Landfill Gas Extraction Feasibility Study

Eloy S. Inos Peace Park

(formerly Puerto Rico Dump) and Marpi Solid Waste Facility
Commonwealth of the Northern Mariana Islands

Prepared for
Commonwealth of the Northern Mariana Islands
Capital Improvement Projects
Office of the Governor

Prepared by
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US Department of Interior Empowering Insular Communities Grant
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OFFICE OF INSULAR AFFAIRS
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CONTENTS

Page

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

°F	Degree Fahrenheit
%	Percent
%v/v	Percent volume per volume
Btu	British thermal unit
BECQ	Bureau of Environmental and Coastal Quality
cfm	Cubic feet per minute
CNMI	Commonwealth of the Northern Mariana Islands
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	U.S. Environmental Protection Agency
ft	Foot (feet)
hr	Hour(s)
in.	Inch(es)
kW	Kilowatt(s)
kWh	Kilowatt-hour(s)
LFG	Landfill gas
min	Minute(s)
MSW	Municipal solid waste
MSWF	Marpi Solid Waste Facility
ND	Non-detect
NMOC	Non-methane organic compound
NPV	Net present value
O&M	Operation and maintenance
ppmv	Part(s) per million by volume
ppmv-C	Part(s) per million by volume as carbon
PRD	Puerto Rico Dump
scf	Standard cubic foot (feet)
RCRA	Resource Conservation and Recovery Act
TNMOC	Total non-methane organic compound

1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA) was contracted by the Commonwealth of the Northern Mariana Islands (CNMI) Office of Grants Management, Office of the Governor, to perform a Landfill Gas (LFG) Extraction Feasibility Study at two landfills on Saipan: Eloy S. Inos Peace Park, formerly known as the Puerto Rico Dump (PRD), and the Marpi Solid Waste Facility (MSWF), also known as the Marpi Landfill (RFP18-OGM-045). The work to complete the feasibility study includes characterization of waste, assessment of LFG generation potential and techniques to increase gas generation, and conceptual design of a LFG collection system at each site. In addition, regulatory requirements, potential LFG beneficial uses, and economic viability are discussed.

The CNMI, a U.S. territory, is a 14-island archipelago in the North Pacific Ocean. Both the Eloy S. Inos Peace Park, formerly the Puerto Rico Dump, and the Marpi Solid Waste Facility are located on the CNMI island of Saipan, CNMI's capital. As of 2015, the island had a population of approximately 48,000 with a substantial influx of tourists (U.S. Census Bureau 2015). Recently, large-scale tourism has been the main economic driver in the CNMI. From 1983 to 2004, the garment industry was a principal source of revenue on the island; however, the industry plummeted thereafter due to tariff and trade barriers (*Saipan Tribune* 2005). The climate of Saipan is tropical, hot and humid all year round, with daytime temperature ranging from 82 to 84 degrees Fahrenheit (°F) in the coolest period and 86 to 88 °F in the warmest, with an average humidity of 79 percent (%) (World Climate Guide 2018). There are two main seasons in Saipan: a relatively cool and dry season from December to June, and a warmer and rainy season from July to November. Rainfall is abundant and mean annual rainfall is approximately 80 in. in Saipan.

1.1 ELOY S. INOS PEACE PARK (FORMERLY THE PUERTO RICO DUMP)

The PRD is a 20-acre facility located in the town of Puerto Rico, Saipan, at the edge of Tanapag Lagoon and adjacent to an oil terminal, approximately 3,500 feet (ft) northeast of Garapan village (Figure 1-1). It is bordered by Tanapag Lagoon on the northwest and southwest, by a dock on the northeast, and by land on the southeast.

PRD began operation as a military heavy scrap metal dump as early as 1945. Debris was initially dumped directly onto sediment in a backwater area of Tanapag Lagoon. Ownership of PRD was transferred to the CNMI government in 1978, which leased the dump to the U.S. Navy from 1983 to 1988. CNMI closed the dump to waste disposal on 11 February 2003 after opening the Resource Conservation and Recovery Act (RCRA) Subtitle D Marpi Solid Waste Management facility (CNMI PRD Closure Alternative Analysis [EA 2011a]). After an Administrative Order of Consent issued by the U.S. Environmental Protection Agency (EPA) in 2005 to prevent continued discharge of leachate into Tanapag Lagoon, PRD was closed and capped in 2011. In order to improve environmental quality and the tourism industry, PRD was converted to a community park (Eloy S. Inos Peace Park) in compliance with the federal regulations and was finally completed in March 2017.

Figure 1-1 Eloy S. Inos Peace Park

1.2 MARPI SOLID WASTE FACILITY

The MSWF is located in Saipan Municipality, Saipan. The landfill was designed in 2002 to include six cells with a total design capacity of 2.5 million cubic yards in a 25-acre lined facility (Harding ESE 2002). The MSWF was designed as a RCRA Subtitle D compliant municipal solid waste (MSW) landfill, with the goal for the new facility to bring Saipan into compliance with federal environmental regulations and utilize state-of-the-art waste reduction and diversion technologies to the island. The full build-out of the facility will include site support facilities (truck weigh scales and scale house, office building, and maintenance building), drop-off areas, leachate storage facilities, water and wastewater systems, stormwater control systems, fuel storage systems, and site access roads and parking.

Cell 1 of the MSWF began operation in 2003, with filling operations anticipated to continue through 2019. The cell was constructed with a landfill liner system including a geosynthetic clay liner, 60-mil high-density polyethylene geomembrane, and geocomposite drainage layer. Leachate collection within the cell consists of a rock drainage layer with high-density polyethylene header and lateral pipes, and sump riser pipes for leachate removal. Currently, waste acceptance is expected to continue in Cell 1 until Cell 2 is ready for waste acceptance.

Figure 1-2 Marpi Solid Waste Facility

1.3 REGULATORY REQUIREMENTS

Under the 1991 Clean Air Act, 40 Code of Federal Regulations Part 60 Subpart WWW – Standards of Performance for MSW Landfills, and 40 Code of Federal Regulations 60.32c Amendments, landfills with a permitted capacity greater than 2.5 million tons and annual non-methane organic compound (NMOC) emissions greater than 50 megagrams are subject to the New Source Performance Standards. When NMOC exceeds 50 megagrams per year, as determined by Tier I or Tier II analysis, the site is obligated to install a LFG emissions collection and control system. Given that the PRD and Marpi landfills are smaller than the federal threshold, and that observed NMOC is lower than regulatory thresholds, installation of a LFG emissions collection and control system is not required, and neither Tier I nor Tier II analysis is required at PRD (EA 2011b), nor MSWF.

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2. HISTORICAL, CURRENT, AND FUTURE WASTE ACCEPTANCE RATES

The most important information to estimate future LFG generation rate and total potential lifetime LFG generation from a solid waste landfill is the amount, type, and location of waste placed in the landfill and projected to be placed there during the remaining landfill life. Waste characterization for the Eloy S. Inos Peace Park, formerly PRD, and the MSWF are discussed in this chapter.

2.1 PUERTO RICO DUMP

During its operation between 1945 and 2003, PRD received military waste including unexploded ordnance and metal scrap, commercial and household waste, batteries, and garment factory wastes. Due to a thriving garment industry during PRD's operation, it is estimated that up to 33% of Saipan's solid waste stream may have been garment waste (Earth Tech, Inc. 2006).

The total volume of PRD is estimated to be approximately 1.75 million cubic yards (AECOM 2011). However, in order to assess LFG generation potential only the total biodegradable waste placed is considered for LFG generation potential. The total biodegradable waste is estimated to be approximately 260,000 tons placed between 1975 and landfill closure in 2003 above elevation 10 ft, based on findings that organic waste placed below elevation 10 ft may have been burned during waste fires attributed to unexploded ordnance explosions, or has decayed since its original placement (AECOM 2011). Of the biodegradable waste placement years in consideration (1975 to 2003), the average annual biodegradable waste placed is estimated to be 9,000 tons per year.

The PRD waste characteristics are summarized in Table 2-1.

Table 2-1 Summary of Puerto Rico Dump Waste Characterization

Summary Item	PRD
Operational Status	Closed in 2003 and capped in 2011; biodegradable waste volume placed between 1975 and landfill closure in 2003
Landfill Total Area (acres)	20
Estimated Total Waste Volume (cubic yards)	1,750,000
Estimated Biodegradable Waste Volume (tons)	260,000
Average Annual Solid Waste Placement (tons per year)	9,000

2.2 MARPI SOLID WASTE FACILTY

Since Cell 1 began waste acceptance in 2003, the MSWF has been primarily used for disposal of MSW and other non-hazardous waste, including light industrial and textile waste, green waste, special waste, free waste, and inert waste. Detailed waste records have been maintained during the life of the facility and are provided in Appendix A. Unlike PRD, garment waste comprises a much smaller fraction of the waste stream due to closure of many of the garment industry facilities previously located on the island. Diverted materials, such as green waste, soil, concrete, cardboard, white goods (fridges, stoves, washers, dryers), used tires, glass, office paper, aluminum, old newsprint, and plastic bottles, are removed from the waste stream prior to waste placement within Cell 1.

CNMI waste records indicate that between 2003 and 2017, the MSWF received and managed approximately 554,000 tons of material, with approximately 371,000 tons landfilled after diversion (recycling rate 33%). Over the 14 years these data have been maintained, this equates to an annual average waste placement of 24,700 tons per year.

MSWF design drawings (Harding ESE 2002) note a design capacity of 2.5 million cubic yards per day of airspace volume. Assuming a waste density of 1,000 pounds per cubic yards, landfill Cells 1 through 6 may accommodate a total waste tonnage of up to 1.25 million tons. Given historical waste placement and assuming a population growth of 7% every 10 years based on recent census data (U.S. Census Bureau 2015), the MSWF may be capable of accepting waste until 2048.

The summary of total projected waste capacity and assumed parameters is provided in Table 2-2.

Table 2-2 Summary of Marpi Solid Waste Facility Waste Characterization

Summary Item	MSWF Cells 1–6
Operational Status	Cell 1 only currently accepting waste
Landfill Total Area (acres)	25
Estimated Total Volume (cubic yards)	2,500,000
Assumed Density (pounds/cubic yard)	1,000
Total Capacity Projected (tons)	1,250,000
Assumed Population Growth (% in 10 years)	7

3. LANDFILL GAS GENERATION AND EXTRACTION POTENTIAL

3.1 LANDFILL GAS GENERATION AND COMPOSITION

Various gases are generated through the action of microorganisms that begin decomposing organic waste within 3–6 months after disposal. The rate of LFG generation caused by waste decomposition depends on the type, volume, age, and spatial distribution, and a number of environmental factors, including moisture, temperature, oxygen, and waste degradability. Typical changes in LFG composition over time are shown in Figure 3-1 below.

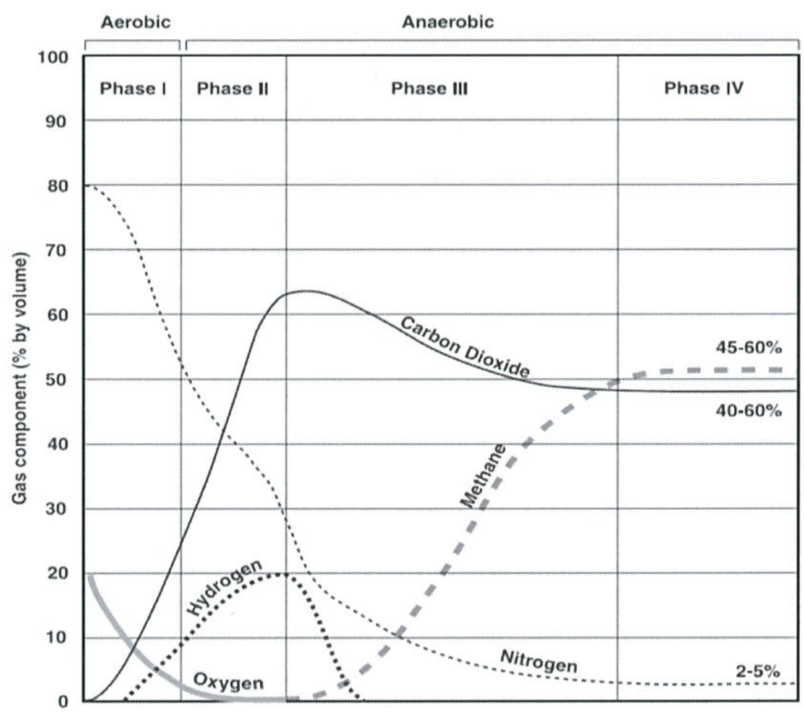

Figure 3-1 Production Phases of Typical Landfill Gas (Agency for Toxic Substances and Disease Registry 2008)

With high ambient temperature, moist climate, and low amount of compaction applied during waste placement, LFG generation would be expected to occur rapidly following placement. The LFG generation rate is highest after waste disposal, and gradually declines over decades as organic waste is depleted. Maximum LFG generation typically occurs within the first 2 years after a landfill stops accepting waste. This trend of LFG generation over time is typically incorporated into LFG models by applying a first-order exponential decay equation, which assumes that LFG generation is at its peak following a time lag (period prior to methane generation), and then decreases exponentially as the organic fraction of waste is consumed.

The goal in collecting LFG is to maximize gas collection while maintaining high gas quality, generally defined as high methane content (around 50%) and low nitrogen (less than 20%) and oxygen (less than 5%) in the collected gas. Adequate methane content and low oxygen are necessary for energy conversion devices such as engines or boilers. Nitrogen and oxygen in collected LFG are mostly due to atmospheric air being drawn into the waste mass due to the vacuum applied by the collection system. Gas quality is important both for energy recovery and combustion, and for landfill safety (i.e., to prevent landfill fires). Typical LFG is composed of approximately half methane and half carbon dioxide, with trace quantities of NMOCs.

3.2 LANDFILL GAS SAMPLING

LFG sampling was conducted at PRD and MSWF to determine the components of gaseous emissions to estimate future LFG generation.

LFG samples were collected as part of the PRD landfill closure in 2011 and as part of the gas feasibility study at MSWF in 2018. The collected samples were analyzed for fixed gases by EPA Method 25C and total gaseous NMOCs (i.e., hexane by EPA Method 3C). Based on EPA Method 3C, samples may contain no more than 20% nitrogen, since high nitrogen concentrations may indicate air intrusion. Sampling efforts at both sites are described in additional detail below. All lab analyses were performed according to the laboratory's National Environmental Laboratory Accreditation Program and Department of Defense Environmental Laboratory Accreditation Program approved quality assurance program.

3.2.1 Puerto Rico Dump Landfill Gas Sampling Results

A total of 19 LFG sample probes were installed per the Tier II Testing Services for Puerto Rico Closure Work Plan (Puerto Rico Dump Landfill Gas Testing Method, Results and Recommendations [EA 2011b]). In June 2011, samples were collected from all probe locations; however, only 5 samples had less than 20% nitrogen, and are the basis for this LFG assessment. The 5 PRD LFG samples with less than 20% nitrogen contained typical concentrations for methane, carbon dioxide, and nitrogen. PRD LFG sampling results are summarized in Table 3-1 with sampling locations and detailed results provided in Appendix B. Sampling results show that the average methane content (%) generated from PRD was 46.1%.

Table 3-1 Puerto Rico Dump Landfill Gas Sampling Results

Analyte	EPA Method	Units	Sample Location				
			LFG-05	LFG-06	LFG-11	LFG-12	LFG-15
Hydrogen	3C	%v/v	ND	ND	ND	ND	ND
Argon	3C	%v/v	3.42	3.22	1.28	2.94	2.39
Nitrogen	3C	%v/v	12.1	11.5	5.78	10.4	12.4
Carbon Monoxide	3C	%v/v	ND	ND	ND	ND	ND
Methane	3C	%v/v	44.3	44.7	50.8	46.1	44.5
Carbon Dioxide	3C	%v/v	40.2	40.6	42.1	40.6	40.7
Non-Methane Organic Compounds	25C	ppmv	11	8.9	22	20	19

Notes: %v/v = Percent volume per volume.
ND = Non-detect.
ppmv = Parts per million by volume as hexane.

3.2.2 Marpi Solid Waste Facility Landfill Gas Sampling Results

Five LFG samples were collected at the MSWF on 10 July 2018 (Figure 1 in Appendix C). At the time of the sample collection the waste in Cell 1 had approximately 10–12 in. of soil cover which varied in depth and may have allowed different degrees of off-gassing. Analytical discrepancies between the samples are likely due to the incomplete status of the landfill cap; the poor cover system likely prevented a uniform accumulation of gas within the cell and the variability in the waste material impacted the depth at which the sampling gas wells were installed. Variations in waste composition, size, and degradation rates likely had impacts on localized gas concentrations. Additionally, at the time of the sample collection there was a pile of wastewater sludge on top of the cell. The pile was located on the east-central part of the cell, this area was avoided during sampling due to the high likelihood of gas production from the sludge.

MSWF LFG sampling results are summarized in Table 3-2 with sampling locations and detailed results included in Appendix C. Based on the site conditions described, NMOC results for MSWF samples were corrected at locations where nitrogen concentration was higher than 20%. After sample correction, collected MSWF LFG samples contained typical concentrations for methane, carbon dioxide, and nitrogen. Sampling results show that the average methane content (%) generated from MSWF was 60.3%.

Table 3-2 Marpi Solid Waste Facility Landfill Gas Analytical Results

Analyte	EPA Method	Units	Sample Location MARPI-1B-071018	MARPI-2A-071018	MARPI-3A-071018	MARPI-4A-071018	MARPI-5B-071018
TNMOC							
TNMOC N_2 corrected	25C	ppmv-C	1,400	1,300	850	1,600	1,400
TNMOC O_2 corrected	25C	ppmv-C	1,400	1,400	890	1,600	1,400
Fixed Gases in Air							
Carbon dioxide	3C	%v/v	44	25	25	42	39
Methane	3C	%v/v	61	36	36	59	61
Nitrogen	3C	%v/v	<3.2	37	35	<3.2	5.9
Oxygen	3C	%v/v	<1.6	10	10	<1.6	1.6

Notes: < = Analyte not detected at a concentration equal to or above the reporting limit.
%v/v = Percent volume per volume.
ppmv-C = Parts per million by volume as carbon.
TNMOC = Total non-methane organic compound.
TNMOC nitrogen corrected (applicable if nitrogen <20%).
TNMOC oxygen corrected (applicable if nitrogen >20% and oxygen <5%).

3.3 LANDFILL GAS GENERATION POTENTIAL

Utilizing the LFG sampling results, a year-by-year estimate of LFG emissions for PRD and MSWF has been developed using EPA's Landfill Gas Emissions Model – LandGEM Version 3.02. LandGEM is a software program based on the first-order decomposition rate equation used to estimate emission rates for total LFG, methane, carbon dioxide, NMOC, and individual air pollutants from MSW landfills as described by the following relation:

$$Q_M = \sum_{i=1}^{n} 2\,k\,L_o M_i \left(e^{-kt_i}\right)$$

Where:

Q_M	=	Maximum expected gas generation flow rate, cubic meters per year.
k	=	Methane generation rate constant in year $^{-1}$.
L_o	=	Methane generation potential in cubic meters per megagram of MSW.
M_i	=	Mass of MSW placed in the i^{th} year in megagrams.
t_i	=	Age of the MSW placed in the i^{th} year (n total years).

The equation above demonstrates that the annual volume of LFG produced in a landfill is proportional to the mass of waste in place, modified by two parameters (k and L_0), and decays exponentially with time after an initial peak. The methane generation rate constant, k, is a function of the moisture content of the waste mass, the nutrients available to the methane-forming bacteria, and the pH and temperature of the waste mass. The higher the methane generation rate constant (k), the earlier LFG generation peaks and begins to taper off. Values of k have been empirically derived by EPA based on actual field measurements at landfills. The potential methane generation capacity (L_0) represents the total potential LFG generation capacity of the waste mass and is a function of the amount of cellulose (biomass) present in the MSW. The higher the value of L_0, the greater the total potential volume of LFG that can be generated from the waste mass. Values of L_0 have been theoretically derived by EPA based on the chemical composition of typical MSW. The LandGEM model was run utilizing methane generation rate (k) and potential methane generation capacity constant (L_0) provided by AP-42 emissions estimation guidelines (EPA 1995). These values are believed to be more realistic than the Clean Air Act default values and more representative of actual projected LFG generation rates.

Given the above model input, the model estimates the amount of LFG generated by the waste mass. The amount of LFG captured by a LFG collection system varies by the capture efficiency of the system. The volume of LFG that is captured is the volume that is available for beneficial use. Many different factors influence LFG capture efficiency, including the permeability of the final cover, distribution and number of gas wells, and design and operation of the collection system.

The following model assumptions were utilized for the LandGEM analysis at PRD and MSWF:

- $k = 0.040$ year^{-1}
- $L_o = 100$ cubic meters per megagram.

A summary and discussion of LFG generation potential at each site is included below.

3.3.1 Landfill Gas Generation Potential at Puerto Rico Dump

The PRD was modeled based on waste placement from 1975 to 2003. The volume of waste from metals, industrial waste, textile debris, special waste, and free waste does not contribute to LFG generation and, therfore, was not considered in the LandGEM model (Earth Tech, Inc. 2006).

Figure 3-2 shows estimated LFG peak generation occurred in 2004, with LFG production declining thereafter. The peak gas generation rate in that year was 82 cubic feet per minute (cfm) and methane gas generation rate was 38 cfm. With active (negative pressure) LFG collection systems, overall capture efficiency can range from 60 to 90%. Since, the PRD has existing passive vents (GHD 2017), it is assumed that 65% of the total LFG produced can be captured by those shallow vents if connected to an active LFG collection system. Assuming 65% capture efficiency, the LFG and methane capture curves are also shown in Figure 3-2. The tabulated model output showing estimated gas generation for each year is provided in Appendix D.

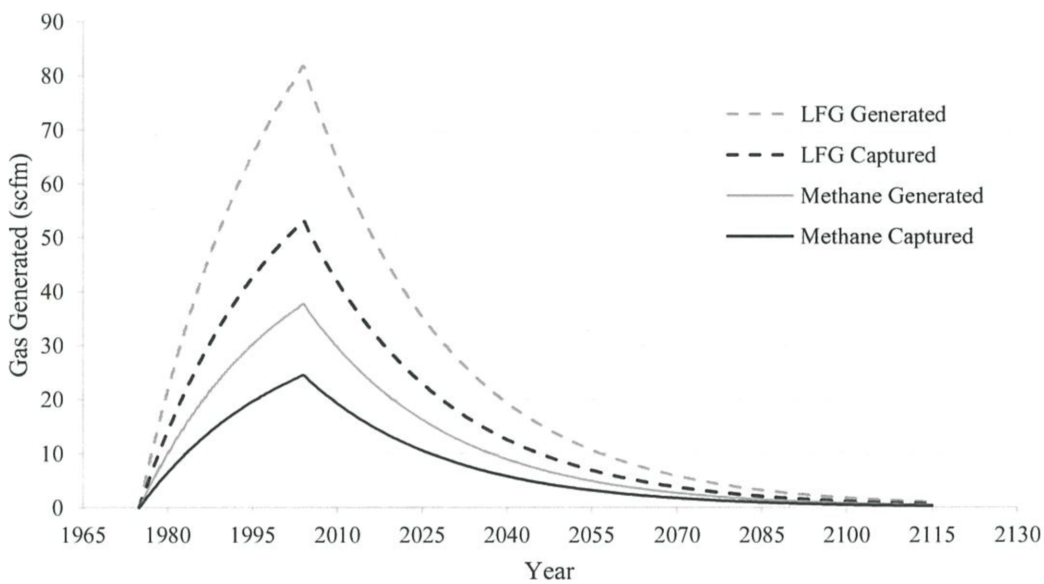

Figure 3-2 Predicted Landfill Gas and Methane Generation from PRD

3.3.2 Landfill Gas Generation Potential at Marpi Solid Waste Facility

The MSWF was modeled based on actual tonnage of accepted waste between 2003 and 2017, with waste disposal through 2048 projected closure. From 2003 to 2017, MSWF accepted a total of 371,000 tons of waste, of which 330,000 tons was considered biodegradable. Throughout this time, average annual waste placement was 24,711 tons per year, of which 70–80% was MSW each year (Appendix A).

For consistency with the PRD LandGEM evaluation, textile debris was excluded from the fraction of biodegradable waste. Additional items excluded from biodegradable waste capture in CNMI annual data include white waste, metals, batteries, glass, plastic bottles, and construction and demolition waste.

Figure 3-3 presents the estimated LFG and methane generation from MSWF. LandGEM estimates peak LFG generation will occur in 2049, approximately 1 year after the projected landfill closure; beyond 2049, LFG generation declines. The peak LFG generation and methane generation in 2049 was found to be 182 cfm and 109 cfm, respectively. Since, MSWF will not be capped until the end of the waste acceptance year of 2048, it is assumed that 75% of the LFG produced before 2048 may be captured by the active LFG collection system, when interim soil cover will be in place. Assuming 75% capture efficiency, the LFG and methane capture curves are also shown in Figure 3-2. The tabulated model output showing estimated gas generation for each year is provided in Appendix E.

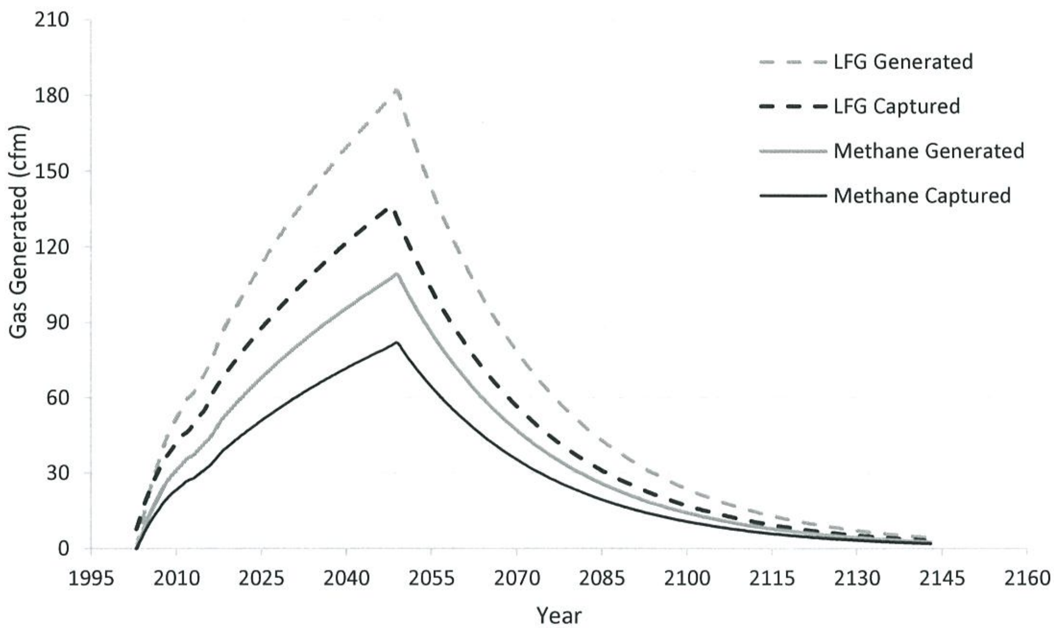

Figure 3-3 Predicted Landfill Gas and Methane Generation from MSWF

3.3.3 Landfill Gas Generation Potential Summary

Based on the findings for LFG generation potential at PRD and MSWF, the following model results summarized in Table 3-3 will be utilized in developing conceptual site design at each site, and assessing the potential for beneficial reuse of LFG captured.

For both PRD and MSWF, the initial project year is assumed to be 2025. Based on PRD having passed peak landfill gas production, beneficial energy reuse is assumed to extend to 2039. At

MSWF, project life is significantly longer since the site continues filling operations; project life is assumed to extend until 2069, evaluated in 15-year increments for viability.

Table 3-3 Potential Landfill Gas Generation and Capture Summary Table

Parameter	PRD	MSWF		
	2025–2039	2025–2039	2040–2054	2055–2069
Peak Year	2004	2049		
LFG Generation (cfm)	35 (2025)[a]	182 (2049)[a]		
Average LFG Captured (cfm)[b]	18	102	126	82
Average Annual Electricity Generation (kW)[c]	41	286	353	230

(a) LFG generation from PRD in year 2025 and peak LFG generation in year 2049 from MSWF will be used for LFG collection system design at PRD and MSWF, respectively.
(b) Average LFG captured will be used for both PRD and MSWF beneficial reuse cost estimation.
(c) kW capacity = 0.9[d] * (scf LFG/min) * (60 min/hr) * (% of scf methane/scf LFG) * (1,012 Btu/scf methane) * (kWh/11,700 Btu) (EPA 2016).
(d) A gross capacity factor of 90% was applied to electricity generation to account for energy production losses due to potential problems in the gas collection system or project equipment, weather related interruptions of the local utilities, and shut-downs at the consumer end of the system (EPA 2017a).

Notes:
% = Percent.
Btu = British thermal unit(s).
hr = Hour.
kW = Kilowatt(s).
kWh = Kilowatt-hour(s).
min = Minute.
scf = Standard cubic feet.

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4. TECHNICAL VIABILITY OF LANDFILL GAS EXTRACTION

LFG extraction is routinely performed at active and closed landfills and can benefit the environment by reducing hazardous air pollutants, greenhouse gas emissions, LFG subsurface migration, and odors. When cells are capped and closed properly, up to 90% of the total LFG generated can be captured and utilized, with the remainder of the gas escaping into the atmosphere or subsurface. Capping allows for the LFG wells to sustain increased vacuum with less potential for air intrusion through the cap into the waste. In addition, landfill capping impacts the time horizon of LFG generation, due to the reduction of moisture infiltration into the waste mass.

LFG collection can be performed once enough waste is placed to install a collection system that will not draw air into the waste. LFG can be collected by either a passive or an active collection system, configured as vertical wells, horizontal trenches, or a combination. The efficiency of the LFG collection depends on a number of factors including, but not limited to, the thickness of waste in the area of the LFG extraction well, distribution of wells within the landfill, and type of cover over the area where gas extraction is taking place.

4.1 LANDFILL GAS COLLECTION SYSTEMS

4.1.1 Passive Gas Collection Systems

Passive gas collection systems (Figure 4-1) use existing variations in landfill pressure and gas concentrations to vent LFG into the atmosphere or to a control system. The system can be installed during active operation of a landfill or after closure. The purpose of a passive gas collection system is to prevent the buildup of gas pressure within the landfill, to maintain the stability of the landfill cover, and to prevent the offsite migration of LFG (U.S. Army Corps of Engineers 2008). Passive gas collection systems are typically used when the landfill is not required to have an active LFG collection system (below Tier II category), the landfill is old and/or small, and the LFG production is small.

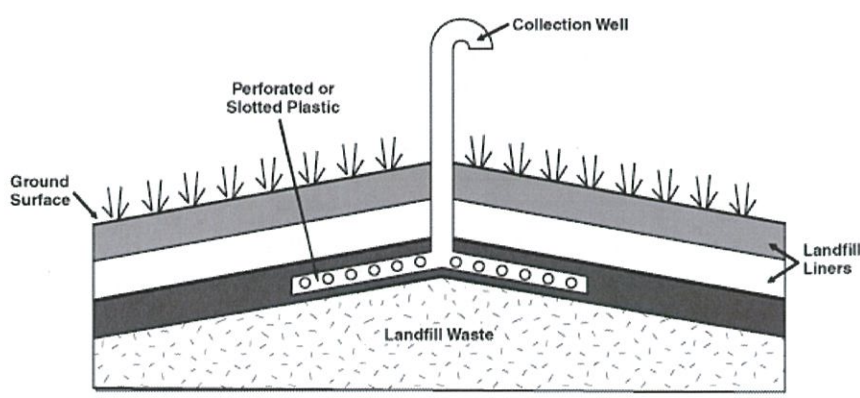

Figure 4-1 Passive Gas Collection System (Agency for Toxic Substances and Disease Registry 2001)

Rules of thumb are commonly applied in the design of passive gas collection systems instead of strict design procedures. The passive vents or extraction wells are typically constructed of perforated or slotted plastic and are installed a minimum of 5 to 10 ft into the waste. Passive collection systems can be utilized for LFG reuse projects; however, collection efficiencies may be very low, especially for vents installed with small perforated lengths.

4.1.2 Active Gas Collection Systems

Active LFG systems function by applying a vacuum to a network of extraction wells and/or trenches located within the waste to extract LFG. Active extraction systems may include the following primary components:

- Extraction wells with well heads for monitoring and control
- Collection system piping, including laterals and header piping
- Condensate drains, sumps, pumps, and tanks
- Blower-flare facility with enclosed flares, blowers (primary and potentially standby), and condensate knockout and/or other gas conditioning equipment.

Figure 4-2 illustrates the design of a typical vertical LFG extraction well, including wellheads with valves to regulate gas flow, and to serve as a sampling port.

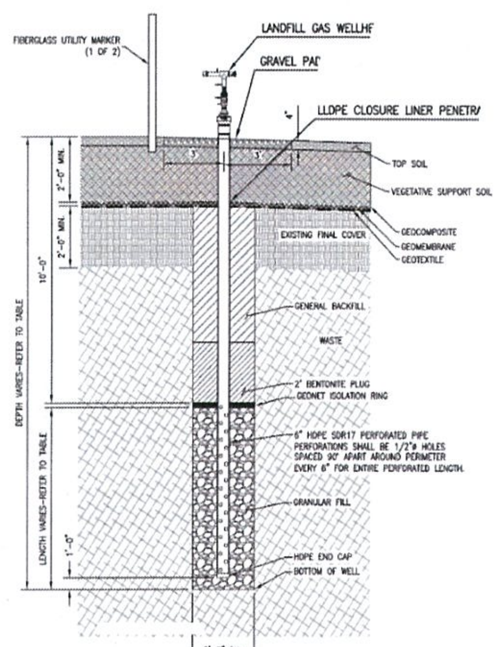

Figure 4-2 Vertical Landfill Gas Extraction Well Detail

Depending on the potential health and environmental risks and local regulatory criteria, LFG can either be directly discharged to the atmosphere or collected for flaring or reuse. The energy potential from LFG generation is dependent on the quality of the LFG (i.e., methane content). It is common for landfills to flare gas due to odor concerns, even if the landfill is not required to collect gas based on regulations.

4.1.3 Landfill Gas Collection System Piping

Collection piping layout may include a looped collection header, allowing connection via laterals to extraction wells, while also providing the advantage of self-equalizing or balancing of the vacuum and flow. LFG collection system piping can be placed on the landfill surface, buried, or a combination. If buried, collection piping material and design should consider achieving minimum slopes to facilitate gas flow and consider potential for landfill settling. If aboveground collection system piping is utilized, it can impact site drainage and is not protected from cold weather conditions.

A wellhead is typically used to connect the vertical extraction well to the below-grade collection system. The wellhead provides for flow adjustment, gas monitoring, flow measurement, and leachate extraction, if needed. The placement of the existing extraction wells typically ranges from every 200 to 500 ft in triangular orientation. Vertical gas collection wells are typically extended from the surface to within 10 ft above the liner system to minimize the potential to damage the liner system or leachate collection system during well installation. Typically, the upper 20 ft of the vertical well is constructed of solid pipe casing to prevent non-LFG intrusion into the system.

4.1.4 Landfill Gas Condensate Collection

As LFG is extracted from the landfill and transported through the LFG collection system, it gradually cools and a liquid (condensate) is formed. The LFG condensate is primarily comprised of water and typically contains minimal quantities of volatile and miscible compounds and can have similar composition to leachate. Typically, the layout of the LFG piping is designed to maintain positive drainage to condensate drains in low-lying areas. Where possible, the pipe network is designed so the condensate runs with the flow of the LFG to minimize pipe surging.

4.1.5 Blower-Flare Facility

A blower applies the required vacuum on the LFG collection system and supplies the required discharge pressure for the flare. The amount of vacuum required depends on the size of the LFG collection system and typically varies from 40 to 60 in. of water column. The flare station for combustion of LFG can act as either the backup control device in conjunction with an end use project or as the single control device for the LFG collection system.

4.2 LANDFILL GAS MONITORING

LFG monitoring probes can be used in conjunction with either active or passive systems to ensure LFG migration offsite can be detected. The regulatory compliance point is the property boundary, with maximum acceptable concentration of methane in the probes typically limited to 0.5–5% by volume. Federal regulations require that LFG concentrations not exceed the lower explosive limit for methane (i.e., 5% methane by volume) at the property boundary or 25% of the lower explosive limit for methane (i.e., 1.25% methane by volume) in facility structures. Increased monitoring and/or modifications to the operating procedures of the LFG collection system are required if methane concentrations exceed acceptable levels.

4.3 OPERATOR TRAINING

LFG collection and control system operations require a certain level of expertise. As such, LFG system operators must have adequate training to properly operate and maintain the system. Some local regulatory agencies recommend a Best Management Practice LFG course including classroom training and field training, often supplemented by annual refresher training and specialty training classes offered by equipment vendors for typical LFG equipment and controls, such as well heads, flares, blowers, flow meters, gas analyzers, and data recorders.

5. TECHNIQUES TO INCREASE LANDFILL GAS PRODUCTION

Due to the organic nature of most of the waste in an MSW landfill, the decay and stabilization of waste largely depends on biological action. The rate of the biological action directly affects the LFG generation rate; degrading waste more quickly increases LFG generation. By providing appropriate and controlled means of introducing leachate into a landfill cell, along with adequate means of measuring and monitoring system operations, leachate recirculation can increase LFG generation while providing a variety of additional benefits to landfill operations, including reducing the volume of leachate for treatment, and maximizing the capacity of the permitted airspace for waste disposal.

Leachate may be applied to landfills via surface application, or horizontal or vertical piping installed within the waste mass. An example of a leachate application system EA designed for another landfill site is shown in Figure 5-1, in which a leachate recharge well was coupled with a LFG extraction well, for leachate application and LFG extraction.

Figure 5-1 Leachate Recharge

5.1 LEACHATE RECIRCULATION DESIGN CONSIDERATIONS

While landfill leachate recirculation can be designed so a system is relatively easy to operate and does not require significant infrastructure, minimum requirements must be met. Typical leachate recirculation design considerations include:

- Leachate recirculation can only occur over a liner and leachate collection system that includes a composite liner system incorporating a geomembrane. Approval of alternate liner systems may be pursued with local regulators.

- EPA regulations require all Subtitle D landfills to maintain less than 12 in. of head on the liner system, with notification to state and or federal regulators within 24 hours if this is exceeded. Typically, leachate head on liner is monitored daily or continuously and reported as a weekly average. As an alternative, some local jurisdictions may allow demonstrated compliance with a leachate head on liner system by using a water balance method.

- Measurement systems may be required to measure leachate head, flow rate, recirculation flow into the landfill, and leachate collected from the landfill.

- Only leachate and LFG condensate generated from the landfill may be recirculated.

- Leachate may be distributed throughout the waste mass as much as practical.

- Due to the potential for leachate seeps, distribution systems should not be installed within 50 linear ft of exterior side slopes.

- Due to higher moisture content as a result of recirculation, slope stability should be determined on the liner, intermediate waste, and cover interfaces with the design providing for a factor of safety greater than 1.5 for saturated conditions.

5.2 LANDFILL GAS GENERATION WITH LEACHATE RECIRCULATION AT PRD

For the purposes of this analysis, EA has assumed leachate recirculation is not a feasible option at PRD because it is not currently operational and has already been capped; therefore, only minimal leachate will be generated.

5.3 LANDFILL GAS GENERATION WITH LEACHATE RECIRCULATION AT MARPI SOLID WASTE FACILITY

The goal of a leachate recirculation system at the MSWF would be to increase LFG generation over a shorter operational period to improve the efficiency of a LFG collection system. Depending on the ultimate use of the LFG, it may be advantageous to produce more gas over a shorter time period, rather than less gas over a longer time period.

Utilizing the LandGEM model with previous input, and modified to account for recirculation, a year-by-year estimate of LFG emissions with leachate recirculation was developed. The model results show that leachate recirculation does reduce the time horizon over which LFG is generated. Figure 5-2 illustrates that additional moisture will increase the rate of generation of methane; the peak methane generation will begin sooner and remain steady from the years 2021 to 2049. LandGEM estimated methane generation will decrease substantially after a year. The tabulated model output showing estimated gas generation with leachate recirculation for each year is provided in Appendix E.

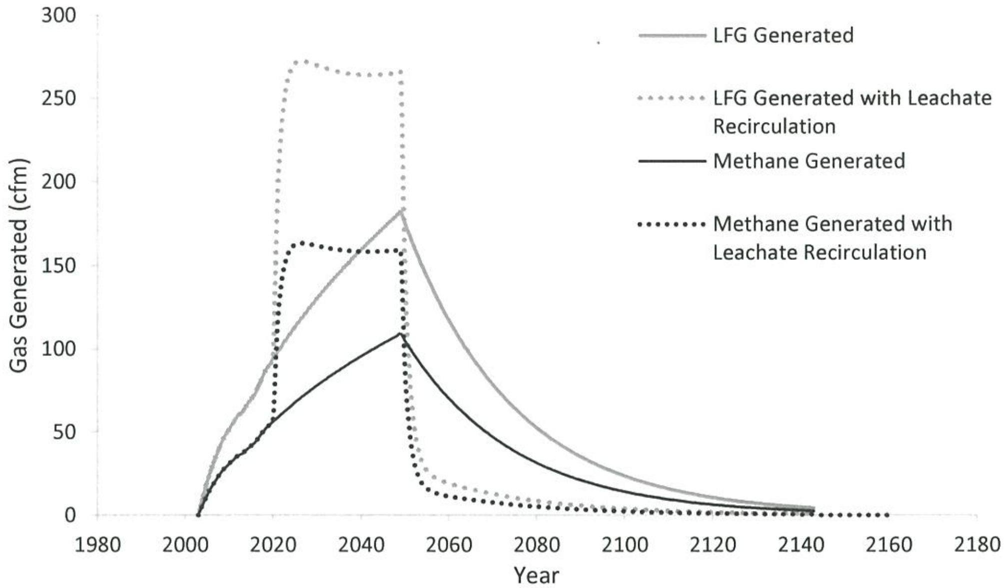

Figure 5-2 Predicted Methane Generation at MSWF with Leachate Recirculation

While landfill leachate recirculation can be designed so a system is relatively easy to operate and does not require significant infrastructure, leachate recirculation can be difficult to permit for landfills with single-liner systems like MSWF. Negotiations would be required with CNMI Bureau of Environmental and Coastal Quality (BECQ) to allow MSWF to begin recirculating leachate without installing a liner system that meets EPA requirements.

For the purposes of this analysis, EA has assumed leachate recirculation is not a feasible option at MSWF. The Department of Public Works could initiate conversations with BECQ to determine if leachate recirculation could be performed with the current liner system at MSWF. EA has initiated discussion with BECQ regarding the potential; however, no definitive guidance has been provided.

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6. CONCEPTUAL LANDFILL GAS COLLECTION SYSTEM DESIGN

6.1 LANDFILL GAS EXTRACTION FROM PUERTO RICO DUMP

6.1.1 Landfill Gas Collection Feasibility

Since beneficial reuse of LFG is directly dependent upon the quantity and quality of methane produced by a landfill, and the fact that PRD peak LFG production has already occurred (2004), the potential for beneficial use of methane collection from PRD may not be economical. However, since passive vents were installed at the site as part of the PRD closure, EA has investigated the feasibility of LFG collection at PRD via these existing vents.

For the basis of design, the LFG production in 2025, 35 cfm (Table 3-3), was utilized for conceptual component layout.

6.1.2 Landfill Gas Collection System Conceptual Design

Currently, the Eloy S. Inos Peace Park has a total of five LFG monitoring probes and 23 passive vents at the top deck and along the perimeter bench (GHD 2017). Since the Eloy S. Inos Peace Park is not required to have an active LFG collection, and to minimize disruption to the existing landfill cap, no additional LFG wells were considered. However, the spacing of existing LFG vents is expected to be sufficient for LFG capture, based on the LandGEM sampling and model results.

In order to collect LFG from existing passive vents, passive vents can be converted to an active system. This may include removing existing vent heads, and other associated piping, extending gas well standpipes, and installing blowers and/or energy generating equipment (if applicable). However, the existing vents may require further investigation before performing any modifications. Figure 6-1 shows the modifications that may be performed to convert from passive vents to an active collection system.

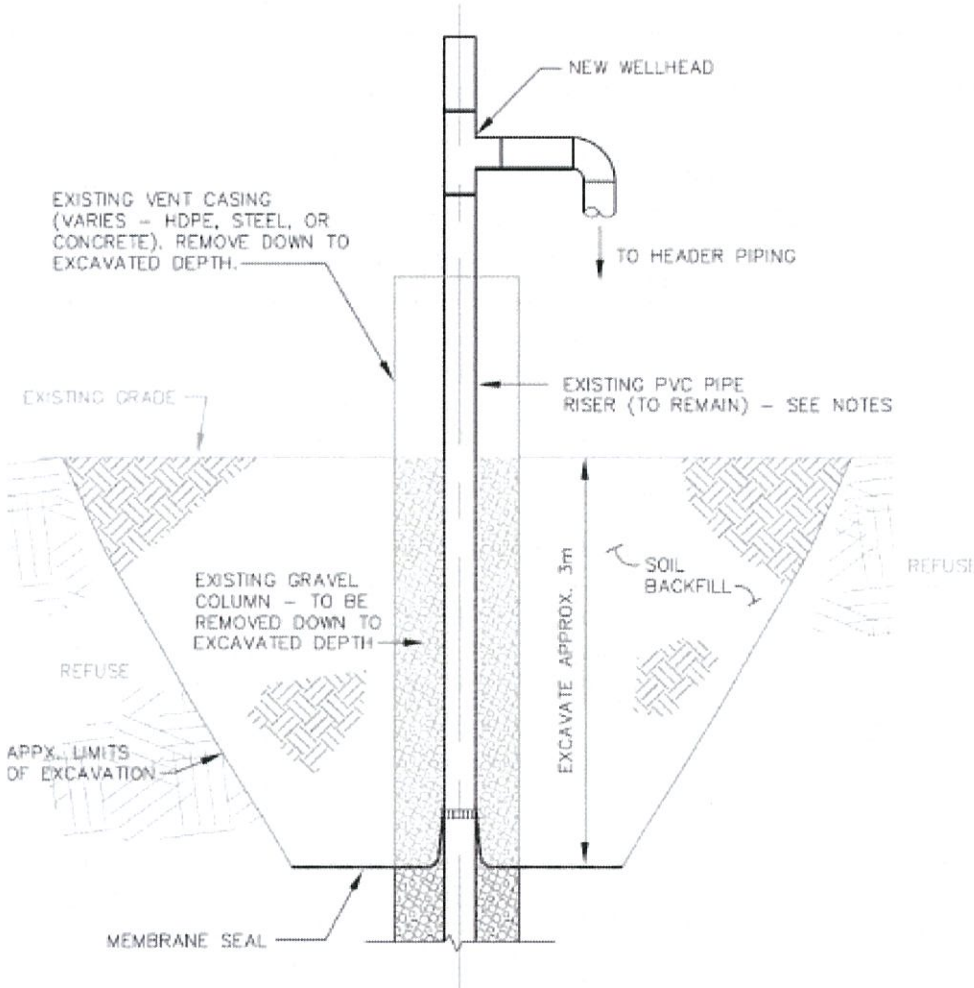

Figure 6-1 Typical LFG Vent Modification (Conestoga-Rovers & Associates 2004).

Collection piping layout includes a looped collection header designed to maintain positive drainage to two condensate drains placed at low points in the collection header. Collection piping would consist of a buried system placed above the closure cap drainage layer and below the final cap. This approach may cause maintenance requiring cap excavation and repair for LFG system installation after cap installation. Based on projected LFG flow rates from LandGEM and EA's experience with LFG collection system design, pipe size for the collection header pipe of 6-in. diameter and a lateral pipe of 4-in. diameter were assumed. A wellhead would be used to connect the extraction well to the below-grade collection system. Wellhead selection can provide for flow adjustment, gas monitoring, flow measurement, and leachate extraction, if needed. A proposed layout for LFG header pipe connecting all existing gas vents is shown in Appendix F.

6.2 LANDFILL GAS EXTRACTION FROM MARPI SOLID WASTE FACILITY

6.2.1 Landfill Gas Collection Feasibility

While a LFG collection system is not required based on landfill size and emissions, an active LFG management system is considered feasible for MSWF based on estimated LFG production. For the basis of design, peak LFG production of 182 cfm (Table 3-3) was utilized for conceptual component layout and sizing.

6.2.2 Landfill Gas Collection System Conceptual Design

As Cell 1 has already been filled and Cells 2–6 will be designed and filled subsequently, the most appropriate LFG extraction well will be a vertical well with a flow control valve that will be connected to a common collection system header. Well spacing was determined based on a calculated radius of influence and considering the LFG extraction capacity with the cost of the system; a spacing of approximately 260 ft was chosen. Based on the calculated spacing requirement, a total of 24 new extraction wells are required. Extraction well spacing calculations are provided in Appendix G.

A proposed LFG extraction well and collection header are shown on Figure 1 in Appendix G. Extraction wells were placed based on aforementioned separation, and to maintain a radius of influence separation distance from the edge of liner to prevent drawing oxygen into the system. Collection piping layout includes a looped collection header designed to maintain positive drainage to two condensate drains placed at low points in the collection header. Collection piping would consist of a buried system placed above the closure cap drainage layer, placed prior to final cap installation. This approach would prevent maintenance requiring cap excavation and repair for LFG system installation after cap installation. Based on projected LFG flow rates from LandGEM, a collection header pipe of 6-in. diameter and a lateral pipe of 4-in. diameter were assumed.

Based on analysis of liner grades and proposed cap closure grades, EA evaluated the proposed extraction well depth. Vertical wells are typically designed to terminate no less than 10 ft above the liner system, with the upper 20 ft of the well to be constructed of solid pipe casing to prevent non-LFG intrusion into the system. The bottom portion of the wells will be placed in the waste and is perforated to provide a preferential pathway. A wellhead would be used to connect the extraction well to the below-grade collection system. Wellhead selection can provide for flow adjustment, gas monitoring, flow measurement, and leachate extraction, if needed.

In addition, the proposed site figure includes an approximately 100-ft × 100-ft area for location of a blower facility. This area would allow adequate spacing for LFG system appurtenances, which may include flares, blowers, backup generators, condensate knockout tank, and gas-to-energy and/or leachate evaporation system.

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7. POTENTIAL BENEFICIAL REUSE

Beneficial reuse options for LFG generally fall into three broad categories: direct-use, electric power generation, and upgrade to pipeline quality gas (Figure 7-1). Direct use options are most attractive when potential users are in fairly close proximity to the landfill and able to employ the gas directly with minimal gas pretreatment. Electric power generation is generally most attractive when power can be sold to a local utility at a favorable rate or when a potential user who would like to displace power purchased from a utility is close to the landfill. Options that require upgrading the gas to pipeline quality are usually favored by situations where larger volumes of LFG are available, and the upgraded gas can compete favorably on the open market with natural gas or other fossil fuels.

Before LFG can be used in an energy conversion process, it may require treatment to remove condensate, particulates, and other impurities (EPA 2017b), depending on the end use. As an example, treatment systems may include a series of filters to remove contaminants that could damage engines and turbines, thereby reducing system efficiency. Advanced treatment is required to produce high-Btu (British thermal unit) gas for injection into natural gas pipelines or production of alternative fuels, including primary processing systems such as de-watering and filtration, and secondary treatment processing such as physical and chemical treatments necessary to remove specific constituents, such as siloxanes and sulfur compounds, depending on the end use.

Each option is discussed in detail in this chapter, with site-specific application of beneficial reuse presented in Chapter 8.

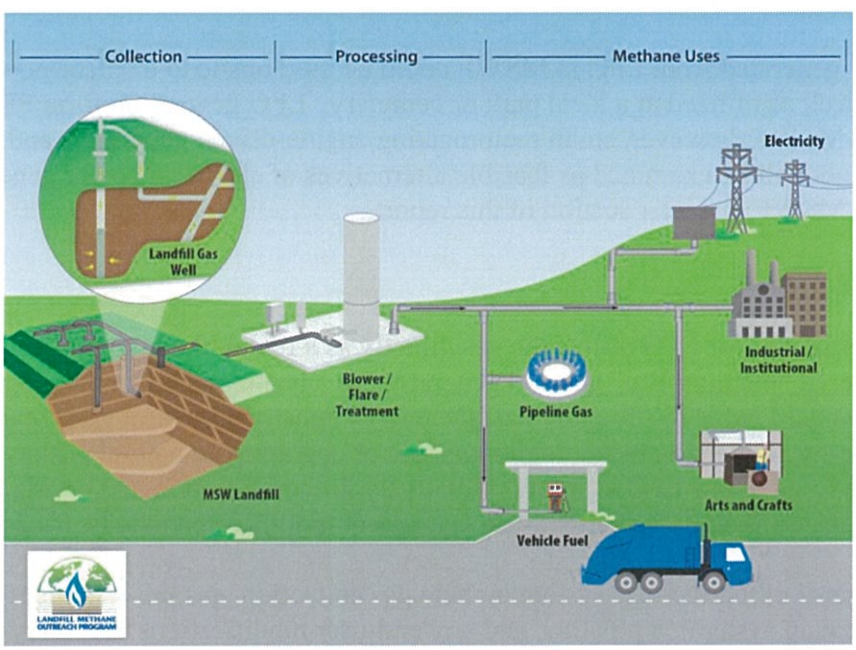

Figure 7-1 Example Landfill Gas End Use Options (EPA 2017b)

7.1 ELECTRIC POWER GENERATION

Currently, the most common beneficial use for LFG is as fuel for power generation. The fuel energy-to-electric power conversion efficiencies of various technologies range from less than 30% for simple-cycle combustion turbines to nearly 50% for fuel cells. Essential elements include gas compression, gas cleanup, a pipeline, the power generation system, and an interconnection with either the onsite user of the power or an electric utility. Primary factors determining optimal generation includes landfill size, variability in LFG flows, energy conversion efficiency of the various electric power generation options, and beneficial end uses. LFG can be used as a fuel energy source in several methods including:

- Firing the gas in a high-pressure boiler connected to a:
    - Reciprocating internal combustion engine driven generator
    - Microturbine driven generator
    - Steam turbine driven generator
    - Combustion turbine driven generator (simple or combined-cycle)
- Direct chemical-to-electric energy conversion in a fuel cell

Both reciprocating engine-driven generators and microturbine-driven generators are well proven in LFG service and are available in various module sizes. Fuel cells create electricity by combining hydrogen (taken from the LFG's methane) and oxygen in an electrochemical reaction. While fuel cells are more efficient, have ultra-low emissions, and are very quiet, extensive gas pretreatment is required to remove the carbon dioxide and impurities from LFG.

