



SUSTAINABLE WASTEWATER SOLUTIONS for Baltic Sea Coastal Tourist Areas

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Target Audience and Sources

This document is intended for stakeholders in Baltic Sea coastal areas, including local authorities, municipalities, water utilities, tourism operators and small communities responsible for wastewater management and environmental protection. It aims to provide clear, practical and easy-to-understand information to support decision-making in areas with seasonal population changes.

The content is based on results from the [NURSECOAST-II project](#) (Interreg Baltic Sea Region), including pilot studies, practical experiences and Sanitation Safety Planning (SSP) risk assessments conducted in different Baltic Sea countries. These findings have been complemented with national guidelines and expert knowledge to ensure relevance and applicability across the region.

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SUSTAINABLE WASTEWATER SOLUTIONS
FOR BALTIC SEA COASTAL TOURIST AREAS

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Introduction

Baltic Sea coastal tourist areas face a special wastewater challenge. In summer, the number of people in small coastal villages can double, triple, or even increase tenfold. Wastewater systems that work well in winter may struggle during peak tourist season.

Many cottages, marinas, small hotels and rural communities use small or on-site treatment systems instead of large municipal sewer networks. When these systems are overloaded or poorly maintained, nutrients and bacteria can enter the Baltic Sea.

This contributes to algae blooms, poor bathing water quality, fish deaths and damage to coastal ecosystems. Clean water is not only an environmental issue – it is also essential for tourism, public health and the local economy.

This document explains practical and sustainable wastewater solutions in simple terms. It focuses on environmental protection, cost-effective choices, climate resilience and realistic solutions for small communities.

Photo: Jari Heiskanen



Key Challenges in Coastal Areas

Seasonal surges

Tourism causes sharp peaks in wastewater volumes. A plant designed for 200 permanent residents may suddenly need to serve 1000 people in summer. Short peak seasons make it difficult to justify expensive expansions.

Small treatment plants matter

Many coastal areas rely on small wastewater treatment plants (under 2000 population equivalent). Individually, they seem small, but together their impact on the Baltic Sea is significant. During peak season, these plants are especially vulnerable.

Climate change increases risks

Heavy rainfall, storms and rising water levels increase pressure on wastewater systems. Rainwater can enter sewer systems and overload treatment plants. Power outages or flooding can disrupt operations exactly when tourist numbers are highest.

Environmental sensitivity

The Baltic Sea is shallow and sensitive to nutrient pollution. Even small increases in phosphorus and nitrogen can worsen eutrophication.



Photo: Jari Heiskanen

Geographical constraints

Rocky soils, high groundwater levels and scattered housing make traditional sewer networks expensive or technically difficult.

Limited local resources

Small municipalities and water cooperatives often have limited budgets and staff. Administrative procedures and permitting processes can be slow, delaying necessary upgrades.

Regulatory Context

The European Union has strengthened its wastewater rules. The revised Urban Wastewater Treatment Directive expands requirements to smaller communities in the coming years. Even plants below strict legal thresholds can have a cumulative environmental impact.

National authorities and municipalities are responsible for ensuring that wastewater is treated properly. In many Baltic Sea countries, rural systems are being upgraded to meet higher environmental standards.

Climate resilience is also becoming part of the EU policy. New frameworks encourage better risk assessment, climate adaptation planning and protection of critical infrastructure — including small wastewater plants.

Authorities increasingly encourage shared systems and cooperative models because they are often more reliable and cost-efficient than many small individual systems.

Sustainability Considerations

Environmental sustainability

Good wastewater treatment removes nutrients, bacteria and harmful substances before water is discharged into rivers, groundwater or the sea. This protects marine ecosystems, biodiversity, bathing waters and drinking water resources across the Baltic Sea region.

Low-energy and nature-based solutions can significantly reduce greenhouse gas emissions and improve climate resilience. Constructed wetlands, soil filtration systems and gravity-based treatment solutions rely on natural biological processes and typically require less energy and maintenance than fully mechanical systems. At the same time, modern mechanical systems can also become more sustainable through energy-efficient aeration, smart automation and renewable energy use.

