# WFD Application – Phase 1

# Technical Overview


Version V1

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# 1 Introduction

This document provides a description of the first phase of development of the EPA WFD Application. The purpose of the Application is to make information available that will assist the EPA and other agencies in the implementation of the Water Framework Directive (WFD). The aim of this first phase of development is to support the Preliminary Risk Screening stage of characterisation.

## 1.1 Overview of characterisation

Characterisation is the foundation of water resources management. It provides an understanding of the ways in which a catchment functions, which influences the impacts of human activities on aquatic ecosystems and resources. A key component of characterisation is the determination of the risk of not meeting WFD objectives, i.e. achieving and maintaining Good Ecological Status and preventing deterioration. Where water bodies are determined to be 'At Risk', measures need to be implemented. Characterisation provides the basis for identifying the most appropriate measures and for developing representative monitoring programmes.

Characterisation is being carried using a three-tiered model outlined in the report '*An approach to characterisation as part of implementation of the Water Framework Directive*' (Jenny Deakin, May 2015). The 3-tier characterisation model can be summarised as follows:

1. **Preliminary Waterbody Risk Screening (Tier 1)**: A screening process to identify waterbodies 'At Risk' based on the national water quality monitoring dataset.
2. **Initial characterisation of subcatchments and catchments (Tier 2)**: Waterbodies are grouped into catchments and subcatchments and prioritised so that integrated catchment science assessments can be carried out where necessary. Where waterbodies are 'At Risk', potential significant pressures causing the impacts are identified.
3. **Further characterisation (Tier 3)**: Potential significant pressures may need to be further investigated to confirm that they are significant pressures, i.e. those actually causing the issues.

Specific measures are then identified, first at the subcatchment scale, and then at the catchment scale, where catchment-wide assessments, economic analyses and other factors are also considered. The outcomes of the assessments are used to inform the programme of measures for the river basin management plan.

## 1.2 Development of the WFD Application

Characterisation is a multi-disciplinary task which involves a wide range of stakeholders. A variety of datasets is also required, many of which are not currently captured or accessible in a centralised system. The WFD Application provides a single point of access to catchment data which will be useful for a range of catchment science and management purposes, not just those that are specific to the WFD. The Application is accessible through EDEN (https://wfd.edenireland.ie/) and is available to EPA staff as well as staff in other public agencies.

A roadmap document (Ward et al, 2014) has been developed in consultation with key stakeholders that sets out a phased development plan for the Application. The timing and content of the phases will be refined over time as business requirements are analysed and confirmed with stakeholders. In summary the roadmap has identified the following phases:

| Phase | Purpose | Target delivery date |
|---|---|---|
| Phase 1 | Support the preliminary risk screening process | Q2 2015 |
| Phase 2 | Support initial characterisation of subcatchments and catchments | Q3/4 2015 |
| Phase 3 | Provide information to the public | Q1/2 2016 |
| Phase 4 | Support further characterisation | TBC |
| Phase 5++ | Support programmes of measures and monitoring programmes | TBC |

The first phase of development has been carried out jointly by the EPA Informatics Unit, EPA WFD Integration and Coordination Unit (WFDI&CU), EPA Ecological Monitoring and Assessment Unit (EMAU) and EPA Hydrometrics and Groundwater Unit (H&GW). Further development of the Application is planned to support the full WFD cycle, including RBM planning, programmes of measures and monitoring programmes.

### 1.3 Phase 1 development

The first phase of development is to support the preliminary risk screening process and it has been progressed in four key areas, as outlined in Figure 1. Users can view water quality data and risk outcomes on a map and can search for, and select, particular waterbodies or groups of waterbodies of interest. For each waterbody, there is a series of data available including location attributes, water quality data and trends for a range of key water quality parameters. The outcomes and details of the preliminary risk characterisation assessments are available for each waterbody and there are national summary characterisation outcome statistics. The Application can be used to track the progress with the update and approvals process as each waterbody is checked. The technical content of each of these four work areas are described in the following sections.

## 2 WFD Home page

### 2.1 Overview

The WFD Home page opens with a map where users can view the Preliminary calculated risk, the approved risk and the most recent ecological or overall status for all waterbody types, not including the influence of the Margaritifera protected areas (See Section 2.2.3 for further details). Users can also search for specific waterbodies or groups of waterbodies using the map or the text box beneath. An advanced search function is provided to allow searches to be filtered.

