Project Groundwater Northumbria

Led by Gateshead Council

The PGN Handbook

Improving Resilience to Groundwater in Former Coalfield Areas.

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About Project Groundwater Northumbria

Project Groundwater Northumbria (PGN) is looking into the risks of groundwater flooding and how old mine workings affect this in Gateshead and the surrounding areas.

Its aims to develop research and new technology, and to improve and share knowledge, to help communities and authorities prepare for and manage groundwater flooding better.

PGN is led by Gateshead Council and is funded by the Department for Environment, Food and Rural Affairs (DEFRA) as part of the £200 million Flood and Coastal Innovation Programmes (FCIP), which is managed by the Environment Agency.

The programmes are enabling innovation in flood and coastal resilience and adaptation to climate change.

PGN will conclude in 2027.

Gateshead Council

Department for Environment Food & Rural Affairs

Environment Agency

Flood and coastal resilience innovation programme

Part of the £200m
Flood and coastal innovation programmes

Things To Know About Groundwater

Groundwater is very important for our environment and our everyday lives.

It is a key part of the natural water cycle.

Important Resource:
Groundwater accounts for around 99% of liquid freshwater on earth. *- The United Nations World Water Development Report 2022.*

It is really important for drinking, farming and industry

Natural Cleaning:
When water moves through soil and rocks, it gets cleaned naturally. This helps to remove dirt and harmful stuff, making the water cleaner.

Where it is Stored:
Groundwater is found in aquifers, pore spaces of rock and soil, and voids that are located underground. These can vary in size and depth, and they are replenished when it rains or when water infiltrates from the surface.

Help for Nature:
Groundwater is important for different ecosystems, like wetlands and rivers. It helps to keep water levels steady and provides homes for plants and animals.

Difficult to Predict:
The way groundwater moves underground can be influenced by how porous the soil is, the cracks and fractures in the layers of rock and the presence of natural & artificial tunnels and empty spaces.

At Risk:
Groundwater can be harmed by pollution, by using too much of it and changes in the climate. This shows why we must take care of it and manage it wisely to keep this important resource safe.

Groundwater Flooding incident, 2016

Definitions Related To Groundwater

What is geology?
Geology is the study of the Earth, including its rocks, minerals and how it changes over time.

Geologists look at how the Earth is formed, how it changes and what natural resources it has.

What is hydrogeology?
Hydrogeology is the study of how water moves through the ground and how it interacts with rocks & soil.

It looks at where groundwater is found, how it travels and how it affects the environment.

What are mine (water) blocks?
Mine blocks are large sections of land that are set aside for mining activities.

There are several mine blocks across the northeast of England generally named after locations, for example the Blaydon minewater block.

What are mineworkings?
Mineworkings refer to the areas and structures involved in the extraction of minerals or resources from the ground, such as coal, metals or other materials. This includes the tunnels, shafts and pits that miners create to access & remove these resources. Once mining is completed, these workings can be left behind and may affect the surrounding environment, including groundwater. Understanding mineworkings is important for managing safety and environmental impact.

What is groundwater recharge?
Groundwater recharge is the process where water from rain, snow, or other sources seeps into the ground and fills up porous rock or soil called aquifers. This is important because it helps to keep the groundwater levels stable, which people, plants and animals depend on for drinking water, irrigation and other needs.

What is groundwater rebound?
Groundwater rebound is when the level of groundwater rises back to its natural level after it has been lowered by mining.

What is perched groundwater?
Perched groundwater is a small pool of water that sits above the main level of groundwater. It happens when a layer of hard soil or rock blocks the water from going deeper. Water collects above that layer instead of sinking down. This can give plants water, even if the main groundwater is at a lower level.

Groundwater Flooding

In England, it's estimated that almost 1.3 million properties are at risk of groundwater flooding.

GeoSmart Reports | geosmartinfo.co.uk

What is groundwater flood risk?

When the groundwater underground rises too high and comes up to the surface, this can cause areas that are usually dry to become wet or flood.

