



# When Rain Becomes A System Challenge

Managing Urban Stormwater Under Pressure

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# The Scale of the Challenge: Climate, Pollution & Urban Pressures

Climate observations across Northern Europe show a clear rise in extreme rainfall, with projections indicating further intensification toward 2050. Across Denmark and the South Baltic region, short-duration, high-intensity rainfall (“cloudbursts”) is projected to increase by 20–40% by mid-century, making these events the primary stressor on urban drainage systems.

Most urban drainage infrastructure was designed for 5–10 year return periods, while recent cloudbursts increasingly exceed these thresholds several times per decade. This widening gap between system capacity and hydraulic load is driving more frequent combined sewer overflows (CSOs) and surface flooding.

Urbanisation compounds the challenge. Over the past two

decades, impermeable surfaces in major Danish cities have increased by an estimated 10–20%, accelerating runoff and reducing infiltration. Stormwater is therefore no longer primarily rainwater. Monitoring across the Baltic region consistently detects:

- Microplastics from tyre wear, roofing materials, and road runoff
- Measurable PFAS in runoff from traffic areas, airports, and some industrial zones
- Metals and hydrocarbons linked to urban surfaces and legacy contamination

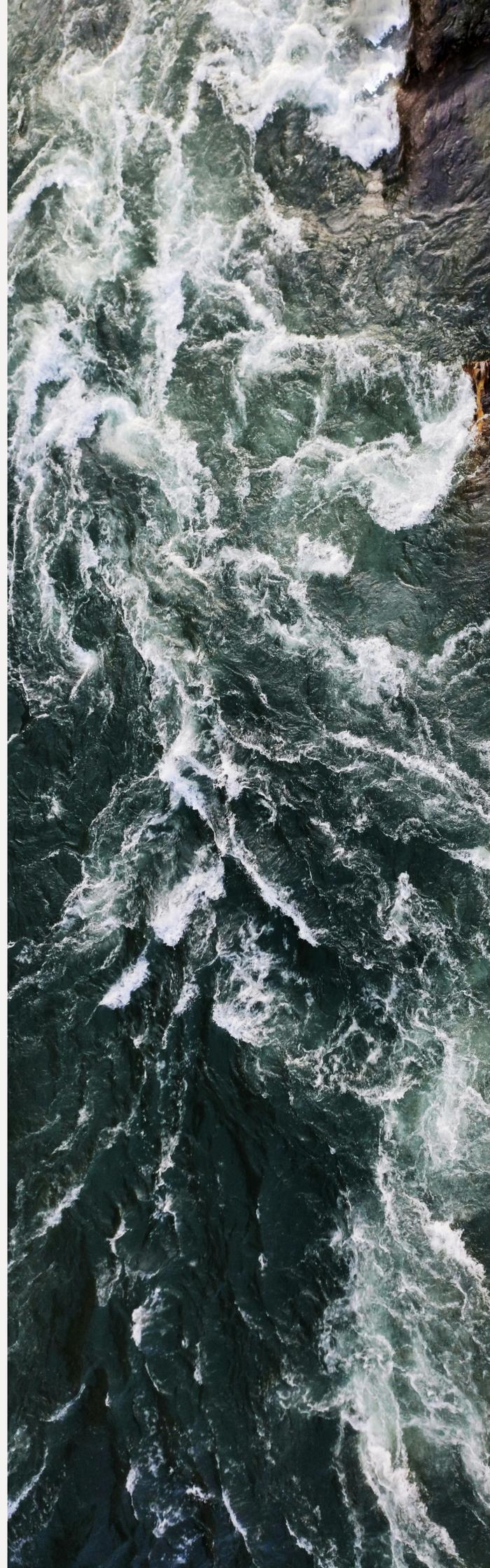
While point sources remain regulated, Baltic Sea assessments indicate that diffuse sources, including urban stormwater, contribute a material share of nutrient and hazardous substance loads, elevating runoff management as a prerequisite for meeting regional marine protection targets.

The impacts extend beyond water quality. Across Europe, pluvial flooding already causes several billion euros in annual losses, while Danish assessments estimate long-term climate adaptation investments in the tens of billions of kroner, with stormwater infrastructure accounting for a significant share.