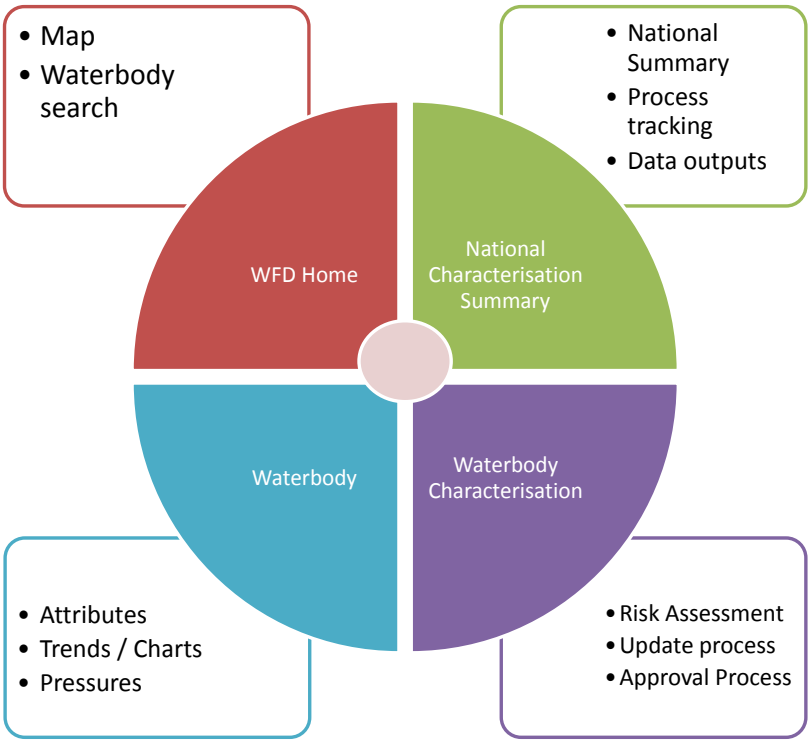


**Figure 1. Four key areas of development in Phase 1**

## 2.2 Technical details

### *2.2.1 Preliminary Risk*

Preliminary risk is the risk as calculated by the Application using data on status, trends and distance to threshold for each waterbody type. These concepts are explained in Section 4.2.2. The mapped preliminary risk outputs largely represent the calculated risk of nutrient enrichment occurring which is the primary water quality issue in Ireland. These preliminary risk results have been calculated in an automated way using the Application and have not yet been checked and approved by members of the WFD I&C Unit, the EMAU, or Hydrometrics and Groundwater Unit.

The waterbodies used in the Application are the second cycle waterbodies which were completed in Spring 2015.

### *2.2.2 Approved risk*

The Approved risk layer combines both the preliminary risk and the approved risk outcomes. This is so that during the transition period before all waterbodies have been reviewed, national summary statistics with the most up to date information can be obtained. The approvals process is described in Section 4.2.3.

### *2.2.3 Ecological status*

Ecological status in the Application means ecological status without consideration of Margaritifera objectives. At present, the Application does not consider special objectives that apply to waterbodies

that include, or are part of, protected areas which may be more stringent than those for achieving Good status. Where a waterbody is part of a Margaritifera protected area and the conservation status of Margaritifera is unfavourable, the ecological status of that waterbody is required to be automatically assigned as Moderate for reporting purposes, as outlined in SI 272 of 2009. This status assignment however masks progress in improvements in other status sub-elements, and does not contribute to the risk assessment. Progress towards achieving Protected area objectives will be considered at a later stage in the characterisation process.

#### *2.2.4 Search and Advanced Search*

Users can search for waterbodies using names, parts of names, or waterbody codes. The advanced search function currently allows users to search for waterbodies in particular Local Authority areas, and/or to search by waterbody type. As part of the next development phase, it is planned that users will also be able to search by catchment and/or subcatchment. Waterbodies identified through the searches can be highlighted or 'zoomed to' on the map using the icons under the Actions column in the table beneath the advanced search.

Links are provided directly from the waterbodies returned in the search to either the waterbody information page (Section 3) through the waterbody code, or to the waterbody characterisation page (Section 4) through the Tier 1 risk outcome link. The contents of the search can be downloaded into a spreadsheet using the csv button.

# 3 Waterbody information

## 3.1 Overview

Once a waterbody has been selected, a range of information about that waterbody is available. This includes location and background details, ecological status including the breakdown of all the status elements for surface water or overall overall groundwater status, and monitoring data and charts for a range of water quality parameters.

The Application also has information on inputting and receiving waterbodies, the relevant monitoring stations and their data, and some limited information on pressures. The pressures functionality was initially developed as part of the prototype in 2014 and was focussed on Urban Waste Water pressures so is only partially complete. Further development is planned.

## 3.2 Technical specifications

#### *3.2.1 Location details*

A range of metadata about each Cycle 2 waterbody is available in the first section of the waterbody page, the majority of which are common to all waterbody types such as Name, Code, Easting and Northing and Cycle 1 RBD code. Some fields are included as placeholders for the first phase of development such as protected areas and intercalibration type for surface waters.

There are also some data that are specific to waterbody types. For example, all groundwater bodies are assigned to one of 40 representative groundwater groups, so the groundwater body group number is given, together with an indication of whether the groundwater body crosses a first cycle RBD boundary and whether it is a parent water body, or a clipped out waterbody. Clipped out groundwater bodies refer to parts of groundwater bodies that have been separated (usually temporarily) from their parent groundwater bodies for the purposes of managing a specific water quality issue.

### *3.2.2 Status details*

For surface water, the 2007-09 and 2010-12 waterbody status results are provided while for groundwater the assessment is based on the 2007-12 dataset. Clicking on the **>** symbol expands the selection to reveal the results for each of the status sub elements.

