From OSS to LOSS: A Case Study Analysis of Puget Sound Community Wastewater Transitions

Prepared by:

Raye Evrard

PUGET SOUND INSTITUTE
UNIVERSITY of WASHINGTON

December 2025

ACKNOWLEDGEMENTS

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement CE-01J97401 through the Puget Sound Partnership. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency or the Washington Department of Fish and Wildlife, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

The author wishes to thank the practitioners, agency staff, and colleagues who provided feedback and content for this report. Your knowledge was indispensable to understanding the world of wastewater among these communities. They include: Andrew Jones, Brian Topolski, Heather Kortuem, Jeff Wilson, Jeremy Simmons, John Keiss, John Poppe, Kathleen Pozarycki, Leigh McIntire, Lynn Schneider, Mark Burch, Mindy Brooks, Seth Elson, Steve Tolzman, Tamara Cowles, Sylvia Kantor, Christopher Andrew James, and Aimee Kinney. The author alone is responsible for any remaining errors or omissions.

Special thanks to Marielle Kanojia for her assistance throughout this report, and to Audrey Coyne, Clara Hard, and the whole Shellfish Strategic Initiative Lead team for their interest in this topic and trust in the author to develop this document.

EXECUTIVE SUMMARY

In rural areas, onsite sewage systems (OSS) are the primary wastewater treatment infrastructure. Across the Puget Sound region, many OSS are aging, poorly maintained, and at risk of failure. To address these aging systems, the Washington State Department of Health works with county-level Local Health Jurisdictions to inspect, repair, and replace systems that are at risk.

Repairing or replacing an OSS is an expensive process, costing on average $34,000. Additionally, repairs may be infeasible due to site and space limitations, particularly when a new drainfield site would be required. When a repair or replacement of an existing OSS is not possible, an alternative solution is needed. Two potential alternatives are Community Drainfields or large onsite sewage systems (LOSS). These alternatives use communal drainfields, which can be located off-site from the buildings served, reducing spatial requirements on individual parcels. There are tradeoffs, however, and developing and managing the long-term performance of a community-based system can be complicated.

The purpose of this report is to describe these tradeoffs and considerations, and to highlight the challenges and lessons learned from communities that have completed this transition. The lessons were identified during the development of a set of case studies, focusing on three communities: Fall City in King County, Packwood in Lewis County, and Maple Grove in Island County. Information collected for the case studies was obtained by reviewing publicly available reports and presentations, as well as consulting with expert practitioners.

An objective of this exercise is to bridge the knowledge gap between local practitioners working directly on OSS transition projects and state planners and agencies who may want to support the use of Community Drainfields or LOSS to address the aging OSS problem.

Lessons learned from the case studies indicate that a successful community wastewater transition is driven by strong leadership from political and local champions, an understanding of community desires for growth, and openness to creative solutions. Challenges include identifying a suitable drainfield location, navigating zoning and permitting processes, and securing funding. The report concludes with reflections derived from a comprehensive review of the three case studies, drawing on key discussion points from practitioners. Reflections from the case study are:

- The willingness to use enforcement actions like denying building permits can be one of the most effective ways to drive wastewater transitions.
- Identifying priority geographies that are well-suited for wastewater transitions can allow for proactive support for those communities through education and permitting coordination.
- Supporting local champions with funding, training, and/or technical assistance can help build and sustain buy-in for wastewater transitions.

- Clarifying community values early helps keep the focus on workable solutions.
- Finding a viable drainfield is often the greatest challenge—success depends on patience, flexibility, and creative partnerships.
- Access to diverse funding sources—and the staff and political support to secure it—is essential to upgrade wastewater treatment infrastructure.
- Even the best-designed and funded wastewater solutions depend on individual property owners' willingness to participate.

CONTENTS

TABLES AND FIGURES

1. INTRODUCTION

The Puget Sound region features thousands of miles of scenic waterfronts, whether along Puget Sound itself or its many lakes, streams, and winding rivers. These waterfronts are scattered with rural pocket communities. In these rural areas, onsite sewage systems (OSS), colloquially known as septic, serve as the main wastewater infrastructure. OSS are comprised of septic tanks that separate liquid sewage from solids and a drainfield that provides soil treatment to the liquid effluent; some systems may also include additional treatment.

When properly designed and maintained, OSS are an effective wastewater treatment technology. The State Department of Health (DOH) approves all new OSS technologies that meet NSF product testing requirements, among others (WAC 246-272A-Table 1). Once installed OSS require regular inspections to ensure compliance is met. Inspections can range from every three years for gravity systems to annual for all other types. An authorized service provider can perform inspections, or as an alternative, some Puget Sound counties provide training to septic system owners, allowing them to conduct their own inspections (DOH, 2016). State law mandates that the county Local Health Jurisdictions ensure OSS receive inspections (WAC 246-272A-0270); however, sufficient funding to support the capacity to ensure inspections remains an ongoing challenge[1].

However, there is a problem. Many OSS in the Puget Sound region are either poorly maintained or aging and at risk of failure. The average lifespan of an OSS is 30 years when properly maintained. Within the Puget Sound region, failing OSS are one of the leading causes of shellfish bed closures (Shellfish SI, 2023). Failures can occur for various reasons, such as a tank malfunction or an oversaturated drainfield that can no longer infiltrate and treat wastewater (DOH, 2025a). When an OSS fails, fecal bacteria, including pathogens such as *Escherichia coli* (*E. coli*) and *Salmonella*, in poorly treated sewage can be released into the building and/or the surrounding environment. These failures can pose risks to human and environmental health. Failures on coastal and riverfront properties are especially harmful. Even a small amount of fecal pollution from upland properties can contaminate the nearshore and close a shellfish bed due to the risk of spreading disease. DOH can restrict shellfish harvesting from shellfish beds that test positive for fecal pollution. In January 2024, DOH approved only 150,000 of the 260,000 acres of commercial shellfish harvesting areas for Puget Sound (Chernoff, 2025).

In some cases, repairing or replacing OSS is a straightforward, though often expensive, process. However, in many instances, the replacement process is not simple. When a drainfield fails, the property owner must install the new drainfield in a new location, which may not be possible

[1] A 2014 DOH needs assessment found that, of the 12 Puget Sound counties, only one had sufficient funding to support all OSS oversight activities. Seven counties faced funding gaps exceeding 50% of what was needed, with a large portion of the shortfall related to funding inspection and repair requirements (DOH, 2014). Progress has been made since 2014, with some counties (e.g., Mason and Clallam) passing ordinances to create dedicated funding mechanisms for OSS management. But local capacity remains a barrier.

due to site limitations. DOH requires a minimum usable land area of 13,000 square feet[2] for a single-family residence with an OSS (WAC 246-272A-Table 11). There is often not enough space in properties along shorelines, a situation potentially worsened by poor soils and sea level rise. If replacement is feasible, costs can be high. In 2023, Greene Economics LLC. (2023) found that for the Puget Sound region, an OSS replacement cost, on average, $34,000. Additionally, a 2024 Public Health Seattle - King County report estimates that the lowest cost to correct all OSS at-risk of failure is $2.5 billion in King County alone. To help fund the repair or replacement of an OSS, a septic owner may apply for a loan from the On-site Sewage System Regional Loan Program, a partnership between Ecology, the Department of Health, local counties and health departments, and Craft3.

Under the Washington State Growth Management Act, most rural communities cannot install centralized wastewater systems due to development restrictions outside designated Urban Growth Areas (discussed further in Section 3.1). Even where sewer connections are possible based on zoning designations, they might still be unfeasible, too expensive, or lack community support. In either case, an alternative system might be necessary or beneficial.

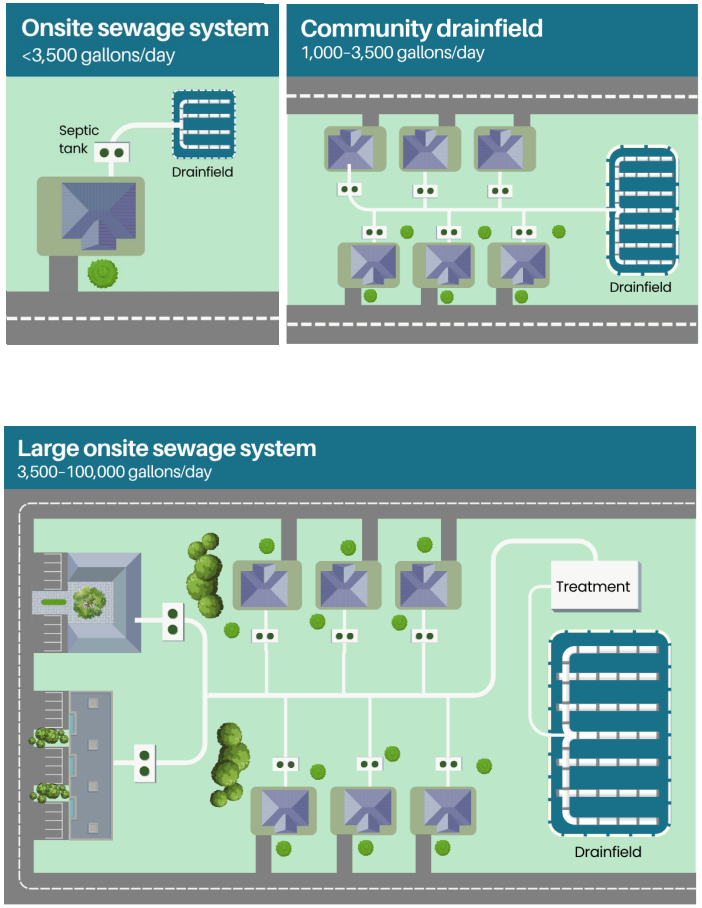
Two potential alternatives are a Community Drainfield or a large onsite sewage system (LOSS) (see Figure 1). Transitioning to either of these alternatives from traditional, single household OSS is complex and requires consideration of state and local zoning, community interests, engineering details, and costs, amongst other things. To highlight these considerations and provide guidance to communities considering this transition, we have developed a set of case studies that focus on community wastewater transitions. The case study analysis identifies the enabling conditions that helped communities successfully transition from individual OSS to a Community Drainfield or a LOSS. The report shares lessons learned from these communities, highlighting the key factors driving the transitions. As local communities and counties around Puget Sound consider their next steps in wastewater management, this report aims to bridge the knowledge gap between local practitioners working on these community transitions and state planners seeking to use these systems to solve the aging OSS problem.

[2] This requirement went into effect in April 2025.

Figure 1. Common Puget Sound Wastewater Systems

Septic systems

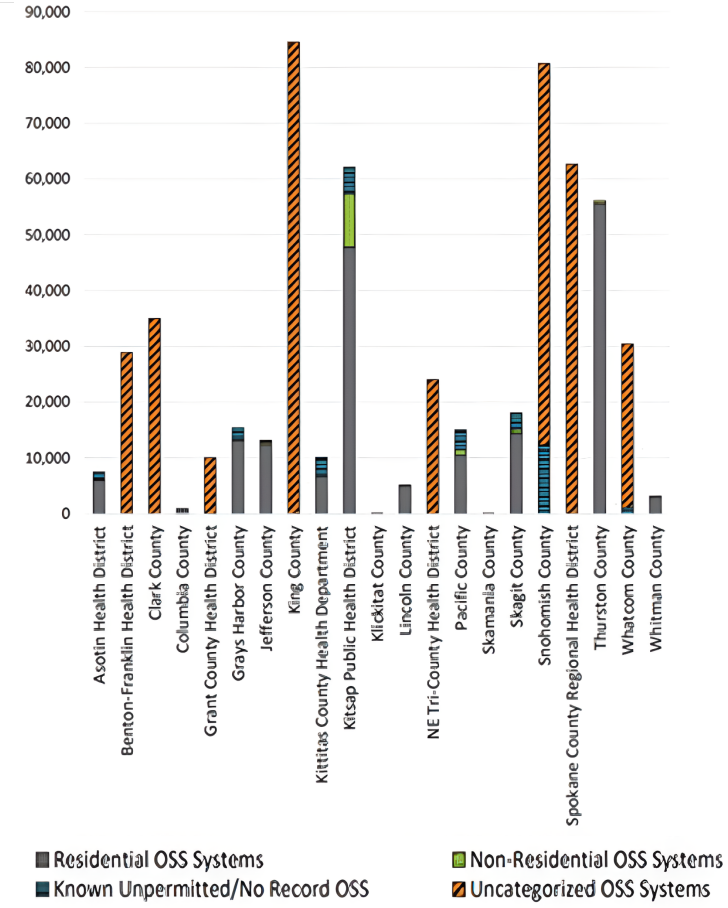
Sewer system



2. WASTEWATER OPTIONS

In the Puget Sound region, there are about 567,118 OSS spread across rural and even some urban areas (Shellfish SI, 2023). As shown in Figure 2, there are a significant number of OSS in King and Snohomish counties, two of the most populous counties in Washington. OSS typically serve single-family homes and are sized according to the number of bedrooms. Any home with fewer than four bedrooms requires a minimum of a 1,000-gallon tank, with each additional bedroom requiring 250 gallons of additional capacity (WAC 246-272A-Table 7).

Figure 2. Number of OSS permits by Local Health Jurisdiction



Source: SCJ Alliance (2025) Figure 4.

OSS are typically owned by the property owner who is responsible for getting inspections and maintenance on the system. Local Health Jurisdictions are accountable for assisting OSS owners in their responsibilities. For Washington state, DOH sets the statewide requirements for OSS in Chapter 246-272A WAC and oversees the Local Health Jurisdictions, which ultimately implement regulations from design to maintenance.

As of April 2025, DOH requires each Local Health Jurisdiction to submit an annual report to DOH to allow for better tracking of the status of OSS. This report must detail the number of OSS, failures, and compliance status—either conforming or non-conforming. WAC 246-272A-0010(13) defines a conforming system as one that meets one or more of the following criteria.

> "(a) In full compliance with new construction requirements under the chapter; or
> (b) Approved, installed, and operating in accordance with requirements of previous editions of this chapter; or

(c) Permitted by the waiver process under WAC 246-272A-0420."

A waiver, as outlined in WAC 246-272A-0420, is typically used for new construction and is required when the OSS design does not meet all state requirements. A waiver is granted when a local health officer evaluates an OSS design and determines that the system can adequately protect public health and the environment by reducing exposure to sewage. The applicant must demonstrate to the local health officer that the proposed system provides treatment that is at least equal to, or better than, the standard method. Systems approved under the waiver are considered compliant. Local Health Jurisdictions are required to notify DOH quarterly about approved and unapproved waivers.

A NONCONFORMING STATUS

Local Health Jurisdictions use a non-conforming status to identify and track existing OSS that do not fully comply with current state or county regulations. A non-conforming status is not permitted on new constructions or vacant lots. The definitions of non-conforming can vary among Local Health Jurisdictions (DOH, 2016; Island County Public Health, 2022). Examples of non-conforming from Local Health Jurisdictions include:

- There is a failure to submit inspection reports.
- Conditions on approved applications or permits are not met. For example, the OSS is being used inconsistently with its design; a bedroom was added without approval, or an unauthorized connection was made to the tank or drainfield.
- The site uses outdated technology that is no longer permitted but still provides adequate treatment (e.g., an undersized tank, tank technology no longer approved, or an undersized drainfield).

This designation directly impacts how a building can be used. For instance, houses labeled as non-conforming cannot add extra bedrooms, and businesses may be restricted from obtaining county permits or expanding. When a building is non-conforming, the Local Health Jurisdiction will work with the property owner to bring the OSS into conformance. If that cannot be accomplished, the Local Health Jurisdiction may impose more frequent inspections, and the property may risk condemnation.

ONSITE SEWAGE SYSTEM FAILURES

Failed OSS pose risks to human and environmental health. WAC 246-272A-0010(31) defines failure as "an OSS or component that threatens public health by inadequately treating sewage or by creating a potential for direct or indirect contact between sewage and the public." Failures can occur for various reasons, such as a breach in a component of the OSS, improper pumping or maintenance of the tank, or inundation of the drainfield due to soil oversaturation. Rising groundwater levels can also cause inundation and result in a drainfield that cannot adequately provide treatment. A failed OSS that cannot be replaced may require permanent closure of the property if there is no viable alternative.

Box 1: The Last Resort

Holding tanks temporarily store but do not treat sewage. Pumping is required to empty tanks approximately every two weeks. This can cost $800+ per visit. This recurring expense raises concerns about the potential for illegal dumping.

OSS owners are responsible for working with their local health officers to reduce the risk of failure through regular inspections and proper maintenance. WAC 246-272A-0270 requires OSS owners to request assistance from a local health officer in the event of a system failure or suspected failure.

Where an OSS failure is occurring or imminent, the system may need a Table 9 emergency repair (WAC 236-272A-0280). During an emergency, a Local Health Jurisdiction might approve a non-conforming repair where not all OSS components meet the minimum state standards for site requirements (see Section 3). Still, all other standards must be met to the maximum extent possible. A Table 9 emergency repair with non-conforming components does not require a waiver. These systems must pass annual inspections, and owners may need to submit additional maintenance reports. At the same time, the connected buildings may be restricted from adding new bedrooms or expanding.

Before permitting a non-conforming emergency repair, the local health officer must consider all alternative options with the OSS owner. All the considerations include:

A. Repair or replace the failing OSS with a similar OSS that provides comparable treatment and effluent disposal to a well-functioning system.
B. Repair or replace with a new OSS in compliance with the WAC.
C. Connect to an approved public or private LOSS or to a public wastewater treatment plant.
D. Repair or replace in conformance with higher levels of treatment if the OSS cannot meet vertical or horizontal separation (treatment levels provided in WAC 246-272A-Table 10).
E. Use a holding tank (see Box 1).
F. Obtain a National Pollution Discharge Elimination System (NPDES) or state discharge permit from Ecology.

The final decision on which option to select is up to the OSS owners. However, option D is only available if options A through C are not feasible, and options E through F are only allowed if all other options are impossible. Even during an emergency repair, the system must meet DOH treatment and effluent dispersal standards (see Section 3), at least for options A through D. A NPDES discharge permit is likely not feasible since Ecology is unlikely to approve direct discharge, and a holding tank is usually considered a temporary solution to allow homeowners to stay in their homes.

ALTERNATIVES TO ONSITE SEWAGE SYSTEMS

Box 2: LOSS FACT

There are currently over 290 LOSS in use throughout the Puget Sound region.

This report focuses on community transitions from OSS to a Community Drainfield or LOSS; however, connecting to a wastewater treatment plant may be an option in some locations. Wastewater treatment plants differ significantly from septic infrastructure. Unlike septic systems that use Drainfields, these plants can discharge treated wastewater directly into Puget Sound or other water bodies, transferring regulatory control to the Department of Ecology (Ecology). Wastewater treatment plants are primarily used in urban areas due to the economics of large-scale wastewater systems. These systems are expensive and require high usage to be cost-effective, which rural communities often lack the density to support. A municipal system, like a wastewater treatment plant, may also facilitate increased development/densities by overcoming the space requirements of individual household Drainfields. Many communities fear that installing a large-scale wastewater system will lead to growth and the loss of rural character, which is important to many rural constituents.

Local Health Jurisdictions are exploring ways to make it easier for homeowners to eventually transition from OSS to a sewer line connection (pers. comm. L. McIntire). One option under consideration is installing septic tanks and pump tanks in the front yard for easier access when connecting to municipal sewer lines. The rest of the report will focus on transitioning to Community Drainfields or LOSS (see Box 2). You can learn more about efforts to strategically replace OSS with sewer line connections through King County's Equitable Wastewater Futures Program.

Table 1 shows the characteristics that determine how OSS, Community Drainfields, and LOSS are managed. A key factor that differentiates these systems is capacity, expressed in gallons per day (gpd). The gpd capacity defines maintenance requirements and who is qualified to design the system. Smaller systems like OSS and Community Drainfields, which handle less flow, can be designed by a licensed OSS designer. Local Health Jurisdictions provide pre-approved lists of licensed OSS designers. In contrast, a LOSS must be designed by a professional engineer. Both LOSS and Community Drainfields may include either onsite or offsite components, such as treatment tanks and the drainfield, which can be located either on the property of origin or on a separate parcel. This difference does not impact regulatory oversight or maintenance responsibilities.