Utilities and municipalities therefore face a convergence of pressures:

- Hydraulic loads exceeding original design standards
- More complex pollutant mixtures and regulatory scrutiny
- Rising expectations for monitoring, documentation, and environmental performance

Stormwater management is consequently shifting from a background operational concern to a visible political, financial, and compliance risk.



# Policy and Regulatory Drivers: From the EU to Local Utilities

## EU Level: Direction and Obligation

At EU level, stormwater is gaining regulatory weight. The revised Urban Wastewater Treatment Directive (UWWTD) strengthens requirements for combined sewer overflows, including monitoring, reporting, and reduction planning. While member states retain flexibility in how reductions are achieved, expectations for documentation, transparency, and demonstrable progress are significantly higher.

Together with the Water Framework Directive (WFD) and Marine Strategy Framework Directive (MSFD), this establishes a compliance logic in which diffuse urban runoff can no longer be excluded from responsibility for failing water quality objectives. The Zero Pollution Action Plan reinforces this shift by explicitly targeting PFAS, microplastics, and

chemical mixtures, even as monitoring methods and thresholds continue to evolve.

For municipalities and utilities, the implication extends beyond technical adaptation to institutional accountability: the ability to demonstrate that stormwater impacts are understood, managed, and progressively reduced.



# Danish Level: Translation into National Priorities

Denmark has translated EU ambitions into national climate adaptation and environmental strategies emphasising:

- Urban flood risk reduction and cloudburst management
- Improved stormwater quality and pollutant control
- Increased use of nature-based and multifunctional solutions
- Heightened focus on PFAS and other emerging contaminants

National guidance generally avoids prescriptive technology choices but increasingly sets performance-

based expectations, particularly around risk mapping, monitoring, and investment prioritisation. This creates:

1. Greater flexibility in solutions, favouring innovation and local adaptation
2. A higher burden of proof on municipalities and utilities to justify chosen approaches

Stormwater systems are therefore assessed not only on functionality, but on whether environmental performance can be documented and defended.



# Municipalities and Utilities: Practical Impact

For municipalities and utilities, the evolving policy landscape represents a growing compliance and governance challenge, rather than a purely hydraulic one. Most stormwater systems were designed to convey water efficiently—not to quantify pollutant loads, assess overflow impacts, or support regulatory reporting.

## **Key structural challenges include:**

### **I. Limited monitoring and data availability**

Many systems lack fixed monitoring points or continuous measurement, limiting the ability to answer basic regulatory questions on overflow frequency, discharged volumes, and pollutant loads. This increasingly constitutes a compliance risk, not merely a knowledge gap.

### **II. Diffuse and event-driven pollution**

Stormwater pollution is episodic and highly variable, driven by rainfall intensity, dry-period buildup, and urban surface characteristics—many outside direct operational control—complicating both management and accountability.

### **III. Fragmented responsibilities and budgets**

Stormwater management spans utilities, municipal planning, road authorities, and environmental regulators. Misalignment between decision authority, budget ownership, and compliance responsibility slows implementation and increases institutional risk.

### **IV. Emerging pollutants and political sensitivity**

PFAS and microplastics attract high public and political attention. Even limited detections can trigger scrutiny and demands for action, raising the reputational stakes for municipalities.

# Who Decides, Who Pays, and Who Feels the Pressure

In practice, stormwater investments are shaped by three overlapping decision logics:

- **Utilities and technical departments:** Focus on operational reliability, cost efficiency, and regulatory compliance. They are typically the technical buyers of monitoring systems, treatment units, and control solutions.
- **Municipal leadership and finance departments:** Hold budget authority and political accountability. Their primary concerns are flood risk, public perception, long-term liability, and alignment with national climate adaptation commitments.

- **Regulators and environmental authorities:** Do not buy solutions directly but define the compliance envelope. Increasingly, their focus is on documentation, transparency, and risk-based prioritisation rather than uniform standards.

