

From Monitoring to Legacy

A Practical NRW Guide
for Landfill Compliance,
Cost Control & Closure

By Michelle Moran

Associate Director & Environmental Scientist,
Egniol (30+ years in landfill management)



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1. Introduction

Landfill sites in Wales face a balancing act: staying compliant with Natural Resources Wales (NRW) permits, controlling the costs of leachate and gas management, and ultimately closing and repurposing sites for community benefit.

With over 21,000 landfill sites in the UK (many long-closed) and a significant legacy footprint across Wales, the pressure is on operators to move **“from monitoring to legacy”**

Managing environmental risks today to safely surrender permits and leave a positive legacy tomorrow. In my 30-year career (spanning landfill gas systems, leachate treatment and permit surrender), I’ve seen how a practical, step-by-step approach turns a compliance burden into an opportunity. This guide shares that approach, aligned to NRW expectations and Welsh policy, and is written for landfill managers and NRW stakeholders who want clear, actionable guidance rather than academic theory.



Developing an NRW-Aligned Monitoring Plan

Covering leachate, landfill gas, and water (groundwater & surface), with a compliance checklist and an example monitoring matrix.

Cost-Effective Leachate & Landfill Gas Management

Sustainable strategies to optimise systems, including leachate recirculation, treatment options, and energy recovery from landfill gas.

Closure and Permit Surrender Pathway

A roadmap to final site closure that satisfies NRW, plus repurposing options (from solar to community parks) relevant to Wales.

We'll cover
three key areas

2. Developing an NRW-Aligned Monitoring Plan

A robust environmental monitoring plan is the cornerstone of permit compliance and the foundation for eventual site closure.

NRW expects landfill operators to routinely monitor leachate, landfill gas, groundwater and surface water, among other parameters – all as specified in your permit and aligned to the Landfill Directive. See NRW permitting and guidance hubs for context and updates:

NRW permits & guidance:

<https://naturalresources.wales/permits-and-permissions/environmental-permits/guidance-to-help-you-comply-with-your-environmental-permit/?lang=en>

Landfill environmental monitoring overview (EA/UK context often mirrored by NRW):

<https://www.gov.uk/guidance/landfill-operators-environmental-permits/monitor-and-report-your-performance?>

In practice, a risk-based plan tailors frequency and parameters to site conditions (e.g., proximity to receptors, waste types).

Regardless of scale, your plan must cover what you monitor, where, how often, and what triggers indicate an issue, with escalation actions agreed with NRW.

Key Components

Leachate monitoring

Measure leachate levels (sumps/wells) and sample chemistry (typical parameters: pH, ammoniacal nitrogen, COD/BOD, chlorides, metals, PFAS where relevant to site history). Define locations, methods, chain-of-custody and accredited labs. (Discuss PFAS scope with NRW based on site risk).

Landfill gas monitoring

Track gas composition (CH₄, CO₂, O₂) at in-waste extraction wells and perimeter boreholes. A key factor with site monitoring is the general increase in Hydrogen Sulphide (H₂S) in new waste and the associated odour issues for site monitoring.

NRW permits typically require at least monthly perimeter readings and regular building checks, with trigger levels (e.g., methane <1% v/v at the boundary).

Gas field balancing techniques are very much an art form and whether balancing to an engine or a flare, understanding the field and suction applied is the key factor. Always include flow data and barometric pressure readings as these complete the picture when analysing the field. Regularly taking compound data is imperative to understand the functionality of the field, ensure that readings are taken when the engine/flare are operational but also when they go offline as normally these readings will establish the cause.

Groundwater & surface water

Monitor up, cross and down gradient perimeter groundwater boreholes and up/downstream surface water points for indicators of possible leachate plume (e.g., pH, conductivity, ammoniacal nitrogen, DOC, chlorides, metals). Record NRW agreed trigger levels and define actions on exceedance (resample, investigate source, notify NRW). NRW site-specific permit conditions and positions on triggers should be your source of truth.

Site inspections & maintenance

Plan weekly walkovers (cap condition, seepages, drainage, fencing), equipment calibration (gas analysers), and preventive maintenance on leachate pumps. Landfill gas system efficiency checks are typically monthly in operation and quarterly to six-monthly in aftercare (align with NRW expectations).

