#

**Guidance on Assessing the Impacts of Developments on Groundwater Dependent Terrestrial Ecosystems**

**August 2024**

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# Introduction

This guidance sets out SEPA’s expectations for the assessment of impact of developments on Groundwater Dependent Terrestrial Ecosystems (GWDTE). This guidance applies to all developments requiring an Environmental Impact Assessment (EIA) provided any temporary or permanent dewatering abstractions are unlikely to exceed 10 m3/day[[1]](#footnote-2). It is intended for developers, local authorities, and determining authorities.

GWDTE are specifically protected under the Water Framework Directive as transposed into Scottish legislation and are considered sensitive receptors. In addition, significant impacts on GWDTE can lead to the associated groundwater body being at less than Good status.

The construction and operation of developments can have adverse impacts on the functioning of GWDTE. The impacts will vary depending on the scale and location of the development as well as on the proximity and sensitivity of the GWDTE. Foundations, borrow pits and linear infrastructure such as roads, tracks and trenches can disrupt groundwater flow. Their construction also removes the protective layers of soil and subsoil making the groundwater below more vulnerable to pollution from leaks or spills.

Dewatering or drainage may change the quantity of groundwater supplying GWDTE. Discharges to ground may change the quality of groundwater. These activities are controlled via The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR). See the CAR Practical Guide for further information.

SEPA expect developments and infrastructure to be designed and constructed such that the water environment, including GWDTE, are protected. The applicant should seek to avoid adverse impacts on any GWDTE through the detailed design of the development and by implementing best practice construction techniques. However, SEPA does not offer guidance on the detailed design of infrastructure or prescribe a specific method or technique for construction as environmental conditions and engineering constraints will be site-specific and construction techniques will require a tailored approach in order to negate risks to identified sensitive receptors.

**SEPA will not provide comment on GWDTE if the potential impacts are all assessed as Low or Unimportant.**

The matrix below shows how both the scale of the effects and the importance of the GWDTE must be considered when assessing potential impacts.

|  |  |  |
| --- | --- | --- |
|   |   | How much is it affected |
|    |   | Substantially | Moderately | Slightly | Negligibly or not at all |
| How important is it | High/important | Major | Major | Medium | Negligible/ no effect |
| Moderately important | Major | Medium | Low | Negligible/ no effect |
| Low importance | Medium | Low | Low | Negligible/ no effect |
| Unimportant | Unimportant effect | Unimportant effect | Unimportant effect | Negligible/ no effect |

Factors to be considered when assessing potential effects include:

* Extent
* Magnitude
* Duration, frequency and reversibility
* Likelihood
* Cumulative effects, including both impact interactions and additive impacts and considering both intra- and inter-project effects.

Factors to be considered when assessing the importance of a GWDTE include:

* Notification as a feature on a designated nature conservation site
* The Scottish Biodiversity List, UKBAP, Habitats Directive Annex 1
* Habitat connectivity
* Ecosystem services provided – flood mitigation, baseflow maintenance, carbon storage, nutrient filtration
* Relative extent in Scotland
* Significant decline / unfavourable condition
* Importance for supporting species.

See also the CIEEM Ecological Impact Assessment guidelines [ECIA-Guidelines-2018-Terrestrial-Freshwater-Coastal-and-Marine-V1.2-April-22-Compressed.pdf (cieem.net)](https://cieem.net/wp-content/uploads/2018/08/ECIA-Guidelines-2018-Terrestrial-Freshwater-Coastal-and-Marine-V1.2-April-22-Compressed.pdf).

# Roles and responsibilities

Developers are responsible for obtaining the relevant information required to support the impact assessment and for designing and undertaking the site works in accordance with the relevant regulations and published guidance.

The determining authority may be the planning authority or relevant Scottish Government departments (e.g. Energy Consents Unit) depending on the nature of the development.

Planning authorities are required to exercise their functions to secure compliance with the Water Framework Directive and the Groundwater Directive as now applicable to Scotland. This includes functions under the Town and Country Planning (Scotland) Act 1997. This requirement is set out in the Water Environment and Water Services (Scotland) Act 2003 and The Water Environment (Relevant Enactments and Designation of Responsible Authorities and Functions) (Scotland) Order 2011.

