

Sewage Pollution and Ocean Health off Hastings: Evidence Review and Three-Year Programme Outline

Oct 24, 2026 · @Chris

A Hastings Kelp Project report

Sewage pollution is one of the best-documented threats to kelp forests and coastal sea life. This report sets out what published science shows, what is known about sewage discharges off Hastings, and what is not yet known. It is the desk-research stage and outline of a planned three-year programme to measure the problem and test whether kelp and native shellfish can help repair it.

Key findings

- Published studies link sewage-derived nutrients and sediment to kelp forests being replaced by low mats of turf algae in Australia and Norway, and to degraded seagrass meadows around the British Isles.
- One outfall, the Bexhill & Hastings long sea outfall about 3 km off Bulverhythe, accounted for about 88% of storm-overflow hours on the Hastings frontage between 2021 and 2025: 6,816 hours in five years.
- No routine offshore monitoring of nutrients or water clarity was found between that outfall and the cliff coast to the east.
- Where pollution has been reduced elsewhere, studies show the harm reducing too.

What comes next. Fieldwork, tank experiments and a community monitoring partnership with local water-quality groups follow this report. Results will be published openly.

About Hastings Kelp Project. HKP is a community interest company researching and restoring kelp off Hastings, working with schools, volunteers, the University of Brighton and Hastings Aquarium. Join the discussion on the [HKP forum](#) or find out more at hastingskelpproject.co.uk.

This report draws on published, linked sources. Corrections and additional evidence are welcome through the forum.

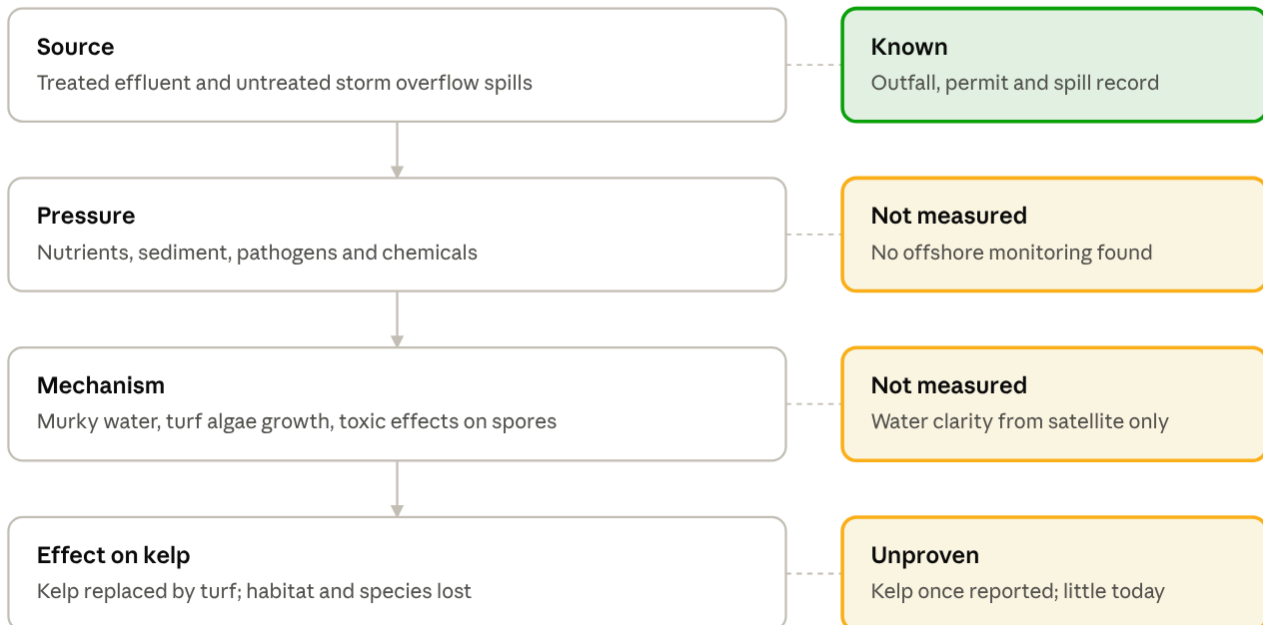
The evidence chain

Published research shows sewage pollution harming kelp coasts at every step from source to habitat loss. For Hastings, only the source is documented; each later step needs local data.