1. **Saturation Levels:** when soil becomes saturated from prolonged rain, it can lead to faster groundwater rise, increasing flood risk.
2. **Seasonal Changes:** groundwater flood risk can vary by season, often being higher during spring due to snowmelt and heavy rains or prolonged rain.
3. **Impact:** groundwater flooding can damage homes, roads and crops, and it can lead to problems like mold and water contamination.
4. **Duration:** this type of flooding can last longer than surface flooding because it takes time for the groundwater to drain down.
5. **Land Use Changes:** urban development and deforestation can change how water is absorbed into the ground, affecting groundwater levels and flood risk.
6. **Invisible Flooding:** it can damage homes and buildings without showing big signs (like rivers overflowing). This can lead to problems that last a long time.

The term forgotten flooding is sometimes used to describe groundwater flooding because it is often less visible and receives less attention compared to surface water and river flooding.

"It is difficult to predict groundwater flooding. Groundwater levels are not monitored in every part of England."
www.gov.uk/guidance/groundwater-flooding

Project Groundwater Northumbria

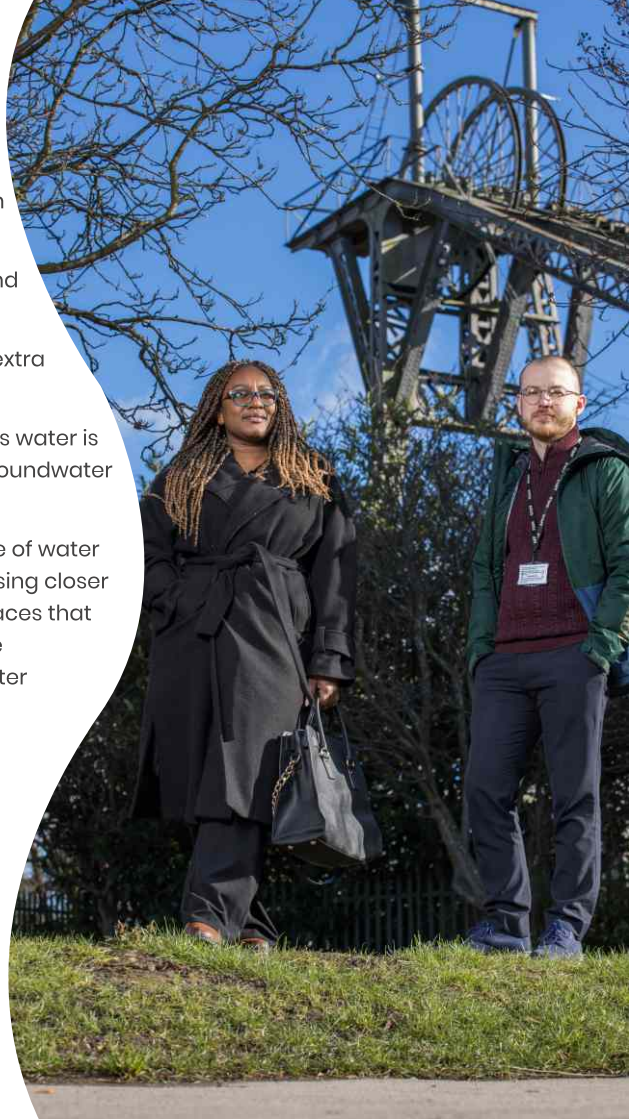
Spittal Beach, Northumberland

The Mining Connection

The North East was a major center for coal mining from the eigteenth century until the late twentieth century, playing a crucial role in the industrial revolution.

In areas with historical mining activities, the impact of mine workings on groundwater movement can be significant.