Electric power generated from LFG at MSWF could be used onsite to displace power currently purchased, as well as utilized at a local park or cemetery. LFG generation form PRD is much lower than the MSWF; however, small reciprocating engine-driven generators and microturbine-driven generators will be examined as feasible alternatives of electrical power generation from both PRD and MSWF in a later section of this report.

7.2 DIRECT USE

Direct use alternatives for LFG utilize the gas directly as a fuel without significant processing. LFG is considered "medium Btu" gas and generally has a heating value in the range of 400 to 600 Btu per standard cubic ft—roughly half the energy density of natural gas. Many well-established energy conversion technologies capable of operating on natural gas or other fossil fuel can be modified to use LFG as a fuel. Relatively limited filtration and drying are needed prior to direct-use as fuel; however, end-use equipment modification may be necessary.

Essential elements of a direct-use system include gas collection, gas pre-treatment (compressor station, gas cleanup system), a pipeline, and any end-user modifications necessary to fire LFG instead of a fossil fuel. Potential direct use options for LFG include:

- Hot water and steam boilers
- Stationary internal combustion engines and combustion turbines operating as prime movers
- Fired process heaters and dryers
- Industrial furnaces and kilns
- Leachate evaporators (Figure 7-2)
- Greenhouse heat, power, and carbon dioxide enhancement.

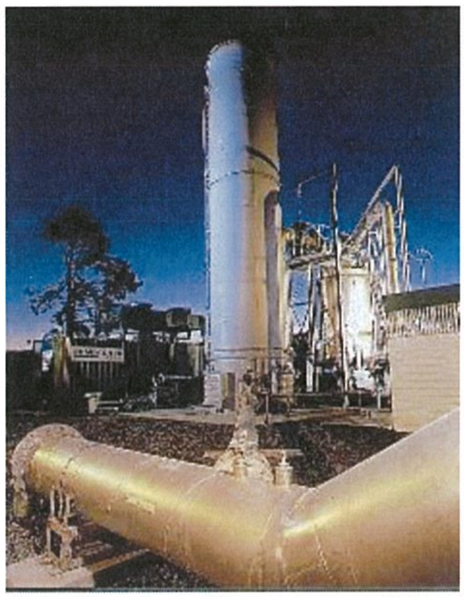

Figure 7-2 Leachate Evaporator (EPA 2017b)

Although direct use of LFG is often the least complex and least expensive beneficial use option to implement, it depends on favorable circumstances to be a viable option. These circumstances include the proximity of an end user that can readily substitute LFG for other fuels and derive an economic benefit. Based on current leachate management practices at MSWF, direct use of LFG for operation of a leachate evaporator will be examined as a feasible option in in a later section of this report.

7.3 UPGRADE TO PIPELINE QUALITY

Processing and treatment of LFG can be used to produce a gas roughly equivalent in content and quality to natural gas. This process requires separation of the carbon dioxide, which constitutes roughly half of LFG by volume. In order to meet the "pipeline standards," treatment to remove moisture, hydrogen sulfide, and NMOCs from LFG are often necessary. This processing yields a gas that is essentially pure methane, increasing the heating value to roughly 1,000 Btu per standard cubic foot. Once the quality specifications of the end-user are met, the pipeline quality LFG is suited for any application for which natural gas is suited, including:

- Direct feed into a natural gas distribution or transmission pipeline system
- Compression or liquefaction for use as vehicle fuels (compressed natural gas or liquefied natural gas)
- Substitution for natural gas as a chemical feedstock.

Due to the significant requirements for compression; gas cleanup; and pretreatment for hydrogen sulfide, NMOC, and moisture, and the complexity of the various carbon dioxide separation technologies, upgrading LFG to pipeline quality is typically not a cost-effective option for low volumes. For LFG flow rates below 2,800 to 3,000 cfm, upgrade of LFG to pipeline quality gas is considered economically infeasible. In addition, due to a limited natural gas distribution network, absence of potential beneficial end users, and smaller volume of LFG generation from both PRD and MSWF, upgrading the LFG to pipeline quality is not considered a feasible option.

8. ENERGY RECOVERY SYSTEM AND ECONOMIC VIABILITY EVALUATION

Implementation of a LFG collection system and energy production system is greatly dependent on the quality and quantity of LFG produced. Additionally, it is important to note that the greatest variable for LFG production is the waste acceptance rate of a landfill. Since PRD stopped operation in 2002, the peak LFG generation year has already passed, and current LFG generation is very low, both energy production alternatives may appear economically non-profitable if implemented in 2025 (Figure 3-2). On the other hand, MSWF is still in operation and will expand in the future with a potential of producing higher amounts of LFG (Figure 3-3). If future waste receipts are not as predicted and modeled in the LandGEM model (i.e., additional waste is accepted at the MSWF), the LFG generation model and the feasibility of the LFG extraction for beneficial use projects can be greatly affected. For example, a significant increase in the quantity of waste disposed could accelerate the feasibility of a LFG to electricity project. The maximum benefit of a LFG collection system will correspond with peak LFG production.

Although PRD has already passed the peak generation period and is currently producing very limited quantities of LFG (Figure 3-2), two energy recovery systems will be considered for further evaluation of beneficial reuse feasibility. For MSWF, after considering the various beneficial uses, end user proximity, gas pretreatment requirements, and energy conversion efficiency for LFG, three alternative options will be evaluated. Alternatives investigated are summarized in Table 8-1 below and discussed in detail in this section.

Table 8-1 Alternatives Matrix

Alternatives	Description	PRD	MSWF
Option 1	Electric Power Generation Using Small Reciprocating Engine	PRD Option 1	MSWF Option 1
Option 2	Electric Power Generation Using Microturbine Generator	PRD Option 2	MSWF Option 2
Option 3	Direct Use for Leachate Evaporation	-	MSWF Option 3

For the active LFG collection system and beneficial reuse alternatives discussed within this section, the EPA LFG energy cost model (EPA 2017a) was utilized for cost comparison, with detailed assumptions documented in Appendix H. Detailed feasibility studies apply project-specific costs, such as cost quotes for a specific model of equipment appropriate to the landfill, right-of-way costs for anticipated pipeline routes and current land owners, state-specific permitting requirements, and interest rates. The EPA model was developed for cost assessment of projects on the mainland of the United States; therefore, a factor of 40% was applied to all costs estimated at PRD and MSWF to account for the increased cost of specialized work in a remote location and contingency to address unknown issues that may arise during project development. A detailed economic feasibility analysis including annual and operation and maintenance (O&M) costs, annual return, and net present value (NPV) calculations for both landfills is provided in Appendix I. A 6% interest rate (based on projected 2025 prime interest rate) and 3% discount rate are utilized to determine annual debt service and NPV, respectively.

8.1 ACTIVE LFG COLLECTION AND ENERGY PRODUCTION ALTERNATIVES AT PRD

The cost estimated for a LFG collection system at PRD is common to the two alternatives presented and is based on the costs for conversion of passive vents to an active collection system, based on a LFG energy collection startup year of 2025. Since 23 passive vents exist at the site, costs associated with drilling and pipe crew mobilization for installation of vertical gas extraction wells are not considered. The detailed header pipe layout connecting all gas vents located at the top deck and bench is shown in Appendix F. The components considered in the cost estimate include:

- Engineering, permitting, and administration
- Site survey, preparation, and utilities
- Wells and wellheads
- Pipe gathering system (includes additional fittings/installation)
- Condensate knockout system
- Blower system
- Instrument control.

The total estimated capital and annual O&M costs for installing a LFG collection system are estimated as $617,000 and $59,800, respectively (Table 8-2) and are included in the economic analysis for each of the options presented below. The capital and O&M cost components were estimated based on the EPA LFG energy cost model; the relevant equations are provided in Appendix H.

Table 8-2 Cost Estimation for Conversion to Active LFG Collection System at PRD

Item Description	Cost
Total Capital Cost	$617,000
Annual Operation and Maintenance cost	$59,800

To utilize the LFG generated from the PRD in the most effective way, two alternatives for electricity generation were considered—electric power generation using small reciprocating engine and electricity generation using microturbine generator. These alternatives are discussed in detail in Sections 8.1.1 and 8.1.2.

8.1.1 PRD Option 1 – Electric Power Generation Using Small Reciprocating Engine

The most common beneficial use for LFG is as fuel for power generation, with reciprocating engine-driven generators being well proven. However, the quality and quantity of LFG generation from PRD is minimal as described in Section 3.3.1. The initial project year and project-life were assumed to be 2025 and 15 years, respectively.

A rough order of magnitude assessment of capital and O&M costs for this option includes: gas compression and treatment (includes dehydration equipment and filtration); reciprocating engine and generator (includes motor controls, switch-gear, radiators, exhaust silencers, and wiring and plumbing); electrical interconnect equipment; and site work, housings, utilities, and total facility engineering, design, and permitting (Table 8-3). The capital cost of electricity generating equipment size was calculated based on the average LFG captured (18 cfm) during the project life (Table 3-3).

Table 8-3 PRD Option 1 – Cost for Electricity Generation Using Small Reciprocating Engine

Item Description	2025–2039
Capital Costs	
Active LFG Collection System (Table 8-2)	$617,000
Electricity Generation Using Small Reciprocating Engine	$133,000
Annual O&M Costs	
Active LFG Collection System	$59,800
Electricity Generation Using Small Reciprocating Engine	$11,200
Cost-Benefit Analysis	
Net Present Value	$(1,513,000)
Average Electricity Rate ($/kWh)[(a)]	$0.145
Annual Return from Beneficial Reuse[(b)]	$21,700

(a) Average electricity rate for commercial use was based on *Northern Mariana Islands Quick Facts – Northern Mariana Islands Territory Energy Profile* (U.S. Energy Information Administration 2018).
(b) Assuming consumption of 10 hours of continuous electricity per day from 41 kW capacity PRD energy production system. Future demand may vary.

Notes: kW = Kilowatt(s).
kWh = Kilowatt-hour(s).

8.1.2 PRD Option 2 – Electricity Generation Using Microturbine Generator

Microturbine technology is widely used for landfill applications and is often preferred to the internal combustion engine since less LFG volume is required, can use LFG with a lower percent methane (35% methane), produces lower emissions of nitrogen oxides, can add and remove microturbines as gas quantity changes, and interconnection is relatively easy because of the lower generation capacity (EPA 2017b). Installed capital and annual O&M costs were determined utilizing the EPA LFG energy cost model user manual (EPA 2017a) and are summarized in Table 8-4.

Table 8-4 PRD Option 2 – Cost Electricity Generation Using Microturbine Generator

Item Description	2025–2039
Capital Costs	
Active LFG Collection System (Table 8-2)	$617,000
Electricity Generation Using Microturbine Generator	$271,000
Annual O&M Costs	
Active LFG Collection System	$59,800
Electricity Generation Using Microturbine Generator	$14,000
Cost-Benefit Analysis	
Net Present Value	$(1,715,000)
Average Electricity Rate ($/kWh)[a]	$0.145
Annual Cost Savings from Electricity	$21,700

(a) Average electricity rate for commercial use was based on *Northern Mariana Islands Quick Facts – Northern Mariana Islands Territory Energy Profile* (U.S. Energy Information Administration 2018).
(b) Assuming consumption of 10 hours of continuous electricity per day from 41 kW capacity PRD energy production system. Future demand may vary.

Notes: kW = Kilowatt(s).
kWh = Kilowatt-hour(s).

8.2 ACTIVE LFG COLLECTION SYSTEM AND ENERGY PRODUCTION ALTERNATIVES AT MSWF

The cost estimated for a LFG collection system at MSWF is common to the three alternatives presented and was developed based on LFG energy collection startup year of 2025, landfill closure year 2048, and projected annual tonnage through landfill closure. The detailed LFG collection system layout is shown in Figure 1 of Appendix G. The components considered in the cost estimate include:

- Engineering, permitting, and administration
- Site survey, preparation, and utilities
- Wells and wellheads
- Pipe gathering system (includes additional fittings/installation)
- Condensate knockout system
- Blower system
- Instrument control.

The total estimated capital and annual O&M costs for installing a LFG collection system are estimated as $1,079,000 and $62,400, respectively (Table 8-5) and is included in the economic analysis for each of the options presented below. The assumptions and relevant equations for the capital and O&M cost estimations are provided in Appendix H.

Table 8-5 Cost Estimation for Active LFG Collection System at MSWF

Item Description	Cost
Total Capital Cost	$1,079,000
Annual O&M cost	$62,400

8.2.1 MSWF Option 1 – Electric Power Generation Using Small Reciprocating Engine

Similar to the alternatives discussed earlier for PRD, LFG generated from MSWF has more potential to be utilized for energy production. Since the reciprocating engine-driven generators are well proven as the most common LFG to energy generation method, the cost-benefit analysis will be performed for MSWF and discussed in this section.

Average LFG flow rates for 15-year periods were used as the basis of cost estimates and are meant to capture differences in three phases (2025–2039, 2040–2054, and 2055–2069) of LFG production at MSWF. It is assumed that the project will begin operation in 2025 and, in the beginning of the next two operational periods, an additional 25% capital cost will be incurred due to the replacement of any damaged system components or due to the landfill expansion. A rough order of magnitude cost for capital and O&M costs for electricity generation using a small reciprocating engine was developed using the EPA model and presented in Table 8-6 (EPA 2017a).

Table 8-6 MSWF Option 1 – Cost for Electric Power Generation Using Small Reciprocating Engine

Item Description	2025-2039	2040-2054	2055-2069
Capital Costs			
Active LFG Collection System (Table 8-5)	$1,079,000	$269,800	$269,800
Electricity Generation Using Small Reciprocating Engine	$921,000	$230,300	$230,300
Annual O&M Costs			
Active LFG Collection System	$62,400	$62,400	$62,400
Electricity Generation Using Small Reciprocating Engine	$77,600	$95,900	$62,400
Cost-Benefit Analysis			
Net Present Value	$(3,629,100)		
Average Electricity Rate ($/kWh)[a]	$0.145		
Annual Cost Savings from Electricity	$153,100		

(a) Average electricity rate for commercial use was based on *Northern Mariana Islands Quick Facts - Northern Mariana Islands Territory Energy Profile* (U.S. Energy Information Administration 2018).
(b) Assuming consumption of 10 hours of continuous electricity per day from 290 kW[c] capacity MSWF energy production system. Future demand may vary.
(c) Average annual electricity (kW) of 290 kW was obtained from average annual electricity generation in three phases, 2025–2039, 2040–2054, and 2055–2069 at MSWF (Table 3-3).

Notes: kW = Kilowatt(s).
kWh = Kilowatt-hour(s).

8.2.2 MSWF Option 2 – Electricity Generation Using Microturbine Generator

As microturbine technology is also widely used for landfill applications, this method is considered for the LFG to energy production at MSWF. Microturbine generator is often preferred to the internal combustion engine as mentioned in Section 8.1.2.

Table 8-7 illustrates a rough order of magnitude cost estimation for capital and O&M costs for electricity generation using a microturbine generator was developed using the EPA model (EPA 2017a). Similar to Option 1, it is assumed that the project will begin operation in 2025 and, in the beginning of the next two operational periods, an additional 25% capital cost will be incurred due to the replacement of any damaged system components or due to the landfill expansion.

Table 8-7 MSWF Option 2 – Cost for Electricity Generation Using Microturbine Generator

Item Description	2025–2039	2040–2054	2055–2069
Capital Costs			
Active LFG Collection System (Table 8-5)	$1,079,000	$269,800	$269,800
Electricity Generation Using Microturbine Generator	$903,000	$225,800	$225,800
Annual O&M Costs			
Active LFG Collection System	$62,400	$62,400	$62,400
Electricity Generation Using Microturbine Generator	$51,100	$57,000	$45,300
Cost-Benefit Analysis			
Net Present Value	$(2,897,000)		
Average Electricity Rate ($/kWh)[c]	$0.145		
Annual Cost Savings from Electricity	$153,100		

(a) Average electricity rate for commercial use was based on *Northern Mariana Islands Quick Facts - Northern Mariana Islands Territory Energy Profile* (U.S. Energy Information Administration 2018).
(b) Assuming consumption of 10 hours of continuous electricity per day from 290 kW[c] capacity MSWF energy production system. Future demand may vary.
(c) Average annual electricity (kW) of 290 kW was obtained from average annual electricity generation in three phases, 2025–2039, 2040–2054, and 2055–2069 at MSWF (Table 3-3).

Notes: kW = Kilowatt(s).
kWh = Kilowatt-hour(s).

8.2.3 MSWF Option 3 – Direct Use with Leachate Evaporator

Currently, the MSWF manages leachate onsite in a lined holding pond and adjacent leachate reactor beds. Leachate from Cell 1 at the MSWF is currently pumped to an existing 4.9-million-gallon leachate treatment pond via a 15-horsepower pump (190 gallons per minute) operated an estimated 8 hours a week, or approximately 91,200 gallons a week. The amount of leachate collected from MSWF was assumed to be approximately 5 million gallons per year. The leachate generation volume will increase as the new cells come online and additional leachate

treatment capacity may be required. The installation and operation of a leachate evaporator may prevent the need for future construction of additional leachate reactor beds.
LFG-fueled evaporation is a technology that effectively integrates the control of LFG and landfill leachate. It can reduce the total volume of leachate to less than 5% of original volume (Purchwitz 1999). Leachate evaporation systems are typically insensitive to changes in leachate characteristics including concentrations of biological oxygen demand, chemical oxygen demand, suspended and dissolved solids, and variations in feed temperature. The only factor to which the evaporative systems are sensitive is pH, and this is due solely to the potential corrosiveness of acidic leachate on alloys used in the evaporators (Purchwitz 1999); therefore, pH adjustment may be required if pH drops below 7.0. An air permit to operate a leachate evaporator and/or a modification to the landfill's solid-waste permit to address leachate-management practices may be required.

A rough order of magnitude cost for capital and O&M for direct use with a leachate evaporation system was developed using the EPA model, and includes the leachate evaporation unit, leachate storage tank, process control instruments and site work, housing, utilities, and total facility engineering, design and permitting.

Table 8-8 presents the LFG collection system and leachate evaporator installation cost estimates for the MSWF. It is assumed that the construction and installation of a LFG collection system and leachate evaporator system will be completed before 2025 and 25% of the capital cost will be incurred in 2040 and 2055 for replacing the damaged system components (if any) or for any additional cost due to landfill expansion. Based on current MSWF leachate operation data, the leachate production rate was assumed to be 10,000 gallons per year. The leachate evaporation rate was assumed to be 95% according to the EPA model (EPA 2017a).

Table 8-8 Cost for Direct Use with Leachate Evaporator at MSWF (Option 3)

Item Description	2025–2039	2040–2054	2055–2069
Capital and Annual O&M Costs			
Capital Cost for Active LFG Collection System (Table 8-5)	$1,079,000	$269,800	$269,800
Annual O&M Cost for Active LFG Collection System	$62,400	$62,400	$62,400
Annualized Capital and O&M Costs for Leachate Evaporator	$146,200	$36,600	$36,600
Cost-Benefit Analysis			
Net Present Value	$(7,397,400)		
Savings from Future Leachate Pond Construction	$50,000	$50,000	$50,000

8.3 ECONOMIC VIABILITY

8.3.1 Summary of Findings

A summary table (Table 8-9) is presented below to compare key findings from the economic analysis, including NPV (Appendix I).

Table 8-9 LFG Beneficial Reuse Financial Summary

Landfill – Option	Net Present Value
PRD – Option 1	$(1,513,000)
PRD – Option 2	$(1,715,000)
MSWF – Option 1	$(3,629,100)
MSWF – Option 2	$(2,897,000)
MSWF – Option 3	$(7,397,400)

Based on the values presented in Table 8-9, the estimated NPV values for all energy production options at PRD and MSWF are negative, suggesting projects will not be profitable if implemented.

8.3.2 Incentive Options for LFG Energy Project

Economic factors that may make LFG beneficial reuse attractive to smaller landfills are incentives related to generating electric power from renewable energy sources. Various funding options or incentives that could be available for the energy project are given below and may be available both as tax credits and/or as preferential electric power sales rates.

- Renewable Energy Production Tax Credit
- Renewable Energy Production Incentive
- Renewable Energy Credits
- Greenhouse Gas Emission Credits.

The incentives or funding opportunities may need to be assessed further before implementing any beneficial reuse project at MSWF.

9. CONCLUSIONS AND RECOMMENDATIONS

Based on information available for both the PRD and MSWF sites, EA has estimated LFG production, developed conceptual LFG collection system design, and provided an economic analysis of proposed LFG collection and beneficial reuse projects. Unlike the PRD, which is a closed landfill where LFG production is not expected to increase, variance in waste acceptance rates experienced at MSWF over the life of the facility may significantly affect LFG production, and the success of a beneficial reuse project. Additional discussion for each site is included below.

9.1 LFG BENFICIAL REUSE SUMMARY FOR PRD

- Based on facility size and emissions, installation of a LFG emissions collection and control system is not required by federal regulations.

- The LandGEM model results show that peak LFG production is estimated to have occurred in 2004 (Section 3.3.2).

- For a LFG collection project initiated in 2025 as investigated in this analysis, LFG produced and collected would be very low (Figure 3-2). However, LFG collected at PRD could be utilized to power a small reciprocating engine or microturbine. The energy projects may replace the existing power source currently in operation for electricity supply to the Eloy S. Inos Peace Park office building and other onsite facilities.

- The economic analysis shows that the NPV is negative for both energy project options (Table 8-9).

- Based on these findings, installation of an active LFG collection system and operation of a beneficial reuse project is not currently economically viable at PRD. Additional considerations for project implementation are presented in Section 9.3.

9.2 LFG BENFICIAL REUSE SUMMARY FOR MSWF

- Based on facility size and emissions, installation of a LFG emissions collection and control system is not required by federal regulations.

- The LandGEM model results shows that peak LFG production is estimated to occur in 2049 (Figure 3-3), during the proposed project life.

- For a LFG collection project initiated in 2025 as investigated in this analysis, LFG produced and collected at MSWF could be utilized to power a small reciprocating engine or microturbine or leachate evaporator. The energy projects may replace the existing generator currently in operation for electricity supply to the office building, scale house, maintenance building, generator house, and pumps.

- Electric power generated from LFG at MSWF could also be used onsite to replace purchased electricity at local park or cemetery.

- The economic analysis shows that the NPV is negative for both energy project options and the leachate evaporator option (Table 8-9).

- Based on these findings, installation of a LFG collection system and operation of a beneficial reuse project is not currently economically viable at MSWF. Additional considerations for project implementation are presented in Section 9.3.

9.3 OTHER CONSIDERATIONS

If CNMI desires to pursue any options investigated herein, additional evaluation, detailed cost estimation, engineering design, and permitting would be required. Moreover, the availability of grant funding may enable project implementation.

In addition to the findings presented in this report, additional considerations may affect the approach of developing LFG collection systems and beneficial reuse projects at PRD and MSWF. The implementation of either an active LFG collection system or beneficial reuse systems depend on many factors, such as available project funding, local resources, public acceptance, and project efficiency. In addition, constructability and equipment mobilization to the remote island should be considered in planning for on-island construction. Moreover, while the economic analysis has considered system costs and NPV, CNMI may also consider local sustainability efforts and carbon footprint considerations when recommending a project proceed.

While the leachate evaporator option was not found to be economically viable at MSWF, the leachate evaporator system may be a good alternative to deal with future leachate volume as additional leachate pond construction will be required as new MSWF cells begin operation.

Upon project implementation, active LFG collection system installation and maintenance, and beneficial reuse system installation and maintenance may require additional training and development of local resources to provide expertise necessary for LFG systems.

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Appendix A

Marpi Solid Waste Facility Tonnage Data

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DPW/SWMD Waste Delivery
Period: February 1, 2003 through January 31, 2004

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	35.00	0.07%	7.22	0.02%	7.22	0.07%	0.00	0.00%	N
Animal	4.00	0.01%	2.12	0.00%	0.00	0.00%	2.12	0.01%	Y
Backfill	69.00	0.14%	680.17	1.53%	680.17	6.24%	0.00	0.00%	N
Battery	2.00	0.00%	1.43	0.00%	1.43	0.01%	0.00	0.00%	N
C&D	1,048.00	2.10%	793.89	1.78%	358.00	3.29%	435.89	1.29%	N
Cardboard	1,839.00	3.69%	1,121.28	2.51%	1,121.28	10.29%	0.00	0.00%	Y
Garment Waste	3,576.00	7.17%	7,051.61	15.82%	6,983.78	64.11%	67.83	0.20%	N
Glass	238.00	0.48%	46.92	0.11%	46.92	0.43%	0.00	0.00%	N
Gov. C&D	5.00	0.01%	16.65	0.04%	0.00	0.00%	16.65	0.05%	N
Gov. Free-loads	4,124.00	8.27%	2,116.62	4.75%	0.00	0.00%	2,116.62	6.28%	N
Gov. Greenwaste [(a)]	299.00	0.60%	283.68	0.64%	283.68	2.60%	0.00	0.00%	Y
Gov. Special Waste [(b)]	14.00	0.03%	129.54	0.29%	0.00	0.00%	129.54	0.38%	N
Gov. White Goods	18.00	0.04%	17.12	0.04%	17.12	0.16%	0.00	0.00%	N
Greenwaste Clean	3,008.00	6.03%	1,175.91	2.64%	1,175.91	10.79%	0.00	0.00%	Y
Greenwaste Mixed	81.00	0.16%	72.42	0.16%	0.00	0.00%	72.42	0.21%	Y
Metal	104.00	0.21%	39.89	0.09%	39.89	0.37%	0.00	0.00%	N
MSW	17,924.00	35.95%	25,251.89	56.63%	0.00	0.00%	25,251.89	74.95%	Y
Mixed Recycling	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Garments Not for Recycle	519.00	1.04%	3,129.63	7.02%	0.00	0.00%	3,129.63	9.29%	N
Plastic Bottles	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Newspaper	5.00	0.01%	5.15	0.01%	5.15	0.05%	0.00	0.00%	Y
Office Paper	88.00	0.18%	22.72	0.05%	22.72	0.21%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	23.00	0.05%	32.97	0.07%	0.00	0.00%	32.97	0.10%	N
Resi. Batteries	16.00	0.03%	1.99	0.00%	1.99	0.02%	0.00	0.00%	N
Resi. Charged	577.00	1.16%	143.78	0.32%	0.00	0.00%	143.78	0.43%	Y
Resi. Free [(c)]	15,009.00	30.11%	1,737.46	3.90%	0.00	0.00%	1,737.46	5.16%	N
Resi. Metal	46.00	0.09%	8.18	0.02%	8.18	0.08%	0.00	0.00%	N
Resi. White Goods	17.00	0.03%	3.64	0.01%	3.64	0.03%	0.00	0.00%	N
Special Waste	698.00	1.40%	557.04	1.25%	0.00	0.00%	557.04	1.65%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	434.00	0.87%	127.84	0.29%	127.84	1.17%	0.00	0.00%	N
White Goods	32.00	0.06%	8.63	0.02%	8.63	0.08%	0.00	0.00%	N
Total	**49,852.00**	**100.00%**	**44,587.39**	**100.00%**	**10,893.55**	**100.00%**	**33,693.84**	**100.00%**	**83.91%**
					Recycling Percentage	**24.43%**			
Monthly Average	**4,154.33**		**3,715.62**		**907.80**		**2,807.82**		
Daily Average	**161.86**		**144.76**		**35.37**		**109.40**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2004 through January 31, 2005

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	191.00	0.35%	24.46	0.06%	24.46	0.22%	0.00	0.00%	N
Animal	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Backfill	264.00	0.49%	2,489.60	5.65%	2,489.60	22.52%	0.00	0.00%	N
Battery	3.00	0.01%	0.53	0.00%	0.53	0.00%	0.00	0.00%	N
C&D	858.00	1.58%	761.08	1.73%	222.25	2.01%	538.83	1.63%	N
Cardboard	1,577.00	2.90%	964.38	2.19%	964.38	8.72%	0.00	0.00%	Y
Garment Waste	1,098.00	2.02%	2,289.76	5.20%	2,201.50	19.92%	88.26	0.27%	N
Glass	464.00	0.85%	80.04	0.18%	80.04	0.72%	0.00	0.00%	N
Gov. C&D	67.00	0.12%	79.95	0.18%	0.00	0.00%	79.95	0.24%	N
Gov. Free-loads	3,858.00	7.09%	2,208.68	5.02%	0.00	0.00%	2,208.68	6.70%	N
Gov. Greenwaste [a]	1,432.00	2.63%	1,497.19	3.40%	1,497.19	13.54%	0.00	0.00%	Y
Gov. Special Waste [b]	5.00	0.01%	50.48	0.11%	50.48	0.46%	0.00	0.00%	N
Gov. White Goods	111.00	0.20%	62.16	0.14%	62.16	0.56%	0.00	0.00%	N
Greenwaste Clean	6,084.00	11.18%	2,977.68	6.76%	2,977.68	26.94%	0.00	0.00%	Y
Greenwaste Mixed	59.00	0.11%	50.26	0.11%	0.00	0.00%	50.26	0.15%	Y
Metal	303.00	0.56%	121.67	0.28%	121.67	1.10%	0.00	0.00%	N
MSW	15,994.00	29.39%	24,765.87	56.24%	0.00	0.00%	24,765.87	75.08%	Y
Mixed Recycling	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Garments Not for Recycle	521.00	0.96%	2,355.66	5.35%	0.00	0.00%	2,355.66	7.14%	N
Plastic Bottles	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Newspaper	19.00	0.03%	1.62	0.00%	1.62	0.01%	0.00	0.00%	Y
Office Paper	276.00	0.51%	112.81	0.26%	112.81	1.02%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	2.00	0.00%	3.72	0.01%	0.00	0.00%	3.72	0.01%	N
Resi. Batteries	25.00	0.05%	1.88	0.00%	1.88	0.02%	0.00	0.00%	N
Resi. Charged	676.00	1.24%	113.07	0.26%	0.00	0.00%	113.07	0.34%	Y
Resi. Free [c]	19,196.00	35.28%	2,206.68	5.01%	0.00	0.00%	2,206.68	6.69%	N
Resi. Metal	351.00	0.65%	61.15	0.14%	61.15	0.55%	0.00	0.00%	N
Resi. White Goods	82.00	0.15%	13.20	0.03%	13.20	0.12%	0.00	0.00%	N
Special Waste	408.00	0.75%	574.99	1.31%	0.00	0.00%	574.99	1.74%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	415.00	0.76%	150.32	0.34%	150.32	1.36%	0.00	0.00%	N
White Goods	73.00	0.13%	21.00	0.05%	21.00	0.19%	0.00	0.00%	N
Total	**54,412.00**	**100.00%**	**44,039.89**	**100.00%**	**11,053.92**	**100.00%**	**32,985.97**	**100.00%**	**85.81%**
					Percentage Recycled	**25.10%**			**83.91%**
Monthly Average	**4,534.33**		**3,669.99**		**921.16**		**2,748.83**		
Daily Average	**176.66**		**142.99**		**35.89**		**107.10**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2005 through January 31, 2006

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	146.00	0.29%	10.60	0.02%	10.60	0.07%	0.00	0.00%	N
Animal	1.00	0.00%	0.02	0.00%	0.00	0.00%	0.02	0.00%	Y
Backfill	584.00	1.18%	6,822.46	14.69%	6,822.46	43.84%	0.00	0.00%	N
Battery	4.00	0.01%	1.13	0.00%	1.13	0.01%	0.00	0.00%	N
C&D	858.00	1.73%	1,118.23	2.41%	0.00	0.00%	1,118.23	3.62%	N
Cardboard	2,138.00	4.30%	1,140.16	2.46%	1,140.16	7.33%	0.00	0.00%	Y
Garment Waste	897.00	1.81%	2,022.18	4.35%	2,022.18	12.99%	0.00	0.00%	N
Glass	235.00	0.47%	64.66	0.14%	64.66	0.42%	0.00	0.00%	N
Gov. C&D	51.00	0.10%	15.31	0.03%	0.00	0.00%	15.31	0.05%	N
Gov. Free-loads	4,520.00	9.10%	1,852.41	3.99%	0.00	0.00%	1,852.41	6.00%	N
Gov. Greenwaste [(a)]	662.00	1.33%	507.33	1.09%	507.33	3.26%	0.00	0.00%	Y
Gov. Special Waste [(b)]	228.00	0.46%	1,866.14	4.02%	1,866.14	11.99%	0.00	0.00%	N
Gov. White Goods	6.00	0.01%	2.38	0.01%	2.38	0.02%	0.00	0.00%	N
Greenwaste Clean	4,740.00	9.54%	2,583.23	5.56%	2,583.23	16.60%	0.00	0.00%	Y
Greenwaste Mixed	50.00	0.10%	92.57	0.20%	0.00	0.00%	92.57	0.30%	Y
Metal	324.00	0.65%	153.65	0.33%	153.65	0.99%	0.00	0.00%	N
MSW	13,792.00	27.77%	22,583.50	48.63%	0.00	0.00%	22,583.50	73.15%	Y
Mixed Recycling	182.00	0.37%	16.43	0.04%	16.43	0.11%	0.00	0.00%	N
Garments Not for Recycle	323.00	0.65%	2,188.01	4.71%	0.00	0.00%	2,188.01	7.09%	N
Plastic Bottles	81.00	0.16%	7.83	0.02%	7.83	0.05%	0.00	0.00%	N
Newspaper	44.00	0.09%	5.27	0.01%	5.27	0.03%	0.00	0.00%	Y
Office Paper	294.00	0.59%	68.80	0.15%	68.80	0.44%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	25.00	0.05%	54.30	0.12%	0.00	0.00%	54.30	0.18%	N
Resi. Batteries	4.00	0.01%	0.13	0.00%	0.13	0.00%	0.00	0.00%	N
Resi. Charged	518.00	1.04%	80.48	0.17%	0.00	0.00%	80.48	0.26%	Y
Resi. Free [(c)]	17,720.00	35.68%	2,079.85	4.48%	0.00	0.00%	2,079.85	6.74%	N
Resi. Metal	256.00	0.52%	48.78	0.11%	48.78	0.31%	0.00	0.00%	N
Resi. White Goods	31.00	0.06%	5.78	0.01%	5.78	0.04%	0.00	0.00%	N
Special Waste	584.00	1.18%	808.05	1.74%	0.00	0.00%	808.05	2.62%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	322.00	0.65%	207.98	0.45%	207.98	1.34%	0.00	0.00%	N
White Goods	45.00	0.09%	28.82	0.06%	28.82	0.19%	0.00	0.00%	N
Total	**49,665.00**	**100.00%**	**46,436.47**	**100.00%**	**15,563.74**	**100.00%**	**30,872.73**	**100.00%**	
					Recycled Percentage	**33.52%**			
Monthly Average	**4,138.75**		**3,869.71**		**1,296.98**		**2,572.73**		
Daily Average	**161.25**		**150.77**		**50.53**		**100.24**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2006 through January 31, 2007

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	33.00	0.07%	4.12	0.01%	4.12	0.03%	0.00	0.00%	N
Animal	2.00	0.00%	0.10	0.00%	0.00	0.00%	0.10	0.00%	Y
Backfill	823.00	1.80%	10,751.55	23.30%	10,751.55	66.16%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	685.00	1.50%	764.18	1.66%	0.00	0.00%	764.18	2.56%	N
Cardboard	2,426.00	5.31%	1,495.09	3.24%	1,280.30	7.88%	214.79	0.72%	Y
Garment Waste	236.00	0.52%	787.20	1.71%	0.00	0.00%	787.20	2.63%	N
Glass	103.00	0.23%	36.61	0.08%	36.61	0.23%	0.00	0.00%	N
Gov. C&D	58.00	0.13%	45.10	0.10%	0.00	0.00%	45.10	0.15%	N
Gov. Free-loads	4,778.00	10.45%	2,426.57	5.26%	0.00	0.00%	2,426.57	8.12%	N
Gov. Greenwaste [(a)]	494.00	1.08%	395.31	0.86%	395.31	2.43%	0.00	0.00%	Y
Gov. Special Waste [(b)]	50.00	0.11%	465.25	1.01%	465.25	2.86%	0.00	0.00%	N
Gov. White Goods	61.00	0.13%	36.41	0.08%	36.41	0.22%	0.00	0.00%	N
Greenwaste Clean	4,321.00	9.45%	2,851.31	6.18%	2,851.31	17.55%	0.00	0.00%	Y
Greenwaste Mixed	29.00	0.06%	47.98	0.10%	0.00	0.00%	47.98	0.16%	Y
Metal	106.00	0.23%	36.16	0.08%	36.16	0.22%	0.00	0.00%	N
MSW	12,118.00	26.50%	20,222.65	43.83%	0.00	0.00%	20,222.65	67.67%	Y
Mixed Recycling	382.00	0.84%	61.20	0.13%	61.20	0.38%	0.00	0.00%	N
Garments Not for Recycle	623.00	1.36%	2,659.49	5.76%	0.00	0.00%	2,659.49	8.90%	N
Plastic Bottles	53.00	0.12%	4.02	0.01%	4.02	0.02%	0.00	0.00%	N
Newspaper	33.00	0.07%	6.39	0.01%	6.39	0.04%	0.00	0.00%	Y
Office Paper	181.00	0.40%	53.21	0.12%	53.21	0.33%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	25.00	0.05%	33.64	0.07%	0.00	0.00%	33.64	0.11%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	494.00	1.08%	94.98	0.21%	0.00	0.00%	94.98	0.32%	Y
Resi. Free [(c)]	16,703.00	36.53%	1,943.97	4.21%	0.00	0.00%	1,943.97	6.50%	N
Resi. Metal	131.00	0.29%	18.89	0.04%	18.89	0.12%	0.00	0.00%	N
Resi. White Goods	33.00	0.07%	4.05	0.01%	4.05	0.02%	0.00	0.00%	N
Special Waste	438.00	0.96%	675.66	1.46%	30.95	0.19%	644.71	2.16%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	284.00	0.62%	206.04	0.45%	206.04	1.27%	0.00	0.00%	N
White Goods	25.00	0.05%	8.20	0.02%	8.20	0.05%	0.00	0.00%	N
Total	**45,728.00**	**100.00%**	**46,135.33**	**100.00%**	**16,249.97**	**100.00%**	**29,885.36**	**100.00%**	
					Recycling Percentage	**35.22%**			
Monthly Average	**3,810.67**		**3,844.61**		**1,354.16**		**2,490.45**		
Daily Average	**148.47**		**149.79**		**52.76**		**97.03**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial prc 0.00%
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2007 through January 31, 2008

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model	
Aluminum	33.00	0.07%	4.12	0.01%	4.12	0.03%	0.00	0.00%	N	
Animal	2.00	0.00%	0.10	0.00%	0.00	0.00%	0.10	0.00%	Y	
Backfill	766.00	1.71%	10,446.69	23.22%	10,446.69	66.24%	0.00	0.00%	N	
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
C&D	616.00	1.37%	657.94	1.46%	0.00	0.00%	657.94	2.25%	N	
Cardboard	2,153.00	4.80%	1,280.30	2.85%	1,280.30	8.12%	0.00	0.00%	Y	
Garment Waste	186.00	0.41%	607.26	1.35%	0.00	0.00%	607.26	2.08%	N	
Glass	98.00	0.22%	35.56	0.08%	35.56	0.23%	0.00	0.00%	N	
Gov. C&D	49.00	0.11%	34.03	0.08%	0.00	0.00%	34.03	0.12%	N	
Gov. Free-loads	4,453.00	9.92%	2,275.28	5.06%	0.00	0.00%	2,275.28	7.79%	N	
Gov. Greenwaste [(a)]	460.00	1.02%	382.49	0.85%	382.49	2.43%	0.00	0.00%	Y	
Gov. Special Waste [(b)]	31.00	0.07%	305.99	0.68%	305.99	1.94%	0.00	0.00%	N	
Gov. White Goods	57.00	0.13%	35.19	0.08%	35.19	0.22%	0.00	0.00%	N	
Greenwaste Clean	4,321.00	9.63%	2,851.31	6.34%	2,851.31	18.08%	0.00	0.00%	Y	
Greenwaste Mixed	29.00	0.06%	47.98	0.11%	0.00	0.00%	47.98	0.16%	Y	
Metal	106.00	0.24%	36.16	0.08%	36.16	0.23%	0.00	0.00%	N	
MSW	12,118.00	27.00%	20,222.65	44.95%	0.00	0.00%	20,222.65	69.20%	Y	
Mixed Recycling	382.00	0.85%	61.20	0.14%	61.20	0.39%	0.00	0.00%	N	
Garments Not for Recycle	623.00	1.39%	2,659.49	5.91%	0.00	0.00%	2,659.49	9.10%	N	
Plastic Bottles	53.00	0.12%	4.02	0.01%	4.02	0.03%	0.00	0.00%	N	
Newspaper	33.00	0.07%	6.39	0.01%	6.39	0.04%	0.00	0.00%	Y	
Office Paper	181.00	0.40%	53.21	0.12%	53.21	0.34%	0.00	0.00%	Y	
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Rejected Garments	25.00	0.06%	33.64	0.07%	0.00	0.00%	33.64	0.12%	N	
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Resi. Charged	494.00	1.10%	94.98	0.21%	0.00	0.00%	94.98	0.33%	Y	
Resi. Free [(c)]	16,703.00	37.21%	1,943.97	4.32%	0.00	0.00%	1,943.97	6.65%	N	
Resi. Metal	131.00	0.29%	18.89	0.04%	18.89	0.12%	0.00	0.00%	N	
Resi. White Goods	33.00	0.07%	4.05	0.01%	4.05	0.03%	0.00	0.00%	N	
Special Waste	438.00	0.98%	675.66	1.50%	30.95	0.20%	644.71	2.21%	N	
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tires	284.00	0.63%	206.04	0.46%	206.04	1.31%	0.00	0.00%	N	
White Goods	25.00	0.06%	8.20	0.02%	8.20	0.05%	0.00	0.00%	N	
Total	**44,883.00**	**100.00%**	**44,992.79**	**100.00%**	**15,770.76**	**100.00%**	**29,222.03**	**100.00%**		**82.67%**
					Recycling Percentage	**35.05%**				
Monthly Average	**3,740.25**		**3,749.40**		**1,314.23**		**2,435.17**			
Daily Average	**145.72**		**146.08**		**51.20**		**94.88**			

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2008 through January 31, 2009

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	2.00	0.01%	0.93	0.00%	0.00	0.00%	0.93	0.00%	Y
Backfill	1,510.00	3.78%	13,589.87	34.92%	13,589.87	82.19%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	604.00	1.51%	734.76	1.89%	110.00	0.67%	624.76	2.79%	N
Cardboard	988.00	2.48%	389.58	1.00%	389.58	2.36%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	100.00	0.25%	29.93	0.08%	29.93	0.18%	0.00	0.00%	N
Gov. C&D	20.00	0.05%	10.10	0.03%	0.00	0.00%	10.10	0.05%	N
Gov. Free-loads	2,763.00	6.92%	1,106.24	2.84%	0.00	0.00%	1,106.24	4.94%	N
Gov. Greenwaste [(a)]	199.00	0.50%	104.82	0.27%	104.82	0.63%	0.00	0.00%	Y
Gov. Special Waste [(b)]	2.00	0.01%	25.80	0.07%	25.80	0.16%	0.00	0.00%	N
Gov. White Goods	3.00	0.01%	0.50	0.00%	0.50	0.00%	0.00	0.00%	N
Greenwaste Clean	3,947.00	9.89%	1,908.38	4.90%	1,908.38	11.54%	0.00	0.00%	Y
Greenwaste Mixed	26.00	0.07%	20.79	0.05%	0.00	0.00%	20.79	0.09%	Y
Metal	85.00	0.21%	33.34	0.09%	33.34	0.20%	0.00	0.00%	N
MSW	10,184.00	25.52%	17,266.51	44.37%	0.00	0.00%	17,266.51	77.14%	Y
Mixed Recycling	591.00	1.48%	75.68	0.19%	75.68	0.46%	0.00	0.00%	N
Garments Not for Recycle	311.00	0.78%	1,129.77	2.90%	0.00	0.00%	1,129.77	5.05%	N
Plastic Bottles	48.00	0.12%	4.55	0.01%	4.55	0.03%	0.00	0.00%	N
Newspaper	7.00	0.02%	1.53	0.00%	1.53	0.01%	0.00	0.00%	Y
Office Paper	227.00	0.57%	90.23	0.23%	90.23	0.55%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	1.00	0.00%	0.28	0.00%	0.00	0.00%	0.28	0.00%	N
Resi. Batteries	2.00	0.01%	0.10	0.00%	0.10	0.00%	0.00	0.00%	N
Resi. Charged	942.00	2.36%	146.12	0.38%	0.00	0.00%	146.12	0.65%	Y
Resi. Free [(c)]	17,028.00	42.67%	2,077.89	5.34%	0.00	0.00%	2,077.89	9.28%	N
Resi. Metal	24.00	0.06%	3.43	0.01%	3.43	0.02%	0.00	0.00%	N
Resi. White Goods	44.00	0.11%	9.63	0.02%	9.63	0.06%	0.00	0.00%	N
Special Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	244.00	0.61%	158.08	0.41%	158.08	0.96%	0.00	0.00%	N
White Goods	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Total	**39,902.00**	**100.00%**	**38,918.84**	**100.00%**	**16,535.45**	**100.00%**	**22,383.39**	**100.00%**	**89.36%**
					Recycling Percentage	**42.49%**			**82.67%**
Monthly Average	**3,325.17**		**3,243.24**		**1,377.95**		**1,865.28**		
Daily Average	**129.55**		**126.36**		**53.69**		**72.67**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2009 through January 31, 2010

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	1.00	0.00%	0.24	0.00%	0.00	0.00%	0.24	0.00%	Y
Backfill	585.00	1.76%	5,893.00	20.98%	5,893.00	63.63%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	475.00	1.43%	472.94	1.68%	0.00	0.00%	472.94	2.51%	N
Cardboard	1,219.00	3.66%	659.54	2.35%	659.54	7.12%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	118.00	0.35%	36.16	0.13%	36.16	0.39%	0.00	0.00%	N
Gov. C&D	2.00	0.01%	0.38	0.00%	0.00	0.00%	0.38	0.00%	N
Gov. Free-loads	2,803.00	8.42%	1,337.46	4.76%	0.00	0.00%	1,337.46	7.10%	N
Gov. Greenwaste [(a)]	281.00	0.84%	146.16	0.52%	146.16	1.58%	0.00	0.00%	Y
Gov. Special Waste [(b)]	54.00	0.16%	621.85	2.21%	621.85	6.71%	0.00	0.00%	N
Gov. White Goods	61.00	0.18%	20.54	0.07%	20.54	0.22%	0.00	0.00%	N
Greenwaste Clean	3,504.00	10.53%	1,518.91	5.41%	1,518.91	16.40%	0.00	0.00%	Y
Greenwaste Mixed	18.00	0.05%	59.59	0.21%	0.00	0.00%	59.59	0.32%	Y
Metal	42.00	0.13%	16.04	0.06%	16.04	0.17%	0.00	0.00%	N
MSW	8,166.00	24.54%	14,904.29	53.05%	0.00	0.00%	14,904.29	79.14%	Y
Mixed Recycling	391.00	1.17%	62.46	0.22%	62.46	0.67%	0.00	0.00%	N
Garments Not for Recycle	23.00	0.07%	142.58	0.51%	0.00	0.00%	142.58	0.76%	N
Plastic Bottles	89.00	0.27%	25.44	0.09%	25.44	0.27%	0.00	0.00%	N
Newspaper	2.00	0.01%	2.93	0.01%	2.93	0.03%	0.00	0.00%	Y
Office Paper	139.00	0.42%	86.60	0.31%	86.60	0.94%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	2.00	0.01%	0.19	0.00%	0.19	0.00%	0.00	0.00%	N
Resi. Charged	804.00	2.42%	123.60	0.44%	0.00	0.00%	123.60	0.66%	Y
Resi. Free [(c)]	14,196.00	42.66%	1,779.48	6.33%	0.00	0.00%	1,779.48	9.45%	N
Resi. Metal	6.00	0.02%	2.19	0.01%	2.19	0.02%	0.00	0.00%	N
Resi. White Goods	5.00	0.02%	0.77	0.00%	0.77	0.01%	0.00	0.00%	N
Special Waste	9.00	0.03%	12.20	0.04%	0.00	0.00%	12.20	0.06%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	261.00	0.78%	162.10	0.58%	162.10	1.75%	0.00	0.00%	N
White Goods	22.00	0.07%	6.43	0.02%	6.43	0.07%	0.00	0.00%	N
Total	**33,278.00**	**100.00%**	**28,094.07**	**100.00%**	**9,261.31**	**100.00%**	**18,832.76**	**100.00%**	**91.48%**
					Recycling Percentage	**32.97%**			**89.36%**
									82.67%
Monthly Average	**2,773.17**		**2,341.17**		**771.78**		**1,569.40**		
Daily Average	**108.05**		**91.21**		**30.07**		**61.15**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.

(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.

