Assessing Decentralized Wastewater Treatment in Santa Barbara County

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Introduction

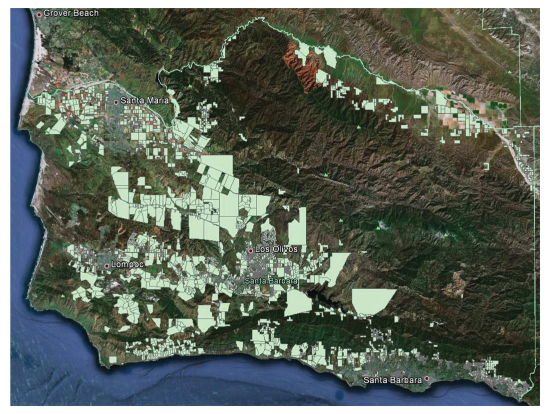
Domestic wastewater management strategies have conventionally focused on centralized municipal infrastructure or the utilization of septic tanks in rural regions.

Advances in decentralized wastewater treatment technologies allow for a potentially viable alternative to this approach. These innovative technologies can complement centralized wastewater treatment by providing additional treatment capacity and reducing the pressure on aging infrastructure. Additionally, these systems can potentially provide onsite recycled water for reuse and provide savings in water and energy.

Significance

Major barriers exist to innovative decentralized system adoption both nationwide and locally. A lack of targeted knowledge amongst stakeholders makes it difficult to select an appropriate decentralized system and navigate the permitting process. To overcome this knowledge gap, we created a guidance tool highlighting the benefits, disadvantages and permitting requirements of 11 different decentralized treatment systems. The goal of this tool is to facilitate future adoption of decentralized technologies within Santa Barbara County.

The map to the right highlights in light green the locations of conventional septic systems throughout Santa Barbara County. Very few innovative systems exist within the County due to barriers to adoption.



Methods

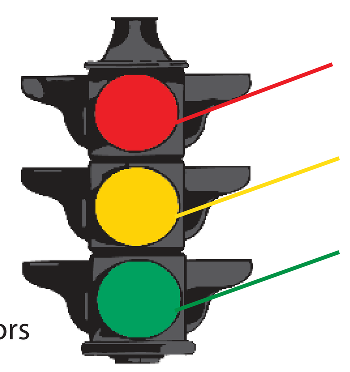
Decentralized treatment systems were assessed from an economic, environmental, social and regulatory perspective, with a focus on unincorporated Santa Barbara County. This included a meta-analysis of scientific literature and life cycle inventory databases, a community workshop, and interviews with local regulators. From these inputs, we developed a permitting flowchart and a stoplight scoring system to compare systems relatively across different valuation categories. The results were integrated into a multi-criteria decision support tool.

Surveyed Treament Systems

Subsurface: Leachfield, Mound, and Evapotranspiration Systems

Constructed Wetlands: Horizontal Subsurface Flow (HSSF), Free Water Surface (FWS), Living Machine®, and Vertical Flow (VF)

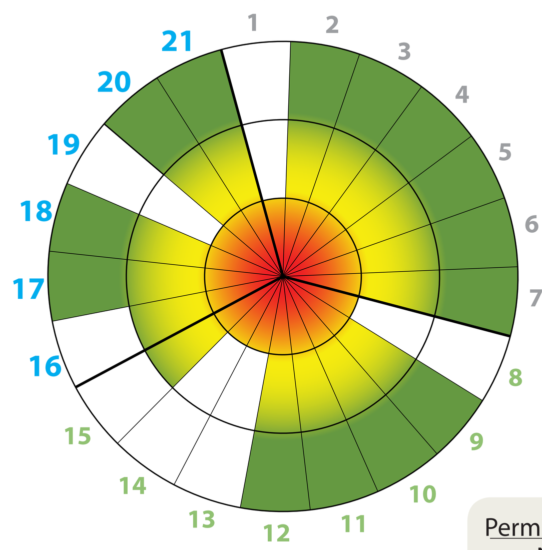
Prefabricated and Modular: Recirculating Filters (RF), Advanced RF, Membrane Bioreactors (MBR), and Activated Sludge



Designing a Guidance Tool

Social
16. Aesthetics: Visual
17. Aesthetics: Odor
18. Aesthetics: Noise
19. Education
20. Owner Supervision Requirements
21. Risk of Vector Contact

