Statement of Qualifications
Solid Waste Advisory Services

Geosyntec consultants
Geosyntec Consultants is a specialized technical advisory and consulting engineering firm that works with private and public-sector clients to address their complex challenges involving the environment, natural resources, and civil infrastructure. Geosyntec’s team of over 1,200 engineers, geologists, environmental scientists, and other technical and project staff are based in more than 80 offices across the United States as well as Canada, Europe, and Australia.

Our private sector clients come from a variety of industries including power and utility, environmental management, food and agriculture, oil and gas, advanced technology, chemical, aerospace, pharmaceutical, and manufacturing. Our private sector clients also include regional and national developers, large commercial property owners, and law firms. Our public-sector clients are departments and agencies of municipal, state/provincial, regional, and national governments.

Since our founding in 1983, we have grown based on the application of sustainability principles to projects involving engineering and design for the environmental, water resources, and civil infrastructure, environmental contamination studies and remediation; natural resources assessment and restoration; compliance management for air emissions, wastewater discharges, and waste disposal. We also provide construction management and quality assurance services in support of these practices.

Our goal is to provide the best possible service and value to our clients, to advance technology in our primary practice areas, and to provide a stimulating, progressive, and friendly work environment that will enable us to continue to recruit and retain great staff. At Geosyntec, our vision of success builds on our internal culture of technical excellence, the outstanding qualities of our staff, a common commitment to our core values, and our long-held belief that exceptional client service coupled with exceptional project solutions will result in long-term, mutually rewarding business solutions. We bring our clients the dedicated, personal service of a small, local firm, backed by the knowledge and experience of a larger, established firm. We are proud of the significant volume of repeat business that we earn from existing clients as being representative of the trust they place in our continued ability to deliver.

We are known for our technology leadership, broad experience, and exceptional client service

www.geosyntec.com
With over 30 years of service, our professionals have been involved in more than 1,000 solid waste management projects for private clients as well as municipalities, local and state governments, regional authorities, and national governmental agencies. The range of professional services provided by Geosyntec includes:

- Solid waste minimization, diversion, and recycling studies;
- Waste flow analysis (collection and hauling), composition, and generation studies;
- Strategic planning and transactional advice;
- Financial modeling, due diligence, and cost/benefit analyses for solid waste facilities;
- Optimization of financial and operations management; and
- Design, permitting, construction, repair/maintenance, and decommissioning/closure of transfer stations, materials recovery facilities (MRFs), composting facilities, and landfills.

Unique amongst our peer firms, in addition to technical services Geosyntec provides due diligence and financial advisory specialists who offer a wealth of experience evaluating solid waste systems and infrastructure assets under a variety of project delivery and contracting mechanisms. Our clients – both private and public – are increasingly driven to improve performance, secure value for money, achieve required returns, and optimize use of assets. To assist their understanding of market drivers and operational issues, our advisory specialists translate technical and commercial issues into financial analyses, valuations, and support for financial models, with clear recommendations made without bias or allegiance to any vendor, service, or product. Geosyntec’s exceptional advisory capabilities are made possible by our practice leaders’ unique understanding of the symbiotic relationship between the technical aspects and the financial performance of solid waste projects. The technical and financial expertise of our practitioners allows Geosyntec to be a trusted advisory resource for counties, municipalities, states, and solid waste authorities.

Additional information on our dedicated capital, assets, and transactions (CAT) advisory services is available at www.geosyntec-cat.com
Strategic Planning and Decision-Making Support

Geosyntec offers deep experience and knowledge of solid waste planning in accordance with state and local goals for waste diversion and recycling while considering dynamic market conditions. Our expertise is built upon a legacy of being recognized leaders in helping our clients implement environmental solutions in a safe, efficient, and cost-effective manner. We are emerging as national leaders in sustainable materials management, specializing in identifying strategies to accomplish financial and environmental goals established with stakeholders and preparing action plans to detail how the strategy will be implemented. These plans serve to identify and quantify materials that could be diverted for recycling or serve as feedstock for recovery and conversion facilities. Once a strategy has been identified and agreed, we develop tools and training materials to educate managers and stakeholders about the strategy. We also develop performance metrics against which to measure the success of new strategies and identify where improvements can be made.

Operational and Organizational Assessments

Geosyntec assists its clients in ensuring that their operations are cost-effective, achieve waste reduction goals, and meet long-term community needs. For many clients, we have provided analysis and guidance in planning and designing the administrative structure for the effective management of solid waste systems. This includes organizational analysis, development of performance measures to gauge efficiency of programs and services, and evaluation of administration of personnel, physical, and financial resources, and benchmarking. We make certain that new or modified planning strategies and objectives are appropriate, financially sound, and viable. We provide operation evaluations that accurately determine the effectiveness, efficiency, and safety of services provided by contract operators. We identify causes of performance shortfalls, offer proven recommendations to reduce costs and improve productivity and services, and assist with monitoring program results. As part of these efforts, we have prepared organizational audits, conducted regulatory compliance assessments, provided cost estimations for operation, maintenance, and equipment replacement, designed management information systems, and assisted in reorganizational planning and selection of personnel to fill key positions. We have identified the organizational strategy and then planned the structure of resources needed to implement effective system management to achieve the goals of the organization. Our efforts have resulted in improved allocation of resources, expanded and more-reliable services, enhanced worker training and safety, reduced customer complaints, and lower costs.

Our professionals understand that fully integrated solid waste management and recycling services are highly complex operations that involve coordinated and sometimes competing interests involving
trucking, heavy equipment, construction, maintenance, finance, and personnel management. We understand the advantages and disadvantages of the various types and sizes of equipment, as well as the multiple options available for operating and maintaining equipment. We offer real-world forensic and operating experience from dozens of MRFs and waste handling facilities, with first-hand knowledge of the common pitfalls affecting solid waste management facilities and their operations. Conversely, we have also worked closely with dozens of clients that operate efficient and well-managed solid waste operations, and so recognize the standards for good practice. We understand the limitations of engineering and where close operational, financial, and management control is essential for a system to perform well.

**Transfer Station and Material Recovery Facility (MRF) Services**

Geosyntec’s professionals have evaluated and designed numerous solid waste transfer stations for our clients. This work has required us to evaluate sites, provide layouts, perform environmental assessment studies, prepare permit applications, and construction documents. Geosyntec projects have included: (i) retrofit design for an existing 3,000 ton/day transfer station in Annapolis Junction, Maryland to incorporate automated material recovery equipment and design; and (ii) permitting, including County and Virginia DOT permits for a citizen’s drop off facility in King George County, Virginia. Geosyntec also has extensive experience in providing construction management (CM) and construction quality assurance (CQA) services for transfer stations and civil infrastructure including resident project representative services and minimizing and managing dispute resolution on behalf of our clients.

Additionally, Geosyntec’s staff have more than 20 years’ experience in design, technical and operational aspects of the solid waste management industry. Transfer station improvement experience includes identifying design and/or operational failures in poorly performing transfer station facilities, reviewing repair alternatives, preparing work scope and budget, and evaluating post-repair success. In cases of substandard operating procedures, we identify equipment and/or training deficiencies and prepare operating plans to address environmental compliance or safety hazards.
Analysis of Integrated Solid Waste Management and Recycling Programs

Geosyntec has extensive experience performing wasteshed analyses of integrated waste management and recycling systems that allow us to identify where materials are going, how they are being managed, and what the market rates are for services. We have designed waste sorting protocols and conducted waste characterization studies for specific processing technologies for recovery of recyclables and organics for composting. We have experience helping our clients understand the highly variable revenue streams that can come from recyclable commodity sales and have expertise at identifying and valuing alternative revenue sources (tax credits, renewable fuels credits, commodity revenue sharing, franchise royalties, asset valuations, etc.) to maximize financial benefits.

Geosyntec’s Marc Rogoff – a 35-year veteran of the business and industry thought leader – literally wrote the book on Solid Waste Recycling and Processing and has devoted a large part of his career to addressing benchmarking and other issues in the fields of collection, recycling, disposal, and ratemaking.

Contracts Review and Management

Waste services can involve a remarkable number of specialized contracts, including host agreements, franchise agreements, long-term maintenance contracts, and capital projects contracting. Geosyntec’s professionals have deep experience in negotiating and managing contracts. We help client organizations understand the current contractual commitments they must work within as well as how to potentially restructure future contracts in a manner that reduces risk and improves performance. Geosyntec assists in negotiation of contract and indemnification language and evaluates the merits of available contracting alternatives for projects such as guaranteed fixed-price versus lump sum and others.
Waste Characterization Studies and Data Review

Geosyntec has significant experience designing wasteshed analyses and conducting waste characterization studies for specific processing technologies for recovery of recyclables and organics. Geosyntec professionals are familiar with the specific challenges posed by waste separation and processing, particularly as the industry moves toward automation of these operations. Our experience is based on actual facility design and facility operating requirements. We have directly managed and performed dozens of waste composition and characteristics studies, both to evaluate the bulk waste stream and to determine properties of specific waste streams of interest for separation and processing, supporting our clients’ assessment of the feasibility of emerging technologies.

