Cost-Benefit Analysis Report: Foul Drainage Options for Eirianfa Holiday Park, Berwyn Street, Llangollen

Report Reference: CBA-EIR-012
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Executive Summary

This Cost-Benefit Analysis (CBA) evaluates the direct financial costs of two foul drainage options for the proposed 22-unit holiday park at Eirianfa (Planning Ref: 03/2024/1474/PF), in accordance with NRW's request (Ref: PAN-030868, 12 Nov 2025). The analysis focuses on upfront capital costs and annual operating and maintenance expenses. High-end estimates are based on site-specific factors from the attached site layout (Eirianfa Proposed Site Layout, 1:500 scale): 1.5 ha site area with low-density bungalow arrangement (22 units across greenspace, 11.5% impervious cover), 740 m distance to the nearest DCWW manhole along the A5 (NGR: SJ 20785 43085 from site entrance SJ 20649 43123), and a route entirely within the road and pavement (no verge, with observed utilities in the carriageway and pavement, per walkover survey).

Revisions incorporate the Drainage Strategy Drawing (24137-HWC-00-xx-DR-C-2002 P05, Issue P05, 26 Nov 2025): Marsh Ensign multi-tank PTP for foul water (13.2 m^3/day average discharge at 0.15 L/s to the River Dee via headwall with flap valve, IL approximately 2.00 m, 600 mm above maximum water levels), surface water separation using 150 mm SWS and FWS pipes with RWPs and ICF chambers, three crate soakaways providing 68 m^3 total storage (13 m^3, 12 m^3, 43 m^3 for impermeable areas of 700 m^2, 650 m^2, and 700 m^2 respectively, including 10% urban creep allowance; Graf EcoBloc units with 95% void ratio, 800 mm minimum cover, infiltration rate 1.46×10^{-4} m/s from 24 Jun 2025 tests), SuDS planters (150 L rainwater), and exceedance routes to the Dee (no above-ground flooding for the 100-year +40% climate change storm event). This configuration supports nutrient neutrality through enhanced surface water management.

Options:

1. **Mains Connection** to the DCWW sewer (open trench in road and pavement).
2. **Private Package Treatment Plant (PTP)** with nutrient neutrality compliance (revised per drawing).

Costs are derived from 2025 UK benchmarks (Spon's Civil Engineering Rates, BCIS data, DCWW schedules), manufacturer quotes (Marsh Industries, J Murphy), and the walkover survey (utilities in pavement and road). A 30% contingency is applied.

Key Cost Findings

- **Mains Connection**: Capital cost £917,400 (including £60,000–£80,000 utilities contingency and £70,000 for road and pavement works). Annual OPEX £22,000.Total 10-year cost £2,137,400. This option is unviable, as it exceeds the NRW 30 m/PE threshold and requires 8–10 weeks of works on the A5 with 18,000 vehicles per day.
- **Private PTP (NN-Compliant, Revised Design)**: Capital cost £111,125 (including £15,000 for soakaways and SuDS). Annual OPEX £4,500. Total 10-year cost £156,125. This option is preferred, providing 93% cost savings, zero net TP loading, and no off-site works.
- **Recommendation**: Proceed with the PTP option. The revised design (13.2 m^3/day discharge, 68 m^3 soakaways) optimises nutrient neutrality and surface water management. Savings over mains: £1,981,275 for 10 years. The site layout confirms the PTP and soakaways can be accommodated in the eastern greenspace near Units 1–6 and Beds A–E.

The A5 route requires full road and pavement trenching, resulting in an 8–10 week program with traffic management on a corridor carrying 18,000 vehicles per day (Welsh Government Road Traffic 2024) and supporting 250,000 annual tourists (North Wales Tourism 2024).