The literature documents every link; Hastings has data only for the source

Evidence chain, documented in the literature

Hastings evidence today



evidence chain · literature vs Hastings, 4 links

Read down the left for what the literature establishes, and across for where Hastings stands. The sections below take each link in turn.

Why sewage pollution matters: a primer

The sea is not a bottomless dilution tank. Sewage changes the chemistry of coastal water, which changes what can grow there, which in turn changes everything that lives there. This section explains how, in plain terms, before the detailed evidence that follows.

1. Feeding the wrong things

In most coastal seas, growth is held back by a shortage of nitrogen. Plants and algae have plenty of light and water in spring and summer, but run short of nutrients. Sewage, treated or not, is rich in exactly the nitrogen and phosphorus they lack.

Adding nutrients does not simply make everything grow more. It favours the fastest growers: microscopic plankton and thin, short-lived "weedy" seaweeds that can turn extra nutrients into growth within days. Slow-growing, long-lived species such as kelp and seagrass cannot keep up. They are shaded, smothered and crowded out. This over-enrichment is called **eutrophication**.

The damage continues after the bloom. When the excess algae die, bacteria decompose them and use up oxygen in the water as they do. In bad cases, bottom water becomes **hypoxic** (too low in oxygen for most animals). By 2008, these "dead zones" had been reported in more than 400 coastal systems worldwide, covering over 245,000 km², and they had been spreading exponentially since the 1960s ([Diaz & Rosenberg 2008, Science](#)).

British seagrass shows the same pattern. Nitrogen isotopes in seagrass leaves at 11 sites across the British Isles carried the chemical fingerprint of sewage and livestock waste. Meadows with stronger signals had shorter, narrower leaves, less cover and less growth. Ten of the eleven meadows lay inside protected sites ([Jones, Cullen-Unsworth & Unsworth 2018](#)). Protection on paper did not stop what came down the pipe.

2. Turning out the lights

Every seaweed is a plant in the sense that matters: no light, no growth. Sewage dims the water three ways. Solids cloud it directly. Plankton blooms fed by nutrients cloud it further. Then filamentous algae grow on kelp blades themselves, like a film over a window. Kelp forests retreat to shallower water, and in the worst cases disappear. Section "Suspended solids, water clarity and light" gives the evidence.

3. Germs and superbugs

Sewage carries the bacteria and viruses of everyone connected to the system, so it carries their illnesses too. People catch stomach bugs, ear and skin infections from contaminated bathing water. Filter-feeding shellfish concentrate these pathogens, which is why shellfish beds are closed after pollution.

Sewage also spreads **antibiotic resistance**. The Beach Bum Survey tested regular surfers and non-surfers in the UK for gut bacteria carrying a clinically important resistance gene. Of 143 surfers, 6.3% carried them, against 1.5% of 130 non-surfers, a risk about four times higher. The authors estimated that over 25 million water sports sessions in England and Wales in 2015 likely involved swallowing at least one such resistant bacterium ([Leonard et al. 2018, Environment International](#)). The sample was small, but the finding matters: the sea can carry resistance back to people.

4. A chemical cocktail

Whatever goes down a household drain reaches the sea: medicines, hormones from contraceptive pills, cleaning products, pesticides, tyre dust washed off roads. Many are active at tiny concentrations.

The best-known example is hormone disruption in fish. In UK estuaries, male flounder were found producing **vitellogenin**, an egg-yolk protein normally made only by females, because of oestrogen-like contaminants in the water. In the Mersey, levels in male

flounder fell about twentyfold between 1996 and 2002 as water quality improved ([Scott et al. 2005, *Environmental Health Perspectives*](#)). Earlier work linked the effect to sewage effluent. The hopeful lesson is that when the input falls, the harm falls too.

5. Losing the forest means losing everything in it

Kelp is an **ecosystem engineer**: like trees on land, it builds the habitat that other species depend on. Its forests shelter juvenile fish, feed grazers and the animals that eat them, dampen waves and store carbon. When kelp gives way to a low mat of turf algae, most of that structure disappears, and with it the animals that used it.



Laminaria hyperborea, one of the main forest-forming kelps of UK coasts, here a small plant on a Barents Sea shore. Photo: Sergey S. Dukachev, [CC BY-SA 3.0](#), via [Wikimedia Commons](#).