SEPA are responsible for assessing groundwater body status and for regulating activities that may impact on the water environment in accordance with CAR.

NatureScot provide advice to determining authorities where there is a potential impact on a qualifying feature of a protected site and/or species with special protection.

# Recommended assessment approach

SEPA recommends adopting a phased approach to the assessment of risks to GWDTE, with greater detail being required for higher risk sites or activities. Our recommended approach is summarised below.

SEPA expect the assessments to be undertaken by suitably qualified and experienced hydrogeological and ecological specialists.

The checklist in Appendix A provides a summary of the information required in support of the Environmental Impact Assessment report.

# Step 1 Identify any GWDTE features

The relevant buffer zones for GWDTE for all proposed infrastructure (provided expected dewatering rates do not exceed 10m3/day) are:

a) 10m radius of all activities;

b) 100m radius of all subsurface activities less than 1m in depth;

c) 250m of all subsurface activities deeper than 1m.

**Habitat survey screening for potential GWDTE:**

Ecological survey(s) are required to identify whether any GWDTE are present within the above buffer zones.

A Phase 1 habitat survey should be provided unless the developer is already aware that GWDTE are likely to be present. The guidance ‘SNIFFER (2009) WFD95 – A Functional Wetland Typology for Scotland’ may be used to identify wetland types, both within and outwith the site boundary, within the relevant buffer zones as a minimum (for the purpose of micro-siting a wider expanse may be surveyed).

If Phase 1 habitat survey results indicate that there may be relevant habitats present, a National Vegetation Classification (NVC) survey should be provided. A list of NVC communities that may be dependent on groundwater is included in Appendix B. Wetlands containing these communities should be considered to be GWDTE unless further information can be provided to demonstrate this is not the case.

Developers can choose to undertake the NVC survey without a Phase 1 habitat survey should they consider it likely that GWDTE are present within the buffer zones. NatureScot holds some information on the occurrence of GWDTE, predominantly within designated sites (SSSIs, SPAs and SACs). However, there are non-designated wetlands that include GWDTE that are not listed. To identify non-designated GWDTE, refer to the guidance set out in ‘SNIFFER (2009) WFD95 – A Functional Wetland Typology for Scotland’.

# Assessing groundwater dependency:

Assessment is required to determine whether the potential GWDTE features identified are likely to be dependent on groundwater, either year around or seasonally.

The interpretation should consider both ecology and hydrogeology. Groundwater dependency should be assessed on a site-specific basis for each potential GWDTE feature identified. Relevant factors include botanical communities present, local ground conditions, topography, and surface drainage. The interpretation should include assessment of the likely rooting depths relative to the water table, including potential seasonal variations. Groundwater dependence should be assumed for the NVC communities listed in Appendix B unless there is clear evidence to the contrary.

Features that are indicative of groundwater dependency include:

* Habitats associated with springs
* Where soils are persistently waterlogged on otherwise well drained steep to moderate slopes, in the absence of surface water sources
* Upper edge of GWDTE is aligned with concave breaks in slope
* Diffuse groundwater emergence is often focused along linear geological features (fractures, faults etc)
* Persistent flow even during dry weather
* Limited variation in temperature
* May be base enriched

**If no potential GWDTE features are present in the area of interest, no further risk assessment is required. SEPA will not comment on this topic in our planning response.**

Otherwise, proceed to Step 2.

# Step 2 Qualitative impact assessment

A conceptual site model (CSM) should be provided as part of the Environmental Statement. This should include interpretation of the hydrogeological setting, including the groundwater flow regime, and the ecological features present. This may be supported, as appropriate, by intrusive ground investigation, groundwater monitoring, or groundwater modelling in addition to topography, properties of the emergent water & the soil, and underlying geology.

Qualitative assessment of the potential impacts to any GWDTE features identified within the relevant buffer zones is required. This should consider the expected extent, magnitude, likelihood, and duration, frequency and reversibility of any potential impacts.

The impact assessment should consider the impacts to each GWDTE feature individually, including any potential cumulative effects if the GWDTE feature is in close proximity to multiple parts of the proposed development.

