CPRG
Climate Pollution Reduction Grant

Smart Landfill Program

Climate Pollution Reduction Grant Implementation Grant Application

Prepared by:

County of Orange, CA

OC Waste & Recycling Department

March 2024

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CPRG IMPLEMENTATION GRANTS COMPETITION
COVER PAGE FOR APPLICATION

APPLICANT INFORMATION

Organization County of Orange, California - Orange County Waste & Recycling

Primary Contact Name Tom Koutroulis

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TYPE OF APPLICATION ☑ Individual Applicant ☐ Lead Applicant for a Coalition

If lead applicant for a coalition, provide a list of the coalition members below.

Applying as an individual but part of the Los Angeles/Orange/Anaheim/Long Beach MSA.

FUNDING REQUESTED: *Provide total EPA CPRG Implementation Grant funding requested.*

$ 24,488,430

APPLICATION TITLE: *Provide the title of your proposed project.*

Smart Landill Program

BRIEF DESCRIPTION OF GHG MEASURES: *Describe each GHG reduction measure contained in the application (1-2 sentences each).*

This SLP measure was identified in the Waste Sector of the PCAP as Measure SW3: Increase Waste-to-Energy and Conversion Technology Potential. PCAP Reduction Strategy SW3.1 is to increase landfill gas capture and build waste-to-energy systems in local solid waste and landfill facilities. The SLP achieves the goals of SW3 and SW3.1 by increasing landfill gas capture, and an anticipated result of additional landfill gas to energy systems to convert the additional gas collected. This measure has the potential to exceed any landfill gas capture efficiency occurring in the nation today.

SECTORS: *Identify the sector(s) associated with the GHG reduction measures included in the application.*

- ☐ Industry
- ☐ Electricity Generation
- ☐ Transportation
- ☐ Other (please describe)
- ☐ Commercial and Residential Buildings
- ☐ Agriculture/Natural and Working Lands
- ☑ Waste and Materials Management

EXPECTED TOTAL CUMULATIVE GHG EMISSION REDUCTIONS

For all proposed measures combined, provide the estimated cumulative GHG reductions:

Estimated cumulative GHG reductions for 2025-2030 (in metric tons)

2,173,770

Estimated cumulative GHG reductions from 2025-2050 (in metric tons)

10,010,241

LOCATIONS: *List the primary location(s) where the proposed measures will be implemented*

City Irvine, Brea, San Juan Capistrano, and other cities in Orange County

State; Territory; Federally recognized Tribe California

APPLICABLE PRIORITY CLIMATE ACTION PLAN(S) (PCAP) ON WHICH MEASURES ARE BASED

PCAP Lead Organization(s): Los Angeles County

PCAP Title(s): Measure SW3: Increase Waste-to-Energy and Conversion Technology Potential

PCAP Website link(s) (if applicable): https://www.epa.gov/system/files/documents/2024-03/5d-98t76801-los-angeles-long-beach-anaheim-msa_pcap.pdf

List of GHG reduction measures and PCAP page reference for each measure:

Solid Waste #3 - Page 4-22

Climate Pollution Reduction Grants – Implementation Grants
County of Orange Smart Landfill Program Workplan for General Competition

1. Overall Project Summary and Approach

a. Description of Greenhouse Gas (GHG) Reduction Measures

The County of Orange (County), OC Waste & Recycling Department (OCWR) is pleased to submit this project application for a Smart Landfill Program (SLP) through the Climate Pollution Reduction Grant (CPRG) Program. OCWR believes this measure perfectly aligns with the goals outlined in our Priority Climate Action Plan (PCAP) that was submitted through a Metropolitan Statistical Area (MSA) collaboration with the County of Los Angeles, South Coast Air Quality Management District (AQMD) and the Southern California Association of Governments (SCAG).

This SLP measure was identified in the Waste Sector of the PCAP as Measure SW3: Increase Waste-to-Energy and Conversion Technology Potential. PCAP Reduction Strategy SW3.1 is to increase landfill gas capture and build waste-to-energy systems in local solid waste and landfill facilities. The SLP achieves the goals of SW3 and SW3.1 by increasing landfill gas capture, and an anticipated result of additional landfill gas to energy systems to convert the additional gas collected. This measure has the potential to exceed any landfill gas capture efficiency occurring in the nation today.

OCWR is responsible for the essential public services of landfilling, organics recycling, and resource recovery for the County of more than 3 million residents. The portfolio of OCWR properties include five large landfill sites (three active and two closed) that continue to generate methane-rich landfill gas. The United States Environmental Protection Agency (US EPA) has identified landfills as the third largest source of human-caused methane emissions in the United States.

The SLP will use new technology to significantly reduce landfill gas emissions. The technology includes the following: data connectivity, Supervisory Control and Data Acquisition (SCADA), wellhead controllers and in-line sensors, a real-time data and control platform, and drone methane detection technology. The remote location of large landfills makes cellular connectivity difficult so OCWR will install a mesh network for remote data collector connectivity as part of the project. SCADA manages remote data coming in from critical environmental control devices. Wellhead controllers and in-line sensors take real-time and continuous measurements critical for the optimization of a landfill gas well field, such as methane content, temperature, pressure, and balance gasses. The real-time data and control platform receives and interprets the information, informing the operators of well field issues, while communicating back to the wellheads for automated adjustments. While the collection system information is monitored in real-time, the drone that is fitted with a methane sensor detects landfill gas emissions from above for fast remediation.

Landfill gas collection systems at large landfills include miles of pipes, hundreds of wells, and hundreds of acres of covered refuse. A landfill gas collection and control systems efficiency can be compromised by daily operational activities as well as barometric pressure and temperature changes in any given moment.

OCWR's facilities are in the State of California, within the SCAQMD's jurisdiction. The SCAQMD has the most rigorous landfill gas collection regulations, which means that wellhead data and emissions monitoring take place over many days and weeks (due to the significant size of these facilities), and at a frequency of one time per month. In many cases, it takes the entire month to finish monitoring, only to start over the next month. The proposed SLP increases the frequency of monitoring and reduces the time of identification of a landfill cover and collection system issues from once per month to once every few minutes, allowing landfill operators to immediately begin repairs and stop unnecessary emissions. The SLP also allows for real-time and automated well tuning, responding to system disruptions and weather changes. Lastly, the wellfield data assists in the proactive identification of new well installation opportunities to ensure landfill gas collection and control systems are the right size and provide the highest quality gas for conversion to renewable fuels and electricity.

The SLP technology allows accurate and frequent measurement of landfill gas collection system performance, resulting in a more efficient collection of methane-rich landfill gas. SLP at OCWR's five large landfills is expected to result in an average collection efficiency increase of 13% across the five-site portfolio, thereby reducing GHGs across all 5 sites by an estimated 2,173,770 $mtCO_2e$ between 2025 and 2030, and 10,010,241 $mtCO_2e$ between 2025 and 2050. This will be explained in more detail in Section 2 below.

SLP implementation is already underway, identifying landfill cellular connectivity technology as the first step. It is expected that full-scale SLP will be completed by the end of 2026. OCWR has not identified any unmanageable or arduous regulatory permitting requirements for implementation. Risks of delay of this measure are highly unlikely and not terminal but may include the following: 1) Agency regulation interpretations leading to local onerous permit application and approval processes, 2) supply-chain disruptions for equipment installation, 3) procurement complications due to low response to OCWR Request for Proposals (RFPs), 4) Onerous local agency permitting processes required for down-stream landfill gas control equipment, or 5) Natural disasters such as wildfires or seismic events resulting in the damage or delay of critical environmental control system equipment. If SLP experiences any of these delays, the timing of GHG emission reductions will be delayed the same duration.

b. Demonstration of Funding Need

OCWR has active memberships and maintains relationships with valuable partners. Our team (CVs included as Attachment A) are highly regarded in the Waste and Recycling field and have traveled all the world presenting on technologies and chairing committees. Just a few of our affiliations can be found below:

- The California Resource Recovery Association
- AEP (Association of Environmental Professionals)
- Association of Compost Producers – *CA State Chapter of USCC*
- US Composting Council
- Orange County City Manager Association (OCCMA)
- Bioenergy Association of California
- County Engineers Association of California (CEAC)
- SWANA (Solid Waste Association of North America), SoCal Chapter – Board Member
- SWANA SoCal Chapter, Legislative Task Force – Board Member
- Sustain OC, Board Member
- National Stewardship Action Council

Through the active search of these industry and policy groups, OCWR has not identified funding availability for this type of initiative.

c. Transformative Impact

The packaging of SLP technologies across a portfolio of this size is unprecedented. The implementation of SLP will demonstrate large scale applicability for the industry, locally and nationally, and globally, setting a new standard for the nation's third largest source of human-caused methane emissions.

2. Impact of GHG Reduction Measures

a. Magnitude of GHG Reductions from 2025 through 2030

The implementation of the existing technology outlined in SLP is expected to reduce GHG emissions by 2,173,770 mtCO_2e between 2025 and 2030, cumulatively. Since the SLP equipment will operate continuously, the resulting collection efficiency improvements will continue until additional improvements can be made as new technology is released.

b. Magnitude of GHG Reductions from 2025 through 2050

The implementation of the existing technology outlined in SLP is expected to reduce GHG emissions by 2,173,770 mtCO_2e between 2025 and 2030, cumulatively. Since the SLP equipment will operate continuously, the resulting collection efficiency improvements will be maintained until additonal improvements can be made as new technology is released.

c. Cost Effectiveness of GHG Reductions

Based on SLPs GHG reduction impact of 2,173,770 mtCO_2e between 2025 and 2030, and the CPRG funding request of $24,488,340, the cost effectiveness of SLP GHG reductions is $11/mt$CO_2$e.

d. Documentation of GHG Reduction Assumptions

Orange County Emissions Reductions Impact				
Landfill	**Incremental Methane Capture Estimate**	**2025-2030 (MT CO2e)**	**2025-2035 (MT CO2e)**	**2025-2050 (MT CO2e)**
Coyote Canyon	10%	134,274	255,770	555,184
Frank R. Bowerman	15%	911,074	1,796,383	4,321,087
Olinda Alpha	15% - 2025-2034 10% - 2035-2050	835,902	1,539,082	2,888,950
Prima Deshecha	15%	256,836	559,171	2,097,476
Santiago	10%	35,684	67,973	147,544
Total		**2,173,770**	**4,218,379**	**10,010,241**

Modeled Emissions Reductions Methodology

The Emissions Reductions Estimation Model from Automated Collection Systems was derived using the "*American Carbon Registry's Methodology for the Quantification Monitoring, Reporting and Verification of Greenhouse Gas Emissions Reductions and Removals from Landfill Gas Destruction and Beneficial Use Projects Version 2.0*". This methodology provided the quantification and accounting framework for the creation of carbon offset credits from the reductions in GHG emissions resulting from the destruction or utilization of landfill gas.

To quantify emissions reductions in this model, a project baseline is established to calculate the expected methane capture for the three years preceding the Automated Collection System installation. This baseline is calculated using the Historic Modeled Methane Generation Rate, Historic Measured Methane Collection, and Historic Landfill Collection Areas, and Historic Waste Landfilled, all of which are publicly available through the EPA Greenhouse Gas Reporting Program (GHGRP). The GHGRP assigns a landfill collection efficiency based solely on the weighted average of coverage area types on the landfill. That collection efficiency is then calibrated to account for the Historic Methane Collected relative to the Historic Modeled Methane Generation Rate for each collection area. Each baseline year's calibrated collection efficiencies are then averaged to calculate an overall baseline calibrated collection efficiency for each landfill coverage area.

The estimation of future emissions reductions at Orange County landfills was done by calculating each future year's Modeled Methane Generation Rate and multiplying it by the baseline calibrated collection efficiency to determine a Modeled Baseline Methane Capture. An Automated Collection System Increment Factor, a 10% increase for closed landfills and 15% increase for active landfills, was applied to the Modeled Methane Capture to determine the Incremental Methane Capture (MT CH_4). When organic waste decomposes in the landfill, a portion of the methane undergoes a chemical reaction with bacteria in the soil that converts it into CO_2 and water. To account for the portion of incremental methane captured that would have oxidized and not realized a harmful GHG impact, a 10% oxidation factor was applied to the Incremental Methane Capture to calculate Emissions Reductions (MT CO_2e), along with a 25x Global Warming Potential factor for methane, as recognized by the California Air Resources Board[2]

Assumptions

A few assumptions were made in the Emissions Reduction Estimation Model. It was assumed that all sites besides Olinda Alpha and Prima Deshecha would landfill the same amount of waste as the last baseline year (2022) in each modeled year for the entirety of the Emissions Reduction Estimation Model. It was also assumed that the landfill would maintain a consistent proportion of coverage areas throughout the entirety of the modeled years, which allowed a consistent baseline calibrated collection efficiency to be applied for each modeled year.

When determining the Automated Collection System Increment Factor for modeling increased methane capture, it was estimated that an automated collection system would yield a 15% increase at an active landfill and a 10% increase at a closed landfill. A 15% increase is the median outcome at a typical active landfill project, while the lower 10% increase applied to closed landfills is attributable to a higher baseline collection efficiency brought on by final landfill cover.

It was assumed that Olinda Alpha would stop taking landfilling waste at the end of 2030, and that the landfill will move all coverage areas to final cover by 2034. Therefore, the incremental methane capture estimate changed from 15% to 10% in 2034. It was also assumed that 67% of the landfilled waste from Olinda Alpha in 2022 would then be landfilled in Prima Deshecha in 2031 following the closure of Olinda Alpha and continue at that rate for each following year.

Increases in methane capture at both active and closed landfills are facilitated by automated collection systems by the real-time measurement of gas composition (CH_4, CO_2, O_2), system pressures, and flow, which are leveraged by automated tuning algorithms to optimize methane capture.

Emission reduction calculations and methodologies are included as Attachment B.

3. Environmental Results – Outputs, Outcomes, and Performance Measures

a. Expected Outputs and Outcomes

Activities performed for this measure support Goal 1, “Tackle the Climate Crisis”; Objective 1.1, “Reduce Emissions that Cause Climate Change.” as outlined in US EPA’s Fiscal Year (FY) 2022-2026 Strategic Plan. In alignment with the US EPA’s strategic plan, the SLP GHG reduction measure activities aggressively reduce the emission of greenhouse gases while increasing energy and resource efficiency and the generation and use of renewable energy.

Funds for the implementation of this reduction measure results in an outcome of GHG emissions of 2,173,770 mtCO_2e between 2025 and 2030, and 10,010,241 mtCO_2e between 2025 and 2050.

b. Performance Measures and Plan

SLP’s real-time data and control platform collects data from the rest of the SLP components and waste deposition inputs (for active landfill sites) to continuously measure collection efficiency, thereby allowing the calculation of emissions and avoided emissions of GHG in mtCO_2e against the baseline. Utilizing the same methods referenced in Section 2.d. (Attachment B), the SLP platform will report GHG reductions monthly and annually.

c. Authorities, Implementation Timeline, and Milestones

- November 2024 – Release RFPs to contract the following contractor services and/or purchases:
    - Drone equipment with methane sensing technology
    - Data connectivity mesh technology
    - SCADA development and implementation
    - Wellhead controllers and in-line sensors
    - Real-time data and control platform development
- April 2025 – Selection of contractor services and/or purchases, and implementation of SLP elements
- April 2026 – Full implementation of SLP
- August 2026 – Full SLP benefit realized.

4. Low-Income and Disadvantaged Communities

a. Community Benefits

The SLP GHG Reduction Measure has a positive impact on Low-Income and Disadvantaged Communities (LIDAC) not only regionally, but globally due to the significant and swift GHG reductions associated with this initiative. A list of Orange County Climate and Economic Justice Screening Tool (CEJST) LIDACs is included as Attachment C.

Expected direct and indirect benefits to these communities from this GHG Reduction Measure are as follows:

- The significant GHG reductions of this project have a direct benefit by mitigating climate impacts including reduced risk of wildfires, drought, extreme weather events, and/or sea level rise.
- The significant GHG reductions of this project supports increased resilience to climate change through GHG reduction benefits and climate adaptation benefits by demonstrating a new standard of landfill gas collection and control for the Waste Sector that will set the standard on a national scale.
- The increase in volume and methane content of captured landfill gas will allow for additional and cost-effective technologies to convert landfill gas to renewable energy. Renewable energy includes electricity and fuels such as renewable hydrogen and renewable natural gas not only at OCWR's facilities but also subsequent SLP adapters. This results in the following: 1) decreased energy costs and improved energy resilience; 2) feasibility of landfill facility microgrid implementation for improved energy resiliency. This results in reliable landfill environmental control system operation during area outages, and reduced demand on local and regional grid; and 3) reduction of demand on local and regional public utilities such as fossil fueled electricity generation as well as natural gas producers and utilities. The reduction of energy-provider production benefits the communities surrounding these facilities by reducing operation demand and associated pollutants from production.
- The SLP improves the feasibility of new additional local energy generation, reducing demand on the local infrastructure, improving energy reliability resulting in housing quality, comfort, and safety.

Given the global benefit of the SLP GHG reduction measure, Community benefits will be assessed, quantified, and reported through the GHG reduction calculation methods identified in Section 2.d. In addition, the measurement of methane collection will be quantified though the SLP technology, allowing for future assessment of landfill gas to electricity and fuels projects that may result from measure outcomes.

b. Community Engagement

Poverty is a reality within the County of Orange, a situation only worsened by the global pandemic. Over 41 percent of Orange County's children, over 32 percent of adults and 20 percent of senior citizens qualify for MediCal. The County receives 8,800 MediCal applications monthly and maintains an average of 940,000 active MediCal clients.[i]

As noted above, the County's most vulnerable and underserved communities also disproportionately share the burden of the effect of climate change. In September 2021, the United States Environmental Protection Agency (EPA) conducted a study on climate change and social vulnerability. [ii] The study found that there is an unequal risk that climate change is projected to have on communities that are least able to anticipate, cope with, and recover from adverse impacts. These risks come from extreme heat that affects weather-exposed outdoor workers; new asthma diagnoses in children ages 0-17; coastal flooding and associated traffic; deaths due to extreme heat; and property damage.

Orange County residents and communities are vulnerable to all these climate change events. As a result, the County created an Office of Sustainability in 2024 and is currently undertaking its first Climate Action Plan (CAP). The focus of the CAP is to benefit the County but particularly our Low-income and Disadvantaged Communities (LIDACs). The County is committed to surveying and engaging with disadvantaged communities to ascertain what initiatives would have the most beneficial impact on these vulnerable communities. This CAP will then address inequalities to avoid excluding or discriminating against marginalized groups. "Encouraging the most vulnerable people to participate in decision-making can make programs more effective for the community as a whole, while prioritizing the needs of the region's poorest."[iii]

The successful implementation of the SLP will be the first measure in the County's CAP to come to fruition and make great strides in gaining the support and participation of our LIDACs. The CAP has a Climate Resiliency Task Force made up of elected officials, subject-matter experts, non-profits organizations and union leaders to ensure that not only a successful CAP but one that delivers green jobs that promote the quality of life for our residents as well.

Efforts to create a successful and inclusive PCAP led to the determination that this measure was shovel-ready and garnered support included the following: workshops with community-based organizations (CBOs), development of a steering committee, participation in municipal meetings and agency committees throughout the region, events with city staff and elected officials, one-on-one meetings with stakeholders, and an online survey. Existing CAPs throughout the MSA were also reviewed to identify community feedback from LIDACs that could be integrated into the PCAP, and the subsequent CCAP. The workshops conducted engaged organizations specializing in key areas such as community development, environmental justice, climate change, climate justice, and workforce development. Within both Los Angeles County and Orange County, SCAG conducted two CBO workshops each between January and March 2024, with each workshop including representatives from six CBOs. The Steering Committee includes approximately 30 members of county departments including public works, airports and waste and recycling. It also includes city participation, air quality regulatory officials, environmental consultants, and Southern California Association of Governments representatives. The committee continues to meet as it will do so after grant award notification to ensure that public engagement education outreach continue.

The County is already proactive with educational and outreach to our communities; particularly our LIDACs. Just a few events and efforts that have occurred include the following: outreach and awareness through our public schools, partnerships with the Anaheim Ducks and Angels, Earth Day events, Battery Day events, National Drive-through Day, Secure your Load Day, American Recycles Day, landfill tours, compost giveaway events, organics recycling informational events, etc. All our outreach events will continue and expand with the successful implementation of the CPRG with demonstrations planned to highlight capture efficiency and bring these STEM lessons to our local classrooms.

OCWR proudly partners with many organizations. These partnerships will continue and grow with grant implementation as our outreach efforts broaden. Just a few partners include the following: California State Parks, Orange County Department of Education, California Coastal Commission, Solid Waste Association of North America, Orange County Sheriff's Department as well as our cities and fellow County departments.

Our Neighborhood Support Portal (NSP) is another tool OC Waste & Recycling uses to stay aware of our community and its concerns and gather pertinent data. The NSP is an immediate response portal for residents and is located on the OCWR website. Every entry into the NSP is logged, tracked, and responded to. The site allows for the uploading of photos and keeps all communication lines open so that no public concern goes unaddressed. This approach will continue upon grant implementation and will serve as another avenue to illustrate to the public that emissions are going down and highlight the associated co-benefits.

[i] County of Orange, Social Services Agency, Orange County Collaborative, 2023.
[ii] EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency, EPA 430-R-21-003. www.epa.gov/cira/social-vulnerability-report
[iii] Illick-Frank, Emma, 5 Benefits to Local Action on Climate Resilience, World Resources Institute, June 23, 2020 accessed February 26, 2024.

5. Job Quality

Jobs related to all phases of the SLP GHG Reduction Measure range from executive leadership to laborers within the County, and a range of contracted jobs, from corporate executive to technicians. This reduction measure results in an increase in labor needs for the County, as well as contracted businesses. The County has implemented the following strategies to ensure job quality:

- County provides family sustaining benefits and retirement contributions.
- County procurement policy requires employers, including contractors and subcontractors, to comply with Article T and Department of Industrial Relations (DIR).
- County employees are represented by a collective bargaining agreement.

- The County has formal partnerships with labor organizations and other workers' rights groups.
- All county contracts incorporate labor and job quality standards within terms & conditions. In high-risk contractor work situations, County contracts provide the County's Safety and Loss Prevention Policy require contractor compliance with the procedure.
- The County provides Health and safety plans that are developed in conjunction with workers, including antiharassment training for workers and management, OSHA training to minimize workplace hazards (e.g., OSHA 10 and OSHA 30), and supplemental health and safety training as needed.
- The County's Design and Construction Policy Manual requires projects over $30,000 to meet the DIR's apprenticeship requirements, including the requirement that 1 of every 5 (20%) straight time journeyman hours must be apprenticeship hours.
- The County uses benchmarks and goals to hire individuals from disadvantaged communities, in alignment with applicable law and to ensure representation of each community within the County through Equal Employment Opportunity (EEO) Policy and Procedure.
- The County Provides supportive services, such as childcare and transportation assistance, for employees that need them, such as Depending child spending accounts (pre-tax) and Rideshare programs.
- The County promotes stable, predictable employment through minimizing the use of temporary or contract workers, and an explanation of how workers will be properly classified with a comprehensive set of position classifications and related compensation parameters.

6. PROGRAMMATIC CAPABILITY AND PAST PERFORMANCE

a. Past Performance

The County of Orange is consistently pursuing funding opportunities wherever possible. This grant, if awarded, would be the responsibility of Orange County Waste & Recycling. The department recently created the Office of Sustainability to assist with environmental grant procurement and implementation and is in the process of adding a grants writer/administrator to our Strategic Communications Team. Below highlights some current grant awards that the department received along with what the funds were used for. This list is in no way an exhaustive list of all funding received throughout the County for environmental programs.

Edible Food Recovery Grant. This grant was awarded to OCWR through CalRecycle in the amount of $150,000. The grant is a partnership with John Wayne Airport (JWA) to supply refrigeration equipment for edible food collection from airport vendors for local food banks and non-profit organizations.

SB 1383 Local Assistance Grant. This grant was awarded to OCWR through CalRecycle in the amount of $181,119. The grant was used to procure Recyclist data tracking software and food scrap containers as well as an instructional video on proper green waste recycling techniques.

Organics Grant Program. This grant was awarded to OCWR through CalRecycle in the amount of $3 million. The grant was used for the Phase II Bee Canyon Greenery expansion project.

SB 1383 Local Assistance Grant. This grant was awarded to OCWR through CalRecycle in the amount of $235,239. The grant was used to purchase a bagging machine, bags and waddles to distribute compost and mulch. Education and outreach were also included in the grant.

Household Hazardous Waste Grant Program. This grant was awarded to OCWR through CalRecycle in the amount of $50,000. The grant will be used to cover two marine flare collection events.

b. Reporting Requirements

Edible Food Recovery Grant. This grant was awarded to OCWR through CalRecycle in the amount of $150,000. The grant is a partnership with John Wayne Airport (JWA) to supply refrigeration equipment for edible food collection from airport vendors for local food banks and non-profit organizations. All reporting and recordkeeping is tracked and maintained through OCWR and submitted successfully to CalRecycle through its Financial Assistance Office.

SB 1383 Local Assistance Grant. This grant was awarded to OCWR through CalRecycle in the amount of $181,119. The grant was used to procure Recyclist data tracking software and food scrap containers as well as an instructional video on proper green waste recycling techniques. All reporting and recordkeeping is tracked and maintained through OCWR and submitted successfully to CalRecycle through its Financial Assistance Office.

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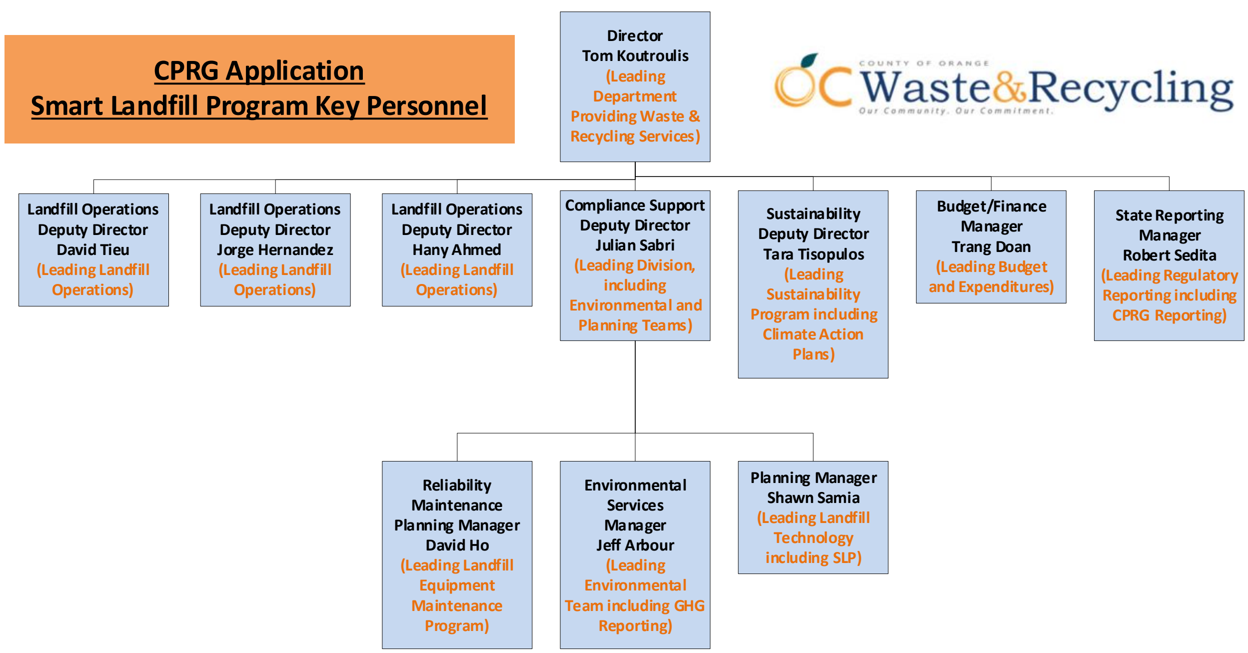
Household Hazardous Waste Grant Program. This grant was awarded to OCWR through CalRecycle in the amount of $50,000. The grant will be used to cover two marine flare collection events. All reporting and recordkeeping is tracked and maintained through OCWR and submitted successfully to CalRecycle through its Financial Assistance Office.

c. Staff Expertise

OCWR's organization is comprised of industry experts from the Director level to front-line team members. The organizational chart below indicates the Department's leaders who are critical to the successful implementation of the SLP and related management of grant funds. The organizational chart below includes a brief description of the individual's role at OCWR. They will play a critical role in the grant implementation from overseeing the budget to providing quarterly reports, to hiring approximately 3-5 new staff for the creation of green jobs, to interacting with the selected vendor on equipment installation and maintenance. Key team member Curricula Vitae (CVs) are attached (Attachment A) for detailed information on team expertise. The role of each member is listed below their position title and name in the organization chart below. The attached resumes show extraordinary depth of experience in the solid waste industry, landfill operations and management, environmental programs and compliance, sustainability programs, reliability maintenance programs, regulatory reporting, project planning and implementation, and budget and procurement controls.



Please see Attachment A for key personnel CVs.

7. Budget

a. Budget Detail

A SLP GHG reduction measure detailed budget has been prepared to support this section of the workplan (Attachment D). Below is a summary budget table showing costs by category and year.

BUDGET BY YEAR								
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5		TOTAL
Direct Costs	TOTAL PERSONNEL	$500,926	$518,459	$536,605	$555,386	$574,825		$2,686,201
	TOTAL FRINGE BENEFITS	$0	$0	$0	$0	$0		$0
	TOTAL TRAVEL	$0	$0	$0	$0	$0		$0
	TOTAL EQUIPMENT	$10,949,539	$0	$0	$0	$0		$10,949,539
	TOTAL SUPPLIES	$0	$0	$0	$0	$0		$0
	TOTAL CONTRACTUAL	$2,405,000	$2,000,400	$2,000,400	$2,000,400	$2,000,400		$10,406,600
	TOTAL OTHER	$112,880	$83,280	$83,280	$83,280	$83,280		$446,000
	TOTAL DIRECT	$13,968,345	$2,602,139	$2,620,285	$2,639,066	$2,658,505		$24,488,340
	TOTAL INDIRECT	$0	$0	$0	$0	$0		0
TOTAL FUNDING		**$13,968,345**	**$2,602,139**	**$2,620,285**	**$2,639,066**	**$2,658,505**		**$24,488,340**

The table below summarizes budget for SLP implementation by OCWR Landfill Site.

BUDGET BY PROJECT			
Project Number	**Project Name**	**Total Cost**	**% of Total**
1	*Olinda Alpha - Active Site*	*$9,829,303*	*40%*
2	*Frank R. Bowerman - Active Site*	*$5,764,106*	*24%*
3	*Prima Deshecha - Active Site*	*$3,166,588*	*13%*
4	*Coyote Canyon - Closed Site*	*$3,715,221*	*15%*
5	*Santiago Canyon - Closed Site*	*$2,013,121*	*8%*
Total		*$24,488,340*	*100%*

b. Expenditure of Awarded Funds

SLP planning and implementation at OCWR has been ongoing for over 2 years. During that timeframe OCWR has defined the approach, services equipment, and labor necessary for this measure. This progress makes timely and efficient expenditures of funds a simple task since the project is ready to go. All contracts awarded to support this initiative will be performed as required by the County's procurement manual and in accordance with the public contract code. All budgets and expenditures will be prepared and performed in accordance with County budget policies and procedures and in accordance with the

Single Audit Act. As indicated in the attached budget as well as section 3.c. above, the measure is scheduled to be fully implemented within one year of award.

c. Reasonableness of Costs

The following demonstrates the reasonableness of the budget for the GHG Reduction Measure of the SLP. Below is a list of applicable categories, descriptions, and associated costs for the SLP GHG Reduction Measure from 2025 - 2030. Budget categories with no anticipated costs are not listed below due to the $0 value.