Example of System Scoring

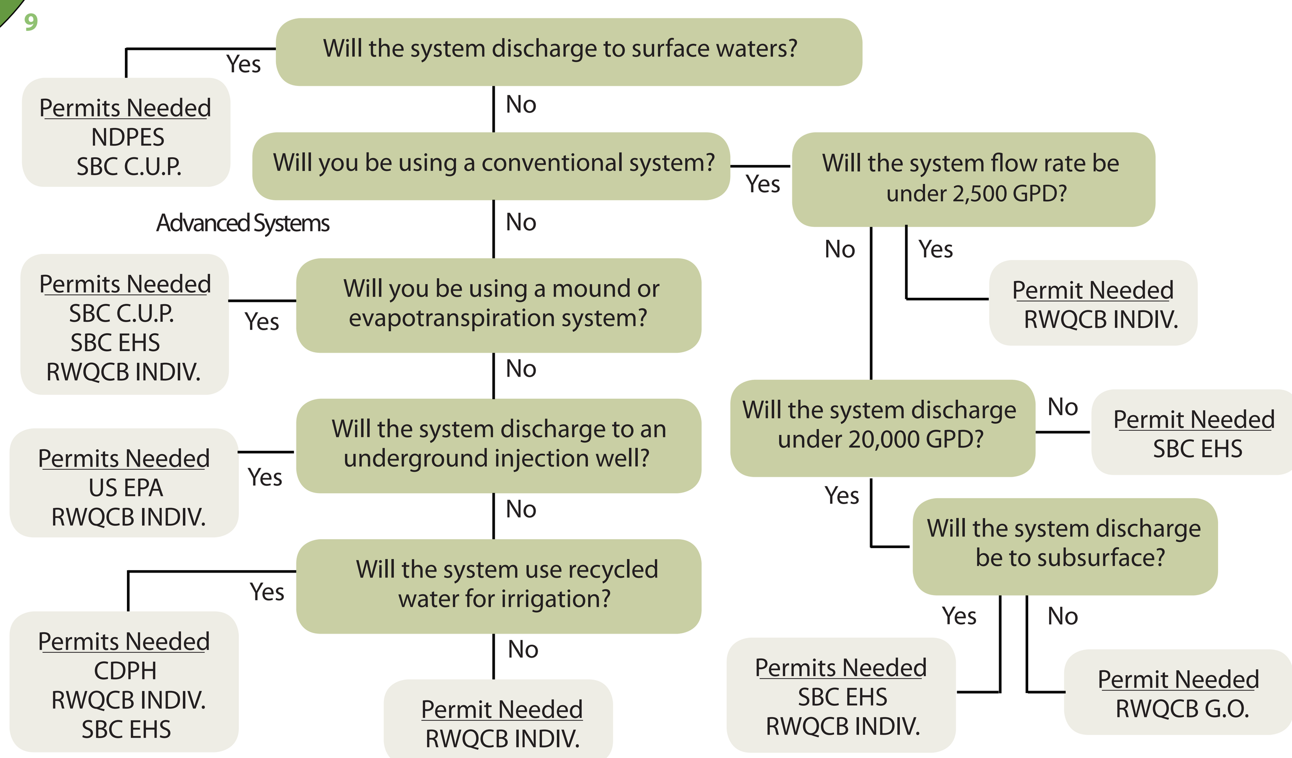


Environmental
8. Reliability
9. Removal of Total Suspended Solids (TSS)
10. Final Total Nitrogen Concentration
11. Biochemical Oxygen Demand (BOD)
12. Removal of Potential Pathogens
13. Soil Site Constraints
14. Slope Site Constraints
15. Habitat Creation Potential

Economic
1. Land Requirement
2. Construction Cost
3. Materials Cost
4. Energy Requirements
5. Operational Labor
6. Current Permitting
7. Predicted Future Permitting

The Guidance Tool includes a description of the selected decentralized technologies and the results for each valuation category, shown in an infographic as seen on the left. In this example, for criteria 1: Land Requirement, the system received a red score; for criteria 15: Habitat Creation Potential, a yellow score; and for criteria 8: Reliability; a green score.