Example Monitoring Plan Matrix

Aspect	Location / Points	Frequency & Partners
Aspect	2 sumps (N/S), 4 wells	Monthly levels; Quarterly chemistry (pH, NH ₄ -N, COD, metals).
Landfill Gas	10 wells; 6 perimeter probes	Monthly CH ₄ /CO ₂ /O ₂ field readings; continuous CH ₄ in site office (alarm 0.5% v/v).
Groundwater	5 boreholes (down-/up-gradient)	Quarterly chemistry (pH, EC, NH ₄ , Cl, Fe) vs NRW triggers.
Surface Water	2 up + 2 downstream points	Quarterly chemistry; event-based after heavy rain.
Inspections	Cap, drains, flare compound	Weekly visual checks; monthly flare/engine checks (T, run-hours).

Checklist Essential Elements

- Permitted parameters & triggers: match permit & risk assessment; include dust/noise/odour if required.
- Monitoring locations: unique IDs and mapped; maintain a monitoring and extraction point plan (MEPP).
- Frequency/schedule: meets minimums; reductions agreed with NRW; Aftercare and Closure plan, aftercare continues until surrender.
- Permitted parameters & triggers: match permit & risk assessment; include dust/noise/odour if required.
- Response plan: documented actions on exceedance; NRW notification routes and timelines.
- Data & reporting: validated datasets; NRW reporting calendar (quarterly/annual).
- Roles & accountability: named individuals for sampling, QA, reporting, actions.
- Review cycle: annual technical review; update on material change (new treatment, capping stage, etc.).

Ask your team

- ? When did we last audit our plan against current NRW guidance and permit conditions?
- ? Are we still monitoring the right parameters at the right frequency?
- ? Are there damaged or lost boreholes?

Act now

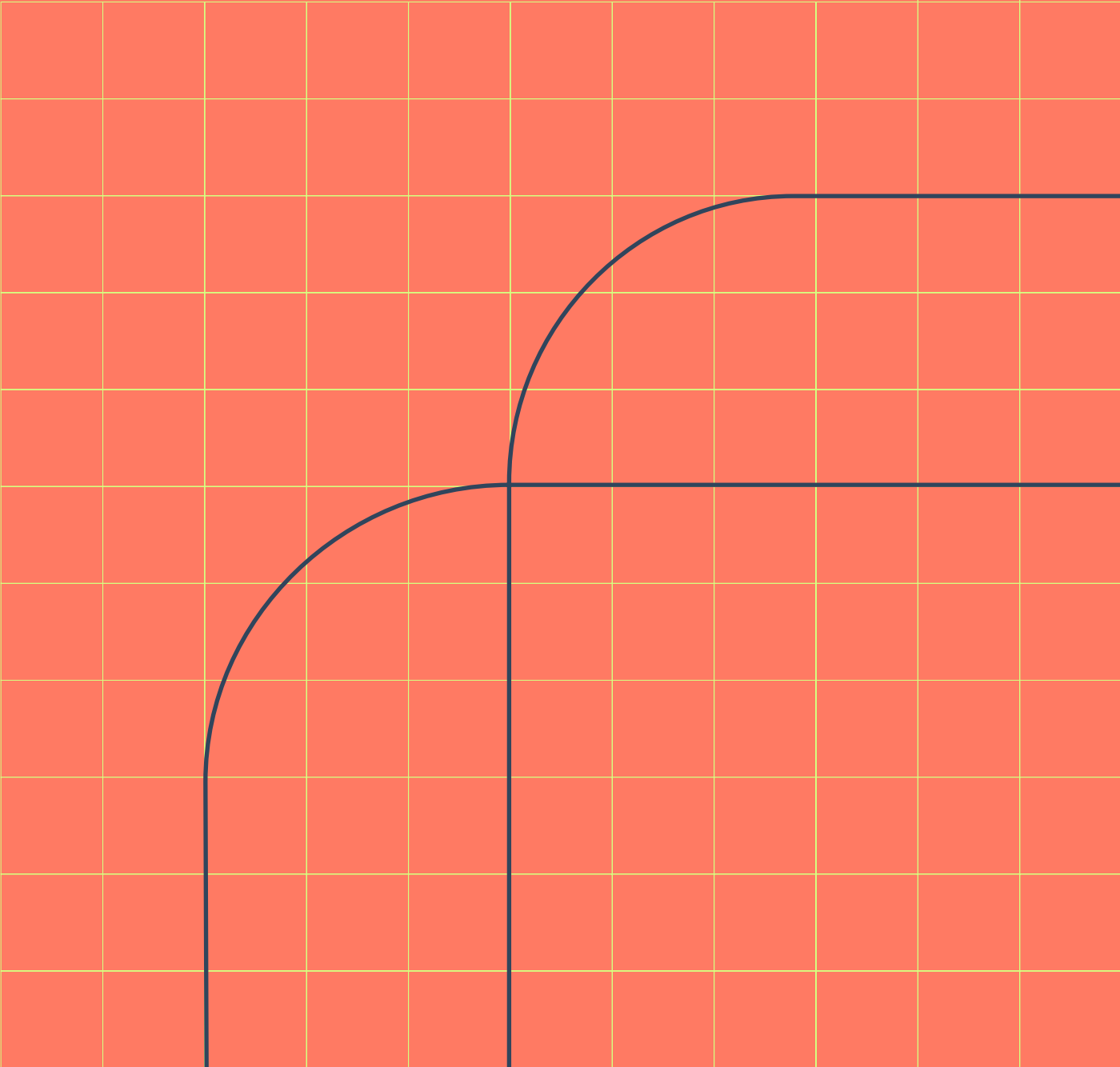
Book a quarterly compliance review. Close gaps (e.g., outdated triggers, lapsed calibrations) this quarter, not after an audit.