Financial Assessments

Geosyntec is regularly engaged to provide valuation services for solid waste assets and has provided financial analysis for long-term and annual budgeting of integrated waste management systems, cost-of-service estimates, and closure and post-closure reserves. We have performed valuation studies and cost-benefit analyses for internal and third-party collection, diversion, and disposal alternatives. Geosyntec performs the full range of consulting services for solid waste programs, including rate studies, financial assurance cost estimates, escrow account analysis, and tipping fee analysis. Our staff has the ability to offer an independent evaluation of solid waste rates and charges that will allow solid waste agencies to meet its financial obligations, capital funding needs for system expansion, renewal and replacements, and to set aside appropriate reserve fund balances. Our financial consulting experts have assisted more than 100 clients in the development of solutions resulting in financial stability. We have made formal and information presentations to county commissions, city councils, authority boards, and citizen’s advisory boards to gain acceptance of proposed new or revised rate and financial recommendations. In the course of this analysis, we have also routinely developed a number of computer models capable of evaluating the economics of current practices in comparison with alternatives. These Pro Forma Models account for the number and density of collection locations; vehicle capacities and compaction cycle times; time per stop; off-route time; fleet size; crew size; labor costs; and comparison of the costs of in-community disposal versus long-haul transport and disposal outside the community. Selected financial and rate study projects are presented in Table 1.
<table>
<thead>
<tr>
<th>Project</th>
<th>Client</th>
<th>Services Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid Waste Rate Study</td>
<td>City of Wauchula, Florida</td>
<td>Development of fleet replacement plan and five-year rate assessment</td>
</tr>
<tr>
<td>Landfill Cost of Service Analysis</td>
<td>Dalton-Whitfield Solid Waste Authority, Georgia</td>
<td>Market study and rate study/audit in support of cost of service and facility ownership review</td>
</tr>
<tr>
<td>Operational and Financial Assessment</td>
<td>Solid Waste Authority of Central Ohio (SWACO)</td>
<td>Rate study in support of cost of service analysis and operational review of integrated system</td>
</tr>
<tr>
<td>Programmatic, Operational, and Financial Assessment</td>
<td>Augusta-Richmond County, Georgia</td>
<td>Recommendations to improve efficiency, compliance, safety, and cash flow</td>
</tr>
<tr>
<td>Integrated Solid Waste Management System</td>
<td>City of Quetzaltenango, Guatemala (for Inter-American Dev. Bank)</td>
<td>Pro forma model for establishing modern solid waste service under private-public partnership</td>
</tr>
<tr>
<td>Long-Term Alternatives Study Solid Waste Business Plan</td>
<td>Santa Cruz County, Arizona</td>
<td>Analysis of long-term landfill closure and post closure fund reserves</td>
</tr>
<tr>
<td>Tipping Fee and Sanitation Assessment Study</td>
<td>Charlotte County, Florida</td>
<td>Countywide assessment and landfill tipping fee</td>
</tr>
<tr>
<td>Operation and Financial System Analysis</td>
<td>City of Dunedin, Florida</td>
<td>Collection system rate studies performed seven years apart</td>
</tr>
<tr>
<td>Residential Collection Rate Study</td>
<td>City of Pasadena, California</td>
<td>Multi-year collection system rate studies</td>
</tr>
<tr>
<td>Solid Waste Services Analysis and Rate Study</td>
<td>City of Pensacola, Florida</td>
<td>Pro forma model enabled what if analysis for multiple rate scenarios and out of county landfill disposal</td>
</tr>
<tr>
<td>Solid Waste Collection and Landfill Rate Study</td>
<td>Port Arthur, Texas</td>
<td>Analysis of continued collection system operations</td>
</tr>
<tr>
<td>Comprehensive Review of Solid Waste Collection and Disposal Options</td>
<td>Town of Chapel Hill, North Carolina</td>
<td>Assessment of management alternatives</td>
</tr>
<tr>
<td>Pro Forma Rate Analysis of Solid Waste Management System</td>
<td>Page County, Virginia</td>
<td>Analysis of re-opening the County landfill</td>
</tr>
<tr>
<td>Solid Waste Collection Request for Proposal Consulting Assistance</td>
<td>Orange County, Florida</td>
<td>Bid analysis and impact on countywide residential assessments</td>
</tr>
<tr>
<td>Feasibility Study of Alternatives Evaluation</td>
<td>Hardee County, Florida</td>
<td>Comparison of expansion of landfill operations versus out of county disposal</td>
</tr>
<tr>
<td>Solid Waste Alternatives Assessment Study</td>
<td>City of Lakeland, Florida</td>
<td>Analysis of automated collection program</td>
</tr>
<tr>
<td>Long Range Solid Waste Master Plan</td>
<td>City of Springfield, Massachusetts</td>
<td>Analysis of pay-as-you-throw (PAYT) and other City-provided collection services</td>
</tr>
<tr>
<td>Recycling Feasibility Study and Landfill Cost Analysis</td>
<td>City of Lawton, Oklahoma</td>
<td>Landfill tipping fee and MRF feasibility analysis</td>
</tr>
<tr>
<td>Solid Waste Plan and Rate Study</td>
<td>City of Killeen, Texas</td>
<td>Rate study performed during development of long-term master plan enabled analysis of multiple planning scenarios</td>
</tr>
<tr>
<td>Solid Waste Cost of Services and Rate Study</td>
<td>City of Kirkwood, Missouri</td>
<td>Long term financial roadmap</td>
</tr>
<tr>
<td>Solid Waste Cost of Services</td>
<td>Indian River County, Florida</td>
<td>Development of long-term assessment and financial plan</td>
</tr>
<tr>
<td>Rate Modeling for Solid Waste Management System</td>
<td>City of Virginia Beach, Virginia</td>
<td>Analysis of fleet replacement plan and rainy-day fund</td>
</tr>
<tr>
<td>Pro Forma Model Long Term Operations</td>
<td>Merced County Regional Solid Waste Authority, California</td>
<td>Cash flow analysis revealed no need for rate increase nor bond issue</td>
</tr>
</tbody>
</table>
Measurement and Benchmarking

For a wide variety of solid waste clients, Geosyntec’s solid waste advisory team has led dozens of benchmarking surveys of solid waste collection, landfill operations, and transfer station and MRF operations. These assignments have included developing metrics on staffing numbers, equipment usage, and various financial metrics. The aim of these studies was to benchmark operations with well-run operations of a similar size to those of the client to determine relative efficiency and operations for operational improvements. We also offer unrivaled expertise in objectively reviewing, analyzing, and measuring operational outcomes and key performance indicators and comparing them to industry benchmarks via data and customizable models we have developed over the course of our careers.

Stakeholder Outreach and Engagement

Geosyntec recognizes the importance of stakeholder engagement in highly visible planning projects, particularly those conducted by local government agencies charged with protecting the public good. While traditionally a provider of “hard” engineering services, we know the value that “soft” services bring and have learned from experience that win-win outcomes are best obtained when communications professionals work alongside technical experts to engage the public and other stakeholders. Our in-house team of communications specialists offer extensive experience developing engaging content via a wide variety of media. We also have experience developing websites, software applications, and other digital products, all of which helps our clients identify and reach the right audiences with the right messages to deliver meaningful interactive experiences. Our graphic designers are communicators first who believe that design is useless if it is not grounded in a clear understanding of audience, purpose, and message.

Waste-to-Energy (WTE) Plant Services

Geosyntec provides the following services in conjunction with WTE facilities:

**Concept and Planning Level**

- Assess the veracity of emerging technologies
- Economic / Pro-Forma assessments
- Feasibility studies
- By-product market studies
- Trouble-shoot existing facilities
- Environmental permitting
- Plant siting studies
- Supporting engineering services
- Grant application assistance
- Presentations to government agencies and non-technical groups

**Operational Level**

Geosyntec provides operational level services, often through sub-consultants. These services include facility management and technical assistance, engineering and specialized part sourcing, and performance optimization and combustion control.

Table 2 presents examples of WTE projects that have been completed by Geosyntec staff.
### Table 2: Illustrative WTE Plant Assessments and Technology Reviews

<table>
<thead>
<tr>
<th>Client</th>
<th>Plant Capacity (tons/day)</th>
<th>Technology</th>
<th>Services Provided</th>
<th>Energy Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipality of Anchorage, Alaska</td>
<td>1,000</td>
<td>Thermal</td>
<td>Technology assessment; Implementation schedule</td>
<td>Electric power</td>
</tr>
<tr>
<td>Confidential client, Dominican Republic</td>
<td>4,000</td>
<td>Thermal</td>
<td>Feasibility study; Conceptual design</td>
<td>Electric power</td>
</tr>
<tr>
<td>Wheelabrator Baltimore, Maryland</td>
<td>2,250</td>
<td>Thermal</td>
<td>Review of capital budgets and O&amp;M costs</td>
<td>Electric power;</td>
</tr>
<tr>
<td>Confidential client, Gulf Coast</td>
<td>300</td>
<td>Gasification</td>
<td>Preliminary engineering design; Market study</td>
<td>Diesel; Jet Fuel</td>
</tr>
<tr>
<td>Green Bay, Wisconsin</td>
<td>200</td>
<td>Pyrolysis</td>
<td>Technical and economic evaluation; Feedstock study</td>
<td>Electric power;</td>
</tr>
<tr>
<td>Marion, Iowa</td>
<td>900</td>
<td>Plasma Gasification</td>
<td>Feasibility study; Multiple feedstock study; Market study</td>
<td>Electric power;</td>
</tr>
<tr>
<td>Terrabon, Texas</td>
<td>250</td>
<td>Biochemical</td>
<td>Multiple feedstock study</td>
<td>Fuels</td>
</tr>
<tr>
<td>Aquarius, California</td>
<td>750</td>
<td>Gasification</td>
<td>Feasibility study; Multiple feedstock study</td>
<td>Fuels</td>
</tr>
<tr>
<td>Atlanta, Georgia</td>
<td>35</td>
<td>Plasma Gasification</td>
<td>Multiple feedstock study</td>
<td>Heat; Steam</td>
</tr>
<tr>
<td>Mckinney, Texas</td>
<td>2,000</td>
<td>Autoclave</td>
<td>Pilot plant operational assessment; Multiple feedstock study; Market study</td>
<td>Fuel; RDF</td>
</tr>
<tr>
<td>Harlingen, Texas</td>
<td>100</td>
<td>Gasification</td>
<td>Multiple feedstock study; Market study</td>
<td>Electric power</td>
</tr>
<tr>
<td>Hamilton County, Ohio</td>
<td>1,000</td>
<td>Thermal, Biological, Chemical</td>
<td>Feasibility study; Multiple feedstock study; Market study</td>
<td>Electric power; Fuel; Steam; Heat</td>
</tr>
<tr>
<td>Orange County, Florida</td>
<td>1,000</td>
<td>Thermal, Biological, Chemical</td>
<td>Feasibility study; Multiple feedstock study; Market study</td>
<td>Electric power; Fuel</td>
</tr>
<tr>
<td>Monterey Regional Waste Management District, California</td>
<td>Pilot</td>
<td>Thermal, Biological, Chemical</td>
<td>Multiple feedstock study</td>
<td>Electric power; Fuel; Heat</td>
</tr>
<tr>
<td>City of Cartagena, Colombia</td>
<td>100-300</td>
<td>Gasification, Plasma Gasification</td>
<td>Technology assessment; Feasibility Study; Feedstock Study</td>
<td>Electric power; Fuel</td>
</tr>
<tr>
<td>Berkeley County, South Carolina</td>
<td>100</td>
<td>Anaerobic Digestion</td>
<td>Feasibility study; Multiple feedstock study; Market study</td>
<td>Electric power</td>
</tr>
<tr>
<td>Hampton Roads Planning District, Virginia</td>
<td>1,000</td>
<td>Thermal, Biological, Chemical</td>
<td>Feasibility study; Multiple feedstock study; Market study</td>
<td>Electric power, Steam, Heat</td>
</tr>
<tr>
<td>City and Borough of Juneau, Alaska</td>
<td>100</td>
<td>Thermal</td>
<td>Review of vendor proposals</td>
<td>Electric power</td>
</tr>
</tbody>
</table>
People

Geosyntec attracts some of the brightest, most creative engineers, scientists, and professionals in the consulting and engineering business. Our practitioners’ exceptional technical and problem-solving skills foster a collaborative environment that puts our clients’ needs first. Geosyntec’s high retention rate is due to a supportive and collaborative work environment that manifests itself in the quality of our work products, our established reputation with regulatory agencies, and the value our clients attest to.

Resumes of key Geosyntec staff are included in the following section.
MARC ROGOFF, Ph.D. / Tampa, Florida  
mrogoff@geosyntec.com

Career Summary
With over 40 years of experience, Dr. Rogoff is one of the nation's top experts in solid waste collection, the evaluation of rates, cost allocation studies, system valuations, and the development of master plans for solid waste agencies. Dr. Rogoff has held executive management positions in both local government and in the private sector. His efforts have included the development of innovative collection and recycling programs, provided guidance on public education and outreach programs, and assisted in grant programs. He has conducted more than 50 solid waste collection studies enabling his clients to improve efficiencies. He has also developed and led engagement strategies with stakeholder groups and regulators under a variety of state, Federal and international regulatory programs. Dr. Rogoff is the former Director of the Collection and Transfer Technical Division with SWANA and was awarded their 2018 Distinguished Individual Achievement Award in March 2018. He currently serves on SWANA’s Executive Board. He has authored more than 150 articles published in solid waste industry trade journals (recent examples are reproduced in Appendix 3). Marc is the author of eight textbooks, including the APWA’s “Solid Waste Rate Setting and Financial Guide.”