For rivers, there has been a significant change to the waterbody boundaries since Cycle 1 but the status assessments for both time periods are for the Cycle 2 waterbodies so that direct comparison is possible. A greater level of detail was available for the breakdown of nutrient conditions for the 2010-12 period than for 2007-09 where a simple pass/fail system was used. Note that for a river waterbody to fail the status test for nutrient conditions, two of the three nutrient indicators (total ammonia, total nitrogen/nitrate and orthophosphorus) must fail.

### *3.2.3 Inputting and receiving surface waterbodies*

For surface waters, the Application provides a link to all waterbodies that are immediately upstream (inputting) and downstream (receiving) of the waterbody of interest. Inputting waterbodies includes tributaries to the section of main channel immediately upstream. This functionality is not available for groundwater bodies.

### *3.2.4 Pressures*

The pressures section of the Application was developed as part of the original prototype and is only partially complete. At present there are links to information for the larger urban waste water treatment plants only, which come directly from LEMA, the EPA licensing and enforcement system. Clicking on the treatment plant returns a map of the agglomeration and the emission points, details of the size of the plant (PE), and links to data on each of the emission points. Emission point data include a map, information on impacts, emission limit values and monitoring results where available. The monitoring data in this part of the application relate to the data collected under the licence by the licencee and they are live data that come directly from EPA systems (Section 3.2.7).

In time, it is planned that there will also be information available about other pressure types.

### *3.2.5 Waterbody trends and charts*

For each waterbody, historical data have been aggregated and trended for a range of parameters, including but not limited to those that are used in the risk characterisation assessment as indicator parameters (Table 1). Clicking on the parameters takes the user into a dedicated parameter trends page (Section 3.2.5.1).

**Table 1. Parameters with trend data available**

| Parameters | Trend data aggregation basis Based on 2007-12 data | Used in risk assessment? |
|---|---|---|
| River Waterbodies: | Aggregations at station level | |
| Molybdate Reactive Phosphate | Annual Mean | ✓ |
| Ammonia | Annual Mean | × |
| Nitrate | Annual Mean | × |
| Lake Waterbodies: | Aggregations at waterbody level | |
| Total Phosphorous | Annual Mean | ✓ |
| Ammonia | Annual Mean | × |
| Chlorophyll | Annual Mean | ✓ |
| Transitional Waterbodies: | Aggregations at waterbody level | |
| Molybdate Reactive Phosphate | Winter and summer median | ✓ |
| Chlorophyll | Winter and summer median, 90%ile | ✓ |
| Dissolved Inorganic Nitrogen | Winter and summer median | ✓ |
| Dissolved Oxygen | Winter and summer 5%ile, 95%ile | ✓ |
| Coastal Waterbodies: | Aggregations at waterbody level | |
| Molybdate Reactive Phosphate | Winter and summer median | ✓ |
| Chlorophyll | Winter and summer median, 90%ile | ✓ |
| Dissolved Inorganic Nitrogen | Winter and summer median | ✓ |
| Dissolved Oxygen | Winter and summer 5%ile, 95%ile | ✓ |
| Groundwater: | Aggregations at station level | |
| Nitrate | Annual Mean | ✓ |
| Molybdate Reactive Phosphate | Annual Mean | ✓ |
| Ammonia | Annual Mean | × |
| Conductivity | Annual Mean | × |
| Chloride | Annual Mean | × |

The data used in the trend analysis have been aggregated in different ways depending on the parameter and the waterbody type (Table 1). The table also has column entries for the status, trend and distance to threshold for each of the parameters. Status here means the status of each parameter as calculated using the water quality standard threshold values or environmental quality standards (Section 4.2.2.2). Trend here means the direction of the trend of the aggregated data, whether statistically significant or not. Further information about the trend data is available on the parameter trends page (Section 3.2.5.1). Distance to threshold describes whether the parameter concentrations are near, i.e. within 25% of the threshold value, or otherwise far (Section 4.2.2.2).

### 3.2.5.1 Parameter trends page

Clicking on each of the parameters sends the user to a separate parameter-specific page where the trends graph, information about the trends, and the status and distance to threshold calculations needed for the risk assessment are presented. Links to the parameter trends pages are also available from the waterbody characterisation page.

***Trend chart***

The trend chart shows the annual aggregated concentrations of the parameter of interest with a trend line drawn using the non-parametric Sens method (Gilbert, 1987) in the statistical package R. The data period used for the trend analysis is 2007-2012. For some parameters and some waterbody types there are also pre-2007 and post 2012 aggregated data presented on the chart, although they have not been used in the assessments. A vertical red dotted line on the chart indicates the end of the period of data used in the trend calculation.

The quality standard against which the data are assessed in the distance to threshold calculation (Section 4.2.2.2) is shown as a grey line or a grey bar. Standards may be environmental quality standards or thresholds and are available for a range of parameters (refer to Table 3). The black diamond on the charts is the baseline concentration (further described below) which is used in the distance to threshold and status calculations.