Climate change further increases the importance of resilient wastewater solutions. More intense rainfall, flooding and seasonal tourism peaks place growing pressure on small wastewater systems, especially in coastal and rural areas. Sustainable systems must therefore be designed to tolerate variable flows and extreme weather conditions while maintaining stable treatment performance.

The potential reuse of treated wastewater — such as UV-treated and hygienised effluent for irrigation, landscaping or other non-potable purposes — could further reduce nutrient loads to water

bodies and support water circularity. Wastewater reuse is actively promoted by EU-level strategies and policy frameworks as part of the transition towards a circular economy and more sustainable water management. However, practical implementation is still constrained by national legislation and permitting practices, which vary significantly between countries. In addition, local regulations and approval requirements must be clarified in close cooperation with municipal authorities before reuse solutions can be implemented in practice.

Nutrient recovery and sludge reuse may also contribute to more sustainable resource management. Properly treated sludge can contain valuable nutrients such as phosphorus and nitrogen, which may support circular economy goals when safely recovered and reused.

The “5R” approach supports sustainable water management:

- **Reduce** pollution and unnecessary water consumption
- **Reuse** treated water where safe and appropriate
- **Recycle** nutrients and materials
- **Recover** energy and valuable resources from sludge
- **Restore** natural water systems and ecosystems



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Together, these approaches strengthen environmental protection, improve climate adaptation and support long-term sustainability in coastal communities.

Social sustainability

Local acceptance and community engagement are essential for successful wastewater management. When residents, property owners and seasonal visitors understand how wastewater systems work and why proper treatment matters, long-term operation and maintenance improve.

Clear responsibilities, simple operating instructions and transparent cost-sharing help reduce conflicts between permanent residents, tourism businesses and seasonal users, especially in small coastal communities with shared systems.

Reliable wastewater treatment protects public health by safeguarding drinking water, reducing exposure to pathogens and preventing pollution. It also improves quality of life by reducing odors and protecting recreational waters, beaches and natural areas.

Social sustainability also requires local knowledge and technical capacity. Training, guidance and awareness-raising help operators, municipalities and households maintain systems properly and respond to disturbances or emergencies. In rural

areas, practical guidance and access to professional support are especially important.

Transparent communication and inclusive decision-making strengthen trust between communities, authorities and service providers, improving acceptance of necessary investments and environmental measures.

Economic sustainability

Modern wastewater systems require investment, but poorly functioning systems often create significantly higher long-term costs through environmental damage, health risks, infrastructure failures and loss of tourism income.

Shared or cooperative systems can reduce per-household costs and enable more professional operation and maintenance. Regional cooperation between municipalities, utilities and local stakeholders may also improve efficiency and access to expertise.

Preventive maintenance and regular monitoring are economically important because they help avoid costly emergency repairs and environmental incidents. Nature-based and low-energy systems may also reduce long-term operating costs, especially in sparsely populated rural areas.

Importantly, funding support is widely available in many Baltic Sea countries. Small municipalities, water cooperatives and even private households can often apply for:

- National rural infrastructure grants
- EU Cohesion Fund support
- Environmental innovation grants
- Municipal support schemes
- Low-interest public loans
- Tax deductions for renovation work

Access to these funding tools significantly improves feasibility for small communities and helps accelerate the transition towards safer and more sustainable wastewater management solutions.



Treatment Options Overview

Nature-based systems

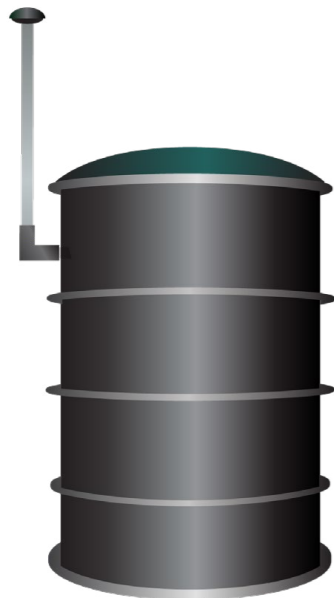
Soil filters and constructed wetlands use natural bacteria and plants to treat wastewater. They require little energy and blend into the landscape.