A global study put the value of kelp forests at about US\$500 billion a year. Per hectare, they were estimated to support around 900 kg of fisheries production and to remove around 620 kg of nitrogen a year ([Eger et al. 2023, *Nature Communications*](#)). That second figure is the cruel irony: kelp is itself a natural water-treatment system. Nutrient pollution that kills kelp also removes one of the sea's own defences against nutrient pollution.

6. Damage that hides in plain sight

Pollution damage is usually slow, and it hides. Each generation takes the coast it grew up with as normal, so a reef covered in turf looks natural to anyone who never saw it covered in kelp. Ecologists call this **shifting baselines**. In Adelaide, only careful reconstruction of the historical record showed that up to 70% of canopy-forming seaweed had been lost from parts of the city's coast (see Connell et al. 2008, below).

This is why historical records matter, and why HKP's search for evidence of past kelp off Hastings is more than nostalgia. It establishes what the coast should look like.

The point to take away

Sewage pollution does not just make the water unpleasant. It feeds the wrong organisms, starves the right ones of light and oxygen, spreads disease and drug resistance, and strips out the habitat-forming species on which coastal life depends. The same evidence also shows a way back: where pollution has been reduced, as in the Mersey, the harm has been reduced too.

What sewage discharges put into the sea

Coastal waters receive sewage by two routes. Treated effluent flows continuously from treatment works. Untreated sewage spills from storm overflows when the network is over capacity.

- **Treated effluent.** Standard secondary treatment is designed to remove organic matter and solids. Unless a works has dedicated nutrient removal, much of the nitrogen and phosphorus passes through to the sea.
- **Storm overflows.** These release untreated sewage, sometimes screened and sometimes not. It carries faecal bacteria and viruses, sewage solids, nutrients and a wide range of chemicals.

Scale in England. In 2024, storm overflows spilled for a record 3.61 million hours across 450,398 spills ([Environment Agency, via Water Magazine](#)). In 2025, recorded spills fell to 291,492, or 20.5 per overflow on average. The Environment Agency attributed the fall partly to an unusually dry year following a wet 2024 ([Water Magazine, March 2026](#)).

What the data does not show. Event Duration Monitoring records when an overflow spills and for how long, but not the volume or what the sewage contained. The ecological load reaching the sea is therefore largely unmeasured.

Nutrients, turf algae and kelp loss

This is the strongest link in the chain. Several studies tie sewage-derived nutrients to kelp forests being replaced by low mats of turf algae. Once turf takes hold, it tends to stay.

Study	Where	What it found
Connell et al. 2008 , <i>Mar Ecol Prog Ser</i> 360:63–72	Adelaide, South Australia	Reconstructed historical kelp cover. Up to 70% of canopy-forming algae lost on parts of the metropolitan coast since urbanisation, compared with reference sites that had once been indistinguishable.
Gorman, Russell & Connell 2009 , <i>Ecological Applications</i> 19(5):1114–1126	South Australia	Traced urban nitrogen reaching the coast after rain to sewage effluent, using nitrogen isotopes in transplanted algae. Turf patches were larger where the extra nitrogen load was greater.
Moy & Christie 2012 , <i>Marine Biology Research</i>	Southern Norway	Survey of over 600 sites found a large-scale shift from sugar kelp to filamentous turf algae, worst in the Skagerrak. The authors pointed to eutrophication (nutrient and particle pollution) acting together with warming.
Filbee-Dexter & Wernberg 2018 , <i>BioScience</i> 68(2):64–76	Global review	Kelp-to-turf shifts are spreading worldwide, driven by warming and eutrophication among other pressures. Feedbacks such as sediment trapping lock reefs in the turf state.

Why this matters for Hastings. Moy & Christie studied sugar kelp, the species HKP is most likely to restore. Their mechanism, nutrients and particles favouring turf that then traps sediment, is the one to test locally.

The recovery question. Later Norwegian monitoring found that some sites flipped back to sugar kelp, so the shift is not always permanent ([Christie et al. 2019](#)). Where turf persists, though, it leaves little space for kelp to recolonise. Gorman's thesis also showed

that clearing turf can help degraded forests recover ([Gorman 2009](#)). That makes reducing the nutrient load a realistic restoration lever, not just a complaint.