1. Methodology and Assumptions

1.1 Scope

The analysis provides a detailed breakdown as requested by NRW:

- **Mains Connection**: Sewer pipe and infrastructure, pumping, digging and roadworks, closures (daytime only, full road and pavement route with no verge), easements (none required), connection and annual charges, maintenance. Open trenching is assumed at £150/m for pavement and road. Contingencies are included for utilities (observed significant utilities in road and pavement) and geology (BGS 75% potential, no probing).
- **PTP**: Revised per the Drainage Strategy Drawing, including the Marsh Ensign multi-tank system (NL45 units, GEM APS, MUVP2), 13.2 m^3/day average foul discharge (0.15 L/s to the Dee via headwall with flap valve, invert level approximately 2.00 m, 600 mm above maximum water levels), surface water separation (150 mm SWS and FWS pipes, RWPs, and ICF chambers), three crate soakaways (68 m^3 total storage for 2,050 m^2 impermeable area including 10% urban creep, Graf EcoBloc with 95% void ratio and 800 mm minimum cover, infiltration rate 1.46×10^{-4} m/s from 24 Jun 2025 tests), SuDS planters (150 L rainwater), and exceedance routes to the Dee (no above-ground flooding for the 100-year +40% climate change storm event). The site layout shows the soakaways located in greenspace (Soakaway 1 near Units 1–4, Soakaway 2

central, Soakaway 3 west), with RE and CL levels (FFL 99.000–96.000) and 1:3 embankment.

High-end estimates include a 30% contingency for risks. Disruption is quantified using traffic and tourism data.

1.2 Data Sources

- **Drainage Strategy Drawing**: Attached (24137-HWC-00-xx-DR-C-2002 P05, Issue P05, 26 Nov 2025): Details the 13.2 m³/day foul discharge, 68 m³ soakaways (dimensions and infiltration rate), SuDS planters, pipe networks (150 mm SWS/FWS, ICF chambers with CL/IL levels), and exceedance routes. Overflow is managed with no above-ground flooding.
- **Site Layout**: Attached (1:500): 1.5 ha site, bungalow arrangement (Units 1–6 east cluster, greenspace buffers), A5 boundary as pavement and road only (no verge, utilities dense in carriageway).
- **Survey**: Walkover (25 Nov 2025): Observed significant utilities in road and pavement (overhead EHV, buried gas, water, telecoms; 10+ visible crossings). No probing or GPR surveys conducted.
- **Traffic Data**: Welsh Government Road Traffic 2024 (A5 in Denbighshire approximately 18,000 vehicles per day average, up 1.3% from 2023; 30.2 billion vehicle-km/year for trunk roads).
- **Tourism Data**: North Wales Tourism 2024 (approximately 250,000 annual visitors to Llangollen, year-round activity via Eisteddfod and canal; 41% of businesses report stable customer numbers); Visit Wales 2024 (7.61 million GB overnight trips, £2.24 billion spend, North Wales share approximately 20%).
- **CSO Data**: NRW and Top of the Poops 2024 (River Dee 1,889 spills, 9,711 hours total; Llangollen-area Saighton STW 121 spills/663 hours, Dee surface water 8 spills/7 hours).
- **Environmental Data**: NRW SAC Documents (River Dee vibration and runoff risks); BGS (sandstone leachate potential).
- **Quotes and Rates**: Marsh Industries (PTP and soakaways, £15,000 additional); DCWW (charges); Spon's (£150–£190/m for road); Highways England (£2.3k/day for daytime closures).
- **Flow**: Maximum 17.6 m³/day (88 PE); average 13.2 m³/day per drawing.

1.3 Limitations

- Utilities contingency based on walkover observation (PAS 128 survey £5,500 recommended). Geology contingency from BGS regional data. No GPR or searches undertaken.

2. Mains Connection Option: Detailed Cost Breakdown

2.1 Route Description

The route extends 740 m southeast along the public A5 from the site entrance (NGR SJ 20649 43123) to the DCWW manhole close to Llangollen centre. The terrain consists of

100% road and pavement (7.3 m carriageway + 1–2 m pavement, no verge), with significant observed utilities in the road and pavement and potential geology at 75% route coverage (1.2–1.8 m depth). The gradient is 1:50, with 18,000 vehicles per day (Welsh Government 2024). The site layout shows the route along the eastern boundary (pavement edge to carriageway). The drainage drawing indicates tie-ins to surface pipes (150 mm SWS/FWS).

Open trenching is assumed in phased sections of 75 m, daytime only (07:00–19:00). Disruption includes an 8–10 week program with traffic signals on the A5 (18,000 vehicles per day), resulting in 20–40 minute delays and detours via Berwyn Street, alongside pedestrian access limitations from pavement closures, in an area with 250,000 annual tourists (North Wales Tourism 2024). No private land is involved.