Personnel Costs - $2,686,201

Personnel costs associated with this SLP GHG Reduction Measure totals and estimated $2,686,2001. These costs come from salary associated with 4 new positions required to manage this new program. These new positions include 3 SLP Data Specialists (2024 Maximum Salary of $114,525/year) and 1 Instrumentation & Controls Engineer (2024 Maximum Salary of $157,352/year). These salaries are estimated to increase by 3.5% per year for the duration of this budget.

Equipment - $10,949,539

Estimated equipment costs for the SLP GHG Reduction Measure totals and estimated $10,949,539. Equipment costs fall into the following categories: 1) Wellhead Sensors/Controllers and Header Sensors, 2) Drone Fitted with Methane Sensor, 3) Connectivity/Mesh Network, and 4) Liquid Level Measurement Devices.

An estimated 887 landfill gas wellhead sensors and controllers, and/or header sensors are expected to be purchased and installed, with a total cost estimated at $9,204,000.

A total of 5 drones will be purchased and fitted with methane sensors for aerial methane mapping. This is expected to cost $450,000.

To ensure data connectivity at each of the 5 sites, mesh network equipment will be installed. This network will utilize a satellite data service. This equipment is estimated to cost $1,962,539.

An estimated 50 liquid level measuring devices are expected to be purchased, with a total cost estimated at $87,500.

Contractual Costs - $10,406,600

Contractual costs for this SLP GHG Reduction Measure totals an estimated $10,406,600. The Contractual costs fall into the following categories: 1) Wellhead Sensor, Controller, and Header Sensor Installation, 2) Wellhead Sensor, Controller, and Header Sensor

Shipping, and 3) Wellhead Sensor, Controller, and Header Sensor Maintenance with Platform Management.

Wellhead Sensor, Controller, and Header Sensor Installation is expected to cost an estimated $330,400.

Wellhead Sensor, Controller, and Header Sensor Shipping is expected to cost an estimated $74,200.

Wellhead Sensor, Controller, and Header Sensor Maintenance with Platform Management is expected to cost and estimated $10,002,000.

Other Costs - $446,000

Other Costs for this SLP GHG Reduction Measure totals an estimated $446,000. The Other Costs are broken down into the following categories: 1) Connectivity Engineering Design, 2) Annual Starlink Connectivity Subscription, and 3) Connectivity System Maintenance.

Connectivity Engineering Design is expected to cost an estimated $29,600.

Annual Starlink Connectivity Subscription is expected to cost an estimated $150,000.

Connectivity System Maintenance is expected to cost an estimated $266,400.

Total Costs - $24,488,340

Total costs are an estimated at $24,488,340.

Please see Attachment D – SLP GHG Reduction Measure Detailed Budget for a detailed breakdown of costs.

Attachment A

Key Team Member CVs

COUNTY OF ORANGE
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HANY AHMED

DEPUTY DIRECTOR

CAREER SYNOPSIS

A highly accomplished Civil Engineer with extensive experience specializing in waste management, public works, transportation, and construction projects. Possesses a Master of Engineering from the University of British Columbia and a Bachelor of Science from Cairo University. Proven track record of leadership in managing multi-disciplinary teams, ensuring regulatory compliance, and spearheading the successful execution of complex engineering projects.

As the Deputy Director for the South Region Landfills at OC Waste & Recycling, oversees operations at Prima Deshecha Landfill, a world-class disposal and resource recovery facility in the city San Juan Capistrano. This modern facility stands as one of three active landfills and greenery in Orange County, offering critical essential public services to the more than three million County residents and 34 cities.

AREAS OF EXPERTISE

Waste Management Leadership | Regulatory Compliance | Construction Engineering and Inspection| Stakeholder Engagement | Public Works Administration| Contract Management | Permit Acquisition | Transportation Project Management | Environmental Impact Assessment| Quality Control| International Experience

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Deputy Director

- Supervise and lead a multi-disciplined team in the daily operation of a large active landfill in compliance with laws, regulations and policies.
- Ensure compliance with local, state and federal laws and regulations including but not limited to those related to water quality, air quality, organics management, landfill design and construction, and native habitat
- Ensure the development and all aspects of implementation for short, mid and long-term plans for design, construction and fill of landfill phases
- Plan, organize and direct daily landfill operations for the region, determine and coordinate implementation of best practices with other landfill regional managers
- Evaluate existing operational techniques and develop new and improved processes
- Establish and maintain positive relationships with waste haulers, adjacent city staff, residents and other stakeholders
- Engage community in issues proactively when possible, understanding time sensitivity
- Interpret and enforce County and OCWR policies and procedures
- Implement and facilitate training programs for regional landfill employees
- Prepare performance reports and budget recommendations for efficient operation of site
- Ensure compliance with all existing operating permits and technical documents

County of Orange - OC Waste & Recycling | Santa Ana, CA
Sr. Civil Engineer

- Lead the Region in all aspects of solid waste engineering. Supervise a team of engineering professionals from civil engineers to technicians
- Prepare and review construction plans and specifications
- Resolve landfill compliance issues

- Prepare various engineering calculations, technical reports, regulatory reports, and cost estimates
- Coordinate with OC Waste & Recycling Operations staff on various maintenance tasks
- Communicate with regulators and stakeholders
- Secure landfill operating permits, draft agreements and agenda staff reports for Board approval
- Administer various public work and service contracts. Review and prepare public works bid documents, and participate in interview panels for selecting A/Es for service contracts
- Provide project leadership and training to lower level staff
- Deliver presentations to variety of audiences, and represent OCWR in public meetings/hearings
- Attend regulatory workshops at several locations within the State, and review and comment on the proposed legislation and regulations

Orange County Public Works | Santa Ana, CA
Sr. Civil Engineer

- Direct the day-to-day activities with Traffic, Design, and the Programming Divisions.
- Lead a design team through preparation of PRs and PS&Es for roadway, drainage, and bikeway improvement projects.
- Monitor scope, schedule, and budget, provide construction support, approve change orders, respond to RFIs, and prepare as-builts for assigned projects.
- Administer the A/E on-call list. Assign projects to A/Es, review and negotiate scope of work, budgets, and project schedules. Prepare RFPs and RFQs and participate in consultant selection, review and approve invoices, contract mods and change orders, review deliverables, lead PDT meetings, and coordinate with other county support units,
- Identify CIP projects and support grant application submittals.
- Prepare agreements with Federal, State, Local Agencies and Utility owners,
- Prepare Agenda Staff Reports (ASRs) to present projects and agreements to the Orange County Board of Supervisors. Attend briefing sessions and prepare executive summaries to Supervisors' executive team, and attend Board meetings to present the subject of the ASR and address any questions raised by the Supervisors,
- Represent the County in public meetings/hearings and meetings with public officials, stakeholders, and oversight agencies,
- Develop the Department's 35-year plan. Chair a committee to update the Department's Standard Plans, and another committee to update the Department's Local Drainage Manual. Serve with the Department's APWA accreditation committee to acquire re-accreditation in 2016.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Master of Engineering** | University of British Columbia (Canada)
- **Bachelor of Science** | Cairo University (Egypt)
- **Licensed Professional Engineer (CA)**
- **Manager of Landfill Operations (MOLO) Certification**

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IRENE ALONSO

STRATEGIC COMMUNICATIONS MANAGER

CAREER SYNOPSIS

Experienced public relations and communications professional, accomplished in strategic planning, partnership cultivation, stakeholder engagement, community outreach, and content creation. Demonstrated ability to navigate complex communication landscapes, driving impactful initiatives in waste diversion and recycling through effective public communication oversight, contract and grant management, and strategic alliance development. Adept at building education programs and fostering meaningful engagement with stakeholders across diverse sectors. Expertise spans strategic communications in private and public sectors, public relations management, marketing strategy formulation, and team leadership.

AREAS OF EXPERTISE

Strategic Planning| Partnership Development | Stakeholder Communications | Community Outreach and Education | Content Development | Social Media | Grant Writing | Contract Management | Program Development & Implementation | Public Relations & Marketing Communications

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Strategic Communications Manager

- Manages Strategic Communications for the Department, including oversight and direction of public communication and information, regional and jurisdictional education and outreach, implementation of the Department's grant programs, and internal/interagency communications.
- Supervises contract implementation with marquee partners and service vendors to meet state mandates for waste diversion and recycling.
- Responsible for the development of strategic partnerships and community programs in support of department initiatives.
- Liaison to key stakeholders including Board of Supervisors, Waste Management Commission, Grand Jury, municipalities, non-profit organizations, school boards and industry organizations.
- Oversight of AB 939 program and expenditures.

County of Orange - OC Waste & Recycling | Santa Ana, CA
Educational Outreach and Recycling Manager

- Managed $35M in AB 939 funds for the Department's waste diversion programs to meet state mandated recycling goals.
- Developed and implemented education and outreach programs, marketing partnerships, strategic planning, grant programs and budgets.
- Collaborated with colleagues, partner agencies and executive team to ensure programs align with the Department's mission and goals.
- Represented the department to key stakeholders including Board of Supervisors, Waste Management Commissioners, educators, and community organizations.
- Administered contracts for public outreach campaigns, partnerships, and vendors. Supervised implementation of $6M grant program for the Department.

Strategic Communications & Public Relations | Tustin, CA
Consultant

- Managed and implemented strategic public relations and communications programs with clients and partner agencies including the California Department of Transportation (Caltrans), the Orange County Transportation Authority (OCTA), Pioneer New Media Technologies Inc., Integrated Research Inc., the Academy for Leadership Communications, SGS International, MPowered PR, Ray PR, and Westbound Communications.

The T&O Group | Irvine, CA
Associate Director of Public Relations

- Managed $1.7M in public relations arm, leading client accounts and managing 10-person public relations team.
- Managed profit and losses and directed strategic growth of overall accounts.
- Developed new business opportunities, presentations, and proposals.
- Provided lead oversight of key accounts including Pioneer New Media Technologies Inc., IBM, Seagate, Hewlett Packard and M-Systems.

Pioneer New Media Technologies Inc.| Long Beach, CA
Marketing Associate

- Managed the marketing and public relations program for the Optical Division products.
- Directed public relations and graphic design contracts.
- Developed marketing communications strategy, content development and support materials including press releases, case studies, white papers, application stories, channel programs, advertorial pieces, brochures, and product review programs.
- Managed national tradeshow presence and media communications strategy, including press tours and events for new product launches and showcases.

CSP Communications | Corona, CA
Senior Account Executive

- Community and media relations liaison for the $118M Caltrans/OCTA SR-55 freeway construction improvement project. Interagency liaison between Caltrans, OCTA, city officials and the public.
- Developed press kits, media and communications outreach strategies and public meeting coordination.
- Pitched and placed feature articles on construction highlights and key project milestones.
- Coordinated public events including open houses and press conferences and ribbon cutting ceremonies with partner agencies and community stakeholders.

California Department of Transportation| Santa Ana, CA
Public Information Associate

- Media and public information support to Orange County regional office. Researched inquiries with internal and external contacts, developed responses to inquiries from media, government officials and the general public.
- Developed materials including press releases, fact sheets and monthly reports to District Director and headquarters office.
- Assisted with writing RFP/RFQs for public awareness campaigns and participated in selection processes.
- Coordinated open houses and special events and implemented public outreach campaigns.
- Created editorial content for the district’s newsletter and state agency publication for regional highlights.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Bachelor of Arts, Communications** | California State University, Fullerton
- **Solid Waste Association of America, member** | Communication, Education & Marketing technical division

JEFFREY D. ARBOUR

COMPLIANCE MANAGER, ASSISTANT DEPUTY DIRECTOR

CAREER SYNOPSIS

Accomplished and highly experienced environmental sustainability leader offering a wealth of experience in overseeing regulatory compliance and sustainable practices. Proficient in developing and implementing environmental policies, managing complex compliance initiatives, and fostering stakeholder relationships. Skilled in grant acquisition, project management, and environmental impact assessments. Highly organized and decisive leader, possessing strong interpersonal skills, business analytical insight, and excellent judgment.

Proficient in team building and collaboration, capable of navigating complex regulatory landscapes, and well-versed in climate change impacts on public health and disadvantaged communities. Adept at data analysis, financial assessment, and developing key performance indicators. Experienced in working collaboratively with various stakeholders, including elected officials, government agencies, businesses, and academic institutions.

AREAS OF EXPERTISE

Environmental Compliance | Regulatory Compliance | Sustainability Strategies | Climate Change Mitigation | Stakeholder Engagement | Policy Development | Grant Writing | Project Management | Environmental Impact Assessment | Data Analysis | Renewable Energy | Waste Management | Energy Efficiency | Water Conservation | Environmental Education and Outreach | Cross-Functional Collaboration | Leadership and Team Management | Communication | Interpersonal Relations

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Administrative Manager II - Environmental Services Manager

- Led and managed the Environmental Services Section of OC Waste & Recycling, overseeing a diverse team of Engineers, Administrative Managers, Biologists, and Staff Specialists, ensuring compliance with environmental regulations for all landfill regions.
- Managed a $6,000,000 annual budget and $4,500,000 in section revenue, overseeing key programs including Regulatory Support, CEQA/Habitat, Renewable Energy, and Closed Site Management.
- Oversaw environmental management by serving as the primary liaison between the department and government agencies and special interest groups, developing policies, and ensuring timely and accurate production of over 500 regulatory deliverables annually and including United States Environmental Protection Agency Greenhouse Gas Reporting
- Coordinated the CEQA/Habitat Program, ensuring compliance with environmental laws and regulations for new projects, and managed real estate transactions, redevelopment opportunities, and litigation for 20 closed landfill sites.
- Spearheaded strategic initiatives and financial plans to support the department's Strategic Plan, represented the County at public hearings and agency board meetings, and negotiated multi-million-dollar contracts, contributing to the department's long-term vision and revenue streams.
- Authored complex Agenda Staff Reports, primarily associated with renewable energy, and related contracts or settlements.
- Successfully secured grants for heavy equipment fleet acquisition from the California Air Resources Board.

MillerCoors LLC | Irwindale, CA
Environmental Manager

- Served as the Regional and Facility Lead for Energy and Water Reduction initiatives, and Zero Waste to Landfill Initiatives to support global corporate goals.
- Led and Managed Renewable Energy Projects, including solar and anaerobic digester biogas conversion technology.
- Changed Greenhouse Gas Legislation AB 32 on behalf of the industry.
- Oversaw comprehensive environmental compliance at MillerCoors, managing air, materials, and water regulations, including EPA Title V Permit Management, RECLAIM Program Management, and hazardous materials handling, storage, and disposal.
- Managed a Permitted Water System Operation, ensuring compliance with various regulations, including Groundwater Case Management and Industrial Waste Discharge Permitting.
- Supervised hourly employees and managed operations and maintenance of the anaerobic digester, generating 2 MW of renewable electricity from biogas.
- Managed a multi-million-dollar budget for regulatory compliance and wastewater treatment plant costs.
- Utilized safety incident and near-miss data for process enhancements and incident prediction, contributing to proactive safety measures.
- Created and maintained global Key Performance Indicators for sustainability at a global, national, state, facility, business unit, and shift level, all to drive swift improvements through visibility and collaboration.

Kleinfelder | Irvine, CA
Staff Professional II

- Managed a comprehensive environmental program for a major oil company, ensuring seamless project progression.
- Led all phases of environmental investigation, remediation, and construction projects with precision.
- Conducted loss prevention audits, near loss investigations, and comprehensive loss investigations, implementing strategic measures to mitigate risks effectively.
- Generated insightful technical reports, including quarterly groundwater monitoring reports, site assessment reports, site conceptual models, sensitive receptor surveys, work plans, and permit compliance reports.
- Oversaw the routine operation and maintenance of remediation systems; analyzed safety and environmental near miss and incident data to identify patterns and implemented decisive safety actions.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Bachelors in Geography, Environmental Analysis** | California State University Fullerton
- **Lean Six Sigma Yellow Belt** | California State University Fullerton
- **Hazardous Materials and Waste Transportation Certification** | Lion Technologies
- **40-Hour Compost Operations Training** | US Compost Council

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TRANG DOAN

FINANCIAL SERVICES SECTION MANAGER

CAREER SYNOPSIS

Dedicated financial professional with 20-year working experience effective in public sector. Proven track record in implementing effective financial strategies. Adept at improving operation efficiency and fiscal accountability through functional and technical analysis. Highly skilled in creating and evaluating complex cost and financial models. Experienced in team leadership and collaborative problem solving.

AREAS OF EXPERTISE

Financial Analysis, Forecasting, Management and Planning | Government Accounting, Auditing and Financial Reporting| Government Grant Management, Claiming, Tracking and Reporting | Procurement Contract Management, Compliance and Resource Governance | Business Intelligence and Data Analytics

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Financial Services Section Manager

- Led and managed the Environmental Services Section of OC Waste & Recycling, overseeing a diverse team of Engineers, Administrative Managers, Biologists, and Staff Specialists, ensuring compliance with environmental regulations for all landfill regions.
- Manage Budget & Finance and Procurement support services to OC Waste & Recycling (OCWR) landfill regions and divisions' programs
- Direct strategic financial planning including budget development and long-range financial forecast for the department with an annual budget of over $200 million and cash flow of over $700 million
- Develop cost models and manage OCWR cost tracking system to ensure compliance with County financial policies and procedures
- Provide financial consultation to landfill operations and business services programs. Resolve issues if problems arise or as needed
- Communicate with external parties on matters related to OCWR financials. Prepare and make presentations to the public – Waste Management Commission, County officials and other stakeholders Prepared budget development, revenue/expenditure monitoring, and strategic financial planning

Budget & Finance Management

- Led and managed the Environmental Services Section of OC Waste & Recycling, overseeing a diverse team of Engineers, Administrative Managers, Biologists, and Staff Specialists, ensuring compliance with environmental regulations for all landfill regions.
- Reviewed and approved procurement requisitions for commodities, services, capital assets, architect-engineering and public works contracts of approximately $100 million per year.
- Directed staff in monitoring and tracking of commitments, encumbrances, contract expenditures and contractors' performance
- Managed OCWR asset management of equipment and fixed assets and supervised staff to coordinate asset activities, annual inventory, and asset reporting in the County financial system
- Provided technical analysis to OCWR Executive Management for financial data and information related to cost elements such as operating, administration, direct and indirect costs, overhead rates

- Served as the Regional and Facility Lead for Energy and Water Reduction initiatives, and Zero Waste to Landfill Initiatives to support global corporate goals.
- Reviewed OCWR's Agenda Staff Report (ASR) to the Board of Supervisors, and Request for Proposals (RFP) to analyze and evaluate contractor's experience, technical ability, and contract pricing, and to assist OCWR in the selection of contractors for financial & professional services, IT systems and capital projects

County of Orange | Santa Ana, CA
Accounting Manager, Satellite Accounting/OC Waste & Recycling, Auditor Controller

- Directed staff accountant in providing general accounting & financial accounting services, preparing OCWR annual audited financial statements & notes, and the OCWR Enterprise component in the County of Orange's Comprehensive Annual Financial Report (CAFR)Managed Accounts Payable team to provide accounts payable services to disburse approximately $68 million per year to commodities and services vendors, and payroll services for 260 OCWR employees
- Supervised and reviewed the work of staff accountant, who performed biennial audit of OCWR cash handling, and biennial review of OCWR purchasing card program
- Provided financial information to external parties including the rating company- Fitch Ratings Inc. for information related to the department's Refunding Revenue Bonds

Accountant, Senior Accountant, Housing & Community Services & Social Services Agency, Auditor Controller

- Directed staff in gathering and preparing financial statements for the Orange County Development Agency at Housing & Community Services department (HCS)
- Supervised accounting staff to monitor funding and to prepare year-end reports for rehabilitation programs
- Reviewed and approved vouchers prepared by accounting staff to disburse funding to recipients of federal and state grants such as Community Development Block Grant (CDBG), Emergency Shelter Grant (ESG)Reconciled and corrected variances between in-house grant program reporting system and the U.S. Department of Housing & Urban Development's (HUD) program reporting system
- Prepared and reconciled the monthly report for programs receiving grants at the Social Services Agency. Consolidated balances and transactions from the old trust fund to the newly set up revenue fund for the programs
- Performed the auditing of selected recipients of HUD grants to ensure compliance with HUD requirements

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Bachelor of Arts, Business Economics, Minor in Accounting |** University of California, Los Angeles
- **Bachelor of Arts, Linguistics, Major in Russian Literature |** National University, Ho Chi Minh City, Vietnam
- **Deputy Purchasing Agent (DPA) certification|** County of Orange
- **Certified Public Accountant (CPA),** licensing application pending
- **Enrolled Tax Agent (EA),** License obtained 2004

JORGE HERNANDEZ

DEPUTY DIRECTOR

CAREER SYNOPSIS

Process-oriented Operations Manager with over 30 years of experience in the waste and recycling industry, managing Material Recovery Facilities, Transfer Stations, Demolition/Construction and compost facilities with proven success leading production and operation teams to meet aggressive safety, financial, and processing goals. Additional strengths include transportation/logistics, safety compliance (VPP), development/training, problem resolution, and strong understanding of international business in export/import material sales, consisting of fibers, plastics, and metals.

AREAS OF EXPERTISE

Cal-OSHA Health and Safety Compliance (VPP) | Accident/Injury Investigation| Bale Quality Control | Export and Import Marketing and Sales| Process Improvement, LEAN/Value Stream Mapping| Hazardous Waste Handling | Training and Development | Transportation and Logistics| Waste | Waste Management

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Deputy Director

- Manage and support a staff of 80 employees ensuring safety, compliance, and day-to-day operations are being performed to county standards at Olinda Alpha Landfill and Valencia Greenery in Brea
- Manage nearly 8,000 tons of waste per day from Orange County residents and commercial haulers.
- Ensure compliance with local, state and federal laws and regulations including but not limited to those related to water quality, air quality, organics management, landfill design and construction, and native habitat.
- Ensure the development and all aspects of implementation for short, mid and long-term plans for design, construction and fill of landfill phases.
- Plan, organize and direct daily landfill operations for the region, determine and coordinate implementation of best practices with other landfill regional managers.
- Evaluate existing operational techniques and develop new and improved processes.
- Establish and maintain positive relationships with waste haulers, adjacent city staff, residents and other stakeholders.
- Interpret and enforce County and OCWR policies and procedures.
- Implement and facilitate training programs for regional landfill employees.
- Prepare performance reports and budget recommendations for efficient operation of site.
- Ensure compliance with all existing operating permits and technical documents.
- Championing MRF operations at all three county landfills.

Universal Waste Systems | Santa Fe Springs, CA
MRF/Transfer Station Manager

- Supervised day to day operations at our transfer station and MRF
- Liaison between company and environmental agencies such as AQMD, DOC, LEA, Cal-OSHA
- Established SOPs to help operators detect, correct, and prevent variations that cause defects or lead to contamination of final product.
- Administered company safety programs by conducting monthly and weekly safety meetings, facility inspections, and ensuring compliance to all Cal-OSHA and DOT regulations.

- Trained new employees on the general safety policies, DOT drug and alcohol program and proper use of assigned equipment, will administer corporate policies and ensure safety compliance.
- Ensured compliance with company and state rules, regulations, and policies, while meeting safety, financial, and processing goals.
- Implemented best practices that lead to waste reduction, increased diversion, and a safe and healthy work environment.
- Implemented and facilitated bilingual safety programs encouraging achievement of ZERO accidents and injuries.
- Conducted employee evaluations and employee mentorship program to improve productivity, quality, and a healthier work environment.

CR&R Incorporated | Perris/Stanton, CA
Operations Manager

- Manage profitable/safe day to day operations, while meeting company goals, initiatives, within budget at MRF/Transfer Station and Green Waste/Demolition facilities with a staff of over 30 employees, which included supervisors, laborers, equipment operators, and transfer drivers. In addition:
- Operated in compliance to ensure ZERO customer complaints and or violations.
- Established SOP's allowing operators to detect, correct, and prevent variations that cause defects or contamination to final product.
- Introduced quality improvement and processing programs that helped with reduction of waste to the landfill and increased diversion %.
- Maintained employee productivity and commitment by encouraging employee suggestions and providing incentives for suggestions that yield positive results for individuals or entire teams.
- Reduced material rejections by over 25% by adjusting schedules and cross-training staff on daily out-bound recycle loads.
- Point of contact for Recycling Import/Export buyers and coordinate trucking to local ports and other recycling centers.
- Liaison between company and environmental agencies such as (AQMD, DOC, LEA, Cal/OSHA)
- Increased bale count by 100% by evaluating and streamlining overall processes to help recover more out of the waste stream.

CR&R Incorporated/Madison Materials/Waste Management | Orange County, CA
Various roles including Route Supervisor, Operations Manager, District Operations Manager, Transfer Operations Manager, Transfer Station Scale House Supervisor

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Business Administration, Management & Operations |** University of Phoenix
- **Leadership Forum Committee Member**
- **Cal/OSHA Special Team Member**
- **Cal/OSHA Golden Gate Certification**
- **Cal/OSHA SHARP Certification**
- **Cal/OSHA VPP Certification**
- **Lean and Value Stream Mapping**
- **HAZWOPER Training**
- **Lock Out/Tag Out Training**
- **Confined Space Training**
- **IIPP Training**
- **Hiring and Interviewing Training**
- **Forklift Certified**
- **OSHA 501 Certified**

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DAVID HO

RELIABILITY MAINTENANCE PLANNING MANAGER

CAREER SYNOPSIS

Accomplished and proven professional with expertise in maintenance and reliability management, and commitment to optimizing asset performance and operational efficiency. As Reliability Maintenance Planning Manager at OC Waste & Recycling, spearheads the deployment and management of a computerized maintenance management system (CMMS), ensuring streamlined maintenance operations and adherence to regulatory requirements. Proficient in developing and tracking maintenance and reliability key performance indicators (KPIs), supervising maintenance planning staff, and strategically planning financial resources for maintenance services. Excels at implementation of lean methodologies, continuous improvement initiatives, and operational excellence strategies.

AREAS OF EXPERTISE

Computerized Maintenance Management System (CMMS) | Key Performance Indicators | Reliability Centered Maintenance | Lean Project Management and Manufacturing | Total Productive Maintenance (TPM) | Root Cause Analysis| Operations Excellence | Visual Factory Management | Standard Work Implementation| Inventory Management | Product Supervision | Industrial Engineering | Process Optimization| Six Sigma Methodologies | SAP CMMS

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Reliability Maintenance Planning Manager

- Provide direct oversight and management of reliability maintenance planning programs
- Design, build, deploy, and manage computerized maintenance management system (CMMS)
- Develop, track, and report maintenance & reliability key performance indicators (KPI)
- Direct supervision of reliability maintenance planning staff
- Establish maintenance strategies and provide oversight of maintenance services associated with various classification of assets that include off-road heavy equipment, portable support equipment, and greenery processing equipment
- Ensure adherence to maintenance requirements under Title V permits
- Ensure timely submission and reporting of DOORS
- Responsible for strategic financial planning related to off-road equipment, portable support equipment, and maintenance services for all regional landfills
- Manage and oversee various equipment rental contracts

Orange County Sanitation District | Fountain Valley, CA
Maintenance Supervisor

- Provide direct oversight and deployment of IBM Maximo CMMS across operations and maintenance division
- Deployment of a maintenance planning & scheduling program using Maximo scheduler
- Enhance root-cause analysis (RCA) through the implementation of failure-hierarchy reporting
- Improve asset reliability through the implementation of PM and PdM program by using various PdM technologies such as oil analysis, thermography, and vibration analysis using Maximo
- Optimize PM program utilizing the combination of both calendar and meter reading runtime-based maintenance strategies

- Develop and deploy mechanism to continuously improve accuracy of maintenance job plans and asset information through the use of various work order logs
- Integration of lockout tagout (LOTO) within Maximo CMMS to further enhance work safety and enable organizational readiness towards obtaining OSHA Safety Voluntary Protection Programs (VPP) certification
- Develop and deploy key performance indicators (KPI) measuring the effectiveness of maintenance reliability programs such as PM compliance, percentage of break-in work, schedule compliance, PM/CM ratio, and maintenance backlog
- Develop procedures, standard work, including workflow diagrams related to CMMS work order management, equipment outage/shutdown request, and inter-plant gas line dig-alert management
- Direct supervision of eleven (11) senior level staff members belonging to various bargaining units, responsible for planning & scheduling, contract management, and regulatory compliance associated with backflow prevention, underground storage tanks, fire suppression systems, inter-plant gas line, boilers, truck loading scales, cranes, and elevators
- Direct department oversight of maintenance service contracts with combined annual value in excess of $8MM per year
- Create and develop scopes of work associated with maintenance service contracts
- Prepare agenda reports associated with maintenance service contracts, and projects to be presented during OCSD Operations Committee and OCSD Board of Directors monthly meetings

Various | B Braun Medical, SHURflo, Steelcase Inc., TDK Electronics Corporation
Operations Excellence Leader/Industrial Engineer/Production Analyst/Lean Manufacturing Engineer & Supervisor

- Provide operational and maintenance management support for a fast-paced, high volume automated continuous production line including over 60 direct and indirect reports
- Provide direct support in the implementation of total productive maintenance (TPM) program
- Establish framework and foundation for a site-wide deployment of SAP PM CMMS and asset management program
- Deploy and implement problem solving methodologies such as Root Cause Analysis (RCA) and Plan, Do, Check, Act (PDCA) throughout the entire organization
- Initiate and implement Overall Equipment Effectiveness (OEE) measurement system leading to reduction of unplanned downtime and increased line efficiency
- Lead and facilitate annual strategic planning with executive team both at the site and functional levels through Value Stream Analysis (VSA)
- Deploy and implement a plant-wide visual factory management system focusing on achieving key performance indicators (KPI)
- Integrate and embed standard work in direct and indirect functional support areas to minimize variability and maximize effectiveness
- Implement an internal parts/inventory replenishment system (KANBAN) leading to storage space and inventory cost reduction
- Rollout and sustain 5S workplace organization method
- Lead several lean/six sigma project opportunities resulting in quality and process improvement

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Executive MBA (EMBA)** | Chapman University, Orange
- **Bachelor of Science, Industrial Engineering (BSIE)** | California Polytechnic University Pomona, California
- **Certifications**
  - Lean Six Sigma Yellow Belt, B Braun Medical
  - Lean Professional, Lean Alliance
  - Total Productive Maintenance (TPM), The Ohio State University

TOM KOUTROULIS

ORANGE COUNTY WASTE & RECYCLING DIRECTOR

CAREER SYNOPSIS

An accomplished environmental sustainability leader with more than 30 years of experience in the waste industry, overseeing one of the nation's premiere solid waste disposal and resource recovery systems serving 34 cities and over three million residents. This system comprises three active landfills, three organic waste greeneries, four household hazardous waste collection centers, and 21 closed sites.