“If you can negate all emissions and have no impact on the surrounding area, that’s when you achieve closure and full surrender.”

**Michelle Moran –
Environmental Services
Director, Egniol**

3. Sustainable, Cost-Smart Leachate & Gas Management



Leachate:

reduce

recirculate

treat

Leachate and landfill gas (LFG) drive most aftercare cost and risk, but also where there are smart optimisation yields savings and compliance wins.

Minimise generation

Start with water management: progressive/final capping, surface water separation, perimeter cut-off drains. Welsh rainfall means infiltration control is a top ROI lever; final caps commonly cut leachate volumes by 50–80%.

**Leachate recirculation
(If the Permit includes)**

Under suitable conditions and with NRW agreement, controlled recirculation accelerates waste stabilisation, often reducing off-site tanker volumes and improving leachate chemistry over time. Best practice: intermittent injection via dedicated points, careful head monitoring, and no flooding of gas wells. Treat it as a bioreactor: let microbes do part of the work.





Ask your team

- ? What's our £/m³ leachate cost trend?
- ? Where are the quick wins (interim covers, pump optimisation, reed bed pilot)?

Act now

Pull 12 months of data; identify one savings trial (e.g., wetland cell, recirculation pilot). Pre-consult with NRW and document KPIs.



On-site treatment vs. tankering

Tanker disposal (haulage + gate fees) can run c.£10–£20/m³; small sites can spend six figures annually.

Model the break-even for:

- Reed beds/wetlands (low-energy polishing, biodiversity co-benefits),
- Aerated/SBR package plants (ammonia & BOD reduction),
- Advanced MBR/RO (high-quality effluent; consider partial-flow polishing). Engage NRW early for discharge permits and receiving water quality limits.

Leachate level optimisation

Keep heads low (often <1 m above liner, per permit). Maintain pumps, seal inflow points, and ensure event-based pumping after storms. Lower heads reduce breakout risk and often improve gas capture.

“Working with Egniol on the Penhesgyn landfill site on Anglesey has been a genuine partnership. Together we’ve addressed both long-term and immediate challenges on site, from groundwater and gas monitoring to ongoing compliance with NRW. The Egniol team’s expertise in landfill management has been invaluable - guiding us through testing, trials and practical solutions that ensure the site continues to operate safely and sustainably.”