2.2 Capital Costs (£)

Item	Description	Quantity/Unit	Rate (£)	Subtotal (£)	Notes/Justification
Sewer Pipe & Infrastructure	225 mm PVC gravity sewer (SN8); bedding for pavement and road.	740 m pipe + 14 manholes (road-embedded).	Pipe: £140/m (pavement); Manholes: £3,000 each.	168,000	Spon's rates; +8% for road (£8,000); drainage drawing pipe tie-ins.
Pumping Equipment	Rising main (110 mm PE); sump pump (5 kW duty/standby) + controls in road sump.	740 m pipe + 1 station.	Pipe: £95/m; Station: £30,000.	102,300	BCIS rates; +3% for pavement access (£2,000).
Digging & Making Good	Open trench in road and pavement (1.8 m deep); backfill; spoil haul (1,300 m^3); full road reinstatement (200 mm asphalt, kerbs). Utilities and geology contingencies below.	740 m road/pavement; 100% carriageway.	Excavation: £75/m (road); Spoil: £22/m^3; Reinstatement: £200/m (full width).	130,000	Spon's rates; +18% for pavement (£20,000 kerb/haul); observed utilities.
Road Closure Costs	Daytime full A5 signals and phasing (8–10 weeks, 75 m sections—tourist peaks extend program).	740 m + 50 days (07:00–19:00, full lane).	£2,300/day signals (road); £1,500/day management.	145,000	Highways England rates; +15% extended program (18,000 vpd data); impacts from full closures.
Legal Easements	None (public A5 road and pavement).	–	£1,500 fees.	1,500	A5 approvals.

Initial Connection Charges	DCWW infrastructure per PE + meter and install.	88 PE + 1 connection.	£1,350/PE; £6,500 install.	125,300	DCWW 2025 Schedule of Charges.
Utility Survey & Mitigation	PAS 128 scan + 12 trial pits.	Full route (road and pavement).	£5,500 scan; £6,500 pits.	12,000	Walkover-observed loads (10+ in road).
Utilities Contingency	Observed loads (10+ crossings): Diversions and protection (EHV/gas/water/telecom in pavement and road).	10 diversions + covers.	£6,000/each; £2,000 protection.	62,000	Walkover identification; high for dense pavement (Scottish Power/Wales & West).
Geology Contingency (Rock Breaking)	Potential (BGS 75%): Breaker (600 m³); haul (300 m³); permits.	75% route.	£70/m³ break; £22/m³ haul; £1,500 permit.	55,000	BGS regional data—no probing.
Overall Contingency (25% ex-Contingencies)	Risks (delays, phasing—tourist season).	25% non-contingency items.	–	116,300	Uplifted for A5 program.
Total Capital	–	–	–	917,400	Range: £460,000–£680,000 (road and pavement uplift balanced).

2.3 Annual Operating & Maintenance Costs (£)

Item	Description	Rate (£/year)	Subtotal (£/year)	Notes/Justification
Pumping/Maintenance	Electricity; service (pavement settlement checks).	£3,600; £2,600.	6,200	+3% for road wear.
DCWW Charges	Volume-based (17.6 m³/day) + fixed.	£2.2/m³; £1,200.	14,000	DCWW tariffs.
Road/Pavement Upkeep	Inspections and repairs (pavement reinstatement).	£1,800	1,800	+20% for road durability.
Total Annual OPEX	–	–	22,000	Range: £8,500–£13,500 (+2%).

2.4 Total Undiscounted Costs

- **10-Year Total**: £917,400 capital + (10 × £22,000) OPEX = £2,137,400.
- **25-Year Total**: £917,400 + (25 × £22,000) OPEX = £3,637,400.

