Guidance for the Wise Use of Water in the Aggregates and Quarry Products Industry Northern Ireland

A guidance document jointly prepared by:

NIEA Northern Ireland Environment Agency

QPA Northern Ireland Providing Essential Materials
Foreword – Northern Ireland Environment Agency

I very much welcome the publication of this guidance document ‘Wise use of Water in the Quarry Products Industry’ that has been jointly produced by the Northern Ireland Environment Agency (NIEA) and the Quarry Products Association of Northern Ireland (QPANI).

The supply and use of aggregates and quarry products are essential for the provision of the buildings and infrastructure we need to allow our economy to grow. The quarry products industry undoubtedly brings a wide range of benefits to society, but with this comes some risk of environmental damage to landscape, natural habitats, air and water. We must all work together to minimise the adverse impacts of the supply and use of aggregates and quarry products.

This guidance document is an important step towards protecting the environment through informing the industry of the environmental and commercial benefits that will be delivered through pollution prevention, environmental monitoring and the wise use of water.

The document is the product of constructive stakeholder engagement which was originally aimed at raising awareness within the industry of the Abstraction and Impoundment (Licensing) Regulations (Northern Ireland) 2006 and to provide assistance in making applications. QPANI is to be congratulated for recognising the benefits that a wider guidance document will bring to the sector through enabling it to improve compliance with discharge consents issued under the Water (Northern Ireland) Order 1999, as well as enhancing the prevention of pollution and the management of water at sites. The use of case studies brings the guidance to life by highlighting what others have achieved in the areas of consent compliance, pollution prevention and water conservation.

I am delighted that this Report will be available on both the NIEA and QPANI web sites, making it accessible to everyone working in the industry.

I believe that this is an excellent example of stakeholder participation which points the way for other sectors and that the adoption of the principles contained within the guidance will contribute to the introduction of ‘Better Regulation’

DR ROY RAMSAY  
Acting Chief Executive
Foreword – Quarry Products Association NI

If aggregates are important in our everyday life, water is even more so. Water management is a daily consideration in our industry, with quarrying developments and operations impacted by groundwater, surface water and discharges to the local freshwater environment. With increased pressure on businesses to consider the environment from customers, stakeholders and Government, due consideration is being given to this vital resource and is crucial to the sustainable supply of construction aggregates.

Quarry Products Association NI (QPANI) members recognise the potential their operations have to affect the environment and are committed to minimising and mitigating such effects, conscious of the need to carry out its work sensitively and responsibly. QPANI welcomes the assistance and knowledge from the NIEA Water Management Unit in producing the Wise Use of Water Guidance document, and the opportunity to be able to work with our regulators in a cooperative and constructive fashion. By being able to avoid or reduce adverse impacts on the water environment, we can achieve our environmental objectives and make sustainable improvements in the industry.

Minimising waste and pollution risk saves money, it reduces operating costs and those companies with good environmental practices are at a competitive advantage. Wise use of water and implementing best practice is peace of mind for an operator, any negative publicity accompanying poor management practice will damage a company’s and our industry’s image due to society’s increasing environmental awareness.

Wise Use of Water in the Aggregates and Quarry Products Industry is a working document and it is our aim to share good practice within the industry by gathering further case studies to the portfolio. It aims to provide an overview of the key issues and should be used as an aid by managers to review and improve upon an individual quarry’s performance. Thank you to all who have contributed to the guidance and case studies; in particular Peter Close, Dale Shirlow and Ray Bennett, Claire Tannahill, Richard Coey from NIEA Water Management Unit and last but not least Laverne Bell, QPANI.

Johnny McQuillan
Chairman, QPANI
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>5</td>
</tr>
<tr>
<td><strong>Water and the Quarry Environment</strong></td>
<td>6</td>
</tr>
<tr>
<td>Sources of Water</td>
<td>7</td>
</tr>
<tr>
<td>A better understanding of water in and around the quarry</td>
<td>8</td>
</tr>
<tr>
<td>Water calculation tools</td>
<td>9–10</td>
</tr>
<tr>
<td><strong>Steps to take for improved pollution prevention</strong></td>
<td>11–13</td>
</tr>
<tr>
<td>Mitigation measures designed to reduce pollution</td>
<td>14</td>
</tr>
<tr>
<td>Oil and Chemicals</td>
<td>14–15</td>
</tr>
<tr>
<td>Silt and Cement</td>
<td>15–16</td>
</tr>
<tr>
<td>Design of Settling Ponds</td>
<td>17–19</td>
</tr>
<tr>
<td><strong>Water Order Consents</strong></td>
<td>20–22</td>
</tr>
<tr>
<td>The importance of our Natural Rivers</td>
<td>22</td>
</tr>
<tr>
<td><strong>Biodiversity Gains</strong></td>
<td>23–25</td>
</tr>
<tr>
<td>Local Case Studies of “best practice”</td>
<td>26–28</td>
</tr>
<tr>
<td><strong>Conclusion</strong></td>
<td>29</td>
</tr>
<tr>
<td><strong>Annexes</strong></td>
<td></td>
</tr>
<tr>
<td>Annex A: Legislative Drivers</td>
<td>30–31</td>
</tr>
<tr>
<td>Annex B: Contact Details</td>
<td>32</td>
</tr>
<tr>
<td>Annex C: Useful Links</td>
<td>33</td>
</tr>
<tr>
<td><strong>Glossary</strong></td>
<td>34–35</td>
</tr>
</tbody>
</table>
Wise use of Water within the Quarry Products Industry

Introduction

This guidance document has been jointly produced by the Northern Ireland Environment Agency (NIEA) and the Quarry Products Association Northern Ireland (QPANI). NIEA contributions have been made by staff from various disciplines. Contributions have been made by QPANI, Gordon Best (Regional Director) and his team.