Client – Bob Parry - Principal Waste Management Officer, Penhesgyn Waste Site, Waste Management Section, Isle of Anglesey County Council

Landfill Gas

control risk capture value

Key Components

Optimise collection

Regular gas well balancing keeps vacuum optimal and limits air ingress. Coordinate with leachate teams to avoid drowned wells, evaluate the free perforated area within the wells and add pumps if necessary. Fix small leaks (big vacuum losses). Schedule monthly tuning in operation and reduce sensibly in late aftercare.

Flare vs. energy recovery

Flaring ensures destruction of methane (compliance/odour control). Where sustained flows allow, engines or micro-turbines can convert LFG to electricity/heat. Explore heat recovery (e.g., space/process heat for nearby users) to improve overall efficiency. As flows decline, right-size flares; consider passive venting or micro-flares for very low flow (with NRW agreement).

Emerging options

In some contexts, biomethane upgrading or hybrid AD co-digestion (to extend engine life as LFG declines) can pencil – feasibility and policy-support dependent. Keep an eye on UK/Wales renewable incentives and grid connection constraints.

Odour & emissions

Proactive odour plans (H₂S/VOC checks, rapid cap repairs) avoid complaints and enforcement. Remember climate: methane management is a visible contribution to Wales' decarbonisation.



Ask your team

- ? Is our gas setup sized for today's flow, not yesterday's?
- ? When did we last balance the field or test a heat-use option?

Act now

Commission a field tuning visit and a quick heat-recovery screening. Draft a 5-year step-down plan (**engine→flare→passive**), with NRW checkpoints.

“Penhesgyn on Anglesey is an example of a complex landfill site, comprising both dilute and disperse and engineered landfill areas. Over the past few years, our role has been to provide clear, evidence-based environmental advice across gases, groundwater and surface water management – we work closely with NRW and help the council move confidently toward full aftercare and long-term environmental stability.”

Michelle Moran
Environmental Services Director, Egniol

4. Closure, Surrender & Legacy (Wales-Ready)

Permit surrender in Wales hinges on demonstrating that the site will not pose an unacceptable risk of pollution going forward. Plan early, engage NRW, and build a defensible evidence base.



Plan early for a smooth exit

- Define criteria: What proves “safe for surrender” at your site? (e.g., low/declining gas, stable leachate chemistry, no expanding groundwater plumes, cap integrity).
- Map timeline: Typical aftercare spans decades; set milestones (e.g., reduce active controls by Year X; switch to passive venting by Year Y).
- Agree triggers: Document action/decision thresholds with NRW (e.g., number of consecutive compliant monitoring rounds).

Work openly with NRW

- Pre-application dialogue: Share your closure strategy; invite feedback on site-specific concerns (e.g., sensitive receptors, PFAS, coastal risks).
- Evidence plan: Co-design monitoring needed to support surrender (parameters, frequency, duration). Expect multiple years of stable compliance data.

Aftercare optimisation

- Step down active controls only as data allow. NRW will not accept surrender if the site still relies on active pumping/flaring to prevent pollution. Document trials (e.g., controlled pump-off periods) and outcomes.
- Maintain cap & drainage; address settlement/erosion quickly; retain storm resilience (event-based checks in Welsh rainfall).

Surrender pack – tell a clear story

- Groundwater & surface water: Show trends to background/limits; address any residuals with risk assessment/attenuation evidence.
- Gas: Show persistent low flows/concentrations; document safe passive management if still generating.
- Leachate: Demonstrate stable, non-polluting conditions; if treatment switched off, show no rebound in groundwater indicators.
- Long-term robustness: Explain how protections remain effective under extreme weather and cap ageing.





Ask your team

- ? What evidence would convince NRW today?
- ? What's missing – and how do we generate it in the next 12–24 months?

Act now

Draft a surrender evidence plan (datasets, analyses, pilots) with dates and owners; book an NRW pre-surrender check-in.

“Egniol has supported Penhesgyn for more than two decades – from the original design and engineering of the landfill cells to the completion of capping, restoration and gas management. Our long-term involvement demonstrates both technical depth and commitment, ensuring the site continues to evolve safely and efficiently while generating value from recovered gas and energy.”

Mike Burrow
Environmental Services Director, Egniol

Beyond Compliance: Legacy uses in Wales

Wales' policy emphasis on biodiversity, community access and renewables makes closed landfills strong candidates for:

-  **Solar PV (ballasted)** on stable cap plateaus;
-  **Nature recovery** (meadows, wetlands, woodland), outdoor learning and access;
-  **Recreation** (paths, viewpoints, low-impact sports pitches);
-  **Mixed energy parks** (where grid and flows allow).