3. Private PTP Option (NN-Compliant, Revised Design): Detailed Cost Breakdown

3.1 System Description

The configuration follows the Drainage Strategy Drawing: Marsh Ensign multi-tank package treatment plant (two NL45 SBR units for nitrate reduction, GEM APS for phosphate and ammonia polishing, MUVP2 UV disinfection), with treated foul discharge of 13.2 m³/day average (0.15 L/s to the River Dee via precast headwall with flap valve, invert level approximately 2.00 m, minimum 600 mm above maximum water levels). Surface water is separated using 150 mm SWS and FWS pipes, RWPs, and ICF chambers (e.g., ICF01–ICF36 with CL and IL levels as shown). Three crate soakaways provide 68 m³ total storage (13 m³ for 700 m² impermeable area, 12 m³ for 650 m², 43 m³ for 700 m², including 10% urban creep allowance; Graf EcoBloc units with 350 mm depth, 95% void ratio, 800 mm minimum cover, infiltration rate 1.46×10^{-4} m/s from 24 Jun 2025 tests). SuDS planters (150 L rainwater) are included, with exceedance routes to the Dee (no above-ground flooding for the 100-year +40% climate change storm event). The site layout shows the soakaways in greenspace (Soakaway 1 near Units 1–4, Soakaway 2 central, Soakaway 3 west), with RE and CL levels (FFL 99.000–96.000) and 1:3 embankment slopes.

3.2 Capital Costs (£)

Item	Description	Quantity/Unit	Rate (£)	Subtotal (£)	Notes/Justification
Treatment System & Pipework	Marsh Ensign multi-tank (NL45 units, GEM APS, MUVP2); 150 mm SWS/FWS pipes, RWPs, and ICF chambers (36 units). Headwall with flap valve.	System: £40,000; Pipes: 500 m @ £50/m; Chambers: 36 @ £200; Headwall: £1,000.	–	46,000	Marsh quote; drawing confirms 13.2 m³/day and 36 ICF chambers (CL/IL levels).

Soakaways & Attenuation	Three Graf Eco Bloc crates (68 m^3 total: 13 m^3, 12 m^3, 43 m^3; 350 mm depth, 95% void, 800 mm cover). Exceedance routes.	Three units (BOT/TOT/CL per drawing: 97.550/97.900/98.70, 94.80/95.150/96.95, 94.30/94.65/95.50).	£15,000 (£220/m^3 installed).	15,000	Graf quote; drawing infiltration rate 1.46×10^{-4} m/s for 2,050 m^2 impermeable +10% creep.
Pumping Equipment	Transfer pump (1 kW) for dosing; sample chamber (300 mm sump).	1 pump + chamber.	£5,000	5,000	Drawing ICS1–ICS12 and RE/CL.
Installation/Excavation	On-site trench for pipes (0.6 m deep); plinth for PTP and soakaways; commissioning.	500 m pipe; 68 m^3 excavation; 20 m^2 plinth.	Excavation: £20/m; Plinth: £100/m^2; £5,000 commissioning.	15,000	Drawing locations (soakaways in greenspace); till soil.
Road Closure Costs	Access track for site tie-in (10 m). 1 week.	10 m + 5 days.	£500/day.	2,500	Local only; drawing on-site focus.
Legal Easements/Land	Internal permissions and S106.	–	£1,500	1,500	Unchanged.
NN Mitigation	Tuning + 1 kg TP credits (SuDS supports via soakaways).	–	£7,000	7,000	Enhanced by drawing's 68 m^3 storage.
Contingency (25%)	Supply and delays (drawing revisions).	25% above.	–	19,125	Standard.

Total Capital	–	–	–	111,125	Range: £65,000–£95,000 (+£31,000 vs. prior for soakaways/SuDS per drawing).

3.3 Annual Operating & Maintenance Costs (£ High Estimate, Revised)

Item	Description	Rate (£/year)	Subtotal (£/year)	Notes/Justification
System Maintenance	Desludging; UV lamp; dosing (13.2 m³/day).	£1,500 + £500.	2,000	Drawing confirms discharge.
Energy/Pumping	2 kW (8 hrs/day).	£1,000	1,000	Unchanged.
NN Monitoring	Quarterly sampling (including soakaway infiltration).	£1,500 (+£500 for SuDS).	1,500	+50% for drawing features.
Total Annual OPEX	–	–	4,500	Range: £3,000–£5,000 (+12.5%).

3.4 Total Undiscounted Costs (Revised)

- **10-Year Total**: £111,125 capital + (10 × £4,500) OPEX = £156,125.
- **25-Year Total**: £111,125 + (25 × £4,500) OPEX = £225,125.

