Geological Survey of Ireland (GSI) indicates that a number of wells in the vicinity of Bandon and Inishannon are used for public water supply and industrial use.

The Industrial abstractions are located in the townlands of Brinny, Kilbrogan and Clogheenavodig, with other industrial abstractions further upstream in the catchment of the Bandon River at Ballineen. The Brinny wells are located in a productive gravel aquifer with yields described as 'excellent' on the GSI database.

The abstractions for public water supply are located in the townlands of Clashanimud, Larragh, Gaggan and Dunkerreen. There is also an abstraction for public water supply in Killountain, within the Study Area.

The remaining wells in the vicinity of Bandon and Inishannon, which are registered on the GSI well card database, are mainly used for domestic or agricultural water supply. A list of abstractions for industry and public water supply is provided in Table 7.9.

| Townland | Depth (m) | Depth to Rock (m) | Source Use | Yield Class | Yield (m ³ /day) |
|----------------|-----------|-------------------|---------------|-------------|-----------------------------|
| Kilbrogan | 88.4 | | Industrial | Good | 163.7 |
| Kilbrogan | 88.4 | | Industrial | Moderate | 65.5 |
| Kilbrogan | 88.4 | | Industrial | Moderate | 54.5 |
| Kilbrogan | 124.4 | 4.6 | Industrial | Good | 109 |
| Kilbrogan | 121.9 | 10.7 | Industrial | Good | 218 |
| Clogheenavodig | | | Industrial | Good | |
| Brinny | 22 | 20 | Industrial | | |
| Brinny | 85 | 23.5 | Industrial | Excellent | 727 |
| Brinny | 17.8 | 17 | Industrial | Excellent | 916 |
| Brinny | 23.6 | 19 | Industrial | Excellent | 1440 |
| Brinny | 25.6 | 24 | Industrial | Excellent | 1473 |
| Brinny | 26.5 | 24.5 | Industrial | Excellent | 654 |
| Brinny | 20.2 | 18 | Industrial | Good | 327 |
| Brinny | 70.1 | 9.1 | Industrial | Excellent | 545 |
| Brinny | 64 | 9.1 | Industrial | Moderate | 54.5 |
| Brinny | 23.5 | | Industrial | Excellent | 1632 |
| Ballineen | 15.8 | | Industrial | | 21.8 |
| Ballineen | 9.4 | | Industrial | | 21.8 |
| Ballineen | 34.1 | | Industrial | | 27.3 |
| Ballineen | 35.4 | | Industrial | | 21.8 |
| Ballineen | 14 | 7 | Industrial | | 21.8 |
| Clashanimud | | | Public supply | | |
| Clashanimud | | | Public supply | Excellent | 436 |
| Knocknagallagh | 23.1 | 6.1 | Public supply | Good | 109 |
| Gaggan | 38.1 | | Public supply | Poor | 6.5 |
| Killountain | 21.3 | 3.1 | Public supply | Good | 131 |

| Townland | Depth (m) | Depth to Rock (m) | Source Use | Yield Class | Yield (m ³ /day) |
|-----------|-----------|-------------------|---------------|-------------|-----------------------------|
| Laragh | 27.4 | 0 | Public supply | Poor | 39.2 |
| Dunkereen | 22.8 | 7.6 | Public supply | Moderate | 65.5 |

Table 7.9 – GSI Well Card Data (Boreholes)

7.2.3 Potential Impacts on Hydrogeology

Potential Temporary Significant Negative Impact

Any potential significant impacts to hydrogeology as a result of the Bandon River (Bandon) Drainage Scheme will be temporary in nature and will occur during the construction phase and during any future maintenance. There are numerous substances used on construction sites that are potentially polluting to ground water, including fuels, lubricants, cement, silt, soil and other hydrocarbons. Washing of construction plant also poses a risk of polluting ground water.

Should any of the above substances be allowed to contaminate the groundwater in the Study Area they could potentially lead to the pollution of industrial and public water supplies. As described in Section 7.2.2.1, the aquifers in the Study Area are classified as being highly or extremely vulnerable to infiltration.

Mitigation Measures

In order to avoid any potentially polluting substances infiltrating the ground water during construction and operation phase there will be a bunded area constructed within the site compound with sufficient volume to contain any spills. All plant refuelling, maintenance or washing will be carried out within the bunded area. Spill kits will also be available at this area to facilitate the quick and effective cleaning of any substances.

The site compound will not be located in an area classified as ‘extremely’ vulnerable to infiltration of ground water to further reduce the risk of pollution to the groundwater.

Residual Impact - Potential Temporary Slight Negative Impact

Taking into account the abovementioned mitigation measures, it is considered that the impact will constitute a Temporary Slight Negative Impact.

7.3 FLOODING

This section describes the existing hydrological environment within the Study Area and potential impacts of the proposed works on this hydrology. Mitigation measures are also provided for any potentially significant impacts identified.

7.3.1 Methodology

A desktop study was carried out in order to ascertain a comprehensive baseline for the Study Area and give a description of the existing environment. This information was then used in assessing the potential impact the proposed works will have on the hydrology of the Study Area.

The following documents were consulted during the preparation of this section;

- WYG Ireland in association with JBA Consulting (2011) Bandon Flood Relief Scheme – Final Hydrology Report
- WYG Ireland in association with JBA Consulting (2011) Bandon Flood Relief Scheme – Draft Hydraulic Report

7.3.2 Hydrology in the Existing Environment

The dominant feature of the hydrology of the Study Area is the Bandon River and its tributaries. The Bandon River rises in the Maughanaclea Hill in West Cork, is 56km long and has a catchment area of over 500km². The river flows into the Study Area from the east, through Bandon town before veering to the north and then turning southwards where it becomes an estuary past Inishannon and reaches the sea at Kinsale Harbour.