Specialties
- Solid waste management
- Solid waste rate studies
- Public works planning and engineering

Professional Registration
- Certified Environmental Professional
- Qualified Environmental Professional

Select Project Experience

**Mecklenburg County, North Carolina, MRF Operations RFP.** Project Manager to develop an RFP for long term operations of the Metrolina MRF facility.

**Orange County, Florida, Residential and Recyclables Collection RFP.** Project Manager to develop an RFP for automated collection of household refuse, yard debris and single-stream recyclables. This RFP resulted in $30 per household savings over a 10-year period.

**Santa Cruz, County, Arizona, Solid Waste Business Plan.** Project Manager to conduct a solid waste rate study for county solid waste operations including a review of existing operations, future capital improvement needs, and reserve requirements. This study includes an evaluation of long-term post closure cost analysis.

**City of Idaho Falls, Idaho, Solid Waste Automation and Rate Study.** Project Manager to conduct a solid waste rate study for city solid waste collections including a review of existing operations, future capital improvement needs, and reserve requirements. This study includes an evaluation of the application of automated collection to improve service levels and reduce Worker’s Compensation claims.

**Charlotte County, Florida, Solid Waste and Assessment Rate Study.** Project Manager to conduct a solid waste rate study for county solid waste operations including a review of existing operations, future capital improvement needs, and reserve requirements. This study includes an evaluation of special, non-ad valorem assessments to pay for the costs of the overall program over a 10-year planning period.

**City of Killeen, Texas, Solid Waste Rate Study.** Project Manager for the development of a 10-year rate study, including the development of customer user rates (residential and commercial), development of a fleet replacement plan, single-steam recycling, and needed funding requirements.
BILL GAFFIGAN, MBA, CVA / Kennesaw, Georgia
bgaffigan@geosyntec.com

Career Summary
Mr. Gaffigan is a financial professional with more than 25 years of experience as an executive and consultant in the solid waste industry. In his solid waste industry career prior to joining Geosyntec in 2013, he served as a regional controller over 22 operations for a large public waste company, and Vice President of Mergers and Acquisitions. He has provided financial and operational consulting for municipalities and other public entities, investors, and private waste companies. He has valued over 100 hauling businesses and contracts, transfer station and MRF operations, and landfills, and has brought over 60 transactions to financial close. He has been called upon and qualified as an expert witness on several occasions to value solid waste operations and has extensive experience in cost and pricing structures associated with solid waste systems.

Select Project Experience

Long-term Planning, Solid Waste Authority of Central Ohio (SWACO). Provided advisory services as project director and project manager for projects encompassing long-term planning, operations analysis, financial analysis and policy recommendations to improve the performance of an integrated waste transfer, disposal and recycling system which handles approximately one million tons a year. Subsequently engaged for additional phases to develop benchmarking as well as input to strategic planning.

Solid Waste Management Options Study, Frederick County, Maryland. Technical lead for an in-depth stakeholder-focused study of long-term waste planning and diversion options. Engagement included qualitative and quantitative evaluations of a significant number of waste diversion options which included, among others, a three-container curbside collection program, centralized and distributed composting, and an advanced materials recovery facility (MRF).

Recycling Composition Study, Santa Rosa County, Florida. Project Director for a recycling composition study of residential curbside single-stream material. The study was developed to better understand the quality, quantity and composition of material collected from the County’s three franchise zones by private waste collection franchisees.

Valuation of Collection Routes, City of Walla Walla, Washington. Served as subject matter expert on a litigation support engagement to value residential hauling routes located in an area annexed by a City. The routes were operated by a private waste company at the time of annexation but would be serviced post annexation by the City.

Cost of Services, Dalton-Whitfield Regional Solid Waste Authority, Northwest Georgia. Project Manager for advisory engagement to provide a cost of services financial analysis in support of the Dalton-Whitfield Regional Solid Waste Authority (DWRWSA) annual budgeting and planning cycle. Provided recommendations on multiple issues including pricing as well as closure and post closure reserves. DWSWA has a highly integrated solid waste infrastructure that operates within a flow control environment. They own and operate an MSW landfill, an industrial landfill, a materials recovery facility, a commercial landfill gas-to-energy project, waste convenience/transfer facilities, and a countywide recycling program.

Specialties
- Solid waste/recycling/planning
- Valuation
- Financial and strategic analysis

Professional Registration
- Certified Valuation Analyst
TOM RAMSEY, P.E. / Columbia, Maryland
tramsey@geosyntec.com

Career Summary
Mr. Ramsey has more than 25 years’ experience in design, technical and operational aspects of the waste containment, civil engineering, and solid waste operations. His extensive experience in new facilities development includes project management, siting studies, and design for landfills, landfill gas-to-energy projects, transfer stations, material recovery facilities (MRFs), and trucking maintenance facilities. He performs fatal flaw analyses, applies siting criteria to area surveys, addresses compliance and/or regulatory issues, directs engineering design and permitting activities, manages real estate acquisitions, negotiates contracts, and prepares project pro forma for management review. His experience also includes construction management and engineering support for over 50 environmental infrastructure projects. This experience includes hundreds of acres of CERCLA and CERCLIS liner and closure construction, landfill gas systems, MRFs and transfer stations, and administrative facilities. His work includes constructability reviews, construction document preparation, engineering cost estimates, resident-project-representative support, claims prevention and resolution.

Specialties
✓ Solid waste/recycling/planning
✓ Design, technical and operational aspects of waste containment, civil engineering, and solid waste operations

Professional Registration
✓ Registered Professional Engineer in 12 states

Select Project Experience

Construction Document Preparation for Rail Transfer Station, Jessup, Maryland. Construction document preparation for a 10,000 ft² addition to a 2,500 TPD rail transfer station. The addition is to provide material recovery capacity to the facility to divert selected wastes for recovery of recyclable materials. The project involved design of the facility in a manner that would not disrupt the existing transfer operations.

Overall Operational Review and Assessment, Solid Waste Authority of Central Ohio. Work included a high-level assessment of landfill operations, LFG management, capital budgeting, in-house engineering support, and staffing for two 600 ton per day (TPD) transfer stations and a 3,000 TPD operating landfill. Provided a prioritized assessment of recommendations to improve operations and reduce costs.

Failure Analysis and Repair Design at Solid Waste Transfer Stations, Various Locations. Failure analysis and repair design for weigh scales, tipping floors, leachate management, and loading pits at solid waste transfer stations in Gastonia, North Carolina; Pendleton, South Carolina; Florence, South Carolina; Raleigh, North Carolina; Sanford, North Carolina; Siler City, North Carolina; Theodore, Alabama; Phenix City, Alabama, and Atlanta, Georgia.

Permitting, Design, and Construction of Solid Waste Transfer Stations, Various Locations. Successful completion of permitting, design, and construction of 1000+ ton per day solid waste transfer stations in Forest Park, Georgia; Lawrenceville, Georgia; and Charlotte, North Carolina. Additional transfer stations with capacities between 100 and 500 tons per day have been completed in Fairfield, South Carolina; Norfolk, Virginia; Newport News, Virginia, and Goochland, Virginia.

Design Review and Analysis of MRFs, Various Locations. Design review and analysis of MRFs with capacities up to 300 tons per day in Leesburg, Virginia; Forsyth County, Georgia; and Newport News, Virginia.
Career Summary

Dr. Morris is an internationally recognized subject matter expert with over 19 years of professional experience in solid waste management. He provides strategic advisory services on solid waste planning, including market valuations and feasibility analyses of alternative waste conversion technologies, and options for meeting waste diversion and recycling goals. Building on a background in landfill design, permitting, and construction oversight, his project experience extends to: (i) preparation of solid waste management and recycling master plans for cities/counties as well as individual facilities; (ii) feasibility studies and conceptual plans for solid waste management facilities; (iii) performing operational reviews and advising on implementing best practices; and (iv) evaluating options for increasing waste diversion, including waste transfer/processing, materials recovery/recycling, composting, and anaerobic digestion. Dr. Morris is an accomplished technical writer, having published over 60 articles, and has served as lead author on several U.S. EPA research reports and guidance documents.

Specialties
- Solid waste planning
- Recycling and waste conversion technologies
- Project lifecycle cost analyses
- Renewable energy systems at landfills
- Market valuations

Professional Registration
- Professional Engineer: Maryland, Virginia

Select Project Experience

Solid Waste Management and Recycling Study, Frederick County, Maryland. Reviewed hard and soft infrastructure programs for increasing countywide waste diversion and recycling rate. Designed outreach forums to ensure high levels of public participation in the decision-making process. Evaluated options and technologies, including cost-benefit analysis, lifecycle cost and environmental footprint assessment, review of operational complexity, and ease of integration into existing programs. Completed strategic planning study for phased implementation of composting.

Strategic Planning for Long-Term Solid Waste Management under Regional Agreement, Confidential Client. Used financial and environmental indicators in scenario analyses to optimize future waste disposal and recycling operations under a regional four-county agreement with a combined population of 150,000.

Structuring and Design of a PPP Concession for Solid Waste Management Services, Quetzaltenango, Guatemala for Inter-American Development Bank. Conceptual design and financial analysis for 20-year service agreement under a public-private partnership (PPP). Included waste collection and transportation, street cleaning, waste separation materials recovery facility (MRF), recycling, composting, and landfill construction and operation.

Update to Waste Handling and Disposal Master Plan, Cecil County, Maryland. Reassessed the master plan to incorporate lifecycle revenue and expense costs associated with construction and operation of alternative waste processing facilities (e.g., composting, anaerobic digestion, materials recovery) into the financial schedule for the County’s operation. Critical assessment of proposed facilities was based on optimal use of resources to serve current and future needs and flexibility for implementing zero waste goals. Deliverable was MS Excel® decision tool.

Master Plan for Solid Waste Management and Recycling, City of Baltimore, Maryland. Long-term planning effort for rejuvenating the City’s solid waste and recycling systems to maximize waste reduction and diversion. The City has historical low rates of recycling, limited landfill capacity, and relies heavily on an aging waste-to-energy facility.
BROCHURES
Geosyntec’s solid waste advisory professionals have successfully completed over 50 cost-of-service and rate study assignments, helping our clients improve the efficiency of their collection and recycling programs.

Doing more with less has become a mantra within solid waste agencies, while an increasingly-engaged population repeatedly calls for more recycling and implementation of zero waste goals. Before changes to existing services can be considered, a study of rate structures and cost-of-service analysis should be undertaken to better understand cash flow implications. By allowing multiple “what if?” questions to be addressed, such studies can help managers overcome myriad issues, such as:

- Declining or negative fund balances
- Difficulty gaining political support for rate increases
- Skyrocketing fuel, equipment, and insurance costs
- Problems with customer service
- Calls for full or part privatization or consolidation with neighbors
- Barriers to entry for new markets or services

Based on our experience, well-executed studies also provide opportunities for introduction of smart technologies, cost optimization, improved customer service, and enhanced long-term financial planning. Our customized models can help decision makers in analyzing operational outcomes and key performance indicators and comparing the financial results to industry benchmarks.