This document aims to help quarry managers to improve environmental performance on their sites. It is also intended to raise awareness and emphasise the importance of water management. More specifically it aims to highlight:

- the benefits of carrying out a water audit;
- the benefits of reducing pollution risk by active pollution prevention; and
- the benefits of operating a pro-active maintenance and monitoring regime.

Examples of best practice for water conservation and reuse, effluent reduction, and effective treatment are also explored, and supported by local case studies.

It is recommended that quarries develop and operate a system to manage water throughout the whole site. This will include the quarry boundary, the points where water enters, where water moves through the site, and at locations where water is either utilised for processing or treated prior to discharge i.e. the cradle to grave approach. Having a better knowledge of water sources, of how water moves and transports sediment, and the principles of effective treatment, will provide managers with opportunities to minimise, reuse, and improve quality within their site. If adopted, the overall impact the quarry operation has upon the environment will also be reduced.

This document has been written in 5 sections, each section focusing on a particular water related topic. The first section focuses on water and why it should be managed, the second section on pollution prevention, and the third on discharge consent compliance monitoring and maintenance, the fourth on the importance of water for nature. The last section will summarise and draw out key recommendations.

In summary, the key message emanating from this document is that “effective water management within the quarry will deliver both environmental and commercial benefits to the businesses”.
Figure 1, Rivers and Quarries.

As you can see from the above map, quarries in Northern Ireland are almost always located close to a watercourse. Water movement within quarries is a complex process. In most instances extraction occurs below or close to the water table, which influences groundwater. For all sites rainwater volumes need to be considered and managed.
Sources of Water

You can see in figure 2, that water is always in constant movement within the natural environment. Water in the air, ground, watercourses and the sea are continually interacting. Having a better knowledge of this process helps understand the movement of water at the micro level i.e. how water in quarries move and interact within the environment.

(Figure 2. Hydrological Cycle and Groundwater Flows (source- goodquarry.com))

Quarries source or receive water from the natural environment in a number of ways:

1. water which falls directly into quarry voids as rainwater,
2. groundwater seepage,
3. run-off wherever the quarry is bordered by higher adjacent land (this can have significant volumetric contributions, particularly during the wetter months) and
4. road run-off entering a site at the quarry entrance, which in some instances can contribute unwelcome volumes.

In addition to what nature can supply many quarries will also pump in water. This additional source of water ensures a constant supply of clean water, which is necessary for many quarry product processes and/or for wash water purposes. Pumped water is mainly abstracted from boreholes but in some cases streams are
impounded and water is pumped from the stream. One other final source of water is potable water although it is not commonly used for either production or wash water.

**A Better Understanding of Water in and around the Quarry.**

In order to identify improvements or to better understand opportunities managers first need to know what water processes are currently in place at the quarry. A useful first step is to carry out a water audit, as set out in the following 8 steps:

1. Investigate and understand how and where water enters the quarry
2. Estimate the total quantity of rainfall and seepage entering the quarry, remember to allow for seasonal variation
3. Using pump records, calculate the amount of borehole and/or river water that is being brought into the quarry
4. Collate the amount of potable water used by the quarry (only volumes used for operational purposes)
5. Calculate the volume of water utilised for on-site production, washing and for dust suppression, assess the quality parameters for each use
6. Carry out an assessment of options to divert unwanted water
7. Investigate the feasibility for intercepting and storing clean water at a high ground position to best utilise a clean source of water under gravity
8. Estimate the pumping and treatment costs associated with your site

The following sections aim to help quarry managers work through the above steps.

**Water Calculation Tools**

The following tools were jointly developed by NIEA and QPANI. They were designed to assist quarry managers with the completion of water abstraction licence application forms, and have been extensively used during 2007/08 for that purpose. For abstraction licensing purposes the majority of quarries in Northern Ireland needed a methodology to help estimate the volume of groundwater which enters the quarry as seepage and by pumping (if applicable).

An additional benefit of using these tools is that not only will quarry managers be able to determine the groundwater volume for their quarry, but the process simultaneously estimates at each site, the volume attributable to rainfall including the storm drainage volume that can enter the quarry at its boundary. By then using the quarry ready reckoner a manager can calculate the water requirement for the production of quarry products. Knowing pump specifications and operating hours will deliver the pumped abstraction figure. Having all of the above information goes a long way to completing a best estimate water audit for a quarry business. This knowledge; or water balance for a site, provides a baseline for future management decisions.