Table 1. Regulatory Requirements for Three Types of Septic Systems

	Onsite sewage system (OSS)	Community Drainfield	Large onsite sewage system (LOSS)
Description	Typically serves **one property** through components that convey, store, treat, and disperse liquids through an onsite drainfield.	Serves **multiple properties** through components that convey, store, treat and disperse liquids through a shared drainfield.	Serves **multiple properties to rural towns** through components that convey, store, treat, and disperse liquids through a shared drainfield.
Capacity	< 3,500 gallons per day	1,000–3,500 gallons per day	3,500–100,000 gallons per day
Implementing Agency	Local Health Jurisdictions		State Department of Health (DOH)
Regulatory Code	Chapter 246-272A WAC	Chapter246-272A WAC with some counties electing to use Chapter 246-272B WAC	Chapter 246-272B WAC
Maintenance Requirements	• Requires inspections every 1 to 3 years.	• Requires inspections every 1 to 3 years. • May require monthly system monitoring reports to Local Health Jurisdictions. • Counties with sole-source aquifers may require additional quarterly groundwater monitoring reports.	• 1-2 annual inspections required by DOH. • Monthly monitoring reports. • Quarterly sample of dose tank • Annual renewal of the Operating Permit.
Designer	Can be licensed OSS designer or Professional Engineer (PE)		Requires a PE
Management	Managed by property owner	Depending on local code, may require a public management entity	Requires public / private management entity
Treatment	Must meet product level standards set by DOH		Generally, more stringent than OSS or Community Drainfields.
Waiver Approval	Approved through Local Health Jurisdiction		Approved through DOH

3. CONSIDERATIONS FOR LOSS AND COMMUNITY DRAINFIELDS

All the considerations discussed in this section are key issues identified in the case studies (see Section 5) and are likely relevant to any group interested in developing a community treatment system. However, additional regulations or requirements may exist in other jurisdictions that are not addressed in this section. Similarities were identified among the case studies, particularly when the communities were in early design stages. Key considerations include system siting, treatment standards, zoning and critical areas, and operations and maintenance.

3.1. REGULATORY SITING STANDARDS

Siting requirements are described in the state-level regulations for OSS and LOSS: Chapter 246-272A WAC and Chapter 246-272B WAC. Both are administered by DOH; however, Chapter 246-272A WAC is implemented and enforced by Local Health Jurisdictions. Local Health Jurisdictions review and approve permits and ensure maintenance on OSS. All LOSS-related activity is conducted through DOH.

Community Drainfields do not have separate state regulations. However, since their capacity is the same as that of OSS (see Table 1), they must meet Chapter 246-272A WAC, which Local Health Jurisdictions implement. These jurisdictions can impose stricter standards than state regulations. Some Local Health Jurisdictions adopt LOSS standards or use a combination of standards from either OSS or LOSS codes. An example of mixing standards includes jurisdictions that require LOSS siting standards for a Community Drainfield but do not require a professional engineer. If a Local Health Jurisdiction chooses for a Community Drainfield to follow LOSS code, it does not transfer the responsibility of implementing those codes to DOH.

CHAPTER 246-272B WAC LOSS DRAINFIELD SITING REQUIREMENTS

For DOH to approve LOSS designs, they must meet specific siting requirements outlined in Chapter 246-272B WAC. LOSS siting designs are created by a licensed professional engineer and submitted for DOH approval. The design package must include a site and soil evaluations, a site risk survey or a hydrogeological report, and an engineering design document. The professional engineer must be licensed in Washington state. During site surveys, a DOH representative may be present to help ensure code compliance.

The viability of a drainfield site for LOSS is determined through several factors, including soil type, proximity to sensitive areas, and terrain. Specific site requirements that a LOSS must meet are:

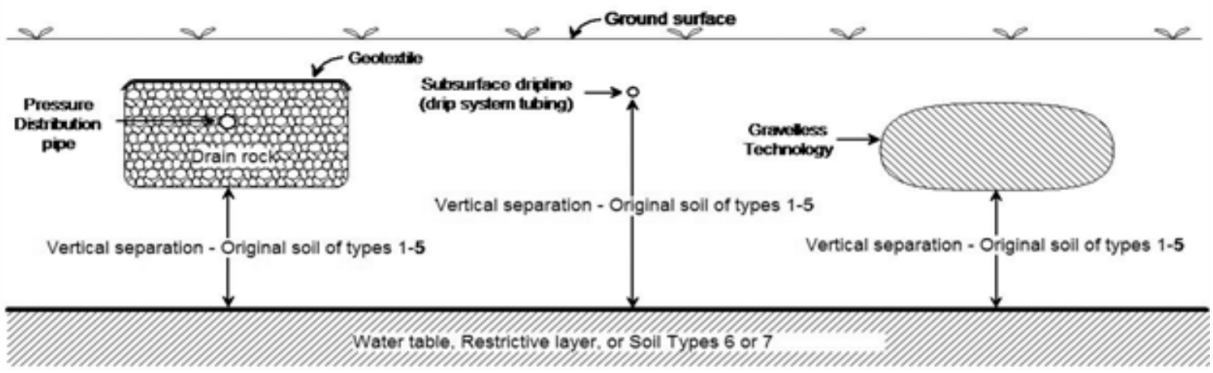
- Drainfields must be located in Soil Types 1-5 (see Table 2).
- LOSS drainfields must be located within half a mile of the buildings they serve.
- Terrain must not be sloped more than 30% (17 degrees).
- Drainfields must be placed within a cleared space (no brush).
- There is a minimum horizontal setback requirement between the drainfield and sensitive areas such as rivers, shellfish beds, wetlands, and shorelines (see below).

- There is a minimum vertical separation requirement between the bottom of the drainfield and the groundwater table, or a restricting layer (see below).
- Drainfields must have a reserve area equal to the size of the primary drainfield to handle excess flow or to take over if the main beds fail.

Horizontal setback requirements are listed under WAC 246-272B-06050. These setbacks create space to protect sensitive areas and decrease the risk to the drainfield from high human activity. Horizontal separations, which can range from 10 feet to 200 feet, are determined based on the distance from the drainfield, sewage tanks, and distribution pipe to sources of drinking water, surface waters, water supply lines, swimming pools, stormwater components, property and easement lines, nearby OSS, and site features that may allow effluent to surface.

A vertical separation is required by WAC 246-272B-06100. Soil treatment is the final treatment for effluent; vertical separation ensures the effluent receives sufficient final treatment before entering the water table. LOSS Drainfields must maintain at least three feet between the bottom of the drainfield and the highest seasonal water table, a restrictive layer, or Soil Type 6 or 7 (see Figure 3). If specific criteria are met, this vertical separation can be reduced to two feet. To meet these criteria, the LOSS must have Soil Types 2-5, meet a minimum of Treatment Level C (see Section 3.2), clearly demonstrate that the vertical separation can be maintained, and provide monitoring reports that show the performance standards continue to be met (WAC 246-272B-06100(2)). This is accomplished through the waiver process.

Figure 3. Profile Drawings of Drainfields Showing Examples of Vertical Separation



Source: WAC 246-272B-01000 (114)

The parcel must also be large enough to meet drainfield sizing requirements. Most LOSS drainfield sizes are calculated based on the design flow and the maximum hydraulic loading rates (described below). The calculation is:

Drainfield size (sf) = design flow (gpd) / maximum hydraulic loading rate (gpd/sf).

The design flow is the maximum volume of sewage that is generated during a 24-hour period in gallons per day (WAC 246-272B-01100(14)). For residential houses, the design flow is primarily determined by the number of bedrooms. One-bedroom equals 120 gpd. A single-family home is assumed to have three bedrooms per home, equaling 360 gpd per house. For non-residential uses, design flow differs. For example, the flow rate for restaurants is 50 gpd per seat, and for hotels/motels, it is 130 gpd per room.

The maximum hydraulic loading rate is the highest rate at which effluent can be applied to a drainfield and is expressed as gallons per day per square foot (gpd/sf). The soil type determines the maximum hydraulic loading rates. Soil types range from 1 to 7, moving from more porous (1) to less porous (7) (see Table 2). The drainage rate decreases as the soil becomes less porous. Soil Type 1 has a maximum hydraulic loading rate of 1 gpd/sf, compared to Soil Type 5, which has a maximum hydraulic loading rate of 0.4 gpd/sf (WAC 246-272B-Table 1). Soil Types 6 and 7 are unsuitable for LOSS Drainfields because they are too dense to infiltrate effluent properly. Table 2 provides an example of drainfield sizing using hydraulic loading rates for a pressure system. As discussed in Section 3.2, drainfield size can be reduced with higher treatment levels.

Table 2. Drainfield Size for a Pressure Distribution System*

Soil Type	Maximum Hydraulic Loading Rate** (gpd/sf)	Soil Description	Drainfield size (acres) @3,600gpd	Drainfield size (acres) @14,000gpd	Drainfield size (acres) @36,000gpd	Drainfield size (acres) @72,000gpd
1	1.0	Gravelly and very gravelly coarse sands	0.16	0.6	0.16	3.4
2	1.0	Coarse sands	0.16	0.6	0.16	3.4
3	0.8	Medium sands, loamy coarse sands	0.2	0.8	2.0	4.2
4	0.6	Fine sands, loamy fine sands	0.3	1.0	2.8	5.6
5	0.4	Very fine sands, very fine loamy sands	0.4	1.6	4.2	8.2
6	Not suitable	Other silt loams, sandy, clay loams	-	-	-	-

Soil Type	Maximum Hydraulic Loading Rate** (gpd/sf)	Soil Description	Drainfield size (acres) @3,600gpd	Drainfield size (acres) @14,000gpd	Drainfield size (acres) @36,000gpd	Drainfield size (acres) @72,000gpd
7	Not suitable	Sandy clay, clay, silty clay, strongly cemented or firm soils	-	-	-	-

* The calculation includes a 100% additional reserve area.

** The maximum loading rate can be increased for systems that meet more stringent treatment levels (see Section 3.2)

Another common drainfield technology used in LOSS is a subsurface drip field. Subsurface drip fields used timed emitters to release effluent into the soil periodically. Drip lines are located closer to the surface, allowing for a more extended soil treatment period before the effluent reaches the water table (see Figure 3). The calculation used to determine the size of a subsurface drip field differs from that used for other drainfield types and excludes hydraulic loading rates. The drainfield size is determined by the design flow, soil type, maximum daily emitter discharge, and number and spacing of emitters.

CHAPTER 246-272A WAC COMMUNITY DRAINFIELD SITING REQUIREMENTS

The baseline siting requirements for Community Drainfields are outlined in Chapter 246-272A WAC. The criteria for siting and sizing are similar to those for LOSS; however, there are some key differences. A professional engineer, licensed OSS designer, or local health officer can perform soil and site evaluations and design the system. A significant difference between Community Drainfields and LOSS is that fewer site investigations are required. Chapter 246-272A WAC does not require a hydrogeological report or engineering design document, though many counties add this requirement to their OSS code for Community Drainfields (pers. comm., H. Kortuem). Siting and sizing a Community Drainfield include:

- The site must have Soil Types 1-5 (see Table 2) and be on slopes of less than 30% (17 degrees).
- The septic tank(s) and drainfield must maintain a horizontal separation of 10 to 200 feet from drinking water, surface waters, pools, stormwater components, nearby OSS, and steep terrain.
- The site must maintain a minimum vertical separation of 12 inches, which is smaller than the LOSS requirement.
- Calculating the size of the drainfield uses the same equations for pressure systems and for subsurface drip fields.

- Community Drainfields share maximum hydraulic loading rates with LOSS for pressure systems.

3.2. REGULATORY TREATMENT STANDARDS

DOH establishes treatment level requirements for both LOSS and Community Drainfields. With OSS, wastewater undergoes at least two treatment stages. The first occurs in the septic tank, and the final treatment happens in the drainfield. For LOSS and Community Drainfields that require LOSS standards, additional treatment occurs in a communal treatment facility (see Figure 1). This section explains the treatment levels for effluent before it enters the drainfield.

Treatment level is designated by the system designer and approved by the implementing agency, either Local Health Jurisdictions for Community Drainfields or DOH for LOSS. The implementing agencies have the authority to impose more stringent treatment levels. The treatment level is determined during site evaluations and is based on site conditions, primarily soil type, vertical separation, and horizontal separation. The treatment level is incorporated within the operator permit if the system requires one. A system needs to be designed to meet those standards. All LOSS, and Community Drainfields designed under Chapter 246-272B WAC, will require an operator permit and must demonstrate compliance based on quarterly monitoring.

WAC 246-272A-0110 outlines the required septic system treatment levels (See Table 3). There are five treatment levels (A, B, C, E, and N) and three bacteria levels (BL1, BL2, or BL3). Treatment levels for septic systems are described as both the letter and the bacteria level. Septic systems used for residential homes must meet treatment levels A-E; treatment level E is a gravity system. A septic tank can qualify for treatment level E based on DOH preapproval list. Treatment level N is required where nitrogen is a contaminant of concern.

Treatment levels for onsite sewage systems are set through vertical separation and soil type. Sites with shallower vertical separation and more porous soils require higher levels of effluent treatment. For example, sites that meet the minimum vertical separation of 12 inches and have more porous soil, such as Soil Type 1, require septic systems that provide Treatment level A with BL1. In contrast, sites with a vertical separation of 24 inches with Type 3 soils require Treatment Level C and BL3 (WAC 246-272A-0230). For Community Drainfields that follow Chapter 246-272A WAC, after treatment, effluent may be discharged from septic tanks to the drainfield.

Varying parameter limits describe treatment levels (Table 3). There are six parameters used to define treatment levels. Three [Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), Total Suspended Solids (TSS), and Fecal Coliform (FC)] define general performance. Three additional parameters (oil and grease (O&G), Total Nitrogen (TN), and *E. coli)* may be considered under specific circumstances.

Table 3. OSS Treatment Levels

Level	Parameters					
	$CBOD_5$ (mg/L)	TSS (mg/L)	O&G (mg/L)	FC (#/100 ml)	TN (mg/L)	E. coli cfu/100 mL
A	10	10	----	----	----	----
B	15	15	----	----	----	----
C	25	30	----	----	----	----
BL1	----	----	----	200	----	126
BL2	----	----	----	1,000	----	----
BL3	----	----	----	50,000	----	----
E	228	80	20	----	----	----
N	----	----	----	----	30	----

Notes: $CBOD_5$ - Carbonaceous Biochemical Oxygen Demand, TSS - Total Suspended Solids, FC – Fecal Coliform, O&G - oil and grease, TN - Total Nitrogen, mg/L - milligrams per liter; cfu – colony forming unit.
Source: WAC 246-272A-Table 3

There are four treatment levels for LOSS (see Table 4): High Quality Effluent (HQE), B, C, and E. HQE is the highest level of treatment and is required in certain instances when effluent may impact shellfish growing areas, swimming beaches, etc. To determine treatment level, the LOSS designer will identify the coarsest soil layer within the vertical separation and based on the facility's design flow, select the appropriate treatment level for the area's condition (see Table 5). The same effluent parameters are used for LOSS as for septic tanks, except that *E. coli* is excluded and phosphorus (P) is added.

Table 4. LOSS Treatment Levels

	Effluent Parameters*					
Treatment Level	**$CBOD_5$ (mg/L)**	**TSS (mg/L)**	**O&G (mg/L)**	**FC (#/100 ml)**	**TN (mg/L)**	**P (mg/L)**
HQE	>15	>15		>1,000	>10	**
B	15	15		1,000		
C	25	30		50,000		
E	125	80	20			
N_{10}					10	
N_{20}					20	
P						**

* Values represent effluent maximum annual averages
** site-specific
Source: WAC 246-272B-Table 5

Higher levels of treatment, like Treatment Levels HQE and B, are required under certain common conditions in the Puget Sound region. This includes sites near shellfish-growing areas, swimming areas, or wellheads, as well as sites with Soil Type 1. Other various conditions that require a minimum treatment level are included in Table 5.

Table 5. Minimum Treatment Levels for Various Conditions

Conditions	Minimum Required Treatment Level
Project Specific (e.g. shellfish-growing areas, swimming areas, or wellheads)	HQE
Vertical Separation of 2 to < 3 feet, design flow higher than 14,000 gpd	HQE
Soil Type 1	B
Vertical Separation of 2 to < 3 feet, design flow 14,000 gpd or less	C
Sewage that is commercial strength	E
Sites where nitrogen or phosphorus is identified as a contaminant of concern	N_{10}, N_{20}, or P

Source: WAC 246-272B-Table 6

Higher treatment levels can reduce the size of drainfields for Community Drainfields and LOSS that use pressure systems. For a Community Drainfield meeting at least Treatment Level C and BL3, a higher hydraulic loading rate is allowed, compared to rates shown in Table 2, increasing by 0.2 gpd/sf for Soil Types 1-5 and 0.16 gpd/sf for Soil Type 5 (WAC 246-272A-Table 8). Under WAC 246-272B-06350, LOSS meeting at least Treatment Level C may request a waiver from DOH to increase the maximum hydraulic loading rate by a factor of 1-2 if the site also has Soil Types 2-5.

3.3. ZONING FOR WASTEWATER TRANSITIONS

Zoning will determine where a LOSS or a Community Drainfield is possible. The Growth Management Act (GMA) (Chapter 37.70A RCW) establishes the framework for long-term planning in Washington state and influences development decisions at the local level. The GMA emphasizes directing growth toward urban areas, and also supports protecting the natural environment and working lands. Under the GMA, sanitary sewer systems are considered a necessary urban service and generally confined to urban areas. RCW 36.70A.030 defines urban and rural services as:

- **Urban services**: "include those public services and public facilities at an intensity historically and typically provided in cities, specifically including storm and sanitary sewer systems, domestic water systems, street cleaning services, fire and police protection services, public transit services, and other public utilities associated with urban areas and normally not associated with rural areas."

- **Rural services**: "include those public services and public facilities historically and typically delivered at an intensity usually found in rural areas, and may include domestic water systems and fire and police protection services associated with rural development and normally not associated with urban areas. Rural services do not include storm or sanitary sewers, except as otherwise authorized by RCW 36.70A.110(4)."

RCW 36.70A.110(4) states that urban services are generally not appropriate for rural areas except in "limited circumstances shown to be necessary to protect basic public health and safety and the environment and when such services are financially supportable at rural densities and do not permit urban development." Under the GMA, LOSS can be considered an urban service because of its capability to serve a community at urban densities. A 100,000 gpd LOSS can support about 370 individual residences (DOH, 2025b). But such a system may not be cost-effective because rural densities are typically low (1 home per 5 acres). Many rural residents support GMA density and service restrictions because they help preserve the rural character of their communities.

Limited Area of More Intense Rural Development (LAMIRD) is a zoning category under the GMA used to recognize historic urban development in rural areas (RCW 36.70A.070(5)(d)). These are existing, denser development areas that can be either commercial or residential and may include urban facilities and services. LAMIRDs allow for LOSS or Community Drainfields if there is a risk of environmental or human harm from the existing OSS. County zoning may assign LAMIRDs different names, such as Rural Town (King County) or Small Town (Lewis County) (see Table 6).

Table 6. Rural zoning allowing sewer / LOSS

Planning	Definition	Connection to LOSS / Sewer	Reference
Rural Towns	Rural Towns are unincorporated towns governed by the county and are recognized as existing concentrations of higher density and economic activity in the Rural Area.	Rural Towns are allowed to use sewer if necessary to solve existing water quality and public health problems that cannot be addressed by other methods. All alternatives must be reviewed before sewer.	2024 King County Comprehensive Plan – Adopted December 10, 2024. Attachment A: Ordinance 19881.
Small Towns	Small Towns are unincorporated areas that provide critical housing, jobs, and services for people living and working in rural areas and resource lands.	Small Towns are allowed to use sewer if necessary to solve existing water quality and public health problems that cannot be addressed by other methods. All alternatives must be reviewed before sewer.	Chapter 17.45 Lewis County Code.