Geosyntec’s team members have provided a wide range of financial modeling assignments as part of rate structure and cost-of-service studies, including for:

- City of Dunedin, FL
- City of Idaho Falls, ID
- City of Killeen, TX
- City of Lakeland, FL
- City of Pensacola, FL
- City of St. Augustine, FL
- City of West Palm Beach, FL
- City of Springfield, MA
- City of Lawton, OK
- City of Oklahoma City, OK
- City of Virginia Beach, VA
- City of Waco, TX
- City of Augusta, GA
- Charlotte County, FL
- Escambia County, FL
- Indian River County, FL
- Lake County, FL
- Orange County, FL
- Oklahoma City, OK
- Miami-Dade County, FL
- Anne Arundel County, MD
- Mecklenburg County, NC
- Dalton-Whitfield SWA, GA
- SWACO, Columbus, OH

geosyntec.com
Selected Project Experience

Solid Waste Service Analysis and Rate Study
CITY OF PENSACOLA, FLORIDA

The City’s Solid Waste Department was seeking guidance and a fact-based method for rate setting for an upcoming five-year planning period. The project team was engaged to identify key data, develop and execute an analysis process, and provide recommendations. Using citywide data, the team developed a customized rate model to analyze the future financial performance of the City's refuse collection program. In the process, we assessed current operational and business practices and potential operational changes to collections as well as transfer station operations. Based on the study, the team was able to make firm recommendations for revising residential rates and identify several cost savings and revenue enhancement measures that could be achieved. Findings were presented to the City Commission and incorporated into the business plan for the Solid Waste Department.

Cost-of-Service Study
DALTON-WHITFIELD SOLID WASTE AUTHORITY, GEORGIA

The Authority owns and operates highly integrated solid waste infrastructure, including two landfills, a MRF, a commercial landfill gas-to-energy project, public drop-off centers and transfer facilities, and a countywide recycling program, within a flow control environment. Geosyntec conducted a financial analysis of system components, providing strategic consulting on a range of issues to help the Authority complete their annual budget cycle and establish pricing for their services. We reviewed detailed revenue and cost inputs, analyzed trends and finer details related to issues such as staffing and equipment maintenance, and developed a model to estimate the timing and cost of major capital projects based on expected waste volumes. We also provided consulting support to help the Authority understand the greater regional marketplace and positively dissuade assertions that their services are not cost competitive. Our expertise provided perspective and a factual basis that allowed adjustments to fee structures and reserve accruals to be identified based on long-term financial and operational trends.

Cash Flow Analysis
MERCED REGIONAL SOLID WASTE AUTHORITY, CALIFORNIA

Prior to engaging the project team, the Authority had operated a deficit over several years despite several disposal rate increases. This trend was the result of the decline in revenue, loss of a major customer, operational inefficiencies, and inadequate unencumbered cash reserves to cover bond debt and liabilities. In addition, the heavy equipment fleet was leased and aging and capacity expansions at their landfill sites would be needed within five years. The team developed a pro-forma model to help the Authority prepare a long-term cash flow analysis and assess whether or not funds were available from operations to forestall a bond issue for the capital improvements as well as to fund adequate emergency reserves. The pro-forma modeling effort enabled decision makers to project costs of various capital, fleet, and waste flow options. Key among the lessons learned was establishing a “rainy day fund” to provide a long-term financial backstop for unforeseen events.

For more information

Marc Rogoff, Ph.D.
Tampa, Florida
813-558-0990
mrogoff@geosyntec.com

Jeremy Morris, Ph.D., P.E.
Columbia, Maryland
410-381-4333
jmorris@geosyntec.com

Bill Gaffigan, MBA, CVA
Kennesaw, Georgia
678-718-4732
bgaffigan@geosyntec.com

about us

Geosyntec Consultants is a specialized technical advisory and consulting engineering firm that works with private- and public-sector clients to address their complex challenges involving the environment, natural resources, and civil infrastructure. Our vision of success builds on our internal culture of technical excellence and long-held belief that exceptional client service coupled with exceptional project solutions will result in long-term, mutually rewarding business solutions. We bring our clients the dedicated, personal service of a small, local company backed by the experience and resources of a larger firm with global presence.
Solid waste procurements are not without challenge, often requiring extensive planning, intense focus, and a tireless effort with the many stakeholders involved.

Solid waste collection, disposal, and recycling services can involve a remarkable number of specialized contracts, including host agreements, franchise agreements, long-term maintenance contracts, and capital projects contracting. Geosyntec's professionals have deep experience in negotiating and managing contracts. We help client organizations understand the current contractual commitments they must work within as well as how to potentially restructure future contracts in a manner that reduces risk and improves performance. Geosyntec assists in negotiation of contract and indemnification language and evaluates the merits of available contracting alternatives for projects such as guaranteed fixed-price versus lump sum and others. We help our clients to navigate the procurement obstacles and advance to successful implementation.

Geosyntec's procurement experience includes:

- Preparing Requests for Qualifications (RFQ) and Requests for Proposals (RFP), including contracts and/or contract provisions working with legal counsel, for various services and facilities;
- Evaluating vendor responses;
- Recommending a preferred vendor or ownership financing strategy;
- Negotiating contracts;
- Developing test protocols and review criteria; and
- Monitoring construction, performance testing, and operations.

Our firm has assisted many communities in procuring services and facilities that yielded increased efficiency, reduced and stabilized costs and/or enhanced revenues, and substantially elevated waste diversion through reuse and recycling. Some of our recent procurements of collection transport, processing, and/or disposal services are among the most comprehensive and far reaching of any U.S. communities and are expected to provide millions of dollars in cost reductions and significant increase in recycling rates compared to their prior systems and programs.
Collection and Recycling Collection RFP  
**ORANGE COUNTY, FLORIDA**

A member of Geosyntec’s project team assisted the County in crafting a procurement solution to transition from manual collection to automated collection and single stream recycling. The effort included identifying state-of-the-art collection practices for development of a new procurement document. The Team assisted in evaluating cost and technical proposals, including a summary of the “business deal” provided by each respondent and contract negotiations. The transition to automated collection resulted in a $64.9 million cost savings to County residents.

MRF Operating Agreement Procurement  
**MECKLENBURG COUNTY, NORTH CAROLINA**

The County currently owns a single stream materials recovery facility (MRF), which processes about 70,000 tons per year. The facility is now operated by a private vendor under a long-term agreement. Geosyntec assisted the County in various facets in determining the best approach for long-term management of the MRF:

- Developing a request for proposal for operations of a county-owned MRF
- Assistance in sole source negotiations with current operator of the MRF facility through evaluating the business and cost proposal presented by the MRF operator
- Helping develop the business deal for a short-term operating agreement
- Researching the pros and cons of County operations of the facility. This included development of a Pro Forma operating budget for County operations.

RFP for Waste-to-Energy Facility  
**MUNICIPALITY OF ANCHORAGE, ALASKA**

As the Municipality of Anchorage’s landfill neared capacity, Geosyntec was retained to assist in developing a request for proposal (RFP) for a waste-to-energy facility to provide additional disposal capacity for the Municipality and neighboring communities. Geosyntec was retained to provide the following procurement advice:

- Development of a White Paper for selection of preferred technology
- Evaluation of risks to the Municipality
- Methodology for company/technology provider selection
- Financing opportunities for the facility
ARTICLES
Tough Decisions for Solid Waste Agencies

Have you ever heard of the Chinese proverb, “May you live in interesting times”? What is noteworthy about the expression is that, based on recent research, it is not Chinese, but probably American and has been in popular vernacular for almost three generations.

The main point of the phrase is that “interesting times” should be good to live in, but when faced with the constant drum beat of doom and gloom voiced in the 24-hour news cycle of politics, wars, street violence, and the like, it seems kind of an ironic curse.

When I started my career as a newbie Resource Recovery Administrator for Hillsborough County, FL, back in the early 1980s, we had unlined and leaking landfills, little if any curbside recycling, rampant illegal dumping, and no real means to pay for the costs of new and improved systems. It was a tough sell to convince county or city commissioners to establish mandatory collection ordinances when the citizens expressed concern about the safety record. Our citizens could use web-based customer service.

- **“Smart” or Emerging Technologies**—Up until recent times, garbage collection changed little, if at all. It has relied on backbreaking manual effort. Automation and the implementation of cameras, side-looking radar, and GPS systems makes waste collection safer and more efficient. Implementation of autonomous collection vehicles over the next few decades can only improve our industry’s safety record.

- **Cost Optimization Tools**—When I started in solid waste in the 1980s, I was happy to receive cost/budget sheets by my county finance department every quarter. How could you run a department and be cost-effective? As a new manager, I toyed with new DOS spreadsheet software such as VisiCalc and Lotus 1-2-3 to try to make sense of a multimillion-dollar operation. We are now at the cusp of having benchmarking data and information available at the touch of a button, enabling managers and decision-makers to control and track operational costs in real time.

- **Financial Planning**—The old DOS tools that we had in the ’80s and ’90s did not allow much, if any, “what if” analysis. That is the ability to change various assumptions at a whim without extensive reprogramming or re-entering of data. Nowadays, the scenario modeling tool in the newer versions of Excel can be easily used to provide decision-makers the answers they need to establish different rates or levels of service. I have used this tool effectively to compare various transfer station locations in terms of net present value or predictions of cash flow with various collection rate structures.

- **Improved Customer Service**—We live in an age with back office software and smart tablets that we can use to reprogram collection routes on the fly and service new accounts. Our citizens can use web-based tools on their smartphones to sign up for bulk waste or special waste pickups, find up-to-date information on materials recycling, or provide details on customer satisfaction that once had to be done door-to-door or through phone surveys.

- **Public Outreach and Engagement**—Social media tools have changed the way we engage the public. In the “olden days,” we had draftsmen develop foam boards using manual lettering tools. There was not much science available on how to run meetings effectively. Today, we have the advantage of computer software to cost-effectively prepare multimedia presentations, gather responses from public presentations, analyze feedback, and deploy the results on web-based applications to the public.

Lastly, Operation Blue Sky 2018/National Sword promulgated by the Chinese government with its bans on recyclable imports and mandates on allowable contamination levels is, in my opinion, a generational wake-up call for our industry, just as the transition from leaking dumps to engineered landfills was a generation ago. There will be great pain as our industry suffers with declining markets in China that once paid relatively high commodity prices. It will take a concerted public education effort to minimize contamination levels, as well as new technology and manpower at existing MRFs, to cull out these contaminants in the incoming wastestream.

In my opinion, we will need to change the way we price recycling services either by raising the effective rate or developing long-term reserve funds to maintain funding for these services through the peaks and valleys of the marketplace. We need less reliance on landfill tipping fees to subsidize recycling and more towards integrated system fees or assessments. Above all, we need to be more transparent in our pricing of these services. The popular perception that disposal is a cost, but recycling is revenue, has to change. Long-term, the issue of recycling markets will only be firmly settled when the country’s tax policy is changed to reward recycling rather than subsidizing the price of virgin materials. Only then can we truly move towards a circular economy for recyclable materials.