Skilled in prioritizing business improvement projects, with a focus on enhancing safety, efficiency, customer service, technology implementation, and providing key research and development in organics recycling. Leading efforts to shape the region's organic waste management infrastructure in alignment with state-mandated recycling goals. Facilitating the transition of the County from landfilling to a more sustainable and environmentally conscious resource recovery model, including organics, anaerobic digestion, renewable energy, and other innovative arenas.

AREAS OF EXPERTISE

Waste Management |Environmental Compliance | Sales Management | Sustainability Strategies | Climate Change Mitigation | Stakeholder Engagement | Account Management | Project Management | Renewable Energy | Hazardous Waste Management | Proposal Writing | | Energy Efficiency | Water Conservation | Environmental Services | Environmental Awareness | Leadership and Team Management | Communication | Interpersonal Relations I Environmental Consulting | Environmental Management Systems

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Director

- Responsible for the operation, planning and financial viability of the County's waste management system comprised of three active landfills, 20 closed sites, four hazardous waste collection centers, three compost facilities, 11 franchise solid waste agreements in county unincorporated area, strategic vision and plan, renewable energy portfolio, environmental and legislative compliance for state and federal, employee safety performance, protecting public health and the environment.
- Report Directly to CEO, providing monthly and regular agency updates on key capital improvement projects, strategic initiatives, future planning, public engagement and education, municipal interaction, industry trends, legislative updates and regulatory changes, and compliance status on key regulatory agencies such as Cal Recycle, CARB, SCAQMD, and various Water Boards.
- Participate in Orange County City Managers Meetings, Recycling Coordinators Meetings, and various city meeting upon request to speak.
- Participate in various board capacities with SWANA Founding Chapter, Sustain So Cal, Association of Compost Producers, Emergency Operations Center Policy Group for legislative and regulatory participation efforts, education and outreach, market creating and development, disaster debris planning and local disaster emergency response.
- Provide reorganization and restructuring of department to flatten communications, create additional positions for development Safety Culture Manager, Standard Operating Procedure, Environmental Compliance, Reliability Maintenance, Organics Recycling Infrastructure, Resource Recovery.
- Create and lead a Sr. Executive Team to execute vision and initiatives by fostering teamwork, establishing goals, greater collaboration, refining leadership skills with a focus on strong EQ by building trust and

accountability.

- Created the Safety Culture Manager position to establish a strong culture of safety to prepare for Cal OSHA application for SHARP/VPP certification and established OC Safety Application to capture and report incidents and accidents to streamline and expedite root cause analysis with a goal of creating a Kaizen Mindset on all aspects of the agency.
- Established Employee Driven Safety Committees at each location that participate in Safety Culture Development with Kaizen Projects to lead and drive safety results, with a rotation schedule, employee and team recognition regarding creative and collaborative efforts on safety program development and continuous improvement.
- Created the Landfill Development Deputy Director to create an agency wide playbook that would create a Standard Operating Procedures (SOP) as a "living breathing document" that would act as the foundation for employee training, establish Job Hazard Assessment and enhance workforce development.
- SOP playbook for landfill operations, composting operations, engineering, environmental services.
- Maintain an "Open Door Policy" and access to Director from all employees either formally or anonymous contact through "Ask The Director" to report concerns, ask questions and either chose to remain anonymous or provide contact information to address concerns and give all employees a "voice" so they are heard and issues addressed to mitigate and strengthen "Chain of Command" culture and promote clear communications.
- Achieved recognition from County Risk Management as having the most improved and best record of safety result with reduction in employee injuries and incidents in the County recorded history. · Successfully negotiated Host City Cooperative Agreements with landfill permit updates: Prima Deshecha Landfill permit update estimated to 2102, and Brea Olinda Landfill permit update estimate to 2036.
- Establish strategic organics recycling initiative for compliance for SB1383 and AB 1594 by building out local infrastructure by colocation of compost facilities at landfill, manufacturing of STA compost and mulch and incorporates circular economy principles with creation and development of local markets and outlets for compost and mulch with "give away events", MWELO requirements, project permitting, city compliance, Cal Trans, IRC, Ag Commissioner.
- As Director, represent County of Orange as expert in the waste and recycling industry regarding Grand Jury Interviews, support local jurisdictions and special districts on industry perspectives and trends on operational, regulatory, legislative, diversion programs and innovative technology.
- Created the "Orange is the New Green" strategy – with a focus on Organics to Renewable Natural Gas and Energy, to incorporate a phased in approach on building out programs that support infrastructure development through larger cooperative agreements with jurisdictions, special districts and key stakeholders such as WWTP and private waste haulers under a Waste Infrastructure System Enhancement (WISE) agreement.
- Hired the first Deputy Director of Sustainability for the County, to help execute OCWR Vision, oversee the Los Angeles/Orange County MSA CPRG process and lead the efforts on creating the first Orange County Climate Action Plan by working with the 22 other county departments.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Masters Business Administration** | University of Phoenix
- **Bachelor of Art in English Literature** | University of California, Irvine
- **Associate Degree General Education** | Saddleback College
- **Developmental Dimension's International Certification**
- **OSHA 40 Hour Certification**
- **Certified Emergency Operational Professional (CEOP)**
- **American Council for Accredited Certification**
- **SWANA Manager of Landfill Operations (MOLO) Certification**
- **US Compost Council Training Certification**
- **California State Association of Counties (CSAC) Senior Executive Credential**
- **FEMA NIMS Training**

COUNTY OF ORANGE
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JULIAN SABRI

DEPUTY DIRECTOR, COMPLIANCE SUPPORT DIVISION

CAREER SYNOPSIS

A seasoned engineering leader with extensive expertise in waste management, compliance oversight, and project management across various industries. Demonstrated visionary leadership, fostering a culture of decisiveness, confidence, and adaptability. Skilled in project management, including coordination with clients, engineers, and field personnel, managing project schedules, bids, estimates, and budgets. Specialized knowledge in controls and automation, encompassing SCADA systems, PLC programming, control panel layout, and project operation and maintenance manuals. Experienced in environmental compliance, regulatory permitting, energy planning, and management, with expertise in single lines, power plant design and operation, and power distribution and protection. Adept in field engineering, overseeing plant start-ups, field surveys, and field reports.

AREAS OF EXPERTISE

Leadership | Project Management | Client Management| Engineering Coordination | Field Personnel Management| Project Scheduling| Bids and Estimates | Budget Tracking | Controls and Automation| SCADA Systems| PLC Programming| Control Panel Layout | Operations & Maintenance Manuals| Training | Computer Software and Databases | Database Programming| Intergraph, GIS and AutoCAD | Instrumentation and Process | P&I Diagrams and Loop Sheets | Reliability Maintenance | CMMS | Preventive Maintenance | Environmental Compliance | Regulatory Compliance | Permitting | Energy Planning and Management

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Deputy Director, Compliance Support Division

- Manage 36 engineers and designers (staff and contractors). Lead the Compliance Support (CS) Division with four (4) sections to support 22 solid waste landfills throughout the County of Orange, California, with three (3) open landfills and two (2) recently closed landfills, and other closed landfills.
- Oversee compliance with national, state, and local regulatory rules.
- Responsible for project management teams to implement various projects, reliability maintenance planning, and engineering planning. Sections include:
  Section – Environmental Compliance
    - Regulatory Compliance
  Section - Project Management Office
    - Implementation of Capital Improvement Projects (CIP) as well as non-CIP projects Section – Environmental Compliance
  Section - Reliability Maintenance Planning
    - Implementation and management of computerized maintenance management system (CMMS) to plan and provide preventive maintenance (CMMS) at OCWR
  Section - Engineering Planning and Renewable Energy
    - Planning for OCWR’s present and future initiatives and programs until the end of operation at all OICWR landfills. In addition, planning developing OCWR’s renewable energy program to support the circular economy, utilizing the latest in energy development and management.

Orange County Sanitation District| Fountain Valley, CA
Engineering Supervisor – Electrical, Instrumentation, and Controls
Manage 16 engineers and designers, part of District engineering department. Review over $300M engineering and construction projects related to OCSD Capital Improvement Program. Create scopes of work and requests for proposals. Evaluate consultant's proposals. Help Select successful consultants. Review consultant design submittals. Develop bid package for construction phase. Provide input for construction phase (field change orders, respond to RFI's, help manage construction cost and schedule). Assist in start-up and commissioning phases. During the long tenure at OCSD, the duties included:

- Operation and Maintenance Engineering Supervisor
    - In charge of maintenance projects and reliability maintenance planning for OCSD assets valued at $10.3B Regulatory Compliance
- Source Control Engineering Supervisor
    - Regulatory compliance for OCSD's waste treatment facility, including NAPDS permits, industry permits to flow sewer to OCSD, and compliance with EPA Region 9, SCAQMD, as well as State and local regulatory rules
- Engineering Planning Supervisor
    - Planning for OCSD's present and future initiatives and programs.
- Electrical & Controls Department Engineering Supervisor
    - Manage 23 electrical, control, and instrumentation engineers
- Project Management Office
    - Senior Project Manager in charge of over $300M CIP and non-CIP projects

Various Engineering, Management, Consultant & Supervision Roles| California, Georgia, Alabama
Electrical, Engineering, Project Management, Design, Controls, Instrumentation, and Automated Systems
Various roles at Washington Group International (formerly Raytheon and Rust International), GE Automation Services, REAL Enterprise Solutions, DAMAS Corporation, Revere Control Systems, Synergy Enterprises, NOVA Automation, International Paper, Simons Easter Consultants, Flour Daniel Corporation and more.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **BS Electrical Engineering** | University of Alabama
- **Master of Public Administration** | California State University, Long Beach
- **JAVA Programming Certificate**| University of Alabama
- **Software Training Certificate**| Rockwell Automation
- **RS View 32 Training Certificate**| Rockwell Software
- **Electrical Engineering Refresher Course Certificate**| California State University, Long Beach
- **Electrical Engineering Update Certificate**| Georgia Institute of Technology
- **Electrical Engineering Update Certificate** | University of Alabama
- **AutoCAD Certificate** | LA CAD
- **Design of Pharmaceutical Plants Certificate**| California State University, Fullerton
- **Pharmaceutical Good Manufacturing Practice (GMP) Certificate**| California State University, Fullerton
- **SAP R/3 Business Modeling Certificate**| Raytheon

OC Waste&Recycling

SHAWN SAMIA

CIVIL ENGINEER

CAREER SYNOPSIS

Managing civil, mechanical, electrical and renewable energy design and developments as Civil Engineer working for multiple Government agencies involving, Orange County Sanitation District, City of Long Beach and Orange County Waste and Recycling. Currently, managing the Planning and Renewable Energy unit at OCWR involving multiple planning & renewable energy projects under design and development and responsible for the current renewable energy facilities at OCWR. Developing smart landfill systems at OCWR including, SCADA systems for all landfills, County wide facility atlas program, integrated grade control, automated LFG collections systems etc. Leading as regulatory engineer generating and submitting reports for multiple government agencies including, EPA, AQMD, CalRecycle, LEA and the Water Board.

AREAS OF EXPERTISE

Environmental Compliance | Regulatory Compliance | Sustainability Strategies | Climate Change Mitigation | Stakeholder Engagement | Policy Development | Grant Writing | Project Management | Environmental Impact Assessment | Data Analysis | Renewable Energy | Waste Management | Energy Efficiency | Water Conservation | Environmental Education and Outreach | Cross-Functional Collaboration | Leadership and Team Management | Communication | Interpersonal Relations

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Civil Engineer

- Managing multiple Planning and Renewable Energy projects including, OCWR integrated master plan development, Establishing the County Facility Atlas program, Managing the County SCADA system program research and implementation, OCWR landfill site traffic control signs and devices standard development, Leading the OCWR & SCWD joint task force regarding Priam's future renewable energy programs and developments and Prima Fortistar departure project.
- Helping the County with SB 1383 ruling and how to meet the legal requirements including planning for future facilities like AD's, MERF's, SSO's and CASP.
- Strategic financial planning (SFP) including all current and future developments.
- Managing the Planning and Renewable Energy budget workbook including future cost implications.
- Managing the renewable energy contractors at all three Regions with all their legal and technical needs.
- Managing the design and construction of new renewable energy generation facilities at all three Regions at the county of Orange. These facilities include landfill gas (LFG) to electricity and LFG to renewable natural gas (RNG) and solar power generation facilities.
- Management and coordination of the LFG collection systems at all five landfills (three active & two closed) including, wellfields tuning and expansion, collections piping improvements, adjustments, design and construction of new wells and headers to improve gas collection.
- Working with multiple Government agencies including AQMD, The Water Board, CalRecycle and LEA for permitting multiple facilities including but not limited to, flare facilities, landfill expansion, landfill operations and new solid waste facilities.
- Root cause analysis of multiple notice of violations (NOV's) including but not limited to, gas emission exceedance, ground water pollution, odor complaints and multiple landfill operation limitations.

- Root cause analysis of multiple notice of violations (NOV's) including but not limited to, gas emission exceedance, ground water pollution, odor complaints and multiple landfill operation limitations.
- Developing ASR packages for County Board meetings. Presenting the projects to the Board as necessary, adjusting and following the guidelines until the project approval.
- Updating the County facilities as-builts archive including, electrical, mechanical, structural and civil drawings.
- Developing County wide standards including, CAD standards, project management manual, ArcGIS standards, landfill site traffic control and safety standards, electrical standards and process monitoring standards.

City of Long Beach, (Port of Long Beach) | Long Beach, CA
Civil Engineer

- Served as the Regional and Facility Lead for Energy and Water Reduction initiatives, and Zero Waste to Landfill Initiatives to support global corporate goals.
- Managing the demolition of the NRG intake forebay structure, involving Jacobs Engineering as the design contractor, Curtin Maritime as the GC and four sub-contractors. Total project worth of $19,000,000.00
- Managing several On-Call construction contracts including, Underground wet utilities, Concrete repairs and restorations, Asphalt paving, traffic striping and other related services, Rubble recycling site including asphalt and concrete material and other related services.
- Helping with the demolition of the old Gerald Desmond Bridge CIP project including, design, pre-construction and construction phases.
- Updating the CMB stockpile plans at pier S including the lift schedules, rout schedules and adjusting as new project get under construction.
- Leading the team with the SWPPP at pier S plans and specifications.
- Preparing documentations including proposals for the Board of Directors regarding pier S future expansion.

Orange County Sanitation District | Fountain Valley, CA
Civil / Wastewater Engineer

- Managed a comprehensive environmental program for a major oil company, ensuring seamless project progression.
- Design and management of maintenance projects for pump stations and sewer collection systems.
- Design and construction of plant-1, plant 2 and collections facility improvement projects under the small project delivery group.
- Sewer pipes rehabilitation projects using Cured-In-Place Pipe, (CIPP) procedure.
- Scope of work development packages for maintenance projects per OCSD purchasing policies and OCSD Delegation of Authority ordinance (OCSD-47)
- Construction management for all maintenance projects at pump stations and collection systems from start to finish.
- Coordination with OCSD service area Cities and Agencies for such as permitting construction and traffic control.
- Root cause analysis and optimization studies for our collection systems and process equipment's.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Master of Science, Civil Engineering** | California State University Fullerton
- **Bachelor of Science, Civil Engineering** | California State University Fullerton
- **Bachelor of Science, Industrial Engineering** | Azad University
- **LEED AP certification**

COUNTY OF ORANGE
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ROBERT SEDITA

BUSINESS SERVICES ADMINISTRATOR, STATE REPORTING & PROGRAM SUPPORTS

CAREER SYNOPSIS

Results-driven professional with over 15 years of extensive experience in local government, offering exceptional leadership, supervision, management, and customer service. Adept at managing multiple tasks, excelling in time management. Possesses outstanding communication abilities, fostering seamless interaction across all organizational levels, including management, elected officials, diverse backgrounds, and various interagency disciplines within government. Currently oversees results-driven team for state reporting, legislation monitoring, contract compliance, strategic projects, and program support for the Business Services division. Expertise spans various local government disciplines including, but not limited to, Public Works, Parks, Facilities, Emergency Services, Fleet, Community Development, Waste and Recycling, Real Estate, and Legislative Affairs.

AREAS OF EXPERTISE

Recycling and Organics Management | Regulatory Compliance | Sustainability Strategies | Reporting | Stakeholder Engagement | Policy Development | Legislative Affairs | Project and Program Management | Capital Improvement Projects | Data Analysis | Facility Management | Waste Management | Energy Efficiency | Water Conservation | Environmental Education and Outreach | Cross-Functional Collaboration | Leadership and Team Management | Communication | Interpersonal Relations| Fleet Management and Maintenance | Emergency Services Management and Response | Infrastructure Maintenance | Plan Review | Real Estate Management | Budget and Finance | Economic Development

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Reporting and Program Support Manager
Provide oversight of the Reporting, Contracts, Compliance, Strategic Projects, Real Estate, Legislative Affairs, and Business Operations Units, within Orange County Waste & Recycling (OCWR). Develop, implement and oversee budgets, grants, policies, programs, and procedure and provide legislative affairs support for the Agency. Work with the Board of Supervisors and Chief Executives Offices on various programs. Work heavily with all jurisdictions within the County on Waste & Recycling regulations including Senate Bill 1383 Organics, in addition to outside organizations including Irvine Company, Special Districts, and state agencies.

- Oversee program and project development, implementation and management
- Provide support for jurisdictions throughout the County of Orange
- Work directly with state and local elected officials
- Provide direct support to or sit on various committees and commissions including the Orange County Waste Commission, OC Recycling Coordinators Committee, Climate Pollution Reduction Grant Committee, County of Orange Legislative Taskforce, Orange County Sustainability Committee, and OCWR Executive Team
- Manage OCWR Real Estate including lease agreements, rate negotiations, easements, right-of-way and access agreements

City of Dana Point | Dana Point, CA
Director of General Services
Provided oversight of the City's Emergency Services, Facilities, Parks, and Information Technology (IT) Divisions, as well as oversaw fleet maintenance and Natural Resources Protection. Recommend, develop and implement policies, programs, and procedures for the City Manager, City Council, and the General Services Department and prepared and

administered the General Services Department budget. Oversaw the General Services Capital Improvement (CIP)/Facilities Improvement Plan and planned, budged, and implemented the CIP/Facilities projects.

- Reviewed and evaluated recommendations regarding emergency preparedness programs and procedures; prepare and present policy and procedure recommendations and updates
- Planed, organized, and directed City network infrastructure (IT), security, cyber security, and oversaw City wireless mesh camera network
- Assisted the Orange County Sheriff Department with planning and preparing for emergency events and responses
- Responded to and managing emergency activations within the City
- Responsible for natural resources protection programs and urban forestry
- Planed, organized, and directed all maintenance, repair, and new construction activities pertaining to all City Facilities and Parks
- Managed tenant relationships including leases, complaints, repairs, suite modifications, rent collection, late notices and evictions
- Negotiated and administered maintenance contracts relating to City Facilities, Parks, IT, and Fleet Maintenance including elevator, janitorial, landscape, tree maintenance/arborist, network administration, and construction.
- Coordinated the preparation, planning and implementation of Capital Improvement Projects/Facility Improvement Projects related to new and existing City facilities, parks, medians, and sidewalks.
- Prepared plans, specifications and cost estimates for contract work; solicit and evaluate bids or proposals; coordinate authorized work
- Prepared and presented City Council and committee agenda items and participate as a technical advisor or staff representative, at City Council sessions, as well as committee, civil group and interagency meetings such as the San Onofre Nuclear Generating Station (SONGS) Interjurisdictional Planning Committee (IPC)

City of Laguna Beach | Laguna Beach, CA
Senior Management Analyst, Public Works
Assisted with oversight and management of the Transit, Signs, Parks, and Fleet Divisions and directly oversaw Parking and Signs Division. Worked directly with the Director and Deputy Directors on project management, division oversight, drafting of policies and procedures, and budget preparation and management. Assisted with review of regulatory changes effecting operations and provided updates and recommendations to the Deputy Director.

City of Laguna Beach | Laguna Beach, CA
Interim Deputy Director, Public Works
Oversaw and managed the Parking, Transit, Fleet Maintenance, and Signs Divisions, overseeing 12 full time staff, 50 year-round part time staff, and 90 seasonal summer staff members. Managed the division’s budget, Summer Parking Program and all Off-Season and Summer Transit Programs. Oversaw Public Works Storm Preparation Planning and acted as Public Works Liaison for Emergency Operations Center activations. Additionally, assisted with oversight of urban forest management, and parks and facility maintenance.

Various Positions| Cities of Dana Point, Garden Grove, Lake Forest, and Villa Park, CA
Various senior and management analyst roles working on high-profile programs and projects, creating policy and spanning areas including community and economic development, grants, strategic partnerships and government relations.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Master of Public Administration, concentration in Urban Planning and Development** | California State University Fullerton
- **Bachelor of Public Administration** | California State University Fullerton
- **Certificate in Economic Development**| California State University Fresno
- **Solid Waste Association of America**| Member

LISA SMITH

DEPUTY DIRECTOR, BUSINESS SERVICES AND EXTERNAL AFFAIRS

CAREER SYNOPSIS

Proven leader within public service and governmental affairs, encompassing strategic planning, business services, regulatory compliance, stakeholder engagement, and legislative oversight. Adept in managing multifaceted operations, securing permits, and driving impactful outreach efforts for high-profile projects. Strong track record of fostering crucial relationships with stakeholders and navigating complex political landscapes. Proficient in strategic communication and policy formulation, with a commitment to achieving organizational excellence.

AREAS OF EXPERTISE

Strategic Planning and Execution | Regulatory Compliance Management | Stakeholder Engagement and Liaison| Financial Management and Budgeting | Policy Development and Implementation | Contract Negotiation and Management | Legislative Affairs and Advocacy| Media and Public Relations | Leadership and Team Management

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Deputy Director

- Lead a diverse team in daily landfill operations, ensuring compliance with laws, regulations, and policies.
- Manage Business Services, including Financial Services, Budgeting, Purchasing, Accounting, Strategic Communications, Special Projects, Contracts, and IT Resources.
- Provide strategic planning to achieve agency goals and act as a liaison with external stakeholders.
- Drive long-term financial and organizational planning for the agency and County initiatives.
- Oversee SB1383 compliance, business implementation, and compost program market development.
- Develop and implement policies and procedures in alignment with County regulations.
- Manage agency service and revenue contracts, including HHW, Franchise Hauler, Importation, and Waste Disposal Agreements.

Congressman Bill McCollum | Washington D.C.
Director, Congressional Affairs

- Acted as the primary liaison between Congressman Bill McCollum and other Congressional stakeholders, including Congressmen, Senators, staff, the public and lobbyists.
- Supervised the Washington D.C. staff, overseeing public affairs procedures and office policies.
- Ensured compliance with House Rules, including financial disclosure, ethics, and franking rules.
- Managed the Congressman's official schedule and travel arrangements, maintaining meticulous records.
- Facilitated the filing of legislation with House Leadership and monitored legislation on the House floor.
- Directed the internship program and managed office operations, including payroll, budgets, and personnel issues.

State Senator Bill Morrow | California 38th Senate District
Regional Director

- Represented the Senator with public officials, Chambers of Commerce, business executives, and community groups, fostering productive relationships to create an efficient political environment in Orange County.

- Conducted official duties at events, including award presentations, speeches, and debates, addressing a wide range of topics and issues.
- Directed district communications efforts, organizing press conferences and TV appearances, drafting press releases, advisories, and articles, and keeping the press informed on legislative developments.
- Initiated the development of local policy by submitting legislative language to Republican Policy Consultant and Legislative Director in Sacramento, briefing the Senator and other legislators, and securing support.
- Served on legislative committees for the Conservative Women Leadership Association and South Orange County Chambers of Commerce, providing updates on legislative and political changes, advising on concerns, and recommending courses of action.
- Provided the Senator with advice on current political events and developments, recommending strategies to achieve objectives while staying within capacity.
- Addressed casework and constituent requests promptly and effectively.

County of Orange, Supervisor Tom Wilson, Fifth District | Santa Ana, CA
Media and Policy Advisor

- Led comprehensive media and outreach initiatives for the Supervisor's office, crafting and disseminating press releases, opinion editorials, letters to the editor, and chamber columns on diverse topics. Fostered robust relationships with journalists to stay abreast of current issues and identify new media opportunities, while also presenting innovative communication strategies and coordinating public relations efforts.
- Provided strategic counsel to the Supervisor in formulating and executing county policies and addressing departmental issues. Served as the liaison for federal and state legislative matters affecting the Fifth Supervisorial District and the County, actively participating in policy revisions and advocating for legislation to improve county operations.
- Orchestrated a collaborative effort among county representatives to tackle state budget shortfalls, organizing a summit to present findings to local officials and state legislators.
- Contributed to the development of Supervisor Wilson's South County Outreach and Review Effort (SCORE), facilitating early community input on the Rancho Mission Viejo application. Engaged with constituents on a range of issues, including El Toro program, John Wayne Airport, Planning and Development Services Department, and other county departments.
- Collaborated with the Chief of Staff to implement the Dana Point Harbor Revitalization Plan, fostering positive relationships between harbor tenants and the County during the revitalization process and addressing community concerns.

Dana Point Harbor | Dana Point, CA
Deputy Director

- Directed all Departmental operations, including Budgeting, Finance, Accounting, Purchasing, Project Management, Operations, and administrative tasks.
- Managed critical external contracts for the Harbor Revitalization Project, serving as liaison to regulatory bodies like the California Coastal Commission.
- Oversaw the environmental process for the project, ensuring compliance with regulatory standards.
- Secured permits and gained approval for the Harbor Revitalization Project within Board-approved parameters.
- Led comprehensive external communications efforts, handling press updates, community communications, and Board briefings.
- Enforced County policies and procedures for smooth Harbor operations, including contract compliance and negotiations for public-serving programs.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Bachelor of Arts in Political Science** | Radford University
- **Certificate de Langue, French** | Catholic University of Louvain

OC Waste&Recycling

COUNTY OF ORANGE

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TARA TISOPULOS

DEPUTY DIRECTOR, SUSTAINABILITY

CAREER SYNOPSIS

Accomplished and highly-experienced environmental sustainability leader offering a wealth of experience in overseeing regulatory compliance and sustainable practices. Proficient in developing and implementing environmental policies, managing complex compliance initiatives, and fostering stakeholder relationships. Skilled in grant acquisition, project management, and environmental impact assessments. Highly organized and decisive leader, possessing strong interpersonal skills, business analytical insight, and excellent judgment.

Proficient in team building and collaboration, capable of reviewing complex legislation and proposed regulations for potential adverse impacts, and well-versed in climate change impacts on our global landscape as well as public health. Experienced in working collaboratively with various stakeholders, including elected officials, government agencies, businesses, non-profit organizations and academic institutions.

AREAS OF EXPERTISE

Environmental Compliance | Regulatory Compliance | Sustainability Strategies | Climate Change Mitigation | Stakeholder Engagement | Policy Development | Grant Writing | Project Management | Environmental Impact Assessment | Data Analysis | Renewable Energy | Waste Management | Energy Efficiency | Water Conservation | Environmental Education and Outreach | Cross-Functional Collaboration | Leadership and Team Management | Communication | Interpersonal Relations

PROFESSIONAL HIGHLIGHTS

County of Orange - OC Waste & Recycling | Santa Ana, CA
Deputy Director of Sustainability

- Oversee program and project development, implementation and management
- Provide support for jurisdictions throughout the County of Orange
- Work directly with state and local elected officials
- Provide direct support to or sit on various committees and commissions including the Orange County Waste Commission, OC Recycling Coordinators Committee, Climate Pollution Reduction Grant Committee, County of Orange Legislative Taskforce, Orange County Sustainability Committee, and OCWR Executive Team
- Manage OCWR Real Estate including lease agreements, rate negotiations, easements, right-of-way and right-of-access agreements

Environmental Compliance Solutions | Santa Monica, CA
Vice President/Senior Project Manager

- Author and/or project manager of numerous environmental documents under the California Environmental Quality Act and National Environmental Policy Act.
- Provided in-house environmental assistance to the Port of Los Angeles in both air quality and CEQA/NEPA for six years.
- Project manager of technical environmental documents to determine readiness for public distribution.
- Independently determined schedules, deliverables and budgets for multi-million dollar projects.
- Organized marketing events for trade organizations.

- Author of grant applications and corporate marketing materials.

- Trained and assisted student workers and new staff.
- Public face of the project for all workshops, hearings and neighborhood meeting.

South Coast Air Quality Management District| Diamond Bar, CA
Air Quality Specialist

- Authored environmental documents to assess potential environmental impacts associated with AQMD proposed rules.
- Authored all complementary materials such as presentations, board reports, mitigation monitoring plans, statements of overriding consideration and responses to comment letters.
- Authored comment letters for outside environmental projects in the four-county South Coast Air Basin where AQMD was identified as a responsible agency.
- Authored Board Reports and brochures related to the Air Quality Management Plan (AQMP) to break down technical information for the public audience.
- Managed the Environmental Impact Report for the 1995 AQMP including its companion brochure.

South Coast Air Quality Management District| Diamond Bar, CA
Technical Writer/Editor

- Authored Board speeches for division director.
- Prepared content for the agency newsletter.
- Reviewed all division documents and provided constructive feedback.
- Prepared presentations for division heads.
- Interfaced with our graphics and printing staff to oversee the finished product.

South Coast Air Quality Management District| Diamond Bar, CA
Student Worker

- Edited all documentation for the Planning Division as a student intern while earning undergraduate degree.
- Assisted with conference preparation on Air Toxics.

EDUCATION AND PROFESSIONAL DEVELOPMENT

- **Master of Arts, Mass Communications** | California State University Fullerton
- **Bachelor of Arts, Print Journalism and English** | University of Southern California

Attachment B

Emission Reduction

Calculations & Methodologies

This attachment includes:

1) Methodology for the Quantification, Monitoring, Reporting and Verification of Greenhouse Gas Emissions Reductions and Removals from Landfill Gas Destruction and Beneficial Use Projects.

2) Detailed calculations of greenhouse gas emission reductions by site

The table below summarizes the findings.

Orange County Emissions Reductions Impact				
Landfill	**Incremental Methane Capture Estimate**	**2025-2030 (MT CO2e)**	**2025-2035 (MT CO2e)**	**2025-2050 (MT CO2e)**
Coyote Canyon	10%	134,274	255,770	555,184
Frank R. Bowerman	15%	911,074	1,796,383	4,321,087
Olinda Alpha	15% - 2025-2034 10% - 2035-2050	835,902	1,539,082	2,888,950
Prima Deshecha	15%	256,836	559,171	2,097,476
Santiago	10%	35,684	67,973	147,544
Total		**2,173,770**	**4,218,379**	**10,010,241**

METHODOLOGY FOR THE QUANTIFICATION MONITORING, REPORTING AND VERIFICATION OF GREENHOUSE GAS EMISSIONS REDUCTIONS AND REMOVALS FROM

LANDFILL GAS DESTRUCTION AND BENEFICIAL USE PROJECTS

VERSION 2.0

April 2021

ACR AT WINROCK INTERNATIONAL

METHODOLOGY FOR THE QUANTIFICATION MONITORING, REPORTING AND VERIFICATION OF GREENHOUSE GAS EMISSIONS REDUCTIONS AND REMOVALS FROM

LANDFILL GAS DESTRUCTION AND BENEFICIAL USE PROJECTS

VERSION 2.0

April 2021

ACR^SM

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ABOUT ACR^SM

ACR is a leading global carbon crediting program operating in regulated and voluntary carbon markets. Founded in 1996 as the first private voluntary greenhouse gas (GHG) registry in the world, ACR creates confidence in the integrity of carbon markets to catalyze transformational climate results. ACR ensures carbon credit quality through the development of environmentally rigorous, science-based standards and methodologies as well as oversight of carbon offset project verification, registration, and credit issuance and retirement reporting through its transparent registry system. ACR is governed by Environmental Resources Trust LLC, a wholly-owned nonprofit subsidiary of Winrock International.