Planning	Definition	Connection to LOSS / Sewer	Reference
Limited Area of More Intense Rural Development (LAMIRD)	A LAMIRD is an area of more intense development in a rural unincorporated area.	LAMIRDs are recognized to minimize and contain growth within these rural areas. LOSS are permitted if they serve the existing population and do not add to rural sprawl.	Growth Management Act RCW: 36.70A.070(5)(d)

SEPTAGE CAPACITY AND THE GMA

Box 5: Septage Capacity Study Findings
(SCJ Alliance, 2025)

- Septage generation for all Washington state may exceed septage receiving by 2040.
- Most wastewater treatment plants are not designed to accept septage.

OSS and LOSS cannot treat solid waste or any inorganic matter that enters the tank; this leftover refuse is called septage. Septage must be pumped from tanks every 5-7 years and then hauled to wastewater treatment facilities or permitted septage receiving facilities. In Washington state, septic tanks generate over 200 million gallons per year of septage.

Washington state is currently facing a shortage of septage receiving capacity (SCJ Alliance, 2025). Where the septage goes depends on the nearest septage receiving facility, which can be hundreds of miles away. To better support communities in handling their septage, SCJ Alliance (2025) recommends an amendment to the GMA that would make all counties account for local OSS and septage treatment facilities within their jurisdictions (see Box 5). The GMA currently lacks a requirement for reviews of septage infrastructure.

3.4. DEVELOPMENT IN CRITICAL AREAS, SHORELINES, AND FLOODPLAINS

Additional development regulations and permitting requirements apply to shorelines, floodplains, and other critical areas. During the pre-design phase of a wastewater transition, each case study had to consider development rules from one or more of these environmental designations:

- **Shorelines**: The Shoreline Management Act (Ch.90.58 RCW) requires that local governments develop Shoreline Master Programs to regulate development within 200 feet of a shoreline of the state. Local jurisdictions approve shoreline modifications through a Substantial Development Permit, Variance, Conditional Use Permit, or Exemption.
- **Critical Areas**: The Growth Management Act (Ch. 37.70A RCW) requires cities and counties to designate environmentally critical areas (e.g. wetlands, critical aquifer areas,

fish and wildlife conservation zones, frequently flooded areas, and geologically hazardous areas) and adopt development regulations to protect them. Impacts to critical areas are assessed during review of development permit applications (e.g., building, land use, clearing and grading).

- **Floodplains**: Local governments must adopt land use controls in flood hazard areas to participate in the National Flood Insurance Program. The Federal Emergency Management Agency (FEMA) sets minimum floodplain management standards that are implemented through local Floodplain Development Permits.

SEA LEVEL RISE

LOSS and Community Drainfields may be alternatives that become particularly important for shoreline homes vulnerable to sea level rise, where failure could affect coastal water quality, shellfish beds, and safe swimming. A 2025 update to Chapter 246-272A WAC now requires all Local Health Jurisdictions to identify areas where sea level rise might impact OSS through reduced horizontal separations.

LOSS and Community Drainfields have the potential to help address shoreline OSS at risk from coastal flooding and rising groundwater levels associated with sea level rise. Effluent from shoreline properties can be moved to off-site Drainfields located further inland. Even if septic tanks stay near the shoreline, removing the drainfield substantially lowers the risk of failure due to rising groundwater and further reaching shorelines.

Box 3: Sea Level Rise

Projections from the University of Washinton Climate Impacts Group estimate a rise in sea levels of 0.4-0.9 feet within Puget Sound by 2050 (Miller et al., 2018).

3.5. OPERATIONS, MAINTENANCE, AND MONITORING REQUIREMENTS

LOSS and Community Drainfields pose risks to people and the environment when not properly operated and maintained. To ensure treatment outcomes are achieved, LOSS require greater oversight than what is seen with individual OSS. These same requirements may be applied to Community Drainfields.

LOSS OPERATIONS, MAINTENANCE, AND MONITORING

LOSS proposals must include an Operations and Maintenance (O&M) document that specifies who will assume specific roles and responsibilities. The document specifies the owner, operator, and management entity, and outlines a maintenance schedule.

LOSS ownership refers to the individual or group responsible for ensuring a LOSS complies with the WAC. LOSS owners can be an individual or a group. Community ownership typically falls to local homeowners through a Homeowners Association (HOA), a franchise, a water-sewer district, or occasionally to the county.

If the LOSS is community-owned, the community must create or partner with a management entity responsible for ensuring that all reporting and financial obligations of the LOSS are fulfilled on time. The management entity can be a public entity (e.g., a Local Health Jurisdiction), an approved wastewater company, or a private entity contracted with a third-party guarantor (e.g., a public entity or approved wastewater company) (WAC 246-272B-04100(1)(b)).

Given the technical complexity of most LOSS systems, the owner must hire an operator to oversee their monitoring and maintenance. Operators must meet the requirements of WAC 246-272B-07200. A key qualification is having experience working with LOSS or similar technology. Local Health Jurisdictions provide owners with a pre-approved list of operators. Operators may be required to have a Department of Ecology wastewater certification (Chapter 173-230 WAC). Approved operators must be willing to co-sign for liability with the owner. The operator can be the same as the management entity if they meet the qualification requirements.

Operators have multiple responsibilities. Operators must submit an annual Maintenance and Monitoring report. An example of a form demonstrating reporting requirements is shown in Figure 4. Operators for LOSS are also responsible for ensuring that effluent leaving the treatment facility meets limits set for the treatment level (see Table 3). These limits are specified within the Operating Permit. Sampling is typically conducted on a quarterly basis from a compliance point upstream from the drainfield (e.g., the dosing tank). Additionally, operators ensure that the flow entering the drainfield is not greater than LOSS design flow. Flow monitoring is reported as average daily readings to DOH (see Figure 4). Owners and operators are also responsible for reporting any failures within the LOSS system to DOH.

WAC 246-272B-06400 provides the design requirements for monitoring and maintenance in a LOSS. A LOSS must have a service access port installed within the drainfield. The port must extend from the top of the soil to the final grade. Additionally, all valves, controls, and warning devices must be fully accessible to the operator.

Figure 4. Large Onsite Sewage System Annual Maintenance and Monitoring Report Form

System Component / Maintenance Task	Minimum Frequency	Insert date or measurement when task is completed											
		Aug 2023	Sep 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	June 2024	July 2024
Sewage Tanks													
Measure and Record Sludge Level	Semi-Annual												
Measure and Record Scum Level	Semi-Annual												
Remove Sludge from Tanks	As Needed												
Check / Clean Effluent Filters	Semi-Annual												
Check Inlets / Outlets	Semi-Annual												
Pump and Pump Chamber													
Visual Inspection	Monthly												
Check / Clean Screen(s)	Semi-Annual												
Test / Run Pumps	Semi-Annual												
Check Float Switch Operation	Semi-Annual												
Pump Controls and Electrical Panel													
Manually Operate Controls	Semi-Annual												
Check for Moisture & CorrosionDa	Semi-Annual												
Test Alarm(s)	Semi-Annual												
Drainfields													
Inspect Monitor Ports	Monthly												
Inspect Drainfields for Ponding; Mow Grass & Remove Brush	Monthly												
Inspect and Exercise Valves	Semi-Annual												
Rotate Drainfield Sectors	Semi-Annual												
Average Daily Flows (gpd) →	Monthly	No Flows. System Not Yet Installed											

Source: DOH. 2024. Fall City Community Sewer: Large Onsite Sewage System Annual Maintenance and Monitoring Report.

COMMUNITY DRAINFIELD OPERATIONS AND MAINTENANCE

Requirements for the O&M of Community Drainfields vary by county, with some utilizing Chapter 246-272A WAC guidance, some using Chapter 246-272B WAC guidance, and others relying on county regulations. Some Local Health Jurisdictions require that Community Drainfields be managed through a public management entity or a private O&M provider. Local Health Jurisdictions that require a public management entity, as specified in WAC 246-272B-04100(1)(b), tend to have fewer Community Drainfields (Island County Public Health, 2025). Community Drainfields that abide by LOSS regulations are required to submit monitoring reports to the Local Health Jurisdiction. These might include average daily flows as well as effluent readings from dosing tanks or monitoring wells.

4. METHODS

This report examines three wastewater transition cases from communities in and around the Puget Sound region: Fall City, King County; Packwood, Lewis County; and Maple Grove, Island County. Two of these transitions involve communities converting from OSS to LOSS (Fall City and Packwood), and one case study examines the transition from OSS to a Community Drainfield (Maple Grove). The goal of these case studies is to summarize and understand each transition, identifying the unique challenges and lessons learned, which can help inform other jurisdictions on how to navigate their own transitions successfully. Each case study will cover:

- Community background,
- A description of the new system,
- Challenges faced throughout the development of the new system, and
- Lessons learned.

The rest of the report is split into six sections:

- **Section 5**: Has a brief overview of each of the three case studies and a summary of lessons learned.
- **Sections 6-8**: Provides an analysis of the case studies - Fall City, Packwood, and Maple Grove.
- **Section 9**: Reflects on community transitions. This section provides a comprehensive review of the three case studies collectively, drawing on key discussion points from practitioners.
- **Section 10**: Provides conclusions and next steps. Next steps provide insight into a planned future study that will build upon the work of this case study analysis.

Information about the projects was collected from various sources. Over several months, the author engaged in discussions with practitioners who are subject matter experts, either involved in the case studies or knowledgeable about wastewater and LOSS. Insights from these conversations are incorporated throughout the report and were used to identify the lessons learned. Additionally, the author reviewed official reports, some obtained through records requests to DOH, as well as online resources such as blog posts and news articles, and notes from official meeting minutes.

5. CASE STUDY DESCRIPTIONS

Each of these case studies is unique and offers a variety of lessons learned, based on the community itself, the county in which the community is located, and the type of system chosen. The author derived lessons learned based on the story created through practitioner discussions and online resources.

5.1. FALL CITY, KING COUNTY

Fall City is an unincorporated rural town (see Table 3) in King County, WA, with a population of just over 2,000. The community depends on OSS for wastewater treatment. In the downtown business district of Fall City, which sits between two rivers, the OSS are aging and have undersized Drainfields, increasing risks to environmental and human health. Over the past 30 years, King County Local Services has collaborated with the Fall City community, supported by a political champion, to find a solution to this problem. As of summer 2025, a LOSS is under construction to connect with the downtown business parcels.

5.2. PACKWOOD, LEWIS COUNTY

Packwood is a small, unincorporated town in rural Lewis County, WA, with a population of just over 900. The community relies on OSS, many of which were installed before 1991 and are at risk of failing. Beneath the town is the community's drinking water aquifer. If an OSS fails, there is a significant risk to the town's drinking water source. Over the past 30 years, Lewis County officials and residents of Packwood have pursued a wastewater transition, focusing on LOSS. This LOSS would connect to all parcels within the downtown district. Lack of funding has halted each proposal. An update to the 2025 Lewis County comprehensive plan aims to turn Packwood into an Urban Growth Area (UGA). As a UGA, sewer infrastructure would be required, which could provide greater support and funding for the project.

5.3. MAPLE GROVE, ISLAND COUNTY

Maple Grove is a small community of 40 homes along the coastline of Island County. In 2012, Island County detected high levels of fecal coliform in the nearshore waters, indicating that at least one failed septic system was present. For over ten years, community members from Maple Grove worked with Island County to permit and build a Community Drainfield. This new system replaced failed and aging tanks in 16 of the 40 homes and moves wastewater effluent upland from the shoreline. As of 2024, water quality tests indicate that high fecal coliform levels persist, albeit at a lower concentration than previously observed.

6. CASE STUDY – FALL CITY

Fall City is an unincorporated rural town in King County located at the junction of the Snoqualmie River and the Raging River. As of 2020, the population was approximately 2,000.

Fall City Demographics
(U.S. Census Bureau, 2023)
Population: 2,032
Size: 2.8 sq.mi
Median Household Income: $144,625
Average Age: 48.4
Project Website

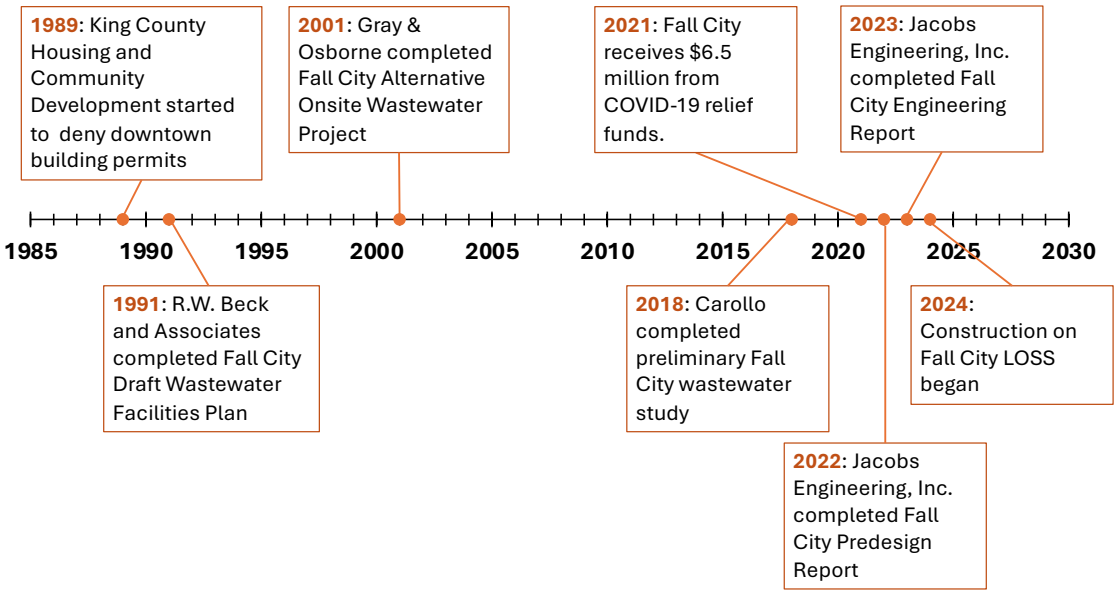
Settled in the mid-1800s, Fall City served as a trading town, taking advantage of the Snoqualmie and Raging rivers. Over time, the Fall City business district expanded along the Snoqualmie River, with each of the 63 parcels eventually having its own OSS.

Concerns about wastewater first appeared in the early to mid-1900s during the construction of State Route 202 along the Snoqualmie River. This project required many buildings in Fall City's business area to be forced back to sit on top of their Drainfields (King County, 2023a; Jacobs Engineering, Inc., 2024). As a result, the space between the septic tank and the drainfield was reduced. Regulations governing OSS were later enacted, resulting in these parcels being designated as non-conforming. The limited drainfield space raised concerns about potential risks to water quality and public health.

As an unincorporated community, Fall City is overseen by King County Local Services. The push for a new wastewater system began in 1989, when King County Local Services denied building permits for renovations within the Fall City business district (R.W. Beck and Associates, 1991). This was due to the non-conforming status of the OSS. The permit denial prompted multiple studies examining potential options (see Figure 5), but it took decades to design and construct a new wastewater system. High project costs and strong community support for preserving a rural character blocked many proposals.

As King County Local Services continued to deny building permits, Fall City business owners continued to ask for a solution. In 2020, a former King County Local Services official, who was also a Fall City resident, met with property owners in the business district to assess current septic capacity and gauge interest in pursuing a wastewater solution. These discussions were reported to King County and helped shape the eventual Fall City LOSS.

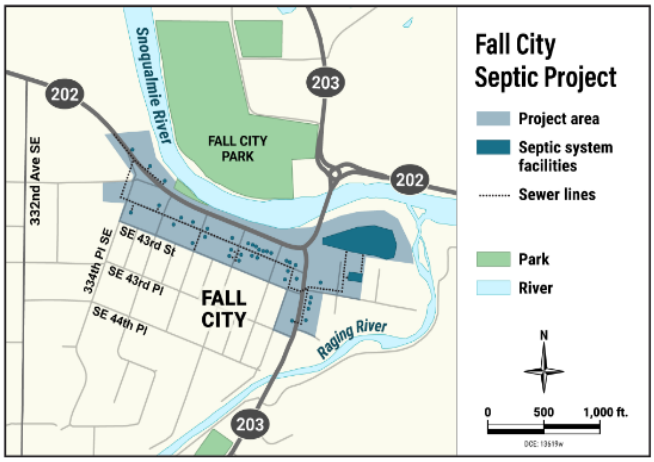
Figure 5. Fall City Wastewater Project Timeline



King County succeeded in its pursuit of a LOSS, garnering support through community discussions and meetings. Success was supported by a state champion who helped to spur local engagement, worked with planners, and aided in obtaining funding for the project. Jacobs Engineering, Inc. serves as the lead engineer for the Fall City LOSS. This project is primarily funded by federal and state sources (see Section 6.5), thereby reducing financial barriers for the community. After receiving DOH approval, construction of the new LOSS system commenced in August 2024 and is scheduled for completion in summer 2026 (King County, 2025). Throughout the project's design and construction phases, the Fall City LOSS received strong support, but it still encountered numerous challenges.

6.1. DESCRIPTION OF NEW WASTEWATER SYSTEM

Figure 6. Project site for the Fall City Large Onsite Sewage System.



Source: Fall City Project Site.

The Fall City business district includes 63 parcels. These parcels are divided among residential areas, commercial zones, restaurants, gas stations, a grocery store, and a park (Jacobs Engineering, Inc., 2023).

The Fall City LOSS involves installing new septic tanks throughout the downtown district to replace the aging OSS. Solid waste stays in these tanks, while liquids are pumped into the connecting conveyance system (i.e., sewer lines). This conveyance system carries the liquids to the treatment facility, after which the treated liquids are discharged through a drainfield for final soil treatment. This LOSS is considered a Septic Tank Effluent Pumping (STEP) system, as it includes septic tanks that hold solids and deliver only liquids to the treatment facility. Figure 6 – taken from the King County Project Site - provides a view of the project locations.

Jacobs Engineering Inc. (2023) details the Fall City LOSS design, which includes:

- **Onsite septic tanks**| Three existing septic tanks and 43 new Orenco Prelos processor tanks are located on-site at the parcels. There are 36, 1,000-gallon tanks, and seven 1,500-gallon tanks.
- **Conveyance system**| The tanks are connected to a conveyance system, which feeds into the facility. The conveyance line will consist of 4,227 linear feet of pressure mains laid along the central business district corridor. Additionally, three Orenco pumps were added to the three existing tanks to help push liquids to the conveyance line.
- **Offsite treatment facility** | A Kubota Membrane Bioreactor (MBR) facility treats wastewater effluent before dispersal through the drainfield. The MBR facility will treat effluent to the highest quality level, HQE (Table 3). Treatment levels for the Fall City LOSS are provided in Table 7. The MBR system has a capacity of 24,000 gpd and includes a surge tank, treatment units, and a clarifying tank. The surge tank equalizes flow, the treatment unit provides aerobic treatment, and the clarifying tank stores the effluent before it enters the drainfield. The treatment facility is located within permanent easements purchased from the Fall City Metropolitan Parks Department by the Fall City Septic Association. The treatment facility is situated near the drainfield.
- **Offsite drainfield** | The drainfield is a subsurface drip irrigation system. The drainfield is within a subterranean utility easement purchased from the Fall City Metropolitan Parks Department by the Fall City Septic Association, located at Bernard Memorial Park. The drip field has a peak daily design flow of 23,600 gpd and spans approximately 89,000

square feet (2 acres). The design features a series of 2-inch-diameter pipes, buried up to 24 inches below ground level, and sand-lined beds. In total, there are five 4,800-square-foot irrigation beds throughout the park, along with a limited reserve area. The drainfield also includes an engineered forest to provide additional phytoremediation treatment.

Table 7. Fall City LOSS Treatment Limits

Parameter	Limit (Annual Average) - HQE
$CBOD_5$	5.00 mg/L
Total Coliform	1000 CFU / 100 mL
O&G	5.00 mg/L
Total Nitrogen	10 mg/L
TSS	5.00 mg/L

Source: DOH. 2023. Large On-Site Operating Permit. Effective October 11, 2023

Jacobs Engineering, Inc. (2023) outlined three phases for the Fall City LOSS development. Phase 1 will connect to 46 parcels within the downtown core. These are priority parcels with non-conforming or aging OSS and include single-family homes, mobile homes, restaurants, and businesses. Phase 2 is expected to occur around 2033, adding 15% more capacity to the system. The LOSS facility must be inspected before increasing capacity, and if approved, all reserve space will likely be utilized. Phase 3 is planned for approximately 2043, with an increase in capacity of about 25% to serve all 63 parcels. The conveyance system is designed to support this future capacity, but the drainfield is not. To include the Phase 3 capacity, additional land for a LOSS and LOSS reserve area will need to be acquired.