An iterative approach is recommended, using the impact assessment findings to inform the design process. Consider modifying the development proposals to avoid potential impacts as far as possible (i.e. by moving proposed activities outwith the relevant buffer zones).

**If the potential impacts to GWDTE are Low or Unimportant, then no further risk assessment is required and SEPA will not provide comment on this topic in our planning response.**

Otherwise, proceed to Step 3.

# Step 3 Detailed quantitative risk assessment

Undertake quantitative assessment of the potential effects on the GWDTE.

This is expected to be supported by appropriate characterisation of the ground conditions at both the relevant infrastructure location(s) and the GWDTE(s), plus the pathway(s) in between if appropriate. This will require ground investigation, including groundwater level and quality monitoring.

The hydrogeological assessment should quantify the potential change(s) in groundwater levels or flow regime, and/or groundwater quality. The modelling approach, input parameters and assumptions should be justified. The hydrogeological modelling predictions should inform the assessment of the ecological risks to the GWDTE.

If the quantitative risk assessment confirms the potential impacts are Major or Medium, then provide details of the site-specific mitigation measures proposed to avoid or offset the potential impacts. The nature of the mitigation measures required will depend on both the development and the GWDTE. Consultation with SEPA, and other relevant stakeholders as appropriate (e.g. NatureScot), may be beneficial when developing site-specific mitigation measures.

Then refine the quantitative risk assessment to confirm whether any residual impacts to GWDTE remain once the proposed mitigation measures are in place.

# Monitoring & contingency planning

If the assessment proceeded to Step 3, then monitoring is required to demonstrate the effectiveness of the proposed site-specific mitigation measures developed during Step 3.

A site-specific monitoring plan should be provided. The scope of the monitoring is expected to include **groundwater monitoring (levels and quality)** and **ecological monitoring within the GWDTE**. The monitoring plan should include detailed justification of why the proposed scope is fit for purpose. See Appendix C for further guidance on monitoring.

The monitoring plan is recommended to include:

* Monitoring point locations
* Monitoring suite
* Monitoring frequency
* Overview of the monitoring methods and associated QA/QC procedures that will be implemented to ensure the monitoring results are representative
* Site-specific compliance metrics that will be used to identify whether any adverse impact is likely to be occurring / has occurred
* Contingency plans that will be implemented if adverse impacts are identified. These should include timescales for notification of relevant stakeholders, and for design and implementation of remedial actions.

Baseline monitoring is expected to commence at least 12 months ahead of the development works starting on site. The baseline monitoring requirement may be combined with the site characterisation works required in support of Step 3 provided the site works commence within 2 years of the monitoring dataset being collected.

Monitoring is expected to continue during the construction phase, and for a minimum of 5 years post-construction.

The monitoring results must be regularly analysed and interpreted to identify whether any adverse impacts on the GWDTE have occurred or are likely to occur. Reporting to the Local Authority, and NatureScot if relevant, is expected at the end of the baseline period and then annually thereafter.

If any potential impacts are identified by the monitoring or through other means, the contingency plan should be implemented. Appropriate remedial measures are expected to be implemented within 6 months of the potential impacts being identified.

# Appendix A Checklist of supporting information

As a minimum, all applications should include the following supporting information:

1. Plans on a base layer Ordnance Survey topographical map (1:10,000 scale if no potential GWDTE identified within buffer plus also 1:2500 scale if GWDTE are present, 10m contours) including the following information:
	1. All proposed infrastructure, including temporary works;
	2. Details of the spatial extent and depth of all proposed subsurface works;
	3. The relevant buffer zones around the proposed infrastructure (10m for all activities, 100m for subsurface activities <1m deep and 250m for subsurface activities >1m depth);
	4. Water features (rivers, streams, lochs, ponds, ditches, springs, wells, issues, collects, etc.); and
	5. The locations and extents of all potential GWDTE (based on Phase 1 habitat survey) within the relevant buffer zones **OR** alternatively a statement confirming that no potential GWDTE are present within the buffer zones.

Supplementing these plans with cross-sectional drawings is highly recommended.

If any potential GWDTE are identified within the relevant buffer zones (during Step 1), then the following additional supporting information should also be provided:

1. NVC survey data
2. Conceptual site model. All assumptions should be justified.
3. Qualitative risk assessment (Step 2).