Aerated or hybrid wetlands can handle higher seasonal loads and improve nitrogen removal. They are particularly suitable for rural tourist areas.

Packaged treatment units

Small factory-built treatment plants can achieve high purification levels. They require electricity and regular maintenance but can meet strict environmental standards.

They are useful where soil conditions do not allow infiltration systems.



Shared community systems

Instead of each property treating wastewater individually, multiple users can share one system.

Benefits include:

- More stable operation
- Lower costs per household
- Easier access to funding
- Professional management

Many successful examples exist in Baltic coastal villages.

Innovative upgrades: Nanobubble aeration

New aeration technologies use extremely small air bubbles that dissolve oxygen more efficiently.

Benefits:

- Increased treatment capacity during tourist peaks
- Improved nutrient removal
- Lower energy consumption
- Easy integration into existing plants

Pilot projects in Baltic Sea countries show promising results, especially for small plants facing seasonal overload.

Constructed Wetlands (Nature-Based Systems)

HOW IT WORKS:

Constructed wetlands treat wastewater using natural processes involving plants, soil and microorganisms. Wastewater flows slowly through a shallow basin filled with vegetation (such as reeds), where pollutants are removed through biological activity, filtration and sedimentation.

ADVANTAGES:

Wetlands are energy-efficient and environmentally friendly. They use natural processes, require little mechanical equipment and can be visually integrated into the landscape. They are also relatively robust and can tolerate fluctuations in flow, which makes them suitable for seasonal tourist areas. Life time is typically 20–30 years.

LIMITATIONS:

Wetlands require space and careful design to function properly. Treatment performance may vary depending on temperature and seasonal conditions, especially in colder climates. Regular maintenance is needed to prevent clogging and ensure proper flow distribution.

USE CASE:

Constructed wetlands are well suited for small communities, rural tourism areas and locations where nature-based solutions are preferred. They can also be combined with other systems (hybrid solutions) to improve performance and resilience. As an indicative planning value, they may require around 2–5 m² per population equivalent (PE). By using intensified constructed wetland, this number can be reduced to 1 m² per PE. Construction costs vary widely, but a preliminary estimate of 100–300 €/m² can be used for early comparison.

Photo: Jari Heiskanen



Soil-Based Systems (Infiltration Fields)

HOW IT WORKS:

A septic tank first settles out solids, then partially treated water flows into a buried sand or gravel filter bed (or leach field). Natural soil bacteria in the sand/soil bed digest organic waste and pathogens as the water percolates through. By the time it reaches groundwater, it's much cleaner.

ADVANTAGES:

Simple and robust – requires no electricity or complex machinery, just periodic sludge emptying from the septic tank. These systems are quiet and out-of-sight. They have a long lifespan (15–30 years) before the soil media clogs or needs renewal. Maintenance is low and mostly infrequent. Also, there's no continuous cost besides occasional pumping and eventual refurbishment.