Suspended solids, water clarity and light

Kelp needs light, and murky water cuts it off quickly. Sewage adds to the murk in two ways: directly through solids, and indirectly by feeding plankton and the algae that grow on kelp blades.

- **Turbid water can push kelp into deficit.** At Helgoland in the North Sea, wind-driven turbidity left *Laminaria hyperborea* with a negative carbon balance below about 3–4 m for several weeks of summer ([Franke et al. 2023, Journal of Phycology](#)).
- **Growths on the blade block most of the light.** A Norwegian transplant study found that layers of epiphytes and other growths on sugar kelp could remove up to 90% of the available light. The authors described a "vertical squeeze" on kelp's depth range ([Ecology and Evolution 2019, 9\(5\):2883–2897](#)). Nutrient enrichment encourages these growths.
- **Kelp depth tracks water clarity.** Natural Resources Wales uses the depth of the deepest kelp as a monitoring indicator for long-term change in turbidity ([NRW](#)). The same method could work off Hastings.

Caution for Hastings. Murky water here also comes from cliff erosion and river runoff. The literature supports light as a key constraint, but separating sewage's share from natural sediment needs local measurement.

Pathogens and human health

The health case is the best established and the least contested. Sewage is a primary source of the faecal pathogens that make bathers and water users ill.

- **International guidance.** The WHO's 2021 *Guidelines on Recreational Water Quality* name sewage discharged through pipes and drains among the most important sources of human faecal contamination. Their health-based limits use intestinal enterococci as the main indicator for coastal waters ([WHO 2021](#)).
- **Shellfish.** Bivalves concentrate bacteria and viruses from the water. Southern Water's 2010–2015 discharges came to light after shellfish were found contaminated with *E. coli* ([Red Lion Chambers](#)). One oyster business stopped harvesting because of norovirus ([Peters & Peters](#)). This is why shellfish in HKP's planned trials will not be harvested or eaten.

The gap. Official bathing-water sampling covers the beach in the bathing season only. It says nothing about pathogens offshore, in winter, or around kelp habitat.

Toxic contaminants

Sewage carries a chemical load that treatment only partly removes and storm overflows do not touch. The south coast now has its own evidence.

- **South coast harbours.** Chichester and Langstone Harbours were sampled in 2022 across 21 sites. The study found 105 compounds in water and living organisms, including 67 pharmaceuticals, 29 pesticides and 9 recreational drugs. Concentrations rose with rainfall and storm overflow discharges, for some chemicals by three orders of magnitude ([Uhlhorn et al. 2025, *Environment International* 199:109417](#)). These are Southern Water's waters, and the samples included seaweed.
- **Overflows as a source.** A review identifies storm overflows as a significant and under-studied route for pharmaceuticals and other emerging contaminants. Some drug concentrations in combined sewage were several times higher in wet weather than dry ([review, PMC8241663](#)).
- **Copper and kelp spores.** Copper, common in urban runoff and sewage, harms kelp in its microscopic early stages. In one experiment, copper hindered spore development more than the warming and acidification tested alongside it ([Scientific Reports 8, 2018](#)). These studies used non-UK kelp species.

Evidence strength. Contaminants are well documented in coastal water. Their measured effect on UK kelp is not, which makes this a genuine research gap rather than a proven harm.

How pollution combines with other pressures

Pollution rarely acts alone in the literature, and the honest reading strengthens the case rather than weakening it.

- **Pollution plus warming.** Moy & Christie named eutrophication and rising temperature as the two main drivers, acting together. Filbee-Dexter & Wernberg list warming and eutrophication side by side among the human drivers of turf takeover.
- **Local pollution against global warming.** Sea temperature is set by global forces that Hastings cannot change. Nutrient and sediment loads are local and controllable. Filbee-Dexter & Wernberg argue that understanding how local and global drivers interact will show which are easier to control.
- **Pollution can outweigh climate effects.** In the copper study above, pollution affected kelp's early development more than the climate conditions tested.
- **Hastings has a warming record of its own.** HKP holds 75 years of local sea temperature data showing the rise. Paired with nutrient and clarity data, it lets the two pressures be weighed against each other locally.

The framing this supports. Sewage pollution is a proven, significant pressure on kelp. It makes coasts less resilient to warming, and unlike warming it can be fixed locally.

Southern Water's regulatory record

Southern Water's record of illegal discharges is a matter of court record, not opinion. The courts have also noted recent improvements.