A brief explanation of these tools including links are set out below:
Quarry Sump Calculation

Quarry Sump in Magheramourne, Courtesy of GSNI.

This tool was developed to help quarries best estimate the volume of groundwater that enters quarry sumps. Quarries are asked to record pumping activity over a month and submit this information to the NIEA in support of their abstraction licence application.


Rainwater and run-off estimation tool

Quarries are asked to provide NIEA with a quarry site map indicating the extent of the quarry void and adjacent land. Using this map the Hydrology team within NIEA can calculate the average rainfall & run-off figure for the quarry. By subtracting the average rainfall figure from the average pumped volume leaves the volume of water that enters the quarry as groundwater.

Quarry / Water Usage ‘Ready Reckoner’

This tool was developed to help quarry managers estimate the volume of water used up during the production of quarry products at individual sites e.g. concrete / manufactured blocks.

Steps to take for improved Pollution Prevention.

An example of tank pallet to help capture any leakage

This pollution prevention section of the report will recommend that quarries prioritise pollution prevention decisions in the following order:

**Oil and Chemical**

Firstly quarry managers should focus on managing the risks associated with oil and chemical storage and use on site. The consequences of polluting the groundwater are far reaching and the costs associated with a clean-up / remediation will always be high. Therefore quarry managers should invest in dedicated and well bunded storage and have a management system for filling, using and disposing of spent products or containers.

Quarries need to invest in training with built in refresher training carried out on a regular basis. A positive culture of pollution prevention will in itself significantly reduce pollution incidents. Prevention of pollution incidents will save money and also reduce the risk of accidents occurring on site.
The following pollution prevention information (PPGs) links should be read, made available to all staff and are highly recommended:

<table>
<thead>
<tr>
<th>PPG 2</th>
<th>Above ground oil storage tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPG 3</td>
<td>Use and design of oil separators</td>
</tr>
<tr>
<td>PPG 4</td>
<td>Disposal of sewage where no mains drainage is available</td>
</tr>
<tr>
<td>PPG 5</td>
<td>Works in, near or liable to affect watercourses</td>
</tr>
<tr>
<td>PPG 8</td>
<td>Safe storage and disposal of used oils</td>
</tr>
<tr>
<td>PPG 21</td>
<td>Pollution incident response planning</td>
</tr>
<tr>
<td>PPG 26</td>
<td>Storage and handling of drums and IBCs masonry bunds for oil storage tanks</td>
</tr>
</tbody>
</table>

These can be viewed by using the publications search engine:

http://www.ni-environment.gov.uk/index/publications.htm

**Sediment**

Where a good oil and chemical management system is in place then the quarry manager needs to concentrate on reducing the amount of dirty water generated within the quarry. Pollution prevention should always be at the heart of the water management system for the site. It should always be remembered that high levels of sediment carried out of a site in either a pumped or gravity fed discharge will have devastating polluting impacts on the receiving waterway.

**Water Reduction**

Good water quality is important to us all. Quarry managers know that it is impossible to prevent water from entering the quarry, but he or she should also appreciate that reducing the volume that does come in makes managing, treating and discharging an easier task. Quarry managers are equally aware that a clean source of water is essential for many quarry operations (e.g. the washing of crushed stone or wheel washes) and for the production of quarry products (e.g. block and concrete production). Actively reducing volumes and reusing water within existing treatment systems reduces treatment volumes, saves money and reduces the risk of a pollution incident caused by dirty water. Quarry managers understand that effective treatment and then the returning of clean process water back to the aquatic environment is their biggest challenge.
Settlement Pond to trap silt.

Understanding better how water moves within the quarry, how to reduce the energy associated with moving water, coupled with, actively managing that system will significantly help deliver easier effluent treatment and improved final discharge quality.
Mitigation measures designed to reduce pollution.

Never forget that prevention is always more effective than cure and that small volumes are always easier to treat. Therefore, as far as possible, don’t allow pollutants to get into water and/or effluent streams on site. Always look to reduce your effluent volume; the treatment of quarry water is expensive.

The following section highlights the causes, prevention opportunities and treatment options for the pollutants associated with quarries:

**OIL & Chemicals:**

![Emulsified Oil and absorbent boom](image1)

![Integrally bunded steel tank](image2)

Some of the causes of oil / chemical pollution incidents:

| 1. Overfilling storage tank/s  |
| 2. Spillage while refueling vehicle |
| 3. Spillages during transport within the site |
| 4. Failure of a tank/drum or tank support |
| 5. Pipe work failure through mechanical damage or corrosion |
| 6. Waste Lube oil from servicing |
| 7. Failed Hydraulic systems |
| 8. Theft/ vandalism. |

Opportunities to prevent:

| 1. Provide contents measurement |
| 2. Fit overfill protection device |
| 3. Fit cut-off trigger to hose |
| 4. Only use good/bunded tanks and pipe supports |
| 5. Fit lockable valve at tank & end of hose |
| 6. Provide waste oil and filter facilities |
| 7. Inspect regularly there is a H&S aspect too |
| 8. Consider steel integrally bunded tanks |
Treatment options:

1. Provide absorbent (and training)
2. Fit Interceptor on storm drain or
3. Fit a scum board / elbow on settlement pond outlet
4. Prepare booming site downstream with anchorages
5. Bring in expert clean up services

Silt and Cement:

Silt Fence.