***Trend data***

A range of data about the trend is available in a table beneath the chart.

| | |
|---|---|
| Status | The status referred to on this page applies to the status of the indicator parameter of interest only, as calculated using the baseline concentration. |
| Trend direction | The direction of the trend is noted as upwards (increasing concentration), downwards (decreasing concentration) or none, whether the trend is statistically significant or not. |
| Statistically significant | Trends are considered to be statistically significant where $P<0.1$. Statistical significance is calculated on the basis of the available data that has been used to generate the trend[1]. |
| Environmentally significant | Environmental significance means that if the current trend continues, a change in status is likely within the next planning cycle (to 2021) for surface water, or next two planning cycles (to 2027) for groundwater. Trends can only be environmentally significant if they are also statistically significant. |
| Sens slope | The Sens slope is the slope of the trend line as calculated using the Makesens method. |
| Sens P value | The P value used to determine whether the trend is statistically significant or not. $P<0.1$ is considered to be statistically significant for the purposes of this analysis. |

[1] It was suggested that a requirement should be added to restrict statistical significance to only those cases where the minimum reporting requirements (in terms of numbers of samples) have been met. However this is currently not possible as there is no means in the system to determine the appropriate number of samples for each station or waterbody.

| | |
|---|---|
| Distance to threshold | An assessment of whether the baseline concentration is near to, or far from, the next nearest worse quality standard as indicated in the trend graph. |
| Median salinity | Median salinity is listed for transitional and coastal waters only as it is needed for the distance to threshold calculation. It is otherwise noted as N/A. |
| Status max and min thresholds | The upper and lower boundaries of the quality standard class relevant to the baseline concentration value. These are used to determine the parameter status and the distance to threshold. |
| Baseline concentration & year | The mean of the 2010-12 aggregated concentrations for rivers and lakes, the median of the 2010-12 aggregated concentrations for transitional and coastal waters, and the mean of the 2007-12 aggregated concentrations for groundwater. The baseline concentration is used to assess the distance to threshold and the parameter status. The year is the position of the baseline concentration on the x-axis which is 2011 for surface water and 2009 for groundwater. |
| Projected year and conc 1 | The concentration of the parameter in 2021 as projected using the trend line. Note that the projected concentration is not a prediction of what the concentration will be in the projected year; it may for example even be a negative value which is impossible in nature. It is simply an extension of the current trend line in the projected year which is used to determine environmental significance. |
| Projected year and conc 2 | The concentration of the parameter in 2027 as projected using the trend line. Used only for groundwater so will be N/A for surface water. Note that the projected concentration is not a prediction of what the concentration will be in the projected year; it may for example even be a negative value which is impossible in nature. It is simply an extension of the current trend line in the projected year which is used to determine environmental significance. |

***Associated aggregation data***

The third table on the parameter trends page provides information on the dataset that was available for use in the assessment. The total results means the number of samples taken in that year. The % results BLD indicates the number of samples below the detection limit. Where concentrations were reported as below the detection limit, a value of half of the detection limit was used in the aggregation calculation. For rivers and groundwater, data have been aggregated to monitoring station level, whereas for lakes, transitional and coastal waters, the aggregations are at waterbody level.

### *3.2.6 Monitoring stations*

This section of the Application lists the monitoring stations located within the waterbody, and the monitoring programme to which they belong, whether surveillance, operational, investigative or pre-

WFD. The monitoring programme field should be used with caution however, as there is a degree of variability in the monitoring programme from year to year, and the overall monitoring programme is being reviewed in 2015 with modifications expected in several phases to 2018. Where monitoring data are available, users can click on the monitoring station code which will return the available sampling results in charts.

### *3.2.7 Monitoring data*

The monitoring data section presents the chemistry data for each of the monitoring stations located in the waterbody, under the headings of general chemistry data, specific pollutants, priority substances and priority hazardous substances. These data are time series of sampling results and are not aggregated data. Note that specific pollutants, priority substances and priority hazardous substances data are only available for surveillance sites. At present under the chemistry data section, only a limited number of parameters are available including BOD, COD, suspended solids, total nitrogen and total phosphorus. These data are live data taken directly from Aquarius and they are available for the period 2007 up until the most recently available dataset, which can be as current as a number of months prior to the query. At present there are no data available for groundwater bodies. This selection could be expanded in future to include other parameters.

# 4 Waterbody characterisation

## 4.1 Overview

Once the user has searched for the waterbody of interest on the home page, a link is provided to the waterbody characterisation information through the Tier 1 Risk link. The same link is also available in the location information at the top of each waterbody page.

This part of the application opens with a short section that identifies which data years the characterisation exercise is based on. This is followed by a comprehensive section that contains all the relevant technical information that is used in the Tier 1 preliminary risk screening process. Basic information about the waterbody is available with a link to the waterbody page (Section 3). The details of the risk assessment are also presented, including the overall risk outcome, and whether the assessment is based on waterbody-specific monitoring data or has been inherited from another waterbody. The final section on this page deals with the approvals process where members of the EPA WFD I&CU, EMAU and H&GWU teams will be checking and updating the overall risk outcome as appropriate.

The preliminary risk characterisation assessment outlines the risk of primarily nutrient pressures causing the WFD objectives not be achieved. The assessment draws on the available water monitoring data through the system and calculates the risk for rivers, lakes, transitional and coastal waters. The groundwater risk assessment is slightly more complex and has therefore been completed offline with the risk results uploaded. Further details on the groundwater risk assessment process are provided in Section 4.2.2.2.