Date	Event	Source
July 2026	Fined £7.13m at Canterbury Crown Court for 13 offences at Margate and Broadstairs pumping stations, 2019–2021. The judge found some failings deliberate and noted 174 previous convictions. Eleven bathing waters had been closed in June 2021. The judge also credited full cooperation, a change of management and real improvements since 2021.	Sentencing remarks
2024 (published 2025)	Rated 2 stars out of 4 in the EA's Environmental Performance Assessment, with 269 pollution incidents reported. Southern, Thames and Yorkshire Water together caused 81% of the year's serious incidents.	EA EPA data report ; Isle of Thanet News ; South Hams Today
2011–2023	Mostly rated 1 or 2 stars by the EA across the assessment's history.	EA EPA ratings 2011–2023
July 2021	Fined a then-record £90m after pleading guilty to 51 offences: 6,971 illegal discharges totalling 61,704 hours at 17 sites in Hampshire, Kent and West Sussex, 2010–2015. The investigation began after shellfish were found contaminated with E. coli.	Kingsley Napley ; Red Lion Chambers
2019	£126m penalty imposed by Ofwat over regulatory failings in the same 2010–2015 period.	Hausfeld

Note. None of these cases concerns Hastings directly. They establish a pattern of conduct and regulatory concern across Southern Water's coast. They do not prove harm off Hastings; local data has to do that.

What this means for Hastings

The literature establishes that sewage pollution damages kelp coasts. For Hastings, the source is well documented, but every link after it is unmeasured.

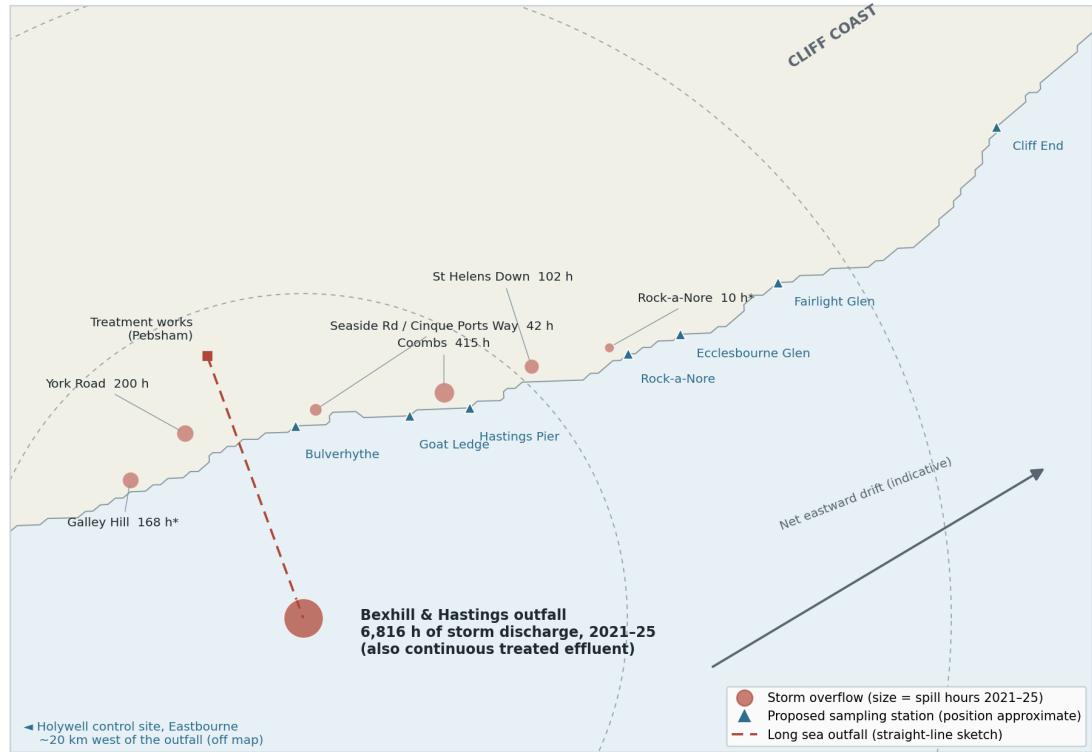


The old sewage outfall pipe at Rock-a-Nore, looking east along the cliff coast, 2008. Hastings sewage now goes to the Bexhill & Hastings treatment works and out through the long sea outfall. Photo: Julian P Guffogg, [CC BY-SA 2.0](#), via [Wikimedia Commons](#).