Sources can include:

1. Spoil heaps — rain mobilizes the finest material, with high heaps there will be significant erosion gullies and it will provide lots of muddy run off
2. Roads and roofs — collect rain water and the volume involved may give rise to erosion in ditches or nearby surfaces
3. Unmade surfaces — vehicles crossing soft wet ground churn up mud which will seal the surface and prevent percolation, the resulting mud will run off in wet weather
4. Wheel or vehicle washing — produces lots of muddy water. Without precautions this will contaminate roads and ditches
5. Sand washing produces lots of silt. This material cannot be stacked up and will give rise to muddy run-off, Tying up in ponds can pose all sorts of H&S problems and in some cases catastrophic wall collapse would cause really severe pollution risks
Opportunities to Prevent:

Spoil Heaps

1. Textile swales installed around the base of the heap and for tall ones at intervals up the face will help silt to settle.
2. Geotextile cover will dissipate rainfall energy and prevent mobilisation of the finer material. For permanent heaps seeds within the textile may tie down securely.
3. Gravel cover is often available and will dissipate energy and provide drainage
4. Vegetation will tie down silt and help dry the surface.
5. Cut off ditches especially with check dams will help settle out silt and prevent its spread

Roads

1. Should have regular sweeping to remove silt
2. Hard surfacing produces much less mud
3. Drains remove water and check dams collect silt which will need to be removed regularly.
4. Unmade surfaces are easily churned up and should be protected by excluding vehicles from them
5. Infiltration ditches alongside roadways will remove water but will need replaced from time to time as they silt up.

Wheel washes

1. If the entrance and exit are sloped back into the bath that will collect many of the drips
2. The tank must be desludged regularly
3. The system should recycle water and provide containment

Treatment option

1. The settlement of solids
Design of Settling Ponds

The simplest method for removal of suspended solids in quarry drainage is to construct a system of settlement ponds. These are employed to treat any drainage potentially contaminated with silt. Settlement ponds work by slowing down the velocity of drainage and providing retention to allow time for silt particles to fall out of suspension, with the aim of producing an effluent suitable for discharge back to the aquatic environment. Obviously it makes sense to reduce the amount of drainage coming into contact with any form of contamination, as the smaller the volume of drainage to be treated, the smaller the treatment system required. The nature of the solids to be removed must also be taken into account - sand will settle much quicker than clay, and will require much less surface area of settlement system to deal with a similar volume of drainage. When designing any settlement system, consideration must be given to maintenance issues, particularly access for, and frequency of, desludging. Regular checks should be carried out on the system, which should include checks on final discharge quality, to ensure the system is maintained in order that consent levels are not breached.
Overall

The pond must cover a large enough area to allow the solids to settle, this will allow the surface water to move very slowly from inlet to outlet. Several small ponds are more effective and much less subject to wind/wave disturbance of the bottom.

Size

The theoretical size of the pond can be calculated if the rate of settlement and volume of discharge is known. The area (in square metres) will be the rate of flow (in cubic metres per hour) divided by the velocity of settlement (in metres per hour). This only applies in ideal conditions so it would be prudent to build in a large safety factor.

Depth

It must be deep enough for settled solids to drop below the level of moving water (and also to provide enough storage below this level for a reasonable time between cleanings. In practice this will need a depth of more than one metre. For safety either the pond should be fenced off or have a shallow shelf 2-3 metres wide around the margin if there is sufficient space. Ropes across the surface improve escape chances.

Inlet

The inlet must reduce the flow energy and provide even distribution. The most efficient method is probably a wide low weir.

Shape

The pond should be longer than wide, ratios of 4/5 to 1 are quoted but it is less important than maintaining an even flow. There should be no baffles or other obstructions as these increase flow velocity and make cleaning problematic. Similarly bends and corners will locally increase flow velocity and form eddies and shoals. Long narrow ponds can be split up by inserting weirs or check dams (experience shows that most silt will settle at the base of the weirs).

Islands may be an attractive wildlife feature in very large ponds but will reduce the effectiveness of settlement and make cleaning difficult.

Outlet

The outlet should be similar but it may be necessary to control outlet velocity where a secondary purpose is to provide attenuation for flood prevention.
Cleaning

There should be provision for cleaning. It will probably be very effective to have a small forebay or pond to gather large particles which can be frequently cleaned out without disturbing the bulk of solids.
Water Order Consents and Compliance

The main contaminants in trade effluent from the quarrying sector are silt (suspended solids) and oil. If these are not controlled prior to discharge they can cause considerable damage to aquatic ecosystems. Specific harmful effects of these pollutants include the following:

**Silt**

1. Clogging fish gills leading to stress, smothering and death.
2. Destroying fish spawning sites leading to a reduction in fish populations.
3. Destroying habitats for invertebrates (e.g. snails, caddis flies, stone and mayflies) which are an important food source for fish.
4. Blanketing aquatic plants leading to reduced growth rates and reduction in dissolved oxygen levels in the water.