Acknowledgements

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Version 2.0 of this Methodology was developed by ACR in cooperation with Loci Controls, Inc.

Acronyms

CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
Offsets	Carbon Offset Credits
CAA	Clean Air Act
CNG	Compressed Natural Gas
ERT	Emission Reduction Tonne
GCCS	Gas Collection and Control System
SSR	GHG Source, Sink, or Reservoir
GWP	Global Warming Potential
LFG	Landfill Gas
LFGTE	Landfill Gas-to-Energy
LNG	Liquefied Natural Gas
CH_4	Methane
MSW	Municipal Solid Waste Landfill
N_2O	Nitrous oxide
NMOC	Non-Methane Organic Compound
NSPS	New Source Performance Standard
O_2	Oxygen
RCRA	Resource Conservation & Recovery Act
WIP	Waste in Place

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1 Background and Applicability

1.1 Summary Description of the Methodology

Table 1: Eligible LFG Activities

PROJECT ACTIVITY	DESCRIPTION
Destruction in a flare	Burning LFG onsite in an open or an enclosed flare.
Landfill gas to energy	Converting LFG in an engine, turbine or boiler to energy to be used on- or off-site.
Natural gas pipeline injection	Processing of LFG for injection into a natural gas pipeline.
Automated collection system	The installation of an automated collection system that increases landfill gas collection efficiency above that obtained with standard collection methods with methane destruction, conversion, or enhancement occurring in a flare, engine, turbine, boiler, or processed for injection into a natural gas pipeline.

The collection and combustion of landfill gas (LFG) is an effective method for decreasing the greenhouse gas (GHG) emissions from landfills that would have otherwise been vented to the atmosphere. This Methodology provides the quantification and accounting frameworks, including eligibility and monitoring requirements, for the creation of carbon offset credits from the reductions in GHG emissions resulting from the destruction or utilization of landfill gas at eligible landfills. The Methodology is intended to be used as an incentive to increase these activities and utilizes a flexible additionality framework which is based on either a performance standard or ACR's three-prong additionality test, as stipulated in Section 3.

1.2 Applicability Conditions

Projects that reduce methane emissions as a result of the combustion or beneficial use of landfill gas in any of the following activities are considered a "project activity" under this Methodology:

- The destruction of landfill gas in an open or closed flare;
- The conversion of landfill gas in a turbine, boiler or generator to energy;
- The enhancement of landfill gas for injection into a natural gas pipeline;
- The enhancement of landfill gas for use in fleet vehicles, trucks and cars;
- The installation of an automated collection system that increases landfill gas collection efficiency above that obtained with standard collection methods with methane destruction, conversion, or enhancement occurring in any of the above "project activities".
    - To qualify as an automated collection system that increases landfill gas collection efficiency, the system must deploy automated control and measurement devices which result in an incremental increase in the aggregate methane volume that is captured and which is shown to be attributable to the automated collection system as determined by Equations 2-10 set forth below. An automated collection system must include equipment installed on individual collection wells as part of the gas collection system that can measure, at minimum, O_2, CH_4, and CO_2 concentrations in the landfill gas being collected, pressure applied to the wellhead, and include an actuated valve where the valve can be operated remotely with automation.

In addition to satisfying the latest ACR program eligibility requirements as found in the *ACR Standard*, project activities must satisfy the following conditions for this Methodology to be applicable:

- The project is located in the United States;
- The project is not located at a bioreactor landfill or a landfill that recirculates leachate[1]; and
- The project is not required by any regulatory agency.

1.3 Start Date

The Start Date is the date that the landfill gas project became operational. For purposes of this Methodology, a project is considered to be operational when methane is continuously destroyed

[1] Per the EPA, a bioreactor landfill is a solid waste landfill in which liquids are added to help bacteria break down waste.

following a start-up period which may be a maximum of 6 months after the date of project commissioning[2]. Project commissioning is the first day which the GCCS and respective destruction device(s) are fully operational and either destroying or enhancing landfill gas.

1.4 Crediting Period

A Crediting Period is the finite length of time for which a GHG Project Plan is valid, and during which a project can generate offsets against its baseline scenario. The crediting period for a project activity shall be ten years.

Projects that have previously generated carbon offsets in a GHG Program other than ACR and whose crediting period has expired may apply for a new crediting period under the ACR program. Projects renewing a crediting period must be revalidated against the current version of this methodology and the current version of the *ACR Standard* at the time of revalidation.

1.5 Reporting Period

A Reporting Period is the portion of time during the crediting period for which the project is reporting emission reductions to be verified and issued. Reporting periods shall not exceed five (5) years.

1.6 Periodic Reviews and Revisions

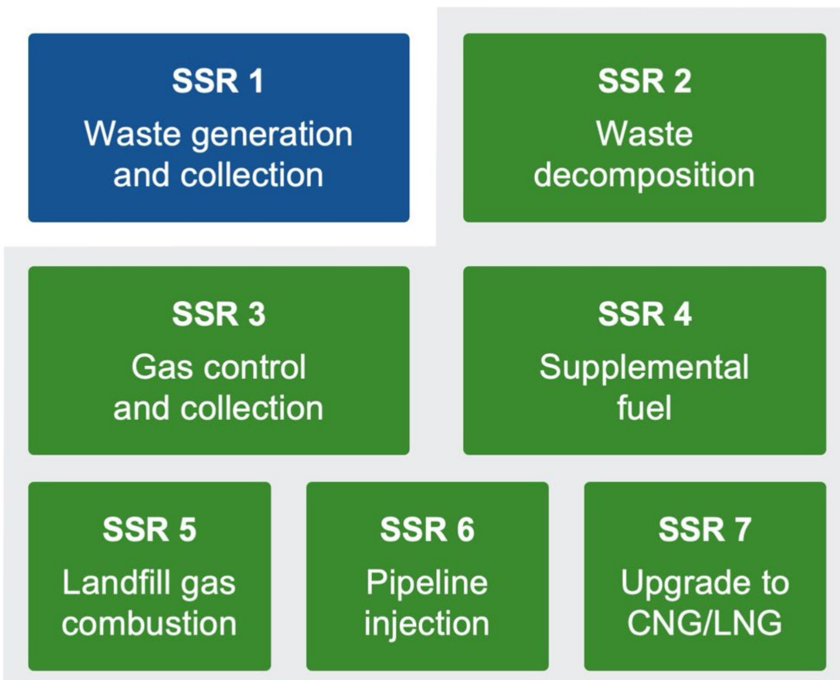
ACR may require revisions to this Methodology to ensure that monitoring, reporting, and verification systems adequately reflect project activities. This Methodology may also be periodically updated to reflect regulatory changes, emission factor revisions, or expanded applicability criteria. Before beginning a project, the project proponent should ensure that they are using the latest version of the Methodology.

[2] For projects that install an automated collection system that increases landfill gas collection efficiency as a stand-alone project activity, a project is considered to be operational upon commissioning of the automated collection system which may be up to 6 months after the system has been deployed. For clarity, the start date of a project that installs an automated collection system that increases landfill gas collection efficiency as a stand-alone project activity is not tied to the date when the landfill gas destruction device(s) began operation.

2 Project Boundaries

2.1 Geographic Boundary

Figure 1: Project Boundary Diagram for Landfill Gas Projects



The Blue SSR represents emission sources outside of the project boundary while the green SSRs are those included in the project boundary. Within the boundaries, the sources of GHG emissions and removals are from the waste decomposition, landfill gas collection and control system, the maintenance or operations of the destruction or combustion device(s), and any emissions associated with the enhancement of LFG. Table 2 lists the GHG sources included and excluded depending on whether the sources are within or outside project boundaries.

Table 2: Greenhouse Gases and Sources

SSR		SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)	COMMENTS
1	Waste Generation & Collection	Emissions from the generation and hauling of waste to the landfill	CO_2	E	Emissions resulting from this SSR should be equivalent in both the project and baseline scenarios.
			CH_4	E	
			N_2O	E	
2	Waste Decomposition	Emissions from the decomposition of waste at the landfill	CO_2	E	Emissions are assumed to be de minimis.
			CH_4	I	Primary GHG affected by the project.
			N_2O	E	Emissions are assumed to be de minimis.
3	Gas Collection & Control	Emissions associated with the energy consumed to collect and process LFG	CO_2	I	Emissions resulting from the GCCS shall be included.
			CH_4	E	Emissions are assumed to be de minimis.
			N_2O	E	
4	Supplemental fuel	Combustion of fossil fuels to supplement the destruction or use of LFG	CO_2	I	Emissions resulting from the use of supplemental fuel shall be included.
			CH_4	I	
			N_2O	E	Emissions are assumed to be de minimis.
5	Landfill Gas Combustion	The combustion of LFG in an	CO_2	E	Emissions are assumed to be de minimis.

SSR		SOURCE DESCRIPTION	GAS	INCLUDED (I) OR EXCLUDED (E)	COMMENTS
		eligible destruction device	CH_4	I	Emissions resulting from the incomplete combustion of LFG shall be included.
			N_2O	E	Emissions are assumed to be de minimis.
6	Pipeline Injection	The enhancement of LFG to be injected into a natural gas pipeline	CO_2	I	Emissions resulting from the enhancement of LFG shall be included.
			CH_4	I	
			N_2O	E	Emissions are assumed to be de minimis.
7	CNG/LNG Upgrade	The enhancement of LFG to be used in fleet vehicles, trucks or cars.	CO_2	I	Emissions resulting from the enhancement of LFG shall be included.
			CH_4	E	Emissions are assumed to be de minimis.
			N_2O	E	

3 Baseline Determination and Additionality

3.1 Baseline Determination

The baseline for a project activity is determined utilizing industry standards and represents the most commonly used practices and technologies. Landfill gas destruction and beneficial use projects are not eligible to generate Emission Reduction Tons (ERT) in instances where the collection and destruction of landfill gas can be considered a standard business practice or is required by law or as a result of any other legally binding framework. The baseline determination shall be consistent with the pre-project activity prior to the start date.

For projects that are or have previously employed ineligible project activities, such as a passive flare, or have an eligible project activity that was implemented prior to the specified start date, emission reductions associated with these activities shall be accounted for in the baseline emission calculations[3]. Project proponents shall submit a proposed method for quantifying pre-project emission reductions to ACR for approval. Emission reductions resulting from ineligible project activities shall be accounted for in Equation 2 as NE_{device}.

3.2 Additionality Assessment

Emission reductions from the project must be additional, or deemed not to occur in the "business-as usual" scenario. Assessment of the additionality of a project will be made based on passing a practice-based performance standard and a regulatory surplus test OR ACR's three-prong additionality test (which, as a first step, includes a regulatory surplus test).

Projects shall demonstrate conformance with the full requirements found in Section 3.2.1 OR 3.2.2 only once at the beginning of a crediting period. However, projects shall demonstrate regulatory

[3] For projects that install an automated collection system that increases landfill gas collection efficiency as a stand-alone project activity, a landfill gas destruction device(s) may be operational prior to the start date of the automated collection system. In these situations, a deduction for baseline pre-project emission reductions is not required.

surplus during verification activities for each reporting period. For more information on the development of the practice-based performance standard, please see Appendix A.

3.2.1 PRACTICE-BASED PERFORMANCE STANDARD

Projects with the characteristics described below may apply the practice-based performance standard to demonstrate that the project activity is not common practice and is therefore considered additional pending the outcome of the regulatory surplus test:

- Project activities located in non-arid counties (defined as counties with more than 25 inches of precipitation historically) implemented at landfills with equal to or less than 500,000 tons of waste in place; or
- Project activities located in arid counties (defined as counties with less than 25 inches of precipitation historically) implemented at landfills with equal to or less than 1,500,000 tons of waste in place.
- Project activities involving the installation of an automated collection system that increases landfill gas collection efficiency.

Appendix A shall be used to determine if a project is located in a non-arid or arid county. Further, Appendix A provides a discussion of the performance standard for projects deploying an automated collection system that increases landfill gas collection efficiency.

3.2.1.1 Regulatory Surplus Test

For projects applying the performance standard discussed in Section 3.2.1, a regulatory surplus test shall also be applied. To pass the regulatory surplus test, a project must not be mandated by existing laws, regulations, statutes, legal rulings, or any other regulatory frameworks that directly or indirectly affect the GHG emissions associated with a project such as the CAA or RCRA. The project proponent must demonstrate that there is no existing law, regulation, statute, legal ruling, or other regulatory framework that mandates the project or effectively requires the GHG emission reductions associated with the installation of a destruction device, the infrastructure necessary for enhancing the landfill gas, or the installation of an automated collection system that increases landfill gas collection efficiency[4]. The project proponent shall provide evidence including all supporting documentation

[4] For projects that install an automated collection system that increases landfill gas collection efficiency at a landfill that is required to install a GCCS under NSPS, only the incremental landfill gas collected through the use of the automated collection system is eligible, per section 4 below.

necessary to prove that landfill gas destruction, abatement, mitigation, or increased collection efficiency is not required.

3.2.2 ACR'S THREE-PRONG ADDITIONALITY TEST

For project activities that do not automatically qualify under the practice-based performance standard outlined in Section 3.2.1, ACR's Three-Prong additionality test shall be applied. The first step in the Three-Prong additionality test, as stated above, is the application of a regulatory surplus test which is followed by a common practice assessment and description of implementation barriers. Landfill gas projects may only demonstrate a financial implementation barrier(s) and may not apply technological or institutional barriers. For a complete description of the ACR Three-Prong Additionality Test, please refer to the *ACR Standard*.

4 Quantification of GHG Emission Reductions

Quantification of project emission reductions requires calculation of baseline emissions and project emissions.

4.1 Baseline Emissions[5]

Equation 1: Volume of CH_4 Combusted

This is the amount of GHG emissions that would take place without the destruction or beneficial use of the landfill gas. Records of continuous landfill gas flows (in standard cubic feet per minute) shall be matched with continuous methane content data using Equation 1.

$$\mathbf{CH_{4_{combusted}}} = [(\mathbf{LFG_{captured}} \times \%\mathbf{CH_{4_{continuous}}}) + (\mathbf{LFG_{captured}} \times \%\mathbf{CH_{4_{weekly}}} \times (\mathbf{1} - \mathbf{DF_{weekly}}))] \times (\mathbf{1} - \mathbf{OF})$$

WHERE

$\mathbf{CH_{4_{combusted}}}$	Total volume of methane combusted (scf)
$\mathbf{LFG_{captured}}$	LFG captured (scf)
$\%\mathbf{CH_{4_{continuous}}}$	Methane content of LFG for continuous methane monitoring (%)
$\%\mathbf{CH_{4_{weekly}}}$	Methane content LFG for duration weekly methane monitoring (%)

[5] Projects that do not deploy an automated collection system as a stand-alone project activity shall not use Equations 2-10 and will skip to Equation 11 after quantifying $CH_{4_{combusted}}$ in Equation 1. Projects that deploy an automated collection system that increases landfill gas collection efficiency as a stand-alone project activity shall utilize all relevant equations (i.e., inclusive of Equations 1-10). This is to ensure that only the additional landfill gas captured and attributed to automated control system operation is considered in the emission reduction calculations. For these projects, Equations 2-7 are calculated and validated once and are used for the duration of the project's crediting period. Equations 8-10 are calculated for each reporting period. For a case study example on the use of Equations 2-9, see Appendix C. In the event that these equations demonstrate zero or less than zero emissions reductions during a reporting period, the project shall apply zero credits to this time period.

DF_{weekly}	Discount factor for weekly methane content monitoring (a value of 0.1 shall be applied only when weekly readings occurred)
OF	Oxidation factor

The oxidation factor is based on the recommended oxidation rates by the U.S. EPA. The following values shall be applied based on the type of landfill cover and methane flux within the project boundary:

- A value of 0.0 shall be applied to landfills with a synthetic cover;
- A value of 0.10 shall be applied to landfills without a synthetic cover that are not required to determine methane flux or for landfills that do not have a soil cover of at least 24 inches for the majority of landfill area containing waste;
- A value of 0.35 shall be applied to landfills have a soil cover of at least 24 inches for a majority of the landfill area containing waste and for which the methane flux rate is less than 10 grams per square meter per day ($g/m^2/d$);
- A value of 0.25 shall be applied to landfills have a soil cover of at least 24 inches for a majority of the landfill area containing waste and for which the methane flux rate is 10 - 70 grams per square meter per day ($g/m^2/d$); or
- A value of 0.10 shall be applied to landfills have a soil cover of at least 24 inches for a majority of the landfill area containing waste and for which the methane flux rate is greater than 70 grams per square meter per day ($g/m^2/d$).

Equation 2: Historic Modeled Methane Generation Rate[6]

The modeled methane generation rate is quantified for the three years preceding the installation of the automated collection system using the below equation. Each year is to be quantified separately.

$$G_{CH_4} = \left[\sum_{x=S}^{T-1} \left\{ W_x \, L_{o_x} \left(e^{-k(T-x-1)} - e^{-k(T-x)} \right) \right\} \right]$$

WHERE

G_{CH_4}	Modeled methane generation rate in year **T** (metric tons)

[6] From Equation HH-1 of the US EPA 40 CFR Part 98 Subpart HH

X	Year in which waste was disposed
S	Start year of calculation; Use the year 1960 or the opening year of the landfill, whichever is more recent.
T	Year for which emissions are calculated
W_x	Quantity of waste disposed in the landfill, in year x (metric tons, as received net weight)
L_o	Methane generation potential (metric tons/metric ton waste)
k	Rate constant year^{-1} from Table HH-1 from US EPA 40 CFR Part 98 Subpart HH

Equation 3: Historic Measured CH_4 Collection

Historic measured methane collection is quantified for the three years preceding the installation of the automated collection system using the below equation. Each year is to be quantified separately.

$$C_{CH_{4_T}} = HLFG_{captured} \times H\%CH_4 \div 385 \times 16.04 \div 2204.62$$

WHERE

$C_{CH_{4_T}}$	Measured methane collected in year **T** (metric tons)
$HLFG_{captured}$	Historic LFG captured (scf)
$H\%CH_4$	Historic methane content of LFG (%)
385	Gas conversion factor (scf/lb-mole CH_4)
16.04	Molecular weight of CH_4
2204.62	$lbCO_2/tCO_2$

Equation 4: Measured Landfill Gas Collection Efficiency

Measured landfill gas collection efficiency is quantified for the three years preceding installation of the automated collection system using the below equation. Each year is to be quantified separately.

$$\mathbf{CE_{measured} = C_{CH_{4_T}} \div G_{CH_4}}$$

WHERE

$\mathbf{CE_{measured}}$	Measured baseline collection efficiency (%)
$\mathbf{C_{CH_{4_T}}}$	Measured methane collected in year $\mathbf{T}$ (metric tons) – as calculated in Equation 3
$\mathbf{G_{CH_4}}$	Modeled methane generation rate in year $\mathbf{T}$ (metric tons) – as calculated in Equation 2

Equation 5: Modeled Gas Collection System Efficiency

Modeled landfill gas collection efficiency is quantified for the three years preceding installation of the automated collection system using the below equation. This equation utilizes landfill gas collection efficiencies from Table HH-3 of US EPA 40 CFR Part 98, Subpart HH. Each year is to be quantified separately. The cover system in place in each area at the end of the year shall apply to the entire year being quantified.

$$\mathbf{CE_{modeled} = (A2_T \times CE2 + A3_T \times CE3 + A4_T \times CE4 + A5_T \times CE5) \div (A2_T + A3_T + A4_T + A5_T)}$$

WHERE

$\mathbf{CE_{modeled}}$	Modeled baseline collection efficiency (%)
$\mathbf{A2_T}$	Area of landfill without active gas collection in year $\mathbf{T}$ (square meters)
$\mathbf{CE2}$	Regardless of cover type, collection efficiency for area without active gas collection (CE2) = 0%
$\mathbf{A3_T}$	Area of landfill with daily soil cover and active gas collection in year $\mathbf{T}$ (square meters)

CE3	Collection efficiency for area with daily soil cover and active gas collection (CE3) = 60%
$A4_T$	Area of landfill with intermediate soil cover and active gas collection in year **T** (square meters)
CE4	Collection efficiency for area with intermediate soil cover and active gas collection (CE4) = 75%
$A5_T$	Area of landfill with final soil and geomembrane cover system and active gas collection in year **T** (square meters)
CE5	Collection efficiency for area with final soil and geomembrane cover system and active gas collection (CE5) = 95%

Equation 6: Calibrated Collection Efficiency based on Landfill Area

The calibrated collection efficiency for each landfill area, by cover type, is quantified for the three years preceding installation of the automated collection system using the below equation. The US EPA LFG collection efficiencies by landfill area are adjusted by the same proportion for each landfill area: A2-A5 (see Equation 5). Specifically, US EPA LFG collection efficiencies are multiplied by the ratio of the measured collection efficiency (Equation 4) divided by the modeled collection efficiency (Equation 5) to calculate the calibrated collection efficiencies by area. This results in an overall calibrated collection efficiency set equal to the measured collection efficiency at the landfill. Note that the same calculation is performed based on each cover type and the associated collection efficiency and is quantified for each year separately.

$$\mathbf{CCE2} = \mathbf{CE2} \times \mathbf{CE_{measured}} \div \mathbf{CE_{modeled}}$$

$$\mathbf{CCE3} = \mathbf{CE3} \times \mathbf{CE_{measured}} \div \mathbf{CE_{modeled}}$$

$$\mathbf{CCE4} = \mathbf{CE4} \times \mathbf{CE_{measured}} \div \mathbf{CE_{modeled}}$$

$$\mathbf{CCE5} = \mathbf{CE5} \times \mathbf{CE_{measured}} \div \mathbf{CE_{modeled}}$$

WHERE

CCE2	Calibrated collection efficiency for area without active gas collection (%)

CE2	Regardless of cover type, collection efficiency for area without active gas collection (CE2) = 0%
$CE_{measured}$	Measured baseline collection efficiency (%) – as calculated in Equation 4
$CE_{modeled}$	Modeled baseline collection efficiency (%) – as calculated in Equation 5
CCE3	Calibrated collection efficiency for area with daily soil cover and active gas collection (%)
CE3	Collection efficiency for area with daily soil cover and active gas collection (CE3) = 60%
CCE4	Calibrated collection efficiency for area with intermediate soil cover and active gas collection (%)
CE4	Collection efficiency for area with intermediate soil cover and active gas collection (CE4) = 75%
CCE5	Calibrated collection efficiency for area with final soil and geomembrane cover system and active gas collection (%)
CE5	Collection efficiency for area with final soil and geomembrane cover system and active gas collection (CE5) = 95%

Equation 7: Average Calibrated Collection Efficiencies

The average of the three years of calibrated collection efficiencies (Equation 6) for each landfill area, by cover type, is quantified using the below equation. Note that the same calculation is performed based on each cover type and the associated calibrated collection efficiency.

$$\mathbf{ACCE2} = \sum \mathbf{CCE2} \div 3$$

$$\mathbf{ACCE3} = \sum \mathbf{CCE3} \div 3$$

$$\mathbf{ACCE4} = \sum \mathbf{CCE4} \div 3$$

$$ACCE5 = \sum CCE5 \div 3$$

WHERE

ACCE2	Average calibrated collection efficiency for area without active gas collection (%)
CCE2	Calibrated collection efficiency for area without active gas collection (%) – as calculated in Equation 6
3	Number of years preceding installation of automated collection system
ACCE3	Average calibrated collection efficiency for area with daily soil cover and active gas collection (%)
CCE3	Calibrated collection efficiency for area with daily soil cover and active gas collection (%) – as calculated in Equation 6
ACCE4	Average calibrated collection efficiency for area with intermediate soil cover and active gas collection (%)
CCE4	Calibrated collection efficiency for area with intermediate soil cover and active gas collection (%) – as calculated in Equation 6
ACCE5	Average calibrated collection efficiency for area with final soil and geomembrane cover system and active gas collection (%)
CCE5	Calibrated collection efficiency for area with final soil and geomembrane cover system and active gas collection (%) – as calculated in Equation 6

Equation 8: Updated Calibrated Collection Efficiency

Following the installation of the automated collection system, the calibrated collection efficiencies are updated annually to reflect changes in the landfill's cover and collection system. The cover system in place in each area at the end of the year shall apply to the entire year being quantified.

$$UCCE = (A2_T \times ACCE2 + A3_T \times ACCE3 + A4_T \times ACCE4 + A5_T \times ACCE5) \div (A2_T + A3_T + A4_T + A5_T)$$

WHERE

UCCE	Updated Calibrated Collection efficiency (%)
$A2_T$	Area of landfill without active gas collection in year **T** (square meters)
ACCE2	Average calibrated collection efficiency for area without active gas collection (%) – as calculated in Equation 7
$A3_T$	Area of landfill with daily soil cover and active gas collection in year **T** (square meters)
ACCE3	Average calibrated collection efficiency for area with daily soil cover and active gas collection (%) – as calculated in Equation 7
$A4_T$	Area of landfill with intermediate soil cover and active gas collection in year **T** (square meters)
ACCE4	Average calibrated collection efficiency for area with intermediate soil cover and active gas collection (%) – as calculated in Equation 7
$A5_T$	Area of landfill with final soil and geomembrane cover system and active gas collection in year **T** (square meters)
ACCE5	Average calibrated collection efficiency for area with final soil and geomembrane cover system and active gas collection (%) – as calculated in Equation 7

Equation 9: ACS Increment

The incremental collection efficiency attributable to the automated collection system is quantified using the below equation.

$$\mathrm{ACSI} = \left(\mathrm{CH}_{4_{total}} - \left(\mathrm{UCCE} \times \mathrm{G}_{\mathrm{CH}_4}\right)\right) \div \mathrm{CH}_{4_{total}}$$

WHERE

ACSI	Incremental collection efficiency attributable to automated collection system (%)

$CH_{4_{total}}$	Total methane combusted (metric tons) – as calculated in Equation 11; projects shall use the $CH_{4_{combusted}}$ parameter when quantifying Equation 11 for use as the $CH_{4_{total}}$ parameter in Equation 9
UCCE	Updated Calibrated Collection efficiency (%) – as calculated in Equation 8
G_{CH_4}	Modeled methane generation rate in year **T** (metric tons) – calculated for the current reporting year based on Equation 2

Equation 10: Increase in Volume of CH_4 Combusted

For projects deploying an automated collection system that increases landfill gas collection efficiency, the below equation is used to determine the increase in landfill gas captured attributable to system deployment.

$$ICH_{4_{combusted}} = CH_{4_{combusted}} \times ACSI$$

WHERE

$ICH_{4_{combusted}}$	Increase in methane combusted using automated collection system (scf)
$CH_{4_{combusted}}$	Total volume of methane combusted (scf) – as calculated in Equation 1
ACSI	Incremental collection efficiency attributable to automated collection system (%) as calculated in Equation 9

Equation 11: Net Mass of CH_4 Destroyed[7]

In order to estimate the amount of methane combusted in metric tons, methane combusted needs to be converted to weight using Equation 11.

$$CH_{4_{total}} = (\left(\left(CH_{4_{combusted}} \text{ OR } ICH_{4_{combusted}} \times CF\right) \times 16.04 \times \left[\frac{1}{10^6}\right] \times \left[\frac{1}{24.04}\right] \times 28.32\right) \times 95\%) - NE_{device}$$

[7] Projects deploying an automated collection system as a stand-alone project activity, shall use the $ICH_{4_{combusted}}$ parameter in Equation 11. Projects that do not deploy an automated control system as a stand-alone project activity shall use the $CH_{4_{combusted}}$ parameter in Equation 11.

WHERE

$CH_{4_{total}}$	Total methane combusted (metric tons)
$CH_{4_{combusted}}$	Methane combusted (scf – as calculated in Equation 1)
$ICH_{4_{combusted}}$	Increase in methane combusted using automated collection system (scf) – as calculated in Equation 10
CF	Correction factor – calculated per Equation 12[8]
16.04	Molecular weight of CH_4
$1/10^6$	Conversion to metric tons (MT/g)
1/24.04	Gas constant (mol/L – measured at standard temperature and pressure – defined as 68°F and 14.7psi)
28.32	Conversion factor (L/cf)
95%	Destruction efficiency of the destruction device[9]
NE_{device}	Emissions from a pre-project, non-eligible device

Equation 12: Correcting LFG Flow Temperature

If the monitoring equipment is set to record landfill gas flow at a temperature other than that defined in Equation 2 (68°F), the project proponent must normalize the landfill gas flow by using the correction factor calculated in Equation 3.

[8] The correction factor shall only be applied in instances where the project flow meter does not use a standard temperature of 68°F. Where project flow meters do apply a standard temperature of 68°F, CF = 1.

[9] In lieu of the default 95% destruction efficiency, project proponents may apply the results of a third-party source test conducted by an organization meeting or exceeding the U.S. Environmental Protection Agency's *Minimum Competency Requirements for Air Emission Testing* rule to determine the actual destruction efficiency of the device.

$$CF = \frac{527.67}{T + 459.67}$$

WHERE

CF	Correction factor
T	Temperature as measured by project flow meters

4.2 Project Emissions

Depending on project-specific circumstances, certain emission sources shall be subtracted from total project emission reductions using the equations below.

Equation 13: CO_2 Emissions from Fossil Fuel Combustion

$$Dest_{CO_2} = \sum y \left(FF_y \times EF_y\right)$$

WHERE

$Dest_{CO_2}$	CO_2 emissions from fossil fuel used in methane destruction process (tCO_2)
FF_y	Total quantity of fossil $fuel_y$, consumed (volume of fuel)
EF_y	Fuel specific emission factor for $fuel_y$ (tCO_2/fuel quantity) – See Appendix B

Equation 14: Emissions from Project Specific Electricity Consumption

$$Elec_{CO_2} = \frac{EL_{total} \times EF_{EL}}{2204.62}$$

WHERE

$Elec_{CO_2}$	Project specific electricity emissions (tCO_2)
EL_{total}	Total grid connected electricity consumption (MWh)

EF_{EL}	Carbon emission factor for grid electricity ($lbCO_2/MWh$) - See Appendix B
2204.62	$lbCO_2/tCO_2$

Equation 15: Project Emissions

$$PE = Elec_{CO_2} + Dest_{CO_2}$$

WHERE

PE	Project emissions (tCO_2)
$Elec_{CO_2}$	Project specific electricity emissions (tCO_2)
$Dest_{CO_2}$	CO_2 emissions from fossil fuel used in methane destruction or transportation process (tCO_2)

4.3 Leakage

Leakage is a term that refers to secondary effects where the GHG emission reductions of a project may be negated by shifts in market activity or shifts in materials, infrastructure, or other physical assets associated with the project. ACR does not expect landfill methane projects to result in any additional activities that would augment GHG emissions outside of the project boundary and, therefore, no leakage assessment is required.

