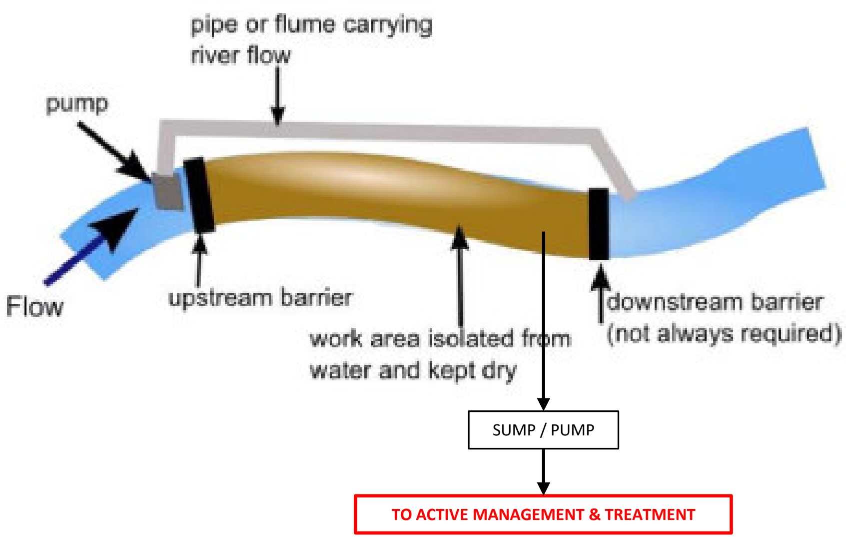
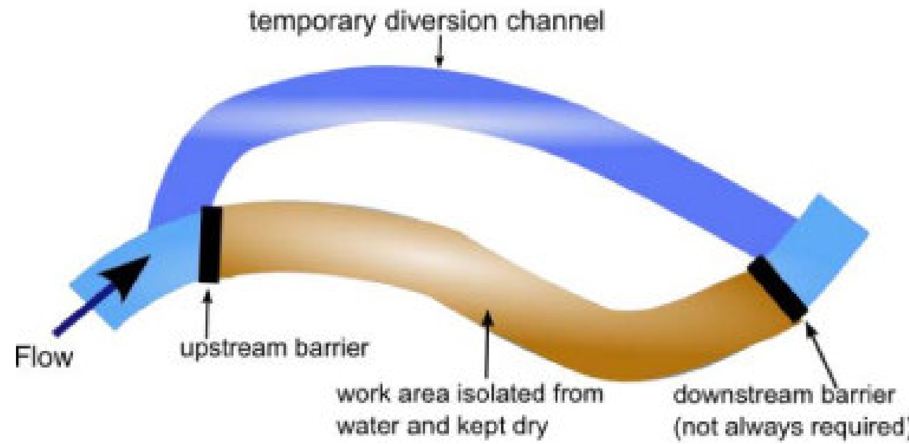
**Full Isolation Over Pumping – Plan**




**Full Isolation by Diversion – Plan**




**NOTES:**

- Full isolation over pumping / siphon. A whole section of the channel is isolated using barriers that span the full width of the river. This keeps a stretch of the river dry and the water is transferred downstream of the works area by mechanical assistance (pumping or siphon). The pump and associated pipework need not be located in the isolated area.
- This method is the preferred method for channel diversion during instream works , for example, during watercourse crossing / culvert construction. However, the pumping equipment deployed must be capable of the surface water feature discharge rate, including back up equipment and fail safe protocols.

**NOTES:**

- Full isolation temporary diversion channel. A whole section of the channel is isolated and kept dry, and the water is transferred downstream of the works area by excavating a temporary open channel.
- This is the less preferred method due to the destructive nature of constructing temporary diversion channels. However, in some instances where discharge rates are high, this method will negate the requirement for large volume pumping and associated inherent risks.

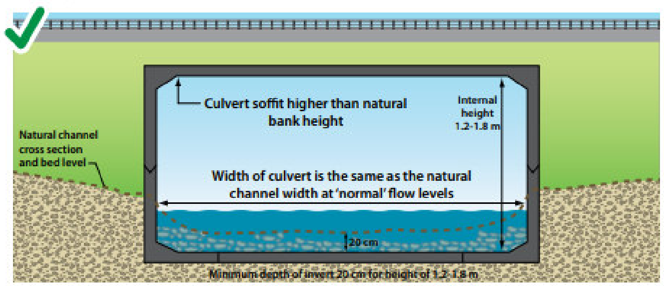
SEPA (2009) Engineering in the Water Environment Good Practice Guide – Temporary Construction Methods.

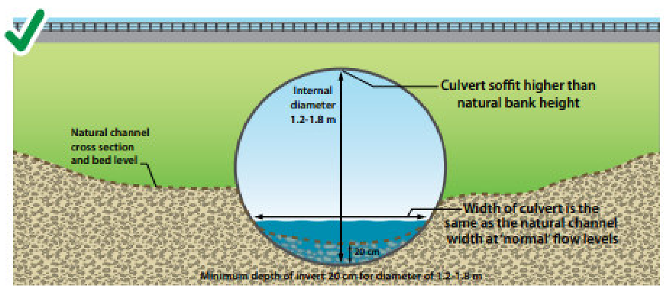
| | | | | | |
|---|---|---|---|---|---|
| Site Name:<br>**Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name:<br>**Appendix 9.6 – Conceptual & Information Graphics – Tile 1<br>Check Dams – General Considerations** | **Date:** | 04/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

## Closed Culvert Good Practice Design Considerations – Section

Figure 40: Good practice, culverts showing invert buried below bed level allowing the natural bed level, slope and material to be maintained. Culvert also maintains natural channel width.




SEPA (2010) Engineering in the Water Environment Good Practice Guide – River Crossings .

## Closed Culvert Good & Bad Examples – Section

Figure 41: Good practice, use a single large culvert for crossings that maintains the natural channel width.