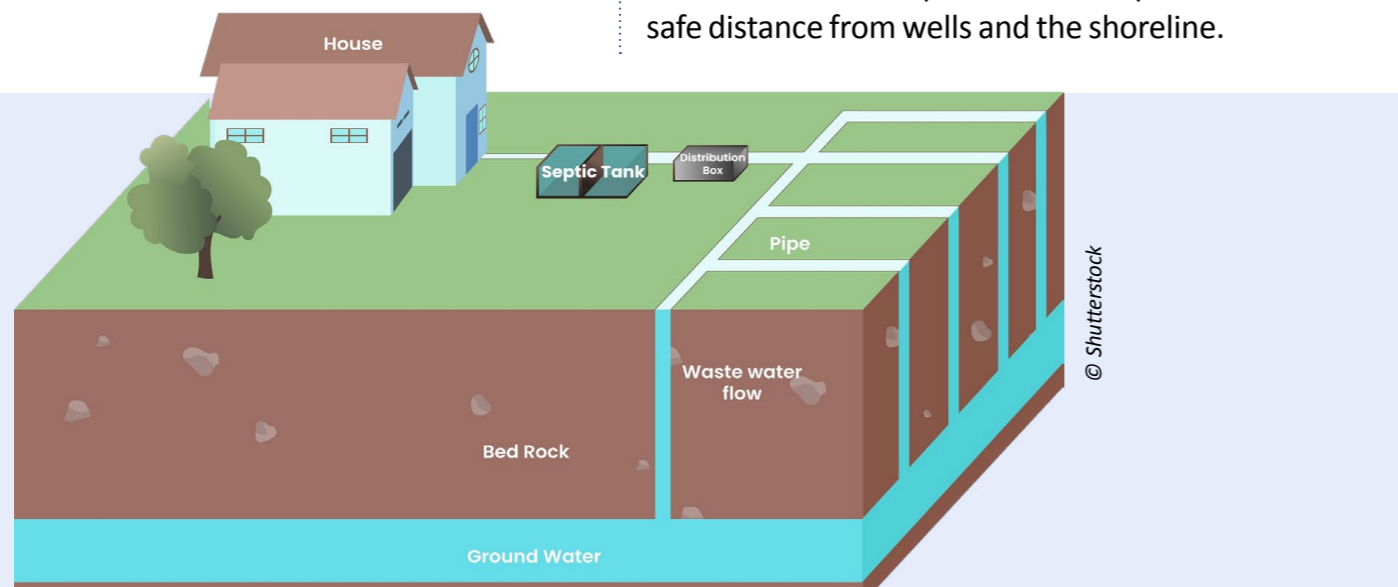
LIMITATIONS:

They need the right soil conditions (permeable sand/gravel and sufficient area).

If the ground is too rocky, clayey, or water-logged, infiltration won't work. Nutrient removal is limited – while they remove most organic matter and bacteria, removing phosphorus and nitrogen is harder (phosphorus filtering declines over time, and nitrogen passes mostly untreated). In sensitive coastal zones, extra measures (like P-sorbing filter materials) might be needed. Eventually, the sand bed must be replaced (typically every 10–20 years as it clogs).

USE CASE:

Best for single-family homes or small clusters where soil is suitable and nutrient loads are moderate. It's the lowest-cost conventional option (often €2000–€6500 to install). Typical land requirements are around 5–15 m² per population equivalent (PE), with construction costs often ranging from €30–100/m². For many Baltic summer cottages with ample land, a well-built sand filter offers a reliable, low-tech solution – provided it's kept at a safe distance from wells and the shoreline.



Small-Scale Treatment Plants (Packaged Units)

WHAT THEY ARE:

Factory-made “mini wastewater plants” that can be buried on-site. These units use electric pumps, aeration, and sometimes chemical dosing to mimic a full-scale municipal treatment process in a compact package. Wastewater is actively treated in stages (settlement, biological digestion, and often phosphorus precipitation) within one enclosed system.

PERFORMANCE:

They achieve high purification levels, meeting strict standards for organic matter and nutrient removal. With proper operation, effluent from a good small plant can have very low BOD and phosphorus, and some designs also remove nitrogen. This makes them suitable in sensitive areas where a simple septic might not be enough.

REQUIREMENTS: These systems do need an energy source (for blowers, pumps) and regular attention. Owners or service providers must perform maintenance like cleaning filters, refilling chemicals (e.g. adding precipitant for phosphorus), and servicing pumps. Many units are mostly automatic, but they will not work optimally if neglected – a degree of user involvement or a maintenance contract is necessary.

COST:

Higher than passive systems. Installation can range roughly €5000–€10 000 per household, plus ongoing costs (€200–€750/year for electricity, service, consumables). However, they are durable when maintained, and their superior treatment can make them worth the investment to protect local waters. They're often recommended if soil-based methods aren't feasible or if regulations demand extra pollution reduction.