4.4 Emission Reductions

Equation 16: GHG Emission Reductions

$$ER = [CH_{4_{total}} \times GWP_{CH_4}] - PE$$

WHERE

ER	Total Emission Reductions (tCO_2e)

$CH_{4_{total}}$	Methane combusted (MT)
GWP_{CH_4}	Global warming potential of methane[10]
PE	Project emissions (tCO_2)

[10] Project proponents shall refer to the ACR Program Standard for the approved IPCC GWP for methane value, which will be updated periodically as new information becomes available.

5 Monitoring and Data Collection

Each project shall include a GHG project plan sufficient to meet the requirements of the *ACR Standard*. The plan shall collect all data required to be monitored and in a manner that meets the requirements for accuracy and precision of this Methodology. Project Proponents shall use the template for GHG project plans available at http://acrcarbon.org. Additionally, projects are required to submit a GHG monitoring report for each reporting period. Project Proponents shall use the template for GHG monitoring reports available at http://acrcarbon.org/program_resources/.

5.1 Description of the GHG Project Plan

These are expanded upon in the sections below. The project proponent must prepare a GHG project plan describing (for each separately) the following: a) project implementation; b) technical description of the monitoring task; c) data to be monitored and collected; d) overview of data collection procedures; e) frequency of the monitoring; f) quality control and quality assurance procedures; g) data archiving; and h) organization and responsibilities of the parties involved in all the above.

The rationale of monitoring project implementation is to document all project activities implemented by the project that could cause an increase in GHG emissions compared to the baseline scenario.

5.2 Data Collection and Parameters to Be Monitored

Project monitoring and recording shall include the following parameters:

- Continuous monitoring of landfill gas flow to each destruction device,
- Methane content analysis using a continuous gas analyzer or gas chromatograph
- Electricity production records, if applicable,
- Quantity of transport fuel or pipeline quality gas generated, if applicable,

- Destruction device operating hours, if applicable,
- Before and after results of field checks
- Project-related emission data (grid electricity consumed and/or fossil fuels used by the project), and
- A GCCS downtime log that includes the duration and cause of a GCCS shutdown or malfunction.
- For projects that deploy an automated collection system either as a stand-alone project activity or as a component of a project:
  - A record of the changes to the gas collection system, including (at the start and end of each reporting period):
    - total number of active collection wells and area of coverage, by cover type,
    - number of collectors with automated control system by area and cover type,
    - number of any new collection wells drilled including date of start of operation and area covered,
    - any collection wells that are de-commissioned,
    - quantity of waste disposed in the landfill by year, and
    - L_0 and k parameters to model methane generation.

5.2.1 FLOW MONITORING

Landfill gas flow shall be continuously monitored using an adequate flow meter. Continuous monitoring is defined as one data point recorded at least every 15 minutes. The flow meter shall be installed along the header pipe at a location that provides a straight section of pipe sufficient to establish laminar gas flow, in order to mitigate any turbulence resulting from bends, obstructions, or constrictions in the pipe. This turbulence may result in inaccurate flow measurements. The flow meter shall be located downstream of the blower and upstream of the destruction device. All flow data used to calculate emission reductions must be corrected for standard temperature (68°F) and standard pressure (14.7psi).

5.2.2 METHANE CONTENT ANALYSIS

The methane fraction in the landfill gas shall be continuously monitored using a methane analyzer. Continuous monitoring is defined as one data point at least every 15 minutes.

Weekly readings may be taken using a handheld gas analyzer for no more than two (2) months with a 10% discount for the duration of the weekly readings if the continuous methane analyzer fails or is being serviced. The discount shall be applied in Equation 1 only for the period in which weekly readings were taken in place of continuous readings. Handheld gas analyzers shall meet the calibration and maintenance requirements of Section 5.2.3.

5.2.3 MONITORING EQUIPMENT CALIBRATION/QUALITY ASSURANCE

The following information regarding flow meter and gas analyzer performance shall be maintained:

- Proof of initial calibration for flow meters and gas analyzers;
- Capability to record flow or methane concentration every 15 minutes;
- Means to correct for temperature and pressure (for flow meter, if necessary); and
- Manufacturer's recommended factory calibration frequency.

It is essential that flow meters and gas analyzers operate properly in order to accurately quantify GHG emission reductions. To ensure proper equipment function, annual field checks for flow meter and methane analyzer accuracy shall be performed by a qualified third-party. Annual field checks must meet the following conditions[11]:

- Field checks must be performed in accordance with manufacturer's specifications and methodologies;
- Field checks must be performed by the manufacturer or other appropriately trained third-party personnel;
- All field checks must be documented and made available for review during the validation and verification process. Documentation must include specific results of the field checks including the percent error demonstrated by the instrumentation capturing the before (as-found) and after (as-left) status;
- Should the instrumentation demonstrate an error in the reading or output of either landfill gas flow or methane content that is greater than or equal to 5%, written documentation must be provided as to the correction applied during the field check and the resulting accuracy of the instrumentation. In situations where the flow meter or methane analyzer percent error is greater than or equal to 5%, all data from the previous field check through to the most recent field check shall be scaled by the percent error documented in the most recent field check.

[11] Annual field checks must be separated by an elapsed time frame of a minimum of 10 months from the date of the preceding field check but must not exceed 12 months.

Projects may choose to conduct more than one field check to ensure that the monitoring equipment continuously meets the requirements of Section 5.2.3. If a project elects to conduct more frequent field checks, they must adhere to the requirements of Section 5.2.3. Additionally, manufacturer specifications regarding instrument calibration shall be followed. No ERTs will be granted for periods where the flow meter or gas analyzer have not been maintained in accordance with manufacturer calibration requirements.

5.2.4 DESTRUCTION DEVICE OPERATING HOURS

The operating hours for each destruction device must be monitored to ensure that landfill gas destruction is claimed for landfill gas destroyed only during periods when the device(s) was/were operational. Emission reductions may not be claimed for time periods where the destruction device(s) is not operating or thermocouple readings are below 500 degrees Fahrenheit. Operating hours must be continuously monitored and recorded except for non-flare destruction devices (e.g., boilers or engines) that are equipped with an operable safety shut off valve and that impede the flow of landfill gas to the device when it is not in operation. In general, operating hours for a flare are tracked through the use of a thermocouple which monitors the presence and temperature of the flame[12]. Operating hours for other destruction devices such as engines should be tracked through operator logs, electricity production records, or other verifiable means.

Projects that treat landfill gas and inject it into a natural gas pipeline shall only provide evidence of the quantity of gas[13] delivered to the pipeline and are not required to provide evidence of landfill methane destruction.

5.2.5 PROJECT-RELATED EMISSIONS

Project-related emissions may result from the used of imported electricity or from the use of fossil fuels. Information related to electricity usage and relevant fossil fuel consumption may be obtained from sources such as on-site electricity meters, utility invoices, and fuel purchase records.

[12] For a flare, operating temperature must be recorded every hour to meet the “continuous monitoring” requirement.

[13] Gas quantity must be provided by a utility-owned meter or taken from a gas flow meter subject to the same calibration, testing, and monitoring requirements found in section 5.2.3.

5.2.6 PARAMETERS MONITORED

PARAMETER	$CH_4\%$
UNIT	Percentage
DESCRIPTION	Percent methane in landfill gas
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	1
SOURCE OF DATA	Gas analyzer/data acquisition device
MEASUREMENT FREQUENCY	Continuous or using a handheld analyzer during calibration

PARAMETER	$LFG_{captured}$
UNIT	Scf
DESCRIPTION	Landfill gas flow
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	1
SOURCE OF DATA	Flow meter(s)/data acquisition device
MEASUREMENT FREQUENCY	Continuous

PARAMETER	Flare Operating Hours
UNIT	Degrees Fahrenheit
DESCRIPTION	Monitoring of operational activity of destruction device to ensure destruction of landfill gas. Not applicable for pipeline injection projects.

RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	1
SOURCE OF DATA	Thermocouple/data acquisition device
MEASUREMENT FREQUENCY	Continuous

PARAMETER	Flare Temperature
UNIT	Degrees Fahrenheit
DESCRIPTION	Monitoring of temperature of destruction device to ensure destruction of landfill gas. Not applicable for pipeline injection projects.
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	1
SOURCE OF DATA	Thermocouple/data acquisition device
MEASUREMENT FREQUENCY	Continuous

PARAMETER	W_x
UNIT	Metric tons
DESCRIPTION	Quantity of waste disposed in the landfill in year x from measurement data, tipping fee receipts, or other company records (metric tons, as received wet weight)
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	2
SOURCE OF DATA	Landfill records as provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	X
UNIT	Year
DESCRIPTION	Year in which waste was disposed
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	2
SOURCE OF DATA	Landfill records as provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	T
UNIT	Year
DESCRIPTION	Reporting year in which emissions are calculated
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	2
SOURCE OF DATA	Landfill records as provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	L_o
UNIT	Metric tons methane per metric ton waste
DESCRIPTION	Methane generation potential
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	2
SOURCE OF DATA	Parameter provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH and confirmed by Table HH-1of Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	K
UNIT	Yr-1
DESCRIPTION	Rate constant from Table HH-1 (0.02 to 0.057)
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	2
SOURCE OF DATA	Parameter as provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH and confirmed by Table HH-1of Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	$HLFG_{captured}$
UNIT	Scf
DESCRIPTION	Historic LFG captured
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	3
SOURCE OF DATA	Parameter provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH.
MEASUREMENT FREQUENCY	In accordance with requirements of US EPA 40 CFR Part 98: Subpart HH

PARAMETER	$H\%CH_4$
UNIT	Percentage
DESCRIPTION	Historic percent methane
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	3
SOURCE OF DATA	Gas analyzer/data acquisition device
MEASUREMENT FREQUENCY	Minimum once per week

PARAMETER	A2, A3, A4, and A5
UNIT	Square meters
DESCRIPTION	Landfill Areas A2: Area without active gas collection, regardless of cover type A3: Area with daily soil cover and active gas collection A4: Area with an intermediate soil cover, or a final soil cover and active gas collection A5: Area with a final soil cover of 3 feet or thicker of clay and/or geomembrane cover system and active gas collection
RELEVANT SECTION	4.1
RELEVANT EQUATION(S)	5
SOURCE OF DATA	Landfill area records as provided by the responsible party to the EPA GHG Reporting Program in accordance with the provisions of US EPA 40 CFR Part 98: Subpart HH.
MEASUREMENT FREQUENCY	Annual

PARAMETER	FF_y
UNIT	Volume of fuel
DESCRIPTION	Total quantity of fossil $fuel_y$, consumed
RELEVANT SECTION	4.2
RELEVANT EQUATION(S)	13
SOURCE OF DATA	Utility or fuel Invoices
MEASUREMENT FREQUENCY	Collected annually

PARAMETER	EL_{total}
UNIT	MWh
DESCRIPTION	Total grid connected electricity consumption
RELEVANT SECTION	4.2
RELEVANT EQUATION(S)	14
SOURCE OF DATA	Electricity Invoices
MEASUREMENT FREQUENCY	Collected annually

6 Definitions

If not explicitly defined here, the definitions in the latest version of the *ACR Standard* apply.

Automated collection system	A system deploying automated control and measurement devices designed to incrementally increase the aggregate methane volume that is captured. An automated collection system must include equipment installed on individual collection wells as part of the gas control and collection system that can measure, at minimum, O_2, CH_4, and CO_2 concentrations in the landfill gas being collected, pressure applied to the wellhead, and include an actuated valve where the valve can be operated remotely with automation.
Clean Air Act	A comprehensive federal law designed to regulate both stationary and mobile air emissions in order to improve air quality and human health.
Compressed Natural Gas	Natural gas under pressure, typically used a fuel substitute.
Gas Collection and Control System	A system of wells and pipes designed to collect landfill gas that can be conveyed under vacuum to a combustion device such as a flare or engine.
Landfill Gas	Landfill gas is a product of the decomposition of organic material contained in municipal solid waste landfills.[14]
Landfill Gas-to-Energy	The process of converting landfill gas to electricity, steam or natural gas for fuel.
Liquefied Natural Gas	Natural gas in a liquid state for ease of use or storage.
Municipal Solid Waste Landfill	A designation for landfills that accept household trash.

[14] As defined by the U.S. EPA's Landfill Methane Outreach Project. Found at http://www3.epa.gov/lmop/faq/landfill-gas.html.

Non-Methane Organic Compound	Non-methane organic compounds consist of hazardous air pollutants and volatile organic compounds, which when exposed to sunlight may form ground-level ozone or smog.
New Source Performance Standard	Federal rules for U.S. landfills, codified in 40 CFR Subpart WWW, that govern emissions from existing landfills with a design capacity greater than 2.5 million megagrams that began receiving waste or began construction or made modifications after May 30, 1991.

Appendix A: Development of Practice-Based Performance Standard

A.1 Location Based Performance Standard

While the total number of landfills in the U.S. has declined over time, the amount of waste sent to landfills has increased. As of 2015, landfills accounted for approximately 18%[15] of anthropogenic methane emissions in the U.S. The Environmental Protection Agency's (EPA) Landfill Methane Outreach Program (LMOP) maintains a database of the 2,434 landfills in the U.S. of which there are approximately 1,000 municipal solid waste (MSW) landfills that are subject to the existing New Source Performance Standards (NSPS). Of the 1,000 MSW landfills subject to NSPS, greater than 50 percent of these landfills have installed gas collection and control systems (GCCS) as a result of the regulatory requirement, while the remainder are only required to report their annual emissions to the EPA[16]. Only landfills that have a design capacity of 2.5 million metric tons and 2.5 million cubic meters of waste are subject to federal NSPS requirements and landfills are only required to abate emissions if they are found to reach or surpass the 50 megagrams per year of non-methane organic compounds (NMOC) emission threshold or 34 megagrams per year beginning in 2025.

For landfills that have reached or have exceeded the allowable NMOC emission threshold, no credits may be claimed once the landfill is required to install a GCCS. However, these landfills can participate in a voluntary carbon offset program if an automated collection system is voluntarily used which increases gas collection system efficiency. In addition, landfills that are not subject to NSPS regulations or have not reached the allowable NMOC threshold may participate in a voluntary carbon offset program for the totality of their captured emissions.

[15] EPA's Air Rules for Municipal Solid Waste Landfills, Proposed Emission Guidelines for Existing Landfills: Fact Sheet. Found at http://www3.epa.gov/ttn/atw/landfill/20150814egfs.pdf.

[16] EPA's Air Rules for Municipal Solid Waste Landfills, Proposed Emission Guidelines for Existing Landfills: Fact Sheet. Found at http://www3.epa.gov/ttn/atw/landfill/20150814egfs.pdf.

While past landfill gas carbon offset protocols have been predicated upon a low adoption rate for LFG GCCS nationally the number of voluntary landfill gas projects has steadily increased to the point where a national, practice-based performance standard is no longer applicable. However, based on analysis of the LMOP database along with assistance from several state or local permitting authorities, ACR has identified that there are still criteria that define landfills with low penetration rates for voluntary landfill gas projects. ACR began by identifying candidate landfills which consisted of the following criteria:

- Landfills that were currently open or had closed within in the last 5 years;
- Landfills that are currently under the waste in place (WIP) threshold for the region (i.e. arid versus non-arid locations, see Table 3; and
- Landfills that are not subject to NSPS or other state/local requirements to install a GCCS.

It should be noted that recently closed landfills may generate enough landfill gas to facilitate a project which is why candidate landfills closed in the last 5 years were included.

Given the above criteria, ACR has calculated that voluntary projects at landfills in non-arid regions (regions with more than 25 inches of rain in the last five years) and less than 500,000 tons of WIP, and at landfills in arid regions (regions with less than or equal to 25 inches of rain in the last five years) with less than 1,500,000 tons of WIP, account for less than 15% of candidate landfills in each region (Table 3)[17]. As these adoption rates are low, landfills that meet the criteria stipulated in Section 3.2.1 automatically qualify under the practice-based performance standard. The historical precipitation map in Figure 2 below shall be used to determine if a project is located in an arid or non-arid region.

Table 3: Penetration Rate of Candidate Landfills

	NON-ARID	ARID
WIP Limit	**500,000**	**1,500,000**
Candidate Landfills	90	92
Candidates Landfills with a Voluntary GCCS	13	12
Percent Adoption	14.44%	13.04%

[17] Precipitation zones defined by the EPA (Section 2.4.4.1). Found at https://www3.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf.

Figure 2: U.S. Historic Precipitation Map

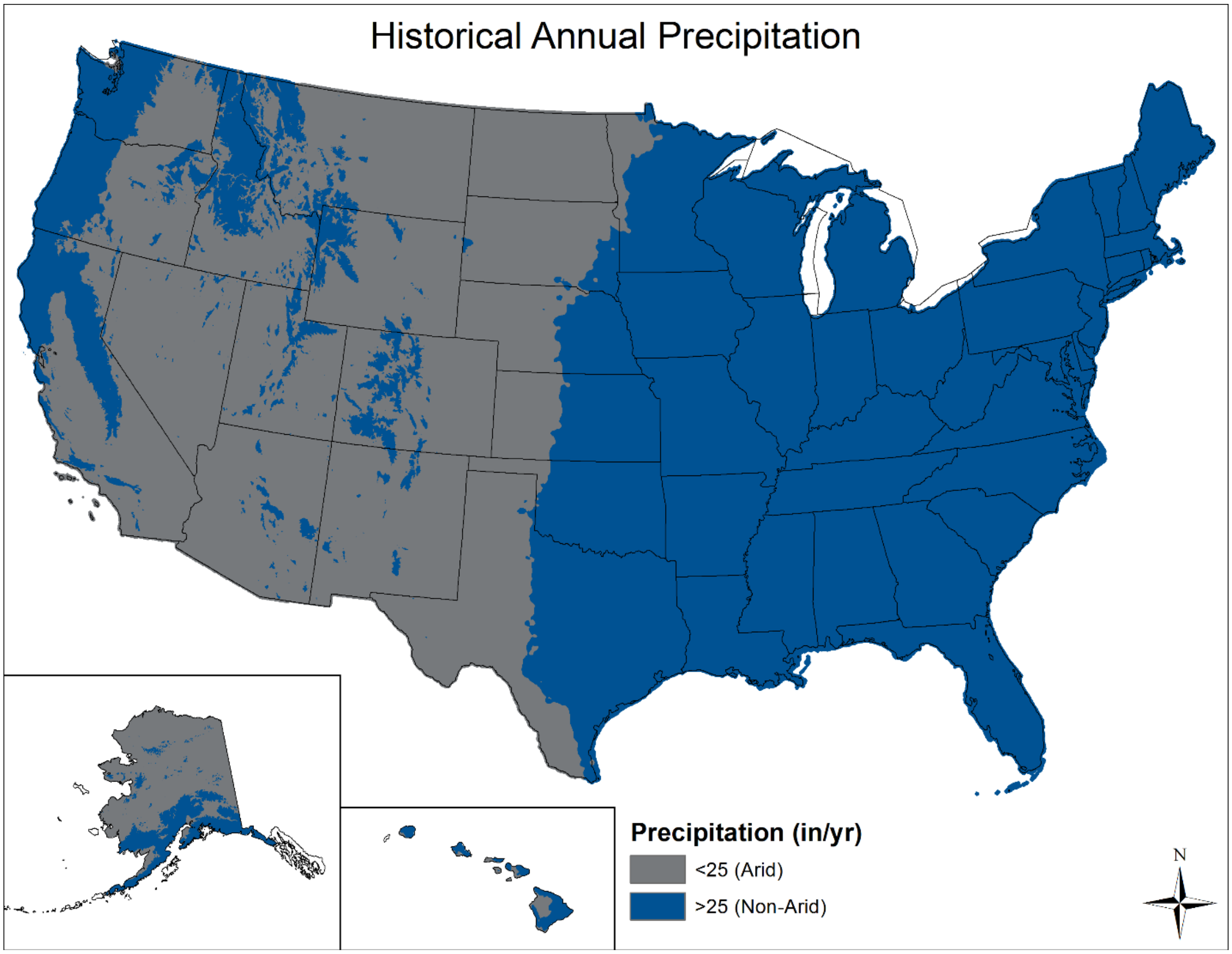


Figure 2 precipitation data sources by region include:

- Continental U.S.: PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created Feb 4, 2004.
- Alaska: Arctic Landscape Conservation Cooperative, 2012. Baseline (1961-1990) average total precipitation (mm) for Alaska and Western Canada. Created by Arctic Landscape Conservation Cooperative staff; data provided by Scenarios Network for Alaska and Arctic Planning. http://arcticlcc.org/products/spatial-data/show/baseline-1961-1990-rasters.
- Hawaii: Giambelluca, T.W., Q. Chen, A.G. Frazier, J.P. Price, Y.-L. Chen, P.-S. Chu, J.K. Eischeid, and D.M. Delparte, 2013: Online Rainfall Atlas of Hawai'i. Bull. Amer. Meteor. Soc. 94, 313-316, doi: 10.1175/BAMS-D-11-00228.1.

A.2 Performance Standard for Automated Collection Systems that Increase Landfill Gas Collection Efficiency

Industry standard landfill gas collection systems are designed to meet minimum requirements established by regulations. NSPS regulations require at least monthly measurements of each collection well for pressure applied to the wellhead (static pressure), landfill gas temperature, and Oxygen or Nitrogen concentrations. These measurements are traditionally taken manually, with a handheld device, designed for this purpose.

Historically, the control of the individual landfill gas collection well can only be made by a manual adjustment to a mechanical valve located on the wellhead above ground. Opening of the manual valve will increase the vacuum applied to the collection well. Closing the valve, will reduce the vacuum applied to the collection well. Higher applied vacuum generally results in increased landfill gas collection and also results in increased concentration of oxygen and nitrogen in the landfill gas. Reducing the applied vacuum generally reduces gas collection and lowers the amount of oxygen and nitrogen in the landfill gas. Too little applied vacuum to a collector, or positive pressure applied to a collection well, will result in excessive emissions and odors. If too much vacuum is applied to a collection well, elevated oxygen concentrations in the landfill gas can result in sub-surface oxidation which can lead to unwanted and difficult to control sub-surface thermal activity. Because of the varying positive and negative impacts of valve adjustments, it is difficult to maintain optimum valve opening given varying conditions during any month when only one or two adjustments are made monthly.

The majority of landfills in the US control individual collection wells based on minimum required once per month compliance measurements, accompanied by a manual valve adjustment. At landfill gas to energy projects with higher value beneficial use, such as current landfill gas to pipeline projects, other refinements to the manual control process have occasionally been used. Most often the method used is to increase the frequency of measurements on individual collections wells to once per week to try to improve collection system efficiency. However, considering that an average large landfill will have approximately 150 collection wells, this process is very time and labor intensive. Approximately 10 landfills with pipeline projects have increased collection well density and substituted much more expensive portable gas chromatographs in lieu of more commonly used and lower cost, but less accurate, handheld gas analyzers, to try to improve measurement accuracy along with increased collection well density, to improve collection system efficiency. In a few cases some operators have tried to incorporate variable speed motors to change overall system vacuum, but this has proven to have little benefit as increasing or decreasing vacuum to the entire collection system indiscriminately affects all collection wells, irrespective of actual collection process conditions on each collector.

Automated landfill gas collection systems allow for near continuous gas collection well measurements and valve adjustments using cellular connections to cloud based computing and data storage systems in order to improve gas collection system efficiency. These automated systems typically deploy collection well mounted hardware, which reproduces the manual, monthly measurements taken traditionally with a handheld, along with remotely actuated valves that allow for continuous gas collection system measurement, control, and optimization. Algorithms are used to automate the valve adjustments to maximize collection efficiency, and reduce GHG emissions, based on individual collection well operating thresholds, along with aggregate gas composition thresholds for the entire collection system. This type of system is an example of an automated collection system that increases landfill gas collection efficiency beyond regulatory requirements.

As of the spring of 2020, there were over 60 operational landfill gas to pipeline projects in the US, and since the introduction of automated collection systems to the market in 2017, current adoption is 9 of the operational projects, or just under 15% of the addressable market. Faster penetration of this market has been slowed due to general industry reluctance to adopt new technology, and an uncertain financial value proposition, due to volatility of the value of renewable natural gas.

There are approximately 500 large landfills in the country, most are NSPS regulated according to the EPA LMOP database, with landfill gas to electricity or other beneficial use projects. In general, automated collection systems have made virtually no penetration into this market, due to the cost of the new automated collection systems versus the value of the electricity being generated in landfill gas to electricity markets.

The opportunity to generate voluntary carbon offsets through use of an automated collection system to increase gas collection system efficiency, and reduce GHG emissions, has the potential to expand the addressable market, and accelerate adoption for a large number of landfills where the system is not financially justified by the incremental increase of gas collection made possible through automated control.

Table 4: Penetration Rate of Automated Collection Systems

	LANDFILL GAS TO PIPELINE PROJECTS	LANDFILL GAS TO ELECTRICITY PROJECTS
CURRENT PROJECTS[18]	65	400
LANDFILLS WITH AN ACS[18]	9	0
PERCENT ADOPTION	13.84%	0%

[18] As of March 2021 in the U.S.

Appendix B: Emission Factors

Project proponents shall use the current version of the U.S. Environmental Protection Agency's Power Profiler (http://oaspub.epa.gov/powpro/ept_pack.charts) to determine what regional emission factor should be used in accordance with the Emissions & Generation Resource Integrated Database (eGRID) for EF_{EL}. eGRID emission factors are available at http://www.epa.gov/energy/egrid.

To calculate $Dest_{CO2}$, project proponents shall use the below emission factors for EF_y which will be revised periodically based on updated information.

	CO_2 EF_y					
FOSSIL FUEL TYPE	**POUNDS (LBS.) CO_2**	**PER UNIT**	**KILOGRAMS (KG) CO_2**	**PER UNIT**	**LBS. CO_2/ MMBTU**	**KG CO_2/ MMBTU**
GASES						
Propane	12.70	Gallon	5.76	Gallon	139.05	63.07
Butane	14.80	Gallon	6.71	Gallon	143.20	64.95
Butane/ Propane Mix	13.70	Gallon	6.21	Gallon	141.12	64.01
Home Heating and Diesel Fuel	22.40	Gallon	10.16	Gallon	161.30	73.16
Kerosene	21.50	Gallon	9.75	Gallon	159.40	72.30
Coal (All types)	4,631.50	Short ton	2,100.82	Short ton	210.20	95.35
Natural Gas	117.10	Thousand cubic feet	53.12	Thousand cubic feet	117.00	53.07
Gasoline	19.60	Gallon	8.89	Gallon	157.20	71.30

FOSSIL FUEL TYPE	POUNDS (LBS.) CO_2	PER UNIT	KILOGRAMS (KG) CO_2	PER UNIT	LBS. CO_2/ MMBTU	KG CO_2/ MMBTU
Residual Heating Fuel (Businesses only)	26.00	Gallon	11.79	Gallon	173.70	78.79
Flared natural gas	120.70	Thousand cubic feet	54.75	Thousand cubic feet	120.60	54.70
Petroleum coke	32.40	Gallon	14.70	Gallon	225.10	102.10
Other petroleum & miscellaneous	22.09	Gallon	10.02	Gallon	160.10	72.62
COALS						
Anthracite	5,685.00	Short ton	2,578.68	Short ton	228.60	103.70
Bituminous	4,931.30	Short ton	2,236.80	Short ton	205.70	93.30
Subbituminous	3,715.90	Short ton	1,685.51	Short ton	214.30	97.20
Lignite	2,791.60	Short ton	1,266.25	Short ton	215.40	97.70
Coke	6,239.68	Short ton	2,830.27	Short ton	251.60	114.12
Source: U.S. Energy Information Administration, published February 2, 2016.						

Appendix C: Incremental Methane Collection for Automated Collection Systems

Improving landfill gas collection system efficiency has the benefit of reducing GHG emissions from landfills. Equations 2-10 provide the methods to determine the incremental increase in landfill gas collection that is achieved by the installation and operation of an automated collection system compared to traditional manual data measurement and gas collection well "tuning".

These equations utilize data that landfills report to the US EPA under the Greenhouse Gas Reporting Program and the formulas and assumptions developed by the US EPA for predicting landfill gas collection system performance based on manual well-field measurement and tuning. Use of this data, which is required by law to be reported annually, allows for a consistent method to be used to calculate historical landfill gas generation and gas collection system efficiency. This data can then be compared to the actual measured and reported landfill gas collection to establish historical gas collection system efficiency for any landfill.

As described in the following case study, using the proposed method will establish the historical baseline collection system efficiency for manual well-field tuning for any landfill. The method allows for this baseline to be updated based on changes to the landfill and the gas collection system in the future. This historical collection system efficiency baseline can then be compared to measured gas collection system efficiencies when enhanced landfill gas collection system technology is used. The result is a consistent method to calculate the incremental increase in gas collection system efficiency through the use of automated collection technology when compared to manual well-field tuning.

This case study has been included to provide an illustrative example of the application of Equations 2-9 for projects that install an automated collection system as a stand-alone project activity. For completeness, emission reductions are calculated in this example but the focus is the application of ACS-specific equations.

C.1 Case Study Landfill Description

During 2014-2016, the subject landfill had a 400,000 square meter (99 acre) footprint that commenced operation in 1995. 500,000 tons of municipal solid waste (MSW) are disposed in the landfill annually. In 2000, the landfill exceeded the 2.75-million-ton size threshold for NSPS reporting and testing of non-methane organic compounds (NMOCs). In 2002, the landfill exceeded the 30 megagram threshold for NMOC emissions and therefore became subject to the control and monitoring requirements of NSPS.

To comply with the NSPS for landfills, a gas collection system was installed during 2003 and continued to expand into new areas of waste disposed. The wells were monitored and adjusted manually by landfill technicians in accordance with the NSPS requirements. The gas collection system continued to expand and operate manually through 2016.

During 2017, an automated collection system was installed and operated on 50% of the wells evenly throughout each of the landfill areas that were covered by the gas collection system. Those wells were automatically adjusted to maximize the collection of methane. The remaining 50% of the wells continued to be operated manually through 2017.

During 2018, the automated collection system was expanded to 100% of the wells throughout the landfill areas that were covered by the gas collection system. All the wells were automatically adjusted to maximize the collection of methane.

The remainder of this case demonstrates how the collection efficiencies from the gas collection system operated manually and automatically are calculated to determine the increase in collection efficiency due to the automated collection system when compared to manual control of the gas collection system. This incremental improvement to gas collection system efficiency is the basis for determining the quantity of methane that is collected and combusted above the regulatory requirements under NSPS. The calculations use data, algorithms, and results from the US EPA GHG Reporting protocols.

C.2 Case Study Equation Applications

Step 1 Determine historic modeled methane generation rate using Equation 2 for the three years preceding the installation of the automated control system (calculate the three years separately using Equation 2). Below is an example calculation for 2014.