The main source. Bexhill & Hastings Wastewater Treatment Works at Pebsham discharges treated effluent and storm overflow through a long sea outfall about 3 km offshore, under permit A00857. It serves roughly 150,000 population equivalent, and storm flows above treatment capacity receive preliminary treatment only ([Water Projects 2003](#); [EA Consented Discharges](#)). It ranked 7th of 970 Southern Water overflows by 2025 spill count and is under high-spill review ([EA EDM returns](#); [FloodRadar](#)). The cliff coast lies roughly 6–13 km to the east, down-current on the dominant drift.

Hastings coast: where the sewage goes in, and where we propose to measure

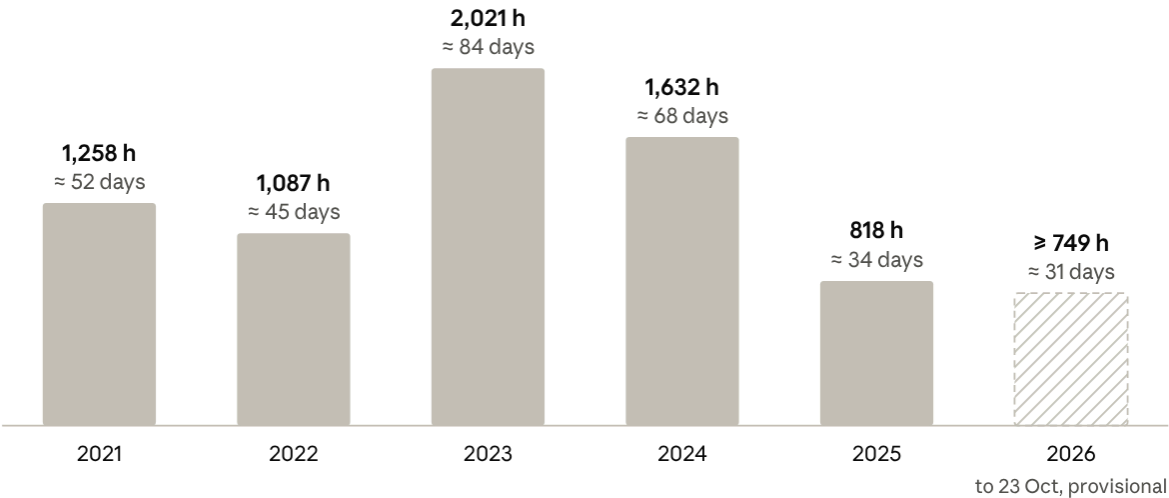
One outfall accounts for about 88% of storm-overflow hours on this frontage; the cliff coast lies about 6–13 km down-drift of it.



Spill hours: Environment Agency Event Duration Monitoring annual returns 2021–25 (via FloodRadar compilation; * 2024–25 only). Outlet positions: EA permit data; Seaside Rd and Cinque Ports Way share a site reference. Spill hours show duration, not volume. Drift arrow indicative only. Coastline: GSHHS full resolution. Hastings Kelp Project, Oct 2026.

The outfall spilled for 818 to 2,021 hours a year

Bexhill & Hastings long sea outfall, storm discharge hours. 6,816 hours in 5 years, about 284 days.



EA Event Duration Monitoring returns 2021–25 (via FloodRadar); 2026 FloodRadar running count to 23 Oct, a minimum

2023, the wettest year on the Hastings rain gauges, was also the worst for spills. The hours measure how long the outfall discharged, not how much.

Link in the chain	Proven in the literature	Known for Hastings	How to fill the gap
Source	Yes	Yes: outfall position, permit, spill history	EIR requests for volumes and effluent quality
Nutrients	Yes	No offshore monitoring found	HKP nutrient sampling at fixed stations
Water clarity	Yes	Satellite only; cliff erosion confounds it	Secchi, turbidity loggers, Sentinel-2 transects
Pathogens	Yes	Beach samples, summer only	CWAG year-round sampling
Contaminants	Partly	Nothing known	University partner analysis of a subset
Kelp response	Yes, elsewhere	Historic kelp reported; little today	Tank trials; Holywell comparison

The honest conclusion. The literature shows the harm is real and well documented elsewhere. Whether it is happening off Hastings, and how much, is an open question that the partnership's data can answer.