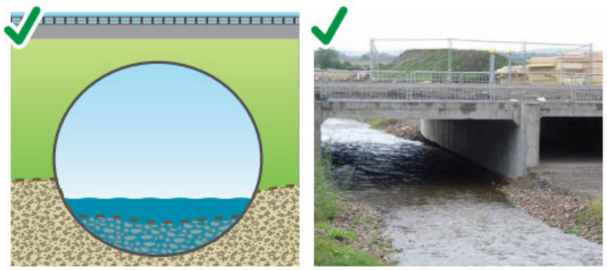


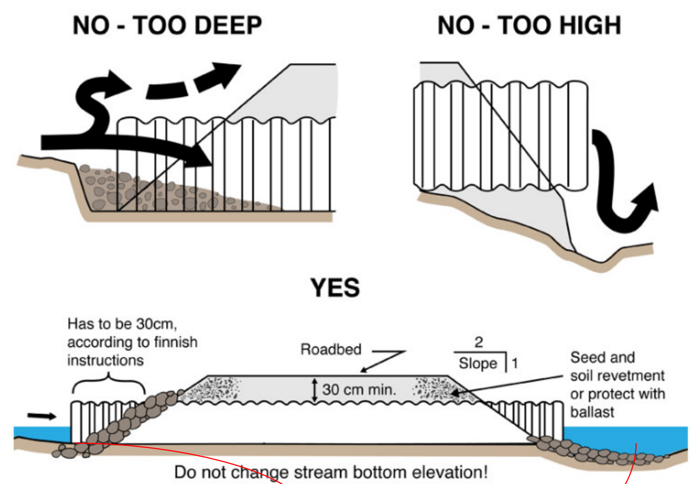
Figure 42: Poor practice, do not use smaller multiple pipes; they can create a barrier to fish passage.

SEPA (2010) Engineering in the Water Environment Good Practice Guide – River Crossings .

**NOTE:** Coarse aggregate has been used for erosion control. Silt fencing has been used to mitigate against the entrainment and mobilisation of solids during the construction process

TrueNorth Steel (2021)

## Closed Culvert Erosion Control Good & Bad Examples – Section




Examples of poorly performing (above) and well built and maintained culverts (below).

**NOTE:** Coarse aggregate will be used for erosion control. These areas at the openings of the culvert will also be designed to reduce velocity / discharge rate in turn further controlling erosion and providing additional beneficial impacts such increased attenuation time, increased recharge to ground etc.

Roadex Network (https://www.roadex.org/e-learning/lessons/drainage-of-low-volume-roads/components-of-road-drainage-system/)

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|---|---|---|---|---|---|
| | Client: | n/a | | | |
| Figure Name: Appendix 9.6 – Conceptual & Information Graphics – Tile 2 Check Dams – General Considerations | Date: | 04/05/2022 | Reviewed By: | SK | |
| | Revision: | 00 FINAL | | | |

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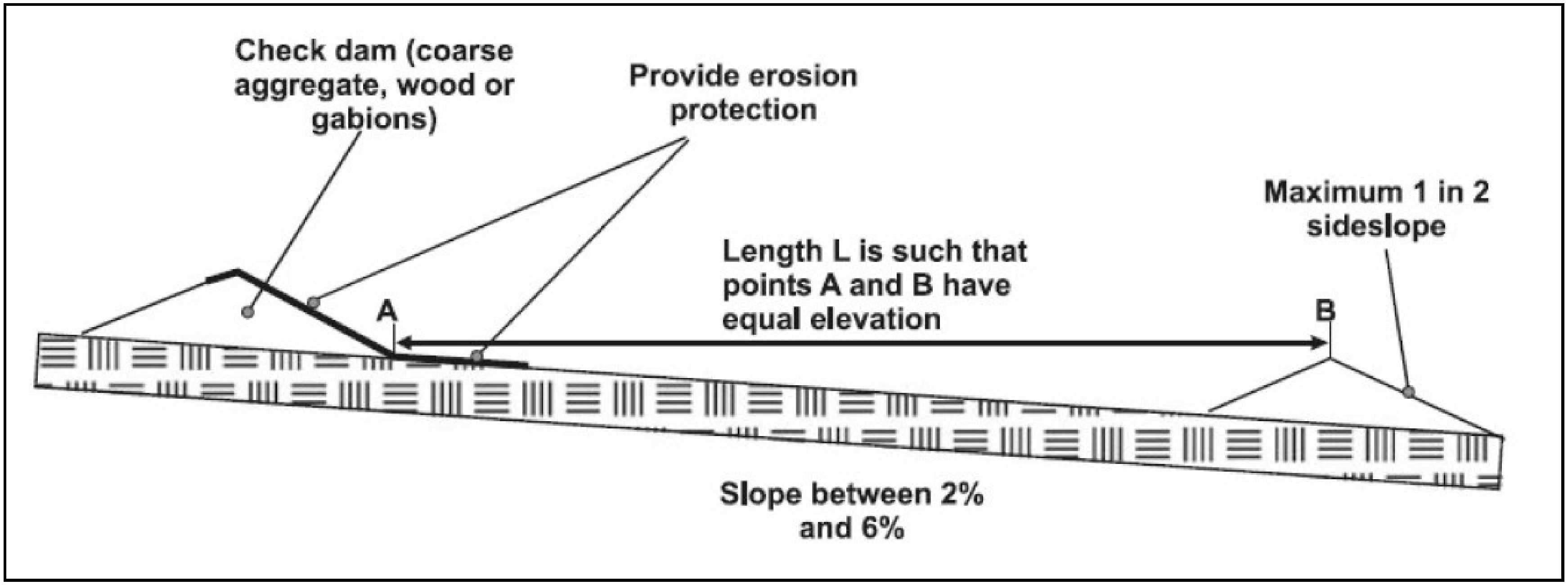
**Constructed Drain and Check Dams – Section**




Check Dam Design Consideration (CIRIA, 2004)

| | | | | | |
|---|---|---|---|---|---|
| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 3 Check Dams – General Considerations** | **Date:** | 04/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