Photo: Jari Heiskanen

Nanobubble Technology – An Innovative Solution

WHAT IS IT:

Nanobubble aeration is a cutting-edge way to improve wastewater treatment by injecting ultra-fine air bubbles (on the nanometer scale) into the water. These bubbles, much smaller than those from typical aerators, stay suspended in water far longer and dissolve more oxygen into the wastewater. Nanobubbles can be used alongside conventional aeration to enhance efficiency, or as a standalone aeration method.

WHY USE NANOBUBBLES:

Small treatment plants often struggle with aeration – keeping oxygen levels high for the bacteria is energy-intensive. Nanobubbles increase oxygen transfer efficiency. This means the biological part of treatment can handle higher loads (helpful during tourist peaks) and run more reliably.

BENEFITS FOR COASTAL PLANTS:

Nanobubble systems can be retrofitted into existing tanks to boost performance without major construction. By improving treatment (especially for harder-to-break-down pollutants) and handling surges better, they reduce the risk of any untreated overflow during summer spikes. Literature data suggest that they also produce micro-oxidants when bubbles collapse, which can help in cleaning water and reducing odor and biofilm (an added plus for small systems).

CURRENT STATUS:

This technology is innovative and being piloted in the Baltic region. For example, the Næstved pilot in Denmark (part of the NURSECOAST-II project) is testing nanobubble aeration to reduce energy costs and improve treatment in a municipal plant's small-scale setup. Early results are promising, suggesting nanobubbles could become a practical upgrade for tourist area wastewater plants in the near future.



Photo: Morten Lyggegaard Christensen

Shared and Community-Based Solutions

ONE SYSTEM, MULTIPLE USERS:

Instead of dozens of individual septic systems, a shared solution connects several homes, cottages, or businesses into a collective treatment system (or a small sewer network leading to a central plant). For example, a village might build one modern treatment plant to serve the whole community, or a group of neighboring holiday cottages might share a common sand filter bed.

KEY ADVANTAGES:

Larger combined systems benefit from economies of scale. Treatment tends to be more effective and stable when serving a higher, steadier flow, and it's easier to justify advanced technology (like chemical nutrient removal) when many users share it. Professional operation is more feasible – the community can hire a qualified operator or involve the municipality, rather than each owner struggling alone. This means better reliability and compliance with environmental standards.

COST SHARING:

While a shared plant has a higher total cost, that expense is split across households. In practice, the cost per

household will typically be lower than if everyone installed their own unit. Joint projects often qualify for government or EU subsidies too, further reducing the burden. Over time, maintenance and monitoring costs per family are typically lower in a cooperative system than maintaining many separate systems.

CHALLENGES:

It requires community cooperation. Neighbours must agree on plans, governance, and cost-sharing. Setting up a water cooperative or similar arrangement is essential. Good communication and clear agreements (who is responsible for what) prevent conflicts down the line. Despite these hurdles, many Baltic Sea communities have succeeded with this model – for instance, “village cooperatives” in Finland and Poland have built shared plants that significantly improved local water quality. The payoff is a more sustainable and robust solution that no single household could achieve alone.

Managing Risks: Sanitation Safety Planning (SSP)

Why risk management matters?

Small wastewater systems in coastal tourist areas are vulnerable to failures caused by peak loads, power outages, heavy rainfall, or insufficient maintenance. Even short disruptions during the tourist season can result in pollution incidents with serious consequences.

What is Sanitation Safety Planning?

Sanitation Safety Planning (SSP) is a structured, preventive approach recommended by the World Health Organization. Instead of reacting to incidents, SSP helps operators identify risks in advance and put control measures in place.



Typical risks and controls

Small wastewater systems are vulnerable to:

- Heavy rainfall
- Power outages
- Hydraulic overload during tourism peaks
- Equipment failure
- Insufficient maintenance

Sanitation Safety Planning is a preventive approach that helps identify risks early and define practical solutions.

Typical measures include:

- Backup generators
- Flow equalization tanks
- Regular inspections
- Clear emergency procedures
- Defined operational responsibilities

This structured risk-based approach improves reliability without excessive cost.