If any potentially significant risks to GWDTE are identified (after Step 2), then the following additional supporting information should also be provided:

1. Characterisation of ground conditions for both the relevant infrastructure location(s) and GWDTE(s) (plus pathway(s) in between if appropriate). This will usually include:
	1. Intrusive and/or non-intrusive ground investigation
	2. Groundwater monitoring data, both levels and quality.

The ground investigation and monitoring should be undertaken in accordance with BS5930:2015+A1:2020. All groundwater level data should be provided both in metres below ground level and in metres above Ordnance Datum. Both factual data and interpretation should be provided. Supplementing the interpretation with appropriate plans and sections is highly recommended. All assumptions should be justified.

1. An updated site plan (see Point 1 above) including groundwater monitoring point locations, groundwater level contours and flow directions.
2. Detailed quantitative risk assessment. Justification should be provided regarding the modelling approach adopted, model input parameters, and all assumptions.
3. Detailed description of proposed mitigation measures to offset any significant residual risks (if applicable). Supplementing this with appropriate plans or drawings is highly recommended.
4. Proposed monitoring plan (if applicable).

# Appendix B NVC communities

NVC communities, which if present, indicate that a wetland may be groundwater dependent depending on the hydrogeological setting[[2]](#footnote-3). Inclusion in the Scottish Biodiversity List as habitats of principle importance for biodiversity conservation in Scotland is shown by a ‘Y’ in the columns for upland and lowland.