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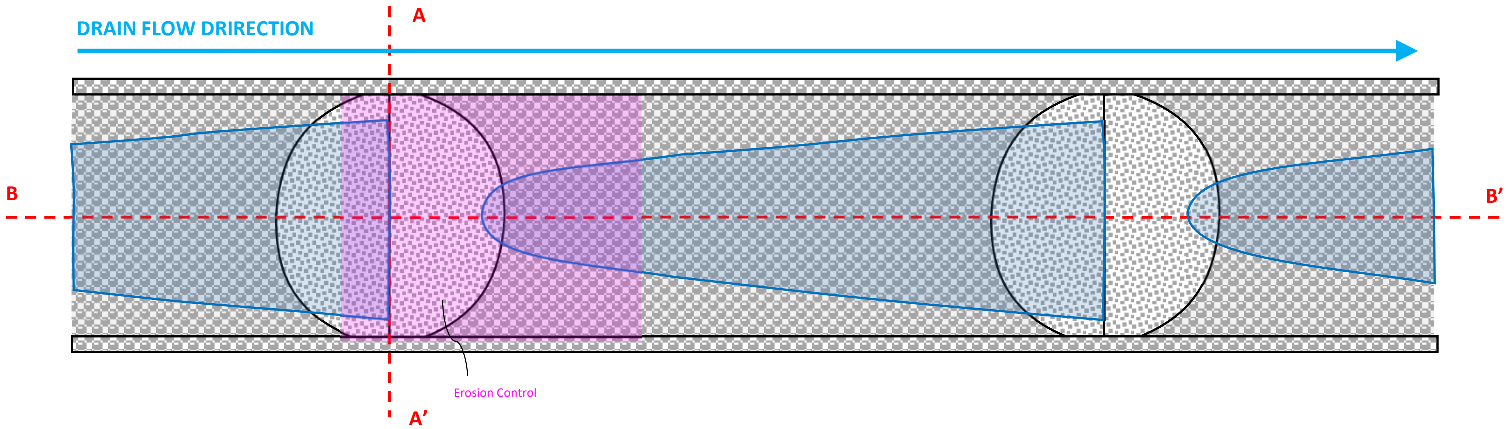
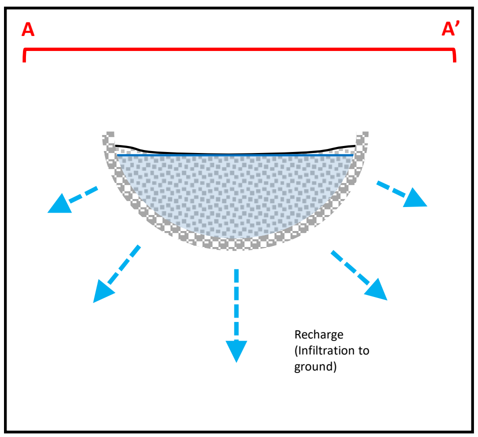
**NOTES:**

- The extensive use of check dams is recommended for the following reasons:
  - Management of runoff in terms of reducing flow velocity and minimising in channel erosion, or erosion at drainage outfalls.
  - Maximise attenuation of runoff with a view to enhancing runoff quality i.e. settlement of suspended solids.
  - Maximise attenuation of runoff with a view to reducing the hydrological response to rain fall at the site.
  - Maintain or improve the site hydrological/ hydrogeological regime with a view to maximising recharge to ground and increasing groundwater levels locally. This is particularly relevant for peatland areas.
- Check dams will be constructed with the following features and specifications:
  - A low flow pipe or small orifice to allow for low flows through the check dam.
  - Check dams will be permanent (life of development) and will be constructed with crushed rock with appropriate geo-chemistry (local) for example; coarse aggregate (100-600 mm). Wooden boards, gabions can also be used.
  - Erosion protection and energy dissipaters (cobbles / boulder 100-150mm diameter) which will extend approximately 1.2 – 1.8m downgradient of the dam and applied to both the base and side walls of the drain / swale.
  - Erosion control can be enhanced with the in-combination use of geotextile base layers (but consider low flow through).
  - It is recommended that the drainage channels / swales are entirely lined with coarse aggregate / erosion control. This will enhance mitigation in terms of attenuation, erosion control, and recharge to ground. Alternatively, allowing drains / swales to vegetate will achieve similar effects.

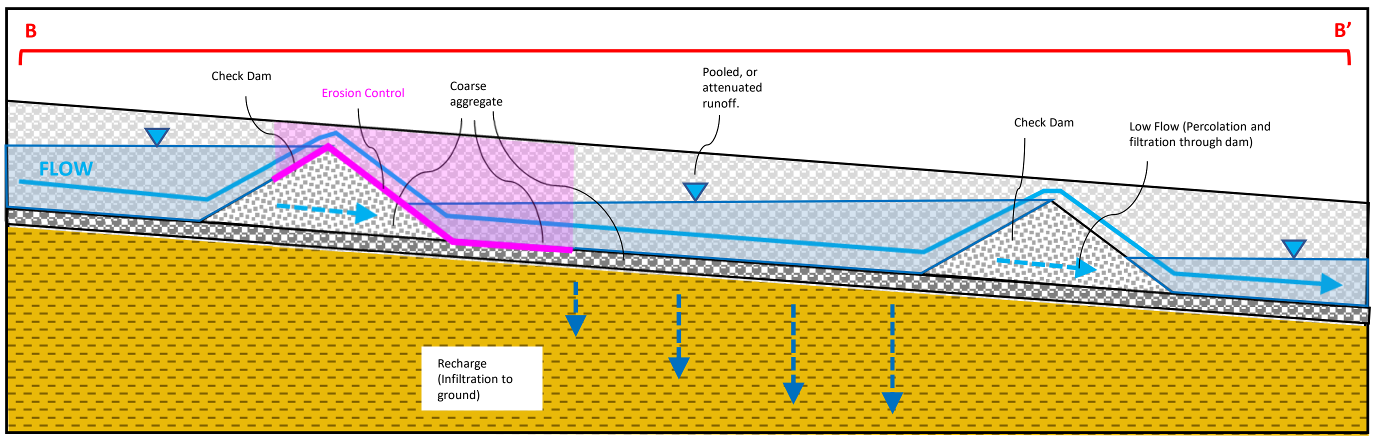
## Constructed Drain and Check Dams – Plan View




## Constructed Drain and Check Dams – Section A-A'




## Constructed Drain and Check Dams – Section B-B'

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|---|---|---|---|---|---|
| Site Name:<br>**Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name:<br>**Appendix 9.6 – Conceptual & Information Graphics – Tile 4**<br>**Check Dams – General Considerations** | **Date:** | 04/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