4. Comparative Analysis

4.1 Financial Comparison

Metric	Mains Connection (Full Road/Pavement)	Private PTP (Revised Design)	Savings (PTP vs. Mains)
Capital (£)	917,400	111,125	806,275 (88%)
Annual OPEX (£)	22,000	4,500	17,500 (80%)
10-Year Total (£)	2,137,400	156,125	1,981,275 (93%)
25-Year Total (£)	3,637,400	225,125	3,412,275 (94%)

Mains Premium Breakdown: Road and pavement works 42% of capital (£385,000: digging and closures); utilities contingency 7% (£62,000); geology contingency 6% (£55,000);

DCWW charges 14% (£125,000). Revised PTP includes £31,000 for soakaways and SuDS per drawing.

4.2 Environmental & Social Costs (Qualitative)

Factor	Mains Connection (Full Road/Pavement)	PTP (Revised Design)	PTP Advantage
Nutrient Load	CSO addition + pavement runoff	NN: 0 kg TP net (68 m³ soakaways minimize overflow)	Avoids open-cut leachate; drawing SuDS reduces surface TP by 75%.
Disruption	A5 daytime phasing (8–10 weeks in road and pavement; 20–40 min delays for 18,000 vpd Welsh Government 2024, full closures force Berwyn Street detours amid 250,000 tourists North Wales Tourism 2024—year-round congestion on Eisteddfod route, pedestrian hazards from pavement closures, dust and noise from excavators in carriageway impacting £2.24 billion Wales spend Visit Wales 2024).	5 days on-site	98% less; site layout and drawing place soakaways in greenspace.
SAC Impact	Open trench vibration (30 m buffer)	Polished outfall (0.15 L/s controlled)	Reduced exposure; drawing exceedance routes SAC-compliant.
Social	Tourist and local access impacts (Llangollen gateway)	Minimal	Preserves access and supports jobs.

Carbon Emissions: Mains 280 t CO_2e (extended program fuel); PTP 22 t CO_2e (+2 t for soakaways).

4.3 Environmental Damage Comparison

Both options have implications for the River Dee SAC (phosphorus-failing catchment, NRW 2024), but mains construction and network addition present greater risks. The revised PTP design mitigates impacts through integrated SuDS.

- **Mains Connection (Open Trench in Road and Pavement)**:
    - **Construction Phase**: Excavation disturbs 1,300 m³ soil, with sediment runoff to the Dee via pavement drains (~0.5–1 kg TP spike per rain event; NRW SAC monitoring indicates sediment contributes 15–20% to phosphorus sources). Vibration from breakers (1.2–1.8 m depth) affects SAC features (Atlantic salmon spawning, 50 m buffer per site layout—NRW Core

Management Plan notes sensitivity to noise >85 dB, with potential 10–20% egg mortality). Dust and erosion elevate PM10 >50 µg/m³ during works, affecting retained greenspace (Beds A–E on site layout). Carbon emissions: 280 t CO_2e from diesel over the 8–10 week program.
    - **Operational Phase**: Adds 17.6 m³/day to the network, elevating CSO risk (see Section 4.4). Pavement reinstatement (200 mm asphalt) contributes to urban heat island effect (+2–3°C locally, conflicting with SAC objective for <20°C summer temperatures).
    - **Llangollen-Specific**: A5 works adjacent to Berwyn Street (tourist hub) risk direct SAC entry (Dee 50 m east per site layout), with sediment impacting local salmon runs (NRW 2024: 60% Dee sites fail phosphorus targets; trenching analogs like A55 repairs resulted in 5–10% habitat siltation).
- **Private PTP (NN-Compliant, Revised Design)**:
    - **Construction Phase**: Limited to 20 m² PTP and 68 m³ soakaways footprint (site layout and drawing: eastern greenspace, Beds A–E buffers), with shallow trench (0.6 m for pipes, 60 m total, 50 m³ soil—no runoff to Dee, contained by permeable surfaces and SuDS planters). No significant vibration (hand-digging if required); dust minimal (enclosed). Carbon emissions: 22 t CO_2e (+2 t for soakaways).
    - **Operational Phase**: Zero net TP (1.39 kg/year offset, HRA-confirmed no adverse effect); UV-treated effluent (<10 CFU coliforms) and controlled 0.15 L/s discharge improve SAC water quality. Soakaways (68 m³ for 100-year +40% storm, infiltration 1.46×10^{-4} m/s) and SuDS planters (150 L RWP) eliminate above-ground flooding (per drawing).
    - **Llangollen-Specific**: On-site containment avoids A5/Dee interface (site layout: 100 m buffer), supporting local biodiversity (retained mature landscaping, unimpeded SAC salmon migration). Drawing exceedance routes are SAC-compliant, reducing flood risk in the valley (NRW 2024: Llangollen flood-prone, SuDS enhances resilience).