“Only c.20 operational landfills remain in Wales, but 1,500+ legacy sites require ongoing understanding and risk management.”

5. Useful Links

NRW permits & landfill guidance:

<https://naturalresources.wales/permits-and-permissions/environmental-permits/guidance-to-help-you-comply-with-your-environmental-permit/?lang=en>

Environmental permitting (UK context):

<https://www.gov.uk/guidance/landfill-operators-environmental-permits/manage-leachate?>

Planning Policy Wales (PPW):

<https://www.gov.wales/sites/default/files/publications/2024-07/planning-policy-wales-edition-12.pdf?>

National Strategy for Flood and Coastal Erosion Risk Management in Wales:

<https://www.gov.wales/national-strategy-flood-and-coastal-erosion-risk-management?>

Landfill Disposals Tax Communities Scheme (grants near landfills):

<https://wcva.cymru/funding/landfill-disposals-tax-communities-scheme/?>

Anglesey Penhesgyn restoration news:

<https://www.anglesey.gov.wales/en/newsroom/news/former-landfill-transformed-into-thriving-biodiversity-and-education-hub?>

About Egniol

Skills, Services & How We Help

Egniol is a Welsh-rooted, UK-wide engineering and environmental consultancy. We bring multi-disciplinary capability across the landfill lifecycle, aligned to NRW expectations and Welsh policy:

Relevant services for this guide

- **Monitoring & compliance:**
Design of NRW-aligned monitoring plans; borehole & probe networks; event-based sampling; QA/QC; reporting dashboards.
- **Leachate management:**
System audits; pump tuning & head reduction; reed-bed/ wetland design; package plant/ MBR/RO easibility and delivery; NRW discharge permitting.
- **Landfill gas:**
Gas field design & balancing; flare/engine right-sizing; heat recovery options; passive venting/micro-flare strategies for late aftercare.
- **Closure & surrender:**
Evidence plans; risk assessments; surrender pack drafting; NRW pre-app engagement; mock inspections; cap & drainage design/repair.
- **Legacy & repurposing:**
Solar PV feasibility on caps; biodiversity/habitat design; access & recreation; drainage/flood resilience; planning support (PPW).
- **Wider support:**
Geotechnical & civil design, EIA, contaminated land assessment, coastal & flood risk interfaces, stakeholder communications and grants signposting (e.g., LDT Communities Scheme).

“Egniol guided us from reactive aftercare to a planned surrender pathway – and a credible community legacy plan the council could back.”

6. Contact

If you'd like a quick, no-obligation review of your landfill site monitoring plan, leachate/gas strategy, or a surrender evidence "gap check", I'm happy to help.

Michelle Moran

Associate Director, Environmental Scientist, Egniol

Contact details

Email: michelle.moran@egniol.com

Email: info@egniol.com

Telephone: 01248 355996



Michelle has over 30 years of experience in the landfill industry. She began as a monitoring technician for Glasgow City Council while completing her MSc in Waste Management.

She has designed and built landfill gas extraction systems, operated and managed leachate and gas divisions (including at one of the UK's largest waste firms), and now leads projects focused on closure and permit surrender.

Her personal aim is to advise and achieve final surrender for the UK's legacy landfills – ensuring sites are understood, assessed and proven neutral in their environmental impact.

About the author

Appendix

Egniol is a Welsh-rooted, UK-wide engineering and environmental consultancy. We bring multi-disciplinary capability across the landfill lifecycle, aligned to NRW expectations and Welsh policy:

Checklist

“8 essentials of an NRW-aligned monitoring plan” (see section 1).

Mini-matrix

The 5-row monitoring matrix table (section 1).

Stats

“Cap & drainage can cut leachate volumes by 50–80%”

“Only ~20 active landfills in Wales; 1,500+ legacy sites.”