(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2010 through January 31, 2011

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model	
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Animal	21.00	0.05%	0.90	0.00%	0.00	0.00%	0.90	0.00%	Y	
Backfill	667.00	1.59%	7,995.22	25.04%	7,995.22	70.51%	0.00	0.00%	N	
Battery	1.00	0.00%	0.02	0.00%	0.02	0.00%	0.00	0.00%	N	
C&D	307.00	0.73%	322.99	1.01%	0.00	0.00%	322.99	1.57%	N	
Cardboard	1,441.00	3.43%	871.48	2.73%	871.48	7.69%	0.00	0.00%	Y	
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Glass	61.00	0.15%	14.33	0.04%	14.33	0.13%	0.00	0.00%	N	
Gov. C&D	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Gov. Free-loads	2,688.00	6.40%	1,336.96	4.19%	0.00	0.00%	1,336.96	6.49%	N	
Gov. Greenwaste [(a)]	205.00	0.49%	80.15	0.25%	80.15	0.71%	0.00	0.00%	Y	
Gov. Special Waste [(b)]	148.00	0.35%	1,609.62	5.04%	0.00	0.00%	1,609.62	7.82%	N	
Gov. White Goods	1.00	0.00%	0.23	0.00%	0.23	0.00%	0.00	0.00%	N	
Greenwaste Clean	3,171.00	7.55%	1,972.76	6.18%	1,972.76	17.40%	0.00	0.00%	Y	
Greenwaste Mixed	2.00	0.00%	1.31	0.00%	0.00	0.00%	1.31	0.01%	Y	
Metal	56.00	0.13%	22.55	0.07%	22.55	0.20%	0.00	0.00%	N	
MSW	7,739.00	18.42%	15,351.56	48.09%	0.00	0.00%	15,351.56	74.58%	Y	
Mixed Recycling	463.00	1.10%	66.70	0.21%	66.70	0.59%	0.00	0.00%	N	
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Plastic Bottles	31.00	0.07%	4.78	0.01%	4.78	0.04%	0.00	0.00%	N	
Newspaper	2.00	0.00%	0.22	0.00%	0.22	0.00%	0.00	0.00%	Y	
Office Paper	247.00	0.59%	120.51	0.38%	120.51	1.06%	0.00	0.00%	Y	
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Resi. Charged	8,987.00	21.39%	144.58	0.45%	0.00	0.00%	144.58	0.70%	Y	
Resi. Free [(c)]	15,454.00	36.79%	1,808.16	5.66%	0.00	0.00%	1,808.16	8.78%	N	
Resi. Metal	6.00	0.01%	2.19	0.01%	2.19	0.02%	0.00	0.00%	N	
Resi. White Goods	24.00	0.06%	3.08	0.01%	3.08	0.03%	0.00	0.00%	N	
Special Waste	8.00	0.02%	8.78	0.03%	0.00	0.00%	8.78	0.04%	N	
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tires	271.00	0.65%	176.47	0.55%	176.47	1.56%	0.00	0.00%	N	
White Goods	9.00	0.02%	8.35	0.03%	8.35	0.07%	0.00	0.00%	N	
Total	**42,010.00**	**100.00%**	**31,923.90**	**100.00%**	**11,339.04**	**100.00%**	**20,584.86**	**100.00%**		**92.80%**
					Recycling Percentage	**35.52%**				**91.48%**
										89.36%
Monthly Average	**3,500.83**		**2,660.33**		**944.92**		**1,715.41**			
Daily Average	**136.40**		**103.65**		**36.82**		**66.83**			

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2011 through January 31, 2012

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	56.00	0.18%	6.45	0.02%	0.00	0.00%	6.45	0.03%	Y
Backfill	754.00	2.43%	10,065.67	28.50%	10,065.67	70.08%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	291.00	0.94%	586.20	1.66%	420.00	2.92%	166.20	0.79%	N
Cardboard	941.00	3.04%	693.32	1.96%	693.32	4.83%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	41.00	0.13%	25.46	0.07%	25.46	0.18%	0.00	0.00%	N
Gov. C&D	24.00	0.08%	66.66	0.19%	0.00	0.00%	66.66	0.32%	N
Gov. Free-loads	2,331.00	7.53%	1,218.73	3.45%	0.00	0.00%	1,218.73	5.81%	N
Gov. Greenwaste [(a)]	171.00	0.55%	211.70	0.60%	211.70	1.47%	0.00	0.00%	Y
Gov. Special Waste [(b)]	190.00	0.61%	2,083.34	5.90%	0.00	0.00%	2,083.34	9.94%	N
Gov. White Goods	1.00	0.00%	0.29	0.00%	0.29	0.00%	0.00	0.00%	N
Greenwaste Clean	3,297.00	10.64%	2,562.71	7.26%	2,562.71	17.84%	0.00	0.00%	Y
Greenwaste Mixed	5.00	0.02%	14.78	0.04%	0.00	0.00%	14.78	0.07%	Y
Metal	12.00	0.04%	3.60	0.01%	3.60	0.03%	0.00	0.00%	N
MSW	7,142.00	23.06%	15,528.51	43.96%	0.00	0.00%	15,528.51	74.09%	Y
Mixed Recycling	256.00	0.83%	39.84	0.11%	39.84	0.28%	0.00	0.00%	N
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	33.00	0.11%	4.78	0.01%	4.78	0.03%	0.00	0.00%	N
Newspaper	3.00	0.01%	1.65	0.00%	1.65	0.01%	0.00	0.00%	Y
Office Paper	98.00	0.32%	59.28	0.17%	59.28	0.41%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	926.00	2.99%	152.02	0.43%	0.00	0.00%	152.02	0.73%	Y
Resi. Free [(c)]	13,900.00	44.88%	1,707.89	4.84%	0.00	0.00%	1,707.89	8.15%	N
Resi. Metal	7.00	0.02%	1.15	0.00%	1.15	0.01%	0.00	0.00%	N
Resi. White Goods	28.00	0.09%	3.20	0.01%	3.20	0.02%	0.00	0.00%	N
Special Waste	6.00	0.02%	15.02	0.04%	0.00	0.00%	15.02	0.07%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	367.00	1.18%	215.75	0.61%	215.75	1.50%	0.00	0.00%	N
White Goods	94.00	0.30%	54.98	0.16%	54.98	0.38%	0.00	0.00%	N
Total	**30,974.00**	**100.00%**	**35,322.98**	**100.00%**	**14,363.38**	**100.00%**	**20,959.60**	**100.00%**	**93.46%**
					Recycling Percentage	**40.66%**			
Monthly Average	**2,581.17**		**2,943.58**		**1,196.95**		**1,746.63**		
Daily Average	**100.56**		**114.69**		**46.63**		**68.05**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
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(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2012 through January 31, 2013

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	14.00	0.05%	2.97	0.02%	0.00	0.00%	2.97	0.02%	Y
Backfill	59.00	0.22%	232.60	1.26%	232.60	7.27%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	157.00	0.57%	159.21	0.86%	0.00	0.00%	159.21	1.04%	N
Cardboard	849.00	3.10%	455.28	2.46%	455.28	14.23%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	117.00	0.43%	33.85	0.18%	33.85	1.06%	0.00	0.00%	N
Gov. C&D	13.00	0.05%	51.73	0.28%	0.00	0.00%	51.73	0.34%	N
Gov. Free-loads	2,618.00	9.57%	2,483.67	13.43%	0.00	0.00%	2,483.67	16.23%	N
Gov. Greenwaste [(a)]	244.00	0.89%	337.10	1.82%	307.51	9.61%	29.59	0.19%	Y
Gov. Special Waste [(b)]	7.00	0.03%	37.22	0.20%	0.00	0.00%	37.22	0.24%	N
Gov. White Goods	17.00	0.06%	10.30	0.06%	10.30	0.32%	0.00	0.00%	N
Greenwaste Clean	2,912.00	10.65%	1,768.55	9.56%	1,768.55	55.26%	0.00	0.00%	Y
Greenwaste Mixed	15.00	0.05%	33.24	0.18%	0.00	0.00%	33.24	0.22%	Y
Metal	38.00	0.14%	11.60	0.06%	11.60	0.36%	0.00	0.00%	N
MSW	5,670.00	20.74%	10,805.60	58.41%	0.00	0.00%	10,805.60	70.63%	Y
Mixed Recycling	319.00	1.17%	46.51	0.25%	46.51	1.45%	0.00	0.00%	N
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	17.00	0.06%	2.47	0.01%	2.47	0.08%	0.00	0.00%	N
Newspaper	4.00	0.01%	2.36	0.01%	2.36	0.07%	0.00	0.00%	Y
Office Paper	83.00	0.30%	86.84	0.47%	86.84	2.71%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	581.00	2.12%	113.14	0.61%	0.00	0.00%	113.14	0.74%	Y
Resi. Free [(c)]	13,073.00	47.81%	1,570.16	8.49%	0.00	0.00%	1,570.16	10.26%	N
Resi. Metal	18.00	0.07%	1.24	0.01%	1.24	0.04%	0.00	0.00%	N
Resi. White Goods	26.00	0.10%	6.56	0.04%	6.56	0.20%	0.00	0.00%	N
Special Waste	6.00	0.02%	12.49	0.07%	0.00	0.00%	12.49	0.08%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	414.00	1.51%	217.37	1.18%	217.37	6.79%	0.00	0.00%	N
White Goods	74.00	0.27%	17.18	0.09%	17.18	0.54%	0.00	0.00%	N
Total	**27,345.00**	**100.00%**	**18,499.24**	**100.00%**	**3,200.22**	**100.00%**	**15,299.02**	**100.00%**	**83.03%**
					Recycling Percentage	**17.30%**			**93.46%**
Monthly Average	**2,278.75**		**1,541.60**		**266.69**		**1,274.92**		
Daily Average	**88.78**		**60.06**		**10.39**		**49.67**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2013 through January 31, 2014

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model	
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Animal	43.00	0.15%	11.07	0.05%	0.00	0.00%	11.07	0.06%	Y	
Backfill	159.00	0.56%	844.36	3.76%	842.91	25.84%	1.45	0.01%	N	
Battery	2.00	0.01%	0.11	0.00%	0.11	0.00%	0.00	0.00%	N	
C&D	368.00	1.30%	395.84	1.76%	0.00	0.00%	395.84	2.07%	N	
Cardboard	918.00	3.23%	286.65	1.28%	286.65	8.79%	0.00	0.00%	Y	
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Glass	120.00	0.42%	25.29	0.11%	17.84	0.55%	7.45	0.04%	N	
Gov. C&D	20.00	0.07%	39.81	0.18%	0.00	0.00%	39.81	0.21%	N	
Gov. Free-loads	2,192.00	7.72%	1,021.26	4.55%	0.00	0.00%	1,021.26	5.33%	N	
Gov. Greenwaste [(a)]	513.00	1.81%	493.48	2.20%	492.69	15.10%	0.79	0.00%	Y	
Gov. Special Waste [(b)]	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Gov. White Goods	27.00	0.10%	21.76	0.10%	21.76	0.67%	0.00	0.00%	N	
Greenwaste Clean	2,216.00	7.80%	1,352.38	6.03%	1,352.28	41.46%	0.10	0.00%	Y	
Greenwaste Mixed	19.00	0.07%	31.93	0.14%	0.00	0.00%	31.93	0.17%	Y	
Metal	20.00	0.07%	6.34	0.03%	6.34	0.19%	0.00	0.00%	N	
MSW	7,499.00	26.40%	15,799.34	70.44%	0.00	0.00%	15,799.34	82.43%	Y	
Mixed Recycling	449.00	1.58%	26.74	0.12%	26.74	0.82%	0.00	0.00%	N	
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Plastic Bottles	24.00	0.08%	1.17	0.01%	1.17	0.04%	0.00	0.00%	N	
Newspaper	10.00	0.04%	0.96	0.00%	0.96	0.03%	0.00	0.00%	Y	
Office Paper	87.00	0.31%	40.53	0.18%	40.53	1.24%	0.00	0.00%	Y	
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N	
Resi. Charged	506.00	1.78%	99.53	0.44%	0.00	0.00%	99.53	0.52%	Y	
Resi. Free [(c)]	12,725.00	44.79%	1,464.15	6.53%	0.00	0.00%	1,464.15	7.64%	N	
Resi. Metal	32.00	0.11%	4.31	0.02%	4.31	0.13%	0.00	0.00%	N	
Resi. White Goods	38.00	0.13%	5.88	0.03%	5.88	0.18%	0.00	0.00%	N	
Special Waste	42.00	0.15%	288.49	1.29%	0.00	0.00%	288.49	1.51%	N	
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y	
Tires	310.00	1.09%	144.69	0.65%	144.69	4.44%	0.00	0.00%	N	
White Goods	70.00	0.25%	23.34	0.10%	17.18	0.53%	6.16	0.03%	N	
Total	**28,409.00**	**100.00%**	**22,429.41**	**100.00%**	**3,262.04**	**100.00%**	**19,167.37**	**100.00%**		**94.08%**
					Recycling Percentage	**14.54%**				**83.03%**
										93.46%
Monthly Average	**2,367.42**		**1,869.12**		**271.84**		**1,597.28**			
Daily Average	**92.24**		**72.82**		**10.59**		**62.23**			

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2014 through January 31, 2015

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	56.00	0.21%	11.20	0.04%	0.00	0.00%	11.20	0.06%	Y
Backfill	577.00	2.12%	5,915.29	18.81%	5,915.29	45.97%	0.00	0.00%	N
Battery	1.00	0.00%	0.12	0.00%	0.12	0.00%	0.00	0.00%	N
C&D	798.00	2.93%	1,000.72	3.18%	1,000.72	7.78%	0.00	0.00%	N
Cardboard	871.00	3.20%	230.01	0.73%	230.01	1.79%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	102.00	0.37%	20.43	0.06%	20.43	0.16%	0.00	0.00%	N
Gov. C&D	14.00	0.05%	32.24	0.10%	32.24	0.25%	0.00	0.00%	N
Gov. Free-loads	2,512.00	9.23%	723.88	2.30%	0.00	0.00%	723.88	3.90%	N
Gov. Greenwaste [a]	281.00	1.03%	297.48	0.95%	297.48	2.31%	0.00	0.00%	Y
Gov. Special Waste [b]	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Gov. White Goods	6.00	0.02%	1.90	0.01%	1.90	0.01%	0.00	0.00%	N
Greenwaste Clean	1,925.00	7.07%	1,462.83	4.65%	1,462.83	11.37%	0.00	0.00%	Y
Greenwaste Mixed	46.00	0.17%	138.36	0.44%	0.00	0.00%	138.36	0.74%	Y
Metal	99.00	0.36%	28.63	0.09%	28.63	0.22%	0.00	0.00%	N
MSW	7,004.00	25.73%	16,081.18	51.15%	0.00	0.00%	16,081.18	86.58%	Y
Mixed Recycling	463.00	1.70%	34.37	0.11%	34.37	0.27%	0.00	0.00%	N
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	36.00	0.13%	1.90	0.01%	1.90	0.01%	0.00	0.00%	N
Newspaper	11.00	0.04%	4.14	0.01%	4.14	0.03%	0.00	0.00%	Y
Office Paper	147.00	0.54%	48.63	0.15%	48.63	0.38%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	504.00	1.85%	85.49	0.27%	0.00	0.00%	85.49	0.46%	Y
Resi. Free [c]	10,696.00	39.29%	1,245.34	3.96%	0.00	0.00%	1,245.34	6.70%	N
Resi. Metal	283.00	1.04%	3,414.05	10.86%	3,414.05	26.53%	0.00	0.00%	N
Resi. White Goods	386.91	1.42%	216.53	0.69%	216.53	1.68%	0.00	0.00%	N
Special Waste	42.00	0.15%	288.49	0.92%	0.00	0.00%	288.49	1.55%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	310.00	1.14%	144.69	0.46%	144.69	1.12%	0.00	0.00%	N
White Goods	50.00	0.18%	12.49	0.04%	12.49	0.10%	0.00	0.00%	N
Total	**27,220.91**	**100.00%**	**31,440.39**	**100.00%**	**12,866.45**	**100.00%**	**18,573.94**	**100.00%**	
					Recycling Percentage	**40.92%**			
Monthly Average	**2,268.41**		**2,620.03**		**1,072.20**		**1,547.83**		
Daily Average	**88.38**		**102.08**		**41.77**		**60.31**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2015 through January 15, 2016

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	85.00	0.29%	8.63	0.02%	0.00	0.00%	8.63	0.04%	Y
Backfill	708.00	2.39%	7,568.22	21.07%	7,568.22	52.20%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	1,351.00	4.57%	1,988.21	5.54%	0.00	0.00%	1,988.21	9.28%	N
Cardboard	956.00	3.23%	286.56	0.80%	286.56	1.98%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	83.00	0.28%	13.98	0.04%	13.98	0.10%	0.00	0.00%	N
Gov. C&D	45.00	0.15%	115.41	0.32%	0.00	0.00%	115.41	0.54%	N
Gov. Free-loads	2,825.00	9.55%	1,148.48	3.20%	0.00	0.00%	1,148.48	5.36%	N
Gov. Greenwaste [a]	647.00	2.19%	692.77	1.93%	692.77	4.78%	0.00	0.00%	Y
Gov. Special Waste [b]	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Gov. White Goods	13.00	0.04%	7.12	0.02%	7.12	0.05%	0.00	0.00%	N
Greenwaste Clean	2,984.00	10.09%	5,604.64	15.60%	5,604.64	38.65%	0.00	0.00%	Y
Greenwaste Mixed	223.00	0.75%	545.04	1.52%	0.00	0.00%	545.04	2.54%	Y
Metal	139.00	0.47%	61.97	0.17%	61.97	0.43%	0.00	0.00%	N
MSW	6,485.00	21.93%	15,964.79	44.45%	0.00	0.00%	15,964.79	74.53%	Y
Mixed Recycling	438.00	1.48%	35.86	0.10%	35.86	0.25%	0.00	0.00%	N
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	90.00	0.30%	5.33	0.01%	5.33	0.04%	0.00	0.00%	N
Newspaper	12.00	0.04%	3.87	0.01%	3.87	0.03%	0.00	0.00%	Y
Office Paper	149.00	0.50%	61.47	0.17%	40.53	0.28%	20.94	0.10%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	668.00	2.26%	111.32	0.31%	0.00	0.00%	111.32	0.52%	Y
Resi. Free [c]	11,072.00	37.45%	1,168.53	3.25%	0.00	0.00%	1,168.53	5.46%	N
Resi. Metal	120.00	0.41%	18.81	0.05%	18.81	0.13%	0.00	0.00%	N
Resi. White Goods	28.00	0.09%	4.18	0.01%	4.18	0.03%	0.00	0.00%	N
Special Waste	84.00	0.28%	315.75	0.88%	0.00	0.00%	315.75	1.47%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	314.00	1.06%	178.35	0.50%	144.69	1.00%	33.66	0.16%	N
White Goods	47.00	0.16%	10.97	0.03%	10.97	0.08%	0.00	0.00%	N
Total	**29,566.00**	**100.00%**	**35,920.26**	**100.00%**	**14,499.50**	**100.00%**	**21,420.76**	**100.00%**	**93.96%**
					Recycling Percentage	**40.37%**			
Monthly Average	**2,463.83**		**2,993.36**		**1,208.29**		**1,785.06**		
Daily Average	**95.99**		**116.62**		**47.08**		**69.55**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
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DPW/SWMD Waste Delivery
Period: February 1, 2016 through January 31, 2017

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	39.00	0.11%	2.76	0.01%	0.00	0.00%	2.76	0.01%	Y
Backfill	549.00	1.53%	4,239.55	9.72%	4,239.55	30.63%	0.00	0.00%	N
Battery	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	2,255.00	6.29%	3,989.74	9.15%	89.32	0.65%	3,900.42	13.10%	N
Cardboard	788.00	2.20%	188.02	0.43%	188.02	1.36%	0.00	0.00%	Y
Garment Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	59.00	0.16%	6.76	0.02%	6.76	0.05%	0.00	0.00%	N
Gov. C&D	296.00	0.83%	627.63	1.44%	0.00	0.00%	627.63	2.11%	N
Gov. Free-loads	2,904.00	8.10%	2,318.33	5.32%	0.00	0.00%	2,318.33	7.79%	N
Gov. Greenwaste [(a)]	1,746.00	4.87%	4,968.54	11.39%	4,968.54	35.90%	0.00	0.00%	Y
Gov. Special Waste [(b)]	116.00	0.32%	604.86	1.39%	604.86	4.37%	0.00	0.00%	N
Gov. White Goods	36.00	0.10%	15.78	0.04%	15.78	0.11%	0.00	0.00%	N
Greenwaste Clean	1,089.00	3.04%	3,056.72	7.01%	3,056.72	22.09%	0.00	0.00%	Y
Greenwaste Mixed	677.00	1.89%	2,509.75	5.75%	0.00	0.00%	2,509.75	8.43%	Y
Metal	1,032.00	2.88%	268.45	0.62%	268.45	1.94%	0.00	0.00%	N
MSW	13,054.00	36.42%	19,357.21	44.38%	0.00	0.00%	19,357.21	65.02%	Y
Mixed Recycling	631.00	1.76%	42.11	0.10%	42.11	0.30%	0.00	0.00%	N
Garments Not for Recycle	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	51.00	0.14%	3.44	0.01%	3.44	0.02%	0.00	0.00%	N
Newspaper	10.00	0.03%	4.97	0.01%	4.97	0.04%	0.00	0.00%	Y
Office Paper	166.00	0.46%	78.32	0.18%	78.32	0.57%	0.00	0.00%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	638.00	1.78%	110.60	0.25%	0.00	0.00%	110.60	0.37%	Y
Resi. Free [(c)]	8,846.00	24.68%	849.88	1.95%	0.00	0.00%	849.88	2.85%	N
Resi. Metal	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. White Goods	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Special Waste	23.00	0.06%	95.75	0.22%	0.00	0.00%	95.75	0.32%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	455.00	1.27%	207.94	0.48%	207.94	1.50%	0.00	0.00%	N
White Goods	383.00	1.07%	65.91	0.15%	65.91	0.48%	0.00	0.00%	N
Total	**35,843.00**	**100.00%**	**43,613.02**	**100.00%**	**13,840.69**	**100.00%**	**29,772.33**	**100.00%**	**91.84%**
					Recycling Percentage	**31.74%**			**93.96%**
Monthly Average	**2,986.92**		**3,634.42**		**1,153.39**		**2,481.03**		
Daily Average	**116.37**		**141.60**		**44.94**		**96.66**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2017 through January 31, 2018

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Animal	9	0.02%	1.03	0.00%	0.00	0.00%	1.03	0.00%	Y
Backfill	656	1.42%	4,545.91	11.12%	4,545.91	32.73%	0.00	0.00%	N
Battery	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
C&D	3,216	6.98%	3,278.05	8.02%	0.00	0.00%	3,278.05	12.14%	N
Cardboard	784	1.70%	169.88	0.42%	169.88	1.22%	0.00	0.00%	Y
Garment Waste	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Glass	6,143	13.33%	7.03	0.02%	7.03	0.05%	0.00	0.00%	N
Gov. C&D	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Gov. Free-loads	2,902	6.30%	919.45	2.25%	0.00	0.00%	919.45	3.40%	N
Gov. Greenwaste [(a)]	1,098	2.38%	2,967.59	7.26%	2,967.59	21.37%	0.00	0.00%	Y
Gov. Special Waste [(b)]	68	0.15%	375.22	0.92%	375.22	2.70%	0.00	0.00%	N
Gov. White Goods	111	0.24%	31.65	0.08%	31.65	0.23%	0.00	0.00%	N
Greenwaste Clean	1,690	3.67%	5,074.92	12.41%	5,074.92	36.54%	0.00	0.00%	Y
Greenwaste Mixed	10	0.02%	16.42	0.04%	0.00	0.00%	16.42	0.06%	Y
Metal	990	2.15%	248.70	0.61%	248.70	1.79%	0.00	0.00%	N
MSW	25,999	56.43%	22,526.10	55.09%	0.00	0.00%	22,526.10	83.42%	Y
Mixed Recycling	648	1.41%	39.58	0.10%	39.58	0.28%	0.00	0.00%	N
Garments Not for Recycle	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Plastic Bottles	56	0.12%	2.16	0.01%	2.16	0.02%	0.00	0.00%	N
Newspaper	17	0.04%	8.41	0.02%	8.41	0.06%	0.00	0.00%	Y
Office Paper	141	0.31%	46.96	0.11%	46.96	0.34%	0.00	0.00%	Y
Recycle Garments	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Batteries	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Charged	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Resi. Free [(c)]	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Resi. Metal	4	0.01%	1.26	0.00%	1.26	0.01%	0.00	0.00%	N
Resi. White Goods	577	1.25%	110.63	0.27%	0.00	0.00%	110.63	0.41%	N
Special Waste	74	0.16%	152.10	0.37%	0.00	0.00%	152.10	0.56%	N
Tip Floor MSW	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	884	1.92%	369.25	0.90%	369.25	2.66%	0.00	0.00%	N
White Goods	0	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Total	**46,077**	**100.00%**	**40,892.30**	**100.00%**	**13,888.52**	**100.00%**	**27,003.78**	**100.00%**	
					Recycling Percentage	**33.96%**			
Monthly Average	**3,840**		**3,408**		**1,157.38**		**2,250.32**		
Daily Average	**150**		**132.77**		**45.09**		**87.67**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

DPW/SWMD Waste Delivery
Period: February 1, 2003 through January 31, 2018

	Total Vehicles	% of Vehicles	Total Delivered	% of total Waste	Diverted for Recycling	% of Rec.	Total Disposal	% of Disposal	Include in the Model
Aluminum	438.00	0.07%	50.52	0.01%	50.52	0.03%	0.00	0.00%	N
Animal	335.00	0.06%	48.52	0.01%	0.00	0.00%	48.52	0.01%	Y
Backfill	8,730.00	1.49%	92,080.16	16.64%	92,078.71	50.43%	1.45	0.00%	N
Battery	13.00	0.00%	3.34	0.00%	3.34	0.00%	0.00	0.00%	N
C&D	13,887.00	2.37%	17,023.98	3.08%	2,200.29	1.21%	14,823.69	4.00%	N
Cardboard	19,888.00	3.40%	10,231.53	1.85%	10,016.74	5.49%	214.79	0.06%	Y
Garment Waste	5,993.00	1.02%	12,758.01	2.31%	11,207.46	6.14%	1,550.55	0.42%	N
Glass	8,082.00	1.38%	477.01	0.09%	469.56	0.26%	7.45	0.00%	N
Gov. C&D	664.00	0.11%	1,135.00	0.21%	32.24	0.02%	1,102.76	0.30%	N
Gov. Free-loads	48,271.00	8.25%	24,494.02	4.43%	0.00	0.00%	24,494.02	6.61%	N
Gov. Greenwaste [a]	8,732.00	1.49%	13,365.79	2.42%	13,335.41	7.30%	30.38	0.01%	Y
Gov. Special Waste [b]	913.00	0.16%	8,175.31	1.48%	4,315.59	2.36%	3,859.72	1.04%	N
Gov. White Goods	529.00	0.09%	263.33	0.05%	263.33	0.14%	0.00	0.00%	N
Greenwaste Clean	49,209.00	8.41%	38,722.24	7.00%	38,722.14	21.21%	0.10	0.00%	Y
Greenwaste Mixed	1,289.00	0.22%	3,682.42	0.67%	0.00	0.00%	3,682.42	0.99%	Y
Metal	3,456.00	0.59%	1,088.75	0.20%	1,088.75	0.60%	0.00	0.00%	N
MSW	170,888.00	29.20%	276,631.65	50.00%	0.00	0.00%	276,631.65	74.63%	Y
Mixed Recycling	5,595.00	0.96%	608.68	0.11%	608.68	0.33%	0.00	0.00%	N
Garments Not for Recycle	2,943.00	0.50%	14,264.63	2.58%	0.00	0.00%	14,264.63	3.85%	N
Plastic Bottles	662.00	0.11%	71.89	0.01%	71.89	0.04%	0.00	0.00%	N
Newspaper	212.00	0.04%	55.86	0.01%	55.86	0.03%	0.00	0.00%	Y
Office Paper	2,504.00	0.43%	1,030.12	0.19%	1,009.18	0.55%	20.94	0.01%	Y
Recycle Garments	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	N
Rejected Garments	101.00	0.02%	158.55	0.03%	0.00	0.00%	158.55	0.04%	N
Resi. Batteries	49.00	0.01%	4.29	0.00%	4.29	0.00%	0.00	0.00%	N
Resi. Charged	17,315.00	2.96%	1,613.69	0.29%	0.00	0.00%	1,613.69	0.44%	Y
Resi. Free [c]	202,321.00	34.58%	23,583.41	4.26%	0.00	0.00%	23,583.41	6.36%	N
Resi. Metal	1,415.00	0.24%	3,604.52	0.65%	3,604.52	1.97%	0.00	0.00%	N
Resi. White Goods	1,352.91	0.23%	391.18	0.07%	280.55	0.15%	110.63	0.03%	N
Special Waste	2,860.00	0.49%	4,480.47	0.81%	61.90	0.03%	4,418.57	1.19%	N
Tip Floor MSW	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tip Floor Waste	0.00	0.00%	0.00	0.00%	0.00	0.00%	0.00	0.00%	Y
Tires	5,569.00	0.95%	2,872.91	0.52%	2,839.25	1.55%	33.66	0.01%	N
White Goods	949.00	0.16%	274.50	0.05%	268.34	0.15%	6.16	0.00%	N
Total	**585,164.91**	**100.00%**	**553,246.28**	**100.00%**	**182,588.54**	**100.00%**	**370,657.74**	**100.00%**	
					Recycling Percentage	**33.00%**			
Annual Average	**45,012.69**		**42,557.41**		**14,045.27**		**28,512.13**		
Monthly Average	**3,751.06**		**3,546.45**		**1,170.44**		**2,376.01**		
Daily Average	**146.15**		**138.17**		**45.60**		**92.57**		

(a) Green waste is composed of organic waste that can be composted, i.e. refuse from gardens, grass clippings or leaves, and domestic or industrial kitchen wastes.
(b) Special waste is composed of industrial process waste, pollution control waste, or toxic waste, which may pose a threat to human health or the environment.
(c) Waste that were not propoerly categorized.

Appendix B

Puerto Rico Dump Landfill Gas Sampling Results

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EA Engineering, Science, and Technology, Inc.

1001 Army Drive, Suite 103
Barrigada, Guam 96913-1402
Telephone: 671-646-5231
Fax: 671-646-5230

18 July 2011

James R. Stump
CIP Contracting Officer
Caller Box 10007
Saipan, MP 96950

RE: Puerto Rico Dump Landfill Gas Testing Method, Results and Recommendations

Dear Mr. Stump:

EA Engineering, Science, and Technology, Inc. is pleased to provide you with method, results and recommendations for Puerto Rico Dump (PRD) landfill gas (LFG) testing efforts that took place of the week of 13 June 2011.

Method:
Sixteen LFG sample probes were installed per the Tier II Testing Services for Puerto Rico Closure Work Plan. No unexploded ordinances (UXO) were encountered. Per USEPA Method 3C, samples may contain no more than 20% nitrogen. A total of five sample locations of sixteen met this requirement. Therefore, three additional sample probes were installed to obtain more samples meeting this criterion. None of the additional probes contained concentrations lower than 20% nitrogen see attached Location Map. Therefore, five samples are the basis of this LFG assessment. The presence of high nitrogen concentrations is indicative of air intrusion, which may be expected given the temporary and thin soil layer cover onsite.

Results:
Collected PRD LFG samples contain typical concentrations for methane, carbon dioxide, and nitrogen. However, non-methane organic compounds (NMOC) are lower than those typically observed in municipal landfills. PRD LFG testing results are summarized in Table 1 below.

Table 1. Results of the PRD LFG testing services

	Sample Location				
Constituent (%, v/v)	LFG-05	LFG-06	LFG-11	LFG-12	LFG-15
Hydrogen (%, v/v)	ND	ND	ND	ND	ND
Argon (%, v/v)	3.42	3.22	1.28	2.94	2.39
Nitrogen (%, v/v)	12.1	11.5	5.78	10.4	12.4
Carbon Monoxide (%, v/v)	ND	ND	ND	ND	ND
Methane (%, v/v)	44.3	44.7	50.8	46.1	44.5
Carbon Dioxide (%, v/v)	40.2	40.6	42.1	40.6	40.7
Non-Methane Organic Compounds (ppmV)	11	8.9	22	20	19
ND=Compound was analyzed, but not detected above the laboratory reporting limit.					

EA Engineering, Science, and Technology, Inc.

1001 Army Drive, Suite 103
Barrigada, Guam 96913-1402
Telephone: 671-646-5231
Fax: 671-646-5230

Recommendations:
We recommend using this collected LFG data as a basis of design for future closed PRD uses. Original sample results are attached. No action with regard to LFG emissions is required. In particular, the threshold of applicability for the federal rule is as follows (40 CFR 60.33c): Only landfills with a permitted capacity over 2.5 million cubic meters are required to calculate NMOC, by either Tier 1 or Tier 2 methods; only when calculated NMOC exceed 50 megagrams per year is the site obligated to install an LFG emissions collection and control system. Given that the PRD is smaller than the federal threshold, at approximately 1.3 million cubic meters, and that observed NMOC are lower than typical concentrations, neither Tier I nor Tier II LandGEM analysis is required.

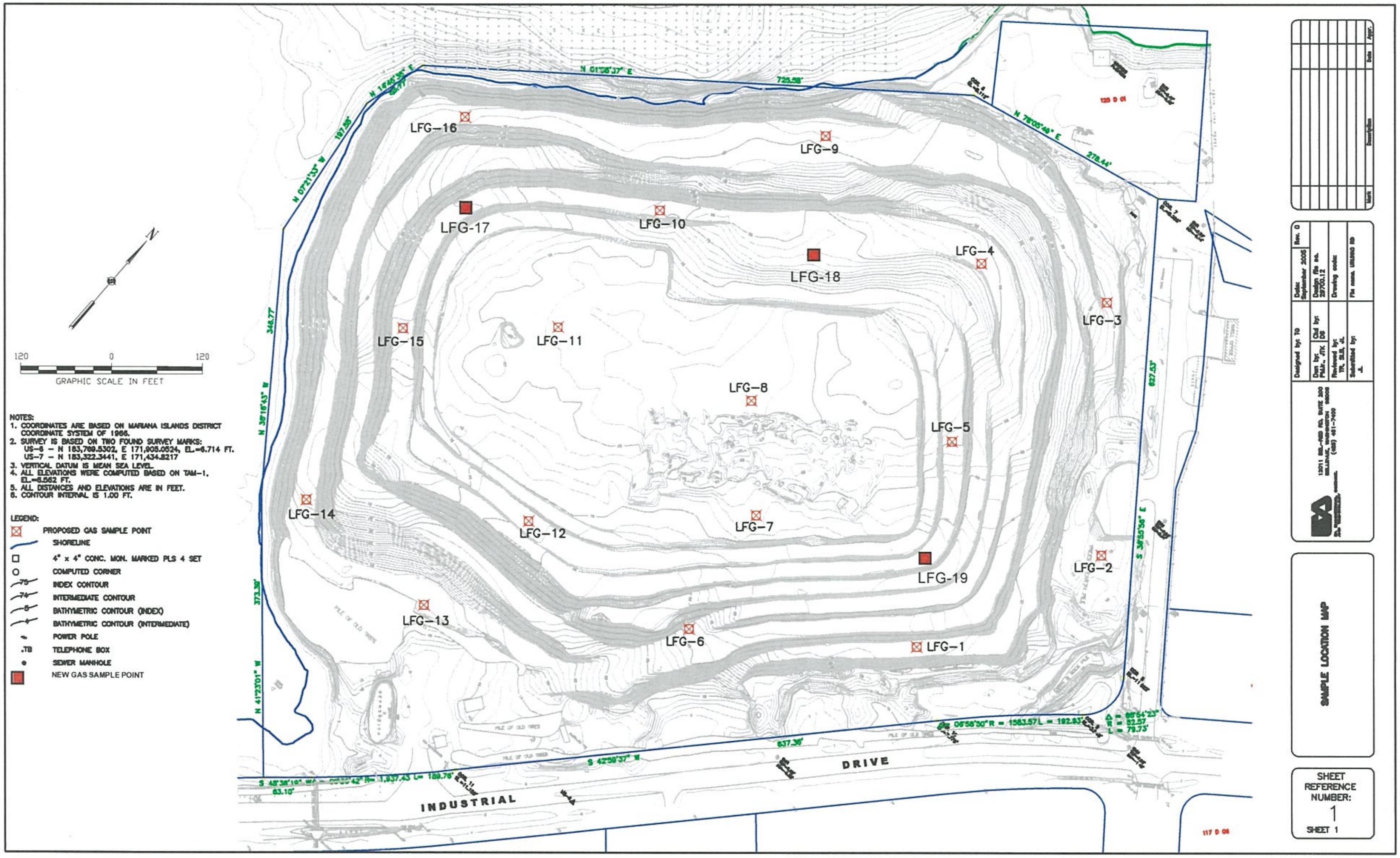
Please contact me at (671) 646-5231 or tword@eaest.com for questions or comments regarding this effort, or if additional information is required. Thanks so much for this opportunity and we look forward to continuing to work with you.

Sincerely,

Tressie Word, PE
Project Manager

Attachments: PRD LFG Sample Location Map
PRD LFG Sample Results

Cc: Roy Reyes; Carl Castro (via email)



N
120
0
120
GRAPHIC SCALE IN FEET
NOTES:
1. COORDINATES ARE BASED ON MARIANA ISLANDS DISTRICT COORDINATE SYSTEM OF 1966.
2. SURVEY IS BASED ON TWO FOUND SURVEY MARKS:
US-6 - N 183,769.5302, E 171,905.0524, EL.=6.714 FT.
US-7 - N 183,322.3441, E 171,434.8217
3. VERTICAL DATUM IS MEAN SEA LEVEL.
4. ALL ELEVATIONS WERE COMPUTED BASED ON TAM-1. EL.=6.562 FT.
5. ALL DISTANCES AND ELEVATIONS ARE IN FEET.
6. CONTOUR INTERVAL IS 1.00 FT.
LEGEND:
PROPOSED GAS SAMPLE POINT
SHORELINE
4" x 4" CONC. MON. MARKED PLS 4 SET
COMPUTED CORNER
75
INDEX CONTOUR
74
INTERMEDIATE CONTOUR
5
BATHYMETRIC CONTOUR (INDEX)
4
BATHYMETRIC CONTOUR (INTERMEDIATE)
POWER POLE
.TB
TELEPHONE BOX
SEWER MANHOLE
NEW GAS SAMPLE POINT
LFG-1
LFG-2
LFG-3
LFG-4
LFG-5
LFG-6
LFG-7
LFG-8
LFG-9
LFG-10
LFG-11
LFG-12
LFG-13
LFG-14
LFG-15
LFG-16
LFG-17
LFG-18
LFG-19
N 01°08'37" E
725.58'
N 78°05'49" E
278.44'
S 38°55'56" E
627.53'
S 42°59'37" W
637.36'
N 41°23'01" W
373.30'
N 38°16'43" W
348.77'
N 07°21'33" W
197.59'
INDUSTRIAL
DRIVE
SAMPLE LOCATION MAP
SHEET REFERENCE NUMBER:
1
SHEET 1

LABORATORY REPORT

July 12, 2011

Brenda Nuding
EA Engineering, Science, and Technology
1221 Kapiolani Blvd. Suite 1030
Honolulu, HI 96814

RE: Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301

Dear Brenda:

Enclosed are the results of the samples submitted to our laboratory on June 27, 2011. For your reference, these analyses have been assigned our service request number P1102411.

All analyses were performed according to our laboratory's NELAP and DoD-ELAP-approved quality assurance program. The test results meet requirements of the current NELAP and DoD-ELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP and DoD-ELAP-accredited analytes, refer to the certifications section at www.caslab.com. Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein.

Columbia Analytical Services, Inc. is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA20007; The American Industrial Hygiene Association, Laboratory #101661; United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP), Certificate No. L10-3-R1; Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-11-2; Minnesota Department of Health, NELAP Certificate No. 219474; Washington State Department of Ecology, ELAP Lab ID: C946. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

Columbia Analytical Services, Inc.

Sue Anderson
Project Manager

Client:	EA Engineering, Science, and Technology	CAS Project No:	P1102411
Project:	Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301		

CASE NARRATIVE

The samples were received intact under chain of custody on June 27, 2011 and were stored in accordance with the analytical method requirements. Please refer to the sample acceptance check form for additional information. The results reported herein are applicable only to the condition of the samples at the time of sample receipt.

Fixed Gases Analysis

The samples were analyzed for fixed gases (hydrogen, oxygen/argon, nitrogen, carbon monoxide, methane and carbon dioxide) according to EPA Method 3C (duplicate injection) using a gas chromatograph equipped with a thermal conductivity detector (TCD).

Total Gaseous Non-Methane Organics as Hexane Analysis

The samples were also analyzed for total gaseous non-methane organics as hexane according to EPA Method 25C. The analyses included a triplicate sample injection analyzed by gas chromatography using flame ionization detection/total combustion analysis.

The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for utilization of less than the complete report.

Use of Columbia Analytical Services, Inc. (CAS) Name. Client shall not use CAS's name or trademark in any marketing or reporting materials, press releases or in any other manner ("Materials") whatsoever and shall not attribute to CAS any test result, tolerance or specification derived from CAS's data ("Attribution") without CAS's prior written consent, which may be withheld by CAS for any reason in its sole discretion. To request CAS's consent, Client shall provide copies of the proposed Materials or Attribution and describe in writing Client's proposed use of such Materials or Attribution. If CAS has not provided written approval of the Materials or Attribution within ten (10) days of receipt from Client, Client's request to use CAS's name or trademark in any Materials or Attribution shall be deemed denied. CAS may, in its discretion, reasonably charge Client for its time in reviewing Materials or Attribution requests. Client acknowledges and agrees that the unauthorized use of CAS's name or trademark may cause CAS to incur irreparable harm for which the recovery of money damages will be inadequate. Accordingly, Client acknowledges and agrees that a violation shall justify preliminary injunctive relief. For questions contact the laboratory.

DETAIL SUMMARY REPORT

Client: EA Engineering, Science, and Technology
Service Request: P1102411
Project ID: Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301

Date Received: 6/27/2011
Time Received: 10:50

Client Sample ID	Lab Code	Matrix	Date Collected	Time Collected	Container ID	Pi1 (psig)	Pf1 (psig)	3C - Fxd Gases Can 2X	25C - TGNMO 3X Can
LFG-00	P1102411-001	Air	6/20/2011	14:00	SC01065	-0.78	3.68	X	X
LFG-11	P1102411-002	Air	6/20/2011	15:46	SC00779	-0.22	3.80	X	X
LFG-5	P1102411-003	Air	6/20/2011	16:16	SC00058	-0.45	3.55	X	X
LFG-12	P1102411-004	Air	6/20/2011	16:51	SC00651	-0.41	3.85	X	X
LFG-15	P1102411-005	Air	6/20/2011	17:20	SC00034	-0.61	3.70	X	X
LFG-6	P1102411-006	Air	6/21/2011	10:43	SC00655	-0.58	4.27	X	X

Columbia Analytical Services

2655 Park Center Drive, Suite A
Simi Valley, California 93065
Phone (805) 526-7161
Fax (805) 526-7270

Air - Chain of Custody Record & Analytical Service Request

Page 1 of 1

Requested Turnaround Time in Business Days (Surcharges) please circle
1 Day (100%) 2 Day (75%) 3 Day (50%) 4 Day (35%) 5 Day (25%) 10 Day-Standard

CAS Project No. P1102411

CAS Contact:

Company Name & Address (Reporting Information): EA Engineering Science & Technology, 3 Washington Center, Newburgh NY 12550

Project Manager: Brenda Nuding

Phone: 1-808-256-8268 | Fax: 1-671-646-5230

Email Address for Result Reporting: bnuding@eaest.com / tworde@eaest.com

Project Name: LANDFILL GAS Puerto Rico Dump, (PRD) Saipan

Project Number: 1487301

P.O. # / Billing Information: P.O.# 9160

Sampler (Print & Sign): Robert Okoniewski / [signature]

Client Sample ID	Laboratory ID Number	Date Collected	Time Collected	Canister ID (Bar code # - AC, SC, etc.)	Flow Controller ID (Bar code # - FC #)	Canister Start Pressure "Hg	Canister End Pressure "Hg/psig	Sample Volume	Analysis Method		Comments e.g. Actual Preservative or specific instructions
LFG-00	1 0.66	6/20/11	1400	SC01065	0A00305	18	0	6L	25C	3C	Quote # 18532
LFG-11	2 0.14	6/20/11	1546	SC00779	0A00222	17	1.5	6L	25C	3C	
LFG-5	3 -0.38	6/20/11	1616	SC00058	0A00270	18	1.0	6L	25C	3C	
LFG-12	4 -0.36	6/20/11	1651	SC00651	0A00353	19	1.0	6L	25C	3C	
LFG-15	5 -0.59	6/20/11	1720	SC00034	0A00693	17	2.0	6L	25C	3C	
LFG-6	6 -0.49	6/21/11	1043	SC00655	0A00305	18	1.0	6L	25C	3C	
	-9.12										
	-8.17										
	-8.15										
	-8.14										
	-7.03										
	-7.50										
	-7.80										
	-7.61										
	-7.14										
	-7.14										
	-6.20										
	-5.63										
	-0.04										

BO

Report Tier Levels - please select
Tier I - Results (Default if not specified) ____
Tier II (Results + QC Summaries) X
Tier III (Results + QC & Calibration Summaries) ____
Tier IV (Data Validation Package) 10% Surcharge ____

EDD required Yes / No
Type: ____

Project Requirements (MRLs, QAPP)

Relinquished by: (Signature) [signature] | Date: 6/22/11 | Time: 1021 BO | Received by: (Signature) [signature] | Date: 6/24/11 | Time: 1050

Relinquished by: (Signature) | Date: | Time: | Received by: (Signature) | Date: | Time:

Cooler / Blank Temperature ____ °C

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Sample Acceptance Check Form

Client: EA Engineering, Science, and Technology   Work order: P1102411

Project: Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301

Sample(s) received on: 6/27/11   Date opened: 6/27/11   by: MZAMORA

Note: This form is used for all samples received by CAS. The use of this form for custody seals is strictly meant to indicate presence/absence and not as an indication of compliance or nonconformity. Thermal preservation and pH will only be evaluated either at the request of the client and/or as required by the method/SOP.

		Yes	No	N/A
1	Were **sample containers** properly marked with client sample ID?	☒	☐	☐
2	Container(s) **supplied by CAS**?	☒	☐	☐
3	Did **sample containers** arrive in good condition?	☒	☐	☐
4	Were **chain-of-custody** papers used and filled out?	☒	☐	☐
5	Did **sample container labels** and/or tags agree with custody papers?	☒	☐	☐
6	Was **sample volume** received adequate for analysis?	☒	☐	☐
7	Are samples within specified holding times?	☒	☐	☐
8	Was proper **temperature** (thermal preservation) of cooler at receipt adhered to?	☐	☐	☒
	Cooler Temperature ______ °C Blank Temperature ______ °C			
9	Was a **trip blank** received?	☐	☒	☐
10	Were **custody seals** on outside of cooler/Box?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
	Were custody seals on outside of sample container?	☐	☒	☐
	Location of seal(s)? ______ Sealing Lid?	☐	☐	☒
	Were signature and date included?	☐	☐	☒
	Were seals intact?	☐	☐	☒
11	Do containers have appropriate **preservation**, according to method/SOP or Client specified information?	☐	☐	☒
	Is there a client indication that the submitted samples are **pH** preserved?	☐	☐	☒
	Were **VOA vials** checked for presence/absence of air bubbles?	☐	☐	☒
	Does the client/method/SOP require that the analyst check the sample pH and if necessary alter it?	☐	☐	☒
12	**Tubes:** Are the tubes capped and intact?	☐	☐	☒
	Do they contain moisture?	☐	☐	☒
13	**Badges:** Are the badges properly capped and intact?	☐	☐	☒
	Are dual bed badges separated and individually capped and intact?	☐	☐	☒

Lab Sample ID	Container Description	Required pH *	Received pH	Adjusted pH	VOA Headspace (Presence/Absence)	Receipt / Preservation Comments
P1102411-001.01	6.0 L Source Can					
P1102411-002.01	6.0 L Source Can					
P1102411-003.01	6.0 L Source Can					
P1102411-004.01	6.0 L Source Can					
P1102411-005.01	6.0 L Source Can					
P1102411-006.01	6.0 L Source Can					

Explain any discrepancies: (include lab sample ID numbers):

Note: 13 of the 19 cans shipped were sent back not to be analyzed.

RSK - MEEPP, HCL (pH<2); RSK - CO2, (pH 5-8); Sulfur (pH>4)

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RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-00**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P1102411-001

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC01065

Date Collected: 6/20/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.41

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.24	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**2.87**	0.24	
7727-37-9	**Nitrogen**	**10.3**	0.24	
630-08-0	Carbon Monoxide	ND	0.24	
74-82-8	**Methane**	**45.5**	0.24	
124-38-9	**Carbon Dioxide**	**41.3**	0.24	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-11** CAS Project ID: P1102411
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301** CAS Sample ID: P1102411-002

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00779

Date Collected: 6/20/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.26

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.23	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**1.28**	0.23	
7727-37-9	**Nitrogen**	**5.78**	0.23	
630-08-0	Carbon Monoxide	ND	0.23	
74-82-8	**Methane**	**50.8**	0.23	
124-38-9	**Carbon Dioxide**	**42.1**	0.23	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-5**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P1102411-003

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00058

Date Collected: 6/20/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.30

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.23	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**3.42**	0.23	
7727-37-9	**Nitrogen**	**12.1**	0.23	
630-08-0	Carbon Monoxide	ND	0.23	
74-82-8	**Methane**	**44.3**	0.23	
124-38-9	**Carbon Dioxide**	**40.2**	0.23	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-12**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P1102411-004

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00651

Date Collected: 6/20/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.32

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.23	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**2.94**	0.23	
7727-37-9	**Nitrogen**	**10.4**	0.23	
630-08-0	Carbon Monoxide	ND	0.23	
74-82-8	**Methane**	**46.1**	0.23	
124-38-9	**Carbon Dioxide**	**40.6**	0.23	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

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RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-15**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P1102411-005

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00034

Date Collected: 6/20/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.36

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.24	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**2.39**	0.24	
7727-37-9	**Nitrogen**	**12.4**	0.24	
630-08-0	Carbon Monoxide	ND	0.24	
74-82-8	**Methane**	**44.5**	0.24	
124-38-9	**Carbon Dioxide**	**40.7**	0.24	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **LFG-6**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P1102411-006

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:
Container ID: SC00655

Date Collected: 6/21/11
Date Received: 6/27/11
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

Canister Dilution Factor: 2.43

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.24	
7782-44-7	**Oxygen +**			
7440-37-1	**Argon**	**3.22**	0.24	
7727-37-9	**Nitrogen**	**11.5**	0.24	
630-08-0	Carbon Monoxide	ND	0.24	
74-82-8	**Methane**	**44.7**	0.24	
124-38-9	**Carbon Dioxide**	**40.6**	0.24	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Sample ID: **Method Blank**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301**

CAS Project ID: P1102411
CAS Sample ID: P110630-MB

Test Code: EPA Method 3C
Instrument ID: HP5890 II/GC1/TCD
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister
Test Notes:

Date Collected: NA
Date Received: NA
Date Analyzed: 6/30/11
Volume(s) Analyzed: 0.10 ml(s)

CAS #	Compound	Result %, v/v	MRL %, v/v	Data Qualifier
1333-74-0	Hydrogen	ND	0.10	
7782-44-7	Oxygen +			
7440-37-1	Argon	ND	0.10	
7727-37-9	Nitrogen	ND	0.10	
630-08-0	Carbon Monoxide	ND	0.10	
74-82-8	Methane	ND	0.10	
124-38-9	Carbon Dioxide	ND	0.10	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

RESULTS OF ANALYSIS

Client: **EA Engineering, Science, and Technology**
Client Project ID: **Landfill Gas Puerto Rico Dump, (PRD) Saipan / 1487301** CAS Project ID: P1102411

Total Gaseous Nonmethane Organics (TGNMO) as Hexane

Test Code: EPA Method 25C
Instrument ID: HP5890 II/GC1/FID/TCA
Analyst: Dante Munoz-Castaneda
Sampling Media: 6.0 L Summa Canister(s)
Test Notes:

Date(s) Collected: 6/20 - 6/21/11
Date Received: 6/27/11
Date Analyzed: 6/29 - 6/30/11

Client Sample ID	CAS Sample ID	Canister Dilution Factor	Injection Volume ml(s)	**Result ppmV**	MRL! ppmV	Data Qualifier
LFG-00	P1102411-001	2.41	0.50	**11**	0.41	
LFG-11	P1102411-002	2.26	0.50	**22**	0.38	
LFG-5	P1102411-003	2.30	0.50	**11**	0.39	
LFG-12	P1102411-004	2.32	0.50	**20**	0.39	
LFG-15	P1102411-005	2.36	0.50	**19**	0.40	
LFG-6	P1102411-006	2.43	0.50	**8.9**	0.41	
Method Blank	P110629-MB	1.00	0.50	ND	0.17	
Method Blank	P110630-MB	1.00	0.50	ND	0.17	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.
MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.
! = For consistency purposes, the actual MRL was divided by six and reported as Hexane.

Appendix C

Marpi Solid Waste Facility Landfill Gas Sampling Results

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September 5, 2018

LA Cert #04140
EPA Methods TO3, TO14A, TO15, 25C/3C, RSK-175

TX Cert T104704450-14-6
EPA Methods TO14A, TO15

UT Cert CA0133332015-3
EPA Methods TO3, TO14A, TO15, RSK-175

EA Engineering, Science & Technology
ATTN: Jason Jaskowiak
1001 Army Dr., Suite 103
Barrigada, Guam 96913

LABORATORY TEST RESULTS

Project Reference: CNMI Landfill Gas Feasability Study; G330601
Lab Number: J082009-01/05

Enclosed are results for sample(s) received 8/20/18 by Air Technology Laboratories. Samples were received intact. Analyses were performed according to specifications on the chain of custody provided with the sample(s).

Report Narrative:

- Samples were received outside the laboratory-established 30-day holding time due to a USPS shipping error. Analyses were performed with client approval.
- Unless otherwise noted in the report, sample analyses were performed within method performance criteria and meet all requirements of the TNI Standards.
- The enclosed results relate only to the sample(s).

Preliminary results were e-mailed to Jason Jaskowiak on 9/04/18.

ATL appreciates the opportunity to provide testing services to your company. If you have any questions regarding these results, please call me at (626) 964-4032.

Sincerely,

Mark Johnson
Operations Manager
MJohnson@AirTechLabs.com

Note: The cover letter is an integral part of this analytical report.

AirTECHNOLOGY Laboratories, Inc.

18501 E. Gale Ave., Suite 130
City of Industry, CA 91748
Ph: 626-964-4032
Fx: 626-964-5832

CHAIN OF CUSTODY RECORD

TURNAROUND TIME: Standard ☐ 48 hours ☐ Same Day ☐ 72 hours ☐ 24 hours ☐ 96 hours ☐ Other: 10-DAY

DELIVERABLES: EDD ☐ EDF ☐ LEVEL 3 ☐ LEVEL 4 ☐

PAGE: 1 **OF** 1

Condition upon receipt: Sealed Yes ☐ No ☐ Intact Yes ☐ No ☐ Chilled ______ deg C

Project No.: G330601
Project Name: CNMI LANDFILL GAS FEASABILITY STUDY
Report To: JASON JASKOWIAK
Company: EA ENGINEERING, SCI., & TECH., PBC
Street: 1001 ARMY DRIVE, SUITE 103
City/State/Zip: BARRIGADA, GUAM 96913
Phone& Fax: 671-646-5231
e-mail: JJASKOWIAK@EAEST.COM

BILLING
P.O. No.: 18034
Bill to: JASON JASKOWIAK
1001 ARMY DRIVE,
STE 103.
BARRIGADA GUAM 96913

ANALYSIS REQUEST

LAB USE ONLY	SAMPLE IDENTIFICATION	SAMPLE DATE	SAMPLE TIME	MATRIX	CONTAINER TYPE	METHOD 25C	NMOC	METHOD 3C	CO_2, NITROGEN, METHANE, OXYGEN		
J082009-01	MARPI-1B-071018	07/10/18	0901	AIR/LFG	SUMMA	X	X	X	X		
-02	MARPI-2A-071018	07/10/18	1203	AIR/LFG	SUMMA	X	X	X	X		
-03	MARPI-3A-071018	07/10/18	1246	AIR/LFG	SUMMA	X	X	X	X		
-04	MARPI-4A-071018	07/10/18	1324	AIR/LFG	SUMMA	X	X	X	X		
-05	MARPI-5B-071018	07/10/18	1422	AIR/LFG	SUMMA	X	X	X	X		

AUTHORIZATION TO PERFORM WORK: T. CHARGUALAF / J. JASKOWIAK	COMPANY: EA	DATE/TIME: 07/10/18 / 0901
SAMPLED BY: TIMOTHY CHARGUALAF 07/11/18, 1550	COMPANY	DATE/TIME
RELINQUISHED BY / DATE/TIME	RECEIVED BY	DATE/TIME: 8/20/18 15:45
RELINQUISHED BY: USPS / DATE/TIME	RECEIVED BY	DATE/TIME: 8/20/18 1500
RELINQUISHED BY / DATE/TIME	RECEIVED BY	DATE/TIME

COMMENTS

METHOD OF TRANSPORT (circle one): Walk-In FedEx UPS Courier ATLI Other ______

DISTRIBUTION: White & Yellow - Lab Copies / Pink - Customer Copy

Preservation: **H**=HCL **N**=None / Container: **B**=Bag **C**=Can **V**=VOA **O**=Other *Rev. 03 - 5/7/09*

Client:	EA Engineering
Attn:	Jason Jaskowiak
Project Name:	CNMI Landfill Gas Feasability Study
Project No.:	G330601
Date Received:	8/20/2018
Matrix:	Air

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

Lab No.:	J082009-01		J082009-02		J082009-03		J082009-04	
Client Sample I.D.:	MARPI-1B-071018		MARPI-2A-071018		MARPI-3A-071018		MARPI-4A-071018	
Date/Time Sampled:	7/10/18 9:01		7/10/18 12:03		7/10/18 12:46		7/10/18 13:24	
Date/Time Analyzed:	8/23/18 22:33		8/24/18 23:32		8/24/18 0:30		8/24/18 1:28	
QC Batch No.:	180823GC8A1		180823GC8A1		180823GC8A1		180823GC8A1	
Analyst Initials:	AS		AS		AS		AS	
Dilution Factor:	3.2		3.0		3.2		3.2	
ANALYTE (Units)	Result	RL	Result	RL	Result	RL	Result	RL
TNMOC N2 corrected (ppmv-C)	1,400	32	1,300	30	850	32	1,600	32
TNMOC O2 corrected (ppmv-C)	1,400	32	1,400	30	890	32	1,600	32
TNMOC uncorrected (ppmv-C)	1,300	32	660	30	440	32	1,500	32
Nitrogen (% v/v)	ND	3.2	37	3.0	35	3.2	ND	3.2
Oxygen (% v/v)	ND	1.6	10	1.5	10	1.6	ND	1.6
Carbon Dioxide (% v/v)	44	0.032	25	0.030	25	0.032	42	0.032
Methane (% v/v)	61	0.0032	36	0.0030	36	0.0032	59	0.0032

RL = Reporting Limit
ND = Not detected at or above the RL.
TNMOC = Total Non-Methane Organic Compounds
ppmv-C = parts per million by volume as carbon
TNMOC N2 corrected (applicable if N2 < 20%)
TNMOC O2 corrected (applicable if N2 > 20% and O2 < 5%)
TNMOC uncorrected = not corrected for N2, O2 or moisture
NA = Nitrogen/oxygen/moisture correction causes division by zero.