| **NVC Community** | **NVC Community Name** | **Lowland** | **Upland** |
| --- | --- | --- | --- |
| M4 | *Carex rostrata - Sphagnum fallax* mire | Y | Y |
| M5 | *Carex rostrata - Sphagnum squarrosum* mire | Y | Y |
| M6 | *Carex echinata - Sphagnum recurvum* mire | Y | Y |
| M7 | *Carex curta - Sphagnum russowii* mire | N | Y |
| M8 | *Carex rostrata - Sphagnum warnstorfii* mire | N | Y |
| M9 | *Carex rostrata - Calliergon cuspidatum/C.giganteum* mire | Y | Y |
| M10 | *Carex dioica - Pinguicula vulgaris* mire | Y | Y |
| M11  | *Carex demissa - Saxifraga aizoides* mire | N | Y |
| M12  | *Carex saxatilis* mire | N | Y |
| M13 | *Schoenus nigricans - Juncus subnodulosus* mire | Y | N |
| M14 | *Schoenus nigricans - Narthecium ossifragum* | Y | Y |
| M15  | *Scirpus cespitosus - Erica tetralix* wet heath | Y | Y |
| M16  | *Erica tetralix - Sphagnum compactum* wet heath | Y | Y |
| M21  | *Narthecium ossifragum - Sphagnum papillosum* valley mire | Y | Y |
| M22  | *Juncus subnodulosus - Cirsium palustre* fen meadow | Y | N |
| M23  | *Juncus effusus/acutiflorus - Galium palustre* rush-pasture | Y | Y |
| M24  | *Molinia caeruleae - Cirsium dissectum fen meadow* | Y | Y |
| M26  | *Molinia caerulea - Crepis paludosa* mire | Y | Y |
| M27  | *Filipendula ulmaria - Angelica sylvestris* mire | Y | Y |
| M28  | *Iris Pseudacorus - Filipendula ulmaria* mire | Y | Y |
| M29 | *Hypericum elodes - Potamogeton polygonifolius* soakway | Y | Y |
| M30  | *Hydrocotylo – Baldellion* | Y | Y |
| M31 | *Anthelia julacea - Sphagnum auriculatum* spring | N | Y |
| M32 | *Philonotis fontana - Saxifraga stellaris* spring | N | Y |
| M33 | *Pohlia wahlenbergii* var. *glacialis* spring | N | Y |
| M34 | *Carex demissa - Koenigia islandica* flush | N | Y |
| M35 | *Ranunculus omiophyllus - Montia fontana* rill | Y | Y |
| M36 | Lowland springs and streambanks of shaded situations | Y | N |
| M37  | *Cratoneuron commutatum* springs | N | Y |
| M38 | *Cratoneuron commutatum* springs | N | Y |
| S2  | *Cladium mariscus* swamp and sedge beds | Y | Y |
| S3  | *Carex paniculata* sedge swamp | Y | Y |
| S7  | *Carex acutiformis* swamp | Y | Y |
| S11  | *Carex vesicaria* swamp | Y | Y |
| S24 | *Phragmites australis - Peucedanum palustre* tall-herb fen | Y | N |
| S25  | *Phragmites australis - Eupatorium cannabinum* tall-herb fen | Y | Y |
| MG4  | *Alopecurus pratensis - Sanguisorba officinalis* | Y | N |
| MG8  | *Cynosurus cristatus - Caltha palustris* lowland neutral grassland | Y | Y |
| MG9  | *Holcus lanatus - Deschampsia cespitosa* grassland | N | N |
| MG10  | *Holcus lanatus - Juncus effusus* rush-pasture | N | N |
| MG11  | Inland wet grassland, *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland | N | N |
| W1  | *Salix cinerea - Galium palustre* woodland | Y | N |
| W2  | *Salix cinerea - Betula pubescens - Phragmites australis* woodland | Y | N |
| W3  | *Salix pentandra - Carex rostrata* woodland | Y | Y |
| W4 | *Betula pubescens - Molinia caerulea* woodland | Y | Y |
| W5  | *Alnus glutinosa - Carex paniculata* woodland | Y | Y |
| W6  | *Alnus glutinosa - Urtica dioica* woodland | Y | N |
| W7 | Residual alluvial forests (*Alnus glutinoso-incanae*)  | Y | Y |
| W20 | *Salix lapponum – Luzula sylvatica* scrub | N | Y |
| CG10  | *Festuca ovina – Agrostis capillaris – Thymus praecox* grassland (when not on limestone) | Y | Y |
| CG11  | *Festuca ovina - Agrostis capillaris - Alchemilla alpina* grassland (when not on limestone) | N | Y |
| CG12  | *Festuca ovina – Alchemilla alpina – Silene acaulis* dwarf-herb community | N | Y |
| U5c | *Nardus stricta-Galium saxatile* grassland *Carex panicea-Viola palustris* sub-community | N | Y |
| U6  | *Juncus squarrosus - Festuca ovina* grassland | N | Y |
| U15 | *Saxifraga aizoides – Alchemilla glabra* | N | Y |
| U16 | *Luzula sylvatica – Vaccinium myrtillus* tall herb community | N | N |
| U17 | *Luzula sylvatica – Geum rivale* tall herb community | N | Y |
| SD13  | *Salix repens -Bryum pseudotriquetrum* dune-slack community | Y | N |
| SD14 | *Salix repens -Campylium stellatum* dune-slack community | Y | N |
| SD15 | *Salix repens-Calliergon cuspidatum* dune-slack community | Y | N |
| SD16 | *Salix repens - Holcus Lanatus* dune slack community | Y | N |
| SD17 | *Potentilla anserina-Carex nigra* dune-slack community | Y | N |

# Appendix C Additional monitoring guidance

Monitoring must provide an evidence base which demonstrates that the construction and operation of infrastructure is proceeding as intended and that it has not resulted in a statistically significant quantitative or qualitative change to groundwater flows or quality that could impact GWDTE.

SEPA recommend the monitoring includes the following as a minimum. Sites with complex hydrogeological settings, multiple or highly sensitive receptors, and/or where high-risk activities are proposed are likely to require considerably more monitoring.