## 4.2 Technical specifications

### *4.2.1 Characterisation summary*

The Tier 1 preliminary risk screening process will take place at least every 6 years and possibly every 3 years. There is therefore a need to relate the outcomes of the assessments to the particular characterisation period so that the changes in risk through time can be tracked. This section provides the name and status (whether open or closed) of the current characterisation iteration period. Once the Tier 1 risk screening process outcomes have been checked and approved, the characterisation status will be set to closed, which means no further changes will be accepted until the next iteration.

### *4.2.2 Characterisation Preliminary Risk Assessment*

#### 4.2.2.1 Initial information

The top part of this section includes some basic information about the waterbody that is relevant to the risk screening. Cycle 1 RBD is included for reference although for the second cycle there will be only one national RBD and two international RBDs.

For surface water bodies:

- ecological status means the ecological status without the influence of Margaritifera or any other protected area objectives;
- ecological potential applies where waterbodies have been classed as heavily modified or artificial waterbodies;
- biological status means the status as determined using the biological quality elements, including fish data when available[2]; and
- biological trend is an assessment of whether the biological status in 2010-12 has changed since 2007-09. It is reported as improved, disimproved or no change.

For groundwater bodies, overall groundwater status refers to the final status outcome for the waterbody following all the groundwater status tests, i.e. including those that are relevant for assessing pressures other than nutrient enrichment.

An information icon button ⓘ is provided on the right hand side of the page which provides a link to a table explaining many of the characterisation terms used and how they have been derived.

#### 4.2.2.2 Tier 1 – Risk calculation table

The risk assessment is carried out in the risk calculation table using the status, significant trend and distance to threshold for each indicator parameter highlighted in Table 3. Where there is more than one monitoring station with data available for the indicator parameter, a representative station which has been previously identified by EMAU is selected. Data for any additional monitoring stations are available from the waterbody page.

[2] Fish data are only collected at surveillance sites once every 6 years.

For surface waters, the application calculates all the entries in the table automatically using data held in the various EPA systems. For groundwater, the risk assessment is less automatable as some of the risk parameters are determined based on monitoring data for the entire groundwater body group, rather than from individual waterbody monitoring data directly. The entries into the groundwater risk assessment tables have therefore been uploaded from a manual assessment carried out in a spreadsheet by Hydrometric and Groundwater Unit staff as described later in this section.

***Indicator parameters***

The indicator parameters used in the risk assessment are listed in Table 3. They are specific to each waterbody type and have been selected as appropriate indicators to represent nutrient enrichment. Although dissolved oxygen (DO) is also a factor in assessing transitional and coastal waters, there are very few waterbodies that have their risk outcome driven by DO alone, so this is dealt with through the update and approvals process (Section 4.2.3). There were also technical development challenges in incorporating DO into the trends tool in the current development phase, as an upwards trend for DO is a positive outcome rather than a negative one as it is for the other indicator parameters.

**Table 3. Parameters used in the risk assessment for each waterbody type**

| Rivers | Lakes | Groundwater | Transitional and coastal |
|---|---|---|---|
| Orthophosphate<br>Biology | TP<br>Chlorophyll | Nitrate<br>Orthophosphate | Winter chlorophyll (median)<br>Winter chlorophyll (90%ile)<br>Winter orthophosphate (median)<br>Winter dissolved inorganic nitrogen (median)<br>Summer chlorophyll (median)<br>Summer chlorophyll (90%ile)<br>Summer orthophosphate (median)<br>Summer dissolved inorganic nitrogen (median) |

For surface water bodies, clicking on each of the parameters sends the user to the parameter trends page (Section 3.2.5.1). For groundwater bodies, these links have been disabled as some of the indicator trends used in the assessment are from the groundwater group and are therefore not necessarily located in the waterbody of interest. Groundwater parameter trends information is still available from the waterbody page, however.

***Assessment approach***

For each waterbody type, the risk is assessed separately for each indicator parameter, against each of the relevant WFD objectives (i.e. Achieve Good Status and Prevent Deterioration) using the matrices in Tables 2a,b. For groundwater bodies a third objective to Reverse Upwards Trends is also included. The combined objective risk outcome presents the worst case risk outcome for all the objectives for each parameter. The Tier 1 Preliminary Risk field beneath the table calculates the overall risk using the 'one out, all out' principle by taking the worst case of all the combined risk outcomes. By way of example, if the winter median chlorophyll data for a transitional waterbody indicates that the waterbody is At Risk of deterioration, the overall risk outcome for that parameter and that waterbody is At Risk.