Example of Equation 2

$$G_{CH_4} = \left[\sum_{x=S}^{T-1}\left\{W_x L_{o_x}\left(e^{-k(T-x-1)} - e^{-k(T-x)}\right)\right\}\right]$$

WHERE	VALUE USED IN THIS CASE
G_{CH_4} = Modeled methane generation rate in reporting year T (metric tons)	Calculation result
X = Year in which waste was disposed	Each year from 1995 through baseline years 2014, 2015, 2016 and then ACS Increment years 2017 and 2018
S = Start year of calculation.	1995
T = Reporting year for which emissions are calculated.	Year of calculation including baseline years 2014, 2015, 2016 and then ACS Increment years 2017 and 2018
W_x = Quantity of waste disposed in the landfill in year x from measurement data, tipping fee receipts, or other company records (metric tons, as received wet weight).	For simplicity, all years in this example are assumed to apply 453,590 metric tons (500,000 short tons) per year
L_o = Methane generation potential (metric tons methane/metric ton waste)	0.067, which corresponds to bulk MSW disposed

k = Rate constant year $^{-1}$ from Table HH-1 from EPA 40 CFR Part 98 Subpart HH: Variable for Equation HH-1.	0.038, which corresponds to a landfill existing in climate that receives 20 to 40 inches of precipitation annually (for this example).

The calculation for modeled methane generation in T = 2014 is shown below. The same calculation is performed for each of the subsequent years (2015 and 2016) to establish the baseline for use of manual gas collection. The same calculation is used for 2017 and 2018 to establish the increment for use of the automated collection system.

YEAR	CALCULATION FOR MODELED METHANE GENERATION IN T = 2014		RESULTS, METHANE METRIC TONS
1995	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-1-1)) - EXP ((-0.038 year $^{-1}$) × (20-1))]	=	571.8
1996	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-2-1)) - EXP ((-0.038 year $^{-1}$) × (20-2))]	=	593.9
1997	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-3-1)) - EXP ((-0.038 year $^{-1}$) × 20-3))]	=	616.9
1998	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-4-1)) - EXP ((-0.038 year $^{-1}$) × (20-4))]	=	640.8
1999	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-5-1)) - EXP ((-0.038 year $^{-1}$) × (20-5))]	=	665.7

2000	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-6-1)) - EXP ((-0.038 year $^{-1}$) × (20-6))]	=	691.4
2001	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-7-1)) - EXP ((-0.038 year $^{-1}$) × (20-7))]	=	718.2
2002	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-8-1)) - EXP ((-0.038 year $^{-1}$) × (20-8))]	=	746.0
2003	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-9-1)) - EXP ((-0.038 year $^{-1}$) × (20-9))]	=	774.9
2004	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-10-1)) - EXP ((-0.038 year $^{-1}$) × (20-10))]	=	804.9
2005	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-11-1)) - EXP ((-0.038 year $^{-1}$) × (20-11))]	=	836.1
2006	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-12-1)) - EXP ((-0.038 year $^{-1}$) × (20-12))]	=	868.5
2007	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-13-1)) - EXP ((-0.038 year $^{-1}$) × (20-13))]	=	902.1
2008	$\mathbf{G_{CH_4}}$ = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-14-1)) - EXP ((-0.038 year $^{-1}$) × (20-14))]	=	937.1

2009	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-15-1)) - EXP ((-0.038 year $^{-1}$) × (20-15))]	=	973.4
2010	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-16-1)) - EXP ((-0.038 year $^{-1}$) × (20-16))]	=	1,011.1
2011	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-17-1)) - EXP ((-0.038 year $^{-1}$) × (20-17))]	=	1,050.2
2012	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-18-1)) - EXP ((-0.038 year $^{-1}$) × (20-18))]	=	1,090.9
2013	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-19-1)) - EXP ((-0.038 year $^{-1}$) × (20-19))]	=	1,133.2
2014	G_{CH_4} = (453,590 Mtons waste) × (0.067 MTons methane/MTons waste) × [(EXP ((-0.038 year $^{-1}$) × (20-20-1)) - EXP ((-0.038 year $^{-1}$) × (20-20))]	=	1,177.1
TOTAL	G_{CH_4}	=	**16,804.0**

Step 2 Determine historic measured methane collection using Equation 3 for the three years preceding the installation of the automated control system (calculate the three years separately using Equation 3). Below is an example calculation for 2014 with assumptions for the standard cubic feet of landfill gas captured as well as the methane content of that gas.

Example of Equation 3

$$C_{CH_{4_T}} = HLFG_{captured} \times H\%CH_4 \div 385 \times 16.04 \div 2204.62$$

$$C_{CH_{4_{2014}}} = 1{,}050{,}000{,}000 \text{ scf} \times 52\% / 385 \times 16.04 \div 2204.62 = 10{,}318 \text{ metric tons C}$$

Step 3 Determine measured landfill gas collection efficiency using Equation 4 for the three years preceding the installation of the automated control system (calculate the three years separately using Equation 4). Below is an example calculation for 2014.

Example of Equation 4

$$CE_{measured} = C_{CH_{4_T}} \div G_{CH_4}$$

$$CE_{measured} = 10{,}318 \div 16{,}804 = 61.4\%$$

Step 4 Determine modeled landfill gas collection system efficiency using Equation 5 for the three years preceding the installation of the automated control system (calculate the three years separately using Equation 5). Below is an example calculation for 2014 with assumptions for the cover area at the landfill that corresponds to each collection efficiency from Table HH-3 of US EPA CFR Part 98, Subpart HH.

A1: Areas with no waste in-place, CE 1 is not applicable
A2: Area without active gas collection, regardless of cover type, CE 2 = 0%
A3: Area with daily soil cover and active gas collection, CE 3 = 60%
A4: Area with an intermediate soil cover and active gas collection, CE 4 = 75%
A5: Area with a final soil and geomembrane cover system and active gas collection, CE 5 = 95%

The landfill areas (A2-A5) shown below are inputs for each specific cover area in the example for year 2014.

LF AREA, SQ METERS		COLLECTION EFFICIENCIES	
A2 =	25,000	CE2 =	0%
A3 =	100,000	CE3 =	60%

A4 =	135,000	**CE4 =**	75%
A5 =	140,000	**CE5 =**	95%

Example of Equation 5

$$\mathbf{CE_{modeled} = (A2_T \times CE2 + A3_T \times CE3 + A4_T \times CE4 + A5_T \times CE5) \div (A2_T + A3_T + A4_T + A5_T)}$$

$$CE_{modeled} = (25{,}000 \times 0 + 100{,}000 \times 60\% + 135{,}000 \times 75\% + 140{,}000 \times 95\%) \div (25{,}000 + 100{,}000 + 135{,}000 + 140{,}000) = 73.6\%$$

Step 5 Calibrate the collection efficiencies based on landfill area using Equation 6 for the three years preceding the installation of the automated control system (calculate the three years separately using Equation 5). Below is an example calculation for 2014.

Example of Equation 6

$$\mathbf{CCE2 = CE2 \times CE_{measured} \div CE_{modeled}}$$

$$\mathbf{CCE3 = CE3 \times CE_{measured} \div CE_{modeled}}$$

$$\mathbf{CCE4 = CE4 \times CE_{measured} \div CE_{modeled}}$$

$$\mathbf{CCE5 = CE5 \times CE_{measured} \div CE_{modeled}}$$

$$CCE2 = 0\% \times 61.4\% \div 73.6\% = 0$$

$$CCE3 = 60\% \times 61.4\% \div 73.6\% = 50\%$$

$$CCE4 = 75\% \times 61.4\% \div 73.6\% = 63\%$$

$$CCE5 = 95\% \times 61.4\% \div 73.6\% = 79\%$$

Step 6 Calculate the average of the three years for each calibrated collection efficiency based on landfill area using Equation 7. The same calculation is performed based on each cover type and the associated calibrated collection efficiency for the three years preceding the installation of the automated control system. Below is the example calculation with CCE values for 2014 taken from Step 5 as well as example values provided in the table for 2015 and 2016

	2014	2015	2016
CCE2 =	0	0	0
CCE3 =	50	49	48
CCE4 =	63	62	60
CCE5 =	79	78	76

Example of Equation 7

$$\mathbf{ACCE2} = \sum \mathbf{CCE2} \div 3$$

$$\mathbf{ACCE3} = \sum \mathbf{CCE3} \div 3$$

$$\mathbf{ACCE4} = \sum \mathbf{CCE4} \div 3$$

$$\mathbf{ACCE5} = \sum \mathbf{CCE5} \div 3$$

ACCE2 = (0 + 0 +0)/3 = 0%

ACCE3 = (50 + 49 +48)/3 = 49%

ACCE4 = (63 + 62 + 60)/3 = 61.7%

ACCE5 = (79 + 78 + 76)/3 = 77.7%

Step 7 Following the installation of the automated collection system (in this example, in 2017), calculate the updated calibrated collection efficiency to reflect changes in the landfill's cover and collection systems. The below example uses the updated landfill areas by cover in the below table.

LF AREA, SQ METERS	
A2 ' =	5,000
A3 ' =	110,000
A4 ' =	145,000
A5 ' =	140,000

Example of Equation 8

$$\mathbf{UCCE} = (\mathbf{A2_T} \times \mathbf{ACCE2} + \mathbf{A3_T} \times \mathbf{ACCE3} + \mathbf{A4_T} \times \mathbf{ACCE4} + \mathbf{A5_T}) \times \mathbf{ACCE5} \div (\mathbf{A2_T} + \mathbf{A3_T} + \mathbf{A4_T} + \mathbf{A5_T})$$

For 2017, the UCCE is calculated as follows:

$$\mathbf{UCCE} = (5{,}000 \times 0 + 110{,}000 \times 49\% + 145{,}000 \times 61.7\% + 140{,}000 \times 77.7\%) \div (5{,}000 + 110{,}000 + 145{,}000 + 140{,}000) = 63\%$$

Step 8 Calculate the incremental efficiency improvement that is attributable to the automated collection system in 2017. To do this, $CH_{4_{combusted}}$ is calculated in accordance with Equation 1 and $CH_{4_{total}}$ is calculated in accordance with Equation 11. In this example and for simplicity, assume that $CH_{4_{combusted}}$ is calculated appropriately and is used to calculate $CH_{4_{total}}$ in Equation 11 with the resulting $CH_{4_{total}}$ set to 13,478 metric tons. Also, assume that G_{CH_4} is calculated per Equation 2 for 2017 and is set equal to 18,395 metric tons.

Example of Equation 9

$$\mathbf{ACSI} = \left(\mathbf{CH_{4_{total}}} - (\mathbf{UCCE} \times \mathbf{G_{CH_4}})\right) \div \mathbf{CH_{4_{total}}}$$

ACSI = (13,478 – (63% × 18,395)) ÷ 13,478 =14%

The ACSI is then used as an input to Equation 10.

Per Step 8, above, we will assume that $CH_{4_{combusted}}$ (Equation 1) is calculated appropriately and is used to calculate $CH_{4_{total}}$ in Equation 11 with the resulting $CH_{4_{total}}$ set to 13,478 metric tons.

Step 9 Calculate the increase in volume of CH_4 combusted that is attributable to the automated collection system in 2017. To do this, $CH_{4_{combusted}}$ is calculated in accordance with Equation 1 and is equal to 750,824,952 scf CH_4.

Example of Equation 10

$$\mathbf{ICH_{4_{combusted}} = CH_{4_{combusted}} \times ACSI}$$

$$\mathbf{ICH_{4_{combusted}}} = 750{,}824{,}952 \text{ x } 14\% = 105{,}115{,}493 \text{ scf of } CH_4$$

Step 10 Calculate the net mass of CH_4 destroyed and attributable to the ACS in 2017. To do this, apply $ICH_{4_{combusted}}$ in Equation 11. Assume in this example that there are no ineligible devices and therefore NE_{device} is zero and no correction factor needs to be applied.

Example of Equation 11

$$\mathbf{CH_{4_{total}} = (\left(\left(ICH_{4_{combusted}} \times CF\right) \times 16.04 \times \left[\frac{1}{10^6}\right] \times \left[\frac{1}{24.04}\right] \times 28.32\right) \times 95\%) - NE_{device}}$$

$$\mathbf{CH_{4_{total}}} = 105{,}115{,}493 \text{ x } 16.04 \text{ x } 1/10\text{^}6 \text{ x } 1/24.04 \text{ x } 28.32 \text{ x}.95 = 1{,}986 \text{ Mt of } CH_4$$

Assume, in this example that there are no project emissions to deduct. Therefore, the emission reductions attributable to the ACS in 2017 are quantified using Equation 16 as follows:

Example of Equation 16

$$\mathbf{ER} = \left[\mathbf{CH_{4_{total}}} \times \mathbf{GWP_{CH_4}}\right] - \mathbf{PE}$$

ER = 1,986 x 25 – 0 = 49,650 Mt carbon dioxide equivalent emission reductions

Appendix D: References

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Quantification of Modeled Methane Emissions Reductions from Automated Collection Systems for Orange County Landfills

Introduction

According to the U.S. EPA, landfills are the world's third-largest source of methane emissions, a harmful greenhouse gas with over 25 times the global warming impact than carbon dioxide over a 100-year period. By implementing Automated Collection Systems with real-time data and controls technology, Orange County can substantially reduce greenhouse gas emissions by increasing the methane capture of their Landfill Gas Collection and Control Systems.

Automated Collection Systems have been demonstrated to increase methane capture by 10-20% at landfill projects with results verified by third-party engineering firms, yielding substantial benefits of improving environmental sustainability, public health, and renewable energy production.

By implementing Automated Collection Systems at Coyote Canyon Landfill, Frank R. Bowerman Landfill, Olinda Alpha Landfill, Prima Deshecha Landfill, and Santiago Landfill, Orange County can reduce emissions by over 2 million MT CO2e during 2025-2030 and over 4 million MT CO2e during 2025-2035, the equivalent of removing the annual emissions of over 90,000 passenger vehicles each year[1].

Orange County Emissions Reductions Impact				
Landfill	Incremental Methane Capture Estimate	2025-2030 (MT CO2e)	2025-2035 (MT CO2e)	2025-2050 (MT CO2e)
Coyote Canyon	10%	134,274	255,770	555,184
Frank R. Bowerman	15%	911,074	1,796,383	4,321,087
Olinda Alpha	15% - 2025-2034 10% - 2035-2050	835,902	1,539,082	2,888,950
Prima Deshecha	15%	256,836	559,171	2,097,476
Santiago	10%	35,684	67,973	147,544
Total		**2,173,770**	**4,218,379**	**10,010,241**

Modeled Emissions Reductions Methodology

The Emissions Reductions Estimation Model from Automated Collection Systems was derived using the American Carbon Registry's Methodology for the Quantification Monitoring, Reporting

[1] A typical passenger vehicle emits about 4.6 metric tons of CO2 per year [Greenhouse Gas Equivalencies Calculator | US EPA]

and Verification of Greenhouse Gas Emissions Reductions and Removals from Landfill Gas Destruction and Beneficial Use Projects Version 2.0. This methodology provided the quantification and accounting framework for the creation of carbon offset credits from the reductions in GHG emissions resulting from the destruction or utilization of landfill gas.

To quantify emissions reductions, a project baseline is established to calculate the expected methane capture for the three years preceding the Automated Collection System installation. This baseline is calculated using the Historic Modeled Methane Generation Rate, Historic Measured Methane Collection, and Historic Landfill Collection Areas, and Historic Waste Landfilled, all of which are publicly available through the EPA Greenhouse Gas Reporting Program (GHGRP). The GHGRP assigns a landfill collection efficiency based solely on the weighted average of coverage area types on the landfill. That collection efficiency is then calibrated to account for the Historic Methane Collected relative to the Historic Modeled Methane Generation Rate for each collection area. Each baseline year's calibrated collection efficiencies are then averaged to calculate an overall baseline calibrated collection efficiency for each landfill coverage area.

The estimation of future emissions reductions at Orange County landfills was done by calculating each future year's Modeled Methane Generation Rate and multiplying it by the baseline calibrated collection efficiency to determine a Modeled Baseline Methane Capture. An Automated Collection System Increment Factor, a 10% increase for closed landfills and 15% increase for active landfills, was applied to the Modeled Methane Capture to determine the Incremental Methane Capture (MT CH_4). When organic waste decomposes in the landfill, a portion of the methane undergoes a chemical reaction with bacteria in the soil that converts it into CO_2 and water. To account for the portion of incremental methane captured that would have oxidized and not realized a harmful GHG impact, a 10% oxidation factor was applied to the Incremental Methane Capture to calculate Emissions Reductions (MT CO_2e), along with a 25x Global Warming Potential factor for methane, as recognized by the California Air Resources Board[2]

[2] GHG Global Warming Potentials | California Air Resources Board

Assumptions

A few assumptions were made Emissions Reduction Estimation Model. It was assumed that all sites besides Olinda Alpha and Prima Deshecha would landfill the same amount of waste as the last baseline year (2022) in each modeled year for the entirety of the Emissions Reduction Estimation Model. It was also assumed that the landfill would maintain a consistent proportion of coverage areas throughout the entirety of the modeled years, which allowed a consistent baseline calibrated collection efficiency to be applied for each modeled year.

When determining the Automated Collection System Increment Factor for modeling increased methane capture, it was estimated that an automated collection system would yield a 15% increase at an active landfill and a 10% increase at a closed landfill. A 15% increase is the median outcome at a typical active landfill project, while the lower 10% increase applied to closed landfills is attributable to a higher baseline collection efficiency brought on by final landfill cover.

It was assumed that Olinda Alpha would stop taking landfilling waste at the end of 2030, and that the landfill will move all coverage areas to final cover in 2034. Therefore, the incremental methane capture estimate changed from 15% to 10% in 2034. It was also assumed that 67% of the landfilled waste from Olinda Alpha in 2022 would then be landfilled in Prima Deshecha in 2031 following the closure of Olinda Alpha and continue at that rate for each following year.

Increases in methane capture at both active and closed landfill are facilitated by automated collection systems by the real-time measurement of gas composition (CH_4, CO_2, O_2), system pressures, and flow, which are leveraged by automated tuning algorithms to optimize methane capture.

Detailed calculations of greenhouse gas emission reductions by County of Orange landfill site

Coyote Canyon Closed Landfill Site GHG Reduction Calculations

Equation	HH-1 Calculation, G_{CH4}: Modeled Methane Generation, metric tons	
2	Reporting Year	2024
	Reporting Year for Calculation (X=T):	62.00
	Fraction of Reporting Year:	1.00
	Lo, methane generation potential, Methane mt/waste mt	0.053
	k, rate constant year^{-1}	0.020

Equation		x	Wx	Wx	Lo	k	(Wx * Lo)	(exp -k(T-x-1)	(exp -k(T-x)		HH-1 G_{CH4}					
2	Year	year in which waste was disposed	Waste, tons	Waste, metric tons	Methane mt/waste mt	rate constant (table HH-1)	first term of Eq. HH-1	first e term of Eq. HH-1	second e term of Eq. HH-1	e term of HH-1	Modeled methane generation rate, metric tons Eq. HH-1	HH1 Modeled Methane Emissions	Calibrated Collection Efficiency	Modeled Methane Capture	Emissions Reduction (MT CH4)	Emissions Reduction (MT CO2e)
	1963	1	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3012	0.2952	0.0060	410.3		86.5%			
	1964	2	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3073	0.3012	0.0061	418.6		86.5%			
	1965	3	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3135	0.3073	0.0062	427.0		86.5%			
	1966	4	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3198	0.3135	0.0063	435.7		86.5%			
	1967	5	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3263	0.3198	0.0065	444.5		86.5%			
	1968	6	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3329	0.3263	0.0066	453.5		86.5%			
	1969	7	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3396	0.3329	0.0067	462.6		86.5%			
	1970	8	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3465	0.3396	0.0069	472.0		86.5%			
	1971	9	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3535	0.3465	0.0070	481.5		86.5%			
	1972	10	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3606	0.3535	0.0071	491.2		86.5%			
	1973	11	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3679	0.3606	0.0073	501.1		86.5%			
	1974	12	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3753	0.3679	0.0074	511.3		86.5%			
	1975	13	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3829	0.3753	0.0076	521.6		86.5%			
	1976	14	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3906	0.3829	0.0077	532.1		86.5%			
	1977	15	1,436,277	1,302,962	0.053	0.020	68,796.4	0.3985	0.3906	0.0079	542.9		86.5%			
	1978	16	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4066	0.3985	0.0081	553.9		86.5%			
	1979	17	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4148	0.4066	0.0082	565.0		86.5%			
	1980	18	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4232	0.4148	0.0084	576.5		86.5%			
	1981	19	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4317	0.4232	0.0085	588.1		86.5%			
	1982	20	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4404	0.4317	0.0087	600.0		86.5%			
	1983	21	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4493	0.4404	0.0089	612.1		86.5%			
	1984	22	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4584	0.4493	0.0091	624.5		86.5%			
	1985	23	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4677	0.4584	0.0093	637.1		86.5%			
	1986	24	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4771	0.4677	0.0094	650.0		86.5%			
	1987	25	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4868	0.4771	0.0096	663.1		86.5%			
	1988	26	1,436,277	1,302,962	0.053	0.020	68,796.4	0.4966	0.4868	0.0098	676.5		86.5%			
	1989	27	1,436,277	1,302,962	0.053	0.020	68,796.4	0.5066	0.4966	0.0100	690.1		86.5%			
	1990	28	213,980	194,119	0.053	0.020	10,249.5	0.5169	0.5066	0.0102	104.9		86.5%			
	1991	29	-		0.053	0.020	0.0	0.5273	0.5169	0.0104	0.0		86.5%			
	1992	30	-		0.053	0.020	0.0	0.5379	0.5273	0.0107	0.0		86.5%			
	1993	31	-		0.053	0.020	0.0	0.5488	0.5379	0.0109	0.0		86.5%			
	1994	32	-		0.053	0.020	0.0	0.5599	0.5488	0.0111	0.0		86.5%			
	1995	33	-		0.053	0.020	0.0	0.5712	0.5599	0.0113	0.0		86.5%			
	1996	34	-		0.053	0.020	0.0	0.5827	0.5712	0.0115	0.0		86.5%			
	1997	35	-		0.053	0.020	0.0	0.5945	0.5827	0.0118	0.0		86.5%			
	1998	36	-		0.053	0.020	0.0	0.6065	0.5945	0.0120	0.0		86.5%			
	1999	37	-		0.053	0.020	0.0	0.6188	0.6065	0.0123	0.0		86.5%			
	2000	38	-		0.053	0.020	0.0	0.6313	0.6188	0.0125	0.0		86.5%			
	2001	39	-		0.053	0.020	0.0	0.6440	0.6313	0.0128	0.0		86.5%			
	2002	40	-		0.053	0.020	0.0	0.6570	0.6440	0.0130	0.0		86.5%			
	2003	41	-		0.053	0.020	0.0	0.6703	0.6570	0.0133	0.0		86.5%			
	2004	42	-		0.053	0.020	0.0	0.6839	0.6703	0.0135	0.0		86.5%			
	2005	43	-		0.053	0.020	0.0	0.6977	0.6839	0.0138	0.0		86.5%			
	2006	44	-		0.053	0.020	0.0	0.7118	0.6977	0.0141	0.0		86.5%			
	2007	45	-		0.053	0.020	0.0	0.7261	0.7118	0.0144	0.0		86.5%			
	2008	46	-		0.053	0.020	0.0	0.7408	0.7261	0.0147	0.0		86.5%			
	2009	47	-		0.053	0.020	0.0	0.7558	0.7408	0.0150	0.0		86.5%			
	2010	48	-		0.053	0.020	0.0	0.7711	0.7558	0.0153	0.0		86.5%			
	2011	49	-		0.053	0.020	0.0	0.7866	0.7711	0.0156	0.0		86.5%			
	2012	50	-		0.053	0.020	0.0	0.8025	0.7866	0.0159	0.0		86.5%			
	2013	51	-		0.053	0.020	0.0	0.8187	0.8025	0.0162	0.0		86.5%			
	2014	52	-		0.053	0.020	0.0	0.8353	0.8187	0.0165	0.0		86.5%			
	2015	53	-		0.053	0.020	0.0	0.8521	0.8353	0.0169	0.0		86.5%			
	2016	54	-		0.053	0.020	0.0	0.8694	0.8521	0.0172	0.0		86.5%			
	2017	55	-		0.053	0.020	0.0	0.8869	0.8694	0.0176	0.0		86.5%			
	2018	56	-		0.053	0.020	0.0	0.9048	0.8869	0.0179	0.0		86.5%			
	2019	57	-		0.053	0.020	0.0	0.9231	0.9048	0.0183	0.0		86.5%			
	2020	58	-		0.053	0.020	0.0	0.9418	0.9231	0.0186	0.0		86.5%			
	2021	59	-		0.053	0.020	0.0	0.9608	0.9418	0.0190	0.0		86.5%			
	2022	60	-		0.053	0.020	0.0	0.9802	0.9608	0.0194	0.0		86.5%			
	2023	61	-		0.053	0.020	0.0	1.0000	0.9802	0.0198	0.0		86.5%			
	2024	62	-		0.053	0.020	0.0	1.0202	1.0000	0.0202	0.0		86.5%			
	2025	63	-		0.053	0.020	0.0	1.0408	1.0202	0.0206	0.0	14,358	86.5%	12,418	1,242	27,940
	2026	64	-		0.053	0.020	0.0	1.0618	1.0408	0.0210	0.0	14,073	86.5%	12,172	1,217	27,386
	2027	65	-		0.053	0.020	0.0	1.0833	1.0618	0.0215	0.0	13,795	86.5%	11,931	1,193	26,844
	2028	66	-		0.053	0.020	0.0	1.1052	1.0833	0.0219	0.0	13,521	86.5%	11,694	1,169	26,313
	2029	67	-		0.053	0.020	0.0	1.1275	1.1052	0.0223	0.0	13,254	86.5%	11,463	1,146	25,792
	2030	68	-		0.053	0.020	0.0	1.1503	1.1275	0.0228	0.0	12,991	86.5%	11,236	1,124	25,281
	2031	69	-		0.053	0.020	0.0	1.1735	1.1503	0.0232	0.0	12,734	86.5%	11,013	1,101	24,780
	2032	70	-		0.053	0.020	0.0	1.1972	1.1735	0.0237	0.0	12,482	86.5%	10,795	1,080	24,290
	2033	71	-		0.053	0.020	0.0	1.2214	1.1972	0.0242	0.0	12,235	86.5%	10,582	1,058	23,809
	2034	72	-		0.053	0.020	0.0	1.2461	1.2214	0.0247	0.0	11,992	86.5%	10,372	1,037	23,337
	2035	73	-		0.053	0.020	0.0	1.2712	1.2461	0.0252	0.0	11,755	86.5%	10,167	1,017	22,875
	2036	74	-		0.053	0.020	0.0	1.2969	1.2712	0.0257	0.0	11,522	86.5%	9,965	997	22,422
	2037	75	-		0.053	0.020	0.0	1.3231	1.2969	0.0262	0.0	11,294	86.5%	9,768	977	21,978
	2038	76	-		0.053	0.020	0.0	1.3499	1.3231	0.0267	0.0	11,070	86.5%	9,575	957	21,543
	2039	77	-		0.053	0.020	0.0	1.3771	1.3499	0.0273	0.0	10,851	86.5%	9,385	939	21,116
	2040	78	-		0.053	0.020	0.0	1.4049	1.3771	0.0278	0.0	10,636	86.5%	9,199	920	20,698
	2041	79	-		0.053	0.020	0.0	1.4333	1.4049	0.0284	0.0	10,426	86.5%	9,017	902	20,288
	2042	80	-		0.053	0.020	0.0	1.4623	1.4333	0.0290	0.0	10,219	86.5%	8,838	884	19,887
	2043	81	-		0.053	0.020	0.0	1.4918	1.4623	0.0295	0.0	10,017	86.5%	8,663	866	19,493
	2044	82	-		0.053	0.020	0.0	1.5220	1.4918	0.0301	0.0	9,819	86.5%	8,492	849	19,107
	2045	83	-		0.053	0.020	0.0	1.5527	1.5220	0.0307	0.0	9,624	86.5%	8,324	832	18,728
	2046	84	-		0.053	0.020	0.0	1.5841	1.5527	0.0314	0.0	9,434	86.5%	8,159	816	18,358
	2047	85	-		0.053	0.020	0.0	1.6161	1.5841	0.0320	0.0	9,247	86.5%	7,997	800	17,994
	2048	86	-		0.053	0.020	0.0	1.6487	1.6161	0.0326	0.0	9,064	86.5%	7,839	784	17,638
	2049	87	-		0.053	0.020	0.0	1.6820	1.6487	0.0333	0.0	8,884	86.5%	7,684	768	17,289

2025-2030	134,274
2025-2035	255,770
2025-2050	555,184

Frank R. Bowerman Landfill Site GHG Reduction Calculations

Equation 2 — **HH-1 Calculation, G_{CH4}: Modeled Methane Generation, metric tons**

Reporting Year	**2024**
Reporting Year for Calculation (X=T):	25.00
Fraction of Reporting Year:	1.00
Lo, methane generation potential, Methane mt/waste mt	0.068
k, rate constant year^{-1}	0.020