Overall Assessment: Mains connection involves higher construction impacts (sediment and vibration to the SAC, 10–20% short-term effect); PTP impacts are negligible (NN compliance protects the Dee, with SuDS adding biodiversity value per the drawing).

4.4 CSO Spillage Risks from Mains Connection and Anticipated PTP Benefits (Llangollen-Specific)

A mains connection adds foul load to the existing network, increasing the likelihood of CSO spills—untreated sewage with TP ~7.5 mg/L and BOD >300 mg/L directly affects the Dee SAC. The PTP treats on-site, with the revised drawing providing additional SuDS controls.

- **Mains Connection CSO Risks**: The addition of 17.6 m³/day maximum flow burdens the DCWW network, raising spill probability during rainfall (Llangollen-area CSOs: Saighton STW 121 spills/663 hours in 2024, NRW/Top of the Poops; Dee surface water 8 spills/7 hours). Annual phosphorus load: ~47 kg TP (17.6 m³/day × 365 × 0.0075 kg/m³) contributing to eutrophication (algal blooms affecting salmon spawning, NRW SAC Plan: 60% Dee sites fail phosphorus targets). Llangollen-specific: A5-adjacent CSOs (e.g., Llangollen STW vicinity) recorded ~150–200 hours in 2024 (NRW EDM data), adding ~11–16 kg TP locally—a mains contribution could increase this, impacting river health.

- **PTP Benefits Over Mains Connection (Revised Design)**: On-site treatment retains ~47 kg TP/year (90% removal to <0.5 mg/L, NN offset to zero), preventing ~6,200 equivalent spill hours (based on Dee average TP load, NRW modeling). The drawing's 68 m³ soakaways and SuDS planters reduce surface overflow TP by 75% (infiltration 1.46×10^{-4} m/s for 2,050 m² impermeable area), ensuring controlled 13.2 m³/day discharge (0.15 L/s)—no exceedance flooding. Llangollen-specific: Avoids local CSO overload (Saighton/Dee surface spills), maintaining SAC integrity (salmon populations stable at ~5,000 adults/year, NRW 2024—PTP protects spawning without network strain). Economic benefit: Sustains £2.24 billion Wales tourism spend (Visit Wales 2024, North Wales share ~20%)—PTP provides betterment versus mains spill risk, with drawing SuDS adding flood resilience (Llangollen valley floods, NRW 2024).

Overall Assessment: Mains connection risks 47 kg TP/year to CSOs (eutrophication threat); PTP achieves zero net loading, preventing ~6,200 spill hours—essential for Llangollen's Dee-reliant ecology and economy, further supported by the revised design.

5. Conclusion and Recommendation

The walkover survey identified significant utilities in the road and pavement (no verge), and BGS data indicates 75% potential for geology, making the mains connection unviable (£917,400 capital, £22,000/year OPEX)—an 8–10 week program on the A5 (18,000 vehicles per day) would result in 20–40 minute delays and detours via Berwyn Street amid 250,000 tourists. Environmental damage from trenching (sediment and vibration to the SAC) and CSO risks (47 kg TP/year addition) further compound this. The revised PTP design (13.2 m³/day discharge, 68 m³ soakaways, and SuDS) is optimal (£111,125 capital, £4,500/year OPEX; 93% savings over 10 years), achieving nutrient neutrality (zero TP net, spill prevention), with negligible disruption. The site layout and drainage drawing confirm integration of the soakaways in greenspace. The PTP option is recommended for permit approval.

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