**Table 2a Surface water risk assessment matrix**

| Assigning preliminary risk Tier 1 screening SW | | Distance to threshold near | | | Distance to threshold far | | |
|---|---|---|---|---|---|---|---|
| | | WFD Objectives | | | WFD Objectives | | |
| **Status** | **Significant trend in concentration** | *Achieve Good status* | *No deterioration of Status* | ***Objectives combined*** | *Achieve Good status* | *No deterioration of Status* | ***Objectives combined*** |
| *High* | *Improving* | Not at risk | Not at risk | **Not at risk** | Not at risk | Not at risk | **Not at risk** |
| | *None/stable* | Not at risk | Review | **Review** | Not at risk | Not at risk | **Not at risk** |
| | *Disimproving* | Not at risk | At risk | **At risk** | Not at risk | At risk | **At risk** |
| *Good* | *Improving* | Not at risk | Not at risk | **Not at risk** | Not at risk | Not at risk | **Not at risk** |
| | *None/stable* | Not at risk | Review | **Review** | Not at risk | Not at risk | **Not at risk** |
| | *Disimproving* | Review | At risk | **At risk** | Review | At risk | **At risk** |
| *Moderate* | *Improving* | Review | Not at risk | **Review** | Review | Not at risk | **Review** |
| | *None/stable* | At risk | Review | **At risk** | At risk | Not at risk | **At risk** |
| | *Disimproving* | At risk | At risk | **At risk** | At risk | At risk | **At risk** |
| *Poor* | *Improving* | At risk | Not at risk | **At risk** | At risk | Not at risk | **At risk** |
| | *None/stable* | At risk | Review | **At risk** | At risk | Not at risk | **At risk** |
| | *Disimproving* | At risk | At risk | **At risk** | At risk | At risk | **At risk** |
| *Bad* | *Improving* | At risk | Not at risk | **At risk** | At risk | Not at risk | **At risk** |
| | *None/stable* | At risk | Review | **At risk** | At risk | Not at risk | **At risk** |
| | *Disimproving* | At risk | At risk | **At risk** | At risk | At risk | **At risk** |

**Table 2b Groundwater risk assessment matrix**

| Assigning preliminary risk Tier 1 screening GW | | Distance to threshold near | | | | Distance to threshold far | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | WFD Objectives | | | | WFD Objectives | | | |
| **Status** | **Significant trend in concentration or level** | *Achieve Good status* | *No deterioration* | *Reverse upward trend* | ***Objectives combined*** | *Achieve Good status* | *No deterioration* | *Reverse upward trend* | ***Objectives combined*** |
| *Good* | *Improving* | Not at risk | Not at risk | Not at risk | **Not at risk** | Not at risk | Not at risk | Not at risk | **Not at risk** |
| | *None/stable* | Not at risk | Review | Not at risk | **Review** | Not at risk | Not at risk | Not at risk | **Not at risk** |
| | *Disimproving* | Review | At risk | At risk | **At risk** | Review | At risk | At risk | **At risk** |
| *Poor* | *Improving* | Review | Not at risk | Not at risk | **Review** | Review | Not at risk | Not at risk | **Review** |
| | *None/stable* | At risk | Review | Not at risk | **At risk** | At risk | Not at risk | Not at risk | **At risk** |
| | *Disimproving* | At risk | At risk | At risk | **At risk** | At risk | At risk | At risk | **At risk** |

***Rivers biology logic***

As not all river monitoring sites have chemistry data available, the rivers biology data was also included as an additional indicator parameter to make the assessment more robust. The biology data could not be used in exactly the same way however, as the calculation of biological trends and distance to threshold was not possible. For the purposes of this assessment, the biological trend is determined by comparing the biological status for 2007-09 with that for 2010-12. Biological trends are recorded as Improved (e.g. from Moderate to Good), Deteriorated (e.g. from High to Good) or No change (e.g. Poor in both assessments). There are no distance to threshold calculations for biology included. The risk outcome calculated using the biological status and biological trends is determined in the following way:

If Biological status equals '**High**' or '**Good**' and

If Biological trend is '**Improved**', then **Not at Risk**

If Biological trend is '**No Change**', then **Review**

If Biological trend is '**Deteriorated**', then **At Risk**

Else if Biological status equals '**Moderate**' and

If Biological trend is '**Improved**', then **Review**

If Biological trend is '**No change**', then **At Risk**
If Biological trend is '**Deteriorated**', then **At Risk**
Else if Biological status equals '**Poor**' or '**Bad**' and
If Biological trend is '**Improved**', then **At Risk**
If Biological trend is '**No change**', then **At Risk**
If Biological trend is '**Deteriorated**', then **At Risk**

Where both phosphorus and biology data are available, the worst case outcome of the biological and phosphorus assessments dictates the overall risk, as per the 'one out, all out' principle used for the other waterbody types.

***Status***

The status used in the risk assessment process is the status of each of the indicator parameters as determined by comparing the baseline concentration with the water quality standard threshold values or environmental quality standards that bound the status classes. The baseline concentration is the mean of the 2010-12 aggregated concentrations for rivers and lakes, the median of the 2010-12 aggregated concentrations for transitional and coastal waters, and the mean of the 2007-12 aggregated concentrations for groundwater.

***Significant trend***

The significant trend is taken from the parameter trends page (Section 3.2.5.1). Significant trends may be upwards, downwards or none and must be both statistically and environmentally significant. Note that this is different to the direction of trends noted in the waterbody trends and charts section on the waterbody page where there is no significance attached (Section 3.2.5).