This dynamic favours solutions that:

- Reduce visible risk (flooding, pollution incidents)
- Produce defensible data for reporting and dialogue
- Can be deployed incrementally, without requiring full system replacement

As a result, monitoring, decision-support tools, and decentralised interventions are often easier to approve and finance than large, monolithic infrastructure upgrades.

# ReCircWater: Turning Stormwater Overflow into a Managed Resource

Across the Baltic Sea region, stormwater overflow is increasingly recognised as a shared environmental challenge. More intense rainfall, widespread combined sewer systems, and urban runoff laden with nutrients and hazardous substances are contributing to deteriorating water quality and growing pressure on municipalities and utilities. ReCircWater is responding directly to this challenge by addressing stormwater overflow as both a pollution risk and a strategic opportunity for climate-resilient water management.

The project focuses on urban stormwater and combined sewer overflows as significant but under-managed sources of pollution, while also recognising their potential as future water resources. Rather than relying solely on large-scale infrastructure expansion, ReCircWater develops compact, adaptable solutions that can be deployed at critical discharge points where environmental and regulatory pressures are highest.

At the core of ReCircWater are pilots and practical methods for improved stormwater analysis and treatment. The project tests combinations of treatment technologies designed to reduce nutrients, hazardous substances, and emerging contaminants such as microplastics and PFAS. In parallel, ReCircWater strengthens monitoring and analytical methods, enabling utilities and municipalities to better understand stormwater impacts, document performance, and support regulatory dialogue.

Finally, the project explores frameworks for stormwater storage and reuse, contributing to circular water strategies and climate adaptation by reducing pollution loads while easing pressure on conventional water resources. Through cross-border collaboration, capacity building, and shared guidelines, Clean is the project lead of ReCircWater as it supports a transition toward more resilient and future-ready stormwater management across the Baltic Sea region.

# Technology Responses & Readiness

Cities are responding with a mix of established and emerging solutions, each at different maturity levels and driven by distinct adoption pressures.

## **Compact Multi-Step Treatment Systems**

Readiness: Commercially available, early-scale deployment

Adoption is driven by space constraints, PFAS scrutiny, and the need for targeted treatment at high-risk discharge points. Key barriers remain cost per treated cubic metre and uncertainty around long-term regulatory thresholds.

## **Digital Monitoring and Predictive Tools**

Readiness: Rapidly maturing, uneven adoption  
Primarily driven by documentation and compliance requirements.  
Increasingly viewed as a prerequisite for credible overflow management, investment prioritisation, and regulator dialogue.

## **Nature-Based Solutions (NBS)**

Readiness: Proven but site-dependent

Favoured for co-benefits such as cooling and biodiversity, but adoption depends on land availability and confidence in performance predictability.

## **Stormwater Storage and Reuse**

Readiness: Emerging to established  
Linked to climate resilience strategies, with strongest uptake where reuse delivers clear local value.

**Together, these technologies point toward hybrid systems that combine grey infrastructure, digital intelligence, and nature-based elements rather than single-solution approaches.**

# Solutions from the Clean Ecosystem

Beyond defining the scale of the stormwater overflow challenge, Clean's ecosystem includes companies that already deliver technologies and solutions addressing key aspects of this issue in practice. These companies operate across monitoring, data integration, and localised system control—areas that are increasingly critical as utilities and municipalities face higher expectations for documentation, transparency, and adaptive management of stormwater and combined sewer overflows.

**Aquasense ApS** contributes advanced sensing solutions for water systems, enabling continuous measurement of parameters such as water level, flow, and quality in dynamic urban environments. Such instrumentation supports early detection of abnormal conditions during heavy rainfall events and provides the data foundation needed to understand system performance under stress. Reliable, high-resolution measurements are a prerequisite for both operational

response and longer-term investment prioritisation in stormwater infrastructure.

**Consibio (Consibo IVS / Consibio ApS)** provides digital monitoring platforms and analytics that translate raw sensor data into actionable insights for utilities and municipalities. By enabling real-time tracking of overflow events, historical trend analysis, and structured reporting, Consibio's solutions directly support the growing regulatory emphasis on documentation and demonstrable progress in managing stormwater impacts. These tools help bridge the gap between technical operations and regulatory dialogue, making diffuse and event-driven pollution more visible and manageable.