Our plan: a three-year trial

HKP's planned three-year programme, with the University of Brighton and Hastings Aquarium, has two aims: to measure what pollution is doing to the Hastings coast, and to test whether nature can help repair it. The repair team is kelp, working alongside native shellfish.

Why kelp and shellfish together

Kelp and filter-feeding shellfish tackle different halves of the problem, and each helps the other.

- **Shellfish clear the water.** Mussels and oysters pump seawater through their gills and strip out plankton and fine particles. A single native oyster can filter around 200 litres a day ([Blue Marine Foundation, Solent Oyster Restoration Project](#)). Clearer water means more light for kelp, and light is the main constraint off Hastings.
- **Kelp takes up dissolved nutrients.** Shellfish excrete ammonium; kelp absorbs it, along with nitrogen already in the water. Kelp forests have been estimated to remove around 620 kg of nitrogen per hectare a year ([Eger et al. 2023](#)).

- **The pairing has been tested on our species.** In a 12-week Swedish tank trial, sugar kelp grown with blue mussels took up mussel-derived nitrogen and carried about half as many epiphytes (growths on the blade) as kelp grown alone ([Hargrave et al. 2021, Journal of Applied Phycology](#)). Growth did not increase, possibly because the water already held enough nitrogen. Fewer epiphytes still matters: they can block most of the light a blade receives.
- **Both are habitat builders.** Kelp forests and oyster reefs each provide shelter and food for many other species. Restoring them is restoration, not just water treatment.

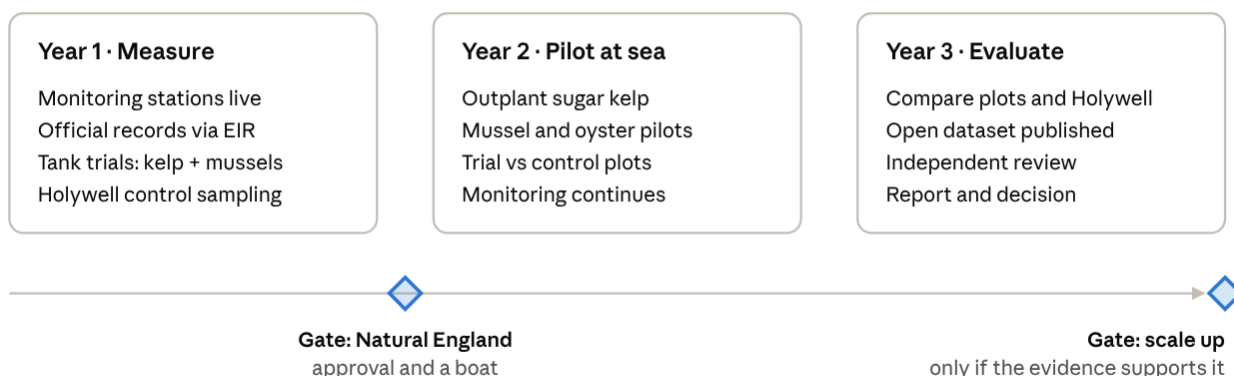


*The European flat oyster, *Ostrea edulis*, the UK's native oyster. Native oyster reefs in the UK have declined by about 95%. Photo: Ryan Hodnett, [CC BY-SA 4.0](#), via [Wikimedia Commons](#).*

This approach is known as integrated multi-trophic aquaculture when used for farming. Here nothing is harvested: the aim is a healthier coast, not a crop.

The three years

Measure first, go to sea once approved, scale only on evidence



three-year trial · 3 phases, 2 gates

Nothing goes into the sea until Natural England approves it, and nothing scales up unless the data says it should.

Year 1: Measure. Establish the monitoring partnership's sampling stations from Bulverhythe to Cliff End, with Holywell as the control. Gather official records through information requests and satellite data. In HKP's tanks, grow sugar kelp in local seawater against cleaner water, with and without blue mussels, repeating the Swedish trial under Hastings conditions.

Year 2: Pilot at sea. Subject to Natural England approval and a boat, outplant tank-grown sugar kelp juveniles at the 1995 kelp-habitat sites. Pilot mussels alongside, and a small native oyster nursery trial, with all necessary licences and biosecurity checks. Monitor water clarity, nutrients and kelp survival inside and outside the trial plots.