Reviewed/Approved By: [signature]
Mark Johnson
Operations Manager

Date 9/4/18

The cover letter is an integral part of this analytical report

Client:	EA Engineering
Attn:	Jason Jaskowiak
Project Name:	CNMI Landfill Gas Feasability Study
Project No.:	G330601
Date Received:	8/20/2018
Matrix:	Air

TNMOC by EPA METHOD 25C
Fixed Gases by EPA METHOD 3C

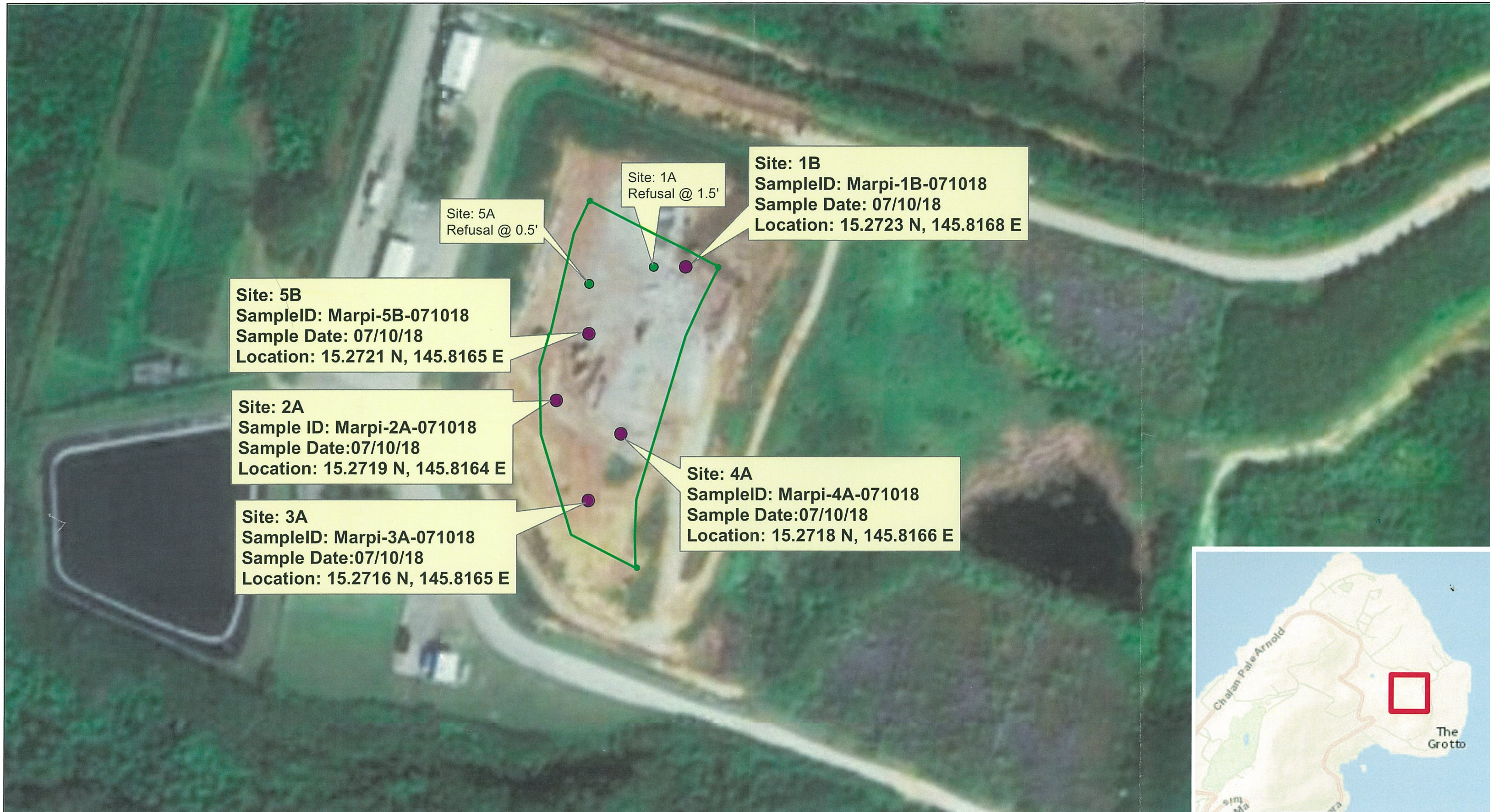
Lab No.:		J082009-05						
Client Sample I.D.:		MARPI-5B-071018						
Date/Time Sampled:		7/10/18 14:22						
Date/Time Analyzed:		8/24/18 2:27						
QC Batch No.:		180823GC8A1						
Analyst Initials:		AS						
Dilution Factor:		3.0						
ANALYTE	(Units)	Result	RL					
TNMOC N2 corrected	(ppmv-C)	1,400	30					
TNMOC O2 corrected	(ppmv-C)	1,400	30					
TNMOC uncorrected	(ppmv-C)	1,300	30					
Nitrogen	(% v/v)	5.9	3.0					
Oxygen	(% v/v)	1.6	1.5					
Carbon Dioxide	(% v/v)	39	0.030					
Methane	(% v/v)	61	0.0030					

RL = Reporting Limit
ND = Not detected at or above the RL.
TNMOC = Total Non-Methane Organic Compounds
ppmv-C = parts per million by volume as carbon
TNMOC N2 corrected (applicable if N2 < 20%)
TNMOC O2 corrected (applicable if N2 > 20% and O2 < 5%)
TNMOC uncorrected = not corrected for N2, O2 or moisture
NA = Nitrogen/oxygen/moisture correction causes division by zero.

Reviewed/Approved By: *[signature]* Date 9/4/18

Mark Johnson
Operations Manager

The cover letter is an integral part of this analytical report



1993 Guam Geodetic Network Transverse_Mercator

Legend

- Top of Cell 1
- Landfill Gas Sample Points

125 62.5 0 125 Feet

N

EA Engineering, Science, and Technology, Inc.
1001 Army Drive, Suite 103,
Barrigada, 96913-1402
Telephone: (671) 646-5231
Facsimile: (671) 646-5230

CNMI Landfill Gas Feasibility Study
Marpi Landfill Saipan, CNMI

Figure 1
Marpi Landfill Gas Sampling Sites

Drawing No. Fig_1_Marpi Landfill	Date: 07/17/18	Drawn By: TCC	EA Project No. 6330601

GC Raw Data Index
General Information

Method: EPA 25C/3C

Lab Project No.: J082009

Conventions and Conversions

1 ppbv = 0.001 ppmv = 0.0000001% v/v
1% v/v = 10,000 ppmv = 10,000,000 ppbv

1 ug/m^3 = 1 ng/L = ppbv x MW/24.45
1 ug/L = 1 mg/m^3 = ppmv x MW/24.45

Where **MW** is the molecular weight of the compound and 24.45 is the molar volume of ideal gas at 1 atmosphere and 25° C.

1 atmosphere = 14.6 psia = 0 psig
30" Hg = 0 psia = -14.6 psig

Standard pressure is taken as 14.6 psia at Air Technology Labs' facility.

1. Supporting Documents

a. Pressurization log (if applicable)

b. ICAL run log

c. CCAL/QC/Samples run log

d. Miscellaneous documents

PRESSURIZATION LOGBOOK

	Date	Sample ID	Can #	Initial Pressure	Final Pressure	Dilution Gas	Dilution Gas Lot #	Initials	ETR #	Client/ Comments	He Prefill
1	8/21/13	J082105-01	3129	6" Hg	10psig	He	165M3188	HM	8895	WEAVER	YES
2	↓	↓ -02	3165	6" Hg	↓	↓	↓	↓	↓	↓	↓
3	8/21/13	J082009-01	3143	5" Hg	10psig	He	165M3188	HM	8849	EA ENG	YES
4		-02	1473	4" Hg							
5		-03	5435	5" Hg							
6		-04	5481	5" Hg							
7	↓	↓ -05	1468	4" Hg	↓	↓	↓	↓	↓	↓	↓
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											

Approved by/Date:__________

Air Technology Laboratories Inc.

Logbook #17

GC Injection Logbook

ment ID: GC 8A

lytical Method: nmocfixed_160711(ical), nmreocfixed_160711(ical)

afile Directory: GC8A\2016\Jul

Chemist: AS

Blank Lot #: 071593139

Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
7/11/16	1020	08Jul031	0.0001% CH4 CO2 CO	AW1216711	STD Loop	—	—	1.0	1	ok	FID ical. nmoc	160711GC8A1
	1035	032	0.001% CH4 CO2 CO	AW121672K					2			
	1049	033	0.01% CH4 CO2 CO	AW1216709					3			
	1104	034	0.1% CH4 CO2 CO	AW1216708					4			
	1119	035	0.5% CH4 CO2 CO	AW1216707					5			
	1133	036	1.0% CH4 CO2 CO	AS014319					6			
	1153	11Jul	0.0001% CH4 CO2 CO	AW1216711					1	ok	FID ical. nmneoc	
	1212	11Jul 001	0.001% CH4 CO2 CO	AW1216710					2			
	1232	002	0.01% CH4 CO2 CO	AW1216709					3			
	1251	003	0.1% CH4 CO2 CO	AW1216708					4			
	1311	004	0.5% CH4 CO2 CO	AW1216707					5			
	1330	005	1.0% CH4 CO2 CO	AS014351					6			
	1357	006	5% CH4 CO2	AW1216712					7	ok		
	1417	007	25% CH4 CO2	AW1216713					8			
	1426	008	50% CH4 CO2	AW1216714					9			
	1441	009	100% CO2	AS014807					10			
	1456	010	100% CH4	AS014808					11			
	1518	011	1% H2 .44% O2 1.5% N2	AW1216715					13	ok		
	1533	012	5% H2 2.2% O2 7.5% N2	AW1216716					14			
	1547	013	7% H2 11% O2 39% N2	AW1216717					15			

Approved by/Date:__________

Air Technology Laboratories, Inc.

GC Injection Logbook

Instrument ID: GC 8A

Analytical Method: nmocfixed_160711(cal), nmnecfixed_160711

Datafile Directory: GC8A\2016\Jul

Chemist: AS

Blank Lot #: 071593139

Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
11/16	1602	11Jul014	10% H_2	AW1216718	STD 400	-	-	1.0	16	ok		160711GC8A1
	1617	015	22% O_2, 78% N_2	AS 7/11/16 AW —					11			
	1631	016	2.5% H_2	AW1216719					1			
	1646	017	100% N_2	AS 7/11/16 AJ 1606 0257					2			
	1700	018	ICV	AW1216720					3	ok	wrong std NR	
	1715	019	ICV						3			
12/16	1122	12Jul ~~020~~	ICV (nmoc)	AS014809					3	ok		
	1138	12Jul001 ~~021~~	ICV TCD (nmnec)	AS014809					3	ok		
	1159	002 ~~022~~	ICV FID (nmnec)	AW1216801					3	ok		

Air Technology Laboratories, Inc.

Approved by/Date:__________

ment ID: GC 8A

GC Injection Logbook

Chemist: AS
Blank Lot #: 1699646603

ical Method: nmoc.fixed_160711
ifile Directory: GC8A\2016\Aug

ate	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
12/16	1114	12aug012	H081002-02	Pdutech	STD LOOP	–	–	1.0	10	ok.	conc NR	160812GC8A1
	1128	013	-03						11			
	1143	014	-04						13			
	1215	015	-05						14			
	1229	016	H081102-01	TA					15	ok		
	1244	017	H081006-01	AEC					16	ok		
	1258	018	H081105-01	Wauer		see log		3.159	9	ok		
	1313	019	-02					3.014	10			
	1328	020	H081201-01	TA				1.743	11	ok	-02 file not gen!	
	1357	021	O2N2 CCV	–		–		1.0	1	ok	NR	
	1412	022	0.1% CH4CO2CO	AW1217106					1	No	line	
	1426	023	25% CH4CO2 7% H2	AW1217107					4	ok	NR	
	1441	024	0.1% CH4CO2CO	AW1217106					3	ok	NR	
	1456	025	blank	–					16	ok	NR	
	08/13/16 1510	026	blank	–								
	1528	027	1% N2 LOQ	AW1217415					16	ok		
	1551	028	1% N2 LOQ	AW1217415							NR	
	1608	029	H081201-02	TA		see log		1.743	10	ok		
	1622	030	0.1% CH4CO2CO	AW1217106		–		1.0	3	ok		
	1637	031	25% CH4CO2 7% H2	AW1217107					4			
	1652	032	O2N2 CCV	–								

Air Technology Laboratories, Inc.

Approved by/Date:__________

GC8A Logbook #38

Instrument ID: GC 8A

Analytical Method: nmocfixed_180627 (ical)

Datafile Directory: GC8A \2018 \ Jun

GC Injection Logbook

Chemist: AS

Blank Lot #: 0610802

Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
6/27/18	1138	27Jun011	30ppmv nmoc	AW1308804	Std Loop	-	-	1.0	1	ok	NR	180627GC8A1
	1152	012										
	1207	013										
	1222	014	300ppmv nmoc	AW1308803					2	ok	ical ✓	
	1236	015										
	1251	016										
	1305	017	3000ppmv nmoc	AW1308802					3	ok		
	1320	018								No	file error	
	1346	019								ok	ical ✓	
	1400	020										
	1415	021										
	1432	022	30ppmv nmoc	AW1308805					1	ok		
	1447	023										
	1552	024										
	1606	025									ical ✓	
	1621	026										
	1635	027										
	1650	028	9999ppmv nmoc	AW1308801					4	ok	ical ✓	
	1704	029										
	1719	030										

Air Technology Laboratories, Inc.

Approved by/Date:__________

GC8A Logbook #44

Instrument ID: GC 8A

Analytical Method: nmocfixed_180627

Datafile Directory: GC8A\2018\Jun

GC Injection Logbook

Chemist: AS

Blank Lot #: 0610802

Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
6/27/18	1734	27Jun031	300ppmv nmoc	ASC14909	Std Loop	—	-	1.0	5	ok	ICV	180627GC8A1

Approved by/Date:_________

Air Technology Laboratories, Inc.

Instrument ID: GC 8A

GC Injection Logbook

Chemist: AS

Analytical Method: nmoc fixed_180627

Blank Lot #: 610802

Datafile Directory: \\AIRTECH-SERVER\InsData\GC8A\2018\Aug

	Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
1	08/23/18	13:47	ug\23aug	O2_N2_CCV	-	Std Loop	None	None	1	2-1	ok		180823GC8A1
2	08/23/18	14:02	23aug001	0.1%_CH4_CO2_CO	AW1309720	Std Loop	None	None	1	2-2			180823GC8A1
3	08/23/18	14:17	23aug002	25%_CH4_CO2_7%_H2	AW1309718	Std Loop	None	None	1	2-3			180823GC8A1
4	08/23/18	14:31	23aug003	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180823GC8A1
5	08/23/18	14:46	23aug004	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180823GC8A1
6	08/23/18	15:00	23aug005	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180823GC8A1
7	08/23/18	15:15	23aug006	LCS	AS014809	Std Loop	None	None	1	2-5	ok		180823GC8A1
8	08/23/18	15:29	23aug007	LCSD	AS014809	Std Loop	None	None	1	2-5			180823GC8A1
9	08/23/18	15:44	23aug008	Method Blank	-	Std Loop	None	None	1	2-6	NO	c/e	180823GC8A1
10	08/23/18	15:58	23aug009	Method Blank	-	Std Loop	None	None	1	2-6	ok		180823GC8A1
11	08/23/18	16:13	23aug010	J082302-01	HALL	Std Loop	None	None	1	2-7	ok		180823GC8A1
12	08/23/18	16:28	23aug011	J082301-01	TA	Std Loop	None	None	1	2-8	ok		180823GC8A1
13	08/23/18	16:42	23aug012	J082007-01	FOTH	Std Loop	see log	None	2.973	2-9	ok		180823GC8A1
14	08/23/18	16:57	23aug013	J082007-02	FOTH	Std Loop	see log	None	2.973	2-10			180823GC8A1
15	08/23/18	17:11	23aug014	J082007-03	FOTH	Std Loop	see log	None	2.973	2-11			180823GC8A1
16	08/23/18	17:26	23aug015	J082007-04	FOTH	Std Loop	see log	None	3.159	2-12			180823GC8A1
17	08/23/18	17:41	23aug016	J082002-03	SCS	Std Loop	see log	None	1	4,	ok		180823GC8A1
18	08/23/18	17:55	23aug017	J082002-03	SCS	Std Loop	see log	None	1	4,			180823GC8A1
19	08/23/18	18:10	23aug018	J082002-03	SCS	Std Loop	see log	None	1	4,			180823GC8A1
20	08/23/18	18:24	23aug019	J082002-03	SCS	Std Loop	see log	None	1	4,			180823GC8A1

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Air Technology Laboratories, Inc.
GC 8A Log# 45

Page ______ of 200

GC Injection Logbook

Instrument ID: GC 8A

Chemist: AS

Analytical Method: nmoc fixed_180627

Blank Lot #: 610802

Datafile Directory: \\AIRTECH-SERVER\InsData\GC8A\2018\Aug

	Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
1	08/23/18	18:39	23aug020	J082002-04	SCS	Std Loop	See Log	None	1	5,	NO	RSD > 5 (Hold)	180823GC8A1
2	08/23/18	18:54	23aug021	J082002-04	SCS	Std Loop	See Log	None	1	5,			180823GC8A1
3	08/23/18	19:08	23aug022	J082002-04	SCS	Std Loop	See Log	None	1	5,			180823GC8A1
4	08/23/18	19:23	23aug023	J082002-04	SCS	Std Loop	See Log	None	1	5,			180823GC8A1
5	08/23/18	19:38	23aug024	J082002-12	SCS	Std Loop	See Log	None	1	13,	ok		180823GC8A1
6	08/23/18	19:52	23aug025	J082002-12	SCS	Std Loop	See Log	None	1	13,			180823GC8A1
7	08/23/18	20:07	23aug026	J082002-12	SCS	Std Loop	See Log	None	1	13,			180823GC8A1
8	08/23/18	20:21	23aug027	J082002-12	SCS	Std Loop	See Log	None	1	13,			180823GC8A1
9	08/23/18	20:36	23aug028	J082002-13	SCS	Std Loop	See Log	None	1	14,			180823GC8A1
10	08/23/18	20:51	23aug029	J082002-13	SCS	Std Loop	See Log	None	1	14,			180823GC8A1
11	08/23/18	21:05	23aug030	J082002-13	SCS	Std Loop	See Log	None	1	14,			180823GC8A1
12	08/23/18	21:20	23aug031	J082002-13	SCS	Std Loop	See Log	None	1	14,			180823GC8A1
13	08/23/18	21:35	23aug032	J082002-14	SCS	Std Loop	See Log	None	1	15,	No	RSD > 5	180823GC8A1
14	08/23/18	21:49	23aug033	J082002-14	SCS	Std Loop	See Log	None	1	15,			180823GC8A1
15	08/23/18	22:04	23aug034	J082002-14	SCS	Std Loop	See Log	None	1	15,			180823GC8A1
16	08/23/18	22:19	23aug035	J082002-14	SCS	Std Loop	See Log	None	1	15,			180823GC8A1
17	08/23/18	22:33	23aug036	J082009-01	EA	Std Loop	See Log	None	1	7,	ok		180823GC8A1
18	08/23/18	22:48	23aug037	J082009-01	EA	Std Loop	See Log	None	1	7,			180823GC8A1
19	08/23/18	23:02	23aug038	J082009-01	EA	Std Loop	See Log	None	1	7,			180823GC8A1
20	08/23/18	23:17	23aug039	J082009-01	EA	Std Loop	See Log	None	1	7,			180823GC8A1

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GC Injection Logbook

Instrument ID: GC 8A

Analytical Method: nmoc fixed_180627

Datafile Directory: \\AIRTECH-SERVER\InsData\GC8A\2018\Aug

Chemist: AS

Blank Lot #: 610802

	Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
1	08/23/18	23:32	23aug040	J082009-02	EA	Std Loop	See Log	None	1	8,	ok		180823GC8A1
2	08/23/18	23:46	23aug041	J082009-02	EA	Std Loop	See Log	None	1	8,			180823GC8A1
3	08/24/18	0:01	23aug042	J082009-02	EA	Std Loop	See Log	None	1	8,			180823GC8A1
4	08/24/18	0:15	23aug043	J082009-02	EA	Std Loop	See Log	None	1	8,			180823GC8A1
5	08/24/18	0:30	23aug044	J082009-03	EA	Std Loop	See Log	None	1	9,			180823GC8A1
6	08/24/18	0:45	23aug045	J082009-03	EA	Std Loop	See Log	None	1	9,			180823GC8A1
7	08/24/18	0:59	23aug046	J082009-03	EA	Std Loop	See Log	None	1	9,			180823GC8A1
8	08/24/18	1:14	23aug047	J082009-03	EA	Std Loop	See Log	None	1	9,			180823GC8A1
9	08/24/18	1:28	23aug048	J082009-04	EA	Std Loop	See Log	None	1	10,			180823GC8A1
10	08/24/18	1:43	23aug049	J082009-04	EA	Std Loop	See Log	None	1	10,			180823GC8A1
11	08/24/18	1:58	23aug050	J082009-04	EA	Std Loop	See Log	None	1	10,			180823GC8A1
12	08/24/18	2:12	23aug051	J082009-04	EA	Std Loop	See Log	None	1	10,			180823GC8A1
13	08/24/18	2:27	23aug052	J082009-05	EA	Std Loop	See Log	None	1	11,			180823GC8A1
14	08/24/18	2:41	23aug053	J082009-05	EA	Std Loop	See Log	None	1	11,			180823GC8A1
15	08/24/18	2:56	23aug054	J082009-05	EA	Std Loop	See Log	None	1	11,			180823GC8A1
16	08/24/18	3:11	23aug055	J082009-05	EA	Std Loop	See Log	None	1	11,			180823GC8A1
17													
18													
19													
20													AS 8/24/18

Approved by/Date ______

Air Technology Laboratories, Inc.
GC 8A Log# 45

Page ______ of 200

J082009

Instrument ID: GC 8A

GC Injection Logbook

Chemist: AS

Analytical Method: nmoc fixed_180627, nmneoc fixed_160711bu

Blank Lot #: 610802

Datafile Directory: \\AIRTECH-SERVER\InsData\GC8A\2018\Aug

	Date	Time	Data File	Lab Number/ Standard Type	Client/ Std Code	Sample Volume	Press. Dilution	Sample dilution	DF	Line #	Status	Comments	QC Batch
1	08/24/18	3:25	23aug056	O2_N2_CCV	-	Std Loop	None	None	1	2-1	ok		180824GC8A1
2	08/24/18	3:40	23aug057	0.1%_CH4_CO2_CO	AW1309720	Std Loop	None	None	1	2-2			180824GC8A1
3	08/24/18	3:55	23aug058	25%_CH4_CO2_7%_H2	AW1309718	Std Loop	None	None	1	2-3			180824GC8A1
4	08/24/18	4:09	23aug059	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180824GC8A1
5	08/24/18	4:24	23aug060	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180824GC8A1
6	08/24/18	4:38	23aug061	300_PPMV_NMOC	AS014909	Std Loop	None	None	1	2-4			180824GC8A1
7	08/24/18	8:24	ug\24aug	0.1%_CH4_CO2_CO+	AW1309720	Std Loop	None	None	1	1,			180824GC8A1
8	08/24/18	8:43	24aug001	LCS	AS014809	Std Loop	None	None	1	2-5	ok		180824GC8A1
9	08/24/18	8:58	24aug002	LCSD	AS014809	Std Loop	None	None	1	2-5			180824GC8A1
10	08/24/18	9:13	24aug003	C2_LCS	AW1309810	Std Loop	None	None	1	2,			180824GC8A1
11	08/24/18	9:33	24aug004	C2_LCSD	AW1309810	Std Loop	None	None	1	2,			180824GC8A1
12	08/24/18	9:53	24aug005	METHOD	BLANK	Std Loop	None	None	1	6,	No	qe	180824GC8A1
13	08/24/18	10:21	24aug006	METHOD	BLANK	Std Loop	None	None	1	6,	ok		180824GC8A1
14	08/24/18	10:51	24aug007	J081403-01	GOLDER	Std Loop	see log	None	2.295	9,	ok		180824GC8A1
15	08/24/18	11:10	24aug008	J081403-02	GOLDER	Std Loop	see log	None	2.295	10,			180824GC8A1
16	08/24/18	11:30	24aug009	J081403-03	GOLDER	Std Loop	see log	None	2.295	11,			180824GC8A1
17	08/24/18	11:49	24aug010	J081403-04	GOLDER	Std Loop	see log	None	2.407	12,			180824GC8A1
18	08/24/18	12:09	24aug011	J081403-05	GOLDER	Std Loop	see log	None	2.193	13,			180824GC8A1
19	08/24/18	12:28	24aug012	J081403-06	GOLDER	Std Loop	see log	None	2.193	14,			180824GC8A1
20	08/24/18	12:48	24aug013	J081403-07	GOLDER	Std Loop	see log	None	2.193	15,			180824GC8A1

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Air Technology Laboratories, Inc.
GC 8A Log# 45

Page ______ of 200

2. Sample Raw Data

a. Calculations (if applicable)

b. Chromatograms/Results

CALCULATIONS

Normalized? NO

	Variable	J082009-01	J082009-02	J082009-03	J082009-04
Moisture content, fraction	B_w	0.03123	0.03123	0.03123	0.03123
Calculated NMOC N2 corr. concentration, ppmv C	C_t	1378.7	1311.4	850.6	1576.8
Calculated NMOC O2 corr. concentration, ppmv C	C_t	1384.1	1385.3	894.5	1562.2
Uncorr NMOC concentration, ppmv C	C_t	1288.2	657.5	441.2	1479.4
Calculated N2 concentration, fraction	C_{N2}	0.02708	0.36825	0.35460	0.02407
Measured N2 concentration, fraction		0.00838	0.12109	0.10974	0.00745
Calculated O2 concentration, fraction	Cox	0.00807	0.10482	0.10086	0.00461
Measured O2 concentration, fraction		0.00250	0.03447	0.03121	0.00143
measured NMOC concentration, ppmv C	C_{tm1}	414.0	224.7	141.4	472.6
measured NMOC concentration, ppmv C	C_{tm2}	411.3	223.0	141.5	472.7
measured NMOC concentration, ppmv C	C_{tm3}	409.3	221.8	139.9	472.5
barometric pressure, mm Hg	P_b	762.0	762.0	762.0	762.0
gas sample tank pressure before sampling, mm Hg	P_{ti}	228.59	228.59	228.59	228.59
gas sample tank pressure at completion of sampling, mm Hg	P_t	634.98	660.38	634.98	634.98
final gas sample tank pressure after pressurization, mm Hg	P_{tf}	1272.13	1272.13	1272.13	1272.13
vapor pressure of H2O, mm Hg	P_w	23.8	23.8	23.8	23.8
sample tank temperature before sampling, oK	T_{ti}	297.0	297.0	297.0	297.0
sample tank temperature at completion of sampling, oK	T_t	297.0	297.0	297.0	297.0
sample tank temperature after pressurization, oK	T_{tf}	297.0	297.0	297.0	297.0
Sample tank temperature in field, oC		25.0	25.0	25.0	25.0
total number of analyzer injections	r	3	3	3	3
barometric pressure, inches Hg		30	30	30	30
sample temp in field before sampling, oF		75	75	75	75
sample temp in field after sampling, oF		75	75	75	75
Sample pressure prior to sampling, inches Hg		-21	-21	-21	-21
Sample pressure after sampling, inches Hg		-5.0	-4.0	-5.0	-5.0
Sample pressure after pressurization, psia		24.6	24.6	24.6	24.6
Sample temp after pressurization, oF		75	75	75	75

			SAMPLE1		SAMPLE2		SAMPLE3		SAMPLE4
	NMOC RUN1		414.0		224.7		141.4		472.6
	NMOC RUN2		411.3		223.0		141.5		472.7
	NMOC RUN3		409.3		221.8		139.9		472.5
	NMOC DATAFILE1								
	NMOC DATAFILE2								
	NMOC DATAFILE3								
	NMOC TIME/DATE1	22:33	08/23/18	23:32	08/23/18	0:30	08/24/18	1:28	08/24/18
	NMOC TIME/DATE2	22:48	08/23/18	23:46	08/23/18	0:45	08/24/18	1:43	08/24/18
	NMOC TIME/DATE3	23:02	08/23/18	0:01	08/24/18	0:59	08/24/18	1:58	08/24/18
	RESULT RSD		0.58		0.64		0.65		0.02
	NITROGEN RUN1		0.839		12.119		10.986		0.749
	NITROGEN RUN2		0.838		12.099		10.962		0.740
	OXYGEN RUN1		0.251		3.448		3.125		0.143
	OXYGEN RUN2		0.249		3.445		3.118		0.142
	3C DATAFILE1								
	3C DATAFILE2								
	3C TIME/DATE	23:02	08/23/18	0:01	08/24/18	0:59	08/24/18	1:58	08/24/18
	3C TIME/DATE	23:17	08/23/18	0:15	08/24/18	1:14	08/24/18	2:12	08/24/18
	N2 RSD		0.12		0.17		0.23		1.18
	O2 RSD		0.72		0.11		0.23		0.75
	Carbon Dioxide Run 1		13.485		8.193		7.741		13.098
	Carbon Dioxide Run 2		13.537		8.212		7.699		13.055
	CO2 RSD		0.39		0.23		0.55		0.33
Measured CO2 concentration fraction			0.13511		0.08202		0.07720		0.13076
Calculated CO2 concentration, fraction			0.43657		0.24944		0.24945		0.42253
	Methane Run 1		18.773		11.794		11.032		18.308
	Methane Run 2		18.729		11.808		11.008		18.257
	CH4 RSD		0.23		0.12		0.22		0.28
Measured CH4 concentration fraction			0.18751		0.11801		0.11020		0.18282
Calculated CH4 concentration, fraction			0.60590		0.35889		0.35608		0.59076
	Carbon Monoxide Run 1		0.0000370		0.0005350		0.0004410		0.0000140
	Carbon Monoxide Run 2		0.0000350		0.0004940		0.0004400		0.0000150
	CO RSD		5.56		7.97		0.23		6.90
Measured CO concentration fraction			0.00000		0.00001		0.00000		0.00000
Calculated CO concentration fraction			0.00000		0.00002		0.00001		0.00000
	Hydrogen Run 1		0		0.218306		0.188295		0.247941
	Hydrogen Run 2		0		0.258007		0.19413		0.192255
	H2 RSD		#DIV/0!		16.67		3.05		25.30
Measured H2 concentration fraction			0.00000		0.00238		0.00191		0.00220
Calculated H2 concentration fraction			0.00000		0.00724		0.00618		0.00711

$$B_w = \frac{P_w}{P_b}$$

OK?	J082009-01		J082009-02	J082009-03	J082009-04
CLOSURE	1.10885	0.00	1.11990	1.09843	1.08031

$N2\_correction$

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \bullet \frac{1}{(1 - B_w - 99/78 * C_{N2})r} \sum_{j=1}^{r} C_{tm(j)}$$

$O2\_correction$

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \bullet \frac{1}{(1 - B_w - 99/21 * C_{Ox})r} \sum_{j=1}^{r} C_{tm(j)}$$

CALCULATIONS

	Normalized? NO	Variable	J082009-05
Moisture content, fraction		B_w	0.03123
Calculated NMOC N2 corr. concentration, ppmv C		C_t	1427.9
Calculated NMOC O2 corr. concentration, ppmv C		C_t	1429.3
Uncorr NMOC concentration, ppmv C		C_t	1276.8
Calculated N2 concentration, fraction		C_{N2}	0.05881
Measured N2 concentration, fraction			0.01934
Calculated O2 concentration, fraction		Cox	0.01601
Measured O2 concentration, fraction			0.00526
measured NMOC concentration, ppmv C		C_{tm1}	433.9
measured NMOC concentration, ppmv C		C_{tm2}	432.7
measured NMOC concentration, ppmv C		C_{tm3}	433.5
barometric pressure, mm Hg		P_b	762.0
gas sample tank pressure before sampling, mm Hg		P_{ti}	228.59
gas sample tank pressure at completion of sampling, mm Hg		P_t	660.38
final gas sample tank pressure after pressurization, mm Hg		P_{tf}	1272.13
vapor pressure of H2O, mm Hg		P_w	23.8
sample tank temperature before sampling, oK		T_{ti}	297.0
sample tank temperature at completion of sampling, oK		T_t	297.0
sample tank temperature after pressurization, oK		T_{tf}	297.0
Sample tank temperature in field, oC			25.0
total number of analyzer injections		r	3
barometric pressure, inches Hg			30
sample temp in field before sampling, oF			75
sample temp in field after sampling, oF			75
Sample pressure prior to sampling, inches Hg			-21
Sample pressure after sampling, inches Hg			-4.0
Sample pressure after pressurization, psia			24.6
Sample temp after pressurization, oF			75

			SAMPLE1
	NMOC RUN1		433.9
	NMOC RUN2		432.7
	NMOC RUN3		433.5
	NMOC DATAFILE1		
	NMOC DATAFILE2		
	NMOC DATAFILE3		
	NMOC TIME/DATE1	2:27	08/24/18
	NMOC TIME/DATE2	2:41	08/24/18
	NMOC TIME/DATE3	2:56	08/24/18
	RESULT RSD		0.14
	NITROGEN RUN1		1.983
	NITROGEN RUN2		1.884
	OXYGEN RUN1		0.539
	OXYGEN RUN2		0.513
	3C DATAFILE1		
	3C DATAFILE2		
	3C TIME/DATE	2:41	08/24/18
	3C TIME/DATE	2:56	08/24/18
	N2 RSD		5.15
	O2 RSD		4.98
	Carbon Dioxide Run 1		13.194
	Carbon Dioxide Run 2		12.739
	CO2 RSD		3.51
Measured CO2 concentration fraction			0.12967
Calculated CO2 concentration, fraction			0.39435
	Methane Run 1		20.368
	Methane Run 2		19.651
	CH4 RSD		3.58
Measured CH4 concentration fraction			0.20010
Calculated CH4 concentration, fraction			0.60854
	Carbon Monoxide Run 1		0.0000700
	Carbon Monoxide Run 2		0.0000720
	CO RSD		2.82
Measured CO concentration fraction			0.00000
Calculated CO concentration fraction			0.00000
	Hydrogen Run 1		0.240271
	Hydrogen Run 2		0
	H2 RSD		200.00
Measured H2 concentration fraction			0.00120
Calculated H2 concentration fraction			0.00365

$$\boxed{B_w = \frac{P_w}{P_b}}$$

OK? J082009-05

CLOSURE 1.11259

$N2\_correction$

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \bullet \frac{1}{(1 - B_w - 99/78 * C_{N2})r} \sum_{j=1}^{r} C_{tm(j)}$$

$O2\_correction$

$$C_t = \frac{\frac{P_{tf}}{T_{tf}}}{\frac{P_t}{T_t} - \frac{P_{ti}}{T_{ti}}} \bullet \frac{1}{(1 - B_w - 99/21 * Cox)r} \sum_{j=1}^{r} C_{tm(j)}$$

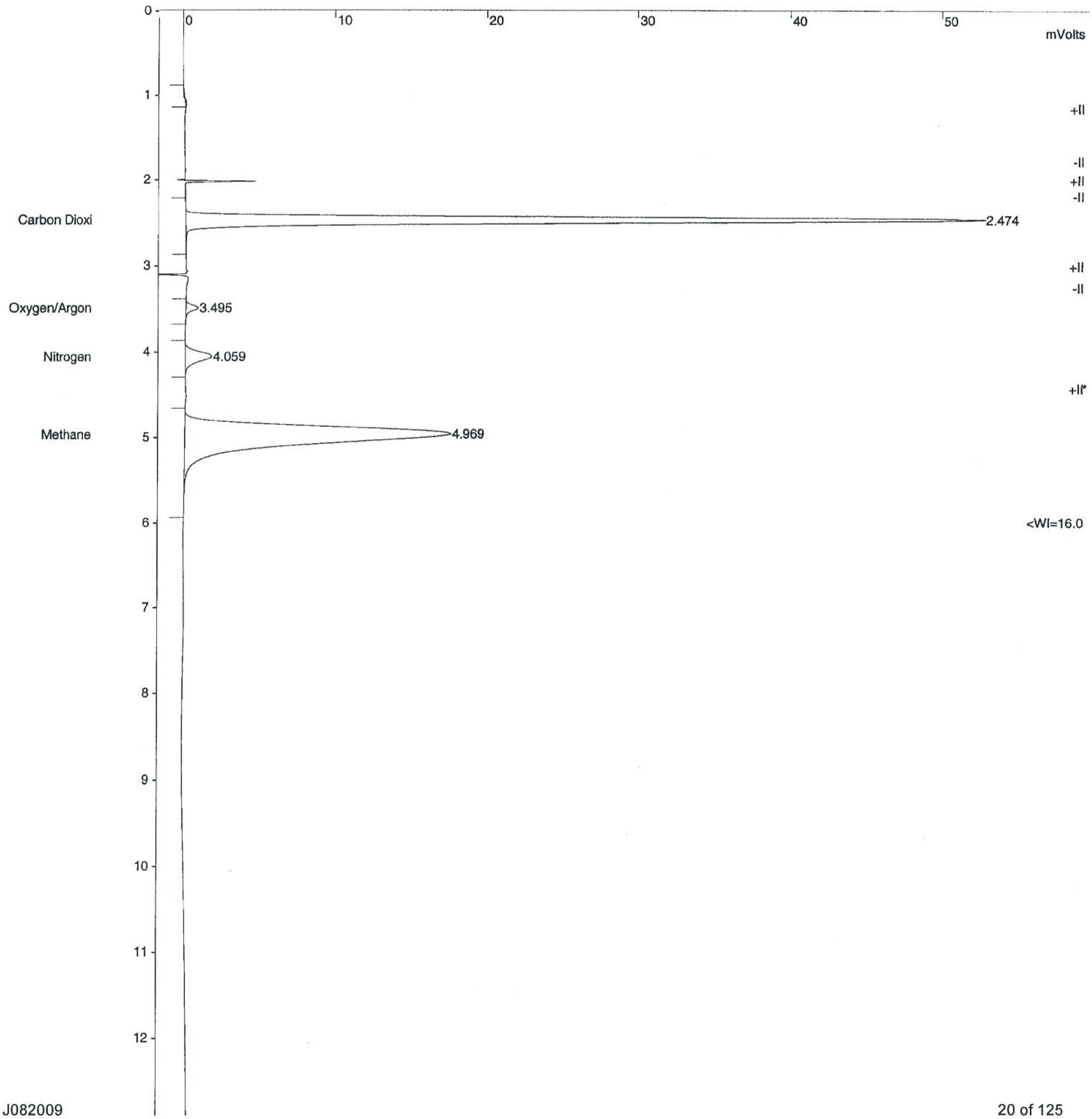
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug036.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-01 EA ENG

Injection Date: 8/23/2018 22:33     Calculation Date: 8/23/2018 22:46

Operator    : AS                      Detector Type: 3800 (10 Volts)
Workstation: DATAPART1                Bus Address  : 44
Instrument : GC8A                     Sample Rate  : 10.00 Hz
Channel     : Front = TCD             Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 25          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 22:46:42 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug036.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 22:33 Calculation Date: 8/23/2018 22:46

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen		1.930					M
2	Carbon Dioxi	13.532410	2.474	0.029	251934	BB	4.5	
3	Oxygen/Argon	0.258808	3.495	-0.002	3768	BB	4.3	
4	Nitrogen	0.872802	4.059	-0.007	13454	BB	7.4	
5	Methane	18.809752	4.969	-0.028	243057	BB	12.4	
	Totals:	33.473772		-0.008	512213			

106% ✓

Status Codes:
M - Missing peak

Total Unidentified Counts : 0 counts

Detected Peaks: 5 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 17 microVolts LSB: 1 microVolts

Noise (used): 7 microVolts - monitored before this run

Manual injection

Revision Log:

8/23/2018 22:46: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 22:31:48

Original Notes:

****

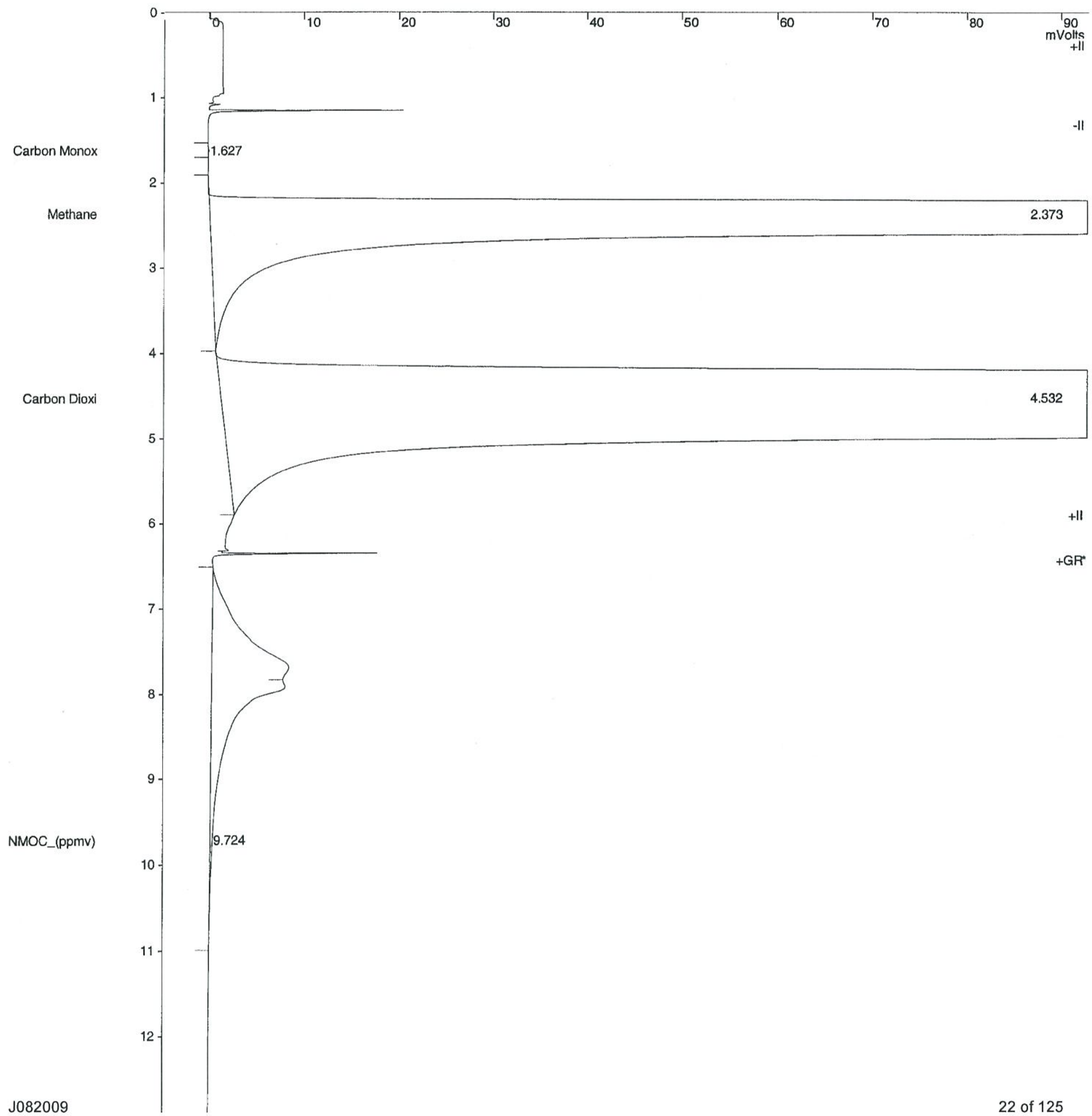
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug036.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-01 EA ENG

Injection Date: 8/23/2018 22:33    Calculation Date: 8/23/2018 22:46

Operator    : AS                  Detector Type: 3800 (10 Volts)
Workstation: DATAPART1            Bus Address  : 44
Instrument : GC8A                 Sample Rate  : 10.00 Hz
Channel     : Middle = FID        Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 22:46:43 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug036.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 22:33 Calculation Date: 8/23/2018 22:46

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000031	1.627	0.049	320	BV	4.6	
2	Methane	11.982968	2.373	0.001	124053872	PP	11.6	C
3	Carbon Dioxi	14.417774	4.532	-0.031	148408720	PB	18.6	C
4	NMOC_(ppmv)	413.998077	9.724	0.001	492356	GR	0.0	C
	Totals:	440.398850		0.020	272955268			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 259 counts

Detected Peaks: 6 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -89 microVolts LSB: 1 microVolts

Noise (used): 10 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/23/2018 22:46: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 22:31:48

Original Notes:

****

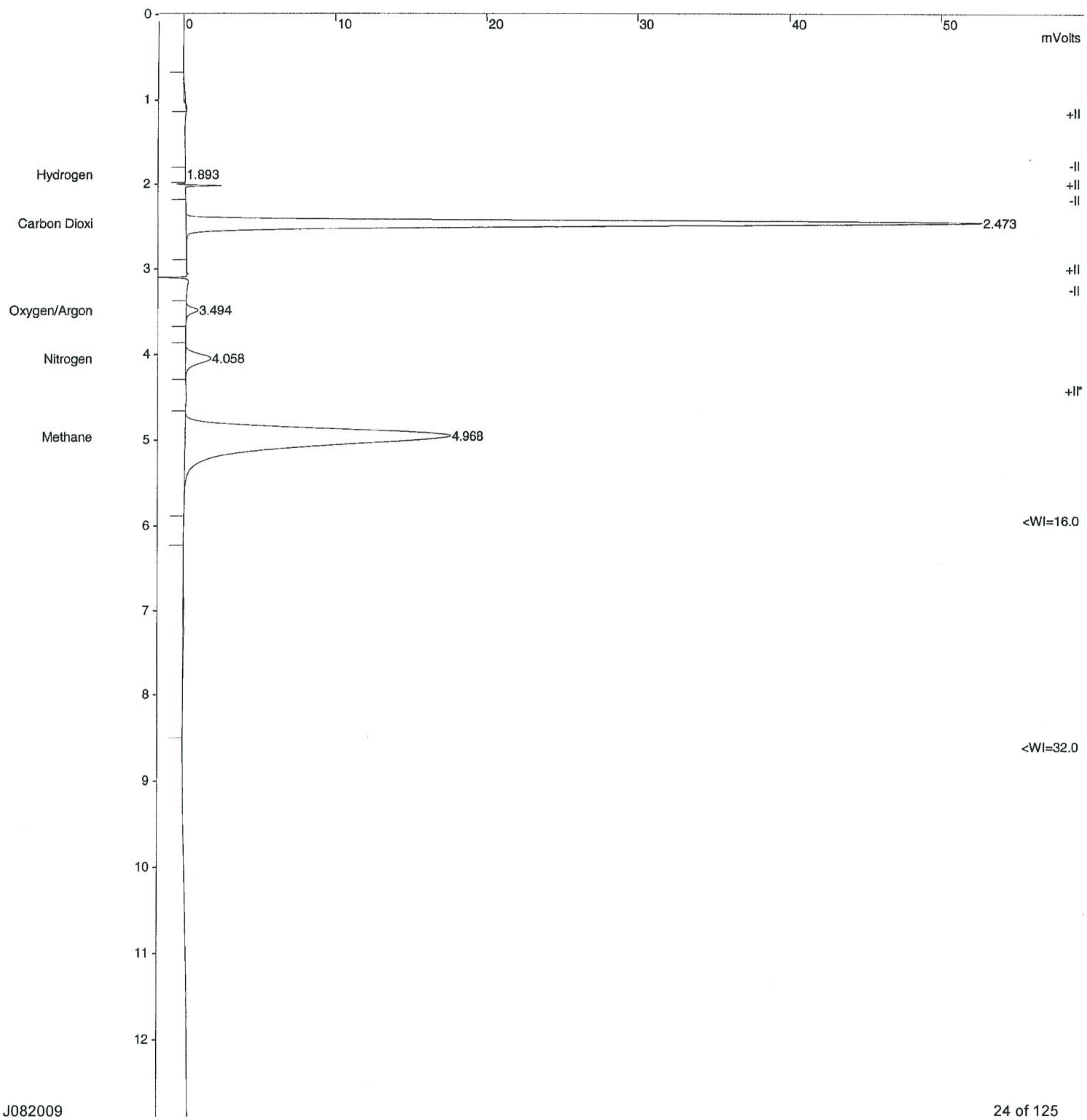
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug037.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-01 EA ENG

Injection Date: 8/23/2018 22:48    Calculation Date: 8/23/2018 23:01

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Front = TCD           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 25         Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:01:18 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug037.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 22:48 Calculation Date: 8/23/2018 23:01

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.200904	1.893	-0.037	48	BB	4.2	
2	Carbon Dioxi	13.485770	2.473	0.028	251066	BB	4.5	
3	Oxygen/Argon	0.253982	3.494	-0.003	3698	BB	4.3	
4	Nitrogen	0.844585	4.058	-0.008	13019	BB	7.3	
5	Methane	18.747854	4.968	-0.029	242258	BB	12.4	
	Totals:	33.533095		-0.049	510089			

Total Unidentified Counts : 4833 counts

Detected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 14 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/23/2018 23:01: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 22:46:27

Original Notes:

****

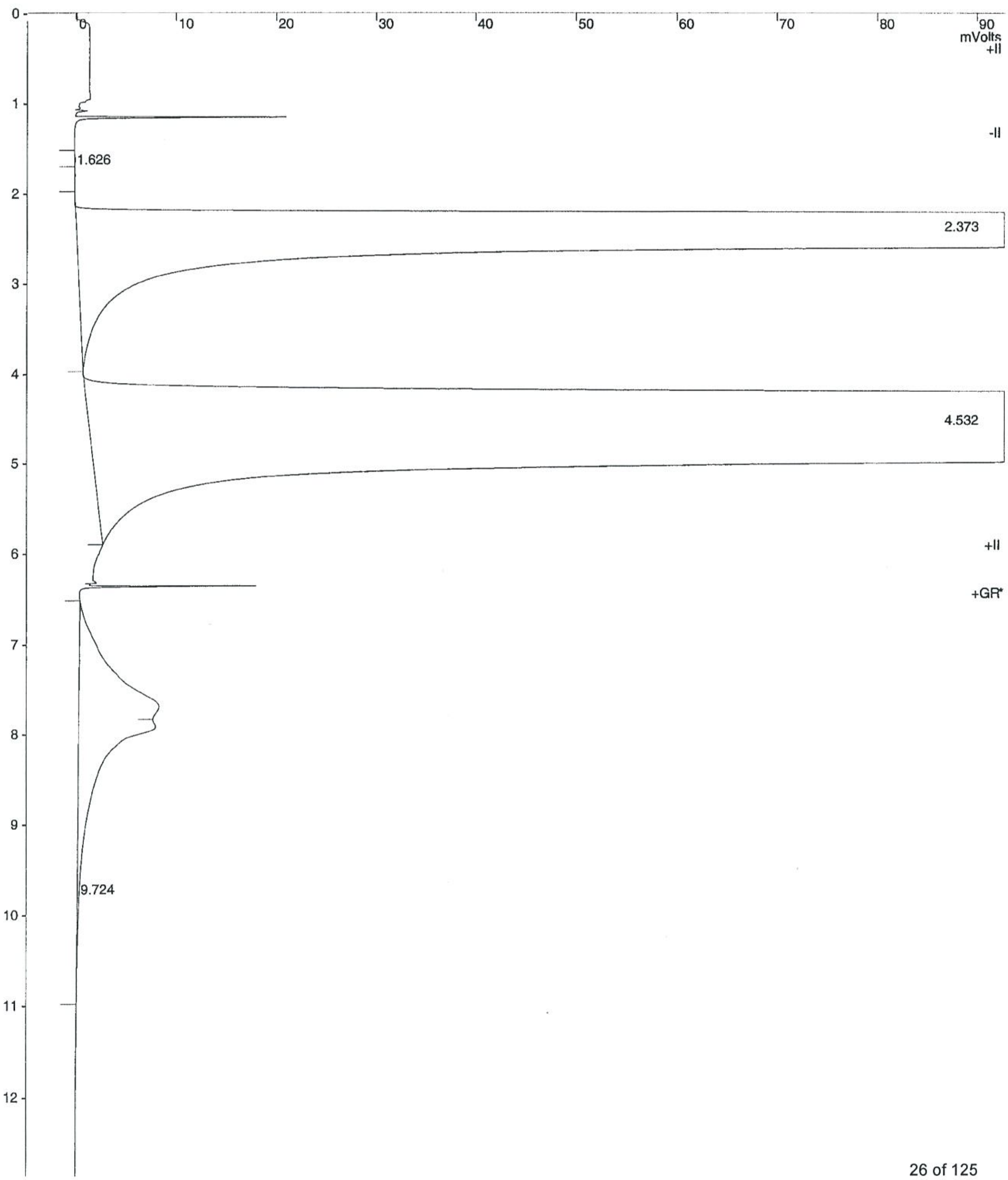
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug037.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-01 EA ENG

Injection Date: 8/23/2018 22:48    Calculation Date: 8/23/2018 23:01

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument : GC8A                  Sample Rate  : 10.00 Hz
Channel     : Middle = FID         Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:01:19 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug037.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 22:48 Calculation Date: 8/23/2018 23:01