6.2. CHALLENGE – ALIGNING WASTEWATER WITH COMMUNITY VALUES

Throughout the history of wastewater for the Fall City downtown district, wastewater studies have struggled to get started. Two of the three previous proposals recommended wastewater treatment plants instead of LOSS. These wastewater treatment proposals either involved high capital costs or sizable O&M estimates. Sometimes, they were accompanied by the threat of forced hookups (R.W. Beck and Associates, 1991), which then failed to garner support among residents who were unwilling to pay the price and who also believed the project might promote growth.

Table 8 displays the associated costs with the past and current Fall City wastewater proposals. Before the 2023 Jacobs Engineering cost estimate of $8 million, the 2018 centralized MBR estimate ranged from $23.6 to $28.6 million. Gray and Osborne (2001) proposed a LOSS, but this failed because they couldn't secure sufficient drainfield space at that time (Jacobs Engineering, 2022). Locating the drainfield wasn't an option until many years later.

Table 8. Fall City wastewater project proposals

Study	Proposal Description	Proposed Costs
R.W. Beck and Associates (1991)	Wastewater treatment plant: Sequencing Batch Reactor wastewater treatment plant with outfall into the Snoqualmie River.	Capital cost estimated between $3 to $4 million ($7 – $9 million in 2025[3] dollars). O&M estimated between $43-$126 per month ($101- $683 per month in 2025 dollars).
Gray and Osborne (2001)	LOSS: Recirculating gravel filter with a subsurface drip	Capital costs estimated at $4.5 million ($8.2 million in 2025 dollars)
Carollo Engineers (2018)	Wastewater treatment plant: Compared a MBR wastewater treatment plant with a river outfall discharge and MBR facility with a wetland enhancement discharge	Construction costs estimated between $18.4 million to $22.3 million ($23.6 million and $28.6 million in 2025 dollars).
Jacobs Engineering Inc. (2023)	LOSS: MBR treatment system with subsurface drip irrigation field.	Construction estimated at $7.4 million ($8 million in 2025 dollars)

6.3. CHALLENGE - KING COUNTY ZONING CONSIDERATIONS

Fall City can offer only limited urban government services because it is outside of a UGA (RCW 36.70A.110(4)). However, King County's 2024 Comprehensive Plan Update designates Fall City as a Rural Town, which allows Fall City to develop a LOSS or connect to sewer if there is a public health risk. Specifically, the Revised Development Condition Zoning overlay permits wastewater services in the business district area. During the Fall City LOSS, the overlay was expanded to include Bernard Memorial Park, allowing it to support a drainfield.

Including an option for alternative wastewater disposal in Rural Towns is not new to the 2024 King County Comprehensive Plan. A 2012 Amendment to the 1999 Fall City Subarea Plan highlighted a preference for an alternative wastewater disposal system like a "Community Drainfield" and specified that connection to King County's regional wastewater system may only be used as a last resort for business district properties (King County, 2012). In 2024, the Fall Area Subarea Plan was repealed and merged with the Snoqualmie Valley/NE King County Community Service Area Subarea Plan, which similarly specified that LOSS may be used in Rural Towns as appropriate. The 2024 King County Comprehensive Plan, including the Snoqualmie

[3] Conversion as of May 2025. The cost was calculated using the Federal Reserve Bank of Minneapolis Inflation Calculator: https://www.minneapolisfed.org/about-us/monetary-policy/inflation-calculator

Valley/NE King County Community Service Area Subarea Plan, indicates that a community system / LOSS are allowed in rural areas when:

1. OSS are failing, and repairs are not practical.
2. A public agency can manage the system.
3. The community system serves only the existing structures and lots and does not expand non-residential uses in residential areas.

Fall City has a strong community desire to preserve its rural character, which the LOSS supports. In the future, the downtown district may have higher density, leading to increased flow to the LOSS. Although zoning could change to enable this, the current LOSS can only support most of the downtown area, as the drainfield lacks additional capacity.

6.4. CHALLENGE – DRAINFIELD SITE SELECTION

This discovery of the drainfield space came after years of challenges. The Gray and Osborne (2001) Alternative Assessment report was the first to thoroughly examine a drainfield as a wastewater disposal option for the Fall City downtown district. The assessment concluded that a drainfield was not feasible due to a lack of suitable locations. Potential drainfield sites were either across the salmon-bearing Snoqualmie River (where raw sewage would need to be pumped underneath), had too steep slopes, were near a Wellhead Protection Zone, or were so far from Fall City that the cost of the conveyance system became prohibitive.

This lack of space was a significant obstacle to implementing a LOSS. The solution did not come until 2020, when the Fall City Metropolitan Parks Department approached King County with the idea of using Bernard Memorial Park. The park was recently gifted to the Fall City Metropolitan Parks Department by the Friends of Fall City Parks, a local organization (King County, 2023a; FCMPD, December 2020). In addition to offering the park, the Fall City Metropolitan Parks Department proposed nearby parcels for the treatment facility.

Bernard Memorial Park borders the Snoqualmie River and the Raging River (see Figure 4), offering several advantages: it is close to downtown, has workable soil, and is located outside the Fall City Wellhead Protection Area (King County, 2023b). There is also a beneficial relationship between the drainfield and the park. While the park allows for the dispersal of treated effluent, the drainfield will help water the grass and trees. The Fall City Metropolitan Parks Department also plans to build bathrooms, a volleyball court, and picnic areas for use in the park (FCMPD, January 2022).

During the approval process, King County Local Services hired engineers to conduct the required site and environmental reviews according to WAC 246-272B standards. These reviews evaluated the park based on its soil, hydrology, proximity to the Snoqualmie River and Raging River (both considered Shorelines of the State under the SMA), and its location entirely within the 100-year FEMA floodplains for both rivers. This process included a completed State

Environmental Policy Act (SEPA) Checklist and a Cultural Resources Technical Report. The reviews concluded that the site is suitable for a drainfield.

This park is not a perfect solution, but it better protects the environment and community than the individual aging systems. The drainfield has weight restrictions, meaning no heavy equipment can be used. It will be built with a limited reserve area, which does not meet the 100% reserve requirement set by DOH. King County Local Services received a waiver from DOH for the drainfield to have a reduced reserve. Due to the drainfield's size, there may be future issues supporting the expected 20-year growth in the Fall City downtown district. Additionally, the eastern part of the drainfield borders a potential channel migration zone for the Raging River, which could lead to future flooding concerns (Jacobs Engineering Inc. 2023).

6.5. CHALLENGE – FINDING CAPITAL FUNDING

The expected completion date for the Fall City LOSS is June 2026. The project is still unfinished, final capital costs are estimates, and additional funding sources may still be required.

PROJECT COSTS

The total capital cost estimate for the Fall City LOSS is $10 million. This includes the cost and sales tax related to construction expenses for the Fall City LOSS, which covers the conveyance systems, pretreatment, and drainfield. About $7.5 million of the $10 million total is associated with construction (Jacobs Engineering Inc., 2023). Some of the costs for the major construction items are shown in Table 9. The remaining costs cover miscellaneous items like permitting support, staff labor, and acquisition and contingency funds.

Table 9. Estimated construction costs for Fall City Large Onsite Sewage System

Construction Item	Costs
Sewer and Collection System	$875,900
Septic Tanks	$1,215,600
Treatment System (MBR)	$2,209,100
Drainfield Site	$886,300

Source: Jacobs Engineering Inc. (2023).

CONSTRUCTION FUNDING

King County Local Services has secured $10 million from various sources for the Fall City LOSS (Table 10). The Fall City downtown community had a strong supporter in a King County councilmember who helped the project obtain funding from the state legislature and through the federal COVID-19 American Rescue Plan Act.

Table 10. Project grants obtained for the Fall City Large Onsite Sewage System

Funding Source	Amount ($)
King County (Design and Management)	$1 million
American Rescue Plan Act Grant (LOSS costs)	$6.5 million
State Capital Budget (Design and Installation)	$1.5 million
County Bond	$1 million
Total	$10 million

Source: King County, 2023a; FCMPD, December 2021; and pers. comm J. Wilson.

6.6. CHALLENGE – OPERATIONS & MAINTENANCE ARRANGEMENTS

The community or the county may own a LOSS. Part of an owner's role is facilitating partnerships to help manage and maintain the LOSS. Alongside ownership, King County requires LOSS to be managed by a public agency. Determining management and operation arrangements can be challenging because it involves multiple parties, requiring negotiations and contracts.

MANAGEMENT MODEL

Ownership of the LOSS, conveyance lines, and facility will be the responsibility of the business owners in Fall City, organized as a private entity called the Fall City Septic Association, chartered as a Homeowners Association (HOA) (King County, 2023). The Fall City Septic Association contracted with Kittitas Sewer District #8, a third-party guarantor, to serve as the management agency, meeting the requirements of WAC 246-272B-04100(1)(b).

The Fall City Septic Association contracted operations to ADC Wastewater Engineering, a local firm. A specialist in LOSS within the firm will serve as the responsible party to ensure the LOSS remains in compliance (Jacobs Engineering Inc., 2023). The operator is responsible for submitting quarterly monitoring reports to DOH, which include grab samples from the dosing tank to test effluent limits (DOH, 2023). The owner and operator are expected to submit a full Monitoring and Reporting plan, in accordance with WAC 246-272B-04300, to DOH by Fall 2025. The Monitoring and Reporting Plan outlines the sampling, transportation, and reporting of sample results.

Fall City Septic Association allocated $30,000 as reserve funds for potential repairs or replacements of the LOSS (Kittitas County Sewer District #8, 2023). A reserve fund is required under WAC 246-272B-07050(2)(a) for operations and maintenance expenses, but the parties determine the amount. Additionally, the Fall City Septic Association entered into an agreement with the Fall City Metropolitan Parks Department regarding easements and accommodations for the drainfield and treatment site (FCMPD, June 2022).

OPERATIONS FUNDING

The Fall City Septic Association will owe the Fall City Metropolitan Parks Department (FCMPD) annual rental and easement costs; as of 2022, these costs were $40,000 per year, as shown in Table 11.

Table 11. Rental and easement costs between Fall City Septic Association (FSCA) and the Fall City Metropolitan Parks Department (FCMPD)

Category	Description	Annual Costs
FCSA payments to FCMPD	Annual easement rate to the park	$15,000
FCSA payments to FCMPD	Yearly rent	$25,000
Total payments		$40,000

Source: FCMPD, June 2022, October 2022

The funding structure and prices for LOSS O&M are still being developed (DOH, 2024). Currently, there are two proposed rate structures:

- Proposal 1: water use-based flat fee plus a per-use meter charge; or
- Proposal 2: flat rate Equivalent Residential Unit (ERU) tier model plus per-use meter charge. One ERU is equal to either the mean, median, or mode for water usage within the community.

6.7. LESSONS LEARNED

The Fall City LOSS provides lessons for other communities aiming to transition their wastewater systems. The LOSS solution for Fall City resulted from 30 years of extensive research and increased collaboration among residents, county and state officials, and political allies.

FINDING A POLITICAL CHAMPION

Lesson Learned: **Political advocacy can be vital in securing funding and policy support for complex infrastructure projects. Fall City's success was aided by a King County councilmember who championed the project's funding.**

Wastewater projects are costly and require funding. Fall City business district owners and residents found a voice through a political ally who advocated for the project with the legislative body and the King County Council. The funding secured successfully catalyzed the Fall City LOSS.

King County Councilmember Kathy Lambert fought for a Fall City LOSS. Because of her advocacy, Fall City businesses stayed open during the decision-making process and avoided

potential violations from the county due to their non-conforming status. Councilmember Lambert, a 20-year member of the King County Council and a former Washington State Representative, utilized her expertise to advocate for state legislative funding for the Fall City LOSS. Her efforts also resulted in securing $6.5 million through the American Rescue Plan Act. Additionally, she played a key role in working with the King County Council to amend the Revised Development Condition overlay in the Fall City business district to include Bernard Memorial Park (FCMPD, January 2020).

DIVERSE FUNDING IS CRUCIAL

Lesson Learned: **Using diverse funding sources can make expensive infrastructure projects more achievable. Access to these resources lessened the financial burden on the Fall City community and helped gain widespread support for the septic project.**

Securing multiple funding sources aided the Fall City LOSS. At the start of the project, a substantial amount of money was available through the COVID-19 American Rescue Plan Act under President Biden. These funds supported infrastructure improvements, including wastewater systems, across the United States. Fall City used these funds to purchase LOSS equipment. Meanwhile, funds from the state capital budget and King County helped support project design and installation. Having a diverse funding portfolio helped the LOSS cross the finish line, as it had secured funding at each phase—from design to installation. Additionally, this funding fostered greater support from Fall City business district residents, who knew they wouldn't have to cover all costs associated with the LOSS.

LISTENING TO COMMUNITY CHAMPIONS

Lesson Learned: **Engaging community champions was crucial for maintaining momentum, addressing local concerns, and ensuring the project goals aligned with the community's values. Local leadership and active participation helped build trust, influence design choices, and garner support for a wastewater solution that protected Fall City's rural character.**

Since residents and business owners within the Fall City business district first started considering a new wastewater system, this community has been very vocal, ensuring that the wastewater solution would meet their needs. During the planning process with King County, community members from the business district repeatedly expressed the desire for a wastewater solution that would not support population growth and would preserve Fall City's rural character. The Fall City project team collaborated with the community to achieve this goal through several meetings held at different stages of the project.

Additionally, the former King County Local Services official and current Fall City resident played a vital role in communicating community needs to King County during the early design process. Through their existing relationships with local business owners, the resident was able to better

assess the level of interest in pursuing a wastewater solution like a LOSS. Having a local lead the survey helped build trust and connect the county with the community.

IDENTIFYING A CO-BENEFICIAL SOLUTION

Lesson Learned: **Wastewater projects might require compromise, since the "perfect" site isn't always available. By recognizing and utilizing co-benefits, a feasible solution can be found that satisfies technical requirements while also aligning with broader community values.**

The Fall City LOSS needed a functional drainfield. Though Bernard Memorial Park was not perfect—it was slightly too small—there are benefits. The park benefits the community as a secure open space for recreation; it also supports the Fall City Metropolitan Parks Department by providing additional income, and it sustains the park itself by maintaining a continuous flow of water to the grass and trees. The co-benefits of the space provided flexibility regarding its imperfections. When seeking a drainfield solution, finding perfection may not be possible, but some flexibility can be acceptable when a co-beneficial solution is identified.

6.8. CONCLUSION

The Fall City LOSS demonstrates persistence. For over 30 years, King County and members of the Fall City community searched for a solution to the Fall City wastewater issue. Without a resolution, the Fall City business district OSS would pose a risk to both the environment and residents. The new LOSS system was developed because community needs were addressed, political support was gained, and an appropriate drainfield site was identified.

7. CASE STUDY – PACKWOOD

Packwood is an unincorporated town in Lewis County that runs along the Cowlitz River and is located 7 miles south of Mount Rainier National Park. Once a bustling lumber town, the lumber mill closed in 1998, leading to a decline in population. As of 2022, the Packwood subarea (see Figure 7) had about 910 residents, many of whom are seniors on fixed incomes. This is a significant increase from roughly 300 residents in 2010 (Lewis County, 2025a). The population is expected to continue growing, with Packwood anticipating a 32% increase between 2025 and 2045 (Lewis County, 2025a).

Packwood Demographics
(U.S. Census Bureau, 2023)
Population: 910
Size: 1 sq.mi
Median Household Income: $59,911 (Lewis County)
Median Age: 63.6
Project Website

With the loss of the lumber mill, Packwood's primary source of income now comes from tourists heading to nearby parks and recreation areas. An estimated one million people visit Packwood each year to enjoy the surrounding nature (Lewis County, 2025a). The town also hosts an annual Packwood Flea Market on Memorial Day and Labor Day. This flea market is one of the largest in the western U.S., attracting thousands of visitors each year (Miller, 2023).

A downside of tourism has been the rising home prices. In the last 10 years, Packwood experienced a 300% increase in house prices (Lewis County, 2024), with many of these recently bought homes turning into short-term rentals. Packwood typically hosts many seasonal workers who are employed at Mount Rainier National Park or the White Pass Ski Area. However, with increasing rental costs, many of those seasonal workers are being priced out.

All Packwood commercial and residential structures are currently connected to individual OSS that are aging, with many having been installed before 1991. Most of the downtown parcels lack the necessary drainfield space to install new OSS, with many labeled non-conforming by Lewis County Public Health. Below Packwood lies the town's drinking water aquifer, which is managed by Lewis County Water District #3 (Lewis County, 2025a). OSS failures could pose environmental and human health risks if sewage were to enter the aquifer. Much of the soil around Packwood is highly permeable Type 1, increasing the risk to the aquifer if a failure occurs.

Due to the number of OSS with non-conforming status, the Lewis County Health Department declines building permits in the downtown area and advises downtown businesses to reduce their overall septic use (BOCC, April 2012; Lewis County Department of Public Works, 2023a). To accommodate tourists, some Packwood restaurants rely on portable bathrooms or have limited seating to lessen the pressure on septic systems. A few restaurants also use disposable dishes to cut water usage (Lewis County Department of Public Works, 2023a).

Starting in the early 1990s, a Packwood Wastewater Working Group, consisting of Lewis County representatives and a Packwood citizen-led organization called Destination Packwood, guided

wastewater decisions with a goal of shifting Packwood away from OSS (Lewis County, n.d.). This group eventually expanded to include representatives from the Department of Commerce and the Lewis County Water District #3. The Packwood Wastewater Working Group supported multiple studies, funded mainly through community development block grants (Lewis County, n.d.(a)), examining alternative wastewater systems, such as a LOSS (See Table 12 and Figure 7).

Table 12. Summary of Packwood LOSS Proposals

Study	Proposal Description	Proposal Costs	Reason for Failure
Gray and Osborne (2002)	LOSS: A STEP or gravity system with drainfield	$3-$5million ($5-$8 million in 2025 dollars)	• Lack of interest from potential operators • Lack of funding
Skillings and Connolly (2010)	LOSS: A Recirculating Textile System[4] with drainfield	$1.9 million ($4.8 million in 2025 dollars)	• Project cost too high for low-income area • Unable to procure grants
Territorial Landworks, Inc. (2013)	LOSS: A gravity system with a Sequencing Batch Reactor[5] with drainfield	$3.5-$2.4 million ($4.4-$5.9 million in 2025 dollars)	• Unknown
Biohabitats (2024)	LOSS: A centralized MBR system and drainfield.	$26 million	• Ongoing

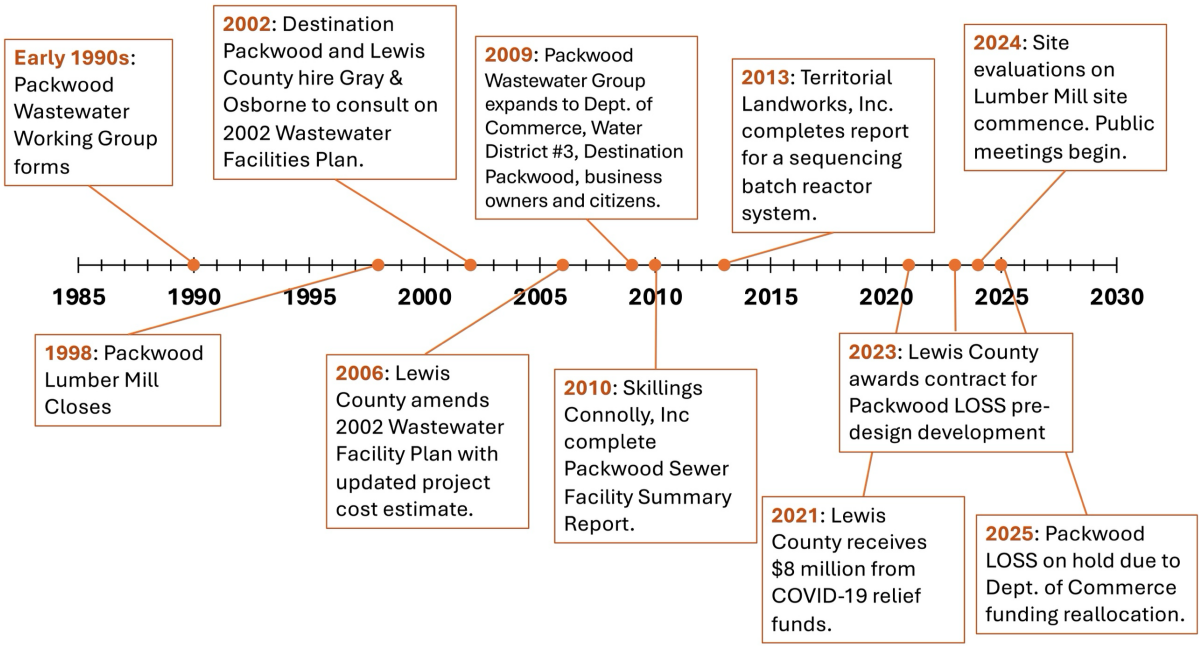
Source: Territorial-Landworks, Inc. (2013), Biohabitats (2024)

Territorial-Landworks (2013) proposed a centralized LOSS, which was approved by DOH. The design failed to proceed to construction, likely due to costs. The most recent study, a 2024 LOSS predesign report (Biohabitats, 2024), received DOH approval to move to the design phase. Lewis County Water District #3 also agreed to be the owner for the LOSS. Construction of the Packwood LOSS was expected to start in 2026, but due to a lack of funding, the project is on hold (see Figure 7).