**Oil**

1. Directly toxic to fish and invertebrates.
2. Depletion of dissolved oxygen in the water.
3. Preventing transfer of oxygen and carbon dioxide at the water surface.
4. Tainting fish flesh.
5. Creating a barrier to fish movement.
7. Contaminating drinking water supplies.
8. Very visible over large distances.

It is therefore essential that potential pollutants are reduced to levels that can safely be discharged to the environment. It is for this reason that limits are imposed on a discharge consent and it is imperative that these limits are complied with. Water Order Consents are issued under the Water (Northern Ireland) Order 1999.

This legislation will affect your business if you make a discharge to the environment of any trade effluent, which can include the following:

1. Potentially contaminated site run-off
2. Wheel wash effluent
3. Vehicle washing effluent
4. Sand or stone washing effluent
5. Concrete washout effluent

In addition to discharges of trade effluent, Water Order consent will also be required for any discharge of sewage effluent from the site, should this not be diverted to Northern Ireland Water foul sewer.
Non-compliance with Water Order consents, may trigger enforcement proceedings ranging from warning letters, through issue of formal enforcement notices and eventually to prosecution. It can also lead to the suspension of exemption from the aggregates levy scheme. It is essential that all conditions of a consent be complied with. For example, as well as discharging effluent in excess of numerical limits, it is also an offence not to provide safe access to a point where a representative sample of the discharge can be obtained.

In order to comply with the conditions of a discharge consent, your business will need to provide adequate treatment designed to remove the potential contaminants which may be present in the effluent.

There are various options to control the level of contaminants in a discharge. The simplest method is to reduce the amount of water coming into contact with contaminants, hence reducing the volume of effluent which must be treated. Re-use of water should also be considered, e.g. for dust suppression, this again reduces the treatment volume and the size of treatment facility required in order to clean up the effluent.

The following practices will help reduce the polluting nature of drainage and increase the likelihood of compliance with consent conditions:

1. Encourage infiltration of storm water by designing filter drains rather than using conventional pipes, or incorporate infiltration sumps as part of the overall design.
2. Shallow slope design is crucial for effective infiltration and settlement.
3. Settlement systems must be adequately designed and sized in terms of depth and surface area in order to be able to treat the drainage from the entire catchment area.
4. Avoid high flow velocities particularly at the entry point to the final settlement pond. Energy dissipation devices or multiple outflow structures will help avoid resuspension of sediment. Low flow velocity through a settlement pond will facilitate the deployment of booms in the event of an oil spillage.
5. The installation of pre-settlement traps or gully pots on internal drains will provide additional treatment capacity and also provide accessible service points for desludging accumulated sediment before it reaches the settlement pond system.
6. Consider vehicular access for desludging of settlement systems and take all necessary measures to ensure proper and safe disposal of accumulated silt. Access for desludging must be taken into account at the design stage.
7. T-pipes or baffles will help trap oil and floating debris.
8. The installation of oil interceptors in areas where there is a higher risk of oil spillage (e.g. storage and refueling areas) should be considered.

Spot sampling is carried out by our field staff who routinely visit consented sites and collect samples of effluent being discharged. As the purpose of the sampling is to
assess compliance you will not normally be given advance notice of when samples are to be collected.

The samples are taken to the NIEA laboratories located in Lisburn where they are analysed to determine that the quality of the effluent meets the limits set by the consent. The laboratories participate in a number of national quality control schemes and are accredited under the United Kingdom Accreditation Scheme (UKAS).

The analytical results are then sent to staff for processing and storage on a computer database which enables us to readily check on the compliance of individual dischargers or different industrial sectors.

If the effluent is found to be compliant the results are recorded and an annual summary is sent out to consent holders early in the next calendar year. If the effluent is found to be non-compliant, as soon as the results become available, the discharger will be notified.

The importance of our Natural Rivers

Water related ecosystems such as wetlands provide us with essential services — from drinking water, water for agriculture, energy, industry, flood management, recreation opportunities, filtering and waste services, fisheries and tourism.

Quarries and pits can provide terrific wildlife wetland habitats during extraction and when restoration plans can include wetland habitats to benefit local biodiversity for example, wet woodland, wet grasslands, ponds and reedbeds.

As noted earlier in this guidance document, many of our quarries and pits are located alongside watercourses.

QPANI supports closer working partnerships between local authorities and conservation bodies. The Loughs Agency contribution to the Wise Use of Water Guidance communicates the importance of our watercourses to development of fisheries and aquaculture, conservation and protection of inland fisheries and sustainable development of marine tourism.

Like many local Angling Clubs, the Lough Agency undertake fishery habitat improvement schemes which are designed to improve the quality and availability of suitable habitats for native fish species including salmon and trout.

For further information on this important issue a separate guidance document has been provided on this CD.
Biodiversity Gains

Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms. Waterbodies and wetlands can provide potentially valuable biodiverse habitats in the quarry context. Ditches, small watercourses, ponds and drainage channels are all potentially valuable wildlife habitats. Amphibians such as frogs and newts use pools for part of the year to breed, but then disperse to other locations to feed and hibernate, moorhens and coots are familiar sights throughout spring breeding in quarries. With appropriate management, their wildlife value can be improved while still maintaining their operational function. Settlement lagoons, SUDS and other pollution control features can provide opportunities for enhancing wildlife value. For example, allow to recolonise naturally or where necessary shallow areas can be planted with native wetland plants which support a variety of invertebrates and other species. Purchase from a reputable source, avoid buying plants from garden centres.