Marc J. Rogoff, Ph.D., is a Senior Consultant with Geosyntec Consultants and serves on SWANA’s Executive Board.
The Changing Dynamics for Recycling in the United States

U.S. residential recycling programs with curbside collection have been in place for the better part of three decades. However, much of the collected material was exported to China. Over the past year, China has restructured its policies toward recyclable material imports. What are the impacts of China’s new policies on U.S. residential recycling?
For years, one of the most visible ways that Americans actively contributed to environmental sustainability and resource conservation has been through recycling materials such as paper, cardboard, plastics, and metal. Residential recycling programs with curbside collection have been in place for the better part of three decades. Throughout this time, recycling markets have seen many normal cyclical ups and downs. However, much of this material has been exported to China where it has been used as raw material to make new products. In recent years, China has been the single largest worldwide importer of post-consumer recyclables, consuming more than 50% of the world’s recycled paper and plastic and almost 30% of all recyclables collected in the United States.

What Has Happened?
Most dual- or multi-stream recycling programs, in which households separate recyclables into different bins prior to curbside collection, have been replaced with more convenient single-stream programs, in which all recyclables are collected in one bin or cart. Typically, single-stream loads are delivered to a materials recovery facility (MRF) for automated sorting. One of the challenges for reusing recycled material is the need to manage contamination. Examples of contamination include such waste residue such as liquid dregs in bottles, food stuck to cardboard packaging, and broken-glass shards mixed in with recyclable paper. Contamination is much harder to control with single-stream collection. In some cases, 10–20% of the weight of recyclables being shipped to China was contamination (usable waste that had to be removed).

In July 2017, China notified the World Trade Organization that effective January 2018 it would ban imports of some recycled materials, including mixed paper and most plastics. In March 2018, China went further and implemented a strict new policy limiting contamination levels to 0.5%, a near-impossible limit for most single-stream recycling programs. To ensure compliance, Chinese customs have implemented the Blue Sky 2018 program to inspect every container entering any Chinese port and reject and return all containers with more than 0.5% contamination. As a result, inspections are now meticulous at the point of delivery in China.

What Are the Impacts of China’s New Policies on U.S. Recycling?
The loss of the Chinese market has disrupted an entire global commodity industry, throwing the global recycling industry into turmoil as commodity recyclables prices crashed. U.S. exports of mixed paper to China fell by 95% in 2018. Only half of materials formerly shipped to China have found alternative end markets. This has reduced revenues as some materials must be sold at significantly lower prices, sometimes even at a loss. Some material cannot be sold even at a loss and must be redirected to waste-to-energy facilities or landfills. As a result, recycling revenues are significantly depressed.

Figure 1 shows that the national average price paid for a ton of mixed paper dropped precipitously from late 2016 to March 2018, when the Blue Sky program took effect. The
impacts of the import ban first appeared in the Pacific Northwest and Alaska, with several solid waste agencies requesting exemptions from state recycling mandates and landfill bans. During the first quarter of 2018, landfilling of recyclables also began in California. Some agencies like Sacramento County have reported that they will be expending much more effort on education and contamination enforcement. The new market realities have severely impacted the county’s recycling budget, with recycled commodities switching from about US$1.2 million in annual revenue to US$1.1 million in expenses. There are reports from several northeastern and mid-Atlantic states of “orphaned” stockpiles of recyclables. Will China eventually relax their standards and reopen their market for imports? Although no one can predict what China will do, signs indicate that the events of the past year represent a paradigm shift regarding how recyclables will be managed going forward. The China Council for International Cooperation on Environment and Development (CCICED) recently released a paper stating that a further stop to material imports will be in place by 2019. China’s government is justifiably concerned about their environment, and has given clear signals of their intent to eliminate the importation of contaminated waste for the sake of raw materials. This suggests that China’s recycling restrictions are here to stay.

While it is anticipated that new markets will eventually develop, the timeline for new market development is highly uncertain due to its dependence on establishing new facilities and infrastructure either in the United States or overseas. In the meantime, recyclers have already reacted by slowing down processing lines, and adding labor and high-tech equipment at MRFs to remove contamination, which adds operational cost. Many are focused on the more economic “core recyclables” such as clean cardboard and paper, HDPE and PET plastic bottles, and aluminum cans. Many state and local agencies such as Oregon’s Department of Environmental Quality have published statements to make residents aware of the difficulties and urging residents to focus on core recyclables and avoid “wishful recycling.”

Dynamics for Recycling

The traditional form of curbside residential recycling may no longer make real economic sense for many locales, unless user fees and customer rates are increased to enable the providers of these recycling services to recover their real costs. As an example, many MRF processors are now charging waste haulers and communities US$50 per ton or more to process recyclables, when they once paid them for these materials. There are two major issues that need to be addressed for any solution to this problem.

First is the issue of contamination. Prior to single-stream recycling, curbside customers with the traditional “blue box” were constrained by the size of the container to place all their recyclable materials into that small box—newspapers, cardboard boxes, plastic bottles, aluminum and ferrous cans, plastic bags, and junk mail. This discouraged filling the...
limited volume with non-recyclable materials and materials of questionable recyclability. There was also a secondary check on contamination at the curbside with the hauler eyeballing the materials and leaving behind those materials not considered recyclable.

As most communities began to implement single-stream recycling during the last decade, customers were given large (64- or 96-gallon), lidded rolling carts for recyclables. Worse, many communities were given the impression that recycling was free while trash collection cost money. Accordingly, the customer was now incentivized to place all potentially recyclable material in the large recycling cart, rather than placing items of questionable recyclability in the trash can. As a result, MRFs have seen items such as strings of Christmas lights, car mufflers, plastic bags, bowling balls, dirty pizza boxes, and dirty diapers, none of which should be sent to these facilities. Consequently, contamination rates have sky rocketed upwards to 30% or more. This contamination results in complex and costly problems for MRF operators who oftentimes are unable to fully eliminate contamination from processed bales of materials sent to markets. Conveyors get jammed or must be slowed down, and additional human sorters must be added to help cull out these materials. All of this increases processing costs, while also lowering the ultimate prices received from the markets.

Second is the issue of the international market for U.S. recyclables. The Chinese market has now disappeared as the authorities there no longer accept their country being the dumping ground for other’s trash. This is part of an overall strategic plan to improve environmental quality in China for a rapidly growing and demanding middle class. As Chinese purchase-markets crashed in 2018, U.S. recyclers turned to other markets such as India, Indonesia, Malaysia, Turkey, and Vietnam as temporary fixes, flooding those markets. These nations, unable to meet processing demand, have either imposed bans or closed their markets, and prices have continued their downward spiral.

In summary, our recycling industry is facing an unprecedented turn of events as a result of policy changes halfway across the world. These changes are not the traditional commodity cycles that we have seen for recyclables. It is a commonly held opinion by most observers that the Chinese ban is not going away—indeed, some in the recycling industry have opined that China appears to be on a path to eliminate imports of all post-consumer recyclables by 2021. Current trade tensions between China and the United States are making this into a political issue as well.

Adapting to the New Norm for Recycling

• Take Steps to Reduce Contamination—Local agencies can deploy waste audits to help identify locales in their service area where high levels of contamination continue to exist. A good source of relevant information are advisories issued by the Solid Waste Association of North America (SWANA) and the National Waste and Recycling Association (NWRA). Legislation can be enacted to address recyclables contamination; for example, recent legislation in Florida will require municipalities to limit material contamination in curbside recycling programs. As written, the law establishes that solid waste agencies and not haulers or MRFs are responsible for reducing contamination.

• Implement Recycling Education Programs—Education is critical to the sustainability of recycling programs. A good rule of thumb is to spend US$1 per household per year to maintain strong participation. For a programmatic change (e.g., switching from single to dual-stream collection), add another US$2 to US$3 per household to cover a marketing campaign. A strong campaign will decrease resident confusion, lessen contamination and disposal expenses, increase quality and quantity of recovered materials, and maximize use of recycling system capacity. Production-ready examples of campaign materials are available from SWANA, NWRA and other local solid waste agencies. Teams of communications specialists can help design a campaign.

• Move Toward Paying True Recycling Costs—Educate the public and businesses as to why recycling can no longer be considered “free,” and that because recycling is such a key component of sustainability, it is reasonable and now necessary to be willing to pay to recycle, certainly up to the avoided cost of disposal.

• Conduct Proactive Financial Planning—Many agencies have not developed long-term financial plans for recycling programs and have not set aside reserves or “rainy day” funds, despite recycling markets having shown significant variability due to a variety of global and local economic issues. Developing a long-term financial strategy can help mitigate these fluctuations. Solid waste advisory specialists have unrivaled expertise in objectively reviewing, analyzing, and measuring financial performance and comparing them to industry benchmarks using custom financial models.

• Improve the Recycling Business Model—Improve the commodity-based business model by transitioning all contracts that rely on commodity prices into alternate contract structures that may allow trading of futures for recyclables. This might require development of an exchange with price-quotes and rules for commodities traded. The goal here is to enable stable inflation protection and reinvestment opportunities and organic growth.
Possible Solutions
Recyclers are adapting as quickly as they can, but there is no expectation of a return to the old status quo. Over time, help must come from the public in the form of cleaner materials; from regulators by allowing variances from recycling goals; and from municipalities by working with their recyclers to understand the options for retaining sustainable programs for the short and longer term. All this and more will be necessary to ensure the future of recycling as a key community service. In the interim, solid waste agencies will be forced to take steps at the local level to mitigate the current recyclables markets conditions.

State and Federal Support
At the U.S. state and federal levels, several concrete policy changes will need to be implemented to support recycling.

Change in Tax Policies
Currently, the Federal Tax Code provides significant financial advantages to manufacturers of virgin materials through investment tax credits, advanced depreciation write-offs and the like. These reduce the price of virgin materials. Changes in tax policy should be examined to “level the playing field” for recycled materials.

Extended Producer Responsibility
Extended producer responsibility (EPR) is a strategy designed to promote the integration of lifecycle disposal/recycling and other environmental costs in the market price of a product. EPR is based upon the principle that because producers (usually brand owners) have the greatest control over product design and packaging, they have the greatest ability and responsibility to reduce toxicity and waste. British Columbia has piloted a novel EPR program in recent years that has transferred the cost of recycling programs from local government to manufacturers and their trade associations (of course, the consumer of the manufactured goods ultimately pays the recycling costs under EPR). Perhaps in the United States, tax credits could be used as a means to encourage companies to adopt EPR.

Infrastructure Investment Program
SWANA and other solid waste organizations have argued that solid waste should be included in a comprehensive national infrastructure program. There are plans to include solid waste and recycling in a plan to improve public works funding and infrastructure development.