[4] Definition of Recirculating Textile System – a wastewater solution that uses a natural media containing living bacteria to aerate and clean liquid waste.

[5] Definition of Sequencing Batch Reactor – wastewater is added to activated sludge (aerobic bacteria) in a timed sequence to promote biological reactions.

Figure 7. Packwood Wastewater Timeline



7.1 DESCRIPTION OF PROPOSED WASTEWATER SYSTEM

Biohabitats (2024) proposed a mounted MBR treatment system with a submersible influent pump station and an equalization tank. The system is designed to treat a daily flow of 81,000 gpd. Effluent from buildings will first pass through a pump station. The pump station times the release of peak-hour flow and includes a fine mesh screen that provides initial filtration of large particles. The pump connects to the equalization chamber, which helps stabilize the flow of wastewater. The flow then passes into the MBR for treatment before exiting into the drainfield.

Effluent will be treated to LOSS standards for discharge through a drainfield to a critical aquifer area (Biohabitats, 2024). The treated effluent will disperse through a 5.7-acre off-site drainfield located at the former Lumber Mill site, now owned by Commerce Meadows, LLC. An extra 5.7 acres of land will be kept for use as the reserve drainfield on adjacent properties also owned by Commerce Meadows, LLC. The facility and Drainfields are designed to include additional tanks to support the 20-year growth estimates for Packwood (Lewis County, 2023).

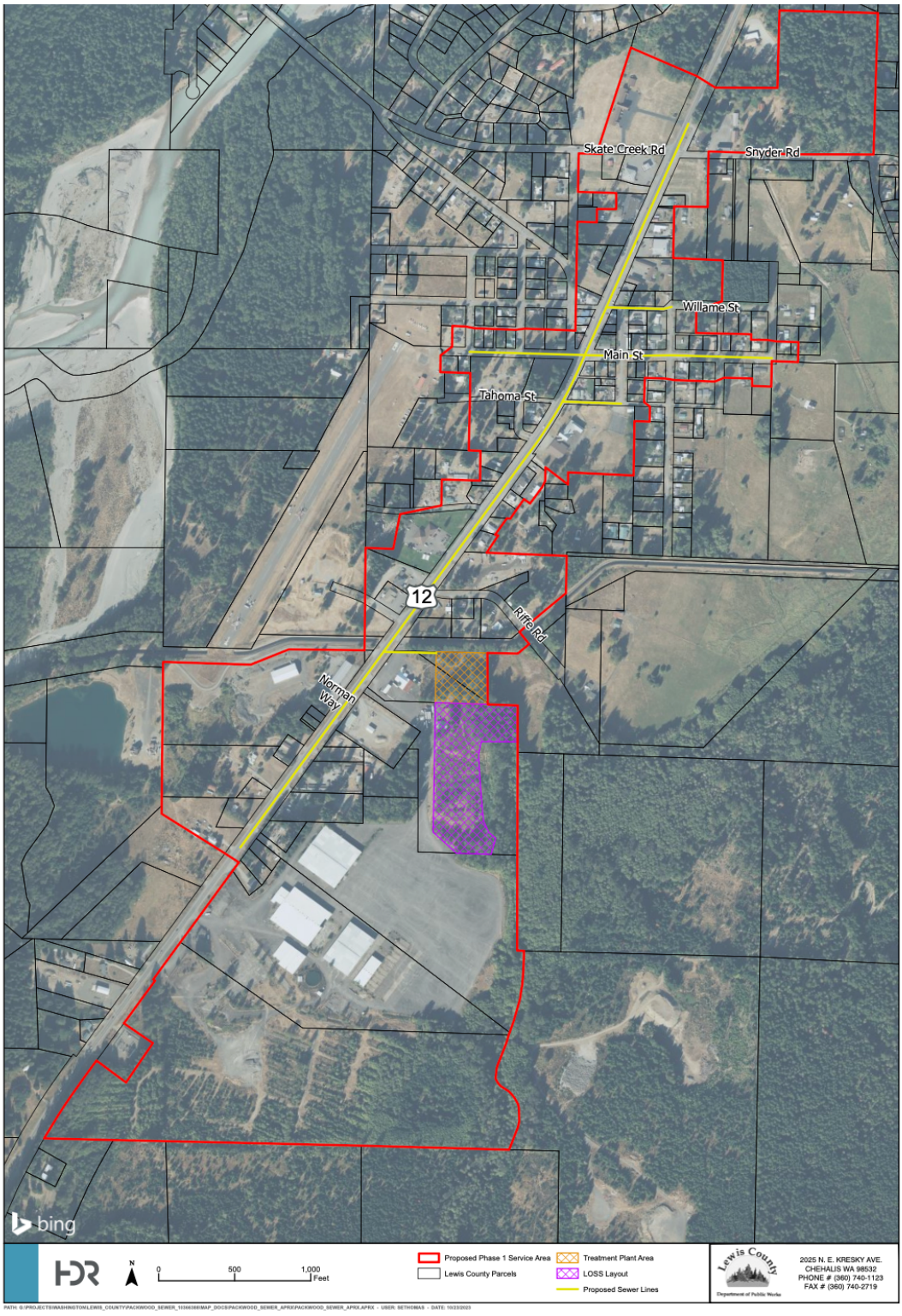
The Lumber Mill site primarily has Type 1 or 2 soils. Under Chapter 246-272B WAC, Type 1 or 2 soils (gravelly or coarse sands) are permitted the highest loading rate (gpd/sf). To protect the aquifer beneath the drainfield, Biohabitats (2024) opted for a conservative approach with their estimated loading rate. They lowered the rate to correspond with denser soils of a Type 3 (see Table 2). This decision increased the expected size of the drainfield, helping to distribute the effluent over a larger area.

The Packwood Sewer Project has two phases:

- Phase 1: convert commercial properties within the downtown district from OSS to LOSS (see Figure 8 for the service area).
- Phase 2: expand the LOSS to all properties within the Packwood Urban Growth Area (UGA) (discussed further in section 7.2).

As of 2025, the project is on pause due to a funding loss; DOH approval for the facility and drainfield expires after three years.

Figure 8. Proposed Phase 1 Service Area for Packwood Large Onsite Sewage System



Designated Packwood downtown area for Phase 1 conversion from onsite sewage systems to the large onsite sewage system. Source: Lewis County (n.d.(b)) Packwood Sewer Project: Service Area – Phase 1.

7.2 CHALLENGE – ZONING CONSIDERATIONS

In 2024, Lewis County adopted the Packwood Subarea Plan as part of its comprehensive plan update. The Packwood Subarea Plan was a collaborative effort involving multiple Lewis County government sectors, the Lewis County Water District #3, and Packwood community members. The Subarea Plan utilizes population growth projections to inform development decisions, supporting a 20-year vision.

As described below, the Subarea Plan changes the zoning in Packwood to better reflect community preferences for development. During the planning process, the Packwood community expressed a desire for new zoning that restricts development to the downtown area and at the former Lumber Mill site (Brooks, 2025a). To support this preference, the Subarea plan proposes designating Packwood as a UGA. The future LOSS would be built to encompass any new developments within the UGA.

LAMIRD TO UGA

The Packwood Subarea Plan suggests changing part of the current LAMIRD designation to a Small Town – Urban Growth Area (UGA) to better support Packwood's urban opportunities and its projected future population (Brooks, 2025b). Surrounded by agricultural, forest, or rural lands, Packwood is considered an urban hub for much of rural eastern Lewis County (Lewis County, 2025a). The closest incorporated city, Morton, is located 35 miles away.

A UGA designation under the Growth Management Act requires Packwood to provide urban services such as sewer and water (Packwood already has a water service area) within 20 years. A LOSS satisfies the sewer requirement. Packwood meets many other requirements for a UGA. A UGA requires a density of 4 dwelling units per acre, which is achieved through the current Small Town Mixed-Use zoning (see Table 13). Additionally, Lewis County must report the expected 20-year population growth, completed in 2017, which projects a 32% increase in Packwood's population over the next 20 years.

The UGA would support housing opportunities for Packwood residents and visitors. The Packwood housing market makes homeownership and rental costs too high for many people wanting to live in Packwood. Current residents have expressed a desire for more affordable housing because they feel they may be priced out of their homes (Lewis County, 2022, 2025a). The UGA designation promotes low- and moderate-income housing by allowing multiplexes, tiny homes, or dormitories. In addition, multiplexes within the UGA may not be used as short-term rentals to increase owner-occupied options in Packwood (Lewis County, 2025b). This helps to ensure that long-term rental properties stay affordable and available.

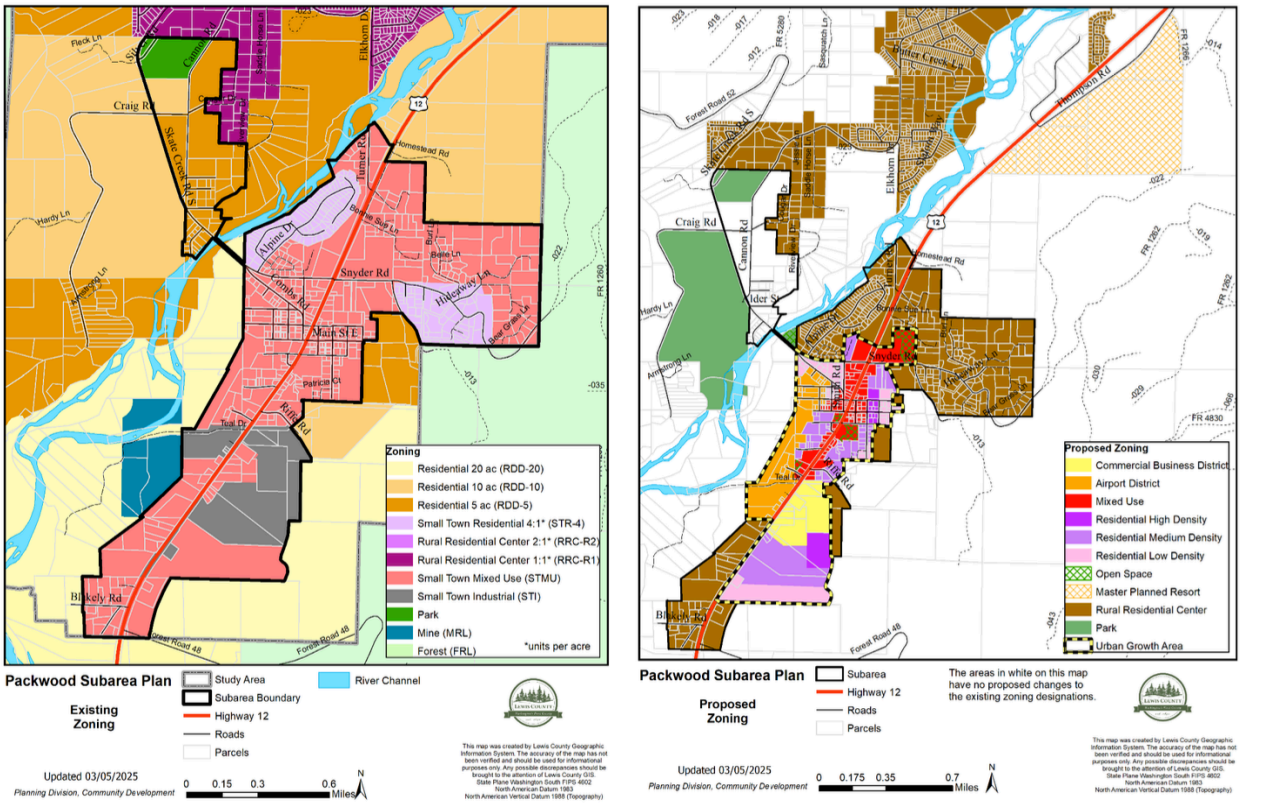
A UGA focuses development around the downtown area, which simplifies any future connections to the LOSS. With the current LAMIRD, commercial development is spread throughout the subarea through the Small Town Mixed-Use zoning (see Figure 9). New development could then occur further away from the downtown area, which would require

longer conveyance lines for a LOSS connection. Alternatively, the UGA restricts new developments to mixed-use and residential zoning focused around the downtown area, which will be built up to support the expected population growth. While development can occur within a LAMIRD designation, under a LAMIRD, LOSS can only serve the existing population (see Table 6). Under a UGA, the LOSS can be designed to support this increased development and the future population of Packwood.

Table 13. Current and proposed designations for Packwood downtown district

Current Designation	**Description**
Small Towns	Small Towns are unincorporated areas that provide critical housing, jobs, and services for people living and working in rural areas and resource lands.
Limited Area of More Intense Rural Development (LAMIRD)	Designated area outside of cities and UGAs that allow for greater residential density.
Small Town Mixed Use (STMU)	Allows for a wide mix of uses – from residential and commercial.
Proposed Designation	**Description**
Small Town – Urban Growth Area (UGA)	A UGA is a tool used through the Growth Management Act that identifies areas where the county should be encouraging and supporting urban development. The designation allows for LOSS or sewer.
Residential High Density	10-16 units per acre. Encourages affordable housing like dormitories, hostels, and multiplexes.
Commercial High Density	Large commercial buildings, 10,000-20,000 sf and highest density residential units (18-30 units per acre).

Figure 9. Proposed Urban Growth Area for Packwood



The left side displays the current zoning of Packwood, while the right side displays the proposed zoning. The proposed Urban Growth Area would replace much of the subarea boundary zoning to allow for higher density developments. The LOSS could serve all parcels within the Urban Growth Area. Source: Lewis County. 2025. Packwood Subarea Plan: 2025-03-05 Packwood UGA & Zoning.

The 2025 Packwood Subarea Plan changes the zoning at the Lumber Mill site from industrial to a mix of residential and commercial. This new zoning helps Commerce Meadows, LLC. develop on-site housing that will connect to the future LOSS. In Lewis County, essential government services are permitted in all zoning designations.

The Packwood LOSS is designed to support the entire UGA. Phase 1 of the LOSS will serve the Packwood downtown district (see Figure 8). In the proposed Subarea Plan, this includes the areas zoned for mixed use and the former Lumber Mill site (see the right-hand map in Figure 9). If the UGA is not adopted, the LOSS can continue to serve this area. If the UGA is adopted, Phase 2 will extend the LOSS to cover the entire UGA.

Most of the downtown district is expected to connect to the LOSS. However, pre-existing developments cannot be forced to connect and may choose not to, while any new developments will be required to connect (Biohabitats, 2025). All non-conforming systems would be required to connect.

As of Fall 2026, the UGA proposal has not been adopted. Until Lewis County adopts the plan, the designation remains the same. For towns like Packwood, which are more than just community centers but active towns providing jobs and housing, having the necessary infrastructure could be vital in meeting rural county needs.

7.3 CHALLENGE - DRAINFIELD SITE SELECTION

Acquiring a drainfield was challenging during the Packwood Sewer Project - sites either had poor soil, were too far from the service area, or were difficult to secure (Territorial Landworks, Inc., 2013).

Territorial-Landworks (2013) overlooked the Lumber Mill as a drainfield site. The study determined the area was unsuitable because it was "wholly within [a] Floodplain" (pg. 6). Although DOH permits Drainfields in floodplains if the vertical separation requirements for groundwater are met, this may have been overlooked. During the 2013 assessment, a local community member offered their property for use of the LOSS site.

Lewis County reapproached the property owner during the LOSS 2024 pre-design phase. A site visit reaffirmed that the parcel was suitable; however, the property owners retracted their offer soon after (Lewis County, 2025c). Biohabitats (2024) then looked for alternative locations. They revisited the Lumber Mill site and determined that it was only partially within the 100-year floodplain, with sufficient room for a drainfield.

Commerce Meadows, LLC purchased the Lumber Mill site in 2022 with plans to develop mixed-use housing (Wenzelburger, 2022; Biohabitats, 2024; Lewis County, 2025d). Lewis County approached Commerce Meadows, LLC, with a proposal to buy part of their land. Commerce Meadows, LLC, agreed because it was a mutually beneficial deal as the new housing could connect to the LOSS.

The Packwood Sewer Project faced a minor obstacle at the Lumber Mill site. Initial studies, conducted in winter 2024, indicated that soils under the Lumber Mill site failed to meet DOH soil criteria (Lewis County, 2025c.). Soil characterization, as listed in WAC 246-272B-03400, must consider not only the soil type but also the soil depth, groundwater level, and the presence of fill or debris in the soil profile. As a former lumber mill, certain portions of the property had leftover subsurface debris that would have precluded its use as a drainfield. However, later soil evaluations in the same year identified other portions of the Lumber Mill property that met the criteria (Lewis County, 2025c).

7.4 CHALLENGE – LOW CAPACITY, SMALL COMMUNITY

For Packwood, low-income levels and a small population pose barriers to the Packwood Sewer Project, making it challenging to secure grants and cover the costs of new infrastructure (Territorial-Landworks, Inc., 2013; BOCC, March 2018; BOCC, June 2023).

Many communities in Lewis County lack financial resources, making it more challenging to support large infrastructure projects, such as the Packwood LOSS. In Packwood, 24% of the population lives on a very low or extremely low income, home prices have doubled over the past decade, and many residents face a high household burden (Lewis County, 2022). A high household burden means an individual spends a large portion of their income on housing expenses. In past discussions, the County hoped that constructing a new community wastewater system would help attract people back to Packwood (BOCC, April 2011) and distribute costs among residents over the long term.

Obtaining large federal grants necessary for a major wastewater project is also challenging. State and federal grants are typically complex and require expertise and time to secure and manage, which can be burdensome for smaller counties (GAO, 2023). Lewis County has limited staff, meaning fewer people are actively seeking and managing grants for the Packwood Sewer Project. These employees often work on tight budgets and juggle multiple roles. Additionally, federal funds can sometimes require a matching contribution, which can be hard for rural areas to fulfill (BOCC, March 2013; BOCC, July 2023).

7.5 CHALLENGE – FINDING CAPITAL FUNDING

High costs for the Packwood Sewer Project are a barrier to construction. Funding for a large-scale wastewater project often requires multiple sources to cover all expenses. The Packwood Sewer Project has historically faced difficulties in obtaining funding, and these challenges persist in the current project, which is facing rising costs (see Table 14).

Table 14. Packwood Sewer Project Proposed Costs

Year	Proposed costs for the Packwood Sewer Project (in 2025 dollars)
2002	$5-$8 million
2010	$4.8 million
2013	$4.4-$5.9 million
2024	$16-20 million
2025	$26 million

Sources: Territorial Landworks, Inc (2013); M. Burch, pers. comm; and BOCC July 2024.

Both the Gray and Osborne (2002) and Skillings and Connolly (2010) reports provided a version of a LOSS; however, the community was unable to obtain funding (BOCC, April 2011; Lewis County, 2013). Although the reason for the Territorial Landworks, Inc. (2013) LOSS proposal not moving forward is unknown, an inability to fund the project is a likely cause.