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000037	1.626	0.048	383	BV	4.5	
2	Methane	11.982177	2.373	0.001	124045672	PP	11.6	C
3	Carbon Dioxi	14.416704	4.532	-0.031	148397712	PB	18.6	C
4	NMOC_(ppmv)	411.321472	9.724	0.001	489172	GR	0.0	C
	Totals:	437.720390		0.019	272932939			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 350 counts

Detected Peaks: 6 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -93 microVolts LSB: 1 microVolts

Noise (used): 8 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/23/2018 23:01: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 22:46:27

Original Notes:

****

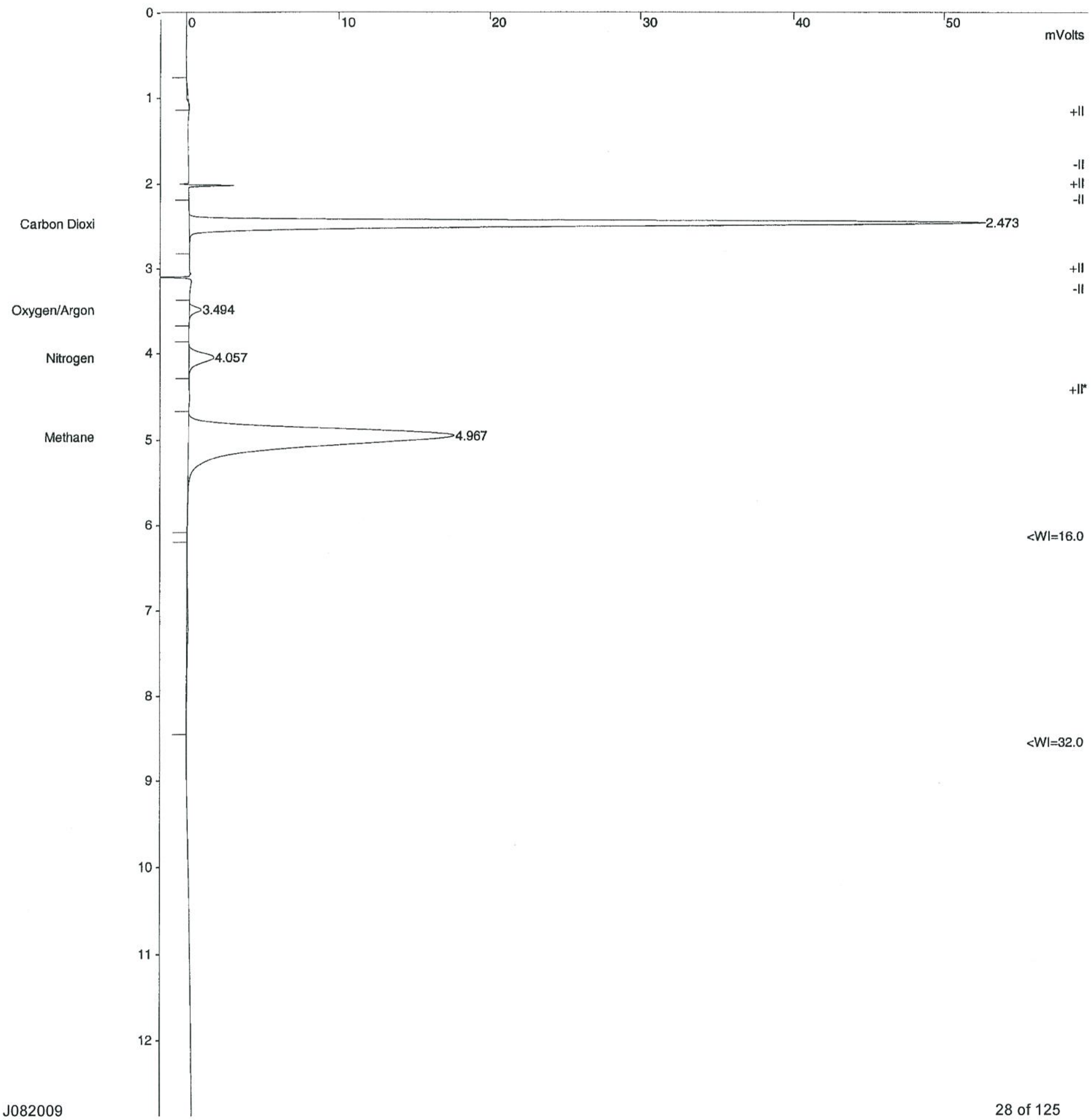
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug038.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-01 EA ENG

Injection Date: 8/23/2018 23:02    Calculation Date: 8/23/2018 23:15

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument  : GC8A                 Sample Rate  : 10.00 Hz
Channel     : Front = TCD          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 25          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min  Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:15:56 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug038.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 23:02 Calculation Date: 8/23/2018 23:15

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen		1.930					M
2	Carbon Dioxi	13.484701	2.473	0.028	251046	BB	4.5	
3	Oxygen/Argon	0.250594	3.494	-0.003	3649	BB	4.3	
4	Nitrogen	0.838550	4.057	-0.009	12926	BB	7.3	
5	Methane	18.772959	4.967	-0.030	242582	BB	12.4	
	Totals:	33.346804		-0.014	510203			

Status Codes:
M - Missing peak

Total Unidentified Counts : 5021 counts

Detected Peaks: 6 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 10 microVolts LSB: 1 microVolts

Noise (used): 6 microVolts - monitored before this run

Manual injection

Revision Log:

8/23/2018 23:15: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 23:01:01

Original Notes:

****

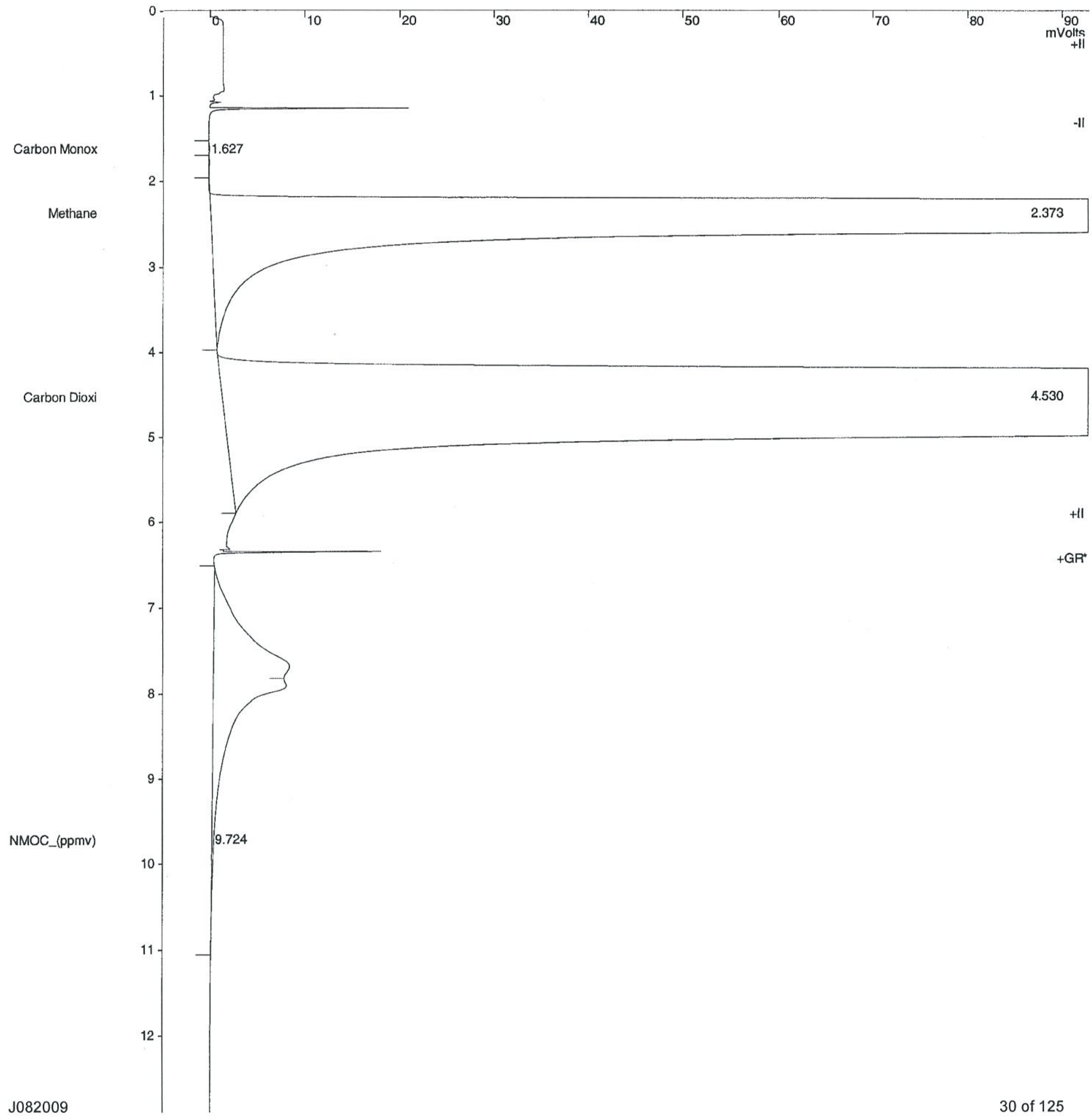
Title   : Fixed Gas from FID/NMOC
Run File   : i:\gc8a\2018\aug\23aug038.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-01 EA ENG

Injection Date: 8/23/2018 23:02   Calculation Date: 8/23/2018 23:15

Operator : AS	Detector Type: 3800 (10 Volts)
Workstation: DATAPART1	Bus Address : 44
Instrument : GC8A	Sample Rate : 10.00 Hz
Channel : Middle = FID	Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed = 1.53 cm/min   Attenuation = 40   Zero Offset = 5%
Start Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Print Date: Thu Aug 23 23:15:57 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug038.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-01 EA ENG

Injection Date: 8/23/2018 23:02 Calculation Date: 8/23/2018 23:15

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000035	1.627	0.049	362	BV	4.3	
2	Methane	11.977551	2.373	0.001	123997792	PP	11.6	C
3	Carbon Dioxi	14.423774	4.530	-0.034	148470480	PB	18.6	C
4	NMOC_(ppmv)	409.278900	9.724	0.001	486743	GR	0.0	C
	Totals:	435.680260		0.017	272955377			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 350 counts

Detected Peaks: 6 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -12 microVolts LSB: 1 microVolts

Noise (used): 7 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/23/2018 23:15: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 7, Advance Time: 23:01:01

Original Notes:

****

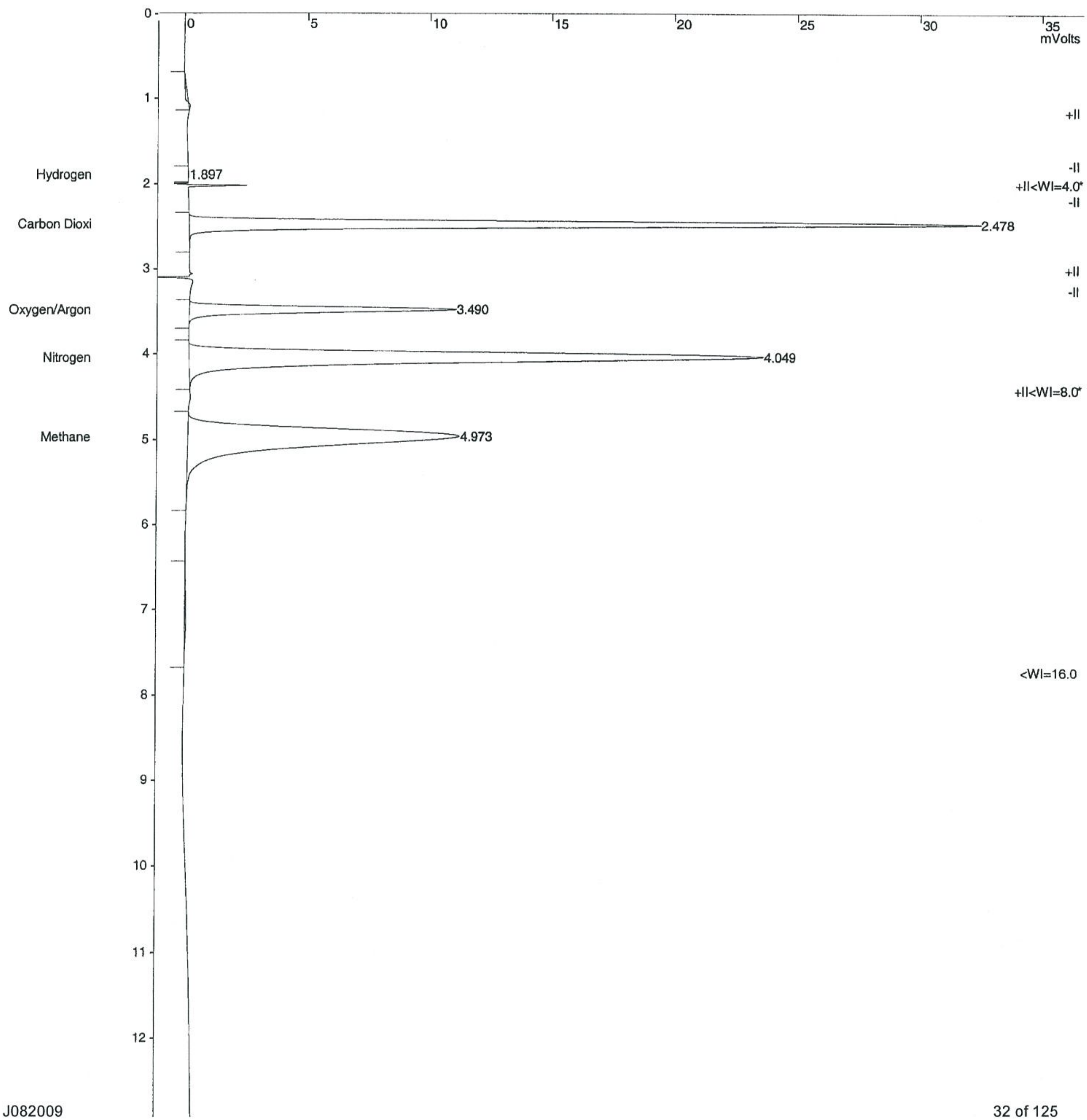
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug040.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-02 EA ENG

Injection Date: 8/23/2018 23:32    Calculation Date: 8/23/2018 23:45

Operator    : AS                  Detector Type: 3800 (10 Volts)
Workstation: DATAPART1            Bus Address  : 44
Instrument  : GC8A                Sample Rate  : 10.00 Hz
Channel     : Front = TCD         Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 15          Zero Offset = 3%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:45:10 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug040.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/23/2018 23:32 Calculation Date: 8/23/2018 23:45

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.227996	1.897	-0.033	55	BB	3.7	
2	Carbon Dioxi	8.209311	2.478	0.033	152834	BB	4.4	
3	Oxygen/Argon	3.449760	3.490	-0.007	50231	BB	4.3	
4	Nitrogen	12.121877	4.049	-0.017	186853	BB	7.3	
5	Methane	11.809709	4.973	-0.024	152604	BB	12.4	
	Totals:	35.818653		-0.048	542577			

Total Unidentified Counts : 2135 counts

Detected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 8 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/23/2018 23:45: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:30:17

Original Notes:

****

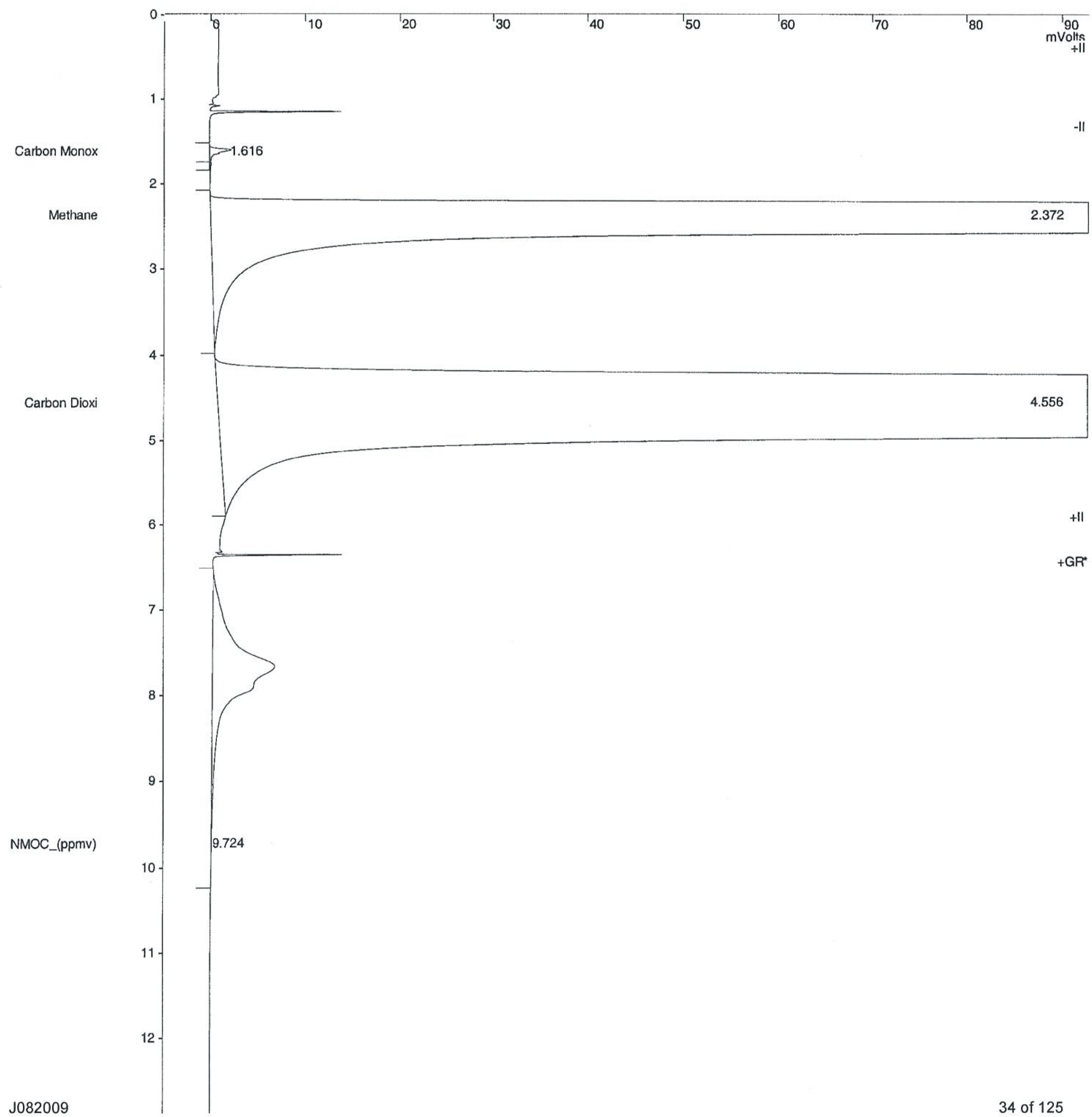
```
Title       : Fixed Gas from FID/NMOC
Run File    : i:\gc8a\2018\aug\23aug040.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-02 EA ENG

Injection Date: 8/23/2018 23:32    Calculation Date: 8/23/2018 23:45

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument : GC8A                  Sample Rate  : 10.00 Hz
Channel     : Middle = FID         Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40           Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:45:10 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug040.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/23/2018 23:32 Calculation Date: 8/23/2018 23:45

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000869	1.616	0.038	8897	BP	2.7	
2	Methane	10.037601	2.372	0.000	103914424	PP	9.6	C
3	Carbon Dioxi	8.876170	4.556	-0.007	91366464	PB	18.4	C
4	NMOC_(ppmv)	224.653152	9.724	0.001	267173	GR	0.0	
	Totals:	243.567792		0.032	195556958			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 110 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -7 microVolts LSB: 1 microVolts

Noise (used): 8 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/23/2018 23:45: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:30:17

Original Notes:

****

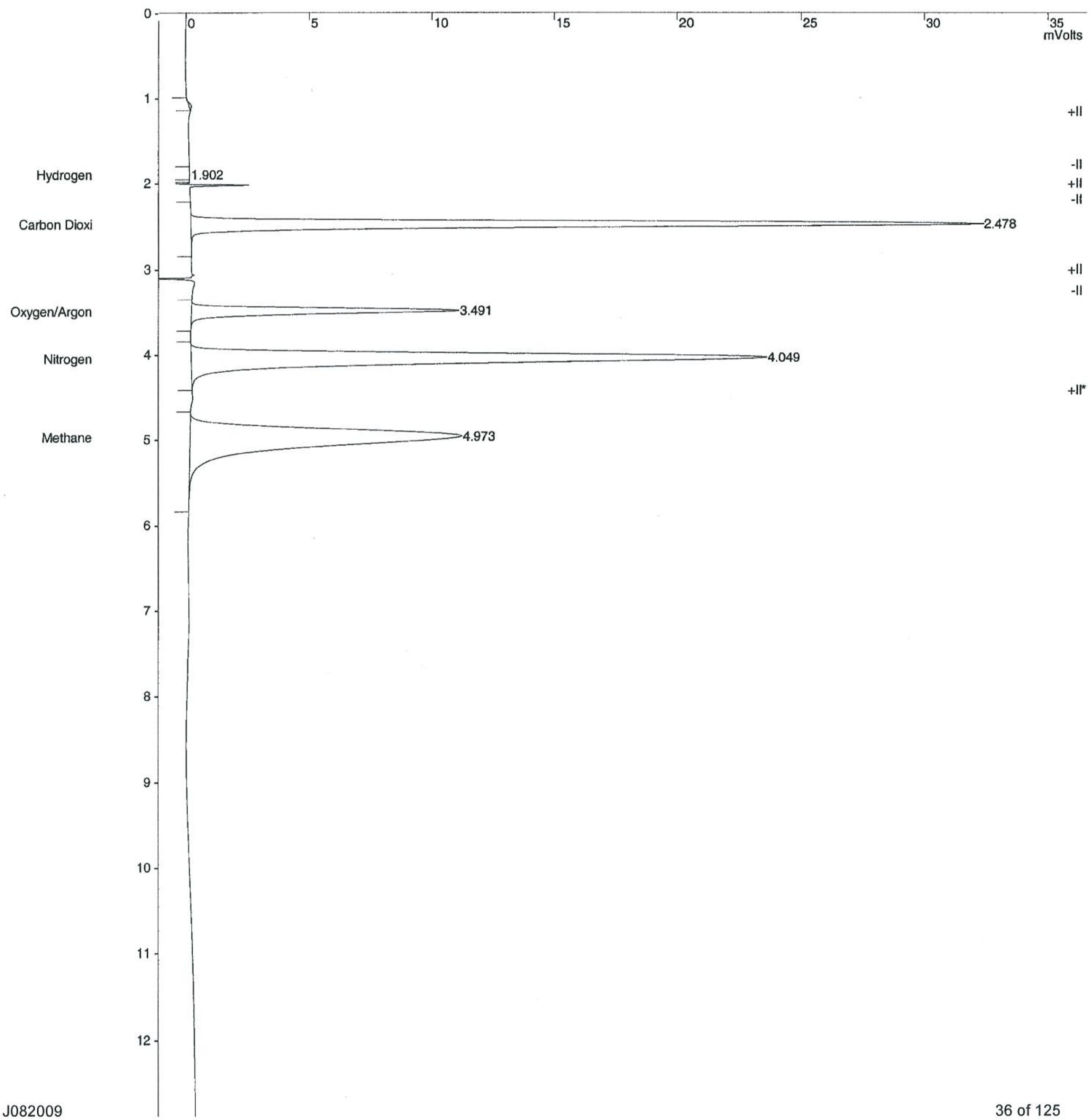
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug041.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-02 EA ENG

Injection Date: 8/23/2018 23:46     Calculation Date: 8/23/2018 23:59

Operator    : AS                     Detector Type: 3800 (10 Volts)
Workstation: DATAPART1               Bus Address  : 44
Instrument : GC8A                    Sample Rate  : 10.00 Hz
Channel     : Front = TCD            Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 15          Zero Offset = 3%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:59:45 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug041.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/23/2018 23:46 Calculation Date: 8/23/2018 23:59

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.261604	1.902	-0.028	63	BV	6.1	
2	Carbon Dioxi	8.210577	2.478	0.033	152857	BB	4.4	
3	Oxygen/Argon	3.445766	3.491	-0.006	50172	BB	4.3	
4	Nitrogen	12.105317	4.049	-0.017	186598	BB	7.3	
5	Methane	11.794831	4.973	-0.024	152411	BB	12.4	
	Totals:	35.818095		-0.042	542101			

Total Unidentified Counts : 413 counts

Detected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 10 microVolts LSB: 1 microVolts

Noise (used): 7 microVolts - monitored before this run

Manual injection

Revision Log:

8/23/2018 23:59: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:44:53

Original Notes:

****

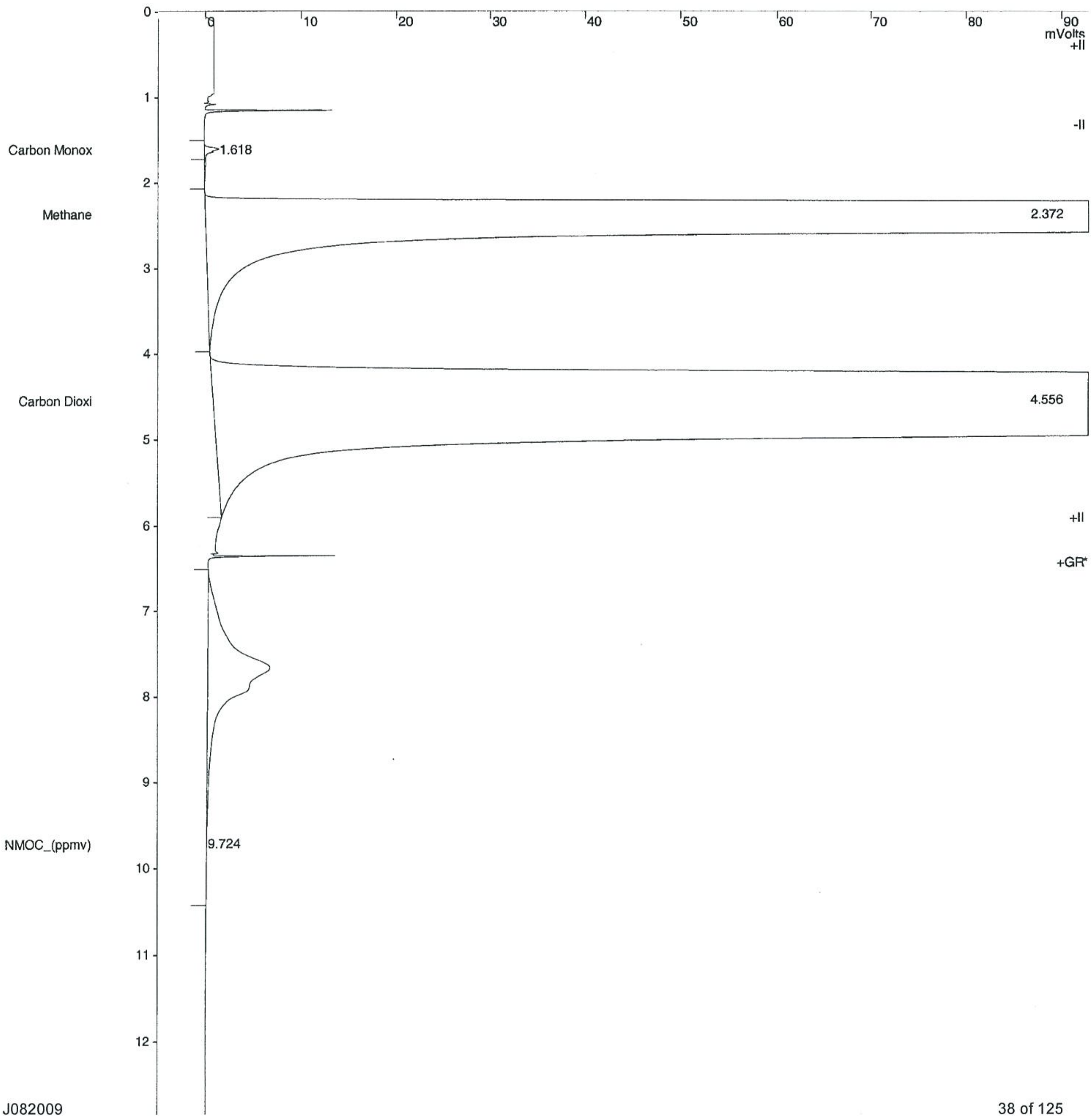
```
Title       : Fixed Gas from FID/NMOC
Run File    : i:\gc8a\2018\aug\23aug041.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-02 EA ENG

Injection Date: 8/23/2018 23:46    Calculation Date: 8/23/2018 23:59

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument : GC8A                  Sample Rate  : 10.00 Hz
Channel     : Middle = FID         Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Thu Aug 23 23:59:46 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug041.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/23/2018 23:46 Calculation Date: 8/23/2018 23:59

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000535	1.618	0.040	5477	BV	3.7	
2	Methane	10.037677	2.372	0.000	103915208	PP	9.6	C
3	Carbon Dioxi	8.875484	4.556	-0.008	91359408	PB	18.4	C
4	NMOC_(ppmv)	223.019501	9.724	0.001	265230	GR	0.0	
	Totals:	241.933197		0.033	195545323			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 1001 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -3 microVolts LSB: 1 microVolts

Noise (used): 9 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/23/2018 23:59: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:44:53

Original Notes:

****

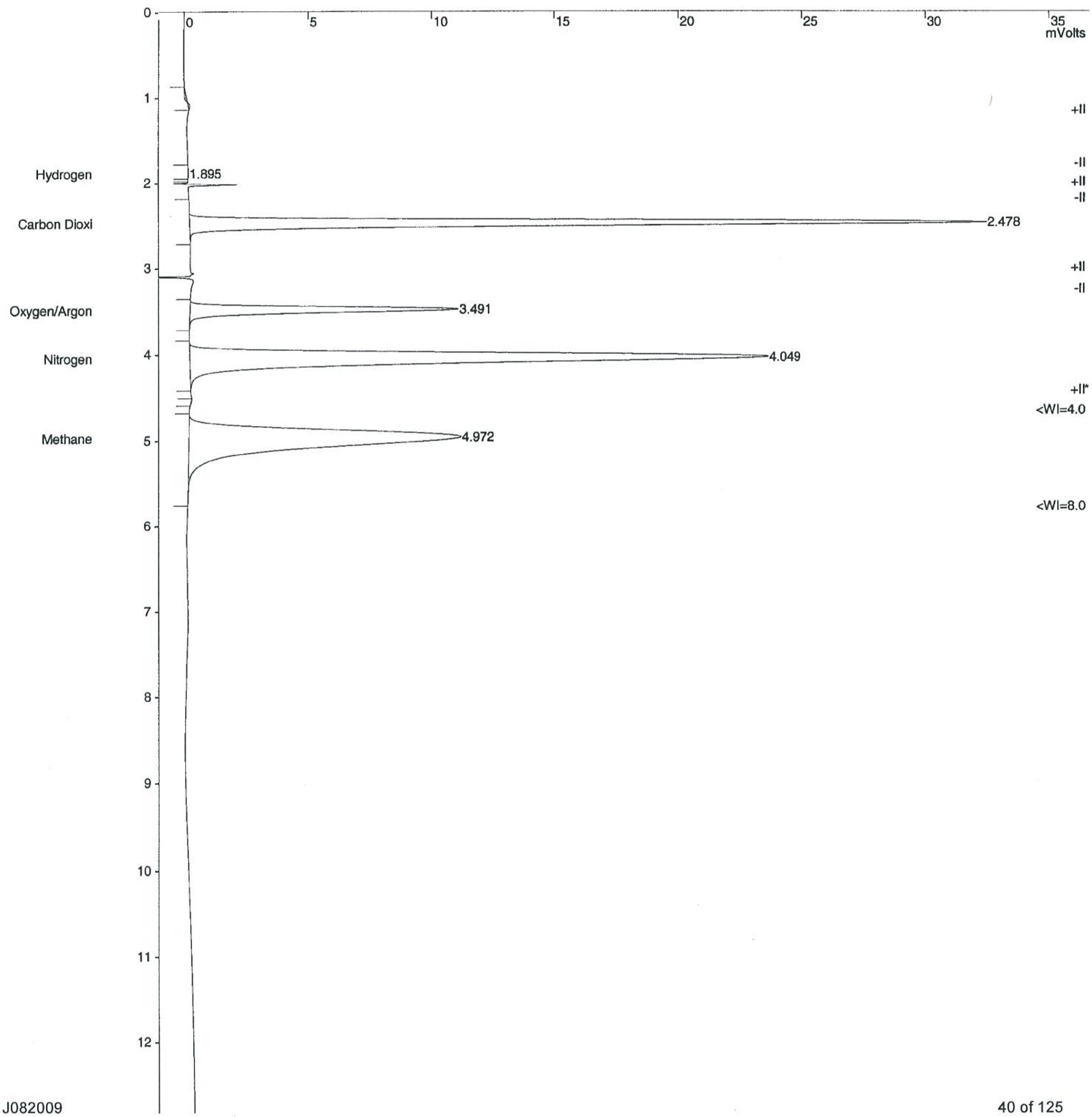
Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug042.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/24/2018 00:01   Calculation Date: 8/24/2018 00:14

Operator : AS   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1   Bus Address : 44
Instrument : GC8A   Sample Rate : 10.00 Hz
Channel : Front = TCD   Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed = 1.53 cm/min   Attenuation = 15   Zero Offset = 2%
Start Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Print Date: Fri Aug 24 00:14:21 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug042.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/24/2018 00:01 Calculation Date: 8/24/2018 00:14

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.218306	1.895	-0.035	52	BP	5.8	
2	Carbon Dioxi	8.192630	2.478	0.033	152523	BB	4.4	
3	Oxygen/Argon	3.448469	3.491	-0.006	50212	BB	4.3	
4	Nitrogen	12.119019	4.049	-0.017	186809	BB	7.3	
5	Methane	11.794215	4.972	-0.025	152403	BB	12.4	
	Totals:	35.772639		-0.050	541999			

Total Unidentified Counts : 47 counts

Detected Peaks: 8 Rejected Peaks: 2 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 5 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 00:14: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:59:30

Original Notes:

****

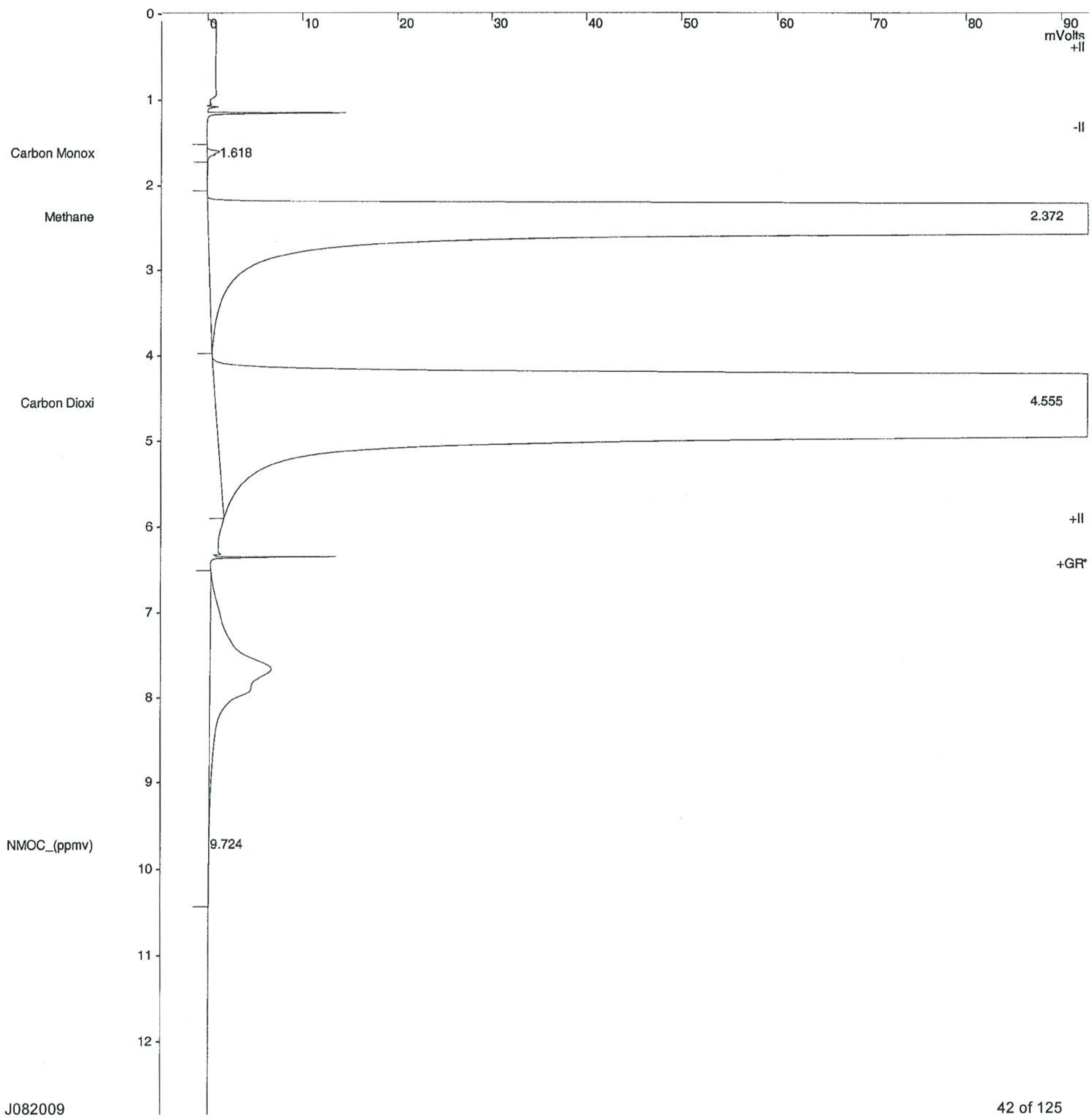
```
Title       : Fixed Gas from FID/NMOC
Run File    : i:\gc8a\2018\aug\23aug042.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-02 EA ENG

Injection Date: 8/24/2018 00:01    Calculation Date: 8/24/2018 00:14

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Middle = FID          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug042.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-02 EA ENG

Injection Date: 8/24/2018 00:01 Calculation Date: 8/24/2018 00:14

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000494	1.618	0.040	5054	BV	3.8	
2	Methane	10.039385	2.372	0.000	103932888	PP	9.6	C
3	Carbon Dioxi	8.881183	4.555	-0.008	91418064	PB	18.4	C
4	NMOC_(ppmv)	221.819717	9.724	0.001	263804	GR	0.0	
	Totals:	240.740779		0.033	195619810			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 1006 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -2 microVolts LSB: 1 microVolts

Noise (used): 9 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 00:14: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 8, Advance Time: 23:59:30

Original Notes:

****

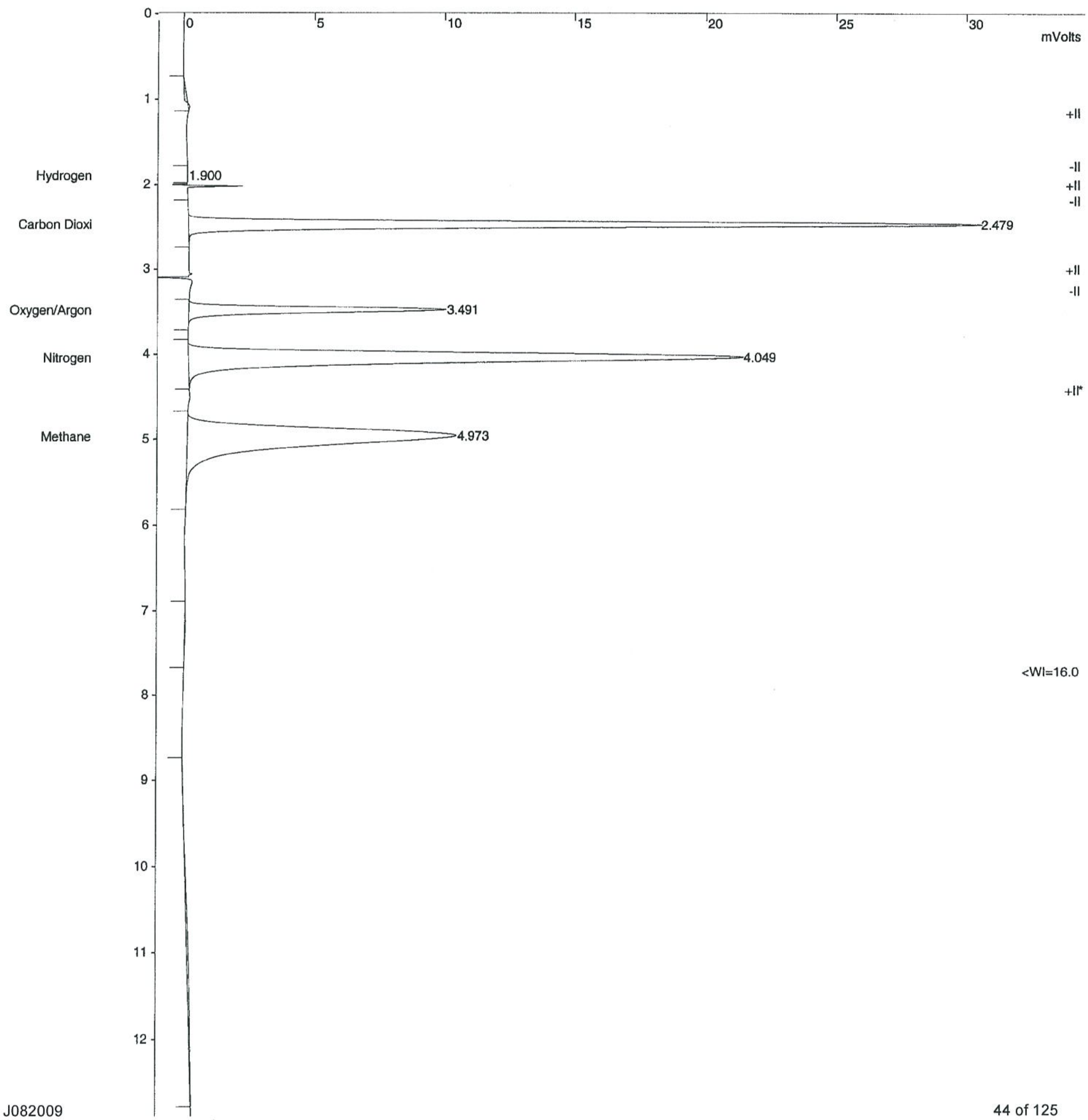
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug044.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-03 EA ENG

Injection Date: 8/24/2018 00:30    Calculation Date: 8/24/2018 00:43

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument : GC8A                  Sample Rate  : 10.00 Hz
Channel     : Front = TCD          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 14          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 00:43:32 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug044.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:30 Calculation Date: 8/24/2018 00:43

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.231331	1.900	-0.030	56	BB	4.4	
2	Carbon Dioxi	7.720663	2.479	0.034	143736	BB	4.4	
3	Oxygen/Argon	3.123269	3.491	-0.006	45477	BB	4.3	
4	Nitrogen	10.982498	4.049	-0.017	169290	BB	7.3	
5	Methane	11.035201	4.973	-0.024	142596	BB	12.4	
	Totals:	33.092962		-0.043	501155			

Total Unidentified Counts : (05 / 7290 counts

Detected Peaks: 8 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 6 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 00:43: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:28:40

Original Notes:

****

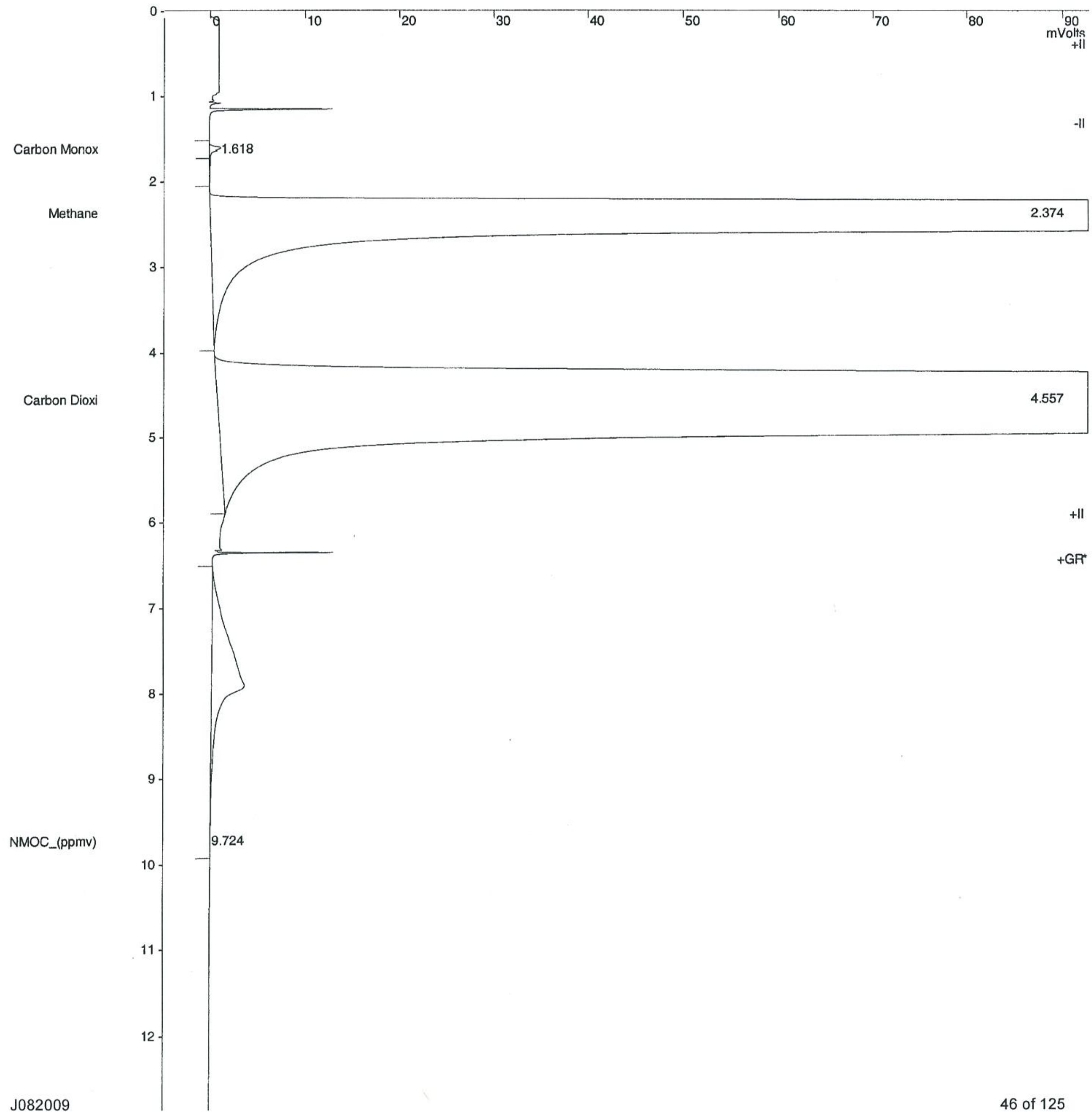
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug044.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-03 EA ENG

Injection Date: 8/24/2018 00:30    Calculation Date: 8/24/2018 00:43

Operator    : AS                     Detector Type: 3800 (10 Volts)
Workstation: DATAPART1               Bus Address  : 44
Instrument : GC8A                    Sample Rate  : 10.00 Hz
Channel     : Middle = FID           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =     1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min      End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 00:43:32 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug044.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:30 Calculation Date: 8/24/2018 00:43

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000438	1.618	0.041	4487	BV	3.8	
2	Methane	9.720655	2.374	0.002	100633240	PP	9.3	C
3	Carbon Dioxi	8.370328	4.557	-0.006	86159600	PB	18.4	C
4	NMOC_(ppmv)	141.417023	9.724	0.001	168183	GR	0.0	
	Totals:	159.508444		0.038	186965510			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 780 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 2 microVolts LSB: 1 microVolts

Noise (used): 8 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 00:43: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:28:40

Original Notes:

****

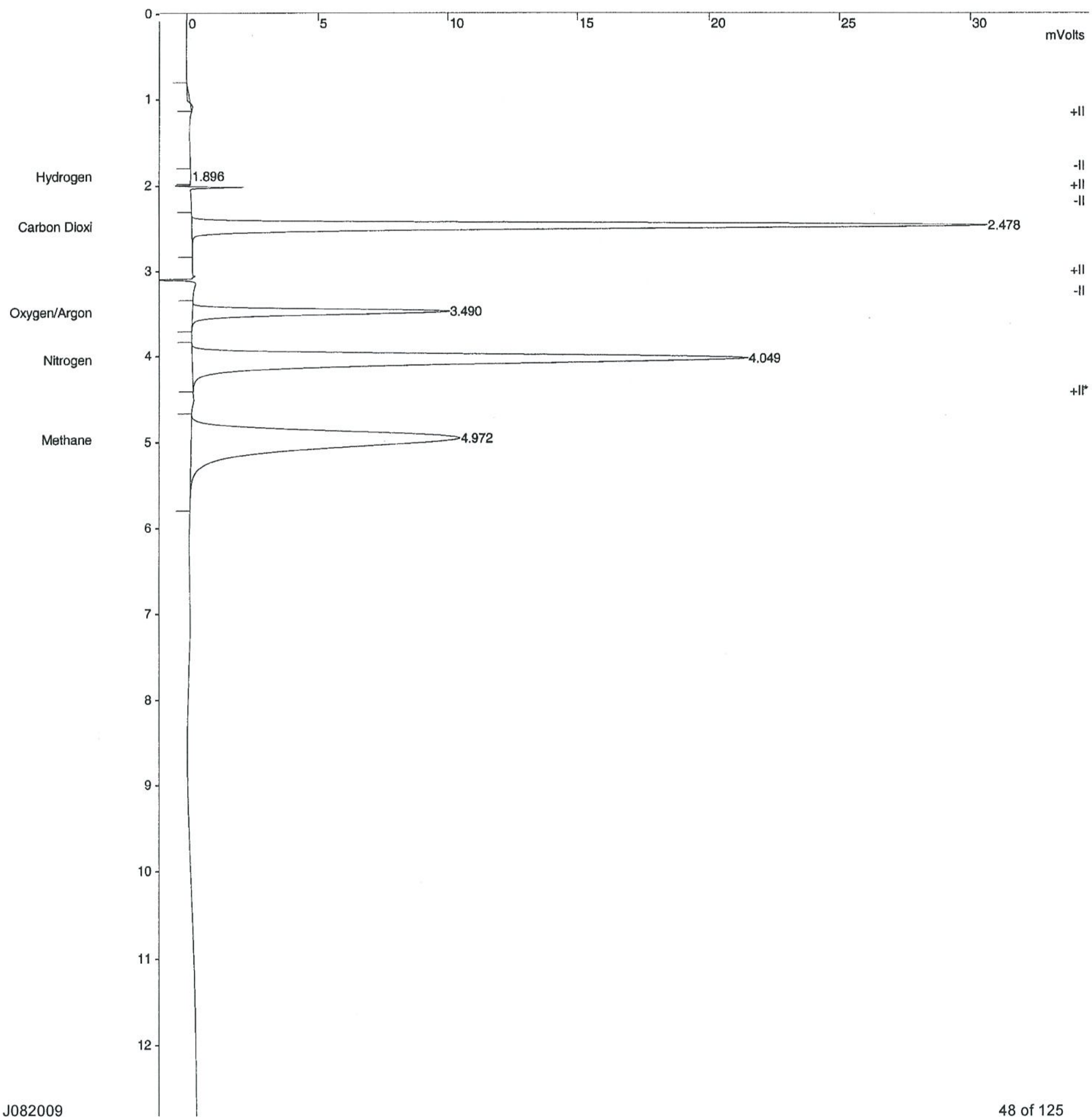
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug045.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-03 EA ENG

Injection Date: 8/24/2018 00:45    Calculation Date: 8/24/2018 00:58

Operator    : AS                      Detector Type: 3800 (10 Volts)
Workstation: DATAPART1                Bus Address  : 44
Instrument : GC8A                     Sample Rate  : 10.00 Hz
Channel     : Front = TCD             Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 14          Zero Offset = 3%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 00:58:07 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug045.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:45 Calculation Date: 8/24/2018 00:58

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.251859	1.896	-0.034	60	BB	4.2	
2	Carbon Dioxi	7.716123	2.478	0.033	143652	BB	4.4	
3	Oxygen/Argon	3.125407	3.490	-0.007	45508	BB	4.3	
4	Nitrogen	10.991739	4.049	-0.017	169433	BB	7.3	
5	Methane	11.022758	4.972	-0.025	142435	BB	12.4	
	Totals:	33.107886		-0.050	501088			

Total Unidentified Counts : 0 counts

Detected Peaks: 6 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 4 microVolts LSB: 1 microVolts

Noise (used): 6 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 00:58: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:43:15

Original Notes:

****

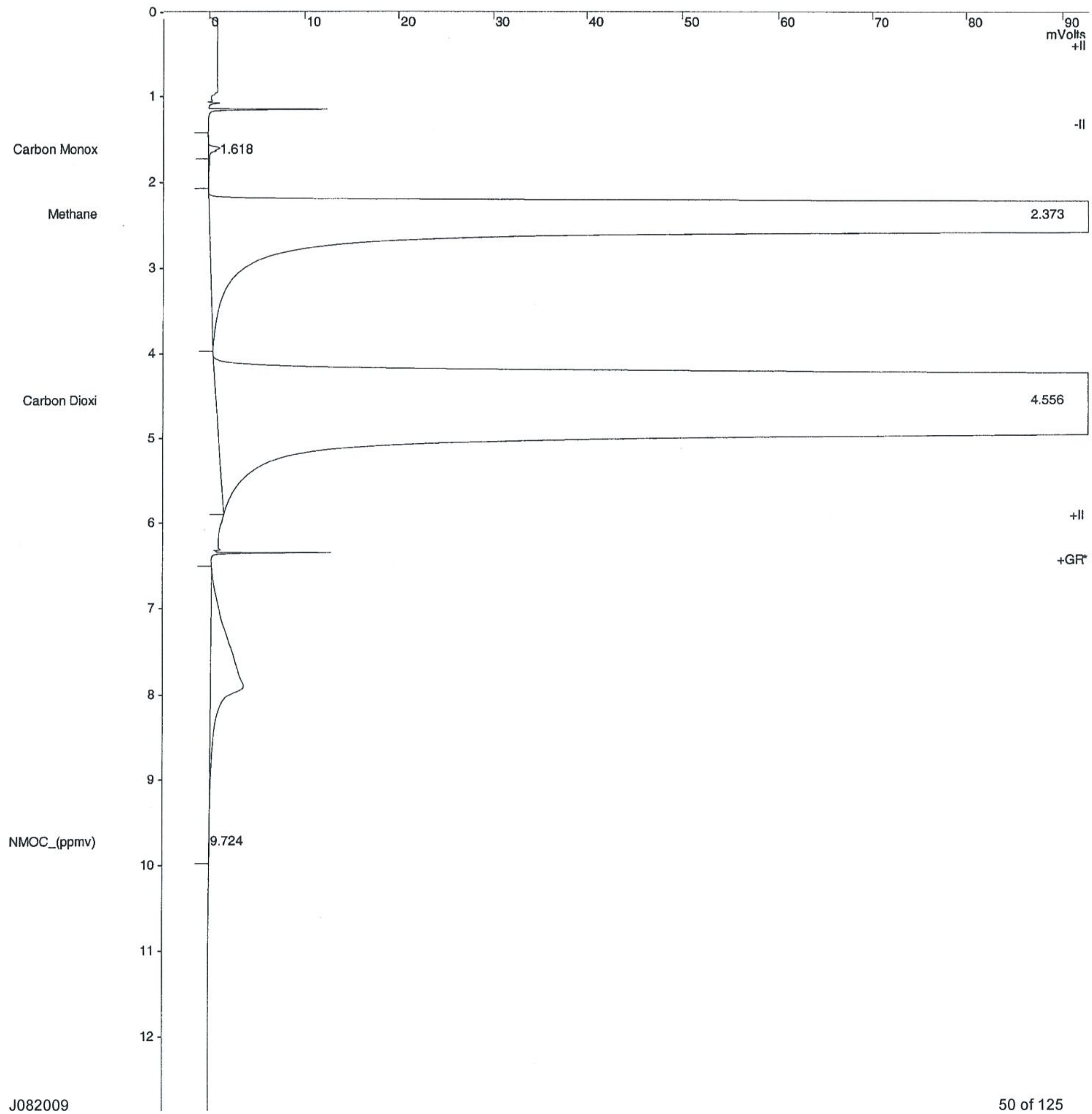
Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug045.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:45   Calculation Date: 8/24/2018 00:58

Operator : AS   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1   Bus Address : 44
Instrument : GC8A   Sample Rate : 10.00 Hz
Channel : Middle = FID   Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed = 1.53 cm/min   Attenuation = 40   Zero Offset = 5%
Start Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug045.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:45 Calculation Date: 8/24/2018 00:58

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000441	1.618	0.040	4514	BV	3.7	
2	Methane	9.718714	2.373	0.001	100613144	PP	9.3	C
3	Carbon Dioxi	8.372804	4.556	-0.007	86185088	PB	18.4	C
4	NMOC_(ppmv)	141.537018	9.724	0.001	168326	GR	0.0	
	Totals:	159.628977		0.035	186971072			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 854 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 2 microVolts LSB: 1 microVolts

Noise (used): 10 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 00:58: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:43:15

Original Notes:

****

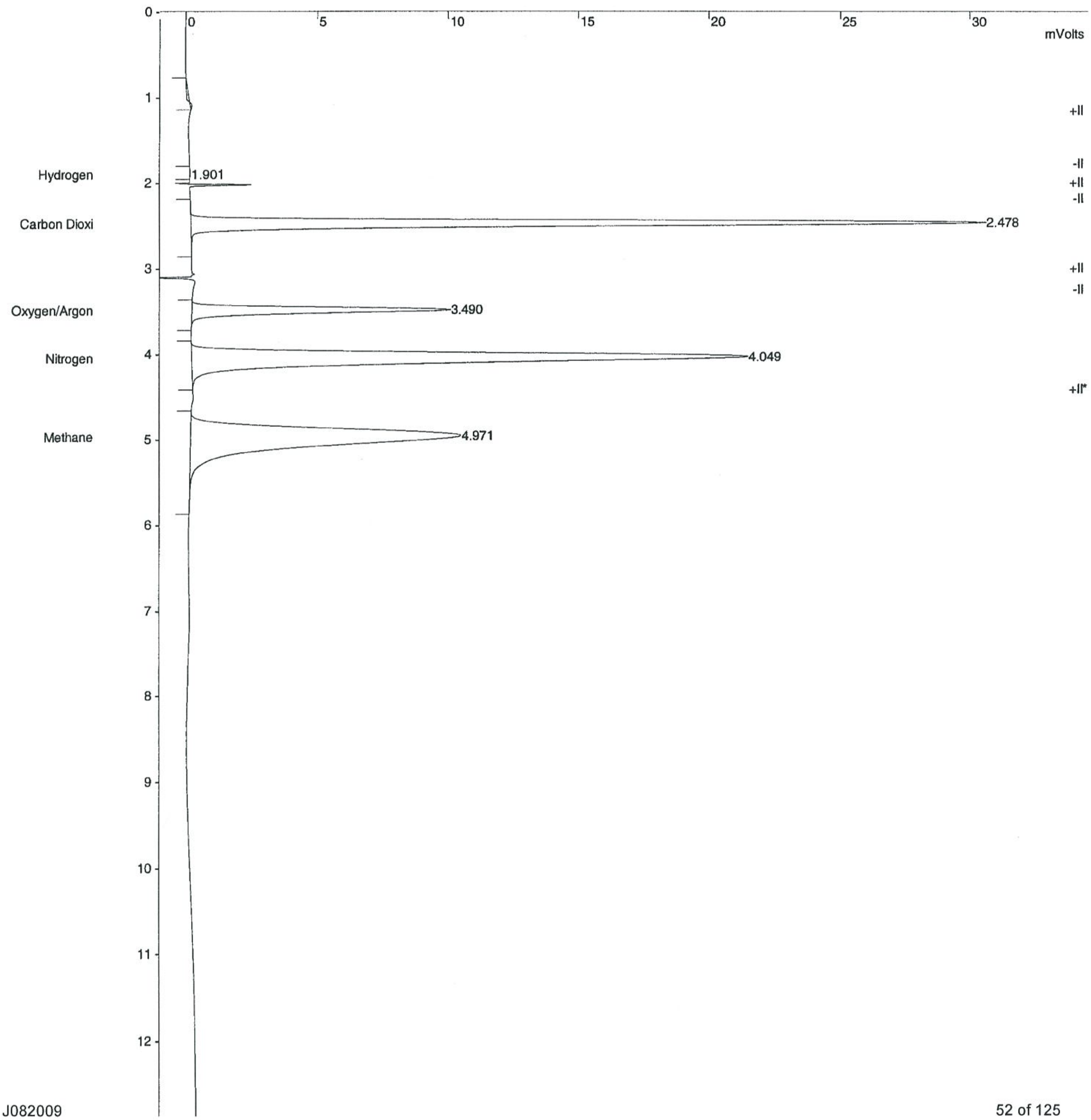
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug046.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-03 EA ENG

Injection Date: 8/24/2018 00:59    Calculation Date: 8/24/2018 01:12

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument  : GC8A                  Sample Rate  : 10.00 Hz
Channel     : Front = TCD           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 14          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 01:12:47 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug046.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:59 Calculation Date: 8/24/2018 01:12

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.188295	1.901	-0.029	45	BB	4.9	
2	Carbon Dioxi	7.741359	2.478	0.033	144122	BB	4.4	
3	Oxygen/Argon	3.124997	3.490	-0.007	45502	BB	4.3	
4	Nitrogen	10.986366	4.049	-0.017	169350	BB	7.3	
5	Methane	11.031891	4.971	-0.026	142553	BB	12.4	
	Totals:	33.072908		-0.046	501572			

Total Unidentified Counts : 0 counts

Detected Peaks: 6 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 0 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 01:12: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:57:51

Original Notes:

****

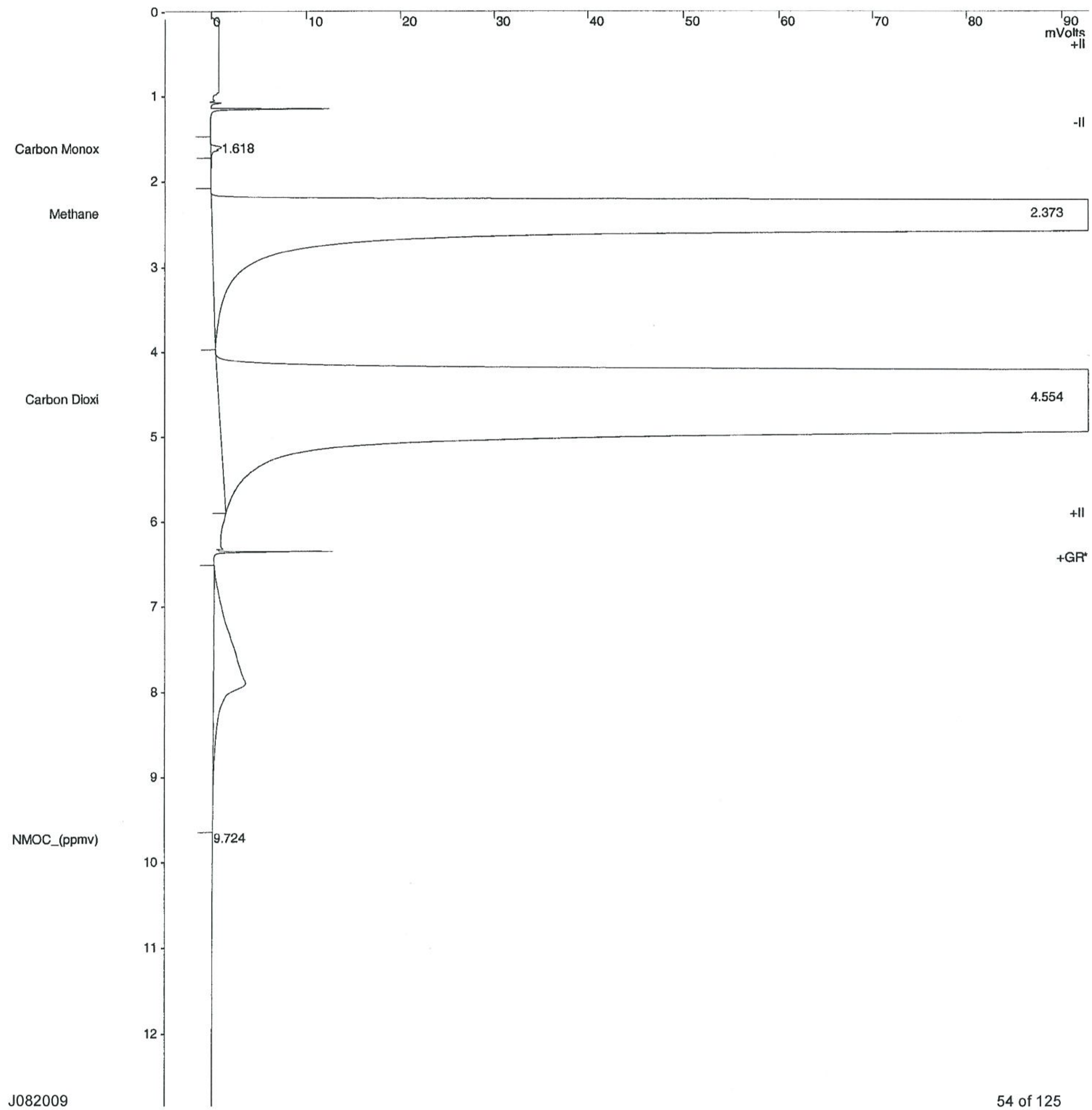
```
Title       : Fixed Gas from FID/NMOC
Run File    : i:\gc8a\2018\aug\23aug046.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-03 EA ENG