A Larger Policy
The far-reaching impacts of the China import ban have likely not yet played out fully. The current policy by China is part of a larger policy to improve environmental quality for an increasing middle class, as well as ongoing trade negotiations with the United States. However, some conclusions can be drawn at this juncture:

- The Chinese import ban was unexpected and represents a major disruption to the management of recyclers in the United States.
- There has always been—and always will be—pricing volatility in the recycling market; however, the current severely depressed U.S. market conditions are expected to persist for at least several years.
- Increased investment in recycling infrastructure and markets will have to be made to improve recyclables quality and to develop local demand for recycled products.
- Much of the cost for recycling will have to be paid by residents and businesses in the form of higher fees for service.
- Communities will have to pay more when they have higher levels of contamination in their recycled materials.
- Dual-stream recycling programs, although typically more expensive in terms of consumer education and collection effort than single-stream programs, may offer lower lifecycle costs and higher recycling rates for communities that are serious about diverting materials from disposal.

Authorities and municipalities are expanding services to stakeholders—doing more with less, while maintaining high standards for safety and environmental compliance. An experienced solid-waste advisory team is a trusted resource for guiding waste-authorities’ efforts to successfully meet these challenges. These private-sector and non-profit experts can help provide comprehensive solid waste advisory and engineering planning for your organization at a time of unprecedented economic disruption of recycling markets.

Sources

Marc Rogoff, Ph.D., is a Senior Consultant, and Jeremy Morris, Ph.D., P.E., and Bill Gaffigan, MBA, CVA, are both Principals, all with Geosyntec. E-mail: mrogoff@geosyntec.com; jmorris@geosyntec.com; bgaffigan@geosyntec-cat.com.
Solid Waste Ratemaking: The Whys and How

Cost of service studies are an essential tool in managing a solid waste agency in these uncertain times. They provide opportunities for introduction of smart technologies, cost optimization, improved customer service and long-term financial planning.

By Marc Rogoff, Bill Gaffigan and Jeremy Morris

Doing more with less has become a mantra within public-sector agencies. As a result, managers and other decision makers face issues such as operating budgets being cut annually, fleet purchases being deferred past normal replacement cycles, and salaries not reflecting the value of employees when compared to their counterparts in similar industries. There are a myriad of reasons why solid waste agencies encounter fiscal pressures, some of which are beyond the control of agency managers. Oftentimes, however, there are remedies to ease fiscal pressures if the issues are well understood. First and foremost, a study of rate structures should be undertaken. This paper will provide guidance on the basis and benefits of conducting such studies and our tried and tested methodologies for effective solid waste ratemaking.

Why Do a Solid Waste Rate Study?

In our experience of conducting cost of service or rate studies for solid waste agencies across the U.S. over the last 20+ years, there are a variety of reasons why a decision to conduct a study has been taken, including:

• Declining or negative fund balances
• Difficulty gaining political support for rate increases
• Fuel, equipment and insurance costs are skyrocketing
• Problems with customer service
• Education of political leaders
• Frequent calls for full or part privatization
• Consolidation with neighbors
• Improve efficiency of recycling programs
• Desire to enter new markets or services

Steps in Conducting a Solid Waste Rate Study

Figure 1 illustrates the 10 steps we use in conducting solid waste rate studies for clients. These are more fully described in the paragraphs below.

Step 1: Identify and Establish the Objectives

Customer rates must be in alignment with the mission of the agency. Rates are an important price signal by which public agencies communicate to customers the value of services they deliver. So, at the onset of performing a rate study, the agency should identify and prioritize its ratemaking objectives. In setting customer rates, agencies typically endeavor to achieve some or all the following ratemaking objectives:

• Generate adequate revenues to meet the jurisdiction’s financial obligations
Solid Waste Ratemaking: The Whys and How

- Comply with legal, regulatory and debt covenant requirements
- Achieve fairness and rate equity among customers and among customer classes
- Design rates that are simple and easy for ratepayers to understand
- Set rates that are competitive in relation to other jurisdictions and/or private operators
- Keep rates stable over time

By identifying and prioritizing these objectives at the outset of the ratemaking process, managers can better inform political decision makers as to what they are seeking to accomplish and improve understanding of the trade-offs inherent in their rate structures. Once the cost structure has been analyzed and the initial results are developed, it is often helpful to revisit (and perhaps even reprioritize) these ratemaking objectives prior to making final decisions about designing new rates.

**Step 2: Develop a Project Road Map**

Experience has taught us that developing a project road map is essential to the success of a rate study project. This includes laying out all facets of the rate design process, how they interact together, and how the rate process interfaces with the agency’s annual budget and capital improvement plan process.

For rate analysis, a Pro Forma Model is typically developed at this point in the rate analysis to help collect all the required data and to prepare a long-term cash flow analysis. This usually includes the following critical information:

- Staffing and organizational charts
- Wages and benefit rates
- Rate schedules
- Bond debt
- Fund account summaries (totals and comparisons)
- Past and current operating budgets
- Fleet replacement plan
- Waste deliveries and customer records
- Capital improvement plan
- Administrative costs

Individual spreadsheets are linked to develop an overall model to conduct the rate analysis. **Figure 2** illustrates the general configuration of a Pro Forma Model. As shown, the Model is crafted to help answer many “what if” questions:

- An analysis of operational expenditures (personnel, contract and purchased services, materials and supplies, transfers)
- Analysis of capital outlays (equipment replacement and capital projects)
- Revenue sufficiency analysis (annual revenue projections and rate plan to provide sufficient revenues)
- Funds analysis (reserve requirements, transfers to reserves, administrative costs, beginning and ending fund balances)

Used in this way, scenario analysis is a process of examining and evaluating possible events that could take place in the future by considering various feasible results or outcomes. In rate modeling, this process is typically used to estimate changes in the solid waste business cash flow.

When performing this analysis, we typically generate different future states of the agency, the industry and the economy. These future states will form discrete scenarios that include assumptions such as customer metrics, operating costs, inflation, interest rate and other such drivers. Our rate models typically start with three basic scenarios:

1. **Base case scenario**—This is the expected scenario based on management assumptions
2. **Worst case (pessimistic) scenario**—Considers the most serious or severe outcome that may happen in a given situation
3. **Best case (optimistic) scenario**—This is the ideal projected scenario

The pessimistic and optimistic scenarios serve to bound expectations around the base case.

**Step 3: Establishing or Adjusting Future Solid Waste Rates**

An important aspect of predicting future revenues and expenditures is to understand the agency’s past operating performance. Therefore, an important step in the ratemaking process is to gather and analyze historical financial and operational information. At a minimum, the financial information needed in the ratemaking process should include:

- The general ledger trial balance for the most recently completed two fiscal years, which typically includes detailed line item revenues and expenditures for the agency as well as the beginning and ending reserve balance
• Fiscal year-to-date revenues and expenditures (year-to-date amounts can be annualized to project the operating results for the current year)
• Debt service schedules
• Operating and capital budgets

The purpose of gathering financial information is to help the solid waste manager understand historical revenues, expenditures and ending fund balance. The financial and operational information gathered in this step will be used further along in the ratemaking process to project the revenue requirements, allocate costs and, ultimately, design new rates. Additionally, and perhaps more importantly, the process of gathering and analyzing historical information will better equip the solid waste manager to understand the agency’s past operating performance.

Step 4: Address Cost Savings

This oftentimes means analyzing operational changes to see if improvements can result in efficiencies. For example, a solid waste agency operating a collection fleet at less than full capacity may consider the possibility of extending collection routes to include accounts in the neighboring community. In this way, they could pick up a few more customers to take advantage of underused labor and equipment. This could result in a win-win for both communities in the form of service efficiency and revenue enhancement.

Step 5: Assess Customer Revenue Stream

This step in the ratemaking process uses current customer census information to estimate expected revenue and compare that to the actual revenue recorded in the agency’s accounting system. Each of the agency’s individual solid waste rates is extended by the number of customers that are charged that rate. In the case of roll-off services, the number of loads at each level/type of service is extended by the corresponding rate for that service. The extended amounts for each level/type of service are annualized and summarized to arrive at the total calculated annual revenue at current rates.

There are three main reasons for performing this step. First, this process organizes the customer census information that will be used in designing the new rates and forecasting the number of customers at each level/type of service and expected revenue at the new rates. Secondly, as discussed further below, the recalculated revenue for each customer sector can be compared to its respective revenue requirement for each customer sector. Finally, the recalculated revenue should be compared to the revenue reported in the accounting system. This serves to confirm that the customer census data is accurate. The accuracy of the customer census information is a critical factor in designing new rates and meeting future revenue requirements, which is the agency’s most important ratemaking objective as discussed in the next step.
Step 6: Assess Revenue Requirements

Required revenue is the total amount of money the agency must collect to pay expenditures and provide its targeted levels of service while meeting its financial obligations. This is expressed on a cash basis (rather than on the accrual or modified accrual basis on which many public agencies base their financial reporting) and should include any rate-funded capital expenditures. The revenue requirement for the current year is determined by annualizing the agency's fiscal year-to-date cash expenditures. For example, if the fiscal year ends on June 30th, year-to-date cash expenditures for the nine months ended March 31 should be divided by nine and multiplied by 12 to annualize the year-to-date amount. Additionally, adjustments should be made for any significant non-recurring expenditures.

Revenue requirements for future years are projected by applying anticipated changes in expenditures to the current revenue requirement. These changes may include such items as inflation, increases in workers' wages and tipping fee adjustments. They may also include expected costs for special projects and new programs. In addition to projected cash expenditures, any adjustments must be made to account for required increases in fund balance or debt coverage ratios. Once the agency has projected the amount of money it will need to collect in future years, the next step in the ratemaking process is to determine how much of that money should come from each customer sector.

Step 7: Allocate Revenue Requirement Among Customer Classes

In this step, the agency should compare their revenue requirement for each customer sector with the actual revenue generated by that customer sector. This comparison enables the solid waste manager to determine the extent to which the jurisdiction is achieving the goal of rate equity among its customer classes. It also provides a target revenue amount for use in designing new rates. The process of allocating the revenue requirement is simply a matter of seeking the cause-and-effect relationship between various types of cost. The activities and use of resources that cause costs to be incurred are cost drivers and need to be clearly identified.

However, this cause-and-effect relationship is not always obvious for all types of cost. Indirect costs (or common costs) are those types of costs that are shared among different types of operations and are not as readily linked to a service. These are cost items such as building rent, utilities, management salaries, allocations of cost from other city departments and transfers to the general fund. Additionally, the portion of the revenue requirement attributable to increasing the agency's reserve balance should also be treated as an indirect cost.

The process of allocating the revenue requirement to the various customer sectors is a two-step process. First, direct costs are assigned to each customer sector based on the appropriate cost driver(s) for each type of cost. Second, the remaining indirect costs are assigned to each customer sector based on their proportionate amount of direct costs. For each customer sector, the combination of direct and indirect costs comprises the revenue requirement.

Step 8: Design Customer Rates

The two general approaches to designing solid waste customer rates are the cost-based approach, and the market-based approach. The cost-based approach entails designing rates that most accurately reflect the cost of providing a service. The market-based approach is more focused on how the rate will be perceived by customers. Solid waste rates are usually set using a measure of both approaches.

The cost-based approach starts with calculating the various direct cost components of each level of service by using cost statistics such as direct labor and equipment cost per home, container cost per home and disposal expense per home. Indirect costs are allocated to each type of service proportionately to arrive at the total cost for that service.