1. **Ecological monitoring**. Condition survey of each relevant GWDTE community or mosaic comprising a minimum of 1 fixed 2m2 quadrat surveyed to NVC level in accordance with standard methodology (Rodwell, 2006)[[3]](#footnote-4) plus additional fixed-point photography, repeated in years 1, 3 and 5 post-completion. Additional monitoring locations may be required for large or complex sites. The adequacy of the monitoring coverage should be justified. The timing of the survey should be consistent between years and be optimal for species identification. At each GWDTE the total extent of the wetland vegetation, presence and abundance of species using the Domin scale, surface patterning, positive indicator species, plus indicators of negative change and of local distinctiveness must be provided.
2. **At least three groundwater monitoring points per GWDTE** (one upgradient and two downgradient). Additional monitoring points may be required for large or complex sites. The adequacy of the monitoring network should be justified. The groundwater monitoring points may include purpose-built monitoring boreholes, springs, and/or co-opted third party wells if suitable. The groundwater monitoring network may be supplemented by surface water monitoring if appropriate for the hydrogeological setting.
3. **Groundwater level monitoring**. Water levels should be measured to at least 10mm accuracy and the data provided in both metres below ground level and metres above Ordnance Datum. Flow rates should be monitored at springs. The use of dataloggers to allow more frequent monitoring is highly recommended to better characterise how groundwater levels respond to weather events.
4. **Groundwater quality sampling and analysis**. Appropriate sampling methods should be selected to ensure the water samples are representative and to avoid cross-contamination between monitoring points.
5. **Rainfall monitoring**. Either a site-specific rain gauge should be established or alternatively rainfall data may be sourced from a third-party rain gauge (e.g. SEPA or Met Office) if the location is adequately representative for the site. Rainfall should be measured at least daily.

The monitoring should be designed and undertaken by appropriately qualified and experienced specialists.

**Table C1 - Recommended minimum groundwater monitoring frequencies**

|  |  |  |
| --- | --- | --- |
| **Monitoring period** | **Groundwater Levels** | **Groundwater Quality** |
| BaselineAt least 12 months prior to construction commencing | Every ~2 weeks | Monthly |
| During construction | Monthly | Quarterly |
| Post-constructionAt least 5 years | Monthly | Quarterly |

The groundwater quality analysis is recommended to include:

* pH, electrical conductivity, dissolved oxygen, redox, temperature (these parameters may be measured in the field)
* Chloride, alkalinity, sulphate,
* Sodium, potassium, calcium, magnesium
* Ammoniacal nitrogen, nitrate, nitrite, orthophosphate
* Total suspended solids
* Dissolved organic carbon
* Other parameters relevant to the activities being undertaken or the hydrogeological setting e.g. hydrocarbons, metals, etc.

The baseline monitoring report is recommended to include:

1. Map showing locations of relevant infrastructure / activities, GWDTE and monitoring points.
2. Details of groundwater monitoring points. This should include geological logs with construction details for all monitoring boreholes, location co-ordinates and datum surveyed in to Ordnance Datum, and photographs.
3. Details of the ecological monitoring points. This should include location co-ordinates and photographs.
4. Description of monitoring methods and associated QA/QC measures.
5. Factual data in electronic format (e.g. Excel or similar). Laboratory certificates should also be provided for the water quality analysis.
6. Interpretation of the data including statistical assessment of any spatial or temporal trends. The use of control charts and piper diagrams is highly recommended.
7. Recommendations for any amendments to the scope of future monitoring.

Subsequent annual monitoring reporting is recommended to include:

1. A summary of monitoring undertaken, including detailed explanation of any amendments or omissions from the agreed scope of monitoring.
2. Factual data in electronic format (e.g. Excel or similar). Laboratory certificates should also be provided for the water quality analysis.
3. Photographs of monitoring points.
4. Interpretation of the data including statistical assessment of any spatial or temporal trends. This should include assessment of whether there are any statistically significant (P <0.05) changes compared with the baseline dataset. The use of control charts and piper diagrams is highly recommended.
5. Summary of any exceedances of agreed compliance metrics.
6. Assessment of whether any significant impacts have occurred or are likely to occur at the GWDTE. This should include interpretation as to the likely reason(s) why this has occurred.
7. Recommendations for any remedial works required to address any issues identified, including any associated additional monitoring. If any of the remedial actions have been implemented ahead of reporting, a summary of the works undertaken should be provided.
1. If abstractions greater than 10 m3/day are likely, additional assessment is likely to be required in support of water permitting requirements. Refer to the CAR Practical Guide for more information. [↑](#footnote-ref-2)
2. ‘UKTAG list of NVC communities and associated groundwater dependency scores (2008)’ contains a full list for all NVCs with Scotland groundwater dependency scores. [↑](#footnote-ref-3)
3. Rodwell, J.S. (2006). National Vegetation Community Users' Handbook. JNCC, Peterborough. [↑](#footnote-ref-4)