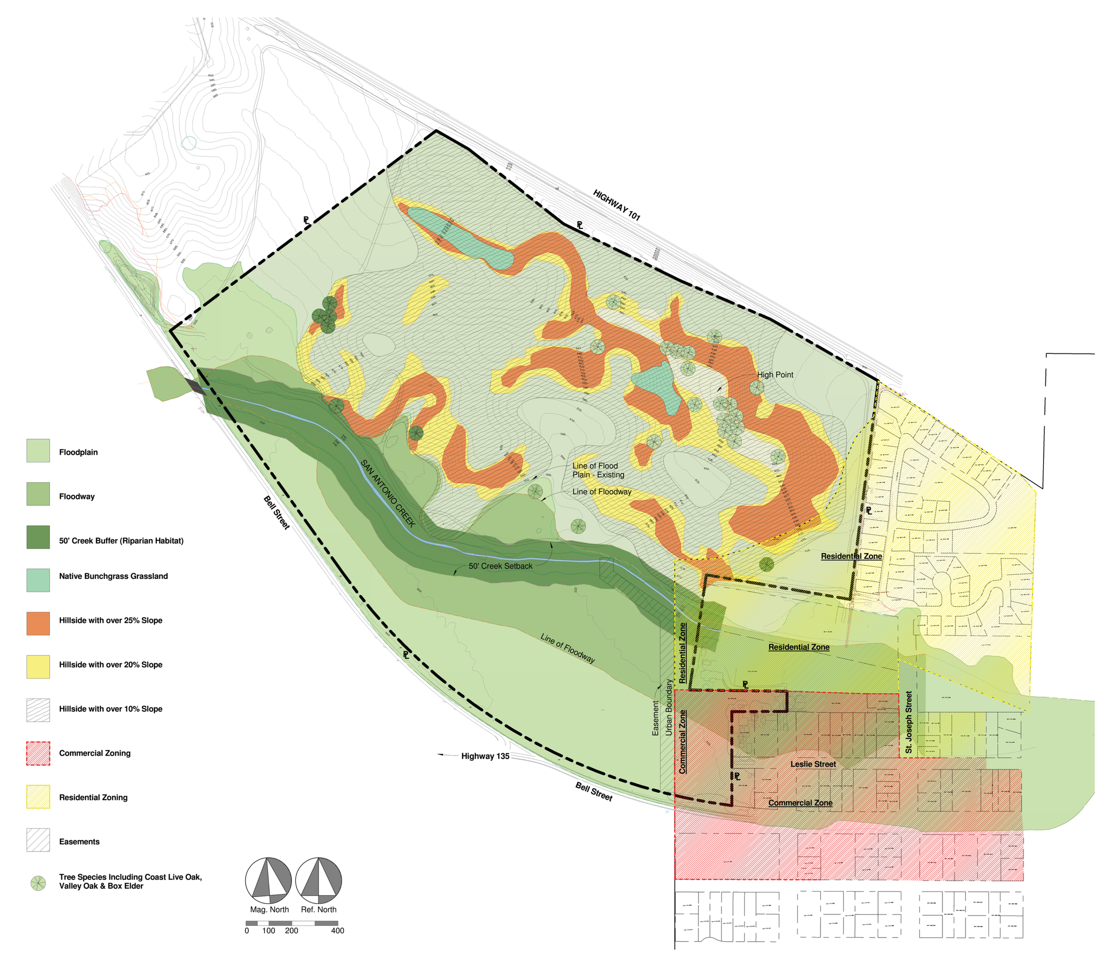
Decentralized Wastewater Permitting Flowchart



The Sustainability Project

The results of our permitting and policy analysis were integrated into a flowchart which demonstrates the process for getting various decentralized wastewater treatment systems permitted within unincorporated Santa Barbara County. Necessary permits are dependent upon system type, capacity of the system, discharge location, as well as whether treated effluent will be reused.

The Children's Project Academy



The Children's Project Academy (CPA) is a residential charter school project, located between the town of Los Alamos and agricultural land. Zoning restrictions require that the CPA reduce their wastewater generation by at least 20% if the school wishes to connect to the centralized sanitary sewer. As a result, the CPA has expressed interest in utilizing an innovative decentralized wastewater treatment system.

In an academic exercise, we applied our guidance tool to make a recommendation about which innovative wastewater treatment system could potentially meet the project's restrictions and goals. Because community involvement is important to the success of these systems, the CPA would consult their neighbours and the Los Alamos Community Services District before making a final decision.