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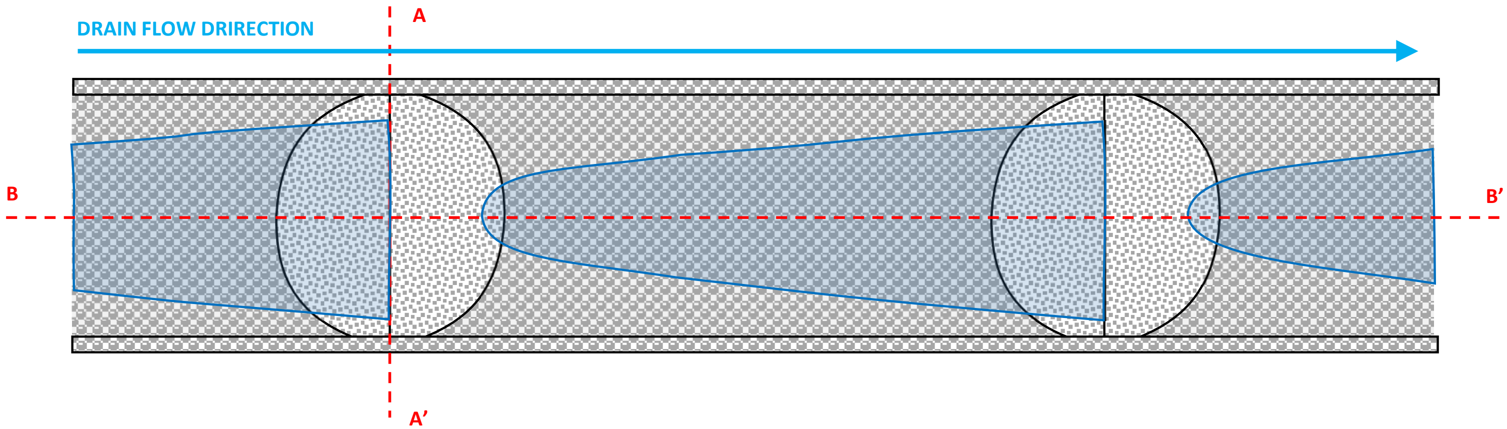
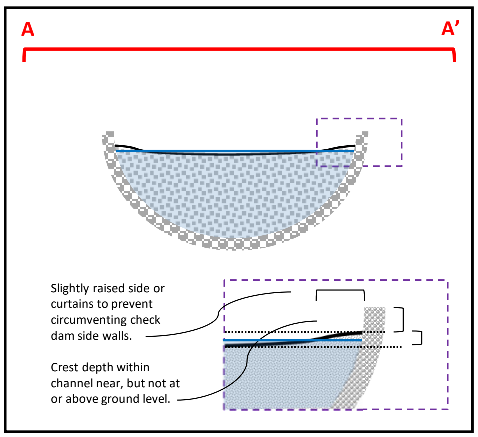
**NOTES:**

- It is recommended to align the elevation of the upgradient toe and downgradient crest. Therefore the spacing (L) of check dams will be dependent on the on the slope angle of a particular length (L) of drainage, whereby; on shallow slopes check dams will have larger spacing and on steeper slopes (up to 15 degrees *) spacing will be smaller.
- The purpose of aligning the toe and crest of respective check dams is recommended with a view to maximising pooling, or attenuation capacity of the drainage channel. The conceptual section presented here is designed with the downgradient crest (A) higher than the upgradient toe, as opposed to the crest (B) which is aligned with the toe. The purpose of this is to further enhance attenuation capacity at the dam, and to maximise hydraulic head ** and infiltration / percolation of runoff to ground water (recharge). However, this approach has limitations including for the potential to adversely impact undermine the integrity of the upgradient dam through erosion etc. or the downgradient dam through loading / excess weight. Mitigation measures including material selection, erosion control, and variable flow (V-notch) *** will be used where relevant to mitigate such impacts.
- (*) Check dams are recommended for drainage channels with slope angle up to 15 degrees. Drainage and runoff on steeper slopes (>15 degrees) will require different drainage velocity control features, for example; rock ripraps.
- (**) Attenuation of runoff in drainage channels is an opportunity to enhance recharge and reduce the hydrological response to rainfall at the site. However, detailed design will consider environmental and geological constraints, for example; enhanced recharge is not recommended in areas of elevated or high landslide susceptibility or risk.
- (***) V-Notch weirs discussed Conceptual Design – Drainage Infrastructure Check Dams – With Variable Flow Rate / V – Notch Weirs

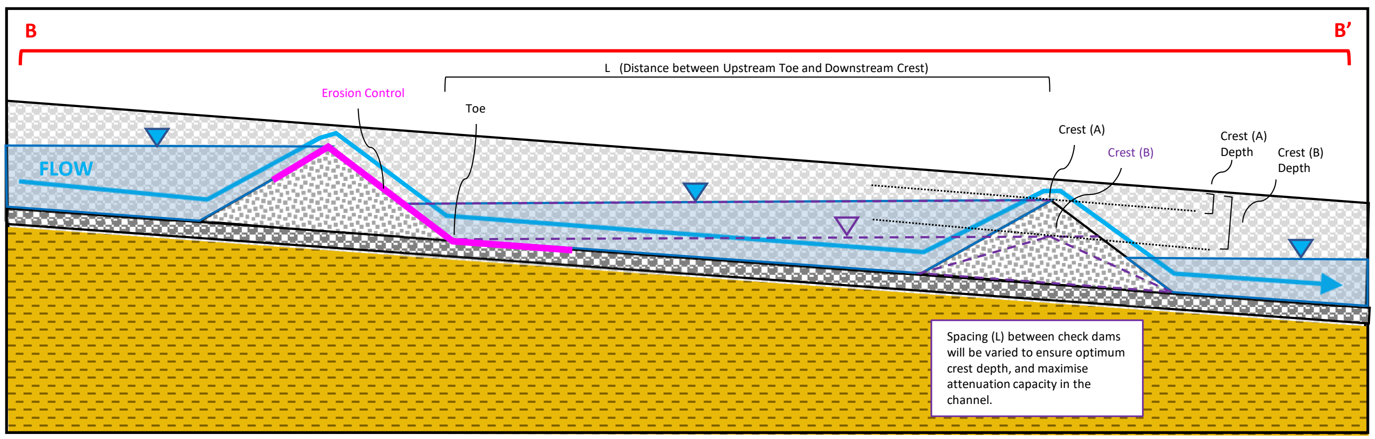
## Constructed Drain and Check Dams – Plan View




## Constructed Drain and Check Dams – Section A-A'




## Constructed Drain and Check Dams – Section B-B'

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| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Client:** | n/a | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 5**<br>**Check Dams – Design Specifications and Considerations** | **Date:** | 04/05/2022 | **Reviewed By:** | SK |
| | **Revision:** | 00 FINAL | | |