Choosing the Right Wastewater Solution in Coastal Tourist Areas

Coastal communities have different wastewater challenges depending on soil conditions, seasonal tourism peaks, available funding and local management

capacity. The table below summarises the main strengths, weaknesses, opportunities and risks of the most common wastewater treatment options.

Table 1 SWOT: Wastewater treatment options

SOLUTION	STRENGTHS (What works well)	WEAKNESSES (Limitations)	OPPORTUNITIES (What can improve)	Risks (What can go wrong)
Soil-based systems (sand filters, infiltration fields)	Simple, low energy use, affordable, long lifespan	Need suitable soil and space, limited nutrient removal	Improved phosphorus filters, hybrid systems	Flooding, groundwater contamination, overload during peak tourism
Small packaged treatment plants	High purification level, compact, suitable for sensitive coastal zones	Need electricity and maintenance, higher operating costs	Remote monitoring, energy-efficient upgrades	Power outages, poor maintenance, equipment failure
Nature-based systems (constructed wetlands)	Very low energy use, environmentally friendly, climate-resilient	Require land area, performance can vary in winter	Hybrid systems, eco-tourism image, EU support funding	Overloading during tourist peaks, clogging, insufficient upkeep
Shared community systems	Cost sharing, professional management, stable operation	Require cooperation and agreements	Access to grants, better technology possible, long-term savings	Delays in decision-making, unclear responsibilities
Nanobubble technology (innovative aeration)	Improves treatment efficiency, reduces energy use, handles peak loads	New technology, investment cost	Easy upgrade for existing plants, energy savings	Technical reliability, lack of experience, maintenance gaps

Funding and Support Opportunities

Upgrading wastewater systems can seem expensive — but you rarely have to pay for everything yourself. Across the Baltic Sea Region, there are many grants, loans and support schemes to help villages, municipalities and homeowners improve wastewater treatment and protect local waters.

National grants

Most countries provide investment grants for wastewater improvements, especially in rural areas and small treatment plants (under 2000 people equivalent).

Examples:

- **Finland:** Economic Development Centres and rural development funds can cover up to 65–70% of costs for water cooperatives and rural projects.
- **Sweden (LOVA):** Up to 90% funding for projects that reduce nutrient pollution.
- **Denmark & Germany:** 30–75% (and in some cases even higher) for innovative or environmental upgrades.
- **Baltic States:** Estonia, Latvia and Lithuania offer strong support for municipalities and small utilities.

Support for homeowners

If you own a house or cottage, you may also receive help:

- **Renovation grants** for elderly or low-income households (e.g. up to 50–70% in Finland).
- **Municipal compensation** for installing individual treatment systems (e.g. Lithuania).
- **Tax deductions** for installation work in some countries.

EU Funding – supporting innovation and rural areas

The European Union supports water protection through:

- **Interreg programmes** – cross-border pilot solutions and testing new technologies.
- **Cohesion and Rural Development funds** – co-financing sewer networks and small treatment plants.
- In some cases, recovery or rural funds may cover up to 100% of eligible costs.

These funds often help test and introduce new solutions such as wetlands, energy-efficient aeration, nutrient removal technologies or smart digital control systems.

Loans and public-private partnerships

When grants are not enough, low-interest loans are often available:

- National environmental banks (e.g. Germany, Poland)
- Municipal loan programmes
- European institutions such as the Council of Europe Development Bank

Some municipalities also use public-private partnerships (PPP) to modernise wastewater plants.

Local municipal support

Many municipalities provide:

- Small subsidies
- Loan guarantees
- Planning and technical guidance
- Help with permits and applications

Early contact with local authorities often makes a big difference.

Innovations and Future Trends



Conclusions

Wastewater management in Baltic coastal tourist areas requires practical, flexible and climate-resilient solutions.

Small treatment plants may seem minor individually, but together they play a major role in protecting the Baltic Sea.

By combining:

- Seasonal adaptation
- Nature-based and hybrid solutions
- Innovative technologies
- Shared community systems
- Risk-based planning
- Climate resilience
- Smart funding tools

Coastal communities can protect their environment, strengthen tourism and secure long-term sustainability.