Year	x year in which waste was disposed	Wx Waste, tons	Wx Waste, metric tons	Lo Methane mt/waste mt	k rate constant (table HH-1)	(Wx * Lo) first term of Eq. HH-1	(exp -k(T-x-1) first e term of Eq. HH-1	(exp -k(T-x) second e term of Eq. HH-1	e term of HH-1	HH-1 G_{CH4} Modeled methane generation rate, metric tons Eq. HH-1	**HH1 Modeled Methane Generation**	**Calibrated Collection Efficiency**	**Modeled Methane Capture**	**Emissions Reduction (MT CH4)**	**Emissions Reduction (MT CO2e)**
1990	**1**	864,900	784,620	0.068	0.020	53,249.5	0.6313	0.6188	0.0125	665.6		**89.9%**			
1991	**2**	1,001,617	908,647	0.068	0.020	61,666.8	0.6440	0.6313	0.0128	786.4		**89.9%**			
1992	**3**	1,162,106	1,054,239	0.068	0.020	71,547.7	0.6570	0.6440	0.0130	930.9		**89.9%**			
1993	**4**	1,392,950	1,263,656	0.068	0.020	85,760.1	0.6703	0.6570	0.0133	1,138.3		**89.9%**			
1994	**5**	1,433,667	1,300,594	0.068	0.020	88,267.0	0.6839	0.6703	0.0135	1,195.3		**89.9%**			
1995	**6**	1,361,074	1,234,739	0.068	0.020	83,797.6	0.6977	0.6839	0.0138	1,157.7		**89.9%**			
1996	**7**	1,657,562	1,503,707	0.068	0.020	102,051.6	0.7118	0.6977	0.0141	1,438.3		**89.9%**			
1997	**8**	1,738,965	1,577,554	0.068	0.020	107,063.3	0.7261	0.7118	0.0144	1,539.4		**89.9%**			
1998	**9**	1,974,826	1,791,523	0.068	0.020	121,584.7	0.7408	0.7261	0.0147	1,783.5		**89.9%**			
1999	**10**	1,972,354	1,789,280	0.068	0.020	121,432.5	0.7558	0.7408	0.0150	1,817.3		**89.9%**			
2000	**11**	2,117,659	1,921,098	0.068	0.020	130,378.5	0.7711	0.7558	0.0153	1,990.6		**89.9%**			
2001	**12**	2,211,357	2,006,099	0.068	0.020	136,147.3	0.7866	0.7711	0.0156	2,120.7		**89.9%**			
2002	**13**	2,230,469	2,023,437	0.068	0.020	137,323.9	0.8025	0.7866	0.0159	2,182.2		**89.9%**			
2003	**14**	2,268,930	2,058,328	0.068	0.020	139,691.9	0.8187	0.8025	0.0162	2,264.7		**89.9%**			
2004	**15**	2,384,275	2,162,967	0.068	0.020	146,793.4	0.8353	0.8187	0.0165	2,427.9		**89.9%**			
2005	**16**	2,448,032	2,220,806	0.068	0.020	150,718.7	0.8521	0.8353	0.0169	2,543.2		**89.9%**			
2006	**17**	2,268,215	2,057,679	0.068	0.020	139,647.8	0.8694	0.8521	0.0172	2,404.0		**89.9%**			
2007	**18**	2,238,831	2,031,023	0.068	0.020	137,838.8	0.8869	0.8694	0.0176	2,420.8		**89.9%**			
2008	**19**	2,121,522	1,924,602	0.068	0.020	130,616.3	0.9048	0.8869	0.0179	2,340.3		**89.9%**			
2009	**20**	1,637,768	1,485,750	0.068	0.020	100,832.9	0.9231	0.9048	0.0183	1,843.1		**89.9%**			
2010	**21**	1,587,493	1,440,142	0.068	0.020	97,737.6	0.9418	0.9231	0.0186	1,822.6		**89.9%**			
2011	**22**	1,625,220	1,474,367	0.068	0.020	100,060.4	0.9608	0.9418	0.0190	1,903.6		**89.9%**			
2012	**23**	1,649,179	1,496,102	0.068	0.020	101,535.5	0.9802	0.9608	0.0194	1,970.7		**89.9%**			
2013	**24**	1,801,575	1,634,353	0.068	0.020	110,918.1	1.0000	0.9802	0.0198	2,196.3		**89.9%**			
2014	**25**	2,167,896	1,966,672	0.068	0.020	133,471.5	1.0202	1.0000	0.0202	2,696.3		**89.9%**			
2015	**26**	2,188,752	1,985,592	0.068	0.020	134,755.5	1.0408	1.0202	0.0206	2,777.2		**89.9%**			
2016	**27**	2,338,388	2,121,339	0.068	0.020	143,968.2	1.0618	1.0408	0.0210	3,027.0		**89.9%**			
2017	**28**	2,460,869	2,232,451	0.068	0.020	151,509.0	1.0833	1.0618	0.0215	3,249.9		**89.9%**			
2018	**29**	2,612,812	2,370,291	0.068	0.020	160,863.7	1.1052	1.0833	0.0219	3,520.3		**89.9%**			
2019	**30**	2,752,609	2,497,112	0.068	0.020	169,470.7	1.1275	1.1052	0.0223	3,783.6		**89.9%**			
2020	**31**	2,203,118	1,998,625	0.068	0.020	135,640.0	1.1503	1.1275	0.0228	3,089.5		**89.9%**			
2021	**32**	2,243,115	2,034,909	0.068	0.020	138,102.5	1.1735	1.1503	0.0232	3,209.1		**89.9%**			
2022	**33**	2,190,675	1,987,337	0.068	0.020	134,873.9	1.1972	1.1735	0.0237	3,197.4		**89.9%**			
2023	**34**	2,190,675	1,987,337	0.068	0.020	134,873.9	1.2214	1.1972	0.0242	3,262.0		**89.9%**			
2024	**35**	685,606	621,968	0.068	0.020	42,210.9	1.2461	1.2214	0.0247	1,041.5		**89.9%**			
2025	**36**	685,606	621,968	0.068	0.020	42,210.9	1.2712	1.2461	0.0252	1,062.6	**60781**	**89.9%**	**54,638**	**8,196**	**184,402**
2026	**37**	685,606	621,968	0.068	0.020	42,210.9	1.2969	1.2712	0.0257	1,084.0	**60413**	**89.9%**	**54,307**	**8,146**	**183,287**
2027	**38**	685,606	621,968	0.068	0.020	42,210.9	1.3231	1.2969	0.0262	1,105.9	**60052**	**89.9%**	**53,983**	**8,097**	**182,193**
2028	**39**	685,606	621,968	0.068	0.020	42,210.9	1.3499	1.3231	0.0267	1,128.3	**59699**	**89.9%**	**53,666**	**8,050**	**181,121**
2029	**40**	685,606	621,968	0.068	0.020	42,210.9	1.3771	1.3499	0.0273	1,151.0	**59353**	**89.9%**	**53,354**	**8,003**	**180,071**
2030	**41**	685,606	621,968	0.068	0.020	42,210.9	1.4049	1.3771	0.0278	1,174.3	**59013**	**89.9%**	**53,049**	**7,957**	**179,041**
2031	**42**	685,606	621,968	0.068	0.020	42,210.9	1.4333	1.4049	0.0284	1,198.0	**58681**	**89.9%**	**52,750**	**7,913**	**178,032**
2032	**43**	685,606	621,968	0.068	0.020	42,210.9	1.4623	1.4333	0.0290	1,222.2	**58355**	**89.9%**	**52,457**	**7,869**	**177,042**
2033	**44**	685,606	621,968	0.068	0.020	42,210.9	1.4918	1.4623	0.0295	1,246.9	**58035**	**89.9%**	**52,170**	**7,825**	**176,072**
2034	**45**	685,606	621,968	0.068	0.020	42,210.9	1.5220	1.4918	0.0301	1,272.1	**57722**	**89.9%**	**51,888**	**7,783**	**175,122**
2035	**46**	685,606	621,968	0.068	0.020	42,210.9	1.5527	1.5220	0.0307	1,297.8	**57414**	**89.9%**	**51,611**	**7,742**	**174,189**
2036	**47**	685,606	621,968	0.068	0.020	42,210.9	1.5841	1.5527	0.0314	1,324.0	**57113**	**89.9%**	**51,341**	**7,701**	**173,276**
2037	**48**	685,606	621,968	0.068	0.020	42,210.9	1.6161	1.5841	0.0320	1,350.8	**56818**	**89.9%**	**51,076**	**7,661**	**172,381**
2038	**49**	685,606	621,968	0.068	0.020	42,210.9	1.6487	1.6161	0.0326	1,378.1	**56529**	**89.9%**	**50,816**	**7,622**	**171,504**
2039	**50**	685,606	621,968	0.068	0.020	42,210.9	1.6820	1.6487	0.0333	1,405.9	**56246**	**89.9%**	**50,561**	**7,584**	**170,644**
2040	**51**	685,606	621,968	0.068	0.020	42,210.9	1.7160	1.6820	0.0340	1,434.3	**55968**	**89.9%**	**50,311**	**7,547**	**169,800**
2041	**52**	685,606	621,968	0.068	0.020	42,210.9	1.7507	1.7160	0.0347	1,463.3	**55695**	**89.9%**	**50,066**	**7,510**	**168,974**
2042	**53**	685,606	621,968	0.068	0.020	42,210.9	1.7860	1.7507	0.0354	1,492.8	**55428**	**89.9%**	**49,826**	**7,474**	**168,164**
2043	**54**	685,606	621,968	0.068	0.020	42,210.9	1.8221	1.7860	0.0361	1,523.0	**55166**	**89.9%**	**49,591**	**7,439**	**167,370**
2044	**55**	685,606	621,968	0.068	0.020	42,210.9	1.8589	1.8221	0.0368	1,553.8	**54910**	**89.9%**	**49,360**	**7,404**	**166,592**
2045	**56**	685,606	621,968	0.068	0.020	42,210.9	1.8965	1.8589	0.0376	1,585.1	**54658**	**89.9%**	**49,134**	**7,370**	**165,829**
2046	**57**	685,606	621,968	0.068	0.020	42,210.9	1.9348	1.8965	0.0383	1,617.2	**54412**	**89.9%**	**48,913**	**7,337**	**165,081**
2047	**58**	685,606	621,968	0.068	0.020	42,210.9	1.9739	1.9348	0.0391	1,649.8	**54170**	**89.9%**	**48,696**	**7,304**	**164,348**
2048	**59**	685,606	621,968	0.068	0.020	42,210.9	2.0138	1.9739	0.0399	1,683.2	**53934**	**89.9%**	**48,483**	**7,272**	**163,629**
2049	**60**	685,606	621,968	0.068	0.020	42,210.9	2.0544	2.0138	0.0407	1,717.2	**53701**	**89.9%**	**48,274**	**7,241**	**162,925**
Total		**84,325,211**	**76,498,145**												

2025-2030	**911,074**
2025-2035	**1,796,383**
2025-2050	**4,321,087**

Olinda Alpha Landfill Site GHG Reduction Calculations

Equation	HH-1 Calculation, G_{CH4}: Modeled Methane Generation, metric tons	
2	Reporting Year	2024
	Reporting Year for Calculation (X=T):	72.00
	Fraction of Reporting Year:	1.00
	Lo, methane generation potential, Methane mt/waste mt	0.067
	k, rate constant year^{-1}	0.020

Year	x year in which waste was disposed	Wx Waste, tons	Wx Waste, metric tons	Lo Methane mt/waste mt	k rate constant (table HH-1)	(Wx * Lo) first term of Eq. HH-1	(exp -k(T-x-1) first e term of Eq. HH-1	(exp -k(T-x) second e term of Eq. HH-1	e term of HH-1	HH-1 G_{CH4} Modeled methane generation rate, metric tons Eq. HH-1	HH1 Modeled Methane Generation	Calibrated Collection Efficiency	Modeled Methane Capture	Incremental Methane Capture Estimate	Emissions Reduction (MT CH4)	Emissions Reduction (MT CO2e)
1960	1	859,306	779,545	0.067	0.020	51,995.7	0.2466	0.2417	0.0049	253.9		64.1%				
1961	2	859,306	779,545	0.067	0.020	51,995.7	0.2516	0.2466	0.0050	259.0		64.1%				
1962	3	859,306	779,545	0.067	0.020	51,995.7	0.2567	0.2516	0.0051	264.3		64.1%				
1963	4	859,306	779,545	0.067	0.020	51,995.7	0.2618	0.2567	0.0052	269.6		64.1%				
1964	5	859,306	779,545	0.067	0.020	51,995.7	0.2671	0.2618	0.0053	275.0		64.1%				
1965	6	859,306	779,545	0.067	0.020	51,995.7	0.2725	0.2671	0.0054	280.6		64.1%				
1966	7	859,306	779,545	0.067	0.020	51,995.7	0.2780	0.2725	0.0055	286.3		64.1%				
1967	8	859,306	779,545	0.067	0.020	51,995.7	0.2837	0.2780	0.0056	292.0		64.1%				
1968	9	859,306	779,545	0.067	0.020	51,995.7	0.2894	0.2837	0.0057	297.9		64.1%				
1969	10	859,306	779,545	0.067	0.020	51,995.7	0.2952	0.2894	0.0058	304.0		64.1%				
1970	11	859,306	779,545	0.067	0.020	51,995.7	0.3012	0.2952	0.0060	310.1		64.1%				
1971	12	859,306	779,545	0.067	0.020	51,995.7	0.3073	0.3012	0.0061	316.4		64.1%				
1972	13	859,306	779,545	0.067	0.020	51,995.7	0.3135	0.3073	0.0062	322.8		64.1%				
1973	14	859,306	779,545	0.067	0.020	51,995.7	0.3198	0.3135	0.0063	329.3		64.1%				
1974	15	859,306	779,545	0.067	0.020	51,995.7	0.3263	0.3198	0.0065	335.9		64.1%				
1975	16	859,306	779,545	0.067	0.020	51,995.7	0.3329	0.3263	0.0066	342.7		64.1%				
1976	17	859,306	779,545	0.067	0.020	51,995.7	0.3396	0.3329	0.0067	349.6		64.1%				
1977	18	859,306	779,545	0.067	0.020	51,995.7	0.3465	0.3396	0.0069	356.7		64.1%				
1978	19	859,306	779,545	0.067	0.020	51,995.7	0.3535	0.3465	0.0070	363.9		64.1%				
1979	20	859,306	779,545	0.067	0.020	51,995.7	0.3606	0.3535	0.0071	371.3		64.1%				
1980	21	859,306	779,545	0.067	0.020	51,995.7	0.3679	0.3606	0.0073	378.8		64.1%				
1981	22	859,306	779,545	0.067	0.020	51,995.7	0.3753	0.3679	0.0074	386.4		64.1%				
1982	23	859,306	779,545	0.067	0.020	51,995.7	0.3829	0.3753	0.0076	394.2		64.1%				
1983	24	859,306	779,545	0.067	0.020	51,995.7	0.3906	0.3829	0.0077	402.2		64.1%				
1984	25	859,306	779,545	0.067	0.020	51,995.7	0.3985	0.3906	0.0079	410.3		64.1%				
1985	26	859,306	779,545	0.067	0.020	51,995.7	0.4066	0.3985	0.0081	418.6		64.1%				
1986	27	859,306	779,545	0.067	0.020	51,995.7	0.4148	0.4066	0.0082	427.1		64.1%				
1987	28	859,306	779,545	0.067	0.020	51,995.7	0.4232	0.4148	0.0084	435.7		64.1%				
1988	29	859,306	779,545	0.067	0.020	51,995.7	0.4317	0.4232	0.0085	444.5		64.1%				
1989	30	859,306	779,545	0.067	0.020	51,995.7	0.4404	0.4317	0.0087	453.5		64.1%				
1990	31	1,432,148	1,299,216	0.067	0.020	86,657.7	0.4493	0.4404	0.0089	771.0		64.1%				
1991	32	1,148,323	1,041,736	0.067	0.020	69,483.8	0.4584	0.4493	0.0091	630.7		64.1%				
1992	33	1,186,919	1,076,749	0.067	0.020	71,819.2	0.4677	0.4584	0.0093	665.1		64.1%				
1993	34	1,413,649	1,282,434	0.067	0.020	85,538.3	0.4771	0.4677	0.0094	808.1		64.1%				
1994	35	1,443,461	1,309,479	0.067	0.020	87,342.2	0.4868	0.4771	0.0096	841.8		64.1%				
1995	36	1,321,763	1,199,077	0.067	0.020	79,978.4	0.4966	0.4868	0.0098	786.4		64.1%				
1996	37	1,156,282	1,048,956	0.067	0.020	69,965.4	0.5066	0.4966	0.0100	701.9		64.1%				
1997	38	1,828,485	1,658,765	0.067	0.020	110,639.6	0.5169	0.5066	0.0102	1,132.3		64.1%				
1998	39	2,188,720	1,985,563	0.067	0.020	132,437.1	0.5273	0.5169	0.0104	1,382.8		64.1%				
1999	40	2,251,918	2,042,895	0.067	0.020	136,261.1	0.5379	0.5273	0.0107	1,451.5		64.1%				
2000	41	2,295,866	2,082,764	0.067	0.020	138,920.4	0.5488	0.5379	0.0109	1,509.7		64.1%				
2001	42	2,336,195	2,119,349	0.067	0.020	141,360.6	0.5599	0.5488	0.0111	1,567.2		64.1%				
2002	43	2,319,194	2,103,926	0.067	0.020	140,331.9	0.5712	0.5599	0.0113	1,587.3		64.1%				
2003	44	2,375,210	2,154,743	0.067	0.020	143,721.4	0.5827	0.5712	0.0115	1,658.4		64.1%				
2004	45	2,383,629	2,162,381	0.067	0.020	144,230.8	0.5945	0.5827	0.0118	1,697.9		64.1%				
2005	46	2,558,411	2,320,939	0.067	0.020	154,806.6	0.6065	0.5945	0.0120	1,859.2		64.1%				
2006	47	2,401,073	2,178,205	0.067	0.020	145,286.3	0.6188	0.6065	0.0123	1,780.2		64.1%				
2007	48	2,104,568	1,909,222	0.067	0.020	127,345.1	0.6313	0.6188	0.0125	1,591.8		64.1%				
2008	49	1,860,043	1,687,394	0.067	0.020	112,549.2	0.6440	0.6313	0.0128	1,435.3		64.1%				
2009	50	1,996,305	1,811,008	0.067	0.020	120,794.2	0.6570	0.6440	0.0130	1,571.6		64.1%				
2010	51	1,990,931	1,806,133	0.067	0.020	120,469.1	0.6703	0.6570	0.0133	1,599.0		64.1%				
2011	52	1,869,371	1,695,856	0.067	0.020	113,113.6	0.6839	0.6703	0.0135	1,531.7		64.1%				
2012	53	1,833,224	1,663,064	0.067	0.020	110,926.4	0.6977	0.6839	0.0138	1,532.4		64.1%				
2013	54	1,903,678	1,726,979	0.067	0.020	115,189.5	0.7118	0.6977	0.0141	1,623.5		64.1%				
2014	55	2,393,000	2,170,882	0.067	0.020	144,797.8	0.7261	0.7118	0.0144	2,082.0		64.1%				
2015	56	2,509,699	2,276,749	0.067	0.020	151,859.2	0.7408	0.7261	0.0147	2,227.6		64.1%				
2016	57	2,499,895	2,267,855	0.067	0.020	151,265.9	0.7558	0.7408	0.0150	2,263.8		64.1%				
2017	58	2,815,266	2,553,953	0.067	0.020	170,348.7	0.7711	0.7558	0.0153	2,600.9		64.1%				
2018	59	2,378,594	2,157,813	0.067	0.020	143,926.1	0.7866	0.7711	0.0156	2,241.8		64.1%				
2019	60	2,331,144	2,114,767	0.067	0.020	141,055.0	0.8025	0.7866	0.0159	2,241.5		64.1%				
2020	61	2,209,088	2,004,040	0.067	0.020	133,669.5	0.8187	0.8025	0.0162	2,167.0		64.1%				
2021	62	2,127,139	1,929,698	0.067	0.020	128,710.9	0.8353	0.8187	0.0165	2,128.8		64.1%				
2022	63	2,142,358	1,943,504	0.067	0.020	129,631.7	0.8521	0.8353	0.0169	2,187.4		64.1%				
2023	64	2,142,358	1,943,504	0.067	0.020	129,631.7	0.8694	0.8521	0.0172	2,231.5		64.1%				
2024	65	2,142,358	1,943,504	0.067	0.020	129,631.7	0.8869	0.8694	0.0176	2,276.6		64.1%				
2025	66	2,142,358	1,943,504	0.067	0.020	129,631.7	0.9048	0.8869	0.0179	2,322.6	75,202	64.1%	48,181	15%	7,227	162,611
2026	67	2,142,358	1,943,504	0.067	0.020	129,631.7	0.9231	0.9048	0.0183	2,369.5	76,280	64.1%	48,871	15%	7,331	164,941
2027	68	2,142,358	1,943,504	0.067	0.020	129,631.7	0.9418	0.9231	0.0186	2,417.4	77,336	64.1%	49,548	15%	7,432	167,226
2028	69	2,142,358	1,943,504	0.067	0.020	129,631.7	0.9608	0.9418	0.0190	2,466.2	78,372	64.1%	50,212	15%	7,532	169,465
2029	70	2,142,358	1,943,504	0.067	0.020	129,631.7	0.9802	0.9608	0.0194	2,516.1	79,387	64.1%	50,862	15%	7,629	171,659
2030	71	2,142,358	1,943,504	0.067	0.020	129,631.7	1.0000	0.9802	0.0198	2,566.9	80,382	64.1%	51,499	15%	7,725	173,811
2031	72	-	-	0.067	0.020	0.0	1.0202	1.0000	0.0202	0.0	66,698	64.1%	42,733	15%	6,410	144,223
2032	73	-	-	0.067	0.020	0.0	1.0408	1.0202	0.0206	0.0	65,378	64.1%	41,887	15%	6,283	141,367
2033	74	-	-	0.067	0.020	0.0	1.0618	1.0408	0.0210	0.0	64,083	64.1%	41,057	15%	6,159	138,568
2034	75	-	-	0.067	0.020	0.0	1.0833	1.0618	0.0215	0.0	62,814	74.4%	46,761	10%	4,676	105,212
2035	76	-	-	0.067	0.020	0.0	1.1052	1.0833	0.0219	0.0	61,570	74.4%	45,835	10%	4,584	103,129
2036	77	-	-	0.067	0.020	0.0	1.1275	1.1052	0.0223	0.0	60,351	74.4%	44,928	10%	4,493	101,087
2037	78	-	-	0.067	0.020	0.0	1.1503	1.1275	0.0228	0.0	59,156	74.4%	44,038	10%	4,404	99,085
2038	79	-	-	0.067	0.020	0.0	1.1735	1.1503	0.0232	0.0	57,985	74.4%	43,166	10%	4,317	97,123
2039	80	-	-	0.067	0.020	0.0	1.1972	1.1735	0.0237	0.0	56,837	74.4%	42,311	10%	4,231	95,200
2040	81	-	-	0.067	0.020	0.0	1.2214	1.1972	0.0242	0.0	55,711	74.4%	41,473	10%	4,147	93,315
2041	82	-	-	0.067	0.020	0.0	1.2461	1.2214	0.0247	0.0	54,608	74.4%	40,652	10%	4,065	91,467
2042	83	-	-	0.067	0.020	0.0	1.2712	1.2461	0.0252	0.0	53,527	74.4%	39,847	10%	3,985	89,656
2043	84	-	-	0.067	0.020	0.0	1.2969	1.2712	0.0257	0.0	52,467	74.4%	39,058	10%	3,906	87,881
2044	85	-	-	0.067	0.020	0.0	1.3231	1.2969	0.0262	0.0	51,428	74.4%	38,285	10%	3,828	86,141
2045	86	-	-	0.067	0.020	0.0	1.3499	1.3231	0.0267	0.0	50,410	74.4%	37,527	10%	3,753	84,435
2046	87	-	-	0.067	0.020	0.0	1.3771	1.3499	0.0273	0.0	49,411	74.4%	36,784	10%	3,678	82,763
2047	88	-	-	0.067	0.020	0.0	1.4049	1.3771	0.0278	0.0	48,433	74.4%	36,055	10%	3,606	81,124
2048	89	-	-	0.067	0.020	0.0	1.4333	1.4049	0.0284	0.0	47,474	74.4%	35,341	10%	3,534	79,518
2049	90	-	-	0.067	0.020	0.0	1.4623	1.4333	0.0290	0.0	46,534	74.4%	34,641	10%	3,464	77,943
Total		109,923,583	99,720,476												2025-2030	835,902
															2025-2035	1,539,082
															2025-2050	2,888,950

Prima Deshecha Landfill Site GHG Reduction Calculations

Equation	HH-1 Calculation, G_{CH4}: Modeled Methane Generation, metric tons	
2	Reporting Year	2050
	Reporting Year for Calculation (X=T):	56.00
	Fraction of Reporting Year:	1.00
	Lo, methane generation potential, Methane mt/waste mt	0.067
	k, rate constant year^{-1}	0.020

Year	x year in which waste was disposed	Wx Waste, tons	Wx Waste, metric tons	Lo Methane mt/waste mt	k rate constant (table HH-1)	(Wx * Lo) first term of Eq. HH-1	(exp -k(T-x-1) first e term of Eq. HH-1	(exp -k(T-x) second e term of Eq. HH-1	e term of HH-1	HH-1 G_{CH4} Modeled methane generation rate, metric tons Eq. HH-1	HH1 Modeled Methane Generation	Calibrated Collection Efficiency	Modeled Methane Capture	Emissions Reduction (MT CH4)	Emissions Reduction (MT CO2e)
1976	1	276,204	250,567	0.067	0.020	16,712.8	0.3396	0.3329	0.0067	112.4		69.3%			
1977	2	276,204	250,567	0.067	0.020	16,712.8	0.3465	0.3396	0.0069	114.7		69.3%			
1978	3	276,204	250,567	0.067	0.020	16,712.8	0.3535	0.3465	0.0070	117.0		69.3%			
1979	4	276,204	250,567	0.067	0.020	16,712.8	0.3606	0.3535	0.0071	119.3		69.3%			
1980	5	439,002	398,254	0.067	0.020	26,563.5	0.3679	0.3606	0.0073	193.5		69.3%			
1981	6	439,002	398,254	0.067	0.020	26,563.5	0.3753	0.3679	0.0074	197.4		69.3%			
1982	7	439,002	398,254	0.067	0.020	26,563.5	0.3829	0.3753	0.0076	201.4		69.3%			
1983	8	439,002	398,254	0.067	0.020	26,563.5	0.3906	0.3829	0.0077	205.5		69.3%			
1984	9	439,002	398,254	0.067	0.020	26,563.5	0.3985	0.3906	0.0079	209.6		69.3%			
1985	10	439,002	398,254	0.067	0.020	26,563.5	0.4066	0.3985	0.0081	213.9		69.3%			
1986	11	439,002	398,254	0.067	0.020	26,563.5	0.4148	0.4066	0.0082	218.2		69.3%			
1987	12	439,002	398,254	0.067	0.020	26,563.5	0.4232	0.4148	0.0084	222.6		69.3%			
1988	13	439,002	398,254	0.067	0.020	26,563.5	0.4317	0.4232	0.0085	227.1		69.3%			
1989	14	439,002	398,254	0.067	0.020	26,563.5	0.4404	0.4317	0.0087	231.7		69.3%			
1990	15	749,034	679,509	0.067	0.020	45,323.3	0.4493	0.4404	0.0089	403.3		69.3%			
1991	16	489,757	444,298	0.067	0.020	29,634.7	0.4584	0.4493	0.0091	269.0		69.3%			
1992	17	364,979	331,102	0.067	0.020	22,084.5	0.4677	0.4584	0.0093	204.5		69.3%			
1993	18	381,212	345,828	0.067	0.020	23,066.7	0.4771	0.4677	0.0094	217.9		69.3%			
1994	19	331,053	300,325	0.067	0.020	20,031.7	0.4868	0.4771	0.0096	193.1		69.3%			
1995	20	276,981	251,272	0.067	0.020	16,759.8	0.4966	0.4868	0.0098	164.8		69.3%			
1996	21	311,842	282,897	0.067	0.020	18,869.2	0.5066	0.4966	0.0100	189.3		69.3%			
1997	22	567,503	514,827	0.067	0.020	34,339.0	0.5169	0.5066	0.0102	351.4		69.3%			
1998	23	698,030	633,239	0.067	0.020	42,237.0	0.5273	0.5169	0.0104	441.0		69.3%			
1999	24	656,998	596,015	0.067	0.020	39,754.2	0.5379	0.5273	0.0107	423.5		69.3%			
2000	25	730,847	663,010	0.067	0.020	44,222.8	0.5488	0.5379	0.0109	480.6		69.3%			
2001	26	800,644	726,328	0.067	0.020	48,446.1	0.5599	0.5488	0.0111	537.1		69.3%			
2002	27	808,443	733,403	0.067	0.020	48,918.0	0.5712	0.5599	0.0113	553.3		69.3%			
2003	28	833,106	755,777	0.067	0.020	50,410.3	0.5827	0.5712	0.0115	581.7		69.3%			
2004	29	868,426	787,819	0.067	0.020	52,547.5	0.5945	0.5827	0.0118	618.6		69.3%			
2005	30	897,077	813,810	0.067	0.020	54,281.1	0.6065	0.5945	0.0120	651.9		69.3%			
2006	31	847,220	768,581	0.067	0.020	51,264.4	0.6188	0.6065	0.0123	628.1		69.3%			
2007	32	698,503	633,668	0.067	0.020	42,265.7	0.6313	0.6188	0.0125	528.3		69.3%			
2008	33	621,981	564,249	0.067	0.020	37,635.4	0.6440	0.6313	0.0128	480.0		69.3%			
2009	34	568,574	515,799	0.067	0.020	34,403.8	0.6570	0.6440	0.0130	447.6		69.3%			
2010	35	481,172	436,510	0.067	0.020	29,115.2	0.6703	0.6570	0.0133	386.5		69.3%			
2011	36	452,353	410,366	0.067	0.020	27,371.4	0.6839	0.6703	0.0135	370.6		69.3%			
2012	37	443,064	401,939	0.067	0.020	26,809.3	0.6977	0.6839	0.0138	370.4		69.3%			
2013	38	438,128	397,461	0.067	0.020	26,510.6	0.7118	0.6977	0.0141	373.6		69.3%			
2014	39	432,469	392,327	0.067	0.020	26,168.2	0.7261	0.7118	0.0144	376.3		69.3%			
2015	40	435,873	395,415	0.067	0.020	26,374.2	0.7408	0.7261	0.0147	386.9		69.3%			
2016	41	494,795	448,868	0.067	0.020	29,939.5	0.7558	0.7408	0.0150	448.1		69.3%			
2017	42	576,566	523,049	0.067	0.020	34,887.4	0.7711	0.7558	0.0153	532.7		69.3%			
2018	43	575,945	522,486	0.067	0.020	34,849.8	0.7866	0.7711	0.0156	542.8		69.3%			
2019	44	606,413	550,126	0.067	0.020	36,693.4	0.8025	0.7866	0.0159	583.1		69.3%			
2020	45	717,034	650,479	0.067	0.020	43,386.9	0.8187	0.8025	0.0162	703.4		69.3%			
2021	46	626,178	568,056	0.067	0.020	37,889.3	0.8353	0.8187	0.0165	626.7		69.3%			
2022	47	685,606	621,968	0.067	0.020	41,485.3	0.8521	0.8353	0.0169	700.0		69.3%			
2023	48	685,606	621,968	0.067	0.020	41,485.3	0.8694	0.8521	0.0172	714.1		69.3%			
2024	49	685,606	621,968	0.067	0.020	41,485.3	0.8869	0.8694	0.0176	728.6		69.3%			
2025	50	685,606	621,968	0.067	0.020	41,485.3	0.9048	0.8869	0.0179	743.3	21,189	69.3%	14,674	2,201	49,525
2026	51	685,606	621,968	0.067	0.020	41,485.3	0.9231	0.9048	0.0183	758.3	21,591	69.3%	14,953	2,243	50,465
2027	52	685,606	621,968	0.067	0.020	41,485.3	0.9418	0.9231	0.0186	773.6	21,985	69.3%	15,225	2,284	51,386
2028	53	685,606	621,968	0.067	0.020	41,485.3	0.9608	0.9418	0.0190	789.3	22,371	69.3%	15,493	2,324	52,288
2029	54	685,606	621,968	0.067	0.020	41,485.3	0.9802	0.9608	0.0194	805.2	22,749	69.3%	15,755	2,363	53,173
2030	55	685,606	621,968	0.067	0.020	41,485.3	1.0000	0.9802	0.0198	821.5	23,120	69.3%	16,012	2,402	54,040
2031	56	2,120,986	1,924,116	0.067	0.020	128,338.5	1.0202	1.0000	0.0202	2,592.6	23,484	69.3%	16,264	2,440	54,890
2032	57	2,120,986	1,924,116	0.067	0.020	128,338.5	1.0408	1.0202	0.0206	2,645.0	25,560	69.3%	17,702	2,655	59,743
2033	58	2,120,986	1,924,116	0.067	0.020	128,338.5	1.0618	1.0408	0.0210	2,698.4	27,595	69.3%	19,111	2,867	64,500
2034	59	2,120,986	1,924,116	0.067	0.020	128,338.5	1.0833	1.0618	0.0215	2,752.9	29,590	69.3%	20,493	3,074	69,162
2035	60	2,120,986	1,924,116	0.067	0.020	128,338.5	1.1052	1.0833	0.0219	2,808.5	31,545	69.3%	21,847	3,277	73,733
2036	61	2,120,986	1,924,116	0.067	0.020	128,338.5	1.1275	1.1052	0.0223	2,865.3	33,462	69.3%	23,174	3,476	78,212
2037	62	2,120,986	1,924,116	0.067	0.020	128,338.5	1.1503	1.1275	0.0228	2,923.2	35,341	69.3%	24,475	3,671	82,604
2038	63	2,120,986	1,924,116	0.067	0.020	128,338.5	1.1735	1.1503	0.0232	2,982.2	37,182	69.3%	25,750	3,863	86,908
2039	64	2,120,986	1,924,116	0.067	0.020	128,338.5	1.1972	1.1735	0.0237	3,042.5	38,987	69.3%	27,000	4,050	91,127
2040	65	2,120,986	1,924,116	0.067	0.020	128,338.5	1.2214	1.1972	0.0242	3,103.9	40,757	69.3%	28,226	4,234	95,262
2041	66	2,120,986	1,924,116	0.067	0.020	128,338.5	1.2461	1.2214	0.0247	3,166.6	42,491	69.3%	29,427	4,414	99,316
2042	67	2,120,986	1,924,116	0.067	0.020	128,338.5	1.2712	1.2461	0.0252	3,230.6	44,191	69.3%	30,604	4,591	103,289
2043	68	2,120,986	1,924,116	0.067	0.020	128,338.5	1.2969	1.2712	0.0257	3,295.9	45,857	69.3%	31,758	4,764	107,183
2044	69	2,120,986	1,924,116	0.067	0.020	128,338.5	1.3231	1.2969	0.0262	3,362.4	47,490	69.3%	32,889	4,933	111,001
2045	70	2,120,986	1,924,116	0.067	0.020	128,338.5	1.3499	1.3231	0.0267	3,430.4	49,091	69.3%	33,998	5,100	114,743
2046	71	2,120,986	1,924,116	0.067	0.020	128,338.5	1.3771	1.3499	0.0273	3,499.7	50,660	69.3%	35,085	5,263	118,410
2047	72	2,120,986	1,924,116	0.067	0.020	128,338.5	1.4049	1.3771	0.0278	3,570.4	52,198	69.3%	36,150	5,422	122,006
2048	73	2,120,986	1,924,116	0.067	0.020	128,338.5	1.4333	1.4049	0.0284	3,642.5	53,706	69.3%	37,194	5,579	125,530
2049	74	2,120,986	1,924,116	0.067	0.020	128,338.5	1.4623	1.4333	0.0290	3,716.1	55,184	69.3%	38,217	5,733	128,984
Total		70,746,220	64,179,556												