**SmartBrønd** focuses on intelligent monitoring and control solutions embedded directly in sewer and manhole infrastructure. By integrating sensors and communication technologies at critical network points, Smart Brønd enables targeted oversight of stormwater and combined sewer systems where overflows are most likely to occur. This localised approach supports incremental deployment and risk-based prioritisation—an increasingly favoured strategy as utilities seek scalable solutions without full system replacement.

Together, these Clean member companies illustrate how Danish technologies already address central challenges associated with stormwater overflow: limited data availability, event-driven system stress, and rising demands for accountability. Their solutions reflect the broader shift toward hybrid stormwater management approaches that combine physical infrastructure with digital intelligence, supporting more resilient and future-ready urban water systems.

## Distribution of Technologies in the Clean Ecosystem

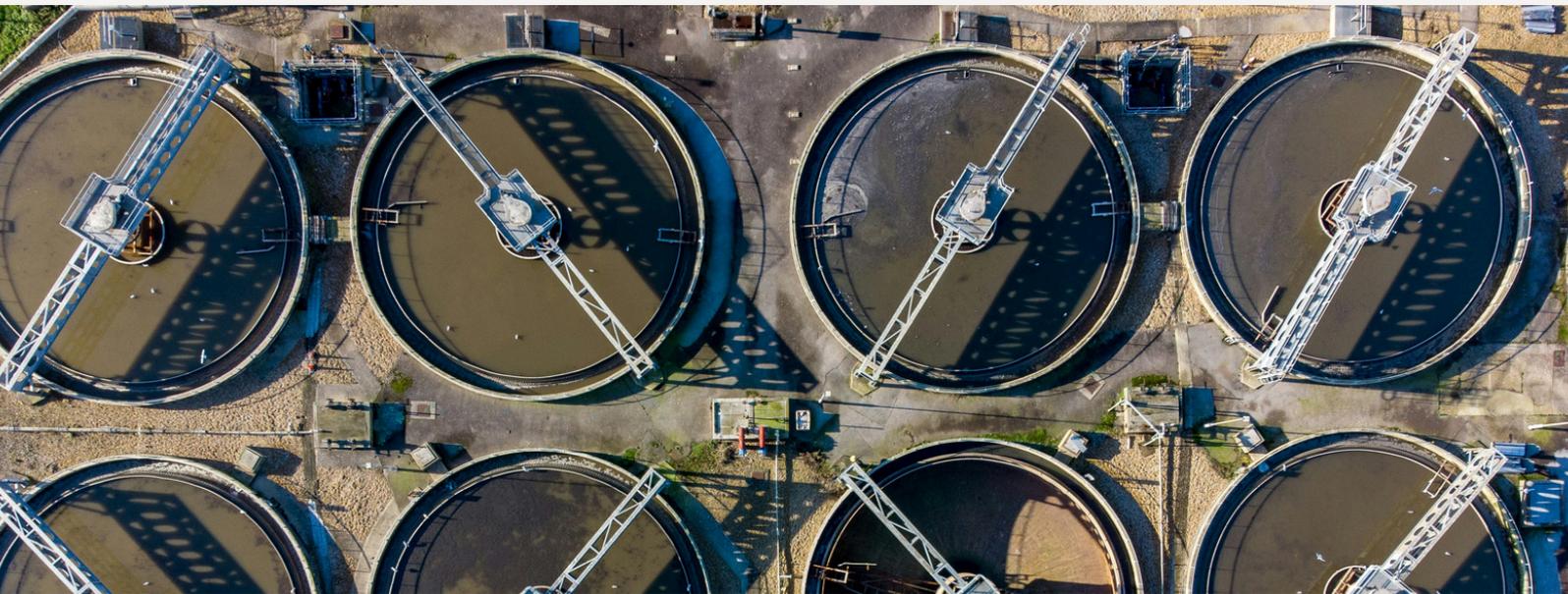


# Business Opportunities for Danish Companies

The transition toward smarter stormwater management is creating opportunity areas aligned with Danish strengths:

- Decentralised treatment technologies for pollutants of concern
- Monitoring, data integration, and analytics supporting compliance
- PFAS and microplastic removal solutions
- Hybrid grey–green system design and integration
- Stormwater reuse solutions linked to climate resilience

Typical buyers include municipalities, utilities, developers, and infrastructure owners, with growing export potential across Northern Europe and the Baltic region.