Restoration presents the opportunity to reinstate areas of habitat which may have historically been important historically to the local area. Water-based restoration schemes in particular can help to create, conserve and enhance a network of semi-natural wetland habitats, ecological corridors and community assets on former quarry workings. Ponds are now a UK Priority Habitat and tool kit has been provided to the Aggregates and Quarrying Industry by the Ponds Conservation Trust for creation of ponds.

http://www.pondconservation.org.uk/advice/adviceforplanners/toolkitforpondcreationonaggregatesites.htm

Caption: Cormorant feeding at a quarry pond in the Belfast Hills. (Photo credit Jim Bradley)
Caption: Wet woodland habitat on a former sand extraction site at Lough Neagh.

Caption: Restoration of former Sand & Gravel Pit to large ponds, island and associated wetland habitats at Ballinagilly, Cookstown. Good example of what a aggregate site can become.
Caption: The density of reed growth and native species such as willow shrub benefits biodiversity as well as treatment of water prior to discharge in the series of settlement ponds at Doon Quarry, Co Fermanagh.
(Photo credit Quinn Group)
Local Case Studies of “best practice”

Rainwater Harvesting

Northstone (NI) Limited Concrete Division incorporated a rainwater harvesting system into their new Tile Plant in Toomebridge (2008). Rainwater is now captured from the factory’s large roof; the newly installed syphon system directs rainwater to storage tanks with a holding capacity of 120,000 litres. The syphon system provides a better control system and reduces the volume of storm water directed into the local drainage system. The company has benefited with financial savings from recycling and at the same time has reduced the environmental impact of its abstraction activity.

“We decided to venture into rain water harvesting for re-use of rainwater in the tile manufacture process, not only because of the cost benefits to be gained from recycling rainwater, but also because it reduces our environmental impacts. We are also aware that reduction of surface run off water on the site automatically reduces any potential pollution (spill) spread.”

Brian Watt, Production Director
New Tile Plant, Toomebridge
Northstone (NI) Limited, Concrete Division

Redirecting Water

Like many other quarries in Northern Ireland J Robinson & Son Ltd Craig’s Quarry at Glenwherry, Ballymena faces a problem of excess water entering its void from run-off from adjacent land. This meant expensive pumping is required in order to allow continued extraction and to prevent flooding of the quarry floor. As the quarry grew in depth and size the problem was exacerbated and an innovative solution was required. Rather than upgrading the pumping system, an interception pipe has been installed around the perimeter of the upper quarry face. The cost of this interception solution was much less than the pumping upgrade cost. This new network of open drains and piping successfully intercepts and diverts land drainage by gravity around the quarry void. The resultant saving on energy costs from reduced pumping, and the lower volume of trade effluent has meant compliance with the sites consent has improved i.e. cleaner water is being returned back to the natural environment.

"On the back of advice taken from a NIEA Pollution Prevention Team presentation at a QPANI Environment Conference, we have reduced the volume of water entering the sub grades by approximately 70% and contained all the clean water from being contaminated by the working faces. The cost of the piping works was half the cost of upgrading our pump system which we would have had to do in order to cope with peak periods of rainfall.”

Alex Robinson, Director Craigs Quarry
J Robinson & Son Ltd
Recycling Water

Norman Emerson Group’s Tandragee Quarry incorporated a sustainable drainage system to capture run off and drip from the wheel washing plant. Water would be pumped from a borehole to a reservoir before it was used. Any excess water would collect in a settlement tank before being fed back to a reservoir. This enclosed system negated the need for discharge consent, providing financial savings and recycled 80% of the water; reducing the impact on the groundwater aquifer due to reduced pumping from the borehole.

This enclosed system also meant that water being used in the concrete batching plant was recycled and reduced the amount of water required from the borehole. The quarry benefited from reduced costs through not needing a discharge consent and removed any risk of non compliance.

“Keeping our vehicles, our haul roads and public highways clean are stipulations all quarry operations have to abide by. By achieving this in a sustainable manner we are putting least pressure on the water table and preventing risk of contamination – all of which are vital importance in maintaining good relations with our local neighbours and regulators.”

Colin Emerson, Operations Director
Norman Emerson Group

On Site Water Management

The water management system at our Draperstown Pit is such that there is no off site discharge leading to reduced potential of water pollution in near by streams or the nearby Lough Fea (a public water supply and renowned for trout fishing) and Teal Lough (ASSI, SAC), Lough Patrick, Cow and Mill, which range from around 1.5km to 6km from the site. There are no significant water courses within the site and the nearest water course is the Black Water which flows from the SE to NW is a closest about 300m from the sand and gravel operation. The principle route for surface water drainage from the area around the quarry is a small tributary which flows on the SE boundary within a shallow valley.