Injection Date: 8/24/2018 00:59    Calculation Date: 8/24/2018 01:12

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Middle = FID          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 01:12:48 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug046.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-03 EA ENG

Injection Date: 8/24/2018 00:59 Calculation Date: 8/24/2018 01:12

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000440	1.618	0.040	4500	BV	3.7	
2	Methane	9.722031	2.373	0.001	100647480	PP	9.3	C
3	Carbon Dioxi	8.374817	4.554	-0.009	86205808	PB	18.4	C
4	NMOC_(ppmv)	139.900681	9.724	0.001	166380	GR	0.0	
	Totals:	157.997969		0.033	187024168			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 837 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 5 microVolts LSB: 1 microVolts

Noise (used): 8 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 01:12: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 9, Advance Time: 00:57:51

Original Notes:

****

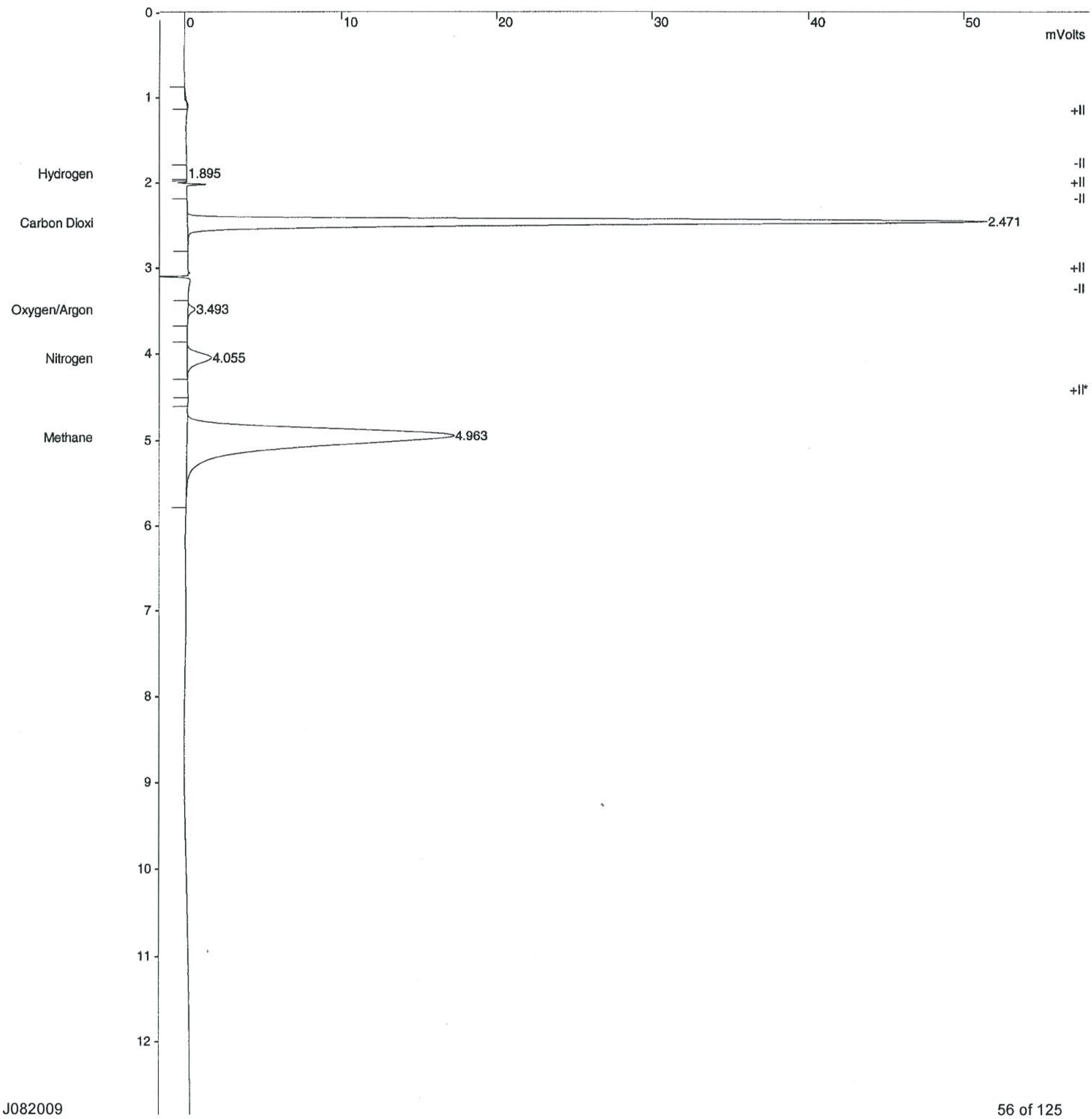
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug048.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-04 EA ENG

Injection Date: 8/24/2018 01:28    Calculation Date: 8/24/2018 01:41

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Front = TCD           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 24           Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug048.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

Injection Date: 8/24/2018 01:28 Calculation Date: 8/24/2018 01:41

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.268219	1.895	-0.035	64	BP	5.5	
2	Carbon Dioxi	13.127443	2.471	0.026	244395	BB	4.5	
3	Oxygen/Argon	0.149376	3.493	-0.004	2175	BB	4.3	
4	Nitrogen	0.771755	4.055	-0.011	11896	BB	7.3	
5	Methane	18.307541	4.963	-0.034	236568	PB	12.4	
	Totals:	32.624334		-0.058	495098			

Total Unidentified Counts : 27 counts

Detected Peaks: 8 Rejected Peaks: 2 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 6 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 01:41: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:27:07

Original Notes:

****

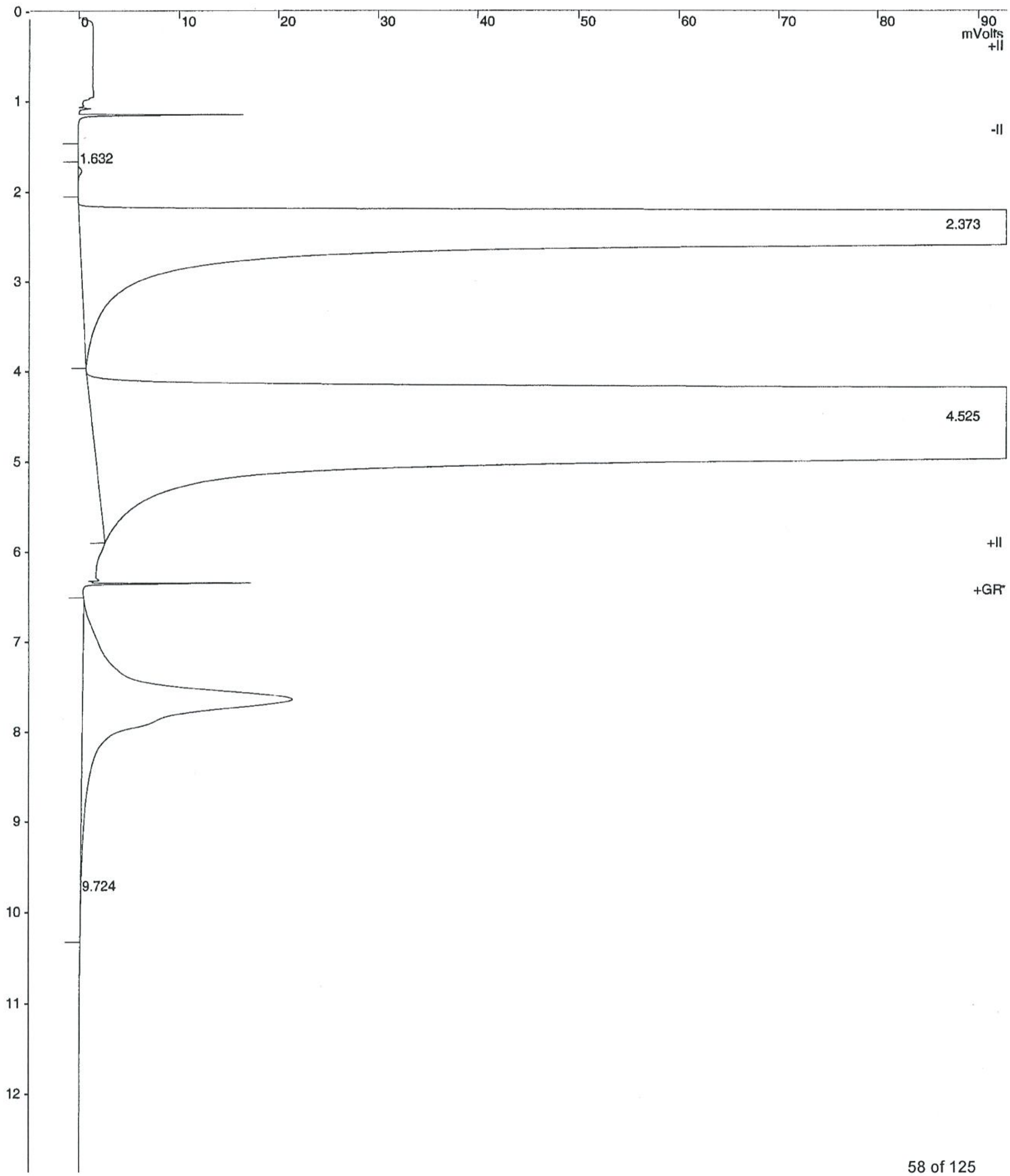
```
Title       : Fixed Gas from FID/NMOC
Run File    : i:\gc8a\2018\aug\23aug048.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-04 EA ENG

Injection Date: 8/24/2018 01:28    Calculation Date: 8/24/2018 01:41

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Middle = FID          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 01:41:59 2018   Page 1 of 1

Title   : Fixed Gas from FID/NMOC
Run File   : i:\gc8a\2018\aug\23aug048.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-04 EA ENG

Injection Date: 8/24/2018 01:28   Calculation Date: 8/24/2018 01:41

Operator   : AS   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1   Bus Address : 44
Instrument : GC8A   Sample Rate : 10.00 Hz
Channel   : Middle = FID   Run Time   : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode   : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000015	1.632	0.054	151	BV	5.2	
2	Methane	11.890101	2.373	0.001	123092464	PP	11.5	C
3	Carbon Dioxi	14.079867	4.525	-0.038	144930496	PB	18.5	C
4	NMOC_(ppmv)	472.610138	9.724	0.001	562061	GR	0.0	C
	Totals:	498.580121		0.018	268585172			

Status Codes:
C - Out of calibration range

Total Unidentified Counts :   1921 counts

Detected Peaks: 5   Rejected Peaks: 0   Identified Peaks: 4

Multiplier: 1   Divisor: 1   Unidentified Peak Factor: 0

Baseline Offset: 4 microVolts   LSB: 1 microVolts

Noise (used): 9 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 01:41: Calculated results from channel Middle using method:
    'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:27:07

Original Notes:

****

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug049.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

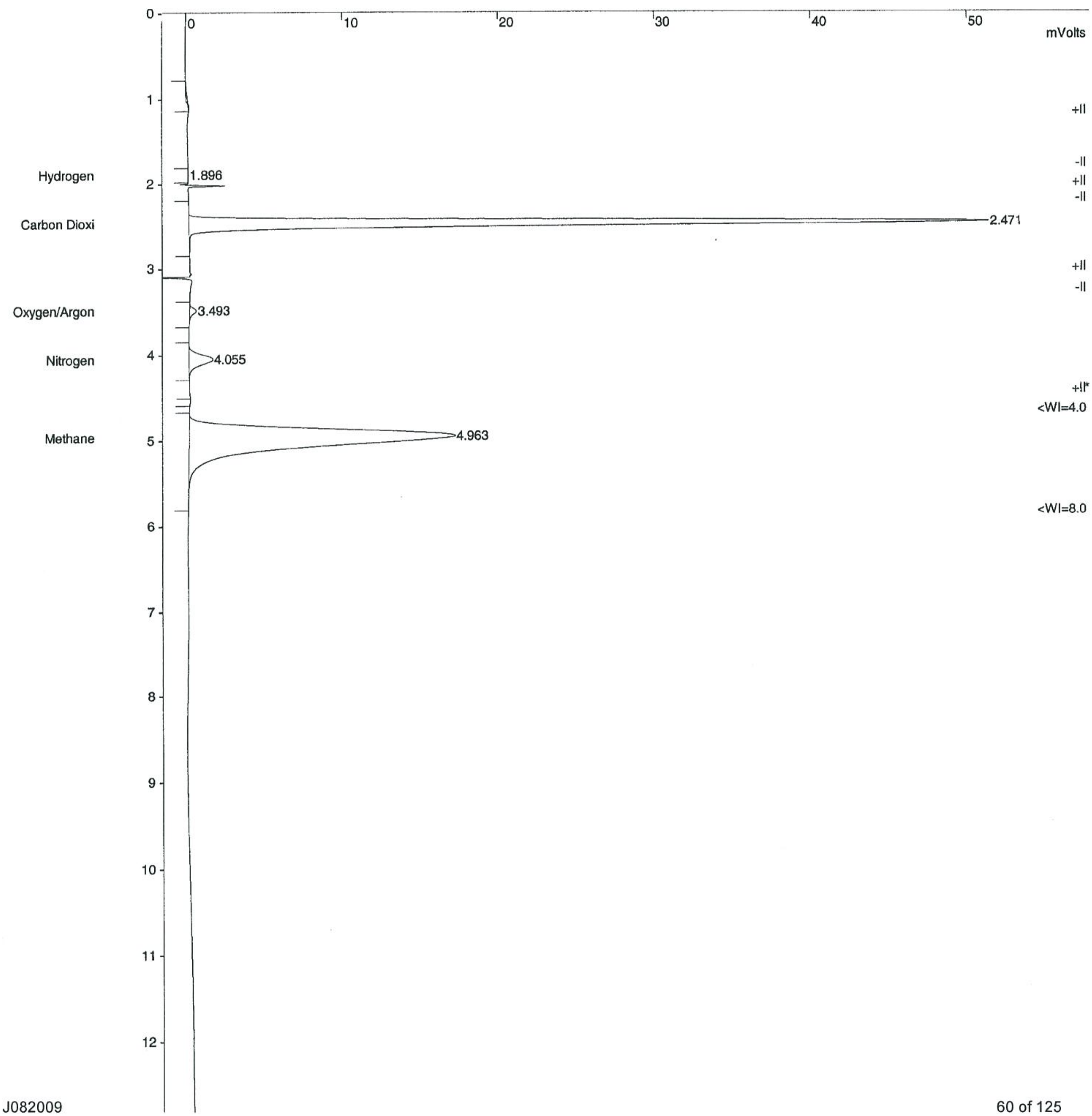
Injection Date: 8/24/2018 01:43 Calculation Date: 8/24/2018 01:56

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed = 1.53 cm/min Attenuation = 24 Zero Offset = 2%
Start Time = 0.000 min End Time = 13.088 min Min / Tick = 1.00



Print Date: Fri Aug 24 01:56:34 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug049.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

Injection Date: 8/24/2018 01:43 Calculation Date: 8/24/2018 01:56

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.197152	1.896	-0.034	47	BB	4.1	
2	Carbon Dioxi	13.082182	2.471	0.026	243552	BB	4.5	
3	Oxygen/Argon	0.143559	3.493	-0.004	2090	BB	4.3	
4	Nitrogen	0.752607	4.055	-0.011	11601	BB	7.4	
5	Methane	18.283112	4.963	-0.034	236252	BB	12.4	
	Totals:	32.458612		-0.057	493542			

Total Unidentified Counts : (32.1 43 counts

Detected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -1 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 01:56: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:41:44

Original Notes:

****

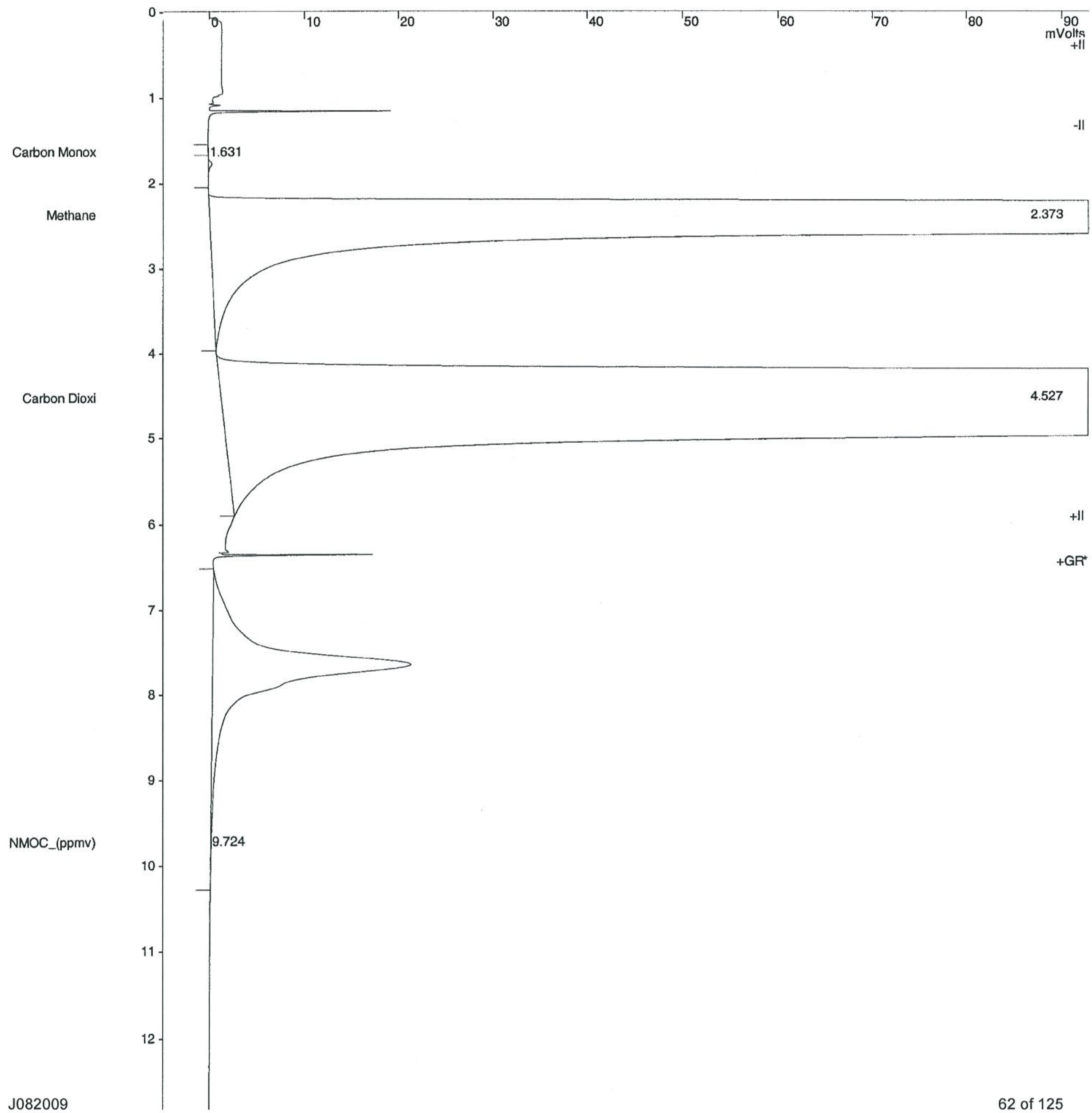
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug049.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-04 EA ENG

Injection Date: 8/24/2018 01:43     Calculation Date: 8/24/2018 01:56

Operator    : AS                     Detector Type: 3800 (10 Volts)
Workstation: DATAPART1               Bus Address  : 44
Instrument : GC8A                    Sample Rate  : 10.00 Hz
Channel     : Middle = FID           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 01:56:35 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug049.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

Injection Date: 8/24/2018 01:43 Calculation Date: 8/24/2018 01:56

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000014	1.631	0.053	139	BV	4.5	
2	Methane	11.889049	2.373	0.001	123081568	PP	11.5	C
3	Carbon Dioxi	14.078229	4.527	-0.036	144913632	PB	18.5	C
4	NMOC_(ppmv)	472.710205	9.724	0.001	562180	GR	0.0	C
	Totals:	498.677497		0.019	268557519			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 1928 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -3 microVolts LSB: 1 microVolts

Noise (used): 11 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 01:56: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:41:44

Original Notes:

****

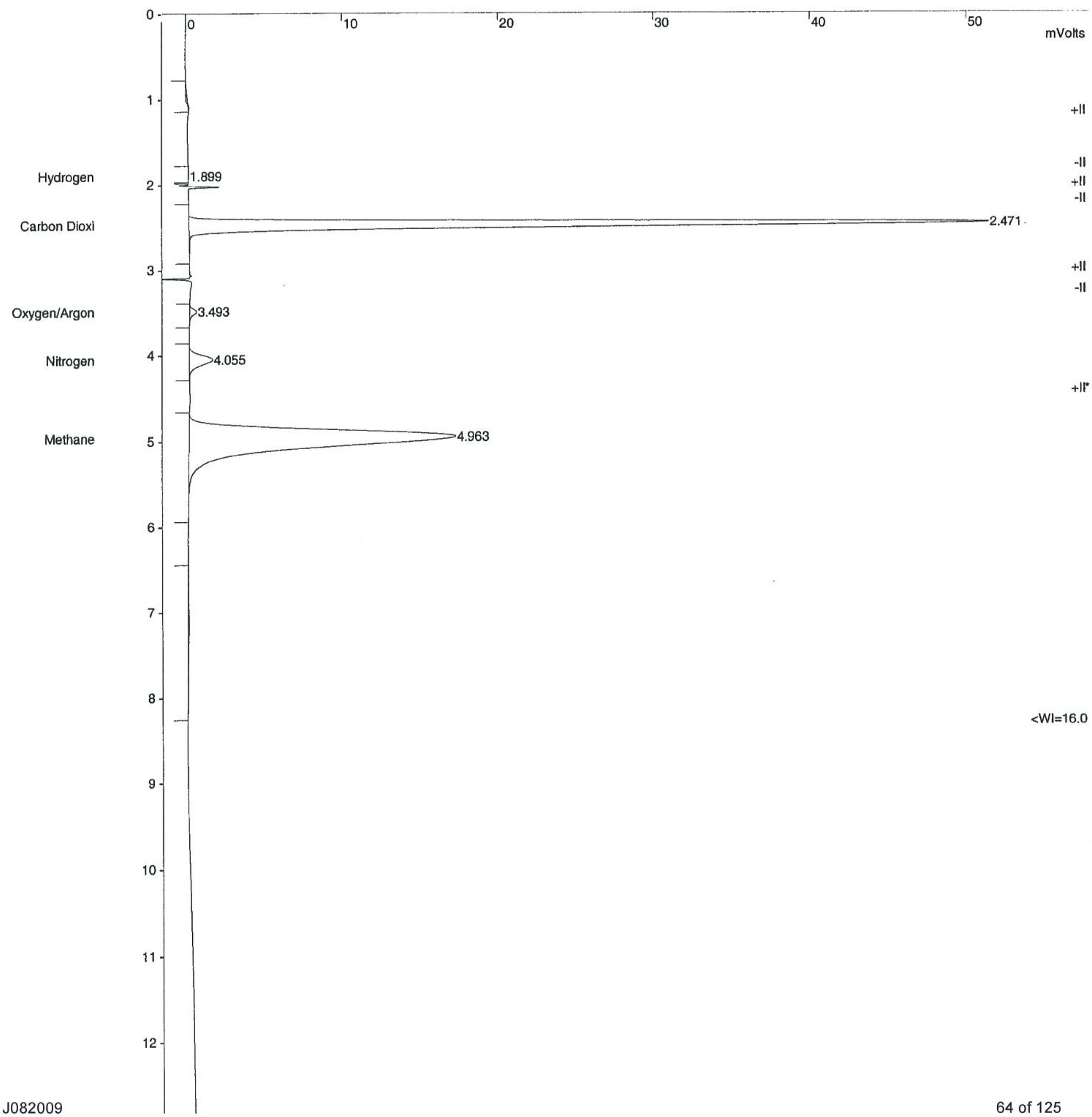
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug050.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-04 EA ENG

Injection Date: 8/24/2018 01:58    Calculation Date: 8/24/2018 02:11

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Front = TCD           Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 24          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 02:11:10 2018 Page 1 of 1

Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug050.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

Injection Date: 8/24/2018 01:58 Calculation Date: 8/24/2018 02:11

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.247941	1.899	-0.031	59	BP	4.4	
2	Carbon Dioxi	13.097672	2.471	0.026	243841	BB	4.5	
3	Oxygen/Argon	0.143136	3.493	-0.004	2084	BB	4.3	
4	Nitrogen	0.749263	4.055	-0.011	11550	BB	7.3	
5	Methane	18.308329	4.963	-0.034	236578	BB	12.4	
	Totals:	32.546341		-0.054	494112			

Total Unidentified Counts : 3660 counts

Detected Peaks: 8 Rejected Peaks: 2 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 0 microVolts LSB: 1 microVolts

Noise (used): 5 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 02:11: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:56:19

Original Notes:

****

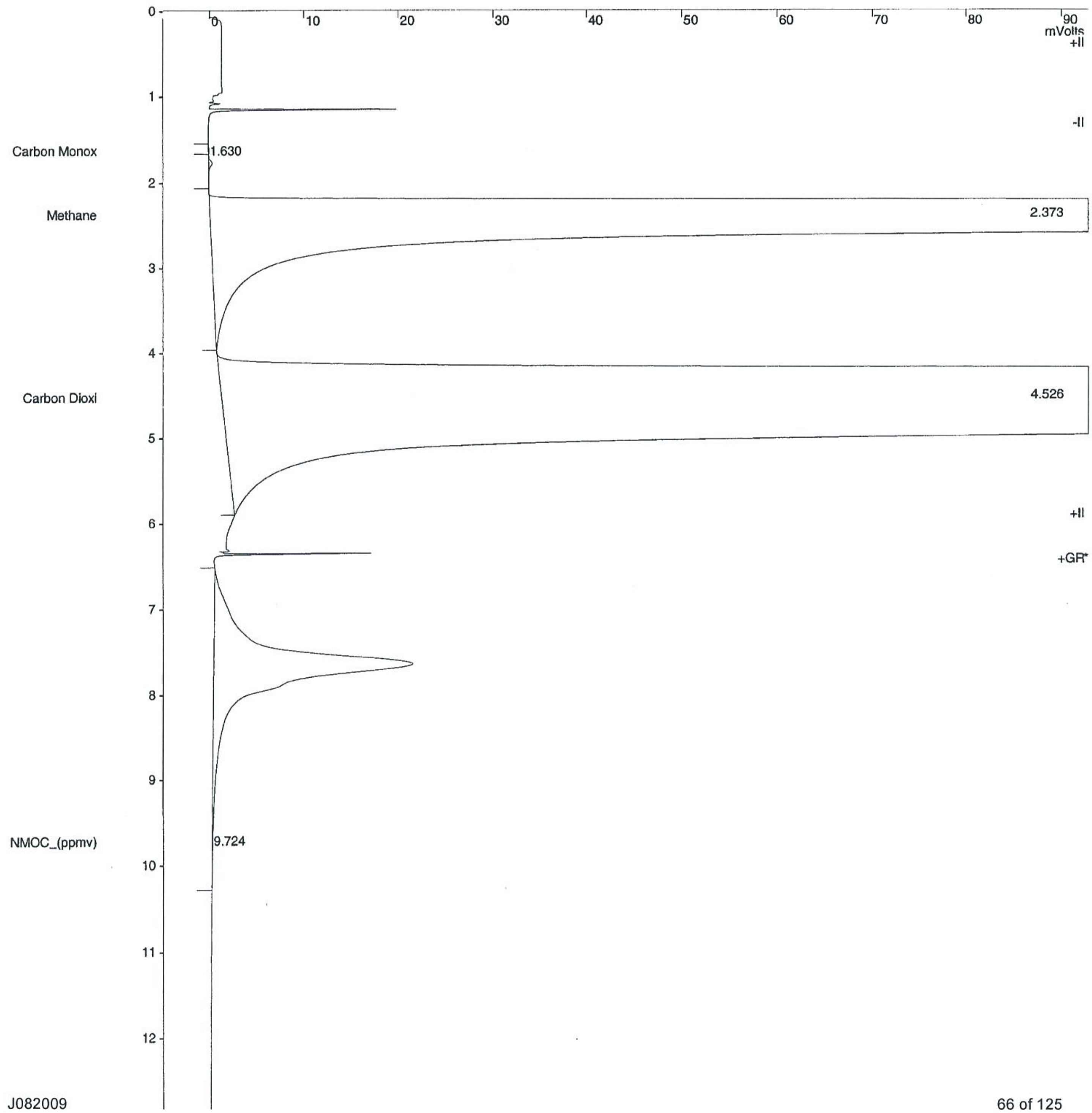
Title   : Fixed Gas from FID/NMOC
Run File   : i:\gc8a\2018\aug\23aug050.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-04 EA ENG

Injection Date: 8/24/2018 01:58   Calculation Date: 8/24/2018 02:11

Operator : AS	Detector Type: 3800 (10 Volts)
Workstation: DATAPART1	Bus Address : 44
Instrument : GC8A	Sample Rate : 10.00 Hz
Channel : Middle = FID	Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed = 1.53 cm/min	Attenuation = 40	Zero Offset = 5%
Start Time = 0.000 min	End Time = 13.088 min	Min / Tick = 1.00



Print Date: Fri Aug 24 02:11:10 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug050.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-04 EA ENG

Injection Date: 8/24/2018 01:58 Calculation Date: 8/24/2018 02:11

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000015	1.630	0.052	153	BV	4.5	
2	Methane	11.894177	2.373	0.001	123134664	PP	11.5	C
3	Carbon Dioxi	14.086224	4.526	-0.037	144995920	PB	18.5	C
4	NMOC_(ppmv)	472.500244	9.724	0.001	561930	GR	0.0	C
	Totals:	498.480660		0.017	268692667			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 1913 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -7 microVolts LSB: 1 microVolts

Noise (used): 10 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 02:11: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 10, Advance Time: 01:56:19

Original Notes:

****

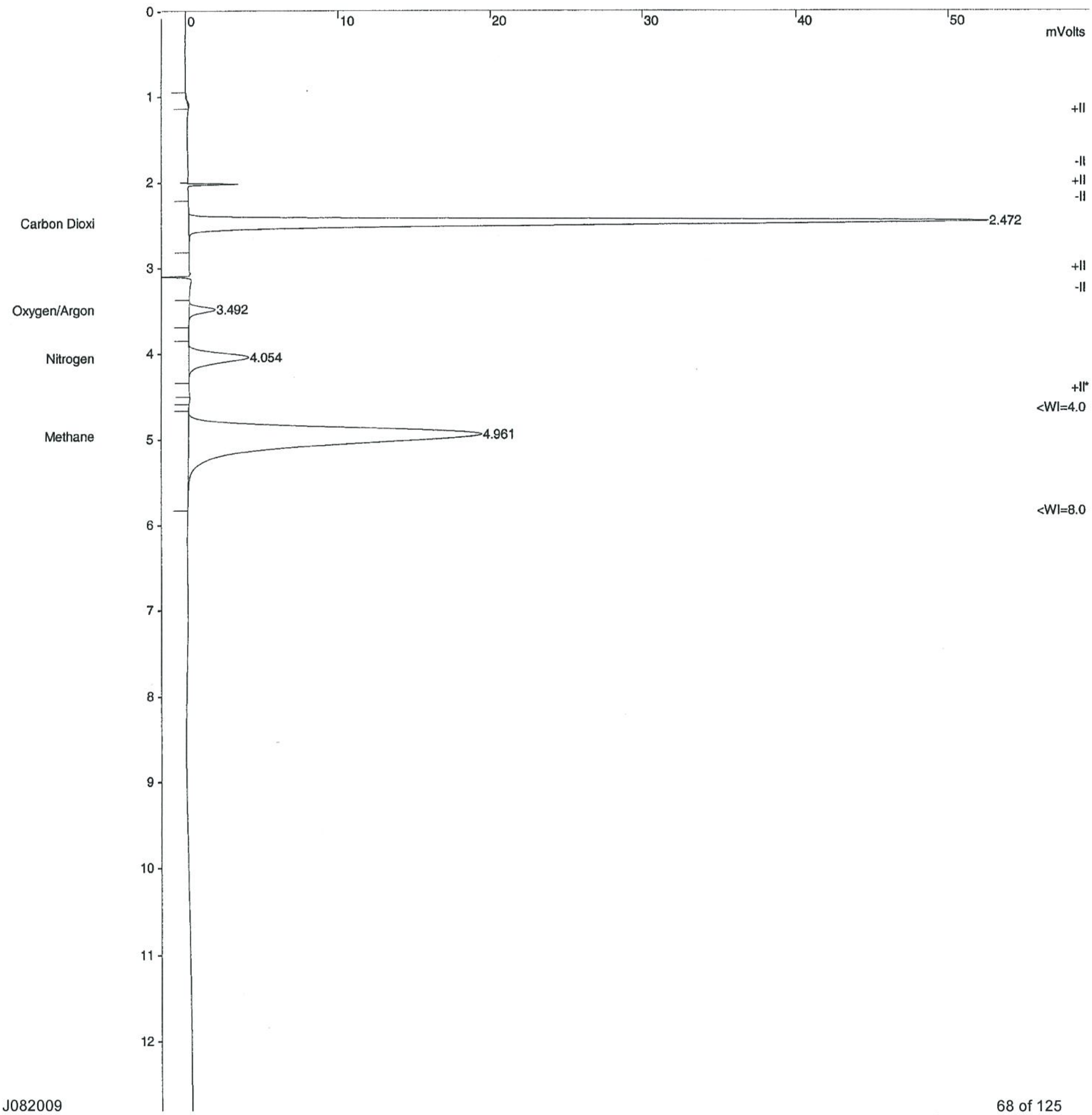
```
Title       : Fixed Gas from TCD
Run File    : i:\gc8a\2018\aug\23aug052.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-05 EA ENG

Injection Date: 8/24/2018 02:27    Calculation Date: 8/24/2018 02:40

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Front = TCD            Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 24          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 02:40:21 2018   Page 1 of 1

Title   : Fixed Gas from TCD
Run File   : i:\gc8a\2018\aug\23aug052.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-05 EA ENG

Injection Date: 8/24/2018 02:27   Calculation Date: 8/24/2018 02:40

Operator   : AS   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1   Bus Address : 44
Instrument : GC8A   Sample Rate : 10.00 Hz
Channel   : Front = TCD   Run Time   : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode   : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen		1.930					M
2	Carbon Dioxi	13.393999	2.472	0.027	249357	BB	4.5	
3	Oxygen/Argon	0.553435	3.492	-0.005	8058	BB	4.3	
4	Nitrogen	2.033714	4.054	-0.012	31349	BB	7.3	
5	Methane	20.614388	4.961	-0.036	266377	BB	12.4	
	Totals:	36.595536		-0.026	555141			

Status Codes:
M - Missing peak

109.6

Total Unidentified Counts :   282 counts

Detected Peaks: 6   Rejected Peaks: 0   Identified Peaks: 5

Multiplier: 1   Divisor: 1   Unidentified Peak Factor: 0

Baseline Offset: -1 microVolts   LSB: 1 microVolts

Noise (used): 7 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 02:40: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:25:30

Original Notes:

****

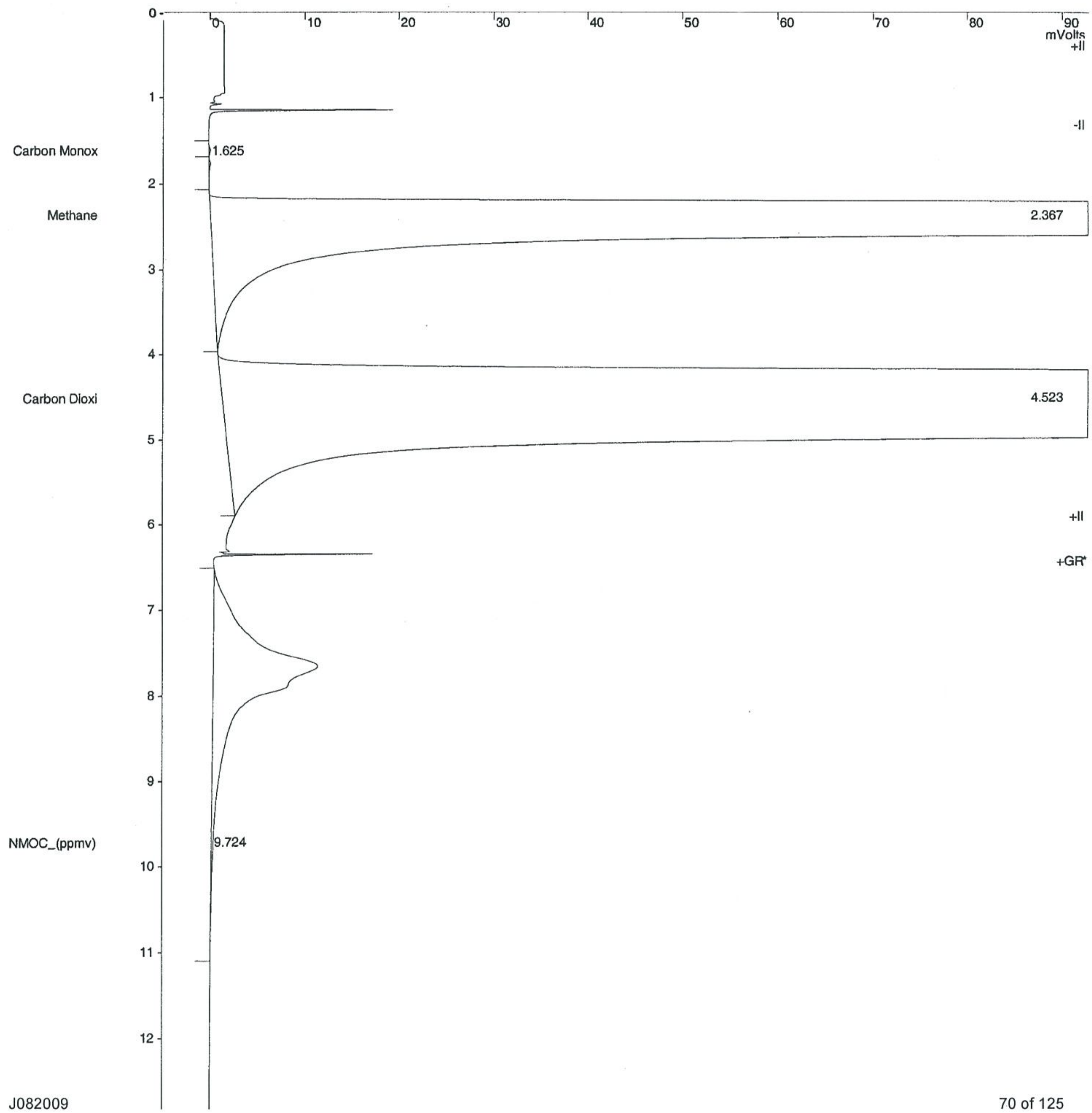
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug052.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-05 EA ENG

Injection Date: 8/24/2018 02:27    Calculation Date: 8/24/2018 02:40

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Middle = FID          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Print Date: Fri Aug 24 02:40:22 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug052.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-05 EA ENG

Injection Date: 8/24/2018 02:27 Calculation Date: 8/24/2018 02:40

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000066	1.625	0.047	672	BV	3.8	
2	Methane	12.357107	2.367	-0.005	127927152	PP	12.0	C
3	Carbon Dioxi	14.399894	4.523	-0.041	148224672	PB	18.6	C
4	NMOC_(ppmv)	433.891449	9.724	0.001	516014	GR	0.0	C
	Totals:	460.648516		0.002	276668510			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 971 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -6 microVolts LSB: 1 microVolts

Noise (used): 11 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 02:40: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:25:30

Original Notes:

****

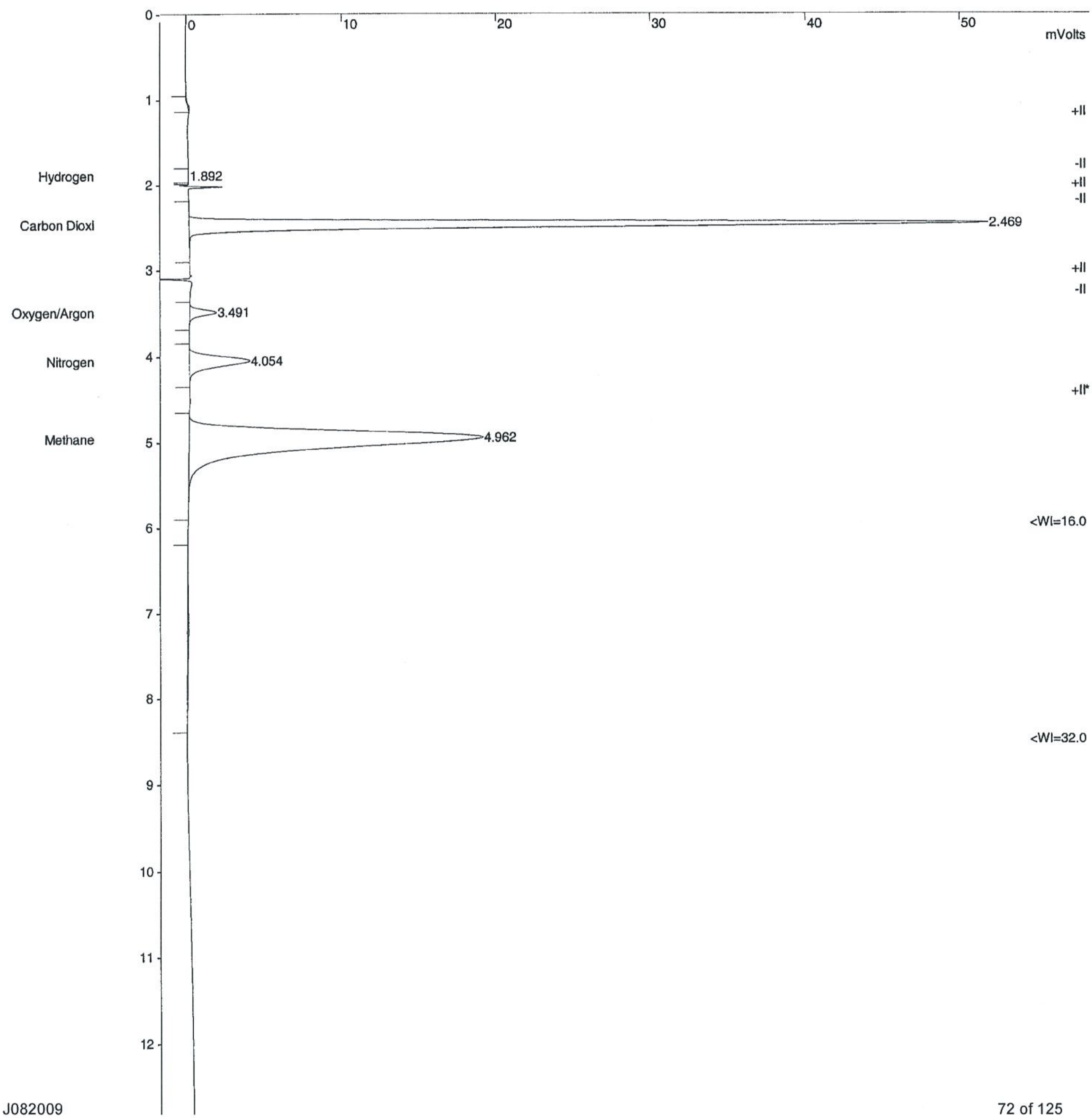
```
Title       : Fixed Gas from TCD
Run File    : i:\gc8a\2018\aug\23aug053.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-05 EA ENG

Injection Date: 8/24/2018 02:41    Calculation Date: 8/24/2018 02:54

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Front = TCD            Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 24          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug053.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-05 EA ENG

Injection Date: 8/24/2018 02:41 Calculation Date: 8/24/2018 02:54

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.240271	1.892	-0.038	58	BP	4.6	
2	Carbon Dioxi	13.194273	2.469	0.024	245639	BB	4.5	
3	Oxygen/Argon	0.539498	3.491	-0.006	7855	BB	4.3	
4	Nitrogen	1.983487	4.054	-0.012	30575	BB	7.3	
5	Methane	20.368279	4.962	-0.036	263197	BB	12.4	
	Totals:	36.325808		-0.068	547324			

Total Unidentified Counts : 4818 counts

Detected Peaks: 8 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: 0 microVolts LSB: 1 microVolts

Noise (used): 6 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 02:54: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:40:06

Original Notes:

****

Title   : Fixed Gas from FID/NMOC
Run File   : i:\gc8a\2018\aug\23aug053.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID   : J082009-05 EA ENG

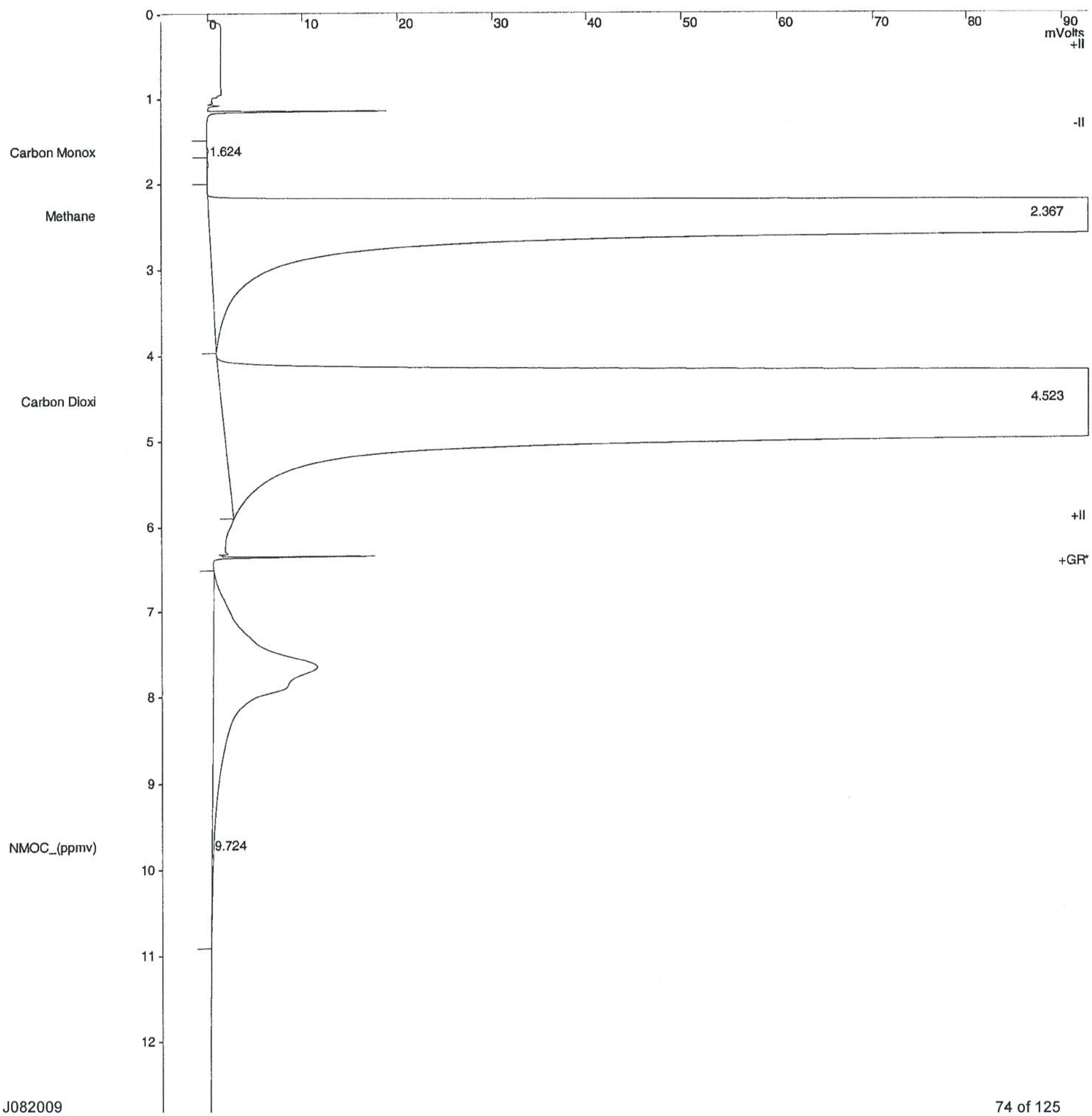
Injection Date: 8/24/2018 02:41   Calculation Date: 8/24/2018 02:54

Operator   : AS
Workstation: DATAPART1
Instrument : GC8A
Channel   : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time   : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =   1.53 cm/min   Attenuation = 40   Zero Offset = 5%
Start Time =   0.000   min   End Time   = 13.088 min   Min / Tick = 1.00



Print Date: Fri Aug 24 02:54:58 2018 Page 1 of 1

Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug053.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-05 EA ENG

Injection Date: 8/24/2018 02:41 Calculation Date: 8/24/2018 02:54

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000070	1.624	0.046	712	BV	3.8	
2	Methane	12.349093	2.367	-0.005	127844192	PP	12.0	C
3	Carbon Dioxi	14.379933	4.523	-0.040	148019216	PB	18.6	C
4	NMOC_(ppmv)	432.666901	9.724	0.001	514558	GR	0.0	C
	Totals:	459.395997		0.002	276378678			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 886 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -8 microVolts LSB: 1 microVolts

Noise (used): 8 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 02:54: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:40:06

Original Notes:

****

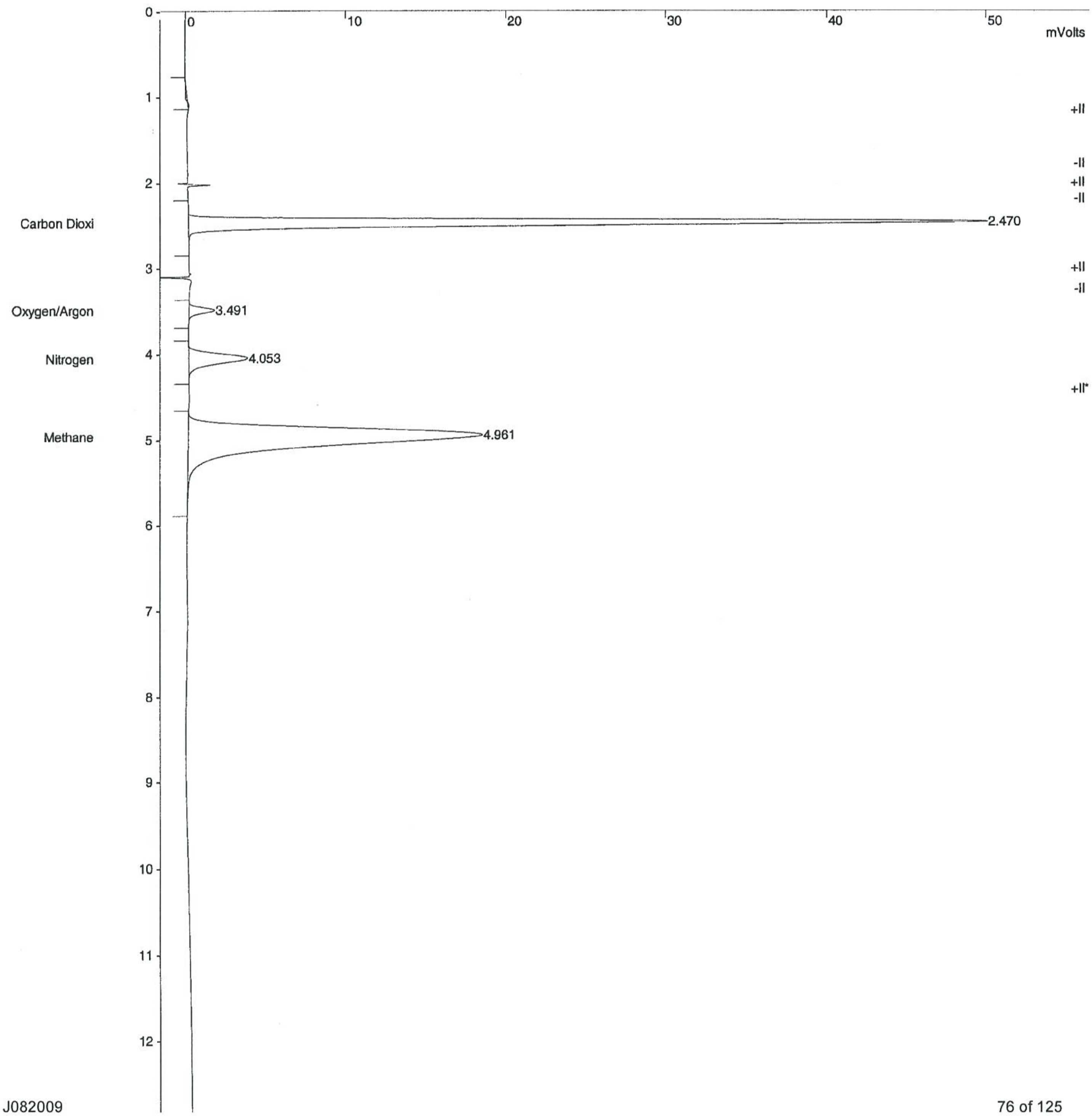
```
Title        : Fixed Gas from TCD
Run File     : i:\gc8a\2018\aug\23aug054.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-05 EA ENG

Injection Date: 8/24/2018 02:56    Calculation Date: 8/24/2018 03:09

Operator    : AS                   Detector Type: 3800 (10 Volts)
Workstation: DATAPART1             Bus Address  : 44
Instrument  : GC8A                 Sample Rate  : 10.00 Hz
Channel     : Front = TCD          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 23          Zero Offset = 2%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Title : Fixed Gas from TCD
Run File : i:\gc8a\2018\aug\23aug054.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-05 EA ENG

Injection Date: 8/24/2018 02:56 Calculation Date: 8/24/2018 03:09

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen		1.930					M
2	Carbon Dioxi	12.739395	2.470	0.025	237171	BB	4.5	
3	Oxygen/Argon	0.513296	3.491	-0.006	7474	BB	4.3	
4	Nitrogen	1.883909	4.053	-0.013	29040	BB	7.3	
5	Methane	19.651237	4.961	-0.036	253931	BB	12.4	
	Totals:	34.787837		-0.030	527616			

Status Codes:
M - Missing peak

Total Unidentified Counts : 0 counts

Detected Peaks: 5 Rejected Peaks: 1 Identified Peaks: 5

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -2 microVolts LSB: 1 microVolts

Noise (used): 6 microVolts - monitored before this run

Manual injection

Revision Log:

8/24/2018 03:09: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:54:41

Original Notes:

****

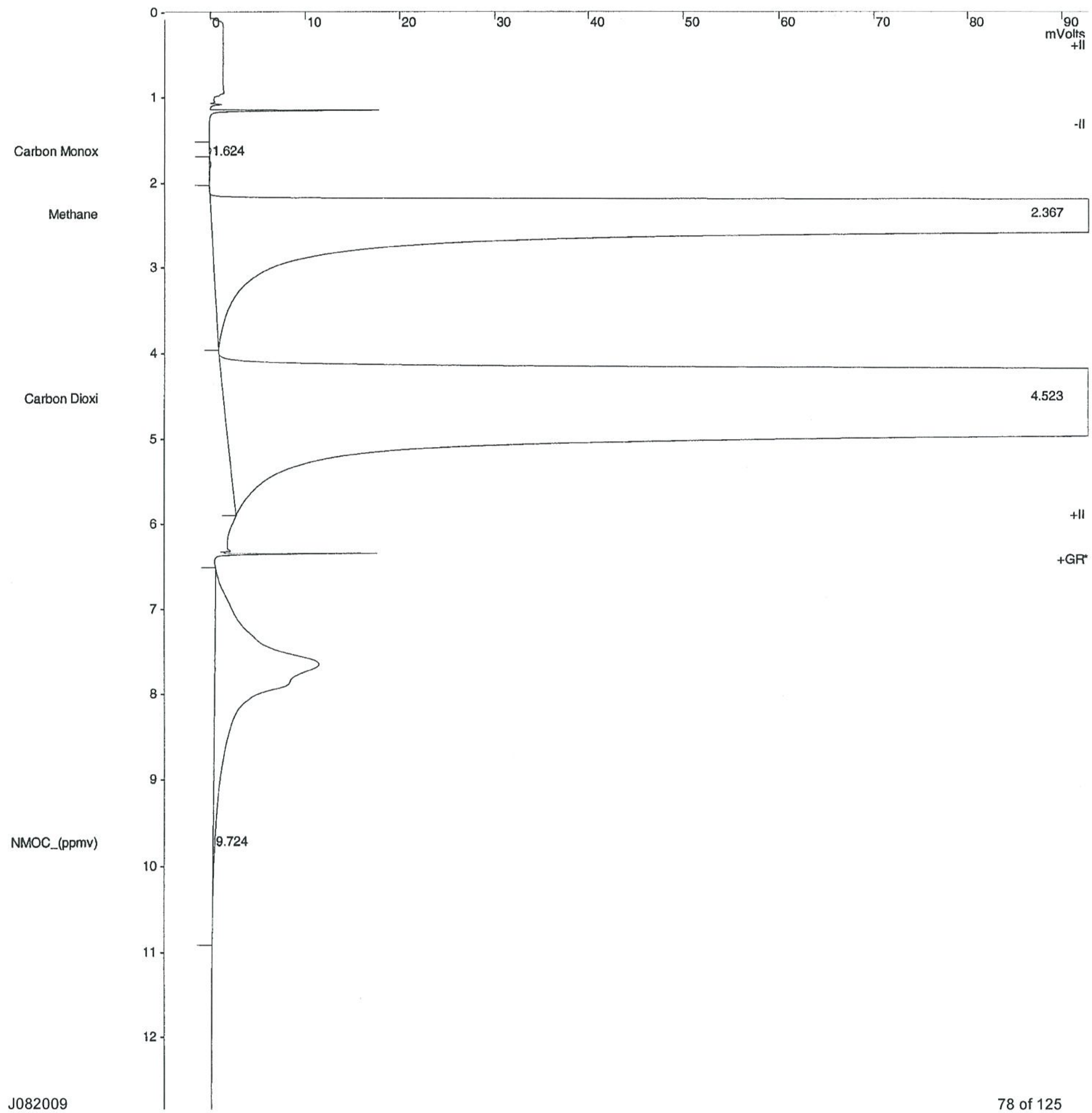
```
Title        : Fixed Gas from FID/NMOC
Run File     : i:\gc8a\2018\aug\23aug054.run
Method File  : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID    : J082009-05 EA ENG

Injection Date: 8/24/2018 02:56    Calculation Date: 8/24/2018 03:09

Operator    : AS                    Detector Type: 3800 (10 Volts)
Workstation: DATAPART1              Bus Address  : 44
Instrument : GC8A                   Sample Rate  : 10.00 Hz
Channel     : Middle = FID          Run Time     : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Chart Speed =    1.53 cm/min   Attenuation = 40           Zero Offset = 5%
Start Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Title : Fixed Gas from FID/NMOC
Run File : i:\gc8a\2018\aug\23aug054.run
Method File : i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth
Sample ID : J082009-05 EA ENG

Injection Date: 8/24/2018 02:56 Calculation Date: 8/24/2018 03:09

Operator : AS
Workstation: DATAPART1
Instrument : GC8A
Channel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

** GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000072	1.624	0.046	739	BV	3.9	
2	Methane	12.349253	2.367	-0.005	127845832	PP	12.0	C
3	Carbon Dioxi	14.364601	4.523	-0.040	147861392	PB	18.6	C
4	NMOC_(ppmv)	433.509460	9.724	0.001	515560	GR	0.0	C
	Totals:	460.223386		0.002	276223523			

Status Codes:
C - Out of calibration range

Total Unidentified Counts : 938 counts

Detected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -10 microVolts LSB: 1 microVolts

Noise (used): 6 microVolts - monitored before this run

Manual injection

Calib. out of range; No Recovery Action Specified

Revision Log:

8/24/2018 03:09: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc calib\nmoc fixed_180627_nmoc180823.mth'
Stream: 11, Advance Time: 02:54:41

Original Notes:

****

3. Initial Calibration

a. ICAL Summary
b. Chromatograms/Results

J082009

a	:	Calibration Block Report			
od File	:	\\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth			
Method Time	:	7/5/2018 08:22			
quested Curve Type	:	linear	Method Detector Type	:	3800 GC
quested Origin	:	force	Method Bus Address	:	44
ibration Type	:	External Standard Analysis	Method Channel	:	Front
ibration Dates					
t Injection Date	:	8/12/2016 15:28	Last Recalculation Date	:	8/29/2016 14:10

********************GC Workstation Multi Instrument********************Version 6.30********************************

tention ne (min)	Peak Name	Curve\ Origin	X³	X²	X	C	r²	Cal. Range	No. of Points	Edit Codes
1.930	Hydrogen	1 F			+2.3992e+002	+0.0000e+000	+9.9632e-001	Locked		
2.445	Carbon Dioxide	1 F			+1.8617e+004	+0.0000e+000	+9.9981e-001	Locked		
3.456	Oxygen/Argon	1 F			+1.4561e+004	+0.0000e+000	+9.9999e-001	Locked		
3.933	Nitrogen	1 F			+1.5415e+004	+0.0000e+000	+9.9999e-001	Locked		
4.997	Methane	1 F			+1.2922e+004	+0.0000e+000	+9.9996e-001	Locked		

Curve Codes	Origin Codes	Edit Codes
1 linear	I include	1 curve
2 quadratic	IG ignore	2 origin
3 cubic	F force	3 coefficient

t. Time: 1.930 min. Locked Peak Measurement: Area
ak Name: Hydrogen Curve\Origin: 1 F

vel	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	1.000000	1	295	295.5	#
2	5.000000	1	1359	1359.1	#
3	7.000000	1	1919	1918.8	#
4	10.000000	1	2585	2585.1	#
5	25.000000	1	5822	5822.4	#

t. Time: 2.445 min. Locked Peak Measurement: Area
ak Name: Carbon Dioxide Curve\Origin: 1 F

vel	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.500000	1	8929	8929.4	#
2	5.000000	1	85991	85990.8	#
3	25.000000	1	464867	464867.1	#
4	50.000000	1	910186	910185.8	#
5	100.000000	1	1872541	1872540.8	#

t. Time: 3.456 min. Locked Peak Measurement: Area
ak Name: Oxygen/Argon Curve\Origin: 1 F

vel	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.438000	1	7782	7781.6	#
2	2.190000	1	32432	32431.8	#
3	10.900000	1	158697	158696.6	#
4	21.900000	1	318802	318801.8	#

t. Time: 3.933 min. Locked Peak Measurement: Area
ak Name: Nitrogen Curve\Origin: 1 F

vel	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	1.560000	1	29017	29017.0	#
2	7.810000	1	122901	122900.8	#

t Date: 05 Jul 2018 08:53:09

J082009

3	39.099998	1	604517	604517.1	#
4	78.099998	1	1202735	1202734.9	#
5	100.000000	1	1541320	1541320.4	#
6	1.000000	1	19879	19878.5	#

. Time: 4.997 min. Locked Peak Measurement: Area
ık Name: Methane Curve\Origin: 1 F

el	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.500000	1	6183	6182.6	#
2	5.000000	1	60996	60995.7	#
3	25.000000	1	321422	321422.2	#
4	50.000000	1	639578	639578.3	#
5	100.000000	1	1296035	1296034.5	#

Too few points to calculate.

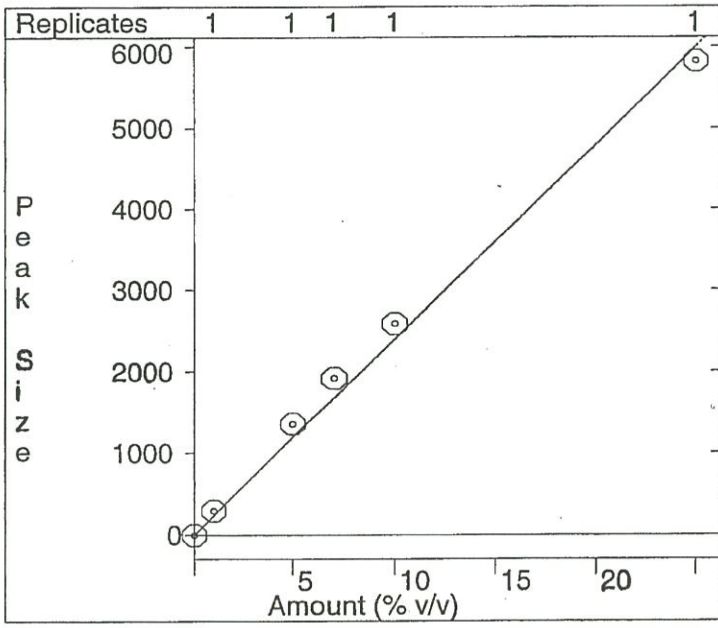
ık Name	Level	Rep.	Injection Date Time	Run Files
ɟrogen	1 L	1	7/11/2016 15:18	c:\temp gc\gc8a\2016\jul\11jul011.run
	2 L	1	7/11/2016 15:33	c:\temp gc\gc8a\2016\jul\11jul012.run
	3 L	1	7/11/2016 15:47	c:\temp gc\gc8a\2016\jul\11jul013.run
	4 L	1	7/11/2016 16:02	c:\temp gc\gc8a\2016\jul\11jul014.run
	5 L	1	7/11/2016 16:31	c:\temp gc\gc8a\2016\jul\11jul016.run
rbon Dioxide	1 L	1	7/11/2016 13:11	c:\temp gc\gc8a\2016\jul\11jul004.run
	2 L	1	7/11/2016 13:57	c:\temp gc\gc8a\2016\jul\11jul006.run
	3 L	1	7/11/2016 14:12	c:\temp gc\gc8a\2016\jul\11jul007.run
	4 L	1	7/11/2016 14:26	c:\temp gc\gc8a\2016\jul\11jul008.run
	5 L	1	7/11/2016 14:41	c:\temp gc\gc8a\2016\jul\11jul009.run
ygen/Argon	1 L	1	7/11/2016 15:18	c:\temp gc\gc8a\2016\jul\11jul011.run
	2 L	1	7/11/2016 15:33	c:\temp gc\gc8a\2016\jul\11jul012.run
	3 L	1	7/11/2016 15:47	c:\temp gc\gc8a\2016\jul\11jul013.run
	4 L	1	7/11/2016 16:17	c:\temp gc\gc8a\2016\jul\11jul015.run
rogen	1 L	1	7/11/2016 15:18	c:\temp gc\gc8a\2016\jul\11jul011.run
	2 L	1	7/11/2016 15:33	c:\temp gc\gc8a\2016\jul\11jul012.run
	3 L	1	7/11/2016 15:47	c:\temp gc\gc8a\2016\jul\11jul013.run
	4 L	1	7/11/2016 16:17	c:\temp gc\gc8a\2016\jul\11jul015.run
	5 L	1	7/11/2016 16:46	c:\temp gc\gc8a\2016\jul\11jul017.run
	6 L	1	8/12/2016 15:28	c:\temp gc\gc8a\2016\aug\12aug027.run
thane	1 L	1	7/11/2016 13:11	c:\temp gc\gc8a\2016\jul\11jul004.run
	2 L	1	7/11/2016 13:57	c:\temp gc\gc8a\2016\jul\11jul006.run
	3 L	1	7/11/2016 14:12	c:\temp gc\gc8a\2016\jul\11jul007.run
	4 L	1	7/11/2016 14:26	c:\temp gc\gc8a\2016\jul\11jul008.run
	5 L	1	7/11/2016 14:56	c:\temp gc\gc8a\2016\jul\11jul010.run

: Locked Coefficients

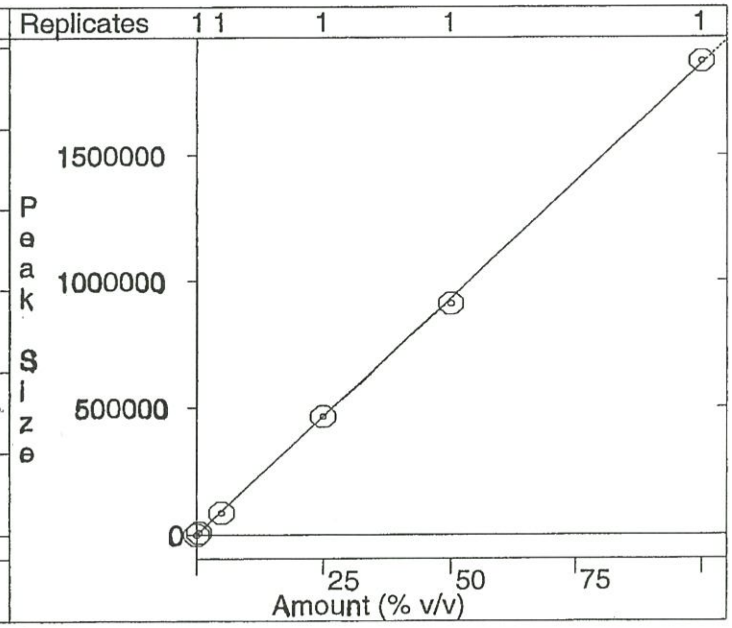
. Date: 05 Jul 2018 08:53:09

Print Date: 05 Jul 2018 08:53:10
Calibration Curves Report - Page 1
File: \\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
Detector: 3800 GC, Address: 44, Channel ID: Front

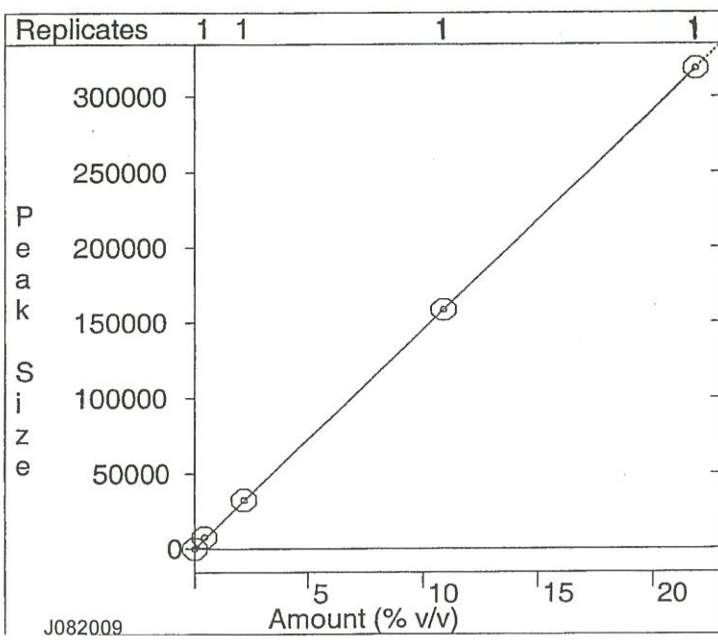
Hydrogen
External Standard Analysis - Locked
Resp. Fact. RSD: 8.632%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.996320
y = +2.3992e+002x



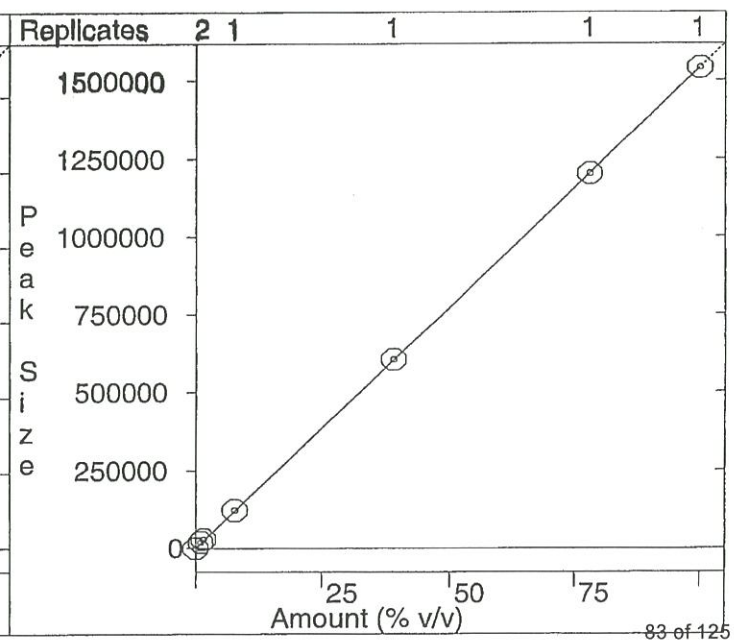
Carbon Dioxide
External Standard Analysis - Locked
Resp. Fact. RSD: 3.399%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999813
y = +1.8617e+004x



Oxygen/Argon
External Standard Analysis - Locked
Resp. Fact. RSD: 10.16%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999985
y = +1.4561e+004x

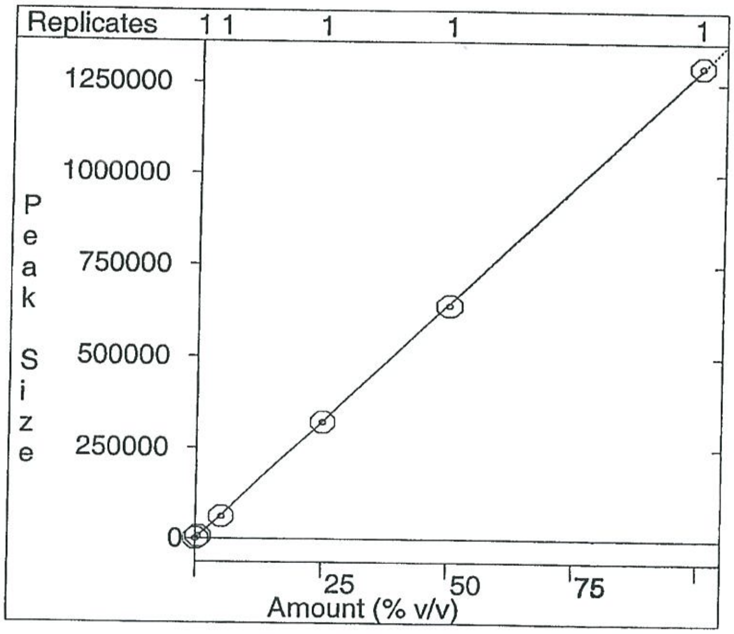


Nitrogen
External Standard Analysis - Locked
Resp. Fact. RSD: 11.79%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999993
y = +1.5415e+004x



Print Date: 05 Jul 2018 08:53:10
Calibration Curves Report - Page 2
File: \\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
Detector: 3800 GC, Address: 44, Channel ID: Front

Methane
External Standard Analysis - Locked
Resp. Fact. RSD: 2.632%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999958
y = +1.2922e+004x



	:	Calibration Block Report
od File	:	\\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
Method Time	:	7/5/2018 08:22

uested Curve Type	:	linear	Method Detector Type	:	3800 GC
uested Origin	:	force	Method Bus Address	:	44
bration Type	:	External Standard Analysis	Method Channel	:	Middle

bration Dates

Injection Date	:	6/27/2018 17:19	Last Recalculation Date	:	6/28/2018 09:16

*********************GC Workstation Multi Instrument*********************Version 6.30**********************************

ention e (min)	Peak Name	Curve\ Origin	X³	X²	X	C	r²	Cal. Range	No. of Points	Edit Codes
1.768	Carbon Monoxide	1 F			+1.0233e+007	+0.0000e+000	+9.9984e-001	Locked		
2.369	Methane	1 F			+1.0353e+007	+0.0000e+000	+9.9982e-001	Locked		
4.558	Carbon Dioxide	1 F			+1.0293e+007	+0.0000e+000	+9.9980e-001	Locked		
9.723	NMOC_(ppmv)	1 F			+1.1439e+003	+0.0000e+000	+9.9947e-001	Locked		

Curve Codes	Origin Codes	Edit Codes
1 linear	I include	1 curve
2 quadratic	IG ignore	2 origin
3 cubic	F force	3 coefficient

. Time: 1.768 min. Locked Peak Measurement: Area
k Name: Carbon Monoxide Curve\Origin: 1 F

el	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.000100	1	1449	1449.2	#
2	0.001000	1	9544	9543.9	#
3	0.010000	1	95963	95963.3	#
4	0.100000	1	985214	985213.7	#
5	0.500000	1	5006934	5006934.0	#
6	1.000000	1	10291208	10291208.0	#

. Time: 2.369 min. Locked Peak Measurement: Area
k Name: Methane Curve\Origin: 1 F

el	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.000100	1	247	246.8	#
2	0.001000	1	9268	9268.2	#
3	0.010000	1	96591	96590.7	#
4	0.100000	1	996839	996839.0	#
5	0.500000	1	5060043	5060043.0	#
6	1.000000	1	10414535	10414535.0	#

. Time: 4.558 min. Locked Peak Measurement: Area
k Name: Carbon Dioxide Curve\Origin: 1 F

el	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
1	0.000100	1	4550	4550.4	#
2	0.001000	1	12437	12437.1	#
3	0.010000	1	96521	96521.4	#
4	0.100000	1	991483	991482.9	#
5	0.500000	1	5025025	5025025.0	#
6	1.000000	1	10358155	10358155.0	#

Time: 9.723 min. Locked Peak Measurement: Area

Name: NMOC_(ppmv) Curve\Origin: 1 F

	Amount	Replicate No.	Response	Avg. Response	Std. Dev.
	29.969999	1	38062		
	29.969999	2	38743		
1	29.969999	3	37870	38225.4	458.79
2	299.700012	1	390338		
2	299.700012	2	388535		
2	299.700012	3	388525	389132.8	1043.51
3	2997.000000	1	3704182		
3	2997.000000	2	3642229		
3	2997.000000	3	3640684	3662364.7	36222.67
4	9999.000000	1	11394963		
4	9999.000000	2	11345066		
4	9999.000000	3	11358176	11366068.3	25867.82

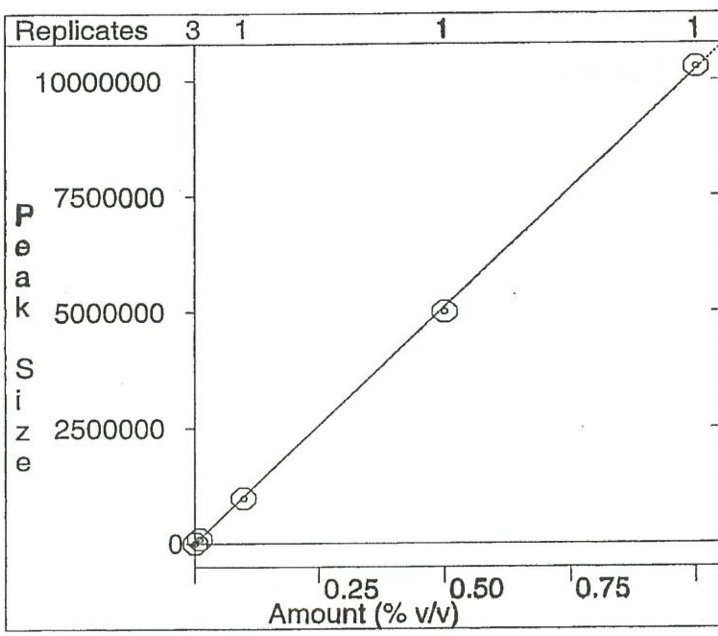
Too few points to calculate.

k Name	Level	Rep.	Injection Date Time	Run Files
bon Monoxide	1 L	1	7/11/2016 10:20	c:\temp gc\gc8a\2016\jul\08jul031.run
	2 L	1	7/11/2016 10:35	c:\temp gc\gc8a\2016\jul\08jul032.run
	3 L	1	7/11/2016 10:49	c:\temp gc\gc8a\2016\jul\08jul033.run
	4 L	1	7/11/2016 11:04	c:\temp gc\gc8a\2016\jul\08jul034.run
	5 L	1	7/11/2016 11:19	c:\temp gc\gc8a\2016\jul\08jul035.run
	6 L	1	7/11/2016 11:33	c:\temp gc\gc8a\2016\jul\08jul036.run
hane	1 L	1	7/11/2016 10:20	c:\temp gc\gc8a\2016\jul\08jul031.run
	2 L	1	7/11/2016 10:35	c:\temp gc\gc8a\2016\jul\08jul032.run
	3 L	1	7/11/2016 10:49	c:\temp gc\gc8a\2016\jul\08jul033.run
	4 L	1	7/11/2016 11:04	c:\temp gc\gc8a\2016\jul\08jul034.run
	5 L	1	7/11/2016 11:19	c:\temp gc\gc8a\2016\jul\08jul035.run
	6 L	1	7/11/2016 11:33	c:\temp gc\gc8a\2016\jul\08jul036.run
bon Dioxide	1 L	1	7/11/2016 10:20	c:\temp gc\gc8a\2016\jul\08jul031.run
	2 L	1	7/11/2016 10:35	c:\temp gc\gc8a\2016\jul\08jul032.run
	3 L	1	7/11/2016 10:49	c:\temp gc\gc8a\2016\jul\08jul033.run
	4 L	1	7/11/2016 11:04	c:\temp gc\gc8a\2016\jul\08jul034.run
	5 L	1	7/11/2016 11:19	c:\temp gc\gc8a\2016\jul\08jul035.run
	6 L	1	7/11/2016 11:33	c:\temp gc\gc8a\2016\jul\08jul036.run
OC_(ppmv)	1 L	1	6/27/2018 16:06	i:\gc8a\2018\jun\27jun025.run
	1 L	2	6/27/2018 16:21	i:\gc8a\2018\jun\27jun026.run
	1 L	3	6/27/2018 16:35	i:\gc8a\2018\jun\27jun027.run
	2 L	1	6/27/2018 12:22	i:\gc8a\2018\jun\27jun014.run
	2 L	2	6/27/2018 12:36	i:\gc8a\2018\jun\27jun015.run
	2 L	3	6/27/2018 12:51	i:\gc8a\2018\jun\27jun016.run
	3 L	1	6/27/2018 13:46	i:\gc8a\2018\jun\27jun019.run
	3 L	2	6/27/2018 14:00	i:\gc8a\2018\jun\27jun020.run
	3 L	3	6/27/2018 14:15	i:\gc8a\2018\jun\27jun021.run
	4 L	1	6/27/2018 16:50	i:\gc8a\2018\jun\27jun028.run
	4 L	2	6/27/2018 17:04	i:\gc8a\2018\jun\27jun029.run
	4 L	3	6/27/2018 17:19	i:\gc8a\2018\jun\27jun030.run

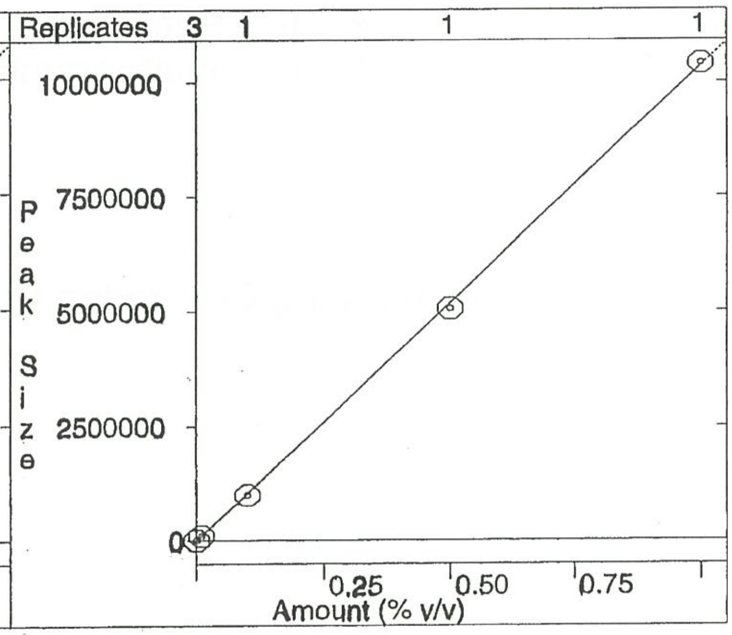
Locked Coefficients

Print Date: 05 Jul 2018 08:53:10
Calibration Curves Report
File: \\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
Detector: 3800 GC, Address: 44, Channel ID: Middle

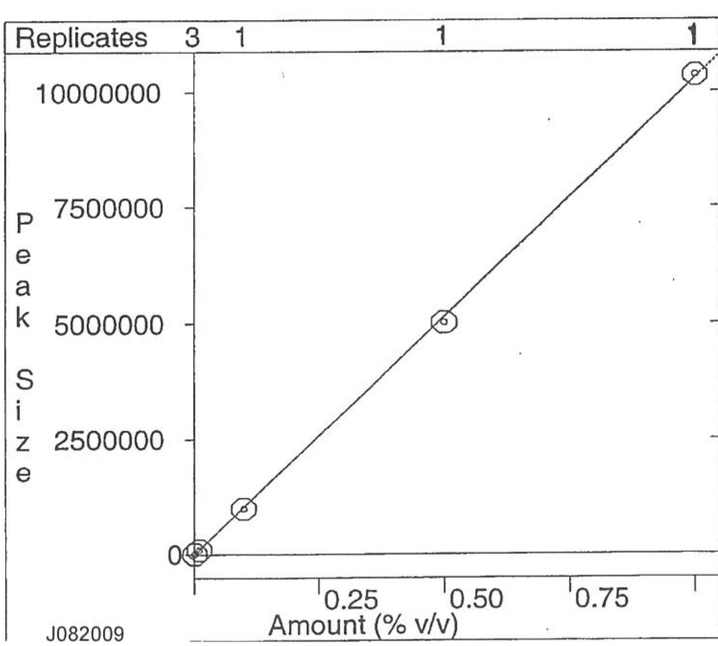
Carbon Monoxide
External Standard Analysis - Locked
Resp. Fact. RSD: 17.98%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999839
y = +1.0233e+007x



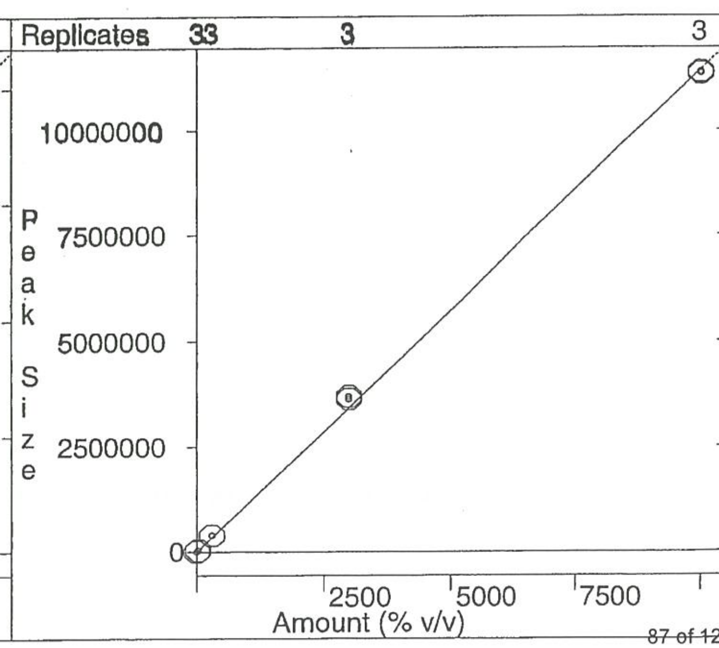
Methane
External Standard Analysis - Locked
Resp. Fact. RSD: 35.30%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999825
y = +1.0353e+007x



Carbon Dioxide
External Standard Analysis - Locked
Resp. Fact. RSD: 87.83%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999803
y = +1.0293e+007x



NMOC_(ppmv)
External Standard Analysis - Locked
Resp. Fact. RSD: 5.823%
Curve Type: Linear
Origin: Force
Coeff. Det.(r^2): 0.999467
y = +1.1439e+003x



4. Initial Calibration Verification

a. ICV Summary
b. Chromatograms/Results

Continuing Calibration Criteria:

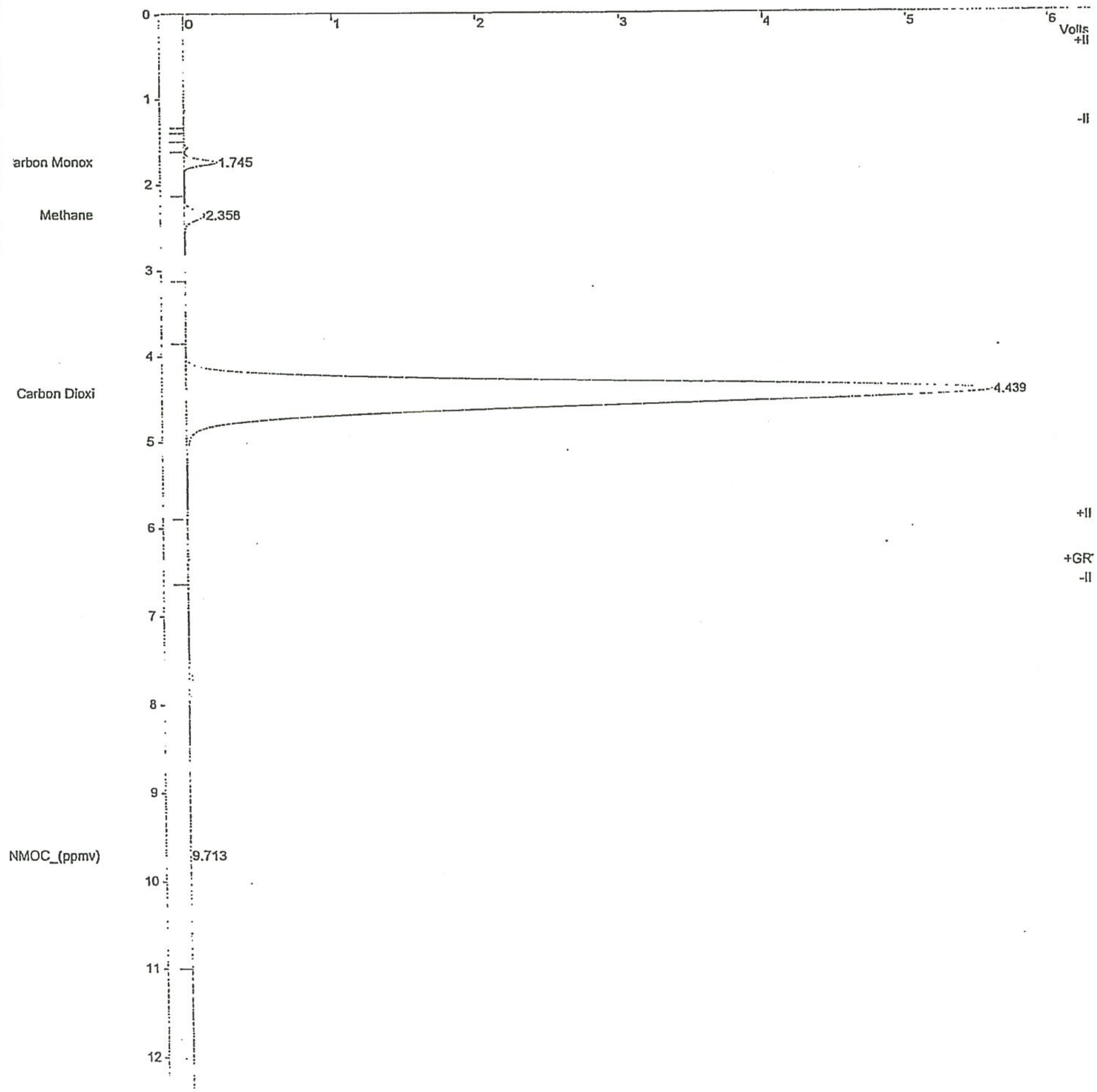
:
le : c:\temp gc\gc8a\2016\jul\12jul.run
File : c:\temp gc\gc8a\methods\nmoc fixed_160711.mth
ID : ICV

ion Date: 7/12/2016 11:22   Calculation Date: 7/12/2016 11:36

or : AS   Detector Type: 3800 (10 Volts)
ation: Bus Address : 44
ment : GC8A   Sample Rate : 10.00 Hz
l : Middle = FID   Run Time : 13.088 min

Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Speed = 1.53 cm/min   Attenuation = 2652   Zero Offset = 2%
Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



```
e           :
 File       : c:\temp gc\gc8a\2016\jul\12jul.run
od File     : c:\temp gc\gc8a\methods\nmoc fixed_160711.mth
le ID       : ICV

tion Date: 7/12/2016 11:22      Calculation Date: 7/12/2016 11:36

ator      : AS                   Detector Type: 3800 (10 Volts)
station:                         Bus Address  : 44
rument  : GC8A                   Sample Rate  : 10.00 Hz
nel     : Middle = FID           Run Time     : 13.088 min

C Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

 Mode          : Analysis - Subtract Blank Baseline
 Measurement: Peak Area
ulation Type: External Standard
```

ak o.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.105600	1.745	0.003	1080566	VV	4.5	
2	Methane	0.103885	2.358	0.003	1075471	VB	7.5	
3	Carbon Dioxi	10.384848	4.439	-0.066	106895968	BB	17.8	C
4	NMOC_(ppmv)	1239.40222	9.713	0.000	694536	GR	0.0	
	Totals:	1249.99655		-0.060	109746541			

```
tus Codes:
 Out of calibration range

al Unidentified Counts :       62269 counts

ected Peaks: 6          Rejected Peaks: 0       Identified Peaks: 4

tiplier: 1          Divisor: 1          Unidentified Peak Factor: 0

eline Offset: 56 microVolts          LSB:     1 microVolts

se (used): 10 microVolts - monitored before this run

ual injection

ib. out of range; No Recovery Action Specified

ision Log:

eam: 3, Advance Time: 17:13:44 7/12/2016 11:36: Calculated results from channel Middle using method:
  'c:\temp gc\gc8a\methods\nmoc fixed_160711.mth'

****************************************************************************
```

1082009

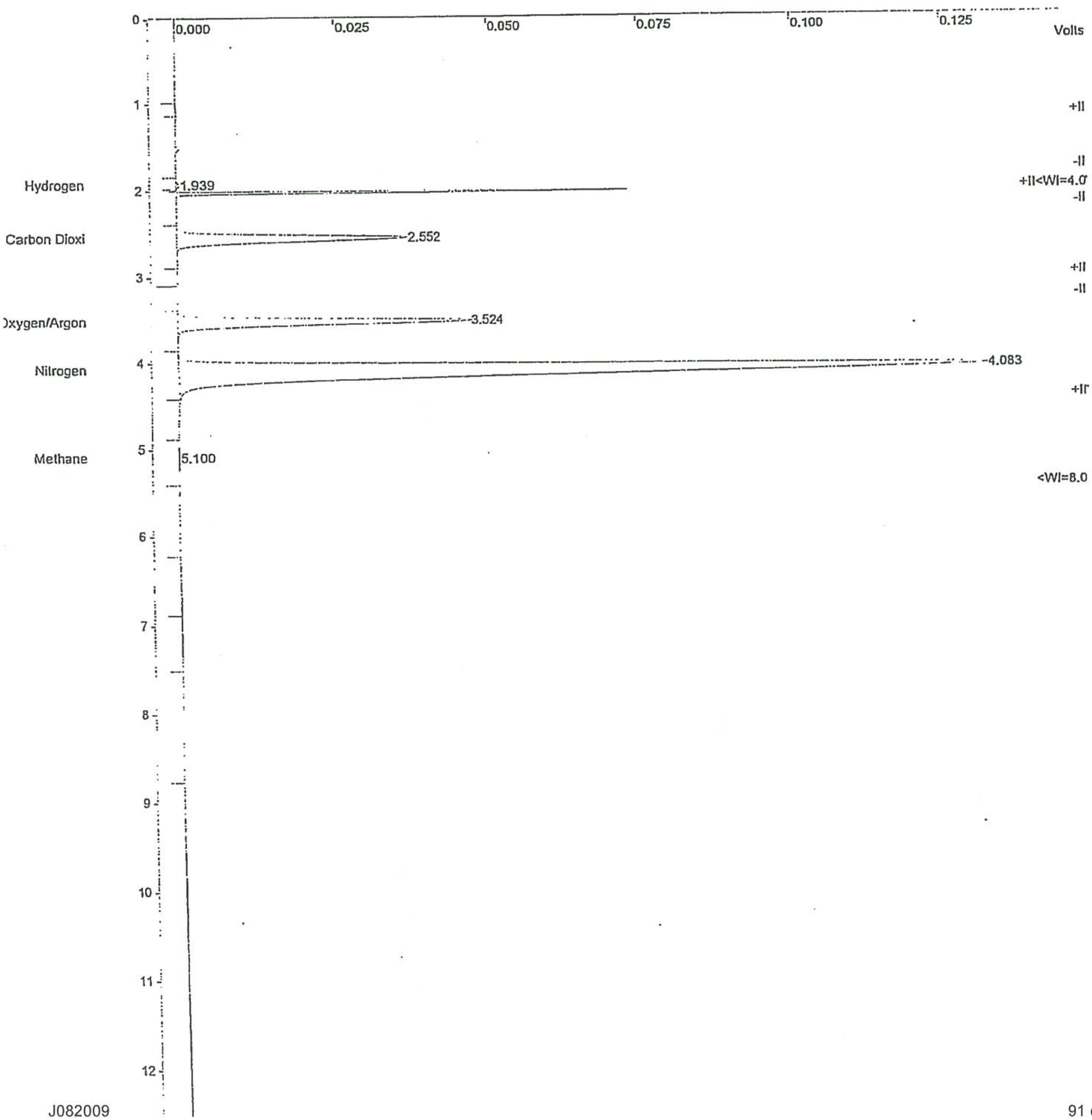
:
le : c:\temp gc\gc8a\2016\jul\12jul.run
File : c:\temp gc\gc8a\methods\nmoc fixed_160711.mth
ID : ICV

ion Date: 7/12/2016 11:22   Calculation Date: 7/12/2016 11:36

or : AS   Detector Type: 3800 (10 Volts)
ation: Bus Address : 44
ment : GC8A   Sample Rate : 10.00 Hz
l : Front = TCD   Run Time : 13.088 min

Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Speed = 1.53 cm/min   Attenuation = 63   Zero Offset = 3%
Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



J082009