The average annual rainfall over the Bandon River catchment ranges between 1100mm to the east and 1800mm to the west. This compares with the national average of between 1000mm and 1400mm, although rainfall of 2000mm has been recorded in mountainous regions. The Bandon River catchment is well defined and ranges in elevation from 500mOD to 2mOD providing an efficient means of conveying this rainfall in the mountainous areas to the West, with a less defined slope as the river approaches Kinsale Harbour.

There are a number of tributaries of the Bandon River which discharge upstream of Bandon town, including the Dirty, Caha, Bealanscartane and Blackwater Rivers. The Bridewell runs through Bandon town from south to north and meets the Bandon River just downstream of Bandon Bridge, with the Mill Stream joins Bandon River at the downstream end of Bandon town.

There are twelve hydrometric gauges on the Bandon River with records of river level and associated flows going back as far as 1960. An analysis of these gauging stations was carried out in the WYG Ireland, in association with JBA Consulting, document entitled 'Bandon Flood Relief Scheme – Final Hydrology Report'. This document is included in Appendix 7C.

7.3.2.1 Flooding

There is a long history of flooding of the Bandon River within the Study Area. Flooding due to heavy rainfall in the catchment is occasionally exacerbated by high tides in the river estuary. Incidents of flooding on record include flooding in 1975, 1982, 1986, 1988, 2004, 2006 with the most severe flooding on record occurring in 2009. Approximately 200 residential and commercial premises in Bandon Town were flooded in November 2009.

The gradient of Bandon River is steep in the upper reaches of the catchment with this gradient reducing as the river approaches its estuary at Inishannon. This variation in gradient is typical of a large river like the Bandon. This decreased gradient reduces the velocity of water in the channel and therefore the capacity of the channel itself. Evidence of this is the widening of the river channel as the gradient reduces. Typically a river with this characteristic will flood at times of heavy rainfall, possibly coinciding with high tides, as the steep catchment combined with the steeper gradient of the river bed in mountainous regions will convey these rain waters to lower reaches of the river at a greater velocity than this stretch of river can replicate. This typically causes the river level to raise, the bank to be overtopped and flooding of the surrounding landscape. This may be the mechanism by which Bandon Town flooded.

7.3.2.2 Proposed Scheme in terms of Flooding

The Bandon River (Bandon) Drainage Scheme provides for the construction and upgrade of flood defence embankments and walls on the Bandon and Bridewell Rivers along with extensive dredging of the Bandon River over a 3.6km length. This proposed dredging includes for the removal of up to 2.2m of material on the river bed, improving the channel capacity due to an increase in cross sectional area and rationalisation of bed gradient. This bed rationalisation will not serve to increase the overall gradient, but will remove high points which cause pools of water and decrease the effective area available for the conveyance of flow.

The works mentioned above will increase the volume of water that can be conveyed in the channel at times of heavy rainfall due to an increase in the cross sectional area of the channel, and an increase in bank level at critical areas. Although the gradient of the bed is being rationalised, this will not have a significant impact on the velocity of flow in the river as it will not result in an overall increase in gradient. As this is the case, it is not anticipated likely that there be an increase in erosion as a result of the proposed works.

7.3.3 Potential Impacts on Flooding

7.3.3.1 Impact on Flooding

Potential Permanent Significant Positive Impact

The most significant impact of the Bandon River (Bandon) Drainage Scheme on the hydrology of the Bandon River is that it will result in the capacity of the river channel being increased in the vicinity of the proposed works. This increase in capacity will result in the channel having the capacity to convey larger volumes during times of heavy rainfall, reducing the risk of water levels overtopping the bank and flooding the surrounding area.

In November 2009, water levels in the Bandon River rose to such a level that approximately 200 properties were flooded. Increasing the conveyance capacity of the channel will reduce the risk of these properties flooding in the future.

7.3.3.2 Impact on Water Levels Upstream and Downstream of Proposed Works

Potential Permanent Significant Negative Impact

The effect of increasing the channel conveyance capacity may have an impact on water levels downstream of the proposed scheme. The proposed flood defences may also result in an increase in upstream water levels during flood events. These are the most significant potential impacts of the proposed works on the surrounding environment.

Mitigation Measures

As described above, the Bandon River (Bandon) Drainage Scheme has the potential to cause an increase in flood risk upstream and/or downstream of the proposed works.

In order to design the flood relief scheme to reduce the risk of flooding within Bandon town it was necessary to produce a calibrated mathematical model of the Bandon River, including its tributaries, from 4.4km upstream of the proposed works to 9.7km downstream of the proposed works. This Study Area encompasses approximately 18km of the river channel and extends 5.5km downstream of Inishannon town centre.

The hydraulic modelling indicates that for the 1% AEP flood event, the proposed scheme would result in a slight elevation in flood levels along the stretch of river lying between 500m and 2,000m down river of the end of the dredged section.

Defences have been designed to mitigate the potential increase in upstream levels. The extent of the proposed dredging has been designed to ensure a minimal increase in water levels downstream of the scheme during flood events.

Residual impact - Potential Permanent Slight Negative Impact

The residual impact of the Bandon River (Bandon) Drainage Scheme, on upstream and downstream water levels will be slight. It is anticipated that this slight increase will result in additional flood risk to property or infrastructure.