1. In the North East region, more than 70% of the land has mine blocks.
2. Coal mining left many underground tunnels and empty spaces.
3. Shallow mine tunnels can create extra paths for groundwater to move.
4. As coal mining has decreased, less water is being pumped out of mines, so groundwater levels have started to rise again.
5. Because there is less industrial use of water and less mining, groundwater is rising closer to the surface. This means that places that were dry, like springs and old mine entrances, might start to have water again. This is called mine water rebound.
6. When the layers of the ground shift in places where mining has taken place, it can make the groundwater rise.



What is PGN doing?

PGN is looking to transform the understanding & response to groundwater flood risk particularly the influence mineworkings across the North East of England.

PGN is a research and technology development project that is studying groundwater, how it interacts with shallow mineworkings, and the associated flood risk in the Northeast, with study areas in Gateshead, Newcastle, and Berwick.

PGN's Delivery Targets

- **Better forecasting & warnings:** build new intelligent systems that can better identify groundwater flood risk with the influence of geology and mineworkings accounted for.
- **Better monitoring & mapping:** gather evidence and track how groundwater behaves across the study areas.
- **Better informed, engaged and prepared communities:** share knowledge & learning, making it accessible to communities for improved awareness, empowerment and preparedness.
- **Better groundwater flood risk management:** develop the technology and intelligent systems that will enable better identification of groundwater flood risk and enable strategic investment to more resilient communities.

NERC Open Research Archive	
Hydrogeological Cross Sections	https://nora.nerc.ac.uk/id/eprint/536957/
Hydrogeological domain maps	https://nora.nerc.ac.uk/id/eprint/538116/ https://nora.nerc.ac.uk/id/eprint/538119/

Our Published Research is Freely Accessible

Our findings so far, along with the technical reports, have been published on the NERC Open Research Archive (NORA), a repository for research from all four Natural Environment Research Council (NERC) centres: British Geological Survey (BGS), British Antarctic Survey, UK Centre for Ecology and Hydrology, and Proudman Oceanographic Laboratories.

Collaboration and Shared Knowledge

This project involves teamwork among scientists, researchers, engineers, local communities, and several professional organisations.

PGN has teamed with key organisations including The Coal Authority, The British Geological Survey, the Environment Agency and several lead local flood authorities. Gathering information and linking knowledge bases to create integrated systems that will help predict, map, and warn us about groundwater flooding across the region.

9 Spittal, Northumberland

The Coal Authority plays a role in managing groundwater rebound, particularly in areas affected by coal mining.

Why: after coal mining operations, the water that was previously pumped out can start to fill the mined areas again, leading to groundwater rebound. The Coal Authority aims to manage this process to prevent negative impacts on communities and ecosystems.

How: the Coal Authority monitors groundwater levels and quality in former mining areas.

The British Geological Survey is the national geological survey of the United Kingdom. It is a research organisation that provides scientific information and expertise about the geology of the United Kingdom.

Collaboration and Shared Knowledge

The lead local flood authority (LLFA) has several important roles concerning groundwater management.

Flood Risk Management:
LLFAs are responsible for managing local flood risks, which include surface water, groundwater and ordinary watercourses. They assess and develop strategies to reduce flood risk.

Mapping and Assessment:
LLFAs create & maintain flood risk maps that include information about groundwater flooding. This helps to identify areas that are at risk and informs planning & development decisions.

Planning and Development:
they provide guidance on how new developments can manage groundwater and reduce the risk of flooding. This includes assessing planning applications to ensure they consider flood risk by using sustainable drainage systems.

Collaboration:
LLFAs work with other organisations such as the EA and local councils, to share information and to coordinate efforts in managing groundwater flooding.

Community Engagement:
they often engage with local communities to raise awareness about groundwater flooding risks and to promote resilience to flooding.

The Environment Agency (EA) plays a crucial role in managing groundwater resources in the UK.

The PGN Podcast

Sharing knowledge is important for building strong and effective ways to manage flood risks. Engaging with local authorities, community organisations, and the public will help us make sure our approach is inclusive and considers the diverse needs of those affected by groundwater flooding.