***Distance to threshold***

The Distance to Threshold has been calculated for all parameters used in the risk assessment where the EQS / Thresholds have been specified (Table 3). The Distance to Threshold can be either 'near', i.e. within 25% of the threshold boundary, or otherwise 'far'. The purpose of the assessment is to determine if the waterbody is at risk of deteriorating to a lower water quality status, based on the proximity of the baseline parameter concentration to the relevant maximum threshold for its current status (Figure 2). For waterbodies at the lowest status class, there is no lower threshold boundary and therefore the distance to threshold is defaulted to 'far'.

As there are five status classes for surface waters, there are four possible boundaries against which the baseline concentration can be assessed. For groundwater there are only two status classes and therefore only one threshold boundary.

**Table 3. Indicator parameter threshold values for the distance to threshold calculations**

| Waterbody type and parameter | High | Good | Moderate | Poor | Bad |
|---|---|---|---|---|---|
| **Rivers** | | | | | |
| Orthophosphate (mg/l as P) | ≤0.025 | ≤0.035 | ≤0.056 | ≤0.097 | >0.097 |
| **Lakes** | | | | | |
| Total phosphate (µg/l as P) | ≤10 | ≤25 | ≤70 | ≤100 | >100 |
| Chlorophyll (lake type 1,2,3,4,13) (µg/l Chl a) | ≤5 | ≤8.62 | ≤16.67 | ≤35.71 | >35.71 |
| Chlorophyll (lake type 5,6,9,10) (µg/l Chl a) | ≤6.36 | ≤10.94 | ≤21.88 | ≤43.75 | >43.75 |
| Chlorophyll (lake type 7,8,11,12) (µg/l Chl a) | ≤5.8 | ≤10 | ≤20 | ≤40 | >40 |
| **Transitional and coastal**[3] | | | | | |
| Orthophosphate (µg/l as P) (median salinity 34.5 psu) | ≤25 | ≤40 | ≤60 | ≤90 | >90 |
| Orthophosphate (µg/l as P) (median salinity ≤17 psu) | ≤30 | ≤60 | ≤100 | ≤200 | >200 |
| Dissolved Inorganic nitrogen (mg/l as N) (median salinity 34.5 psu) | ≤0.17 | ≤0.25 | ≤0.80 | ≤1.00 | >1.00 |
| Dissolved Inorganic nitrogen (mg/l as N) (median salinity 0 psu) | ≤1.00 | ≤2.60 | ≤3.20 | ≤4.00 | >4.00 |
| 90%ile Chlorophyll (µg/l Chl a) (median salinity 35 psu) | ≤10 | ≤20 | ≤30 | ≤40 | >40 |
| 90%ile Chlorophyll (µg/l Chl a) (median salinity ≤17 psu) | ≤15 | ≤30 | ≤45 | ≤60 | >60 |
| Median Chlorophyll (µg/l Chl a) (median salinity 35 psu) | ≤5 | ≤10 | ≤15 | ≤20 | >20 |
| Median Chlorophyll (µg/l Chl a) (median salinity ≤17 psu) | ≤7.5 | ≤15 | ≤22.5 | ≤30 | >30 |
| **Groundwater** | | | | | |
| Nitrate (mg/l as $NO_3$) | n/a | ≤28 | n/a | >28 | n/a |
| Orthophosphate | n/a | ≤0.035 | n/a | >0.035 | n/a |

[3] The threshold values for transitional and coastal waters are on a sliding scale depending on the salinity. The values shown in the table represent the two extremes of the salinity scale.

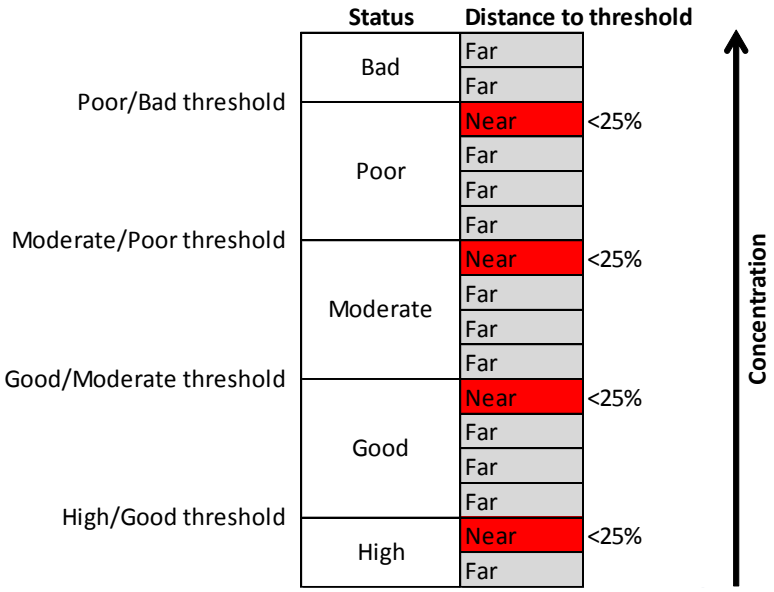


**Figure 2. Distance to threshold calculations for surface waters for the No deterioration objective**

***Groundwater assessment approach***

The risk assessment for groundwater has not been automated in the same way as for surface water. The groundwater monitoring network is distributed widely and there are not always waterbody-specific monitoring data. Forty groundwater groups have been identified that have been used to group waterbodies with similar impact potential (pathway and pressure combination) for the purposes of the status tests and these groupings are also being used for characterisation. The monitoring data available for each group are pooled for the purposes of assigning risk. The following assumptions are made:

- Waterbodies are assessed in the context of the whole group, even where they have their own monitoring data.
- The status is determined for each waterbody separately using the full range of WFD status tests. This includes data such as groundwater level trends in the quantitative assessments and ecological assessment in the case of GWDTE.
- The trends and distance to thresholds are determined by assigning the worst case outcome of all the monitoring stations in the group. The worst case outcomes may not necessarily be from the same station, for example the trend may be assigned from one station, while the distance to threshold may come from another.
- Where the trend for the group is worse than a waterbody trend, the group trend is adopted. The relationships and priorities for assigning waterbody and group trends are shown in Table 4.
- Where a trend from the group is used in the risk assessment for a particular waterbody, the group trend cannot be used to dictate an At Risk outcome for that waterbody but instead can only drive a Review.

**Table 4. Relationships between groundwater body monitoring point trends and group trends**

| | | Worst case for MP in Groundwater Body (if present) | | |
|---|---|---|---|---|
| | | Disimproving | No trend | Improving |
| **Worst case for MP in Group of GWB** | Dis-improving | Disimproving (GWB) | Disimproving (Group) | Disimproving (Group) |
| | No trend | n/a | No trend (GWB) | No Trend (Group) |
| | Improving | n/a | n/a | Improving |

#### 4.2.2.3 Overall risk outcome

The Tier 1 preliminary risk field beneath the risk calculation table indicates the overall risk outcome, whether the risk is calculated or updated, and what the donor waterbody was if it was unmonitored and the risk was inherited. The overall risk may not appear to reflect the risk outputs in the risk characterisation table. This may be because either the waterbody is a river and the biological risk is dominating the outcome, or because the risk has been manually updated to reflect the possible presence of a different pressure (Section 4.2.3).

### *4.2.3 Characterisation update and approvals*

The automated preliminary risk output largely reflects the risk from nutrient pressures and does not explicitly consider risks from other pressure types at this stage[4]. This is because nutrients are by far the biggest pressure in the Irish context. Where members of the EMAU, WFD I&CU and/or H&GWU have evidence to consider that there are other pressure types or other elements influencing the ecological outcomes, they may update the risk outcome to Review. Updating risk requires the user to select a reason for the update from a drop down menu and to enter some brief text describing the evidence to support the issue. The possible reasons are presented in Table 4. The tier 1 risk progress field at the bottom of this section in the application identifies whether the risk is draft or approved.

**Table 4. Possible reasons for updating the automated risk outcome**

| | | |
|---|---|---|
| Dissolved oxygen | Hydromorphology | General chemical conditions |
| Macrophytes | Fish | Priority substances |
| Margaritifera | Quantitative assessments | Specific pollutants |

The update will cause the waterbody to be flagged for consideration at Tier 2, and tagged with the key issue requiring review. The overall approved preliminary risk outcome is therefore an evidence-

[4] The one exception is for rivers where these other pressure types have impacted upon the Q-value, as the Q-value is part of the rivers risk assessment approach.

based combined pressure risk. Additional risk assessments for pressures without currently available evidence may be carried out separately in the future (e.g. priority substances).

In the first instance, the focus in the approvals process is on the waterbodies that have been designated as Not at Risk, to confirm that the next stage of assessment, the initial characterisation stage, is not required. Waterbodies that are either At Risk or for Review will be considered in the context of the whole subcatchment in the initial characterisation stage where the available evidence is looked at in more detail. Waterbodies may also be updated following this assessment.

# 5 National characterisation summary

## 5.1 Overview

The National characterisation summary page provides a visual overview of the number of waterbodies of each waterbody type that are At Risk, Not at Risk or for Review. It also allows the user to search for groups of waterbodies in a specific risk category. This section of the application is also used to track progress with the update and approvals process.

## 5.2 Technical specifications

### *5.2.1 Characterisation summary*

The characterisation summary is the same as that on the waterbody characterisation page (Section 4.2.1)

### *5.2.2 Characterisation risk waterbody summary*

The bar chart provides the percentage of each waterbody type (nationally) in each risk category. Clicking on the items in the legend removes or replaces particular risk categories and recalculates the percentages. This allows the user to calculate the percentages of risk without the unassigned waterbodies for example.

### *5.2.3 Waterbodies*

The table in this section details the numbers of waterbodies in each risk category, and the number of waterbodies that have been updated and approved. Clicking on the links in the table returns a list of the waterbody type and risk category in the table below.

### *5.2.4 Search filter*

The search filter can be used to find specific waterbodies of interest or will return the groups of waterbodies selected from the table above. Links are provided from each waterbody to the waterbody page and the waterbody characterisation page.

# 6 Conclusion

The WFD Application is being developed as a platform for disseminating a wide range of WFD and catchment science information. The first phase of development has focussed on supporting the first stage of the characterisation process, i.e. the Preliminary Risk Screening. Further development phases are planned to support Initial Characterisation, Further Characterisation and providing public access to the information. Comments and/or feedback are welcome and should be emailed to catchments@epa.ie.