Quotes:

Bob Parry (Page 15)

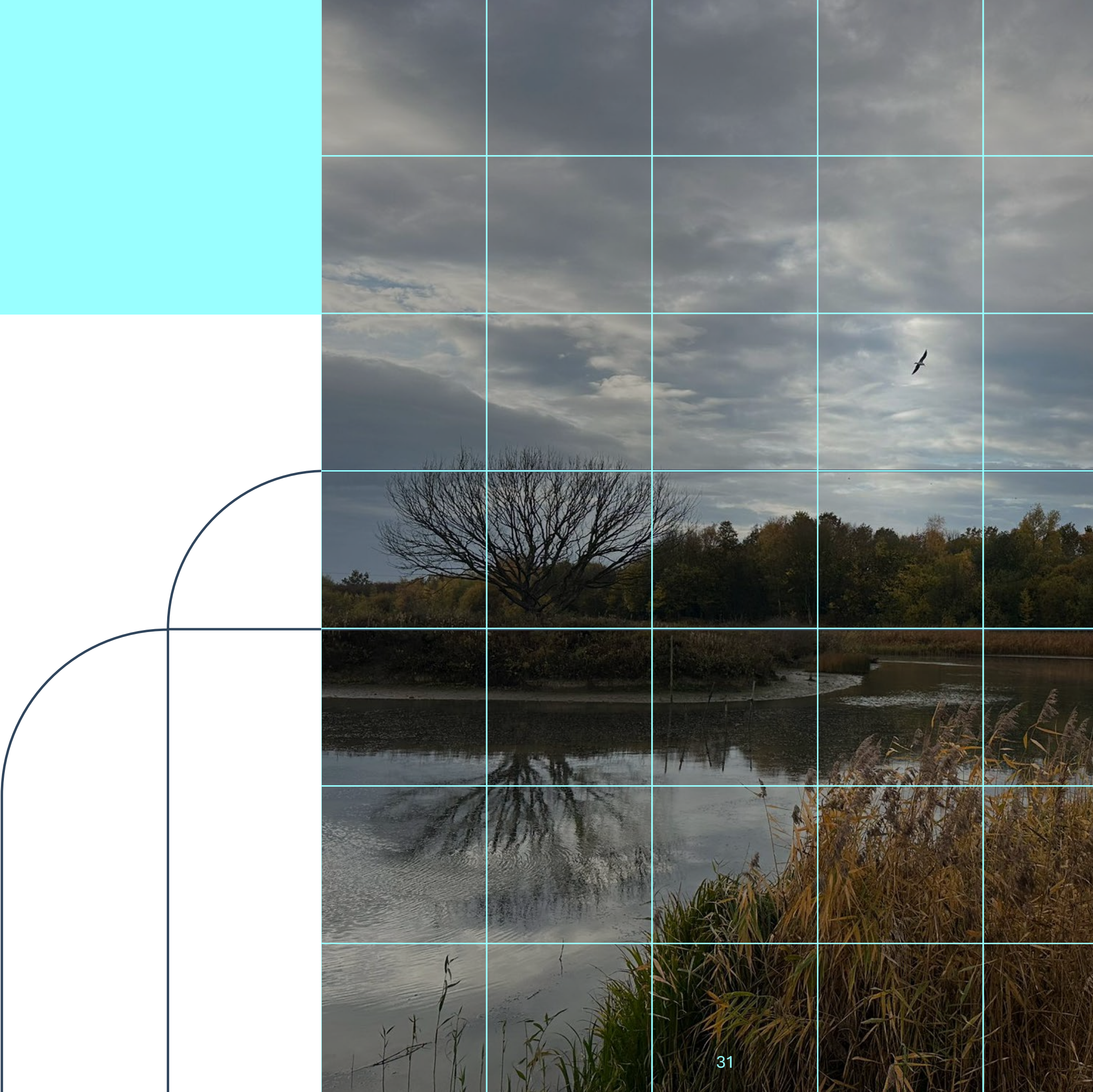
Michelle Moran (Page 18)

Mike Burrow (Page 22)

Links panel

NRW permits, PPW, Flood & Coastal Risk, LDT grants, Anglesey news.

Note: All links are provided for reader convenience; always confirm the latest NRW permit conditions and local planning/consenting requirements for your site.





01248 355996
egniol.com

Llys Onnen, Ffordd Y Llyn,
Parc Menai, Bangor LL57 4DF