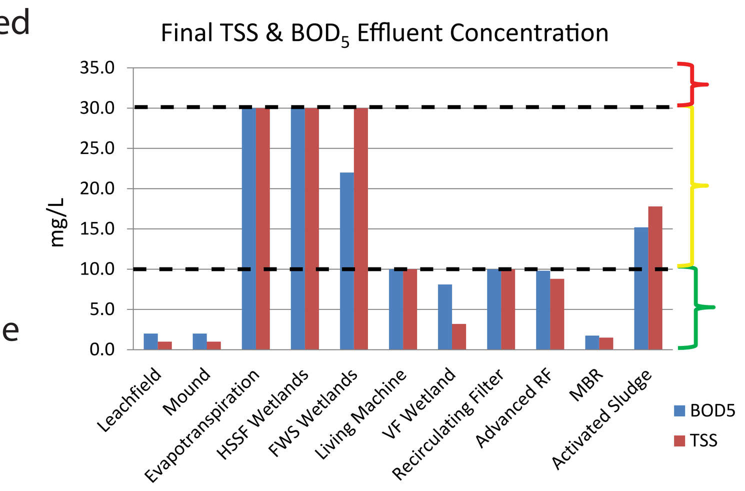
~Project Overview~

Economic: $1,000,000 budget; limited land available
Environmental: Prefer systems that can provide recycled water
Social: Desire systems that can provide educational opportunities

The Children's Project ACADEMY

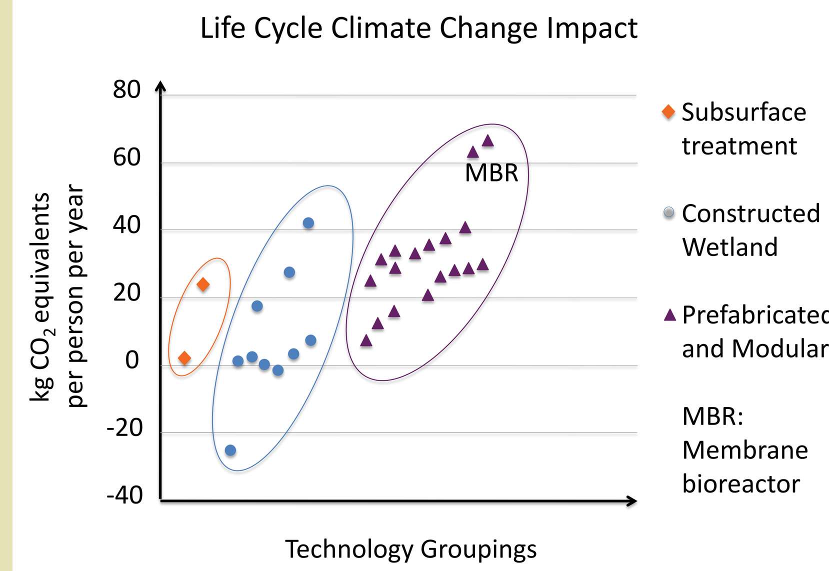
PGA www.peikertgroup.com

Analyzing Performance



Perfomance of decentralized wastewater treatment systems are typically assessed by measuring the final concentrations of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS). The dotted threshold lines and bracket colors of red, yellow, and green show how each system scored within our Guidance Tool utilizing our stoplight scoring approach. Leachfield, Mound, Living Machine®, Leachfield, Mound systems all scored highly; however other considerations such as pathogen content must also be taken into account if water reuse is the system's ultimate goal.

Assessing Impacts



Life cycle impacts are often overlooked when evaluating wastewater systems. To address this oversight we analyzed life cycle climate change data for all the systems. We found that prefabricated and modular systems have the highest greenhouse emissions of all compared systems.

The negative points show how constructed wetlands can be carbon sequesters, reducing contribution to greenhouse gas emissions. However, wetlands can also release methane, a greenhouse gas 20–25 times more potent than carbon dioxide. These findings indicate the importance of considering life cycle greenhouse gas emissions when assessing impacts.

Conclusions

No wastewater system achieves a high scoring for all of the assessed criteria. For example, a system that produces a high-quality effluent typically uses more energy, resulting in a high score for performance and a low score for energy use.

Based on the project constraints and desirable factors, we identified a few suitable technologies that the CPA can explore further.

Life cycle environmental impacts are not typically considered when evaluating wastewater treatment systems. However, these impacts vary across technologies and should be assessed prior to system selection.

The regulatory framework for alternative decentralized systems needs to be streamlined amongst agencies to facilitate their adoption.

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