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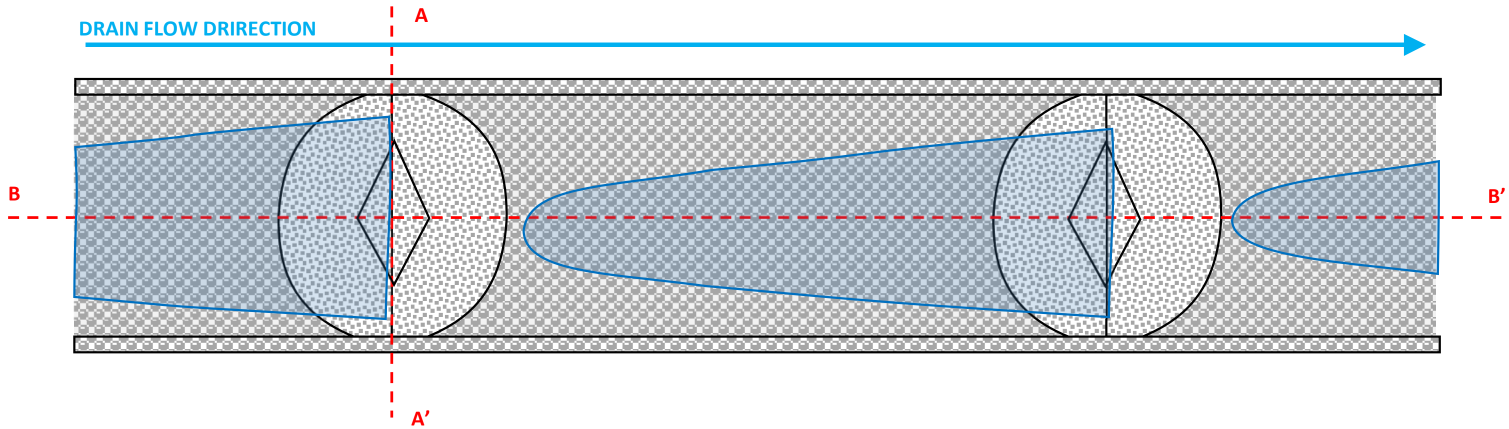
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

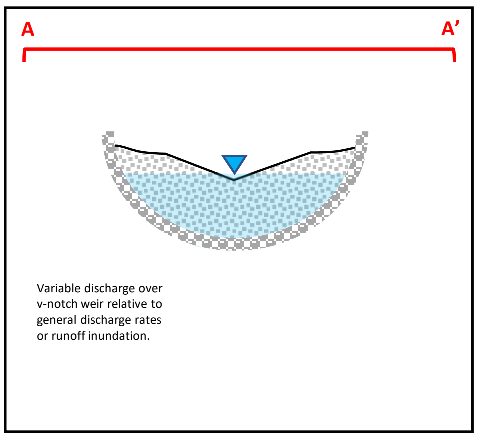
**NOTES:**

- V-Notch weirs can be included in designs as a control to mitigate against variable or peak flows / drainage discharge rates.
- V-Notch can also be employed to correct the elevation differential (between Toe and Crest) of respective in line check dams.

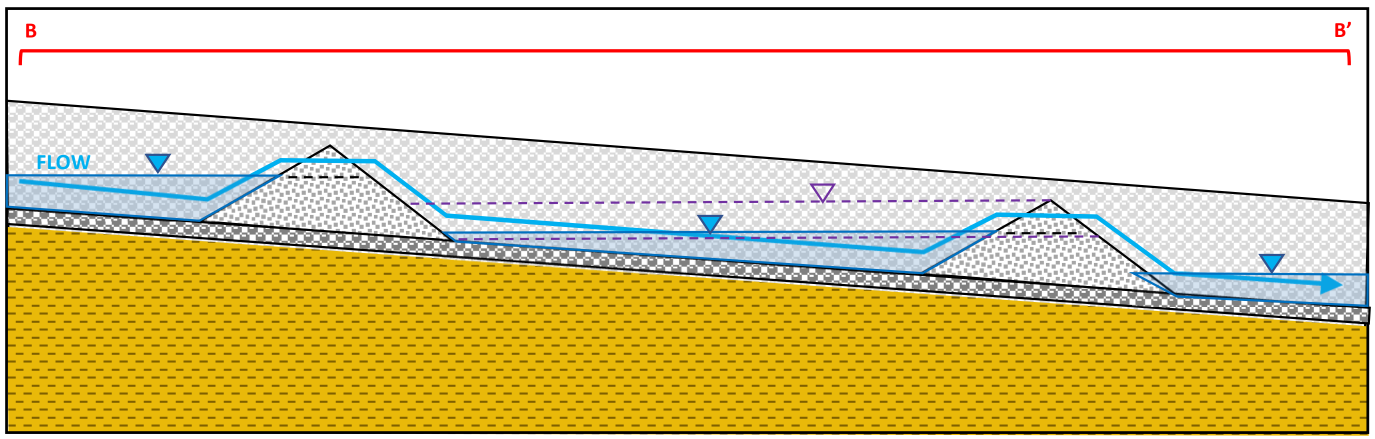
## Constructed Drain and Check Dams – Plan View




## Constructed Drain and Check Dams – Section A-A'




## Constructed Drain and Check Dams – Section B-B'

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| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 6 Check Dams – With Variable Flow Rate / V – Notch Weirs** | **Date:** | 04/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

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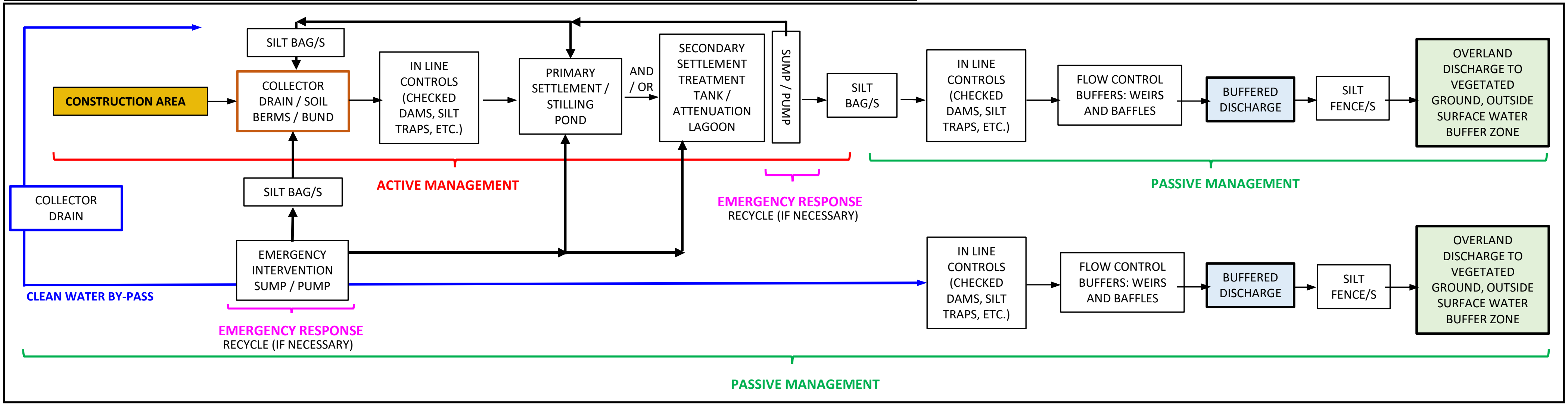
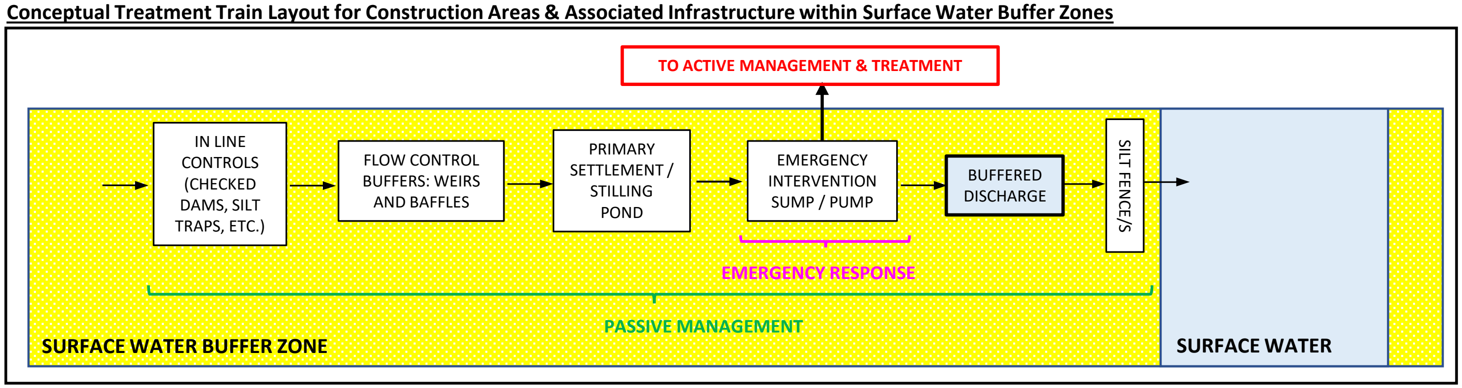
## Conceptual Treatment Train Layout for Construction Areas (Access Tracks, Hardstand Areas, Turbine Base, etc.) & Clean Water By-Pass