In 2021, Lewis County received an $8 million grant for the Packwood Sewer Project through COVID-19 – American Rescue Plan Act funds. Project managers used cost estimates from the 2013 Territorial Landworks - Packwood (LOSS) Predesign report to determine the requested amount. This cost would cover design, environmental permitting, property acquisition, and construction (Lewis County Department of Public Works, 2024). Lewis County received an initial grant of $1.6 million for pre-design work with the expectation that the remaining allocation would follow.

Since receiving those initial funds, the project's estimate has more than doubled (Lewis County Department of Public Works, 2023b). Inflation played a role, and costs may have also risen because the size of the LOSS was expanded to include future development. An updated cost estimate from July 2024 placed the Packwood Sewer Project's cost at $16-$20 million, with the latest 2025 estimate increasing to $26 million (BOCC, July 2024; M. Burch, pers. comm.). Due to this new high price, the Department of Commerce re-obligated the remaining funds because Lewis County was unable to cover the remaining project costs (BOCC, December 2024). Since this grant was the only source of funding for the LOSS, the Packwood Sewer Project was paused until new financing could be secured. The project managers requested support from state legislators in hopes of securing funding from Washington's capital budget.

7.6. LESSONS LEARNED

The Packwood Sewer Project offers valuable lessons for other communities seeking to enhance their wastewater systems. Its history can help other counties recognize potential funding challenges when planning a new wastewater solution and inspire innovative solutions.

LOSS COSTS AND LIMITED CAPACITY CAN BE PROHIBITIVE FOR RURAL AREAS

Lesson Learned: **Smaller communities like Packwood face significant challenges in advancing costly wastewater projects due to limited financial resources and staff capacity. Long-term success depends on state investment in grants for infrastructure and also in building local government capacity to manage and sustain complex projects.**

Packwood has historically struggled to secure new wastewater infrastructure, and those challenges persist. For the past 30 years, residents of Packwood and representatives from Lewis County have been searching for a solution. Previous proposals have included various wastewater options, such as LOSS, but obtaining funding was a persistent challenge.

Over the years, finding an affordable solution for a relatively low-income area like Packwood has become increasingly difficult. The current proposal, with an estimated cost of $26 million, raises further concerns about affordability. The gap between Packwood's ability to pay and capital costs will continue to widen as this project remains on pause.

Washington state has programs that offer extra support to rural counties looking to improve infrastructure, such as the Rural Development Council and the Infrastructure Assistance

Coordinating Council. These programs can provide vital funding help for counties that need it. For counties like Lewis, which have limited staff and economic capacity, having access to outside programs that can supplement funding is especially important.

ALIGNING WITH GROWTH PLANNING

Lesson Learned: **By coordinating growth and infrastructure planning, communities like Packwood can better address housing needs and support long-term development opportunities.**

The UGA designation allows for future development to support a larger Packwood population. The LOSS is designed to accommodate future development within the Packwood downtown district, with a drainfield size that matches the expected population growth. The goal is that by having the infrastructure in place first, Packwood will be better equipped to meet the future population projection. The UGA designation helps Packwood pave the way for building affordable housing. As seasonal park workers have expressed a desire to live in Packwood, a known population is ready to move. As they say from the often-misquoted 1989 Field of Dreams movie, "if you build it, he [they] will come." However, if the Packwood Sewer Project cannot move forward due to cost constraints, the UGA designation may also be delayed. Packwood residences will then continue with OSS or find funding for a smaller-scale LOSS.

COLLABORATING WITH PRIVATE PARTNERS

Lesson Learned: **Zoning changes can create opportunities for mutually beneficial solutions between private partners and local governments.**

Zoning changes can enable a working relationship between commercial developers and local governments that provide infrastructure services. The Lumber Mill site was the best choice for the drainfield; it was properly sized and conveniently located near downtown. When Commerce Meadows, LLC purchased the property in 2022, Lewis County and the engineering firm recognized the advantages of using that space. To develop the property, Commerce Meadows, LLC would need to pay for the installation of wastewater infrastructure. Instead, with the LOSS, Commerce Meadows, LCC. would have wastewater infrastructure in place and would receive additional funding through the sale of the land to the city.

7.7. CONCLUSION

Over the past 30 years, Lewis County has planned for a new Packwood wastewater system and continues to do so. The existing OSS are over 30 years old and risk contaminating the town's drinking water aquifer. Packwood also serves as a community hub for eastern Lewis County, providing space for gatherings, housing, and employment, but it lacks the infrastructure to support these activities. A new wastewater system is needed to enable Packwood to accommodate the current and future community.

8. CASE STUDY - MAPLE GROVE

Maple Grove Demographics
(U.S. Census Bureau, 2023)
Size: 40 houses
Median Household Income: $100,124 (Camano Island)
Median Age: 55.2 (Camano, Island)

Maple Grove is a small community situated along the northern coast of Camano Island in Island County. Once a fishing village, it has grown into a popular vacation rental area, with waterfront homes and a public boat launch. In the nearshore waters, wild clams, mussels, and oysters can be harvested by the public.

The community has about 40 houses, all equipped initially with either OSS or cesspools, and some with straight pipes. Most OSS installations date back to the 1960s or 1970s (H. Kortuem, pers. comm.). Almost all of the homes have wastewater systems within 200 feet of the Ordinary High Water Mark. These systems pose environmental risks due to the potential for introducing poorly treated waste into the nearshore.

Within Island County, three out of four residents use OSS (Island County Code Chapter 15.03.010.d). Island County established the Clean Water Utility (Chapter 15.03) to fund the management of surface water and groundwater quality and quantity, including efforts to reduce contamination risks from OSS. The utility partially funds Island County Public Health to ensure OSS compliance under Chapter 246-272A WAC and funds the Surface Water Quality program staff who monitor surface water for contaminants at a rotating set of locations throughout the county. To maintain water quality, the Island County Surface Water Quality (SWQ) program monitors a station at the Maple Grove boat launch.

Consistent sampling revealed high bacterial levels in the vicinity of the boat launch area. Island County PIC then designated the Maple Grove boat launch as a PIC focus area. Focus areas are where the county concentrates efforts to find pollution sources in order to mitigate pollution and reopen shellfish beds (Island County, 2025). Early PIC efforts, in 2012, found at least three failing OSS releasing sewage directly onto the beach (Island County Public Health, 2025). Once identified, these homes were referred to the Island County Public Health OSS team. At this stage, enforcement involved sending compliance letters and performing inspections.

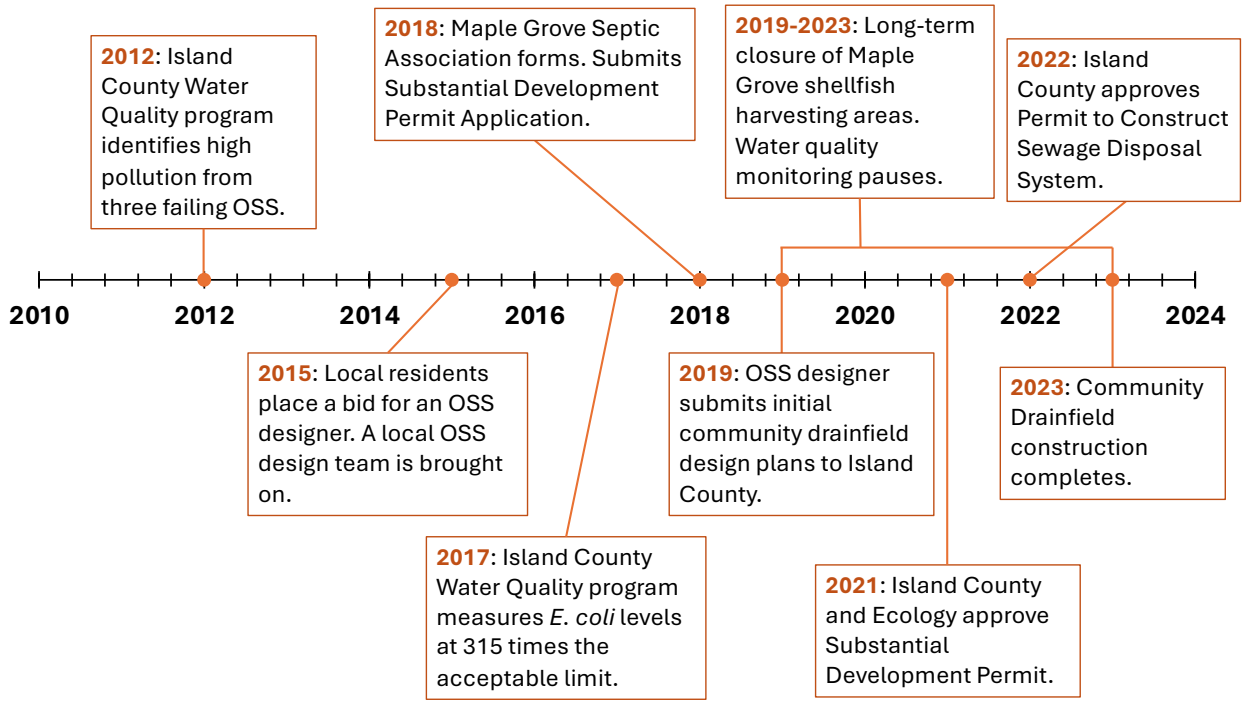
By 2017, PIC monitoring indicated *E. coli* levels were 315 times above the acceptable limit (Hansen and Van Sistine, 2023), as more OSS failures were found. The ongoing high *E. coli* levels caused continued closures of the Maple Grove shellfish beds (see Figure 10). Eventually, Island County Public Health determined that the Maple Grove community required a Table 9 (non-conforming) emergency repair. The failures were classified as “shoreline systems with no vertical separation” (Island County Public Health, 2022).

The discovery of failed OSS was no surprise to long-time residents of Maple Grove, who had been smelling raw sewage for years (Hansen and Van Sistine, 2023). A few residents banded together to form the Maple Grove Septic Association. The goal of the Maple Grove Septic Association was to find a solution to the failing OSS problem.

During early planning stages, Island County proposed the idea of a LOSS in Maple Grove. The benefit was that the LOSS could serve the entire Maple Grove community. Maple Grove community members, who would go on to form the Maple Grove Septic Association, identified a potential drainfield site for a LOSS, but the location did not meet WAC 246-272B site requirements (H. Kortuem, pers. comm.). The community also expressed concerns about the costs associated with a LOSS. LOSS systems can be expensive for smaller communities because they require special site inspections and more site investigations, which DOH must approve. The cost of construction materials was also a concern.

Ultimately, the community sought a more affordable, faster solution that required less involvement from the state government. A Community Drainfield was chosen. After permitting (see Figure 10), construction of the Maple Grove Community Septic started in 2022 and finished in 2023 (Hansen and Van Sistine, 2023; Angeli, 2023). This system replaces failing septic units with new tanks and moves effluent away from the shoreline to a shared drainfield in an upland area.

Figure 10. Maple Grove Community Septic Timeline



8.1. DESCRIPTION OF NEW WASTEWATER SYSTEM

The Maple Grove Septic Association hired a local OSS designer, C&H designs, to design the Maple Grove Community Septic. Per Island County codes, the Community Drainfield is designed in accordance with WAC 246-272B LOSS siting requirements (see Section 8.2).

The Community Drainfield is situated on private residential property, located upland from the coastline. The private property is home to a residential house with a pre-existing OSS. To separate the OSS from the Community Drainfield, a gravel road was constructed with a permanent protective barrier between the gravel road and the Community Drainfield. The Maple Grove Septic Association acquired the land through an off-site easement drainfield contract (discussed more in Section 8.4) with the property owner for use of the space. Though finding space for a drainfield is a significant challenge for many wastewater projects, the discovery of drainfield space for the Maple Grove Community Septic was not noted as a challenge. This could be due to the strong community desire to support the development of new wastewater infrastructure and the community's tight-knit nature.

The Community Drainfield is designed to handle 3,000 gpd but is required to operate at 75% capacity. 25% of the capacity (750 gallons) is reserved for surge capacity and safety protocols. The system treats effluent to LOSS Treatment Level B standards and utilizes nitrogen reduction processes (see Table 3).

The system supports 25 bedrooms. Flow affidavits can reduce the bedroom count for a house based on an agreement that the household limits its effluent flow. These affidavits are permanent. Reducing one or more bedrooms in a home then allows another house to connect if the total number of bedrooms remains the same. Due to the use of flow affidavits, the Maple Grove Septic Association is required to submit monthly flow reports to Island County Public Health (H. Kortuem, pers. comm.). These reports are intended to ensure that effluent levels stay below capacity.

The Maple Grove Community Drainfield initially served 11 homes, but through flow affidavits later expanded to accommodate 14. Most of the houses are owned by year-round residents, although a few are short-term rentals. Homes were added to the system on a first-come, first-served basis, primarily based on the owner’s ability to pay a $40,000 investment fee being collected by primary organizers of the Maple Grove Community Septic (discussed in Section 8.4). No prioritization took place based on homes with the greatest needs. Some houses that were originally scheduled to connect withdrew before installation, allowing new homes to connect to the drainfield.

The new community system features tanks, generators, lift stations, transport lines, a retaining wall, and a pressure drainfield. Much of the Community Drainfield is located on or near a steep slope, classified as a Geological Hazardous Area, a type of GMA-designated critical area. The drainfield is situated on level ground at the top of the slope. A review by a geoengineering firm assessed the site and found that the Community Drainfield plans adequately addressed slope stability, allowing the project to move forward (Island County Planning, 2021). System details for the Maple Grove Community Septic include:

- **Household tanks**| seven individual or community sewage holding tanks (capable of having multiple connections) with capacities ranging from 1,000 to 3,000 gpd, located

on or near household properties. These serve as replacements for failing or aging tanks. Some tanks are equipped with pumps to access the transport line.

- **Retaining wall** | one wall supports slope stabilization on the drainfield property. The retaining wall includes drainage to collect surface and subsurface water from the site for disposal in the County Road Right-of-Way.
- **Transport line**| a gravity-fed effluent sewer pipe that connects the property tanks to the drainfield. To connect to the drainfield and prevent shifting, an 8-inch sewer pipe is anchored to the geologically hazardous slope leading to the shared drainfield. The liquid effluent from the tanks passes into the transport line, which pumps it to the drainfield.
- **Drainfield tank installations** include six 1,000-gallon NuWater processing tanks and two 3,000-gallon single-chamber pump tanks located near the drainfield for pressure distribution. The NuWater processing tanks use an extended aeration activated sludge process to treat wastewater (Enviro-Flo Inc, 2013).
- **Drainfield**| 12 – 10' x 58' pre-treated gravelless chamber pressure beds. Four are sand-lined, and eight are with the original soil. Installation includes a 100% reserve field; 50% is currently built, with the remaining 50% held.

The new Maple Grove Community System lowers risks to environmental and human health by replacing old septic tanks or cesspools with new OSS and relocating effluent disposal upland out of the shoreline zone. Placing the Community Drainfield in an upland area also eliminates the risk of flooding from sea-level rise.

ZONING

Unlike in many other communities, zoning was not an issue for the Community Drainfield. Maple Grove is zoned as a Rural Residential – Shoreline Residential Historic Beach Community. Island County's Shoreline Master Program (Chapter 17.05A.070) defines a Shoreline Residential Historic Beach Community as:

"...[L]imited areas within the shoreline of Island County that have been platted in a dense pattern with small lots relative to other areas of the county. The existing marine waterfront lots are developed with residential structures constructed thirty (30) feet or less from the ordinary high water mark and the structures were established prior to enactment of the Shoreline Management Act."

A Shoreline Residential Historic Beach Community is not classified as a LAMIRD, which is the common designation for zones within Puget Sound that allow community wastewater services. However, according to Island County Chapter 17.05A-Table 1, accessory utilities are permitted in shoreline rural residential zones. Accessory utilities include features such as wastewater infrastructure located on the property.

8.2. CHALLENGE - REGULATORY REQUIREMENTS

Island County Code 8.07D.210 requires Community Drainfields to be "designed in accordance with site evaluation, design, maintenance, and management criteria as set forth in WAC 246-272B." This means the Community Drainfield must meet LOSS permitting requirements, including submitting a Pre-Design report to Island County, conducting a site and soil evaluation, creating a hydrogeological report, and submitting an engineering design document (Island County Public Health, 2025). Although the Island County Code requires compliance with LOSS standards, it does not mandate the use of a professional engineer. As a community-led project supported by a local OSS designer, the project needed additional technical assistance from Island County staff.

The project required a shoreline substantial development permit because many homes are within 200 feet of the shoreline. Obtaining the permit took three years, from 2018 to 2021 (see Figure 10). To secure the permit, the OSS designer had to submit an approved Community Drainfield design. A recently hired Island County staff member closely helped the OSS designer, ensuring the Community Drainfield design met WAC 246-272B standards. The design underwent several rounds of edits after it initially failed to meet the LOSS siting requirements. The approved proposal includes several non-conforming elements (see Section 8.4), which are allowed through the Table 9 emergency repair.

Along with the development permit, the project required approval from the Washington State Department of Archaeological and Historic Preservation (DAHP) (see Table 15). The Maple Grove area holds significant historical importance, with evidence that at least 12 indigenous tribes have lived in the area (H. Kortuem, pers. comm.). Since it is a Historic Archaeological Site, the project needed a DAHP permit before construction could start.

A State Environmental Policy Act (SEPA) review was not required for this project. Ecology issued an Optional Determination of Nonsignificance (ONDS) in October 2020. An ODNS is issued when an environmental impact statement is not needed due to the lack of likely significant negative impacts on the environment (Island County Planning, 2021).

Table 15. Maple Grove Community Septic Permit Requirements

Regulatory Requirement	Complies (Yes/No)	Comments
Land Use Standards – ICC 17.03.180.A	Yes	Meets applicable standards.
Exemptions from SDP Requirements ICC 17.05A.130.E & WAC 173-27-040	No	Project not categorically exempt. Substantial Development Permit required
Shoreline Use Classification - ICC 17.05A.080	Yes	Accessory Utilities are permitted within the Shoreline Residential environment.
General Shoreline Standards ICC 17.05A.090	Yes	Project can comply, with conditions of approval.
State Environmental Policy Act (SEPA)	Yes	ODNS issued October 25, 2020
WA State Dept. of Archaeology & Historic Preservation (DAHP)	Yes	DAHP Monitoring Permit No. 2021-41 issued July 16, 2021
Public Works/Engineering	Yes	Approved with conditions.
Public Health	Yes	Approved with conditions.

Source: Island County Planning (2021). Shoreline Development Permit.

WAC 246-272A-0200 requires all major OSS repairs or new installations to submit a Sewage Disposal System permit to their Local Health Jurisdiction. The Maple Grove Septic Association submitted its permit to Island County Public Health in March 2021, and it was approved in May 2022. Construction on the Community Drainfield began shortly after approval of this final permit.

8.3. CHALLENGE – NON-CONFORMING ELEMENTS

The location of the Maple Grove Community Drainfield influenced the construction of the system. Parcels in Maple Grove are small, many with large impermeable surfaces, and are located very close to the shoreline. The Maple Grove Community Septic was completed as a Table 9 emergency "non-conforming" repair, due to site limitations (Island County Public Health, 2022). The non-conforming features of the Maple Grove Community Septic include:

- The placement of three new septic tanks near homes does not meet the minimum required horizontal setbacks to the ordinary high water mark. These tanks required a special waterproofing coating and testing to demonstrate water tightness to comply with WAC 246-272B-05200.
- Two 3,000-gallon on-site community tanks lack enough space to comply with the 5-foot horizontal separation requirement for easements. Easements are required for any shared tank not located on the property of origin.
- Not all drainfield beds meet the Chapter 246-272B WAC vertical separation requirements, but they do satisfy the criteria outlined in the hydrogeologic assessment. Vertical separation requirements protect groundwater, while the hydrogeologic assessment ensures the safety of the surrounding community. When the vertical separation required by the WAC cannot be achieved, the designer must include sand lined trenches or additional treatment methods. The Maple Grove Community Drainfield employs both. Hydrogeologic assessments evaluate nitrogen levels, which

must remain below a specific threshold. This threshold was met through the additional treatment provided.