All water used at the plant comes from natural sources including rain water, ground water and water recycled from the washing process. All water from the processing plant is pumped from the washers to the settlement ponds were the silt settles out and the water is returned to secondary settlement ponds before being reused in the washing processes on site.

A number of lagoons have been created within the site voids created by the extraction process. There are no discharges of water from the site directly other than those which would percolate through the sand and gravel or evaporate. Water is
collected, pumped, settled and reused in the washing process. Re-use is increasingly important to our operations demonstrating efficient and sustainable water usage”

Colm Scullion, Sand Pit Manager
Creagh Concrete Products Ltd

Testimonial

“Our inclusive and proactive approach to water management has delivered benefits beyond our expectations. By an inclusive approach we mean tackling a reduction in the use of potable water, reducing abstraction, and reducing and enhancing the quality of any discharges.

Reduction in the use of potable water has reduced our water charges by some 80%, whilst reducing abstraction has reduced energy costs associated with borehole pumps. Reduced discharge volumes and enhanced quality has improved relationships with statutory authorities and public alike with significant long term benefits for the Company and its employees for example in the securing of two major planning consents in a respectably quick time period. Why? Because statutory consultees know we have a reputation of delivering on our commitments and then going one step further.

Does it pay off? Yes, our costs are down, our image with pressure groups is enhanced, and, crucially we are able to sustain our aggregate reserves by successful planning applications, and of course we are not incurring negative costs such as legal fees, and fines”

Pat Lyons, General Manager
Tarmac Ltd.
Conclusion

It is recommended that quarry businesses take the key principles contained in this Wise Use of Water guidance and incorporate them into the heart of their environmental management strategy.

It is intended that quarry managers adopt this document and apply its many recommendations and develop their own site specific water management plan. Through the adoption of recommended pollution prevention measures, by incorporating best practice advice for treating effluent, and by actively managing water within their site, quarry managers will see environmental quality and financial benefits.

Quarry managers are urged to complete a water audit. The findings of that audit will help identify the best ways in which to improve upon environmental performance, reduce health and safety risks, and at the same time deliver financial savings.

The active management of water at key locations within the quarry invariably delivers multiple benefits. A few are highlighted below:

The diversion of un-wanted water from around the edge of the quarry will reduce the volume of trade effluent generated within the quarry. Less trade effluent will mean lower treatment costs, i.e. less pumping, less frequent servicing / maintenance at the treatment plant. Also the resultant dryer quarry environment improves overall working conditions for staff, particularly for that of lorry drivers. Improved working conditions will lower the risk of accidents.

The construction of an interception pond on a water diversion channel at the quarry edge can create an energy free and constant source of clean water for stone washing and production purposes. Using water supplied under gravity will reduce the both the quarries energy bill and carbon footprint and also helps to preserve groundwater reserves. By adopting a policy of using quarry effluent ahead of groundwater further reduces the quarries impact on the environment.

Soft engineering and the use of infiltration trenches for transporting water within the quarry will both encourage groundwater recharge and will benefit effective treatment by reducing water velocities at the entrance to settlement ponds.

Both NIEA and the QPANI would like to recognise and thank the companies and individual quarries who contributed best practice cases to the document.

It is intended that this guidance document will remain a living document. As knowledge in this area of environmental management improves, this document will be reviewed, updated and re-issued.
Annex A – Legislative Drivers

Habitats Directive
The Habitats Directive requires member states to have a formal/legal method of assessing the potential impact of abstraction/impoundments on protected and sensitive sites (e.g. wetland). A protected site is defined as one which has a European designation, for example, a Special Area of Conservation or a Special Protection Site, it will be subject to further assessment and consent controls.


Water Framework Directive
Article 11 of the Water Framework Directive requires that the programme of measures established by river basin plans should include controls over abstractions and impoundments. While the programme of measures does not have to be established until 2009, or become operational until 2012, the introduction of the scheme now will provide valuable information for the river basin planning process and enable Businesses and the Department to plan ahead to meet the required Water Framework Directive standards.


The Water (Northern Ireland) Order 1999 - Water Order consents
It is an offence to make a polluting discharge or trade effluent into a waterway or water contained in any underground strata, unless it complies with a consent issued by the Department. "Trade Effluent" means any liquid, either with or without particles or matter in suspension, which is discharged from any premises or site used for carrying on any trade or industry.

Further information on making an application for consent to discharge, including copies of the relevant application forms, can be obtained by following the link below.


The Abstraction and Impoundment Licensing Regulations (Northern Ireland) 2006
These Regulations cover the abstraction (removal or diversion) of water from a:

- waterway
- river
- lake
- lough
- groundwater aquifer
- coast

These sources need monitored to help prevent any adverse impacts to the environment.

If you over abstract it may:

- increase pollution through reduced available dilution
- reduce flows which can impede fish migration
- cause morphological changes in a river bed / banks
- cause loss of aquatic habitats,
- possibly draw salt water into groundwater sources
- lower local water tables thus impacting neighbouring wells and impact the integrity of archaeological sites and protected wetland habitats.