**NOTES:**

- Wherever possible, outfalls will be positioned outside of Surface Water Buffer Zones.
- For areas of the development footprint within Surface Water Buffer Zones, in line measures such as silt screens will be over specified e.g. double / triple silt screens, and access to emergency intervention sump / pumps will be facilitated through design and/or emergency response.
- Quality of runoff entering buffer zones will be good i.e. suspended solids <25mg/l. Where runoff quality is poor, emergency response will be to use an intervention sump / pump and pump divert runoff to an area of the drainage network where it will be treated before redistribution and discharge.

## Conceptual Treatment Train Layout for Construction Areas & Associated Infrastructure within Surface Water Buffer Zones

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| Site Name:<br>**Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Client:** | n/a | | |
| Figure Name:<br>**Appendix 9.6 – Conceptual & Information Graphics – Tile 7**<br>**Water Treatment Train Layouts** | **Date:** | 24/05/2022 | **Reviewed By:** | SK |
| | **Revision:** | 00 FINAL | | |

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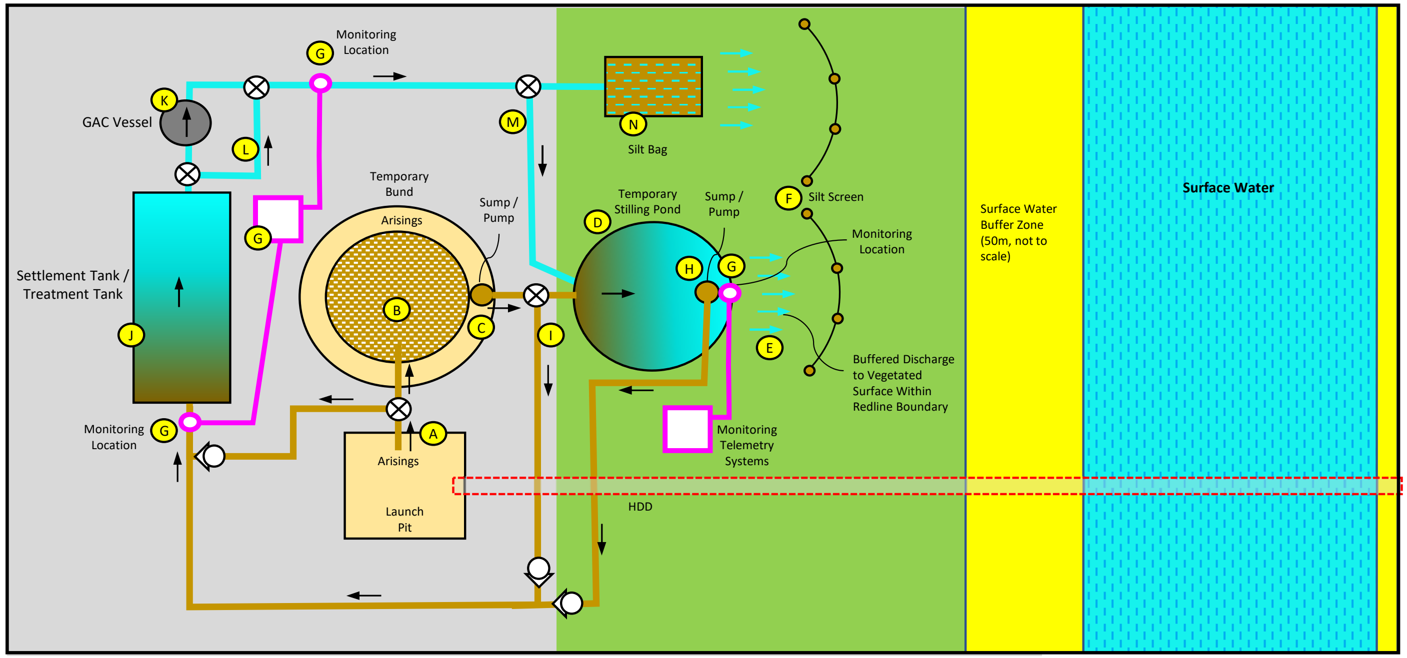
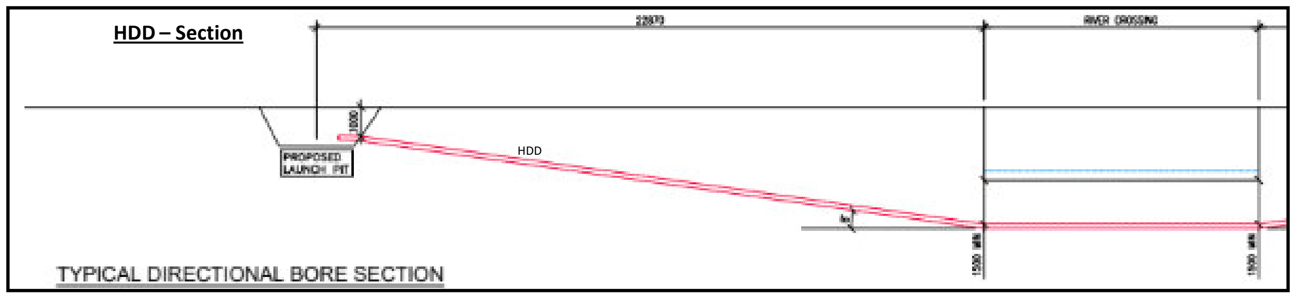
## NOTES:

- This methodology and example scenario is designed with a view to managing Horizontal Drilling arisings, but can be applied to all scenarios whereby active dewatering, treatment, or management of construction waters is required.
- Contaminated water arising from construction works, namely; excavations, drilling and temporary stockpiling, will be contained and treated prior to release or discharge. The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff;
  - A. Arisings from the launch / reception pit, or any other significant excavation (e.g., cable joint bays), will be directed the treatment train.
  - B. Arising control area i.e., a temporary bund. Gross solids will be temporarily deposited here. Water arsing with the material will be allowed to drain to sump.
  - C. Sump / Pump. Sump will discharge by gravity / pumped to stilling pond.
  - D. Temporary stilling pond. This can be constructed using soils for bunding in combination with an impermeable liner.
  - E. The outfall from the stilling pond will be buffered (coarse aggregate) to dissipate energy and diffuse discharging water.
  - F. Silt Screen. A silt screen will be in place down gradient of the Stilling Pond outfall. This is a precautionary measure to mitigate peak loads or surcharges in the system.
  - G. Monitoring Location/s. Discharge quality will be monitored in real time using telemetry systems. Monitoring of discharge quality will be carried out at the outfall of the stilling pond i.e., before being actually discharged to surface vegetation or surface water (licenced).
  - H. Sump / Pump. Discharge By-Pass. If water discharging from the stilling pond exceeds quality reference limits water will be diverted (pumped) from the stilling pond to the settlement / treatment tank.
  - I. Stilling Pond By-Pass. Similar to Discharge By-Pass, if conditions dictate water can be diverted directly to Settlement / Treatment Tank.
  - J. Settlement / Treatment Tank. A settlement tank will in line and ready to use if required i.e., water quality at stilling pond outfall fails to meet quality reference limits. The tank will be equipped with treatment systems which will be activated as the need arises, for example; very fine particles which are very slow to settle can be treated with a flocculant agent to promote settlement of particles.
  - K. GAC Vessel/s. As a precautionary measure, GAC (Granulated Activated Carbon) vessel/s will be in line and ready to use if required. GAC vessels are used to filter out low concentrations of hydrocarbons. Significant hydrocarbon contamination is only envisaged under accidental circumstances. If a hydrocarbon spill does occur, normal operations will pause and the treatment train will be utilised to remediate captured contaminated runoff.
  - L. GAC Vessel By-Pass. If the quality of the water is acceptable in terms of hydrocarbon contamination.
  - M. Treated water will be discharge by gravity / pump to the stilling pond for additional clarification, monitoring and buffered discharge to vegetated area.
  - N. Silt Bag. A silt bag can be used as alternative to stilling ponds. However, silt bags must only be used as primary method in lower risk areas i.e., outside of buffer zones, etc. Stilling ponds will be the primary method (D, N) is circumstances where risk is elevated, however a gate vale and silt bag can be included in the treatment train and used as an emergency discharge route in the event that the stilling pond needs remediation or maintenance.
- In all instances, stilling ponds (D), Silt Bags (N) and outfalls (E) will be situated outside of surface water buffer zones. At many locations, particularly at HDD locations works will be within buffer zones. In these instances, the treatment train can be positioned upgradient along the road where discharge to vegetated areas / roadside drains can be managed.

## Conceptual Treatment Train Layout for HDD – Plan View

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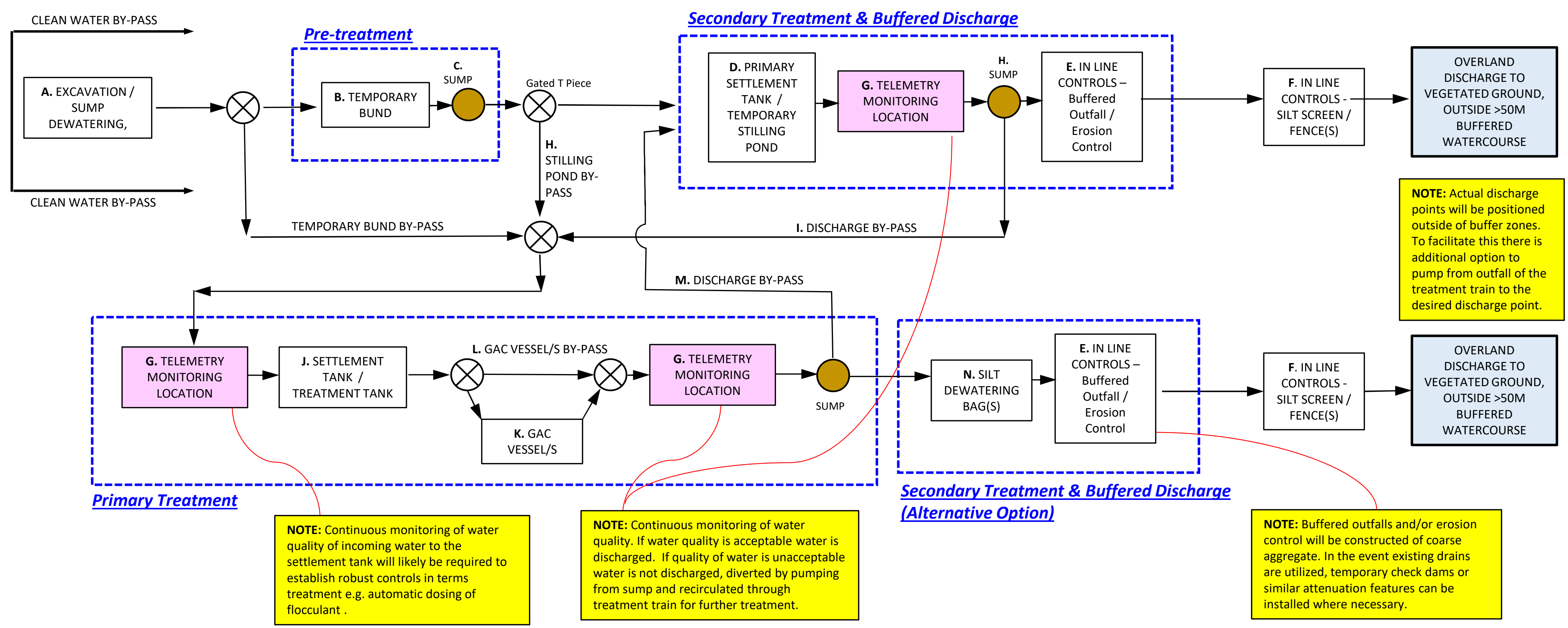
| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 8**<br>**Treatment Train Layout for Active Runoff Management (e.g. HDD)** | **Date:** | 05/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

## Conceptual Dewatering and Treatment Train Flow Diagram

Contaminated water arising from construction works, namely; excavations and temporary stockpiling, will be contained and treated prior to release or discharge.
The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff.