Year 3: Evaluate and decide. Compare trial plots with control plots and with Holywell. Publish the full dataset and an independently reviewed report. Decide, on the evidence, whether the approach is worth scaling.

What this can and cannot do

Be clear about scale. A few hectares of kelp and shellfish cannot clean up the discharges of a treatment works serving around 150,000 people. Fixing pollution at source is the water company's job, and nothing here lets anyone off that hook.

What the trial can show is whether restored kelp and shellfish improve water clarity and nutrient levels locally, whether kelp can re-establish off Hastings, and what holds it back. If it works, it gives the coast a natural ally. If it fails, the data will show why.

Shellfish in the trial will not be harvested or eaten. Filter feeders concentrate the bacteria and viruses that sewage carries, so trial sites will be clearly marked.

Open questions, tests and hypotheses

These are starting points, not conclusions. Each is framed so that data can support it or knock it down. Volunteers, students and partners are welcome to take one on through the HKP forum.

Hypotheses to test

#	Hypothesis	How to test it	Data needed
H1	Nutrient levels and turbidity rise after storm spills, beyond the effect of rain alone.	Sample within 48 hours of spills, and after heavy rain with no spill; compare.	Spill records, rainfall, nutrient and Secchi readings
H2	Nutrients and turbidity fall with distance east of the outfall.	Compare readings across the fixed stations from Bulverhythe to Cliff End.	Monthly station data
H3	On the cliff coast, cliff erosion causes more turbidity than sewage.	Compare turbidity after rain with and without spills; examine satellite images for the source of plumes.	Satellite images, turbidity, spill dates
H4	Water off Hastings has more nutrients and less light than at Holywell, where kelp grows.	Paired sampling on the same days at both sites.	Station and Holywell data
H5	Sugar kelp grows more slowly in Hastings seawater than in cleaner water.	Tank trial: local versus filtered or offshore water.	Growth, tissue nitrogen, epiphyte cover

#	Hypothesis	How to test it	Data needed
H6	Blue mussels reduce turbidity and epiphytes on sugar kelp in Hastings conditions.	Tank trial: kelp alone, mussels alone, both together.	Turbidity, ammonium, epiphyte cover, growth
H7	Turf algae on Hastings rock holds enough sediment to stop kelp settling.	Clear turf from test patches, leave controls, compare kelp recruitment.	Settlement counts, sediment depth
H8	Outplanted kelp survives better where water is clearer.	Record survival at each outplant site against local light readings.	Survival, light at depth

Open questions

- Where exactly does the outfall plume go on different tides and winds?
- Where is the second long sea outfall, and what does it discharge?
- How much nitrogen does the outfall release in a year, and how does that compare with what a hectare of kelp can take up?
- Do contaminants such as copper or pharmaceuticals reach the kelp sites at levels that matter?
- Is there grazing or other pressure on kelp off Hastings, besides water quality?
- What depth did the historic kelp reach off Hastings, and what depth could it reach now?

Ideas for further work

- **Kelp depth limit as an indicator.** Record the deepest kelp at each site each year, as Natural Resources Wales does, to track water clarity over time.
- **Nitrogen isotopes as a fingerprint.** Sewage nitrogen leaves a chemical signature in seaweed. Testing kelp or other seaweed along the coast could show how far sewage nitrogen reaches.
- **Citizen Secchi network.** Train volunteers, kayakers and surfers to take water clarity readings, building a long-term public dataset.
- **Pathogen and resistance sampling.** Work with CWAG and a university partner on antibiotic-resistant bacteria at the stations.
- **A shared, open dataset.** Publish all results in one place, so anyone can check them or test their own hypotheses.

Approaches for support

Hastings Kelp Project has asked the water company and its owners to support local monitoring and restoration. In September 2026, HKP and Southern Water planned a joint bid to an Ofwat fund for a three-year, £250,000 kelp restoration and water-quality programme; Southern Water paused the bid in October 2026. HKP then approached Southern Water's main investor, Macquarie Asset Management, and its shareholder Asterion Industrial Partners for funding for the same programme. Neither replied. The programme now continues independently, with the University of Brighton and Hastings Aquarium.

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