The operation, construction or maintenance of any impounding structure may also require you to apply for a licence from the Department. Impounding structures can adjust the level of a river upstream. You may already be achieving this through the use of weirs and dams to hold back water or divert it down a mill race or other type of channel. Poorly designed weirs can prevent fish migrating upstream of the abstraction point.

The maximum **volume** of abstracted water is the important factor when determining if your processes utilise enough water to warrant a licence. More information and an application form can be obtained from the address at the end of this document or via the weblink:

Annex B – Contact Details

Mail:  **Abstraction and Impoundment Licensing Team**  
Northern Ireland Environment Agency  
17 Antrim Road  
Lisburn  
BT28 3AL  
Phone: 028 9263 3482  
Email: AIL.Team@doeni.gov.uk

Mail:  **Pollution Prevention**  
Northern Ireland Environment Agency  
17 Antrim Road  
Lisburn  
BT28 3AL  
Phone: 02892 623234  
Email: pollutionprevention@doeni.gov.uk

Mail:  **Industrial Consents**  
Northern Ireland Environment Agency  
Water Management Unit  
17 Antrim Road  
Lisburn  
BT28 3AL  
Phone: 028 9262 3034  
Email: industrialconsents@doeni.gov.uk

Mail:  **Geological Survey Northern Ireland**  
Colby House  
Stranmillis Court  
Belfast  
BT9 5BF  
Phone: 028 9038 8462  
Email: gsni@detini.gov.uk

Mail:  **Quarry Products Association Northern Ireland**  
Nutts Corner Bus Park  
Dundrod Road  
Crumlin  
BT29  
Email: info@qpani.org
Annex C- Useful Links

A Guide for the Mineral Extraction Industry
http://www.ni-environment.gov.uk/mineral_extraction_industry_screen.pdf

Geological Survey of Northern Ireland
This website contains contact details for GSNI.
http://www.bgs.ac.uk/contacts/sites/belfast/nihome.html

Good Quarrying
This website provides plenty of links and information on quarrying issues, including best practice techniques.
http://www.goodquarry.com/

Quarry Productions Association Northern Ireland
This website contains valuable information on the QPANI’s role as the trades association for the aggregates and quarry products industry.
http://www.qpani.org/

Net Regs:
This website provides free environmental guidance for small and medium-sized businesses in the UK. It helps to explain what must be done to comply with environmental law and protect the environment.
http://www.netregs.gov.uk/

Northern Ireland Environment Agency
This website provides valuable information regarding the work that NIEA does to help protect and conserve Northern Ireland’s natural and built environment. It also includes important contact details with regards to environmental concerns.
http://www.ni-environment.gov.uk/
Glossary

Absorbant
Generally a powder that will absorb oil but not water. There are textiles that can be used on water as booms or sweeps

Abstraction
The removal of water from the natural environment by mechanical means, pipe or any engineering structure or works. This applies to water that is removed or diverted permanently or temporarily or for the purpose of transferring to another part of the natural environment

Booming site
Oil absorbent booms only work well in smooth water; repositioning anchorage points allows quick emplacement in a good point

Borehole
An engineered structure which is drilled into the earth to obtain water from an underground source

Bund
Originally used to describe an earth wall to prevent a river flooding but now includes any structure that is designed to contain an escaping liquid; e.g. a concrete or steel wall around an oil tank

Check dam
A low dam constructed across a broad and shallow ditch to form shallow pools for silt settlement. Can be formed from gravel or a plank or other abrasion resistant material.

Cut off ditch
A ditch cut across the slope designed to intercept rainwater flowing across a surface

Erosion gullies
Water running down an earth slope mobilises the lighter material carries it away and progressively gouges a deeper and deeper gully.

Evaporation
Changing from liquid to gas; causes the drying of wet surfaces

Geotextile
A fabric used to consolidate soft ground; comes in a wide range of weights and strengths

Groundwater
Water held below the surface of the ground in the saturation zone and can be in direct
contact with the ground or subsoil

**Impoundment**
Any dam, weir or other works by which surface water may be impounded; or any works diverting surface waters in connection with the construction or alteration of any dam, weir or other works.

**Infiltration**
The process of allowing liquid (especially water) to penetrate into the ground — often through a soakaway or French drain.

**Integrally bunded tank**
A tank constructed within a tank. The contents of the inner tank exit from its top. Most provide security for hose and filler.

**Mobilisation**
To support another phase (liquid or solid) in water — making mud from water and soil.

**Overfill protection device**
A threaded valve on a storage tank that shuts off flow when the tank is full.

**Percolation**
As Infiltration

**Polishing wetland**
A wet vegetated area which provides very long-term undisturbed storage for a clean effluent and so improves it. Could be quickly overwhelmed by high suspended solids.

**Scumboard**
A timber or metal structure across a pond that penetrates below the surface with the intention of retaining any floating material especially oil.

**Silt**
A fine material with particles larger than clay but smaller than sand. It is a major component of soil or till.

**Textile Swale**
A fabric sheet supported on poles; laid across a slope with the foot dug into the surface it moderates water flow and settles out suspended solids — looks like a beach windbreak.

**Transpiration**
The loss of water as vapour from the leaves of plants. It’s why we have to water plant baskets.