We launched this podcast to share knowledge through accessible channels. Its primary aim is to normalise discussions around resilience, our environment, and our future in a changing climate, with communities at the core. We seek to encourage conversations about flooding, climate resilience, and related environmental issues to better support local communities. The podcast is free and available on YouTube and Spotify.

We have also:

- Produced user-generated content videos to raise awareness of groundwater flooding.
- Published blogs with learning opportunities, research and progress updates.
- Developed image-led and infographic-style content.
- Conducted technical "show and tell" sessions to showcase new innovations and technologies.
- Created and shared videos on our social media platforms.
- Participated in technical expos.
- Hosted technical and industry networking opportunities.
- Created community voices opportunities, including surveys.

By keeping the lines of communication open and sharing knowledge, we can build a stronger foundation for managing groundwater effectively.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Supporting STEAM

STEAM stands for science, technology, engineering, arts and mathematics.

PGN believes that sharing knowledge is important for building strong and effective ways to manage flood risks.

One of its goals is to help to fill the gap in skills by making learning materials easier to access.

These include:

- Developing materials which explain how groundwater interacts.
- Flooding links to the geology of the area, and mining infrastructure.
- Provide accessible learning materials.
- Support upskilling through further learning.

PGN has been collaborating with & supporting schools to enhance early years education.

- Face-to-face interactive classroom sessions.
- Animations and pictorials.
- Sponsoring STEAM competitions.
- Develop shareable or interactive learning materials.
- STEM UK Learning approved ambassadors.

Be prepared. Stay prepared.

Flooding can happen for a variety of reasons and come from many sources. Here are some important tips to help you be prepared;

1. **Know Your Risk:** Find out if you live in an area that is prone to flooding. You can do this by checking local flood maps and paying attention to weather forecasts.
2. **Create an Emergency Plan:** Make a detailed plan with your family. This should include evacuation routes, ways to communicate with each other, and a specific meeting place if you need to leave your home.
3. **Build an Emergency Kit:** Prepare a kit with essential items like water, non-perishable food, medications, flashlights, batteries, and important documents. Having these ready can make a big difference in an emergency.
4. **Consider PFR:** Look into ways to make your property more resistant to flooding for example installing Property Flood Resilience (PFR) measures.
5. **Maintain Drainage Systems:** Regularly clean out gutters and drains to ensure they work properly during heavy rain. This can help prevent water buildup around your home.
6. **Stay Informed:** Sign up for local alerts and warnings about severe weather and flooding. Staying informed can help you act quickly if needed.
7. **Consider Insurance:** Consider flood insurance, especially if you live in a high-risk area.

- For information on who is responsible for different types of flooding, you can visit **www.gov.uk/report-flood-cause**
- If your home is in a high-risk flood area, **Flood Re** may help you find affordable insurance options. You can reach out to your insurance company or check out **www.floodre.co.uk** for more details.
- To learn more about Property Flood Resilience (PFR) and how to reduce flood risk, visit **BeFloodReady.uk** for free guidance and advice.
- It's important to make long-term plans to protect your property from flooding. You can get helpful advice from the National Flood Forum at **www.nationalfloodforum.org.uk/about-flooding/reducing-your-risk/property-protection-advisor/**

Answers to frequently asked questions

Q: **What is the typical colour of groundwater?**

A: It usually appears clear or slightly coloured due to minerals and organic matter. However, in some cases, groundwater can appear reddish brown due to the presence of iron oxide, which can give it a rusty colour. This can happen when iron is oxidized in the presence of oxygen.
When groundwater moves through mine areas, it can pick up iron from the rocks around it. When this water reaches the surface or a place where it flows out, it reacts with oxygen and turns into reddish-brown deposits.

Q: **Why is groundwater flood risk difficult to predict?**

A: Groundwater flood risk is difficult to predict for a few reasons.