Due to these non-conforming elements, there are restrictions on the Maple Grove Community Septic (see Section 8.5). Homes connected to the Community Drainfield cannot expand to add more bedrooms, and the maximum daily flow to the drainfield is limited to its operating capacity of 2,250 gpd (Island County Public Health, 2022). The Maple Grove Community Septic must submit annual inspection reports and undergo additional well monitoring. Several drinking water wells are near the Maple Grove Community Septic, including one on the drainfield property. Although they meet horizontal setback requirements, the county believed additional monitoring of drinking water wells close to the drainfield was necessary due to the non-conforming aspects.

The Maple Grove Septic Association initially proposed a phased plan for the Community Drainfield project. The first phase focused on connecting homes that bought-in first to the drainfield, while the second phase aimed to expand connections to a larger part of the Maple Grove community. The drainfield already meets the strict operating capacity with current connections.

8.4. CHALLENGE – PROJECT COSTS AND FUNDING

Total project costs, including construction, exceeded $1 million (Hansen and Van Sistine, 2023; H. Kortuem pers. comm.). In June 2021, the Maple Grove Septic Association purchased the drainfield space through an off-site drainfield easement contract with the property owner for $200,000 (Island County, 2025). The project budget also included an $800-per-day archaeologist fee, which was necessary to fulfill the DAHP permit requirements (Hanson and Van Sistine, 2023).

Payment for the Community Drainfield was made through an initial buy-in fee. Each homeowner who planned to connect paid a buy-in fee of $33,000; this cost increased over time (H. Kortuem, pers. comm.). This cost is similar to the cost of replacing a septic system, which averages $34,000 (Green Economics, LLC, 2023). These fees covered easement acquisition, design, permits, and initial construction but did not meet funding goals for final construction (Angeli, 2023). To make up for this shortfall, the Maple Grove Septic Association contacted Ecology's On-Site Sewage Regional Loan Program for assistance.

The On-Site Sewage Regional Loan program is a collaborative effort involving Ecology, DOH, local county and health departments, and Craft 3. The program usually provides financial assistance to individual households for repairing or replacing aging septic systems. This was the first time the program assisted with a Community Drainfield. It offered a $250,000 loan to support construction activities, such as purchasing and installing septic tanks in the neighborhood and piping to the Community Drainfield (Angeli, 2023; S. Elson and T. Cowles, pers. comm.). The Maple Grove Septic Association is responsible for the loan; the property

owners provide payment through dues to the Maple Grove Community Septic Association over time.

8.5. CHALLENGE – NOT ALL HOMES CONNECTED TO THE SYSTEM

Between 2019 and 2023, the Island County Water Quality team paused monitoring at the Maple Grove site to await the end of the Community Drainfield construction. During this time, the beach remained closed to shellfish harvest. Water quality monitoring resumed in early 2023 with sampling done from the same Maple Grove boat launch monitoring location (Island County, 2025).

The 2024 Island County Marine Water Quality report noted that elevated levels of *E. coli* were detected throughout both 2023 and 2024 at the Maple Grove site. The Water Quality team initially could not identify the source, but a homeowner stepped forward, requesting that Island County Public Health assess their septic tank. A dye test revealed that poorly treated wastewater was "pouring" directly onto the beach from the house (Island County Public Health, 2025, p. 58). This house is not connected to the Community Drainfield. Other homeowners in the area were notified to undergo OSS inspections. Because the Community Drainfield had reached its maximum capacity, no more houses could be added to the system at this point. Due to the first-come, first-served basis of the Community Drainfield, it's possible more homes with failing OSS could be missed.

The Community Drainfield improved water quality. Although the water quality remains poor, levels of fecal coliform and *E. coli* have decreased. When first sampled in 2023, four years after the previous sample, the percentage of exceedances over the state standard (<10%) dropped from 32% to 22%. In 2024, the Water Quality team recorded an exceedance rate of 14%, just 4% above the state standard (Island County Public Health, 2025).

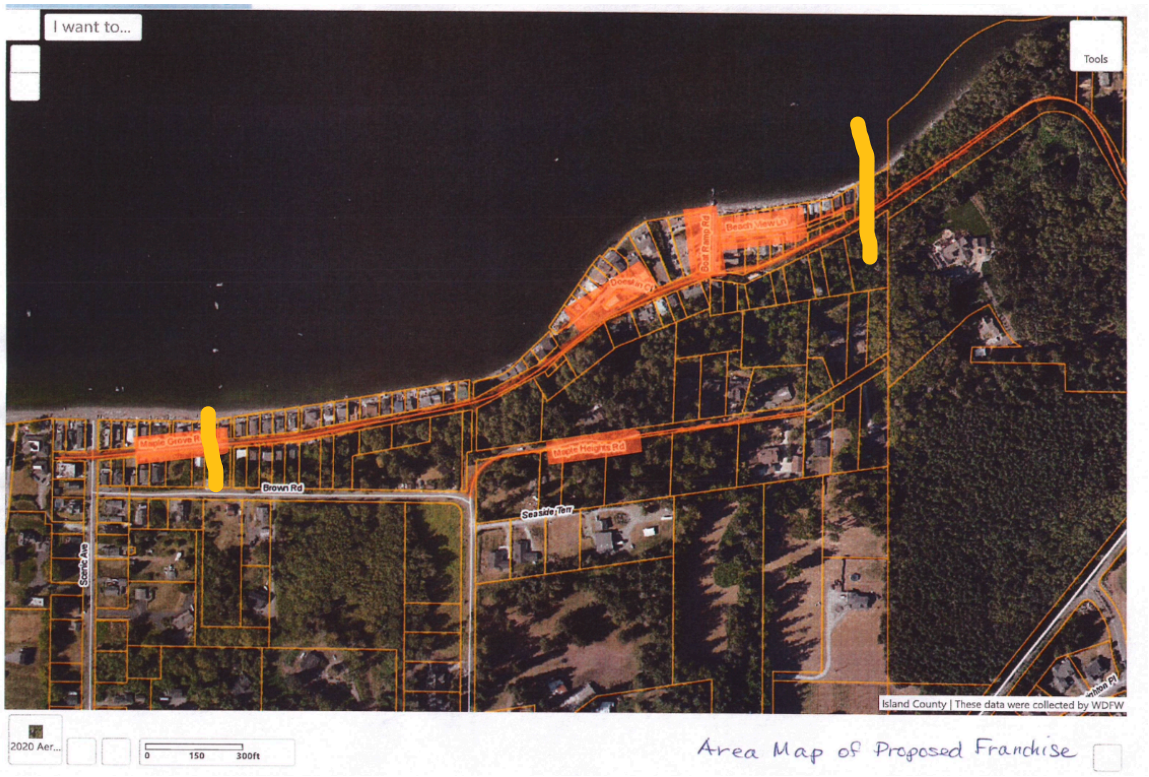
8.6. CHALLENGE – MANAGEMENT MODEL

Three members of the Maple Grove community promoted the development of the Maple Grove Community Septic and established the Maple Grove Septic Association, a third-party organization. To meet LOSS standards for management and maintenance, as outlined in WAC 246-272B-04100, the Community Drainfield is required to have a public entity or a private management entity. The Maple Grove Septic Association fulfills this requirement. Two founders previously served on the board of the Maple Grove Water Association and had experience in local government. This expertise helped them recognize the seriousness of water quality issues in Maple Grove (Hanson and Van Sistine, 2023).

In February 2022, Island County Public Works submitted a franchise application on behalf of the Maple Grove Septic Association for Maple Grove Septic Operations, Inc. Maple Grove Septic Operations, Inc. is a nonprofit organization dedicated to providing oversight to the development, building, operating, and maintenance of the Maple Grove Community Septic (Island County Commissioner, 2022). Figure 11 shows the area served by this franchise. As a nonprofit, it must have a Board of Directors oversee its operations. Key members of the Maple

Grove Septic Association serve on this board. The application also includes three LLCs. The LLCs each own a portion of the Community Drainfield property and are overseen by the Maple Grove Septic Operations, Inc. The LCCs are run by the same owners of Maple Grove Septic Operations, Inc.

Figure 11. Area served by Maple Grove Septic Operations, Inc.



(Island County Commissioner, 2022)

The Maple Grove Septic Association submitted a Business License Application for Maple Grove Septic Operations (Island County Commissioner, 2022). This license enables the owners to generate revenue to support the Maple Grove Community Septic. All costs for the franchise and business application are outlined in Table 16. In October 2025, the Maple Grove Community Septic submitted its final Operating and Maintenance Agreement, finalizing its role as the owner of the community septic system.

Table 16. Island County Processing and Licensing Fees

Fee Name	Cost
Franchise Application and Processing Fee	$527.36
3 x LLC Articles of Incorporation Fee	Individual - $50, combined - $150
Business Licensing Fee	$92.25

8.7. LESSONS LEARNED

The Maple Grove Community Septic project offers valuable lessons. The challenges Maple Grove faced may mirror those of other small coastal communities with aging infrastructure and limited space. The county and the community worked together to address perceptions, find common ground, and navigate difficult state and local requirements.

LESSONS LEARNED – PERCEPTIONS OF COMMUNITY DRAINFIELDS

Lesson Learned: **Community Drainfields can be a quicker and more affordable solution than LOSS. However, they can still involve complex permitting and maintenance needs that demand time, money, and careful planning.**

There is a perception that Community Drainfields are a simple solution. The perception is not inaccurate, but it detracts from the complexities communities may face with a Community Drainfield. Community Drainfield projects can still be time-consuming and expensive for homeowners.

For Maple Grove, the water quality results revealed an urgent need for change. The Community Drainfield provided a more straightforward solution because it did not require DOH approval. DOH approval would have resulted in additional costs and increased site investigations. Although Island County requires Community Drainfields to meet LOSS standards, they do not need to go through the full LOSS process with DOH. Even with this less stringent process, it still took over ten years, a million dollars, and required the formation of a public entity. For a system serving 14 homes, this was a lengthy and costly project.

There may be a perception among the Maple Grove community that the drainfield could act like a LOSS with greater capacity. The evidence of the additional phases planned by local champions suggests that the drainfield could be more than it is now. Island County is clear that the drainfield cannot support additional bedrooms. This leaves a large portion of the community on existing aging wastewater systems. Because of the perception of additional phases, there was a missed opportunity to prioritize OSS actively failing or most at risk of failure. Houses were added on a first-come, first-served basis, which could have helped the project get funding faster, but also might have caused homes that needed the update more to miss out on a connection.

LESSONS LEARNED – IMPORTANCE OF COMMUNITY CHAMPIONS

Lesson Learned: **Maple Grove demonstrates that strong community champions are essential to advancing wastewater solutions, as their leadership, persistence, and advocacy can sustain momentum despite delays and challenges.**

Maple Grove needed community members to lead the effort for a wastewater transition. Failing OSS continued to be found by Island County. Although replacing individual systems

would help reduce direct discharges, a larger project was required. This is especially true for homes with Drainfields within 200 feet of the shoreline, where parcel space was limited.

The Maple Grove Community Septic succeeded because of community champions who stepped forward. These champions created a solution, hired designers, acquired funding, found drainfield space, and advocated for what they believed was the best course of action. Their experiences serving on the Maple Grove Water Association board heightened a need for a solution, as they could see the damage caused by the failing OSS.

These champions helped keep the Maple Grove Community Septic plan afloat over a sustained period, despite a permitting process that delayed construction. It took seven years to acquire the final permit after the initial bid. These delays led to increased costs, as the inflation of construction materials rose over the years. The delays also potentially led to a loss of community support for the project.

The champions envisioned the Maple Grove Community Septic project, and although it was not a perfect solution, it successfully reduced effluent from the nearshore. The community champions also encouraged more discussion among residents of Maple Grove about the septic issue, which could motivate current landowners to maintain their systems better or consider alternative options if their OSS needs to be replaced.

LESSONS LEARNED – COUNTY SUPPORT

Lesson Learned: **Island County's technical support to the OSS designer helped ensure plans would meet local standards and was essential to reducing further delays due to rejected designs.**

The county provided additional support for the project design to facilitate permit approval. Recognizing the urgency and necessity of permits, the county collaborated with designers and community champions to ensure the Community Drainfield met all county and state requirements. The county support became a source of creativity and compromise during the Table 9 emergency repair to ensure project continuation.

Since Island County requires Community Drainfields to follow LOSS codes, designers with only a background in OSS might lack the detailed knowledge needed to meet LOSS standards. The county worked with the designers to help guide them toward a Community Drainfield design that complied with LOSS codes and could be approved.

8.8. CONCLUSION

The Maple Grove Community Septic demonstrates the community's ability to handle complex decisions. It successfully connected some homes with aging, failing OSS to a new system, reducing water-quality concerns in those residences. The future of Maple Grove depends on how to upgrade homes that are not connected to the Community Drainfield. Since space for new Drainfields is limited, some properties without existing connections will require an alternative solution. The Community Drainfield initiated the conversation with Maple Grove, and septic systems will likely remain an important topic among residents.

9. REFLECTIONS ON COMMUNITY TRANSITIONS

This section highlights key reflections that emerged from the case studies and conversations with practitioners. These insights may seem obvious to those working directly on these projects but might not be well-known among state and regional planners. A goal of this report is to bridge that gap, by clearly communicating the technical, regulatory, and community considerations that affect the transition from individual OSSs, to LOSS or Community Drainfield systems.

The willingness to use enforcement actions like denying building permits can be one of the most effective ways to drive wastewater transitions.

Enforcement actions can serve as powerful catalysts for wastewater transitions when education and voluntary measures fall short. Counties are understandably cautious about using their most severe enforcement tools—such as condemning properties—given the hardship they can impose on families and the potential for political or legal backlash. Yet other enforcement tools, including shellfish closures, non-compliance notices, and denied building permits often motivate residents and business owners who might otherwise delay upgrades. Shellfish closures set by DOH can help prioritize capacity within Local Health Jurisdictions to identify any non-compliant properties. Closures can also help catalyze support from local shellfish growers, Tribes, and communities. Local Health Jurisdictions issue non-compliance notices to inform property owners that their septic systems no longer align with regulations. Shellfish bed closures also provide momentum for communities and businesses to act to reopen the shoreline. Denied building permits, issued through County permitting departments, can be a particularly effective enforcement tool. When a County permitting office rejects a building permit due to septic non-compliance, the County office will coordinate with the Local Health Jurisdiction to resolve the issue.

In Fall City and Packwood, for instance, the denial of building permits became a turning point—spurring communities to organize around shared wastewater treatment options after realizing that individual repairs would no longer support local economic goals. Because permitting restrictions directly affect property use and economic activity, they are a particularly effective lever for encouraging consideration of Community Drainfields or LOSS. Equally important, cultivating understanding and support among elected officials and department leaders helps frame enforcement as an essential tool to encourage transitions that protect public health, safeguard shellfish and water resources, and enable the continued existence of the community.

Identifying priority geographies that are well-suited for wastewater transitions can allow for proactive support for those communities through education and permitting coordination.

Community wastewater transitions are dependent on a group of individual property owners, living near to one another, working together to develop a collective solution. However,

homeowners often act individually, replacing individual OSS on a one-by-one basis, which can unintentionally restrict future opportunities for collective solutions. Identifying areas with space limitations, poor soils, environmental sensitivity, or other factors that make individual systems less feasible—and engaging property owners before systems fail—can help foster support for shared infrastructure. Many homeowners may be unaware of these alternatives and could initially feel overwhelmed by additional design, permitting, and maintenance steps. Early collaboration among planners, health departments, and permitting agencies can assist communities in assessing when Community Drainfields or LOSS might offer both environmental and economic advantages.

Identifying communities where wastewater transitions are feasible and potentially beneficial can create the opportunity for Local Health Jurisdictions and permit departments to work proactively. For instance, if a neighborhood is identified as a candidate for a Community Drainfield, LOSS, or sewer connection, permitting staff could advise homeowners planning to replace a failing OSS to postpone upgrades until collective options are evaluated. Practitioners repeatedly pointed to Belfair as a 'cautionary tale'. There, widespread upgrades to individual systems happened shortly before the implementation of a new sewer system. Many residents chose not to connect to sewer because they had recently invested in an OSS replacement, leaving the wastewater utility with fewer customers than anticipated, reducing the financial support base, and affecting the plant's operational efficiency (Mason County, 2022). This example highlights the importance of anticipating where shared wastewater solutions may eventually be necessary and the role local jurisdictions can play in encouraging these transitions through education, incentives, and technical support—*before* homeowners commit to individual replacements.

Supporting local champions with funding, training, and/or technical assistance can help build and sustain buy-in for wastewater transitions.

Having an advocate who can serve as a bridge between the community and county planners can make the difference between stalled efforts and successful wastewater transitions. An individual community member like an elected official, county employee, or community leader who can explain the need to the rest of the community, and help maintain focus throughout the process, is a key element of a successful transition. These advocates work alongside county or community-led groups to translate technical concepts into local priorities and ensure two-way communication throughout the process. In Fall City, for example, a resident who previously worked for the Department of Local Services led a survey that helped King County understand business district needs and gauge interest in a shared wastewater solution. In Maple Grove, a community member's prior experience with the Maple Grove Water Association, along with their persistence through several years of permitting delays, helped keep the project alive. Investing in this kind of local capacity — especially in trusted advocates who already understand both community dynamics and government processes — can help communities navigate the long, complex transition process.

While local champions play a crucial role in building community trust and momentum, their efforts are most effective when paired with strong technical support from county staff. In Island County, early progress in Maple Grove was delayed by limited staff capacity, even though the area was a known source of fecal coliform. When new county staff arrived, they offered the technical expertise and administrative support needed to move the project forward—helping community leaders navigate permitting and refine system designs. Keeping both local champions and knowledgeable county staff is essential, as these wastewater transitions often span decades—requiring trusted relationships and institutional knowledge from beginning to end.

Clarifying community values early helps keep the focus on workable solutions.

Conversations about wastewater treatment capacity fundamentally involve growth and community identity. When Local Health Jurisdictions focus only on technical or public health issues, they risk missing community concerns about how wastewater infrastructure could impact future development. For example, centralized wastewater treatment with sewer systems are often seen as enabling urban-style growth, while Community Drainfields and LOSS are more aligned with preserving a rural character. Recognizing and openly discussing these perceptions early can help ensure that system design matches community values and prevent conflicts later in the transition process.

Clarifying what a community values—whether preserving its rural landscape or planning for long-term growth—helps determine the appropriate system scale and type. In Fall City, for instance, significant time and resources were invested in engineering studies for a sewer system that ultimately conflicted with the community's rural vision. Meanwhile, Packwood planned for the future. With their updated comprehensive plan and goals to become an urban growth area, the new LOSS must support the 20-year population projection to serve as "sewer."

Aligning the system scale with community priorities early is also critical because design firms and contractors typically specialize in specific system types—such as Community Drainfields, LOSS, or full wastewater treatment plants—and selecting a team without the right expertise can lead to costly setbacks, like in Maple Grove. Local Health Jurisdictions may require Community Drainfields to meet LOSS standards, which should be considered by the community when selecting a design contractor. Local Health Jurisdictions should highlight and emphasize the additional requirements of LOSS standards, so that the community can select a firm that understands that nuance upfront. The lesson for local jurisdictions is clear: understanding community values and growth expectations from the outset is just as important as soil conditions or drainfield sizing when designing sustainable, publicly supported wastewater solutions.

Finding a viable drainfield is often the greatest challenge—success depends on patience, flexibility, and creative partnerships.

Finding a suitable drainfield site is often the single biggest obstacle to replacing failing onsite systems—whether through a new individual OSS, a Community Drainfield, or a LOSS. Drainfields

need sufficient space and the right soil conditions, which are often lacking in developed or shoreline areas. Identifying and permitting a viable site requires patience, flexibility, and creativity.

In the case studies, none of the Drainfields were built on county-owned land, highlighting the importance of working with private landowners and other local entities to find an appropriate site. In Packwood, for example, rezoning incentivized a developer to purchase and cleanup contaminated property for new while also providing a drainfield for the LOSS, creating a solution that benefits both the development and the wider community. In Fall City, locating the drainfield in a community park provided multiple benefits, such as reliable irrigation for the grounds, lease income for the local parks department, and protection of the site as public open space. Although the reserve drainfield was slightly undersized and needed a waiver, it still marked a major improvement over the area's previous failing systems. And finally, in Maple Grove, leaning on the community champions who knew the area and had strong relationships with other community members helped to locate a drainfield on a private parcel. In return for offering the property for use as a drainfield, the parcel owner received fair compensation.