The market-based approach is often more of an art than a science and must account for customer behavior and sensitivities. Under the market-based approach, for example, rates can be designed to: 1) encourage customers to recycle, 2) be consistent with the rates in nearby jurisdictions or 3) maintain the structure of the existing rates.

Step 9: Revisit Ratemaking Objectives and Set Final Rates

In this step, solid waste managers should revisit the ratemaking objectives described previously and evaluate whether, and the extent to which, the new rates meet their agency’s objectives. In this way, the solid waste ratemaking process is completed where it began, with a review of the jurisdiction’s ratemaking objectives.

Step 10: Presenting Rate Analysis

Completion of Step 9 provides the agency with a new rate structure to sustain the types of services offered. However, the key to successfully implementing these new rates is spending time with the folks that will have to approve them, all the while educating them on the objectives and the methodology used. This is very much like presenting your case before Judge Judy. You must remember that most politicians are not financial experts nor are they experts of your operations. You and your consultant are the experts. Bear in mind also that the ultimate jury are the ratepayers, and they can be a tough sell. Openness and transparency throughout the rate setting process will go a long way towards convincing people of the need for new rates.

As such, Step 10 needs to be conducted in parallel with previous steps and should not only start after Step 9 is completed.

Lessons Learned

Having completed more than 50 solid waste rate studies for local agencies throughout the United States and U.S. territories, there are number of important lessons we have learned that can serve as valuable lessons for our readers. These include:

- **Benchmarking of Rates and Levels of Service**—We typically undertake this exercise at the end of the assignment to provide local decision makers with an idea of how their agency matches up with sister communities. It is important to ensure that this benchmarking survey is conducted in a way to provide an “apples to apples” comparison, otherwise the results are meaningless.
• Reserve or “Rainy Day” Funds—There is no standard financial policy for reserve funds of enterprise systems. However, we have found that “best in class” solid waste systems have established financial policies to reserve an annual minimum of 15 to 25 percent of the operating expenses of the agency. This kind of reserve policy enables the agency to have the financial wherewithal to fund recurring operational expenses such as fleet replacement, weather emergencies or Acts of God. This is a prudent financial policy in our experience.

• Scenario Analysis—We do most of our rate analysis assignments using Microsoft Excel providing the client with this non-proprietary software after the conclusion of the study. Excel offers a Scenario Modeling Module that allows numerous “what-if” comparisons. This is a wonderful tool. It is important to recognize, however, that, while using the module, dozens or more comparisons can be developed, but it is oftentimes difficult to communicate all these comparisons to political decision makers. Consequently, we have used the rule of simplicity in providing model comparisons to our clients.

An Essential Tool
As indicated previously, cost of service studies are an essential tool in managing a solid waste agency in these uncertain times. With experience in more than 50 such financial studies in recent years, it is our opinion that they provide opportunities for introduction of smart technologies, cost optimization, improved customer service and long-term financial planning. The customized models developed in these studies can help decision makers in analyzing operational outcomes and key performance indicators and comparing the financial results to industry benchmarks.

Marc Rogoff is a Senior Consultant for Geosyntec Consultants and can be contacted at (813) 810-5547 or mrogoff@geosyntec.com.

Bill Gaffigan is a Principal with Geosyntec Consultants and can be contacted at (678) 728-4732 or bgaffigan@geosyntec.com.

Jeremy Morris is a Principal with Geosyntec Consultants and can be contacted at (410) 381 4333 or jmorris@geosyntec.com.

References
1. Marc J. Rogoff (Editor), Analyzing Cost of Service and Designing Rates for Solid Waste Agencies (Kansas City, MO, American Public Works Association, 2007)
4. Marc J. Rogoff and Laurel Urena, The Value of Solid Waste Rate Analysis (APWA Florida Reporter, Fall 2016)
6. Marc J. Rogoff and Donald Ross, Cost of Service Studies in Solid Waste Management (APWA Reporter, March 2006)
Save the Date!

2019 SWANA FL Summer Conference

July 28-30
Grand Hyatt Tampa Bay

Registration Details Coming Soon!
Optimizing Downtown Solid Waste Collection

Marc J. Rogo and Bill Gaffigan, Geosyntec Consultants

Many municipalities across the U.S. are facing the age-old challenge of keeping busy commercial corridors clean and litter free, while at the same time reducing service fees and providing additional recycling opportunities. They are looking for ways to embrace the smart transformation of waste operations in their downtown areas enabling that their public spaces are noticeably cleaner. The streets are calmer too—reduced collection requirements mean fewer trash trucks congestion and using less fuel. This article provides a brief discussion of possible solutions to an improved downtown collection program for your city.

Valet Collection

In recent years, many cities across the U.S. have expressed an interest in improving the cleanliness of alleys in their downtown business districts. Offentimes, these areas were developed before the era of modern solid waste management. Consequently, sanitation agencies and private haulers have great difficulty in servicing these areas with large collection trucks in the early hours of the morning while at the same time businesses are receiving traffic in these same alleys from food, beverage, and service purveyors. Typically, there is also very little room to access refuse and recycling containers or compaction equipment. Further, these alleys are unsanitary because of spilled garbage, feeding from loose animals and vermin.

The Seattle Public Utilities (Washington) implemented their “Clean Alleys Program or CAP” in historic Pioneer Square and then expanded the program to other adjacent downtown areas. Briefly, CAP has eliminated all solid waste dumpsters in the alleys requiring placement of solid waste in bags. Customers are required to purchase special garbage and recycling bags online from the franchise hauler and can be set out three hours before scheduled pick up, every day, seven days a week, 24/7. Disposal tags can also be purchased for bulky items that cannot easily fit in a CAP plastic bag. The City reports that surveys conducted indicate more than two thirds of the businesses in these areas believe that the alleys are cleaner, safety has improved and that the benefits outweigh the costs.

Vacuum Collection

An automated vacuum waste collection system, or AVAC, transports waste at high speed through underground pneumatic tubes to a collection station where it is compacted and sealed in containers. When the roll-off container is full, it is transported away and emptied. The process begins with the deposit of trash into intake hatches, called portholes, which may be specialized for waste, recycling, or compost (see Figure 1). Portholes are in public areas and on private property where the owner has opted in. The waste is then pulled through an underground pipeline by air pressure difference created by large industrial fans, in response to porthole sensors that indicate when the trash needs to be emptied and help to ensure that only one kind of waste material is traveling through the pipe at a time. The pipelines converge on a central processing facility that uses automated software to direct the waste to the proper container, from there to be trucked to its final location, such as a landfill or composting plant.

Although there are more than 100 AVAC systems operating in more than 15 foreign countries serving large city centers, residential areas, airports, and theme parks, and dozens more serving hospitals and food plants for decades in the U.S. and internationally, they were slow to be introduced for the urban waste sector in the U.S. However, things are starting to change as the real benefits of this technology become better appreciated. It should be noted that Canada has been a faster adopter of this technology, having more large-scale AVAC systems in operation than the U.S.

Underground Vault System

The City of Kissimmee, just south of Orlando, has recently installed an underground vault system. Lake Toho
Redevelopment is a new mixed-use development underway, which will encompass four city blocks downtown. A fulfillment of the City’s goals for a “live, work, play” environment, it will feature 260 apartments, 16 townhomes, 15,000 square feet of commercial space and a 120-room hotel. Nearby is a lakefront park and a train station. However, there is one thing that the project lacks—room for the typical, metal solid waste dumpsters.

The City researched various underground vault systems, both in the U.S. and Europe, finally deciding on an underground vault system offered by Nord Engineering, an Italian company. The U.S. agent for the system is Underground Refuse Systems, an Orlando-based company. Nord Engineering’s underground container is about the size of a community mailbox (Figures 2 and 3, pages 5 and 6) and can contain six and a half cubic yards of material (comparable to 15 large garbage cans). The units include a sensor that tells the collection vendor when the trash container is full and needs collection.

The portion of the trash bin above ground has a modern rounded look with a trash door that leads to underground bins in 11-foot deep vaults. A specially-designed $424,000 truck (Autocar) attaches a crane to a bell housing on the top of the bin, then hoists and dumps the bin into the truck, which has an onboard compactor. Once the waste is collected, the bin is then lowered back into the concrete housing in the street or sidewalk. A concrete lip and special drainage help avoid ground water contamination.

Since 2018, six units were installed at various locations throughout the City’s downtown area. The City plans Zones 1, 2, 3, 4, and 5 are required to use the sealed compactor units for solid waste disposal (which includes both trash and recycling) or make alternate provisions for solid waste removal.

Businesses and residential customers empty the big blue cans using tippers or place bagged trash into the compactors. Each location also has a drop-off area for recycling (bottles, cans, plastics, mixed paper, and cardboard). Businesses and residents in the compactor zone can call Downtown Roanoke Incorporated (DRI) to register for compactor use and to receive a fob (electronic key). The compactors are housed in enclosed areas with video surveillance and can be accessed only with a key fob provided by DRI.

DRI initially conceptualized the idea as an attempt to keep loose garbage off the streets. Three years after DRI installed the first trash compactor in the central business district near the City Market on private leased property, the new system is expanding and gradually has been met with more acceptance than some business owners originally were willing to provide. Business owners and employees say they have grown accustomed to the change, which initially was met with strong opposition.

The DRI and the City initially held meetings with focus groups (businesses, property owners, and residential owners) and then used these groups to implement a training program.

Figure 2 - Street view of the underground vault system in Kissimmee, FL. Figure courtesy of Underground Refuse Systems, 2018.
program for use of the compactors and the recycling containers, and food preparation tips to reduce trips to the compactors.

Previously, the City provided curbside pickup of solid waste in the district to businesses and property owners. When the first compactor was installed near Market Square in the fall of 2013, business owners complained that the switch would cost hundreds of dollars a month in additional manpower. They said it would also require employees to haul large amounts of trash as many as four blocks at the end of a work shift. Under the current configuration, the farthest any restaurant is from a compactor is about a block or a block and a half.

Each compactor location cost the City approximately $150,000 in addition to the monthly rental costs. The monthly service cost is allocated to all businesses and residential units within each zoned area. Overall, the businesses, property owners and residences have seen a reduction in the cost of waste collection and an increase in the opportunities for recycling.

**Big Belly Containers**

Bigbelly was originally a solar powered, rubbish-compacting bin, manufactured by U.S. company Bigbelly Solar for use in public spaces such as parks, beaches, amusement parks, universities, retail properties, grocery industry, and food service operators. The bin was designed and originally manufactured in Needham, Massachusetts by Seahorse Power, a company set up in 2003 with the aim of reducing fossil fuel consumption. Due to the bin’s commercial success, Seahorse Power changed its name to BigBelly Solar.

The bin has a capacity of 33 gallons—one normal trash bin. However, its compaction mechanism increases the bin’s effective capacity by five. The compaction mechanism is chain-driven, using no hydraulic fluids. Maintenance consists of lubricating the front door lock annually. The mechanism runs on a standard 12-volt battery, which is kept charged by the solar panel. The battery reserve lasts for approximately three weeks. Wireless technology-enabled units report their status into the CLEAN (Collection, Logistics, Efficiency, and Notification system) dashboard that gives waste management and administration insights for monitoring and route optimization. BigBelly Solar also provides companion recycling units that allow cities, parks, and universities to collect single-stream or separated recyclable materials in public spaces.