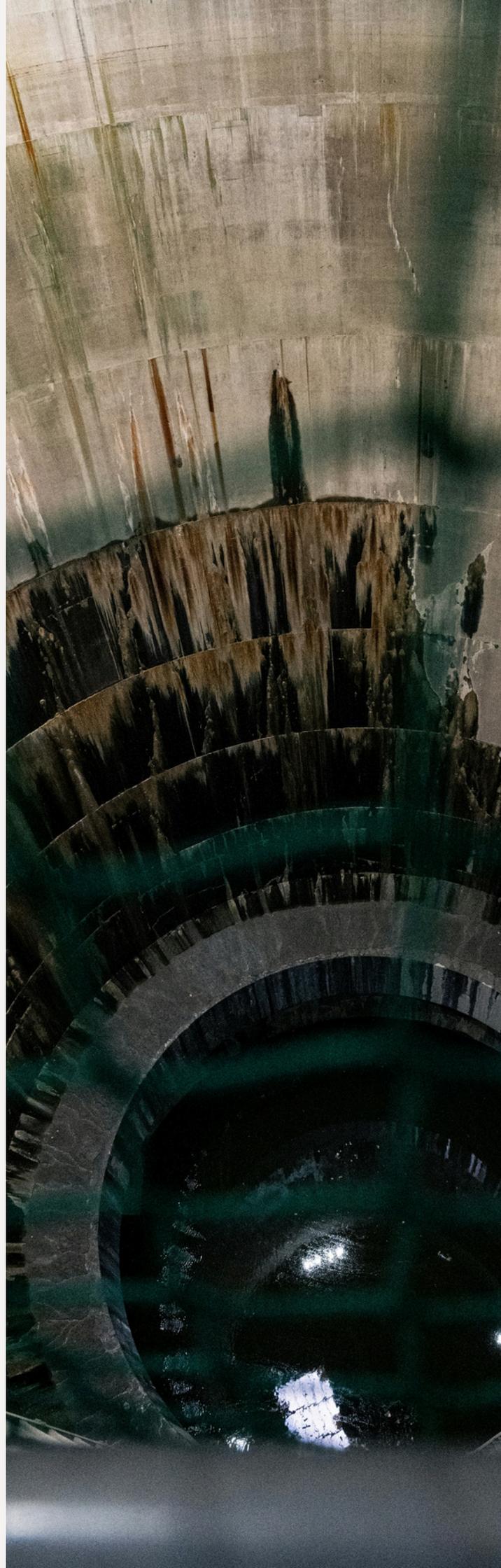


# How Clean Can Support Companies

Clean plays a central role in Denmark's water innovation ecosystem by:

- Connecting companies with municipalities and utilities
- Translating policy and regulatory trends into concrete market needs
- Supporting pilots, demonstrations, and scaling
- Facilitating international collaboration and export readiness

By bridging policy, technology, and practice, Clean helps reduce risk and accelerate adoption of innovative stormwater solutions.



# Get Involved

Stormwater management is becoming a defining challenge for cities, utilities, and water environments across Denmark, EU and Globally.

As pressures from climate change, regulation, and pollution increase, collaboration and shared learning are essential to developing solutions that work in practice.

Clean brings together companies, municipalities, utilities, and knowledge institutions to support innovation, testing, and implementation within areas such as stormwater management, water reuse, and climate adaptation.

Through projects, pilots, and international cooperation, Clean helps translate emerging challenges into concrete action.

If the topics explored in this report are relevant to your organisation, there are opportunities to engage through ongoing projects, knowledge exchange, and future initiatives.

Learn more about Clean's activities  
and how to get involved at

**[cleancluster.dk](https://cleancluster.dk)**

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## Clean Insights Report

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