Clean water
is not only
an environmental necessity
— it is a foundation for
healthy coastal life and
future prosperity.

Recommendations for Baltic Sea Coastal Communities

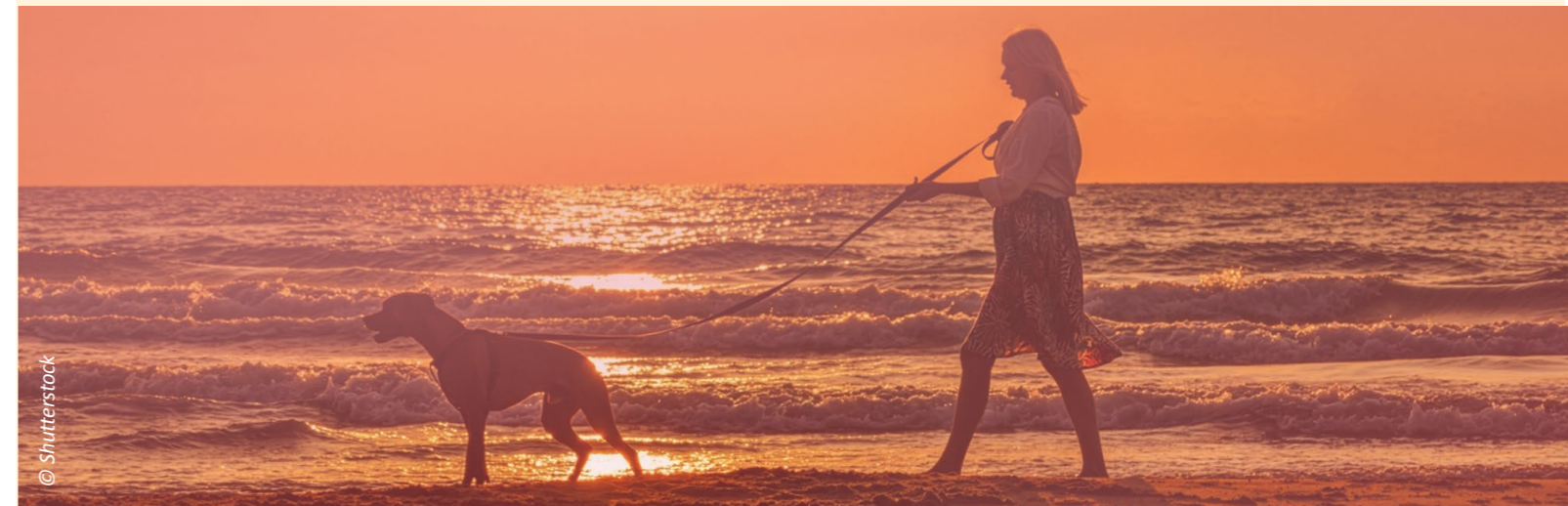
- Prioritize risk-based planning using sanitation safety planning to prevent failures during peak seasons
- Select technologies that match local conditions and operational capacity
- Encourage shared and cooperative wastewater solutions where feasible
- Actively seek national and EU funding to improve affordability
- Treat wastewater management as an ongoing service, not a one-time investment

Read more about project publications

- <https://interreg-baltic.eu/project/nursecoast-ii/>
- [Policy Brief: Adapting Wastewater Management to Seasonal Tourism Peaks in the Baltic Sea Region](#)
- [Review of the Seasonal Wastewater Challenges in Baltic Coastal Tourist Areas](#)
- [Technical preparation for wastewater treatment investments at BSR tourist destinations](#)
- [Maps for the touristic seasonality areas and technology criteria for pilots](#)

See also these materials:

- Animation: [A Baltic Tale – Sustainable Wastewater for a Touristic Restaurant](#)
- Web-based tool help you select best wastewater treatment solution for your needs [Information tool](#)
- [Solutions for Wastewater](#)
- [A Guide to Wastewater](#)
- [A Guide to Summer Cottage Wastewaters](#)



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