Communities in 50+ countries now deploy Bigbelly’s suite of smart, sensor-equipped waste stations. Each unit communicates its real-time status and notifies crews when it is ready to be collected. This streamlines waste management operations, increases productivity and keeps public areas clean.

**Lessons Learned**

Solutions discussed previously can play a measurable role in helping improve the collection program in your downtown area. Based on our firm’s experience, it is important to conduct a feasibility study to help assess which solutions make sense for your area. It is important then to work with your specific stakeholders to identify the implementation costs and how they can be successfully deployed.

Marc J. Rogoff, Ph.D. is a Senior Consultant with Geosyntec Consultants. He can be reached at (813) 810-5547 or e-mail mrogoff@geosyntec.com.

Bill Gaffigan, CVA is a Principal with Geosyntec Consultants. He can be contacted at (678) 718-4732 or e-mail bgaffigan@geosyntec-cat.com.
The Growing Solid Waste Disposal Problem

Over the past several decades, various non-governmental organizations (NGOs) such as the Asian Development Bank, United Nations, World Bank, and international research agencies supported by various European nations have estimated that solid waste, which is generated worldwide, is estimated to be approximately 1.3 billion metric tons per year and expected to increase to approximately 2.2 billion metric tons by 2025. This assumes an increase in per capita waste generation rates from 1.2 to 1.42 kilograms per person per day over the next decade (Table 1.1).

MSW generation rates are influenced by several key factors; among these are economic development, degree of industrialization, urbanization, and climate. Data collected by international organizations such as the World Bank and the United Nations suggest that the higher the degree of economic development and urbanization, the greater the amount of solid waste produced. Further, income level (gross domestic product or GNP) and urbanization are usually correlated as well as disposable incomes and living standards. As the levels of these factors increase, there is a corresponding increase in the generation of solid waste, with urban residents generating almost twice as much solid waste as rural inhabitants. Waste reduction efforts are anticipated to produce a leveling of peak waste in OECD countries by 2050, East Asia and Pacific countries by 2075, and continued growth of waste in Sub-Saharan Africa. Global waste generation is projected to possibly hit 11 million metric tons per day by 2100.

How to dispose of the cans, cereal boxes, newspapers, tires, bottles, and other castoffs of communities in the industrialized and the developing world in an environmentally sound and economically efficient way has become a problem of critical proportions. Up until the recent past, resources were considered as something scarce, which needed to be reused with little, if any, going to waste. To assist in this effort, the “ragmen” and piggeries could be found in most urban areas of the industrialized countries and formed the basis of an active recycling industry.

With population growth and waste generation rates spiraling upward, many communities worldwide are beginning to search for alternative long-term solutions to the methods they once employed to dispose of their solid wastes. Sanitary landfilling of solid waste has become the traditional approach for most communities in the industrialized world where it has progressed from an earlier era of dumps and open burning to its present state of engineered landfills.

Sanitary landfills can be designed today to be an environmentally acceptable means of waste disposal, provided they are properly operated. New regulations regarding landfill liners, leachate control systems, landfill gas collection and control systems, and long-term closure requirements, however, have dramatically increased the cost of landfilling. In addition, suitable land for landfill sites close to nearby urbanizing areas is now less available for many communities, thereby resulting in communities having to locate more distant landfills. The Not-In-My-Back-Yard (NIMBY) attitude on the part of citizen opposition groups, however, has increased the difficulty of many communities in the siting and permitting of these new landfills.

Consequently, as existing landfill capacity has been

---

Table 1.1
Estimate of Municipal Solid Waste Worldwide (2025)

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Urban Population (Millions)</th>
<th>Urban MSW Generation Per Capita (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>518</td>
<td>0.85</td>
</tr>
<tr>
<td>East Asia and Pacific</td>
<td>1,230</td>
<td>1.52</td>
</tr>
<tr>
<td>Eastern and Central Asia</td>
<td>240</td>
<td>1.48</td>
</tr>
<tr>
<td>Latin American and the Caribbean</td>
<td>466</td>
<td>1.56</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>257</td>
<td>1.43</td>
</tr>
<tr>
<td>OECD</td>
<td>842</td>
<td>2.07</td>
</tr>
<tr>
<td>South Asia</td>
<td>734</td>
<td>0.77</td>
</tr>
<tr>
<td>Total</td>
<td>4,287</td>
<td>1.42</td>
</tr>
</tbody>
</table>

Source Reference: D

Legend:
- Landfill
- Waste-to-Energy
- Recycling+Composting

BY MARC ROGOFF
programs in the 1960s. Many European countries, along with Japan, embarked on massive construction programs for WTE and landfilling, many European countries, along with Japan, which was experiencing severe landfill problems. The success of these projects helped the WTE industry gain acceptance by local government leaders and by the financial community. Tax incentives made available by the federal government for WTE projects attracted private capital investment in such projects assisting in the maturing of this industry in the US and sparked the development of many new projects.

During the 1990s, the WTE industry in the US experienced several setbacks, which resulted in no new WTE facilities being constructed from 1995 through 2014. Expiration of tax incentives, significant public opposition in facility siting, and the US Supreme Court decision in Carbone dealing with solid waste flow control forced many communities in the US to opt for long-haul transport of their solid waste to less costly regional landfills. A more recent Supreme Court decision on flow control has restored the ability of communities to enact flow control ordinances and enable them to direct their wastes to WTE facilities. As a result, some WTE facilities have recently begun to expand by adding new processing lines to their existing operations. These facilities are basing their requests for financing and permitting on their successful records of operation and environmental compliance. In 2014, the first new WTE facility since 1995 was constructed by the Solid Waste Authority (SWA) of Palm Beach County, FL. The SWA’s Renewable Energy Facility 2 (REF2) is a $672,000,000, state-of-the-art WTE facility. The REF2 project is the first of its kind in more than 15 years and is the most advanced and cleanest waste-to-energy power plant in North America.

As of this writing, there are currently 87 WTE plants operating in 25 US states managing about 7% of the nation's MSW, or about 90,000 tons per day. This is the equivalent of a baseload electrical generation capacity of approximately 2,700 megawatts to meet the power needs of more than two million homes while servicing the waste disposal needs of more than 35 million people.

Europe

Europe is the largest and most enhanced market for WTE facilities. Large numbers (Figure 1.1) are in Europe, primarily because of the EU Circular Economy Package adopted in January 2018 that requires a 65% reduction in the landfilling of biodegradable MSW by 2030 with a binding landfill target to reduce landfill to a maximum of 10% of MSW. Nonetheless, a large part of the EU’s wastestream (40%) is still landfilled. These WTE plants converted about 69 million metric tons of MSW (or about 20% of the EU wastestream) generating 30 TWh of electricity and 55 TWh of heat. This is roughly equivalent to supplying the annual needs of 13 million inhabitants with electricity and 12 million inhabitants with heat in these countries. Given the EU’s directive on landfilling, estimates of new WTE facility construction range from 60 to 80 new plants by 2020. Scandinavian counties (Denmark and Sweden) have historically been significant proponents of WTE.
China
Economic development and rapid urbanization in China over the past few decades has resulted in a rapid generation of 200 million tons of MSW requiring disposal in 2016. Currently, one of the largest markets for WTE plant construction is in China. According to the World Bank, China surpassed the US as the largest generator of MSW in 2004. This has produced an unprecedented trash crisis in many of its cities. Due to a deficiency of land for continued landfilling of MSW, China has embarked on a major construction program of WTE facilities.

The Chinese WTE capacity has increased steadily from 14 million tons in 2007 to nearly 75 million tons by 2016, although landfilling remains the dominant means of waste disposal in China. Since the beginning of the 21st century, China has become the fourth largest user of waste-to-energy (WTE), after the EU, Japan, and the US, with most plants located in the heavily industrialized cities in southeastern China. 259 WTE mass-burn plants have been built in China as of 2016 with a total capacity of 280,000 TPD, according to The China Municipal Solid Waste Industry Development Report by China Association of Urban Environmental Sanitation & China Urban Construction Research Institute Co. LTD. Early WTE plant designers experimented with CFB (Circulating Fluidized Bed technology used in 58 plants as of 2016) and locally-made grate technologies that resulted in low plant utilization factor. Despite the relatively high capital cost of WTE, the central government of China has been very proactive regarding increasing WTE capacity. One of the measures brought in provided a credit of about $30 per MWh of electricity generated by means of WTE rather than by using fossil fuel.

As China pushes WTE technology, there have been protests over the siting of these facilities from local citizens who are fearful that they emit toxic air pollutants. Over the past few years, protests have taken place in major provinces such as Hainan, Hubei, Hunan, Guangdong, Jiangxi, Shandong, and Zhejiang. Siting concerns persist despite assurances from project developers and city administrators.

Africa
The Koshe dump site has been the only landfill in Addis Ababa since the 1960s. As the city has expanded, the landfill, which used to lie in the rural areas on the outskirts of the Ethiopian capital, has become part of the urban landscape, sprawling over an area the size of 36 football fields and attracting hundreds of waste pickers who make their living from salvaged trash. In 2017, a landslide on the dump site killed 114 people, prompting the government to declare three days of mourning. A new WTE plant is set to transform the site and revolutionize the entire city’s approach to dealing with waste.
The plant, which is due to begin operating in 2019, will incinerate 1,400 tons of waste every day, which is roughly 80% of the city’s MSW. Further, the plant supplies greater Addis Abba with 30% of its household electricity needs and meeting EU standards on air emissions.

**Numbers of WTE Facilities**
As of the writing of this article, there are about 2,179 WTE facilities worldwide (Figure 1.2). Asian countries (Japan, Taiwan, Singapore, and China) have the largest number of WTE facilities worldwide. All these countries face limited open space issues for the siting of landfills and high urban populations. For example, Japan has addressed its solid waste issue by processing about an estimated 70% of MSW in WTE facilities.

*Marc J. Rogoff and Francois Screve (President of Deltaway Energy)*

**References**

**Improving Operational Efficiency with Cloud Solutions**
for Municipal Solid Waste Professionals

**On-Demand FREE Webinar**
**Earn 1 PDH / 0.1 CEU**

Join Forester University for this free, live, educational webinar as experts from AMCS Group provide an overview of the benefits of moving to a cloud-based platform to improve business productivity and efficiency.

*Sponsored by AMCS*

Register for This Webinar Today at

**FORESTERUNIVERSITY.NET**

www.mswmanagement.com 47
Geosyntec Consultants is a consulting firm with engineers, geologists, environmental scientists, and other technical and project staff based in offices throughout the United States, Canada, the United Kingdom, Ireland, and Australia. We address new ventures and complex problems involving our environment, natural resources, and civil infrastructure.

**CONTACT INFORMATION**

Marc Rogoff, Ph.D.
12802 Tampa Oaks Blvd.,
Suite 151
Tampa, Florida 33637
p: (813) 558-0990
e: mrogoff@geosyntec.com

**Geosyntec consultants**

engineers  |  scientists  |  innovators

**Offices in Principal Cities of the United States and Select International Locations**
geosyntec.com