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| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 9 Conceptual Dewatering and Treatment Train Flow Diagram** | **Date:** | 18/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

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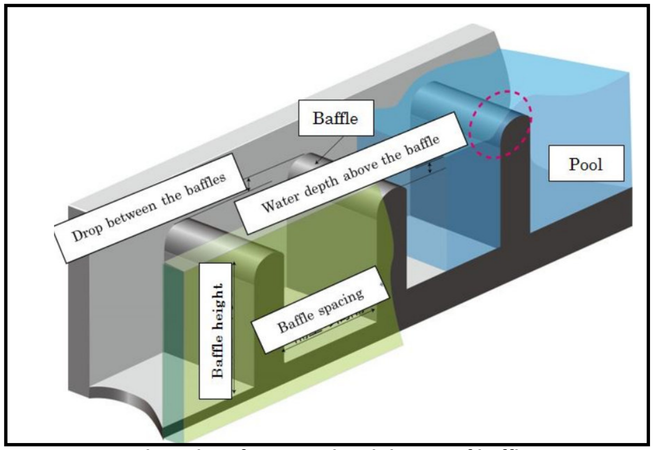
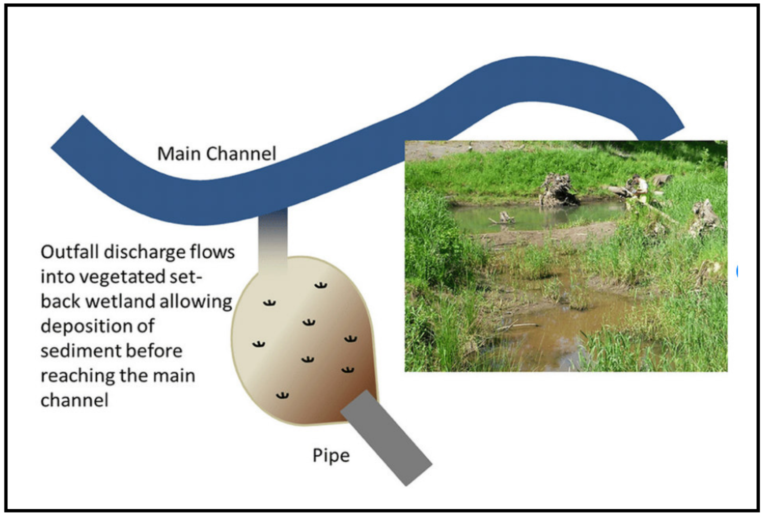



**Conceptual graphic of weir pool and the use of baffles**
(Public Works Research Institute, 2015)




**Conceptual graphic of a discharge to vegetated outfall**
(Janes-Bassett *et al.,* 2016)

**Example of an underflow baffle in a weir pool, in practice**
(Open Channel Flow Manufacturers, 2022)

**Example of a silt bag**
(Cascade Geotechnical Inc., 2022)

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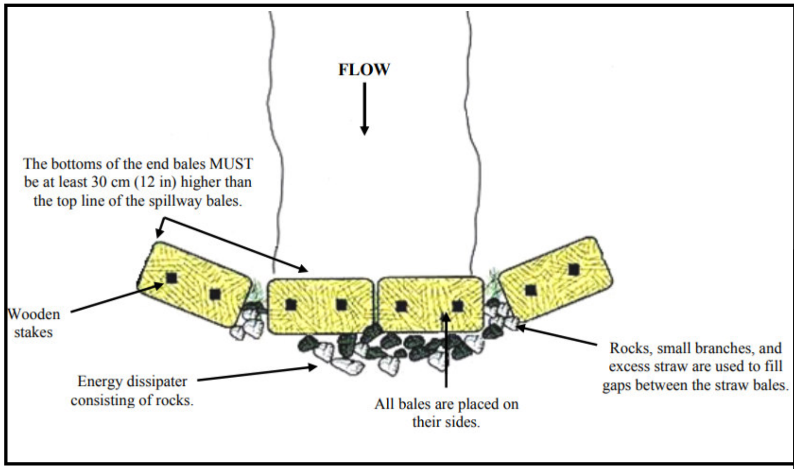
|---|---|---|---|---|
| Site Name:<br>**Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Client:** | n/a | | |
| Figure Name:<br>**Appendix 9.6 – Conceptual & Information Graphics – Tile 10**<br>**Examples of Mitigation Measures to Reduce Sediment Transport** | **Date:** | 04/05/2022 | **Reviewed By:** | SK |
| | **Revision:** | 00 FINAL | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.




**Conceptual graphic of a straw bale checked dam**
(Storrar, 2013)

**Example of an underflow baffle in a weir pool, in practice**
(Kawartha Conservation, 2020)

**Example of buffered outfall with coarse aggregate**
(Catchments and Creeks Pty Ltd., 2020)

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|---|---|---|---|---|
| Site Name: **Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Client:** | n/a | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 11 Examples of Mitigation Measures to Reduce Sediment Transport** | **Date:** | 04/05/2022 | **Reviewed By:** | SK |
| | **Revision:** | 00 FINAL | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

**Example of a clear-span bridge, which retains the existing river channel and column set back from the river bank**
(National Roads Authority, 2008)

**Example of a clear-span bridge which retains the existing river channel, abutments are set back from the river bank**
(AT&F, 2022)

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|---|---|---|---|---|---|
| Site Name:<br>**Gortyrahilly Wind Farm, Co. Cork** | **Project No.** | 603679 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | RSK |
| | **Client:** | n/a | | | |
| Figure Name:<br>**Appendix 9.6 – Conceptual & Information Graphics – Tile 12**<br>**Examples of Mitigation Measures to Reduce Sediment Transport** | **Date:** | 04/05/2022 | **Reviewed By:** | SK | |
| | **Revision:** | 00 FINAL | | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.