Additionally, incorporating treatment technologies - like membrane bioreactors (MBRs) - can also help meet higher treatment standards and reduce the required drainfield size. Both Fall City and Packwood selected MBR systems to improve performance and reduce space constraints. In Fall City, a reduced drainfield was permitted due to the higher treatment levels achieved through the MBR.

Local jurisdictions might reduce future barriers by helping communities proactively identify and protect potential drainfield sites before existing systems fail. Using tools like conservation easements, community land trusts, or tax incentives similar to the Designated Forest Land program or Public Benefit Rating System could help secure land before it's lost to development. As sea levels rise and shoreline growth continues to limit space, innovative partnerships and early land protection will become increasingly vital for maintaining and adapting wastewater infrastructure.

Access to diverse funding sources—and the staff and political support to secure it—is essential to upgrade wastewater treatment infrastructure.

With transition costs ranging from $10 million to more than $26 million, funding is a primary challenge in developing LOSS. Successful transitions may require multiple funding sources across local, state, and federal programs, spanning several years. Staff capacity and political advocates are significant in securing this funding. For instance, Fall City used infrastructure funding from the COVID-19 American Rescue Plan Act under President Biden to purchase LOSS equipment. Councilmember Kathy Lambert – a 20-year member of the King County Council and a former Washington State Representative – played a key role in securing this funding. She also advocated for funds from the state capital budget and King County to support the design and

installation. This funding increased support in the Fall City business district, who knew they wouldn't have to cover all the costs related to the LOSS.

In contrast, Packwood's experience highlights the financial and staffing difficulties rural communities face. They received a large initial grant to support their transition, though relying on a single grant made the project vulnerable, and limited staff capacity hindered the pursuit of additional funding. Current costs are estimated at $26 million, and the gap between community resources and capital costs continues to grow. Ongoing investment in statewide programs like the Rural Development Council and the Infrastructure Assistance Coordinating Council is essential to help small communities access funding, build capacity, and maintain progress. Strong staffing and political support can help communities secure the funding required to turn wastewater solutions from plans into reality.

Even the best-designed and funded wastewater solutions depend on individual property owners' willingness to participate.

Even with strong technical support and funding, the decision to connect to a Community Drainfield or LOSS ultimately depends on individual property owners. Counties can identify failing or non-conforming systems, promote more effective solutions, and ensure proposed designs meet regulatory standards, but they cannot force collective participation. In Fall City, for example, several businesses chose not to connect to the new LOSS despite significant grant funding and existing building permit limits. Similarly, in Maple Grove, some homeowners withdrew from the Community Drainfield during planning. These examples highlight that wastewater treatment transitions rely not only on sound engineering and funding, but also on the community's willingness to participate. Building trust, providing clear information about long-term implications, and aligning solutions with residents' values and constraints are key to improving participation.

10. CONCLUSION AND NEXT STEPS

Community wastewater systems are effective tools for addressing large-scale OSS repairs. Both LOSS and Community Drainfields can replace multiple aging and potentially failing OSS systems that might harm the surrounding natural and human environment. As shown in the case studies, building new wastewater infrastructure is costly, time-consuming, and requires patience from both the county and the community.

Without action, aging and failing OSS near Puget Sound's coastline and rivers will impact water quality and cause a decline in shellfish harvesting areas. To accelerate wastewater transitions in these communities, it is necessary to identify suitable sites for alternative systems. The UW Puget Sound Institute plans to conduct a study building on lessons learned from this case study analysis, which will aim to identify these potential sites along with the barriers and co-benefits of adopting alternative wastewater systems.

11. REFERENCES

Angeli, Thea. 2023. Camano Island community takes the lead on septic solution. *Department of Ecology.* October 26, 2023. Retrieved from: https://ecology.wa.gov/blog/october-2023/community-takes-the-lead-on-septic-solutions

(BOCC) Lewis County Board of County Commissioners. Lewis County, Washington. Board Meeting Minutes. April 4, 2011. https://lewiscountywa.gov/offices/commissioners/bocc-minutes/?page=1

(BOCC) Lewis County Board of County Commissioners. Lewis County, Washington. Board Meeting Minutes. April 9, 2012. https://lewiscountywa.gov/offices/commissioners/bocc-minutes/?page=1

(BOCC) Lewis County Board of County Commissioners: Public Works Update. March 8, 2017. https://lewiscountywa.gov/offices/commissioners/bocc-minutes/?page=1

(BOCC) Lewis County Board of County Commissioners. Agenda for BOCC Update. March 14, 2017. https://lewiscountywa.gov/offices/commissioners/bocc-minutes/?page=1

(BOCC) Lewis County Board of County Commissioners. Grants Discussion with Melanie See. Minute Minutes. March 22, 2018.

(BOCC) Lewis County Board of County Commissioners. County Manager / 2025 Legislative Kickoff. July 29, 2024.

(BOCC) Lewis County Board of County Commissioners. BOCC Wrap-up / County Manager Update. December 23, 2024.

Brooks, Mindy. 2025a. Planning Commission Workshop: Staff Report. Lewis County. February 14, 2025. https://lewiscountywa.gov/media/documents/2025-02-14_StaffReport_Ea3bfa6.pdf

Brooks, Mindy. 2025b. Planning Commission Public Hearing: Staff Report. Lewis County. March 31, 2025. https://lewiscountywa.gov/media/documents/2025-03-31_StaffReport_PackwoodUGAZoning.pdf

Biohabitats. 2024. Large On-site Septic System (LOSS) Pre-Design Report. Village of Packwood Wastewater System. Lewis County, Washington.

Bronin, Sara C., Scott Markley, Aline Fader, and Evan Derickson. 2023. How to Make a Zoning Atlas 2.0: The Official Methodology for the National Zoning Atlas, updated June 2023. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4476927

Carollo Engineers. 2016. Technical Memorandum: Preliminary Study of Wastewater Disposal Concepts for Fall City Business District. Prepared for King County Department of Natural Resources and Parks, Wastewater Treatment Divisions. May 2016.

Carollo Engineers. 2018. Fall City Business District General Sewer Plan. Prepared for King County Department of Natural Resources and Parks, Wastewater Treatment Divisions. July 2018.

Chernoff, Scott. 2025. Shellfish Growing Areas & PIC. Presentation. August 6, 2025. Regional PIC Meeting.

(DOH) Washington State Department of Health. 2014. Puget Sound Septic Financing Assessment: Local Septic Management Program Needs Assessment. October 14, 2014. Prepared by Sound Resolutions, BERK Consulting, Cascadia Consulting Group, and Clean Water Consultant. https://doh.wa.gov/sites/default/files/2025-08/SFAC_LSMNeedsAssesment.pdf

(DOH) Washington State Department of Health. 2016. Puget Sound Septic System Management Programs: Best Management Practices Reference Manual. https://doh.wa.gov/sites/default/files/legacy/Documents/Pubs//332-166.pdf

(DOH). Washington State Department of Health. 2023. Large On-site Sewage System (LOSS) Operating Permit. Fall City Community Sewer. Effective Oct. 11, 2023.

(DOH) Washington State Department of Health. 2025a. Signs of Septic System Failure. https://doh.wa.gov/community-and-environment/wastewater-management/septic-system/signs-failure

(DOH) Washington State Department of Health. 2025b. Large On-site Sewage Systems (LOSS). https://doh.wa.gov/community-and-environment/wastewater-management/loss-program

Ecolotree. 2025. Water Treatment Powered by Trees. Website: https://www.ecolotree.com/ .

Enviro-Flo, Inc. 2013. NuWater: BNR Series Wastewater Treatment Systems Installation & Owners Manual. https://cdn.hibuwebsites.com/343f4e7c6cff4e388ebd15762cd13eda/files/uploaded/BNR600.Manual.washington.April%202013.pdf

EPA. 2005. Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems. U.S. Environmental Protection Agency. December 2005. https://www.epa.gov/sites/default/files/2015-06/documents/onsite_handbook.pdf

EPA. 2012. Case Studies of Individual and Clustered (Decentralized) Wastewater Management Programs. U.S. Environmental Protection Agency. June 2012. https://www.epa.gov/sites/default/files/2015-06/documents/decentralized-case-studies-2012.pdf

(FCMPD) Fall City Metropolitan Park District. 2020. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Held December 8, 2020".
https://www.fallcityparks.org/downloads/MeetingMinutes12082020.pdf

(FCMPD) Fall City Metropolitan Park District. 2020. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Special Monthly Meeting Held January 29, 2020".
https://www.fallcityparks.org/downloads/MeetingMinutes1292020SpecialMeeting.pdf

(FCMPD) Fall City Metropolitan Park District. 2021. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Meeting Held December 14, 2021".
https://www.fallcityparks.org/downloads/Meeting-Minutes-12142021.pdf

(FCMPD) Fall City Metropolitan Park District. 2022. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Meeting Held June 9, 2022".
https://www.fallcityparks.org/downloads/Meeting-Minutes-06092022.pdf

(FCMPD) Fall City Metropolitan Park District. 2022. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Meeting Held October 11, 2022".
https://www.fallcityparks.org/downloads/Meeting-Minutes-10112022.pdf

(FCMPD) Fall City Metropolitan Park District. 2022. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Meeting Held January 11, 2022.
https://www.fallcityparks.org/downloads/Meeting-Minutes-01112022.pdf

(FCMPD) Fall City Metropolitan Park District. 2023. Item 5.5 in "The Monthly Meeting Minutes of the Board of Commissioners of Fall City Metropolitan Park District of King County, Washington. Monthly Meeting Held February 14, 2023".
https://www.fallcityparks.org/downloads/Meeting-Minutes-02142023.pdf

Gray & Osborne, Inc. 2001. Fall City Alternative Onsite Wastewater project. August 1, 2001. Prepared for King County Public Health Department of Natural Resources.
https://your.kingcounty.gov/dnrp/library/wastewater/resourcerecovery/techAssess/WWPlanning/FallCityAlternativeOnsiteWastewaterProject_0108.pdf

Greene Economics, LLC. 2023. Cost Estimate of On-site Septic System Maintenance in Puget Sound.

Headwater Economics. 2023. Match requirements prevent rural and low capacity communities from accessing climate resilience funding. January 13, 2023. https://headwaterseconomics.org/equity/match-requirements/

Hansen, J., & Van Sistine, T. 2023. On Camano shore contaminated by feces, locals blame lack of oversight. *The Herald* (Everett). August, 19, 2023. Retrieved from *HeraldNet* website: https://www.heraldnet.com/news/on-camano-shore-contaminated-by-feces-locals-blame-lack-of-oversight/

HCC. 2012. News: Ribbon Cutting at Belfair Sewer Plan. https://www.hcc.net/news/?id=6650

Island County. 2025. Island County Assessor and Treasurer Property Search. https://assessor.islandcountywa.gov/propertyaccess/PropertySearch.aspx?cid=0

Island County Commissioner. 2022. Island county Commissioner's Work Session Schedule. Item #2. February 2, 2022. https://www.islandcountywa.gov/AgendaCenter/ViewFile/Agenda/_02022022-139

(Island County Planning) Island County Planning and Community Development. 2021. Staff Report & Decisions: Shoreline Substantial Development Permit (SDP) – Type II. Island County Planning & Community Development. For Paul Rochon, Maple Grove Septic Association. August 27, 2021.

Island County Public Health. 2022. Permit to Construct a Sewage Disposal System. Received March 09, 2021.

Island County Public Health. 2025. *Water Year 2024 (Oct. 2023-Sept. 2024) Island County Surface Water Quality Report*. Island County, WA. Prepared by: Carlie Miller, Renee Zavas Silva, and Jessica Reed. Prepared for: Island County Public Health. https://www.islandcountywa.gov/DocumentCenter/View/10487/Surface-Water-Quality-Report-for-Water-Year-WY-2024-

Island County. 2025. Onsite Wastewater Management: Island Regional Innovative Solutions Report. Prepared by: Biohabitats, ASE, and Site Story. Prepared for: Island County Public Health. June 30, 2025.

Jacobs Engineering, Inc. 2021. Agreement for Professional Services for Engineering Services for 2021 Fall City Wastewater Project.

Jacobs Engineering, Inc. 2022. Memorandum: Fall City Wastewater Flow Projections. Fall City Wastewater Project. From: Brian Shuck and Melissa Wu / Jacobs Engineering, Inc. To: Jeffery Wilson / King County. February 3, 2022.

Jacobs Engineering, Inc. 2022. Predesign Report. Prepared for: King County Department of Local Services.

Jacobs Engineering, Inc. 2023. Engineering Report. Prepared for: King County Department of Local Services.

Jacobs Engineering, Inc. 2024. From Septic Woes to Success: Jacobs Develops Innovative Wastewater Solution for King County's Fall City. October 1, 2024. https://www.jacobs.com/newsroom/news/septic-woes-success-jacobs-develops-innovative-wastewater-solution-king-countys-fall

King County. 2012. King County Comprehensive Plan 2012: Attachment I. Amendments to Fall City Subarea Plan. September 2012. https://kingcounty.gov/en/dept/executive/governance-leadership/performance-strategy-budget/regional-planning/king-county-comprehensive-plan/subarea-plans

King County. 2023a. Report: Large On-Site Septic System (LOSS) is a big win for Fall City. King County Local. August 14, 2023. Accessed: 05.23.25. https://kingcountylocalblog.com/2023/08/14/report-large-on-site-septic-system-loss-is-a-big-win-for-fall-city/

King County. 2023b. After years of work, Local Services helps Fall City Wastewater project reach milestone. King County Local. December 18, 2023. Accessed: https://kingcountylocalblog.com/2023/12/18/after-years-of-work-local-services-helps-fall-city-wastewater-project-reach-milestone/

King County. 2024a. Fall City on-site community septic system. August 13, 2024. https://cdn.kingcounty.gov/-/media/king-county/depts/local-services/director/projects/fall-city-septic-system-flyer-202408.pdf?rev=8f0bf3d862d1426bb58109cd2cdb13c4&hash=9A18F0112698700327C86992B6587FE7

King County. 2024b. 'Sustainable and prosperous future': Executive Constantine, Councilmember Perry join Fall City community to kick off construction of transformative septic project. August 26, 2024. https://kingcountylocalblog.com/2024/08/26/sustainable-and-prosperous-future-executive-constantine-councilmember-perry-join-fall-city-community-to-kick-off-construction-of-transformative-septic-project/

King County. 2024c. 2024 King County Comprehensive Plan. Ordinance 19881, Attachment A. Adopted December 10, 2024. https://kingcounty.gov/en/dept/executive/governance-leadership/performance-strategy-budget/regional-planning/king-county-comprehensive-plan/current-adopted-plan

King County. 2025a. Photo essay: Fall City On-Site Septic project enters a new phase. May 16, 2025. King County Local. Accessed: 05.22.2025. https://kingcountylocalblog.com/2025/05/16/photo-essay-fall-city-on-site-septic-project-enters-a-new-phase/

King County. 2025b. Fall City on-site community septic system. Website: https://kingcounty.gov/en/dept/local-services/governance-leadership/local-government-for-unincorporated-king-county/fall-city-septic-system

Kittitas County Sewer District #8 and Fall City Septic Association Contract. 2023. Agreement For Municipal Management / Oversight of Large On-Site Sewage System. 9/16/2023.

Lewis County Department of Public Works. 2023a. Packwood Sewer System Project: Public Engagement Plan. July 26, 2023. https://lewiscountywa.gov/media/documents/Packwood_Sewer_Project_Public_Engagement_Plan-7_26_23.pdf

Lewis County Department of Public Works. 2023b. Packwood Sewer Project Open House. November 8, 2023. https://www.canva.com/design/DAF0iPFSJf0/Q68dkCF3q37yb9_9DR-TZw/edit

Lewis County Department of Public Works. 2024. Packwood Sewer System Project Overview: Updated January 25, 2024. https://lewiscountywa.gov/media/documents/FAQs_Packwood_Sewer_System_Project.pdf

Lewis County. 2022. Exhibit A: Lewis County Housing Initiative. February 2022. https://lewiscountywa.gov/media/documents/2022.02.11_Exhibit_A_-_Lewis_County_Housing_Initiative.pdf

Lewis County. 2024. Packwood Subarea Plan – Phase 1. https://lewiscountywa.gov/media/documents/ThePackwoodPlan_ADOPTED_Ordinance1350.pdf

Lewis County. 2025a. Packwood UGA Findings Report. June 30, 2025. https://lewiscountywa.gov/media/documents/Packwood_UGA_FIndings.pdf

Lewis County. 2025b. Planning Commission Public Hearing: Staff Report: Packwood UGA and Zoning. March 31, 2025. https://lewiscountywa.gov/media/documents/2025-03-31_StaffReport_PackwoodUGAZoning.pdf

Lewis County. 2025c. Packwood Sewer Project Coordination Chronology Timeline. Updated: 02/24/2025.

Lewis County. 2025d. Comprehensive Plan Periodic Update Packwood Area: Presentation. April 2, 2025. https://lewiscountywa.gov/media/documents/2025-04-02_PackwoodPresentation_1.pdf

Lewis County. n.d.(a) Packwood Wastewater Project Timeline.

Lewis County. n.d.(b) Packwood Sewer Project Phase 1- Service Area. https://lewiscountywa.gov/media/documents/Phase1_ServiceArea.pdf

Mason County. 2022. Belfair Sewer Public Hearing: Proposed Sewer Extension. January 31, 2022. https://dms.masoncountywa.gov/WebLink/DocView.aspx?id=485979&dbid=0&repo=mason&cr=1

Miller, Ashley. 2023. Packwood Flea Market: A Hub for Antiques and Crafters Alike. Flea market Insiders. Retrieved 6/9/2025. https://www.fleamarketinsiders.com/packwood-flea-market/

Miller, I.M., Morgan, H., Mauger, G., Newton, T., Weldon, R., Schmidt, D., Welch, M., Grossman, E. 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. A collaboration of Washington Sea Grant, University of Washington Climate Impacts Group, University of Oregon,

University of Washington, and US Geological Survey. Prepared for the Washington Coastal Resilience Project. updated 07/2019. https://cig.uw.edu/wp-content/uploads/sites/2/2019/07/SLR-Report-Miller-et-al-2018-updated-07_2019.pdf

MRSC. 2025. Shoreline Management Act. https://mrsc.org/explore-topics/environment/regulations/shoreline-management-act

Public Health Seattle - King County. 2024. The Cost of Addressing Failing Septic Systems in King County – Executive Summary. Prepared by: Greene Economics, LLC. https://cdn.kingcounty.gov/-/media/king-county/depts/dph/documents/health-safety/environmental-health/oss/cost-of-aging-oss-in-king-county-executive-summary.pdf?rev=3ad4113a504e4d818a0a99eab870313f&hash=483B2C5157D24D6525CA19A6424F4902

R.W. Beck and Associates. 1991. Fall City 2nd Draft Wastewater Facilities Plan, Draft Environmental Impact Statement. June 1991.

SCJ Alliance. 2025. Septage Capacity Assessment. Prepared for: Washington State Association of Local Public Health Officials (WSALPHO). Prepared by: SCJ Alliance. Lacey, WA. https://apps.ecology.wa.gov/publications/SummaryPages/2507045.html

Shellfish Strategic Initiative. 2023. Shellfish Beds Implementation Strategy: Protect and Restore Shellfish Beds in Puget Sound as Measured by the Area of Harvestable Shellfish Beds 2023 Update. Washington State Department of Health, Puget Sound Partnership.

U.S. Census Bureau. 2023. *American Community Survey 5-year estimates.* Retrieved from *Census Reporter Profile page for Fall City, WA.* http://censusreporter.org/profiles/16000US5323200-fall-city-wa/

U.S. Government Accountability Office (GAO). https://www.gao.gov/blog/communities-rely-federal-grants-may-have-challenges-accessing-them

Wenzelburger, Jared. 2022. Packwood Mill Site Sold to Developers. *The Chronicle.* October 12, 2022. https://www.chronline.com/stories/packwood-mill-site-sold-to-developers,301724