- Groundwater moves very slowly, so it is not obvious how quickly it will rise after heavy or prolonged rain fall.
- The ground has different layers of soil & rock, and each one behaves differently, making predictions uncertain.
- Weather can change suddenly: for example, when heavy rain downpours happen in a very short period which can surprise us.
- Things people do: buildings or farming can change how water moves underground.
- Sometimes, we do not have enough information from wells or other tools to know exactly what is happening with groundwater deep below the surface.

Q: **Can groundwater enter pipes and drainage systems?**

A: Yes, groundwater can enter pipes and drainage systems, especially if there are cracks or openings. This can happen during heavy rainfall or when the water table rises during prolonged rainfall.

Q: **Does the Coal Authority oversee abandoned mines and the management of groundwater?**

A: Yes, the Coal Authority is responsible for overseeing abandoned coal mines in Great Britain. They manage issues related to these mines, including the safety of the sites and the impact on groundwater. The Coal Authority is however not a risk management authority.

Q: **What role does DEFRA have?**

A: The Department for Environment, Food and Rural Affairs is the policy lead for flood and coastal erosion risk management in England.

Q: **What is the flood and water management act?**

A: The Flood and Water Management Act 2010 is the legislation that focuses on better managing flood risks and water resources. There is no single body responsible for managing flood risk in England: the responsibility is shared between several bodies known as risk management authorities (RMAs).

The act requires RMAs to work together to manage floods more effectively and

to promote good water management practices.

Q: **Who is a risk management authority?**

A: A RMA is an organisation responsible for managing and reducing flood risks within a specific area. In the United Kingdom, RMAs are mainly government bodies.

Q: **Can you help me with my flooding?**

A: PGN is focused on research and will not be making physical changes to reduce flooding. Instead, we will direct you to advice for managing flood risk and provide information that you can use to help yourself.

Q: **Why should I follow PGN's work?**

A: PGN is helping to tackle many of the reasons why groundwater flood risk is difficult to predict and prepare for. This research will help RMAs to be better prepared for ground water flood risk problems. Knowledge sharing will help to empower communities towards becoming better prepared.

Q: **How you can help?**

A: The North East takes pride in its mining history, which has been shared through generations of mining communities. These communities have firsthand knowledge of the underground workings and networks.

We want to hear from you. The knowledge in our communities is an important part of the information we are collecting as part of PGN.

The Environment Agency	Has as a strategic overview of all sources of flooding and coastal erosion. Also manages flood risks from main rivers and the sea, providing guidance and support for flood management strategies.
Lead Local Flood Authorities (LLFAs)	These are local councils responsible for managing local flood risks, including surface water, groundwater, and ordinary watercourses.
District and Borough Councils	Key partners in planning local flood risk management.
Coast protection authorities	Lead on coastal erosion risk management activities in their area.
Water and Sewerage Companies	They manage water supply and wastewater services, which can also influence flood risk management.
Highway Authorities	Manage flood risks related to highway and transportation infrastructure.
Internal Drainage Boards	These authorities manage water levels in low-lying areas of England and are responsible for drainage and flood risk management.
The Regional Flood and Coast Committees	Are responsible for overseeing flood risk management and coastal erosion in their respective regions across England. They play a key role in advising the Environment Agency on the management of flood risk and coastal erosion, ensuring that local needs and priorities are considered in flood risk strategies.

Useful links and contacts

PGN inquiries	info@pgn.org.uk	www.pgn.org.uk
Environment Agency	Telephone: 0345 988 1188 Textphone: 0345 602 6340 24-hour service	Home page - Sign up for flood warnings - GOV.UK (environment-agency.gov.uk)
Gateshead Council Customer Services	0191 433 3000 0191 477 0844 (24-hour emergency number)	www.gateshead.gov.uk
Gateshead Council LLFA	flooding@gateshead.gov.uk	
Northumbrian Water	0800 393 084 for burst water mains 0800 328 7648 for sewers	www.nwl.co.uk

Some of our other partners

Spittal Beach, Northumberland

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The PGN Handbook

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Our Website

Instagram

Tik Tok

LinkedIn

Our Podcast

Our Podcast

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