2025-2030	256,836
2025-2035	559,171
2025-2050	2,097,476

Santiago Closed Landfill Site GHG Reduction Calculations

Equation	HH-1 Calculation, G_{CH4}: Modeled Methane Generation, metric tons	
2	Reporting Year	2024
	Reporting Year for Calculation (X=T):	57.00
	Fraction of Reporting Year:	1.00
	Lo, methane generation potential, Methane mt/waste mt	0.067
	k, rate constant year^{-1}	0.020

Year	x year in which waste was disposed	Wx Waste, tons	Wx Waste, metric tons	Lo Methane mt/waste mt	k rate constant (table HH-1)	(Wx * Lo) first term of Eq. HH-1	(exp -k(T-x-1) first e term of Eq. HH-1	(exp -k(T-x) second e term of Eq. HH-1	e term of HH-1	HH-1 G_{CH4} Modeled methane generation rate, metric tons Eq. HH-1	HH1 Modeled Methane Generation	Calibrated Collection Efficiency	Modeled Methane Capture	Emissions Reduction (MT CH4)	Emissions Reduction (MT CO2e)
1968	1	397,218	360,348	0.067	0.020	24,035.2	0.3329	0.3263	0.0066	158.4		45.6%			
1969	2	397,218	360,348	0.067	0.020	24,035.2	0.3396	0.3329	0.0067	161.6		45.6%			
1970	3	397,218	360,348	0.067	0.020	24,035.2	0.3465	0.3396	0.0069	164.9		45.6%			
1971	4	397,218	360,348	0.067	0.020	24,035.2	0.3535	0.3465	0.0070	168.2		45.6%			
1972	5	397,218	360,348	0.067	0.020	24,035.2	0.3606	0.3535	0.0071	171.6		45.6%			
1973	6	397,218	360,348	0.067	0.020	24,035.2	0.3679	0.3606	0.0073	175.1		45.6%			
1974	7	397,218	360,348	0.067	0.020	24,035.2	0.3753	0.3679	0.0074	178.6		45.6%			
1975	8	397,218	360,348	0.067	0.020	24,035.2	0.3829	0.3753	0.0076	182.2		45.6%			
1976	9	397,218	360,348	0.067	0.020	24,035.2	0.3906	0.3829	0.0077	185.9		45.6%			
1977	10	397,218	360,348	0.067	0.020	24,035.2	0.3985	0.3906	0.0079	189.7		45.6%			
1978	11	397,218	360,348	0.067	0.020	24,035.2	0.4066	0.3985	0.0081	193.5		45.6%			
1979	12	397,218	360,348	0.067	0.020	24,035.2	0.4148	0.4066	0.0082	197.4		45.6%			
1980	13	397,218	360,348	0.067	0.020	24,035.2	0.4232	0.4148	0.0084	201.4		45.6%			
1981	14	397,218	360,348	0.067	0.020	24,035.2	0.4317	0.4232	0.0085	205.5		45.6%			
1982	15	397,218	360,348	0.067	0.020	24,035.2	0.4404	0.4317	0.0087	209.6		45.6%			
1983	16	397,218	360,348	0.067	0.020	24,035.2	0.4493	0.4404	0.0089	213.8		45.6%			
1984	17	397,218	360,348	0.067	0.020	24,035.2	0.4584	0.4493	0.0091	218.2		45.6%			
1985	18	397,218	360,348	0.067	0.020	24,035.2	0.4677	0.4584	0.0093	222.6		45.6%			
1986	19	397,218	360,348	0.067	0.020	24,035.2	0.4771	0.4677	0.0094	227.1		45.6%			
1987	20	397,218	360,348	0.067	0.020	24,035.2	0.4868	0.4771	0.0096	231.7		45.6%			
1988	21	397,218	360,348	0.067	0.020	24,035.2	0.4966	0.4868	0.0098	236.3		45.6%			
1989	22	397,218	360,348	0.067	0.020	24,035.2	0.5066	0.4966	0.0100	241.1		45.6%			
1990	23	1,190,649	1,080,133	0.067	0.020	72,044.9	0.5169	0.5066	0.0102	737.3		45.6%			
1991	24	1,445,407	1,311,244	0.067	0.020	87,460.0	0.5273	0.5169	0.0104	913.2		45.6%			
1992	25	1,445,344	1,311,187	0.067	0.020	87,456.2	0.5379	0.5273	0.0107	931.6		45.6%			
1993	26	678,503	615,524	0.067	0.020	41,055.5	0.5488	0.5379	0.0109	446.2		45.6%			
1994	27	5,704	5,175	0.067	0.020	345.2	0.5599	0.5488	0.0111	3.8		45.6%			
1995	28	5,704	5,175	0.067	0.020	345.2	0.5712	0.5599	0.0113	3.9		45.6%			
1996	29	540	490	0.067	0.020	32.7	0.5827	0.5712	0.0115	0.4		45.6%			
1997	30	-	-	0.067	0.020	0.0	0.5945	0.5827	0.0118	0.0		45.6%			
1998	31	8,232	7,468	0.067	0.020	498.1	0.6065	0.5945	0.0120	6.0		45.6%			
1999	32	-	-	0.067	0.020	0.0	0.6188	0.6065	0.0123	0.0		45.6%			
2000	33	3,314	3,006	0.067	0.020	200.5	0.6313	0.6188	0.0125	2.5		45.6%			
2001	34	-	-	0.067	0.020	0.0	0.6440	0.6313	0.0128	0.0		45.6%			
2002	35	-	-	0.067	0.020	0.0	0.6570	0.6440	0.0130	0.0		45.6%			
2003	36	-	-	0.067	0.020	0.0	0.6703	0.6570	0.0133	0.0		45.6%			
2004	37	-	-	0.067	0.020	0.0	0.6839	0.6703	0.0135	0.0		45.6%			
2005	38	-	-	0.067	0.020	0.0	0.6977	0.6839	0.0138	0.0		45.6%			
2006	39	-	-	0.067	0.020	0.0	0.7118	0.6977	0.0141	0.0		45.6%			
2007	40	-	-	0.067	0.020	0.0	0.7261	0.7118	0.0144	0.0		45.6%			
2008	41	-	-	0.067	0.020	0.0	0.7408	0.7261	0.0147	0.0		45.6%			
2009	42	-	-	0.067	0.020	0.0	0.7558	0.7408	0.0150	0.0		45.6%			
2010	43	-	-	0.067	0.020	0.0	0.7711	0.7558	0.0153	0.0		45.6%			
2011	44	-	-	0.067	0.020	0.0	0.7866	0.7711	0.0156	0.0		45.6%			
2012	45	-	-	0.067	0.020	0.0	0.8025	0.7866	0.0159	0.0		45.6%			
2013	46	-	-	0.067	0.020	0.0	0.8187	0.8025	0.0162	0.0		45.6%			
2014	47	-	-	0.067	0.020	0.0	0.8353	0.8187	0.0165	0.0		45.6%			
2015	48	-	-	0.067	0.020	0.0	0.8521	0.8353	0.0169	0.0		45.6%			
2016	49	-	-	0.067	0.020	0.0	0.8694	0.8521	0.0172	0.0		45.6%			
2017	50	-	-	0.067	0.020	0.0	0.8869	0.8694	0.0176	0.0		45.6%			
2018	51	-	-	0.067	0.020	0.0	0.9048	0.8869	0.0179	0.0		45.6%			
2019	52	-	-	0.067	0.020	0.0	0.9231	0.9048	0.0183	0.0		45.6%			
2020	53	-	-	0.067	0.020	0.0	0.9418	0.9231	0.0186	0.0		45.6%			
2021	54	-	-	0.067	0.020	0.0	0.9608	0.9418	0.0190	0.0		45.6%			
2022	55	-	-	0.067	0.020	0.0	0.9802	0.9608	0.0194	0.0		45.6%			
2023	56	-	-	0.067	0.020	0.0	1.0000	0.9802	0.0198	0.0		45.6%			
2024	57	-	-	0.067	0.020	0.0	1.0202	1.0000	0.0202	0.0		45.6%			
2025	58	-	-	0.067	0.020	0.0	1.0408	1.0202	0.0206	0.0	7,233	45.6%	3,300	330	7,425
2026	59	-	-	0.067	0.020	0.0	1.0618	1.0408	0.0210	0.0	7,090	45.6%	3,235	323	7,278
2027	60	-	-	0.067	0.020	0.0	1.0833	1.0618	0.0215	0.0	6,950	45.6%	3,171	317	7,134
2028	61	-	-	0.067	0.020	0.0	1.1052	1.0833	0.0219	0.0	6,812	45.6%	3,108	311	6,993
2029	62	-	-	0.067	0.020	0.0	1.1275	1.1052	0.0223	0.0	6,677	45.6%	3,046	305	6,854
2030	63	-	-	0.067	0.020	0.0	1.1503	1.1275	0.0228	0.0	6,545	45.6%	2,986	299	6,719
2031	64	-	-	0.067	0.020	0.0	1.1735	1.1503	0.0232	0.0	6,415	45.6%	2,927	293	6,586
2032	65	-	-	0.067	0.020	0.0	1.1972	1.1735	0.0237	0.0	6,288	45.6%	2,869	287	6,455
2033	66	-	-	0.067	0.020	0.0	1.2214	1.1972	0.0242	0.0	6,164	45.6%	2,812	281	6,327
2034	67	-	-	0.067	0.020	0.0	1.2461	1.2214	0.0247	0.0	6,042	45.6%	2,756	276	6,202
2035	68	-	-	0.067	0.020	0.0	1.2712	1.2461	0.0252	0.0	5,922	45.6%	2,702	270	6,079
2036	69	-	-	0.067	0.020	0.0	1.2969	1.2712	0.0257	0.0	5,805	45.6%	2,648	265	5,959
2037	70	-	-	0.067	0.020	0.0	1.3231	1.2969	0.0262	0.0	5,690	45.6%	2,596	260	5,841
2038	71	-	-	0.067	0.020	0.0	1.3499	1.3231	0.0267	0.0	5,577	45.6%	2,545	254	5,725
2039	72	-	-	0.067	0.020	0.0	1.3771	1.3499	0.0273	0.0	5,467	45.6%	2,494	249	5,612
2040	73	-	-	0.067	0.020	0.0	1.4049	1.3771	0.0278	0.0	5,358	45.6%	2,445	244	5,501
2041	74	-	-	0.067	0.020	0.0	1.4333	1.4049	0.0284	0.0	5,252	45.6%	2,396	240	5,392
2042	75	-	-	0.067	0.020	0.0	1.4623	1.4333	0.0290	0.0	5,148	45.6%	2,349	235	5,285
2043	76	-	-	0.067	0.020	0.0	1.4918	1.4623	0.0295	0.0	5,046	45.6%	2,302	230	5,180
2044	77	-	-	0.067	0.020	0.0	1.5220	1.4918	0.0301	0.0	4,946	45.6%	2,257	226	5,078
2045	78	-	-	0.067	0.020	0.0	1.5527	1.5220	0.0307	0.0	4,849	45.6%	2,212	221	4,977
2046	79	-	-	0.067	0.020	0.0	1.5841	1.5527	0.0314	0.0	4,753	45.6%	2,168	217	4,879
2047	80	-	-	0.067	0.020	0.0	1.6161	1.5841	0.0320	0.0	4,658	45.6%	2,125	213	4,782
2048	81	-	-	0.067	0.020	0.0	1.6487	1.6161	0.0326	0.0	4,566	45.6%	2,083	208	4,687
2049	82	-	-	0.067	0.020	0.0	1.6820	1.6487	0.0333	0.0	4,476	45.6%	2,042	204	4,595
Total		13,522,187	12,267,058												

2025-2030	35,684
2025-2035	67,973
2025-2050	147,544

Attachment C

List of Orange County CEJST LIDACs

TABLE: ORANGE COUNTY CEJST LIDACS

Orange County Census Tracts							
6059011601	6059110402	6059088701	6059074502	6059099703	6059075100	6059087806	6059088905
6059062625	6059110500	6059074806	6059075201	6059099904	6059075202	6059088107	6059099247
6059087803	6059086702	6059075003	6059076103	6059074200	6059074803	6059099702	6059063808
6059088104	6059110201	6059075514	6059001404	6059074408	6059074902	6059099802	6059074102
6059088403	6059086502	6059086406	6059001801	6059074805	6059074005	6059099223	6059074602
6059088602	6059086901	6059087601	6059075002	6059074901	6059074403	6059087300	6059074701
6059088801	6059087101	6059087802	6059001304	6059075004	6059074501	6059086903	6059087801
6059088802	6059088201	6059088502	6059001401	6059099249	6059074801	6059088002	6059087105
6059089003	6059110603	6059088702	6059011720	6059087505	6059087405	6059089001	6059087200
6059089004	6059110606	6059089102	6059001201	6059099203	6059087503	6059087602	6059087403
6059089105	6059001802	6059089104	6059087002	6059074702	6059087902	6059099226	6059088001
6059099222	6059011602	6059089106	6059087404	6059088501	6059099204	6059088601	6059088106
6059099229	6059042312	6059099202	6059087504	6059076204	6059086501	6059074601	6059088402
6059063605	6059021813	6059087106	6059087901	6059076102	6059001202	6059099248	6059088902
6059063702	6059001103	6059086404	6059088301	6059086802	6059074405	6059099250	6059088904
6059110202	6059074407	6059086405	6059088901	6059088203	6059074406	6059099801	6059011101
6059099601	6059074802	6059086601	6059088903	6059088302	6059063701	6059110110	6059099402
6059099903	6059099701	6059099803					

Source: CEJST 2023

Attachment D

SLP GHG Reduction Measure

Detailed Budget

Detailed Budget Table - Orange County SLP GHG Reduction Measure

Summary Tables

BUDGET BY YEAR								
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**		**TOTAL**
Direct Costs	TOTAL PERSONNEL	*$500,926*	*$518,459*	*$536,605*	*$555,386*	*$574,825*		*$2,686,201*
	TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*		*$0*
	TOTAL TRAVEL	*$0*	*$0*	*$0*	*$0*	*$0*		*$0*
	TOTAL EQUIPMENT	*$10,949,539*	*$0*	*$0*	*$0*	*$0*		*$10,949,539*
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*		*$0*
	TOTAL CONTRACTUAL	*$2,405,000*	*$2,000,400*	*$2,000,400*	*$2,000,400*	*$2,000,400*		*$10,406,600*
	TOTAL OTHER	*$112,880*	*$83,280*	*$83,280*	*$83,280*	*$83,280*		*$446,000*
	TOTAL DIRECT	*$13,968,345*	*$2,602,139*	*$2,620,285*	*$2,639,066*	*$2,658,505*		*$24,488,340*
	TOTAL INDIRECT	$0	$0	$0	$0	$0		0
TOTAL FUNDING		**$13,968,345**	**$2,602,139**	**$2,620,285**	**$2,639,066**	**$2,658,505**		**$24,488,340**

BUDGET BY PROJECT			
Project Number	**Project Name**	**Total Cost**	**% of Total**
1	*Olinda Alpha - Active Site*	*$9,829,303*	*40%*
2	*Frank R. Bowerman - Active Site*	*$5,764,106*	*24%*
3	*Prima Deshecha - Active Site*	*$3,166,588*	*13%*
4	*Coyote Canyon - Closed Site*	*$3,715,221*	*15%*
5	*Santiago Canyon - Closed Site*	*$2,013,121*	*8%*
Total		*$24,488,340*	*100%*

Detailed Budget Table - Olinda Alpha Landfill SLP

BUDGET BY YEAR								
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**		**TOTAL**
Direct Costs	**Personnel**							
	Smart Landfill Program Data Specialist - Civil Engineering Associate: On behalf of the Departmental Region, this position is responsible for obtaining, reviewing, and interpreting data to identify and implement system optimization plans and maintenance activites. 2024 Max Annual Salary is $114,525 and 3.5% COLA adjusted annually	*$114,525*	*$118,533*	*$122,682*	*$126,976*	*$131,420*		*$614,135*
	Instrumentation and Controls Engineer - Sr. Professional Engineer: On behalf of the Department, lead the SLP and the 3 SLP Data Specialists, incuding overall program oversight. 2024 Max Annual Salary is $157,352 and a 3.5% COLA adjusted annually.	*$157,352*	*$162,859*	*$168,559*	*$174,459*	*$180,565*		*$843,795*
								$0
	TOTAL PERSONNEL	*$271,877*	*$281,392*	*$291,241*	*$301,435*	*$311,985*		*$1,457,930*
	Fringe Benefits							
								$0
								$0
								$0

TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Travel						
						$0
						$0
						$0
						$0
						$0
						$0
						$0
						$0
TOTAL TRAVEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Equipment						
Wellhead Sensor/Controllers & Header Sensors (370 @ $9,750 each)	*$3,607,500*					*$3,607,500*
1 Drone fitted with Methane Sensor	*$90,000*					*$90,000*
Connectivity/Mesh Network (Equipment & Installation)	*$510,673*					*$510,673*
10 Liquid Level Measurement Devices @ $175 each	*$17,500*					*$17,500*
TOTAL EQUIPMENT	*$4,225,673*	*$0*	*$0*	*$0*	*$0*	*$4,225,673*
Supplies						
						$0
						$0
TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Contractual						
Wellhead Sensor and Controller Installation	*$129,500*					*$129,500*
Wellhead Sensor and Controller Shipping	*$24,000*					*$24,000*
Wellhead Sensor and Controller Maintenance and Platform	*$780,600*	*$780,600*	*$780,600*	*$780,600*	*$780,600*	*$3,903,000*
						$0
TOTAL CONTRACTUAL	*$934,100*	*$780,600*	*$780,600*	*$780,600*	*$780,600*	*$4,056,500*

	OTHER						
	Connectivity Engineering Design Fee	*$5,920*					*$5,920*
	Annual Starlink Connectivity Subscription	*$6,000*	$6,000	$6,000	$6,000	$6,000	*$30,000*
	Connectivity System Maintenance	*$10,656*	$10,656	$10,656	$10,656	$10,656	*$53,280*
	TOTAL OTHER	*$22,576*	*$16,656*	*$16,656*	*$16,656*	*$16,656*	*$89,200*
	TOTAL DIRECT	*$5,454,226*	*$1,078,648*	*$1,088,497*	*$1,098,691*	*$1,109,241*	*$9,829,303*

Indirect Costs	**Indirect Costs**						
							$0
							$0
	TOTAL INDIRECT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*

TOTAL FUNDING		***$5,454,226***	***$1,078,648***	***$1,088,497***	***$1,098,691***	***$1,109,241***	***$9,829,303***

Detailed Budget Table - Frank R. Bowerman Landfill SLP

BUDGET BY YEAR							
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	**Personnel**						
	Smart Landfill Program Data Specialist - Civil Engineering Associate: On behalf of the Departmental Region, this position is responsible for obtaining, reviewing, and interpreting data to identify and implement system optimization plans and maintenance activites. 2024 Max Annual Salary is $114,525 and 3.5% COLA adjusted annually	*$114,525*	*$118,533*	*$122,682*	*$126,976*	*$131,420*	*$614,135*
							$0
							$0
	TOTAL PERSONNEL	*$114,525*	*$118,533*	*$122,682*	*$126,976*	*$131,420*	*$614,135*
	Fringe Benefits						
							$0
							$0
							$0
	TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Travel						
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0

							$0
	TOTAL TRAVEL	$0	$0	$0	$0	$0	$0
	Equipment						
	Wellhead Sensor/Controllers & Header Sensors (215 @ $9,750 each)	$2,096,250					$2,096,250
	1 Drone fitted with Methane Sensor	$90,000					$90,000
	Connectivity/Mesh Network (Equipment & Installation)	$490,071					$490,071
	10 Liquid Level Measurement Devices @ $175 each	$17,500					$17,500
	TOTAL EQUIPMENT	$2,693,821	$0	$0	$0	$0	$2,693,821
	Supplies						
							$0
							$0
	TOTAL SUPPLIES	$0	$0	$0	$0	$0	$0
	Contractual						
	Wellhead Sensor and Controller Installation	$75,250					$75,250
	Wellhead Sensor and Controller Shipping	$16,200					$16,200
	Wellhead Sensor and Controller Maintenance and Platform	$455,100	$455,100	$455,100	$455,100	$455,100	$2,275,500
							$0
							$0
	TOTAL CONTRACTUAL	$546,550	$455,100	$455,100	$455,100	$455,100	$2,366,950
	OTHER						
	Connectivity Engineering Design Fee	$5,920					$5,920
	Annual Starlink Connectivity Subscription	$6,000	$6,000	$6,000	$6,000	$6,000	$30,000
	Connectivity System Maintenance	$10,656	$10,656	$10,656	$10,656	$10,656	$53,280
							$0
							$0
							$0
	TOTAL OTHER	$22,576	$16,656	$16,656	$16,656	$16,656	$89,200
	TOTAL DIRECT	$3,377,472	$590,289	$594,438	$598,732	$603,176	$5,764,106

Indirect Cos	**Indirect Costs**						

							$0
							$0
	TOTAL INDIRECT	$0	$0	$0	$0	$0	$0
TOTAL FUNDING		***$3,377,472***	***$590,289***	***$594,438***	***$598,732***	***$603,176***	***$5,764,106***

Detailed Budget Table - Prima Deshecha Landfill SLP

BUDGET BY YEAR							
COST-TYPE	CATEGORY	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	TOTAL
Direct Costs	**Personnel**						
	Smart Landfill Program Data Specialist - Civil Engineering Associate: On behalf of the Departmental Region, this position is responsible for obtaining, reviewing, and interpreting data to identify and implement system optimization plans and maintenance activites. 2024 Max Annual Salary is $114,525 and 3.5% COLA adjusted annually	*$114,525*	*$118,533*	*$122,682*	*$126,976*	*$131,420*	*$614,135*
							$0
							$0
	TOTAL PERSONNEL	*$114,525*	*$118,533*	*$122,682*	*$126,976*	*$131,420*	*$614,135*
	Fringe Benefits						
							$0
							$0
							$0
	TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Travel						
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
	TOTAL TRAVEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Equipment						
	Wellhead Sensor/Controllers & Header Sensors (85 @ $9,750 each)	*$828,750*					*$828,750*

	1 Drone fitted with Methane Sensor	*$90,000*					*$90,000*
	Connectivity/Mesh Network (Equipment & Installation)	*576,753*					*$576,753*
	10 Liquid Level Measurement Devices @ $175 each	*$17,500*					*$17,500*
	TOTAL EQUIPMENT	*$1,513,003*	*$0*	*$0*	*$0*	*$0*	*$1,513,003*
	Supplies						
							$0
							$0
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Contractual						
	Wellhead Sensor and Controller Installation	*$29,750*					*$29,750*
	Wellhead Sensor and Controller Shipping	*$10,000*					*$10,000*
	Wellhead Sensor and Controller Maintenance and Platform	*$182,100*	*$182,100*	*$182,100*	*$182,100*	*$182,100*	*$910,500*
							$0
							$0
	TOTAL CONTRACTUAL	*$221,850*	*$182,100*	*$182,100*	*$182,100*	*$182,100*	*$950,250*
	OTHER						
	Connectivity Engineering Design Fee	*$5,920*					*$5,920*
	Annual Starlink Connectivity Subscription	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$30,000*
	Connectivity System Maintenance	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$53,280*
							$0
							$0
							$0
	TOTAL OTHER	*$22,576*	*$16,656*	*$16,656*	*$16,656*	*$16,656*	*$89,200*
	TOTAL DIRECT	*$1,871,954*	*$317,289*	*$321,438*	*$325,732*	*$330,176*	*$3,166,588*
Indirect Costs	**Indirect Costs**						
							$0
							$0
	TOTAL INDIRECT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
TOTAL FUNDING		***$1,871,954***	***$317,289***	***$321,438***	***$325,732***	***$330,176***	***$3,166,588***

Detailed Budget Table - Coyote Canyon Closed Landfill SLP

BUDGET BY YEAR							
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
Direct Costs	**Personnel**						
	SLP Data Specialist Position covered by Prima SLP Specialist, therefore no cost						*$0*
							$0
							$0
	TOTAL PERSONNEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Fringe Benefits						
							$0
							$0
							$0
	TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Travel						
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
	TOTAL TRAVEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Equipment						
	Wellhead Sensor/Controllers & Header Sensors (160 @ $9,750 each)	*1,560,000*					*$1,560,000*
	1 Drone fitted with Methane Sensor	*90,000*					*$90,000*
	Connectivity/Mesh Network (Equipment & Installation)	*192,521*					*$192,521*
	10 Liquid Level Measurement Devices @ $175 each	*$17,500*					*$17,500*
	TOTAL EQUIPMENT	*$1,860,021*	*$0*	*$0*	*$0*	*$0*	*$1,860,021*

	Supplies						
							$0
							$0
	TOTAL SUPPLIES	$0	$0	$0	$0	$0	$0
	Contractual						
	Wellhead Sensor and Controller Installation	*$56,000*					*$56,000*
	Wellhead Sensor and Controller Shipping	*$12,000*					*$12,000*
	Wellhead Sensor and Controller Maintenance and Platform	*$339,600*	*$339,600*	*$339,600*	*$339,600*	*$339,600*	*$1,698,000*
							$0
	TOTAL CONTRACTUAL	$407,600	$339,600	$339,600	$339,600	$339,600	$1,766,000
	Other						
	Connectivity Engineering Design Fee	*$5,920*					*$5,920*
	Annual Starlink Connectivity Subscription	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$30,000*
	Connectivity System Maintenance	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$53,280*
							$0
							$0
							$0
	TOTAL OTHER	$22,576	$16,656	$16,656	$16,656	$16,656	$89,200
	TOTAL DIRECT	$2,290,197	$356,256	$356,256	$356,256	$356,256	$3,715,221

Indirect Costs	**Indirect Costs**						
							$0
							$0
	TOTAL INDIRECT	$0	$0	$0	$0	$0	$0

TOTAL FUNDING		***$2,290,197***	***$356,256***	***$356,256***	***$356,256***	***$356,256***	***$3,715,221***

Detailed Budget Table - Santiago Canyon Closed Landfill SLP

BUDGET BY YEAR							
COST-TYPE	**CATEGORY**	**YEAR 1**	**YEAR 2**	**YEAR 3**	**YEAR 4**	**YEAR 5**	**TOTAL**
Direct Costs	**Personnel**						
	SLP Data Specialist Position covered by FRB SLP Specialist, therefore no cost						*$0*
							$0
							$0
	TOTAL PERSONNEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Fringe Benefits						
							$0
							$0
							$0
	TOTAL FRINGE BENEFITS	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Travel						
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
							$0
	TOTAL TRAVEL	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Equipment						
	Wellhead Sensor/Controllers & Header Sensors (114 @ $9,750 each)	*$357,000*					*$357,000*
	1 Drone fitted with Methane Sensor	*$90,000*					*$90,000*
	Connectivity/Mesh Network (Equipment & Installation)	*$192,521*					*$192,521*
	10 Liquid Level Measurement Devices @ $175 each	*$17,500*					*$17,500*
	TOTAL EQUIPMENT	*$657,021*	*$0*	*$0*	*$0*	*$0*	*$657,021*
	Supplies						
							$0

							$0
	TOTAL SUPPLIES	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
	Contractual						
	Wellhead Sensor and Controller Installation	*$39,900*					*$39,900*
	Wellhead Sensor and Controller Shipping	*$12,000*					*$12,000*
	Wellhead Sensor and Controller Maintenance and Platform	*$243,000*	*$243,000*	*$243,000*	*$243,000*	*$243,000*	*$1,215,000*
							$0
	TOTAL CONTRACTUAL	*$294,900*	*$243,000*	*$243,000*	*$243,000*	*$243,000*	*$1,266,900*
	OTHER						
	Connectivity Engineering Design Fee	*$5,920*					*$5,920*
	Annual Starlink Connectivity Subscription	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$6,000*	*$30,000*
	Connectivity System Maintenance	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$10,656*	*$53,280*
							$0
							$0
							$0
	TOTAL OTHER	*$22,576*	*$16,656*	*$16,656*	*$16,656*	*$16,656*	*$89,200*
	TOTAL DIRECT	*$974,497*	*$259,656*	*$259,656*	*$259,656*	*$259,656*	*$2,013,121*
Indirect Costs	**Indirect Costs**						
							$0
							$0
	TOTAL INDIRECT	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
TOTAL FUNDING		***$974,497***	***$259,656***	***$259,656***	***$259,656***	***$259,656***	***$2,013,121***