```
File     : c:\temp gc\gc8a\2016\jul\12jul.run
.od File : c:\temp gc\gc8a\methods\nmoc fixed_160711.mth
le ID    : ICV

tion Date: 7/12/2016 11:22     Calculation Date: 7/12/2016 11:36

ator    : AS                    Detector Type: 3800 (10 Volts)
station:                        Bus Address  : 44
rument : GC8A                   Sample Rate  : 10.00 Hz
nel     : Front = TCD           Run Time     : 13.088 min

C Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Mode          : Analysis
: Measurement: Peak Area
ulation Type: External Standard
```

k .	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	5.608941	1.939	0.009	1346	BB	2.5	
2	Carbon Dioxi	10.120130	2.552	-0.046	188407	BB	4.8	
3	Oxygen/Argon	15.463351	3.524	0.006	225156	BP	4.4	
4	Nitrogen	70.980759	4.083	0.030	1094118	PB	7.7	
5	Methane	0.092556	5.100	0.102	1196	BB	11.0	
	Totals:	102.265737		0.101	1510223			

```
.l Unidentified Counts :       10647 counts

cted Peaks: 9          Rejected Peaks: 0       Identified Peaks: 5

iplier: 1          Divisor: 1          Unidentified Peak Factor: 0

line Offset: -33 microVolts          LSB:     1 microVolts

e (used): 4 microVolts - monitored before this run

al injection

sion Log:

eam: 3, Advance Time: 17:13:44 7/12/2016 11:36: Calculated results from channel Front using method:
 'c:\temp gc\gc8a\methods\nmoc fixed_160711.mth'

**************************************************************************
```

itle : Fixed Gas from FID/NMOC
ın File : i:\gc8a\2018\jun\27jun031.run
ethod File : \\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
ample ID : 300 PPMV NMOC ICV

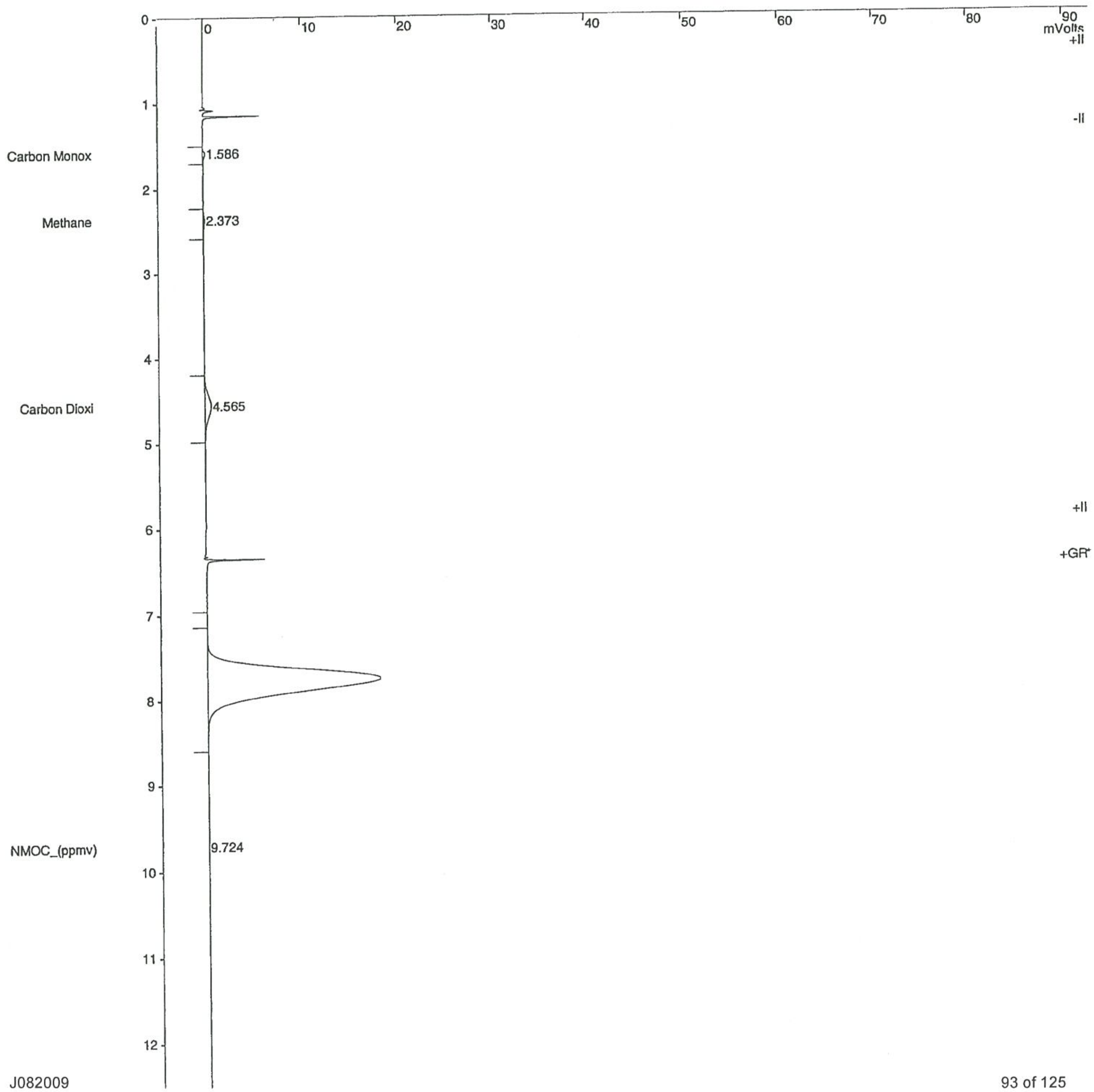
ıjection Date: 6/27/2018 17:34 Calculation Date: 6/28/2018 09:17

perator : AS
orkstation:
nstrument : GC8A
hannel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

hart Speed = 1.53 cm/min Attenuation = 40 Zero Offset = 5%
tart Time = 0.000 min End Time = 13.088 min Min / Tick = 1.00



Verification Report

J082009

```
        : Fixed Gas from FID/NMOC
'ile    : i:\gc8a\2018\jun\27jun031.run
od File : \\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth
le ID   : 300 PPMV NMOC ICV

ction Date: 6/27/2018 17:34     Calculation Date: 6/28/2018 09:17

ator    : AS                     Detector Type: 3800 (10 Volts)
station:                         Bus Address  : 44
rument : GC8A                    Sample Rate  : 10.00 Hz
nel     : Middle = FID           Run Time     : 13.088 min

C Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Mode             : Verification
 Measurement: Peak Area
ulation Type: External Standard
l                : 2
rance            : 25.0%
```

k .	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000115	88.5	1.586	-0.182	1179	V
2	Methane	0.001000	0.000108	89.2	2.373	0.004	1120	V
3	Carbon Dioxi	0.001000	0.001166	16.6	4.565	0.007	12003	
4	NMOC_(ppmv)	299.700012	296.046631	1.2	9.724	0.001	338642	
	Totals:		296.048020			-0.170	352944	

```
:us Codes:
 Out of verification tolerance

al Unidentified Counts :            0 counts

ected Peaks: 5          Rejected Peaks: 0        Identified Peaks: 4

tiplier: 1          Divisor: 1          Unidentified Peak Factor: 0

eline Offset: -19 microVolts          LSB:     1 microVolts

se (used): 10 microVolts - monitored before this run

ual injection

ification Failure; No Recovery Action Specified

ision Log:

7/2018 17:47: Calculated results from channel Middle using method:
 '\\airtech-server\insdata\gc8a\methods\nmoc fixed_161212bu_c.mth'
eam: 5, Advance Time: 17:32:23 6/28/2018 09:17: Calculated results from channel Middle using method:
 '\\airtech-server\insdata\gc8a\methods\nmoc fixed_180627.mth'

ginal Notes:

ended Notes:
```

****

5. Continuing Calibration Verification

a. CCV Summary
b. Chromatograms/Results

Continuing Calibration Criteria:

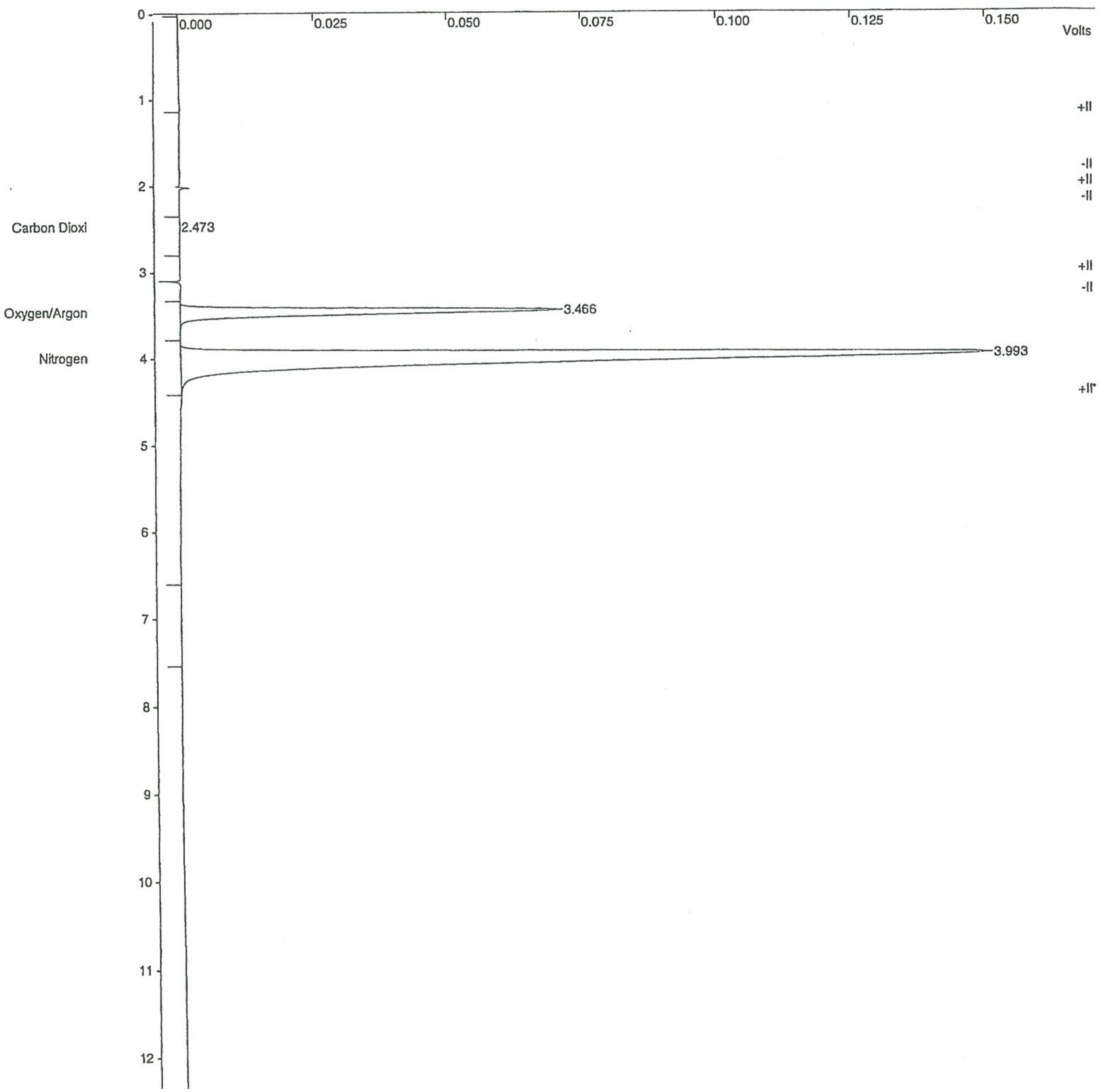
```
le        : Fixed Gas from TCD
 File     : i:\gc8a\2018\aug\23aug.run
hod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ple ID    : O2_N2_CCV

ection Date: 8/23/2018 13:47    Calculation Date: 8/23/2018 14:00

rator     : AS                    Detector Type: 3800 (10 Volts)
kstation: DATAPART1               Bus Address  : 44
trument  : GC8A                   Sample Rate  : 10.00 Hz
nnel      : Front = TCD           Run Time     : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

rt Speed =    1.53 cm/min   Attenuation = 71          Zero Offset = 2%
rt Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



int Date: Thu Aug 23 14:01:00 2018 Page 1 of 1

Verification Report

tle : Fixed Gas from TCD
n File : i:\gc8a\2018\aug\23aug.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : O2_N2_CCV

jection Date: 8/23/2018 13:47 Calculation Date: 8/23/2018 14:00

erator : AS
rkstation: DATAPART1
strument : GC8A
annel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 4
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Hydrogen	10.000000			1.930			VM
2	Carbon Dioxi	50.000000	0.048908	99.9	2.473	0.028	911	V
3	Oxygen/Argon	21.900000	23.180603	5.8	3.466	0.010	337524	C
4	Nitrogen	78.099998	81.224274	4.0	3.993	0.059	1252035	
5	Methane	50.000000			4.997			VM
	Totals:		104.453785			0.097	1590470	

atus Codes:
- Out of verification tolerance
- Missing peak
- Out of calibration range

tal Unidentified Counts : 904 counts

tected Peaks: 5 Rejected Peaks: 1 Identified Peaks: 5

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -8 microVolts LSB: 1 microVolts

ise (used): 5 microVolts - monitored before this run

nual injection

lib. out of range; No Recovery Action Specified
rification Failure; No Recovery Action Specified

vision Log:

23/2018 14:00: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 1, Advance Time: 13:47:23

iginal Notes:

****

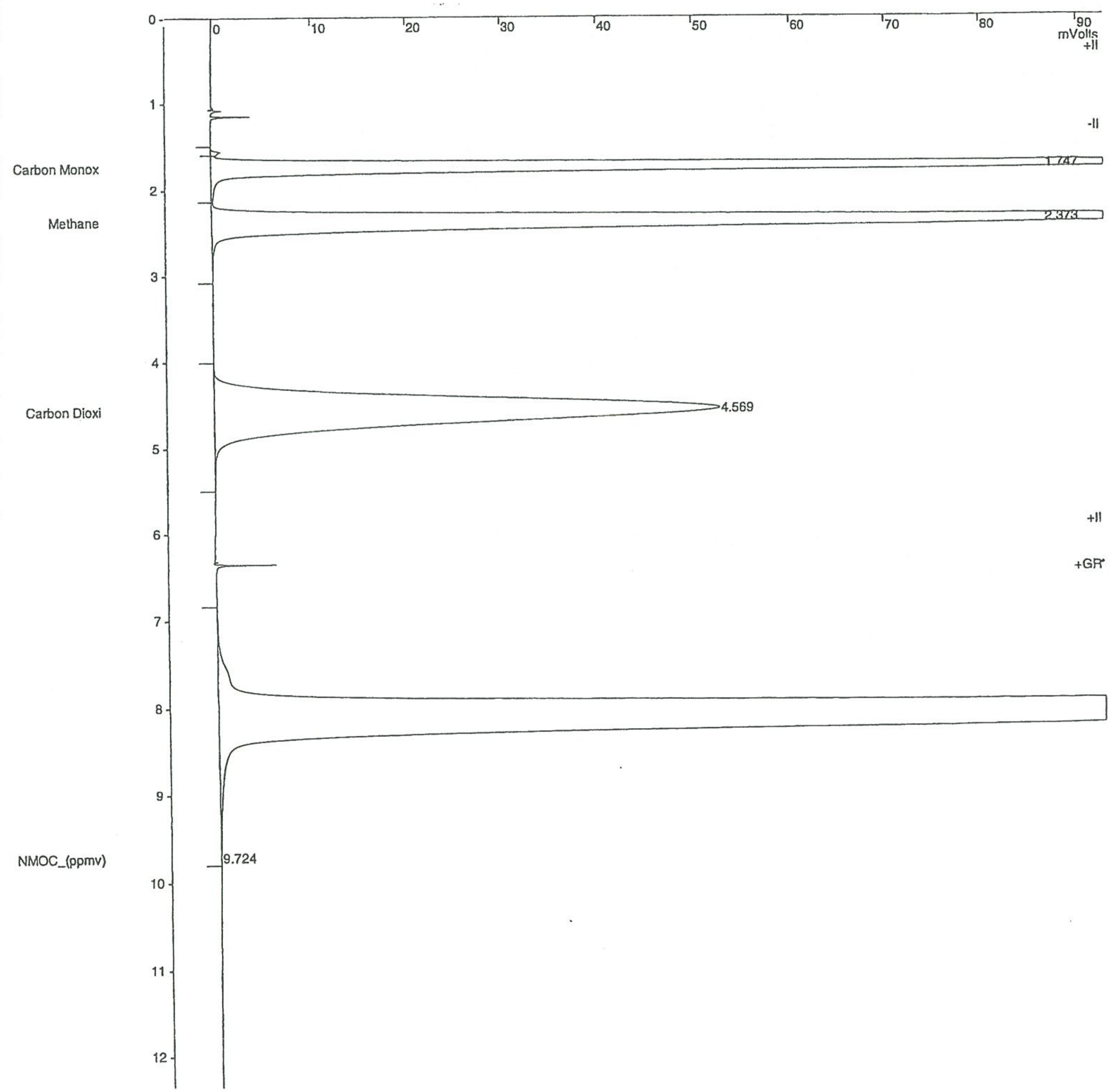
```
e          : Fixed Gas from FID/NMOC
 File      : i:\gc8a\2018\aug\23aug001.run
od File    : i:\gc8a\methods\nmoc fixed_180627-2.mth
le ID      : 0.1%_CH4_CO2_CO

ection Date: 8/23/2018 14:02     Calculation Date: 8/23/2018 14:15

ator      : AS                   Detector Type: 3800 (10 Volts)
kstation: DATAPART1              Bus Address  : 44
rument    : GC8A                 Sample Rate  : 10.00 Hz
nel       : Middle = FID         Run Time     : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

t Speed =    1.53 cm/min   Attenuation = 40         Zero Offset = 5%
rt Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



Verification Report

:le : Fixed Gas from FID/NMOC
ı File : i:\gc8a\2018\aug\23aug001.run
:hod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
nple ID : 0.1%_CH4_CO2_CO

jection Date: 8/23/2018 14:02 Calculation Date: 8/23/2018 14:15

erator : AS Detector Type: 3800 (10 Volts)
rkstation: DATAPART1 Bus Address : 44
strument : GC8A Sample Rate : 10.00 Hz
annel : Middle = FID Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

ı Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 4
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.100000	0.093907	6.1	1.747	-0.021	960913	
2	Methane	0.100000	0.108333	8.3	2.373	0.004	1121521	
3	Carbon Dioxi	0.100000	0.099152	0.8	4.569	0.010	1020617	
4	NMOC_(ppmv)	9999.00000	5027.53808	49.7	9.724	0.001	5750899	V
	Totals:		5027.83947			-0.006	8853950	

atus Codes:
- Out of verification tolerance

tal Unidentified Counts : 2514 counts

tected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -21 microVolts LSB: 1 microVolts

ise (used): 12 microVolts - monitored before this run

nual injection

rification Failure; No Recovery Action Specified

vision Log:

23/2018 14:15: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 2, Advance Time: 14:00:44

iginal Notes:

****

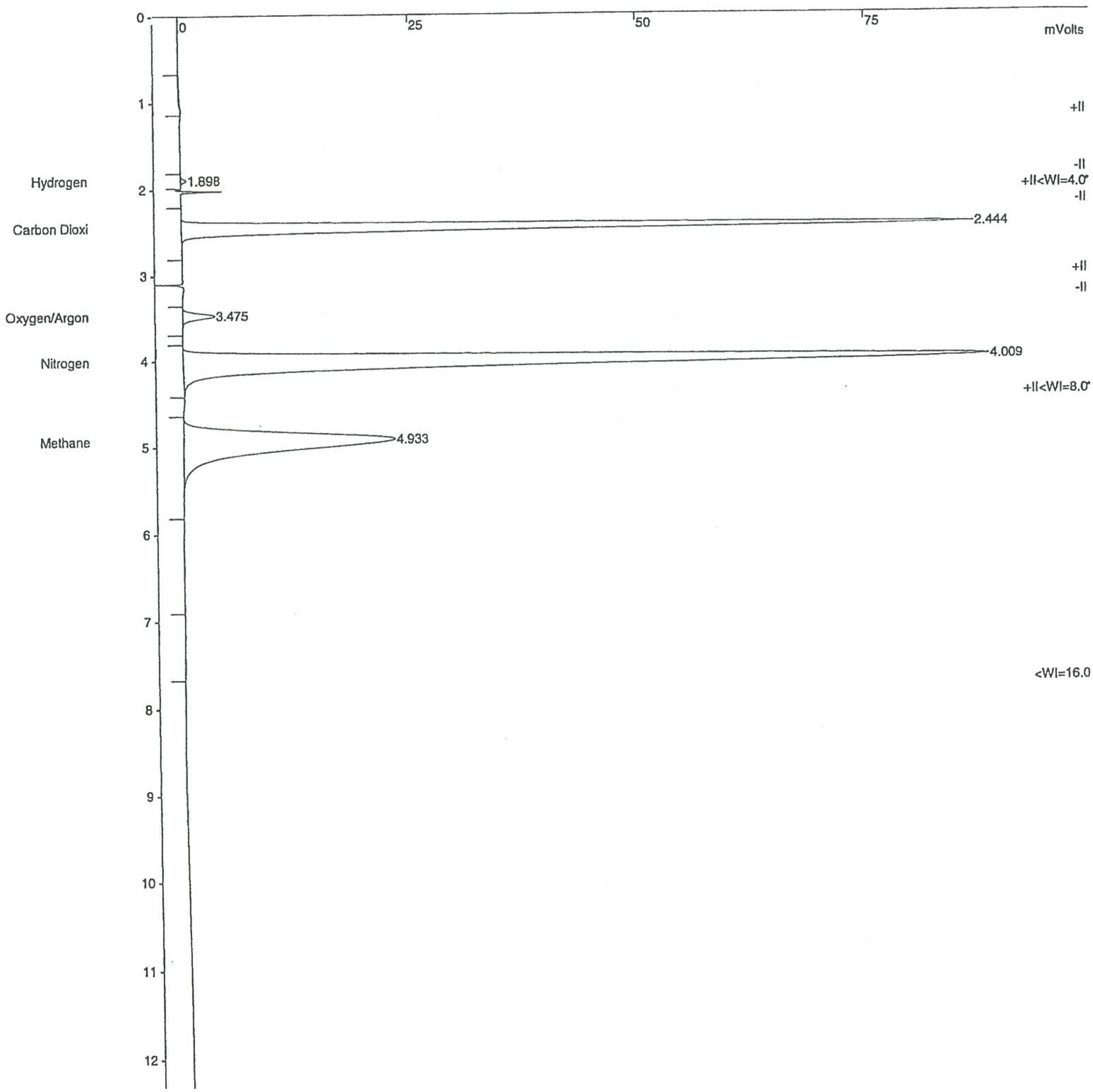
e : Fixed Gas from TCD
File : i:\gc8a\2018\aug\23aug002.run
od File : i:\gc8a\methods\nmoc fixed_180627-2.mth
le ID : 25%_CH4_CO2_7%_H2

ection Date: 8/23/2018 14:17   Calculation Date: 8/23/2018 14:30

rator : AS   Detector Type: 3800 (10 Volts)
kstation: DATAPART1   Bus Address : 44
rument : GC8A   Sample Rate : 10.00 Hz
nel : Front = TCD   Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

rt Speed = 1.53 cm/min   Attenuation = 41   Zero Offset = 2%
rt Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Verification Report

tle : Fixed Gas from TCD
n File : i:\gc8a\2018\aug\23aug002.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : 25%_CH4_CO2_7%_H2

jection Date: 8/23/2018 14:17 Calculation Date: 8/23/2018 14:30

erator : AS
rkstation: DATAPART1
strument : GC8A
annel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 3
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Hydrogen	7.000000	6.573445	6.1	1.898	-0.032	1577	
2	Carbon Dioxi	25.000000	22.225119	11.1	2.444	-0.001	413767	
3	Oxygen/Argon	10.900000	1.116918	89.8	3.475	0.019	16263	V
4	Nitrogen	39.099998	46.031353	17.7	4.009	0.076	709552	
5	Methane	25.000000	24.533443	1.9	4.933	-0.064	317018	
	Totals:		100.480278			-0.002	1458177	

atus Codes:
- Out of verification tolerance

tal Unidentified Counts : 548 counts

tected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: 1 microVolts LSB: 1 microVolts

ise (used): 4 microVolts - monitored before this run

nual injection

rification Failure; No Recovery Action Specified

vision Log:

'23/2018 14:30: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 3, Advance Time: 14:15:18

riginal Notes:

****

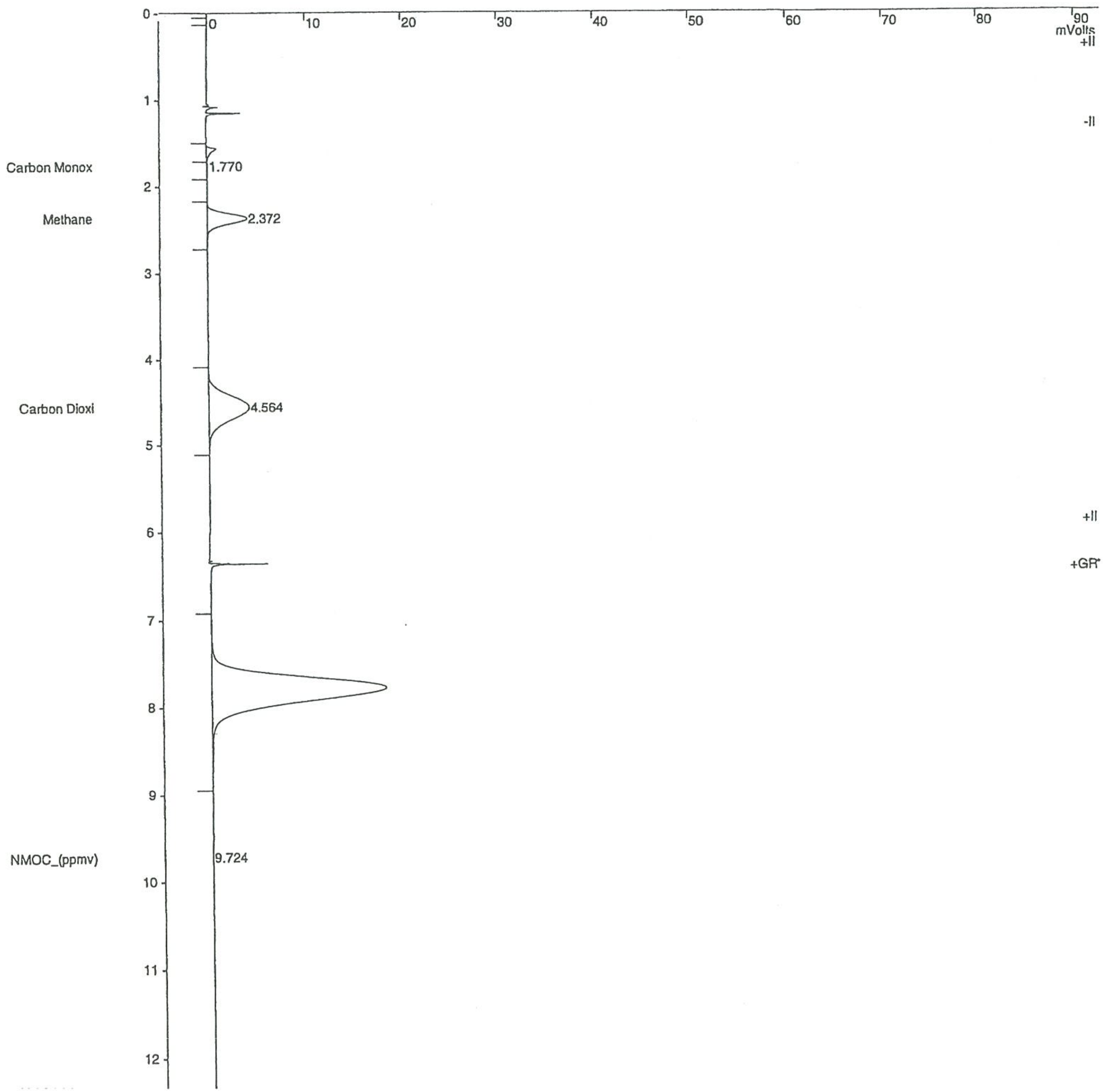
```
le          : Fixed Gas from FID/NMOC
n File      : i:\gc8a\2018\aug\23aug003.run
hod File    : i:\gc8a\methods\nmoc fixed_180627-2.mth
ple ID      : 300_PPMV_NMOC

iection Date: 8/23/2018 14:31     Calculation Date: 8/23/2018 14:44

rator     : AS                     Detector Type: 3800 (10 Volts)
rkstation: DATAPART1               Bus Address  : 44
trument  : GC8A                    Sample Rate  : 10.00 Hz
nnel     : Middle = FID            Run Time     : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

rt Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
art Time =    0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



int Date: Thu Aug 23 14:44:41 2018 Page 1 of 1

Verification Report

tle : Fixed Gas from FID/NMOC
n File : i:\gc8a\2018\aug\23aug003.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : 300_PPMV_NMOC

jection Date: 8/23/2018 14:31 Calculation Date: 8/23/2018 14:44

erator : AS
rkstation: DATAPART1
strument : GC8A
annel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 2
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000041	95.9	1.770	0.002	416	V
2	Methane	0.001000	0.003182	218.2	2.372	0.003	32937	V
3	Carbon Dioxi	0.001000	0.007749	> 500	4.564	0.006	79760	V
4	NMOC_(ppmv)	299.700012	312.551270	4.3	9.724	0.001	357521	
	Totals:		312.562242			0.012	470634	

atus Codes:
- Out of verification tolerance

tal Unidentified Counts : 3894 counts

tected Peaks: 6 Rejected Peaks: 0 Identified Peaks: 4

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -11 microVolts LSB: 1 microVolts

ise (used): 8 microVolts - monitored before this run

nual injection

rification Failure; No Recovery Action Specified

vision Log:

'23/2018 14:44: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 4, Advance Time: 14:29:51

iginal Notes:

****

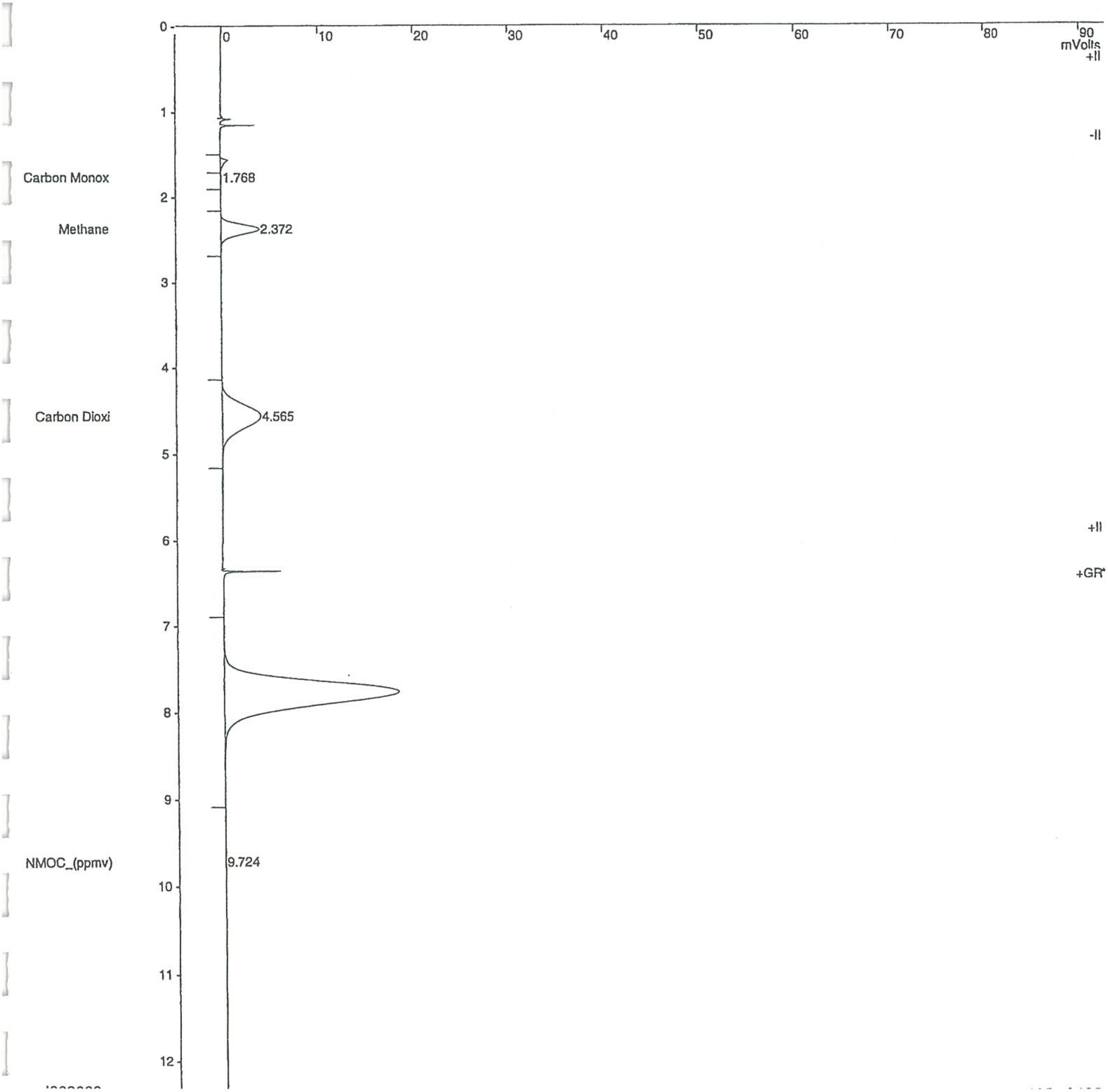
e : Fixed Gas from FID/NMOC
File : i:\gc8a\2018\aug\23aug004.run
od File : i:\gc8a\methods\nmoc fixed_180627-2.mth
le ID : 300_PPMV_NMOC

ection Date: 8/23/2018 14:46   Calculation Date: 8/23/2018 14:59

ator : AS   Detector Type: 3800 (10 Volts)
kstation: DATAPART1   Bus Address : 44
rument : GC8A   Sample Rate : 10.00 Hz
nel : Middle = FID   Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

t Speed = 1.53 cm/min   Attenuation = 40   Zero Offset = 5%
rt Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Verification Report

:le : Fixed Gas from FID/NMOC
1 File : i:\gc8a\2018\aug\23aug004.run
:hod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
nple ID : 300_PPMV_NMOC

jection Date: 8/23/2018 14:46 Calculation Date: 8/23/2018 14:59

erator : AS
rkstation: DATAPART1
strument : GC8A
annel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 2
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000041	95.9	1.768	0.000	419	V
2	Methane	0.001000	0.003120	212.0	2.372	0.003	32299	V
3	Carbon Dioxi	0.001000	0.007454	> 500	4.565	0.007	76725	V
4	NMOC_(ppmv)	299.700012	311.282471	3.9	9.724	0.001	356070	
	Totals:		311.293086			0.011	465513	

atus Codes:
- Out of verification tolerance

tal Unidentified Counts : 3035 counts

tected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -19 microVolts LSB: 1 microVolts

ise (used): 9 microVolts - monitored before this run

nual injection

rification Failure; No Recovery Action Specified

vision Log:

23/2018 14:59: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 4, Advance Time: 14:44:24

iginal Notes:

****

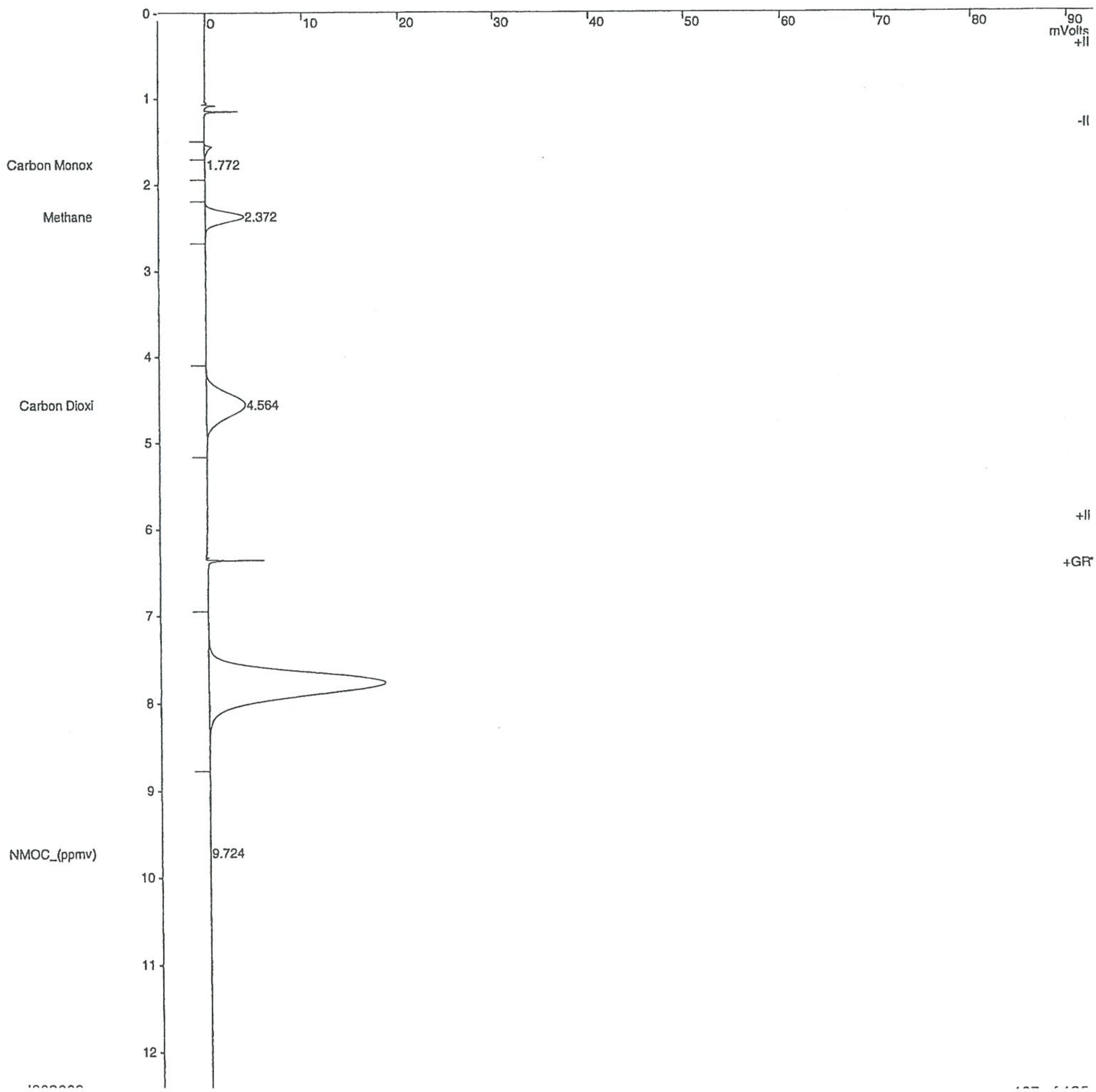
```
.e          : Fixed Gas from FID/NMOC
. File      : i:\gc8a\2018\aug\23aug005.run
hod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ple ID      : 300_PPMV_NMOC

ection Date: 8/23/2018 15:00     Calculation Date: 8/23/2018 15:13

rator     : AS                    Detector Type: 3800 (10 Volts)
kstation: DATAPART1               Bus Address   : 44
trument  : GC8A                   Sample Rate   : 10.00 Hz
nel       : Middle = FID          Run Time      : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

rt Speed =    1.53 cm/min    Attenuation = 40           Zero Offset = 5%
rt Time  =   0.000   min      End Time    = 13.088  min   Min / Tick  = 1.00
```



Verification Report

tle : Fixed Gas from FID/NMOC
n File : i:\gc8a\2018\aug\23aug005.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : 300_PPMV_NMOC

jection Date: 8/23/2018 15:00 Calculation Date: 8/23/2018 15:13

erator : AS
rkstation: DATAPART1
strument : GC8A
annel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Verification
ak Measurement: Peak Area
lculation Type: External Standard
vel : 2
lerance : 25.0%

eak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000048	95.2	1.772	0.004	490	V
2	Methane	0.001000	0.003098	209.8	2.372	0.003	32073	V
3	Carbon Dioxi	0.001000	0.007471	> 500	4.564	0.006	76899	V
4	NMOC_(ppmv)	299.700012	309.801117	3.4	9.724	0.001	354375	
	Totals:		309.811734			0.014	463837	

atus Codes:
- Out of verification tolerance

tal Unidentified Counts : 2915 counts

tected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -12 microVolts LSB: 1 microVolts

ise (used): 9 microVolts - monitored before this run

nual injection

rification Failure; No Recovery Action Specified

vision Log:

'23/2018 15:13: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 4, Advance Time: 14:58:57

riginal Notes:

****

le : Fixed Gas from TCD
n File : i:\gc8a\2018\aug\23aug056.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ple ID : O2 N2 CCV

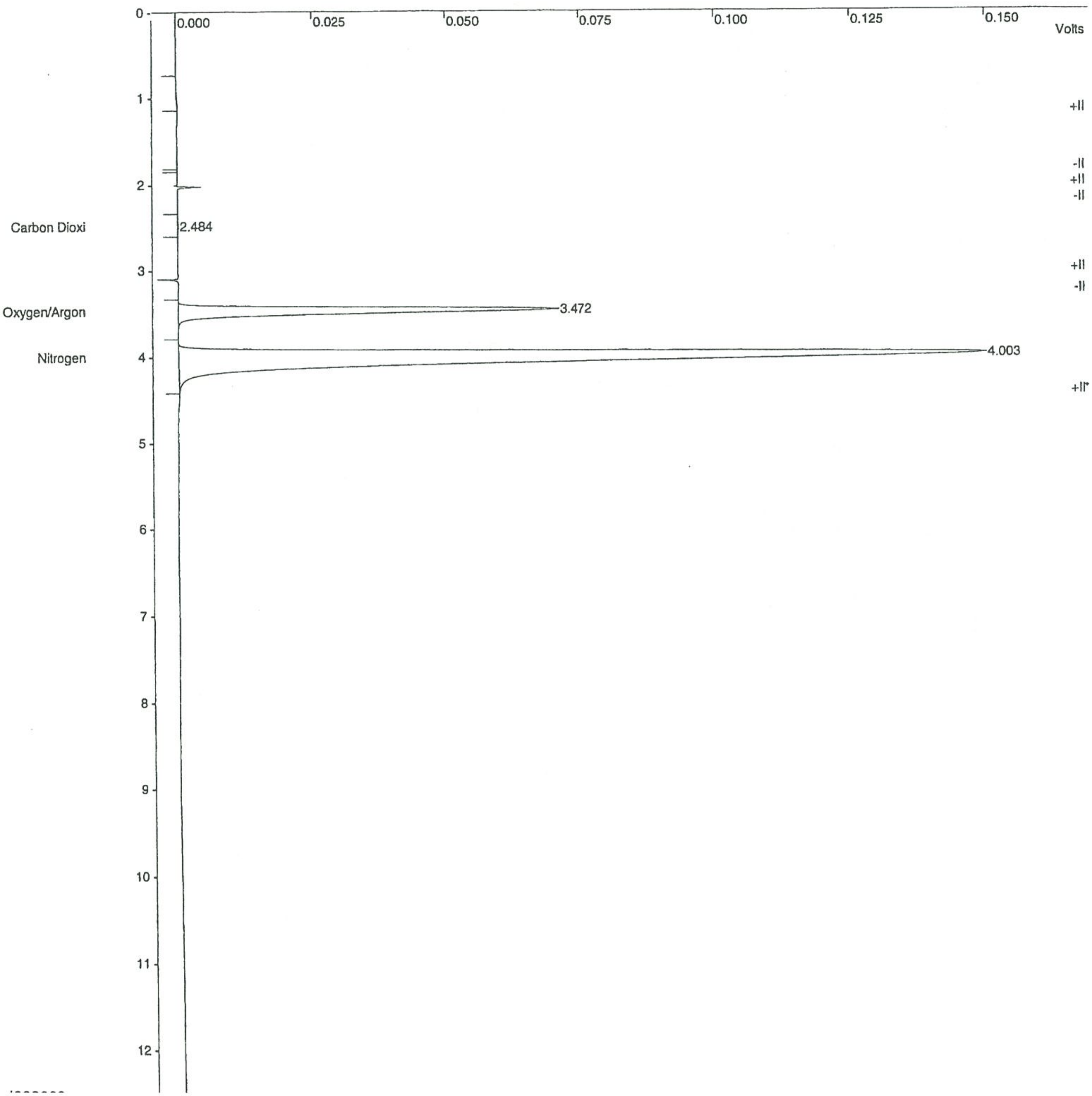
jection Date: 8/24/2018 03:25 Calculation Date: 8/24/2018 03:38

rator : AS
rkstation: DATAPART1
strument : GC8A
nnel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

rt Speed = 1.53 cm/min Attenuation = 71 Zero Offset = 2%
art Time = 0.000 min End Time = 13.088 min Min / Tick = 1.00



Verification Report

itle : Fixed Gas from TCD
un File : i:\gc8a\2018\aug\23aug056.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : O2 N2 CCV

njection Date: 8/24/2018 03:25 Calculation Date: 8/24/2018 03:38

perator : AS
orkstation: DATAPART1
nstrument : GC8A
hannel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

un Mode : Verification
eak Measurement: Peak Area
alculation Type: External Standard
evel : 4
olerance : 25.0%

Peak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Hydrogen	10.000000			1.930			VM
2	Carbon Dioxi	50.000000	0.045571	99.9	2.484	0.039	848	V
3	Oxygen/Argon	21.900000	23.171669	5.8	3.472	0.016	337394	C
4	Nitrogen	78.099998	81.133293	3.9	4.003	0.070	1250633	
5	Methane	50.000000			4.997			VM
	Totals:		104.350533			0.125	1588875	

tatus Codes:
- Out of verification tolerance
- Missing peak
- Out of calibration range

otal Unidentified Counts : 0 counts

etected Peaks: 5 Rejected Peaks: 2 Identified Peaks: 5

ultiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

aseline Offset: -25 microVolts LSB: 1 microVolts

oise (used): 6 microVolts - monitored before this run

anual injection

alib. out of range; No Recovery Action Specified
erification Failure; No Recovery Action Specified

evision Log:

/24/2018 03:38: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
tream: 1, Advance Time: 03:23:51

riginal Notes:

****

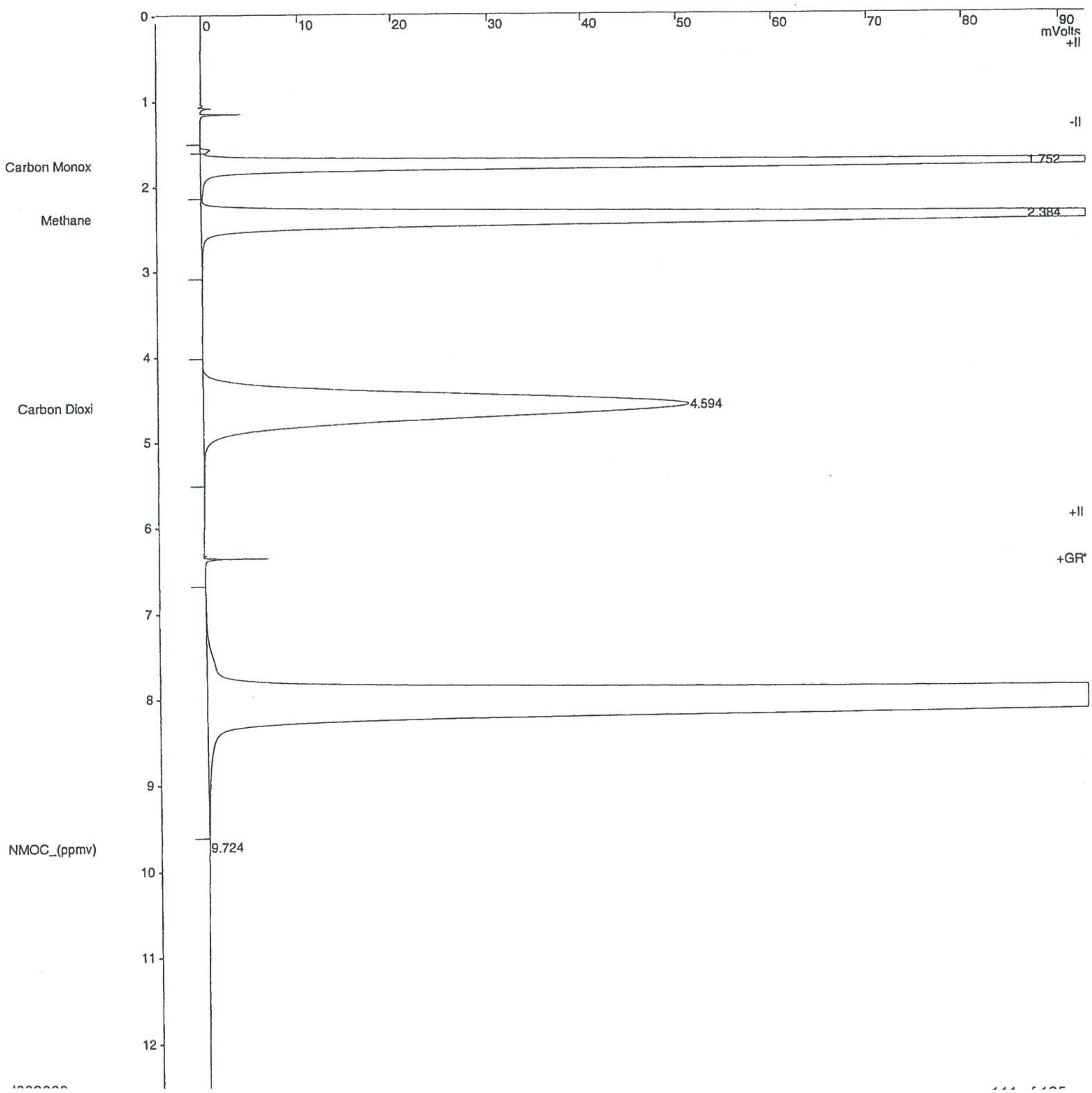
```
:le         : Fixed Gas from FID/NMOC
n File      : i:\gc8a\2018\aug\23aug057.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
nple ID    : 0.1% CH4 CO2 CO

jection Date: 8/24/2018 03:40     Calculation Date: 8/24/2018 03:53

erator     : AS                      Detector Type: 3800 (10 Volts)
rkstation: DATAPART1                 Bus Address   : 44
strument : GC8A                      Sample Rate   : 10.00 Hz
nnel       : Middle = FID            Run Time      : 13.088 min

 GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

art Speed =     1.53 cm/min    Attenuation = 40          Zero Offset = 5%
art Time  =    0.000    min     End Time     = 13.088  min   Min / Tick  = 1.00
```



Verification Report

itle : Fixed Gas from FID/NMOC
un File : i:\gc8a\2018\aug\23aug057.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : 0.1% CH4 CO2 CO

njection Date: 8/24/2018 03:40 Calculation Date: 8/24/2018 03:53

perator : AS
orkstation: DATAPART1
nstrument : GC8A
hannel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

un Mode : Verification
eak Measurement: Peak Area
alculation Type: External Standard
evel : 4
olerance : 25.0%

Peak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.100000	0.092291	7.7	1.752	-0.016	944380	
2	Methane	0.100000	0.106609	6.6	2.384	0.015	1103673	
3	Carbon Dioxi	0.100000	0.097117	2.9	4.594	0.036	999665	
4	NMOC_(ppmv)	9999.00000	4880.19726	51.2	9.724	0.001	5582359	V
	Totals:		4880.49328			0.036	8630077	

tatus Codes:
- Out of verification tolerance

otal Unidentified Counts : 2708 counts

etected Peaks: 5 Rejected Peaks: 0 Identified Peaks: 4

ultiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

aseline Offset: -18 microVolts LSB: 1 microVolts

oise (used): 11 microVolts - monitored before this run

anual injection

erification Failure; No Recovery Action Specified

evision Log:

/24/2018 03:53: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
tream: 2, Advance Time: 03:38:45

riginal Notes:

****

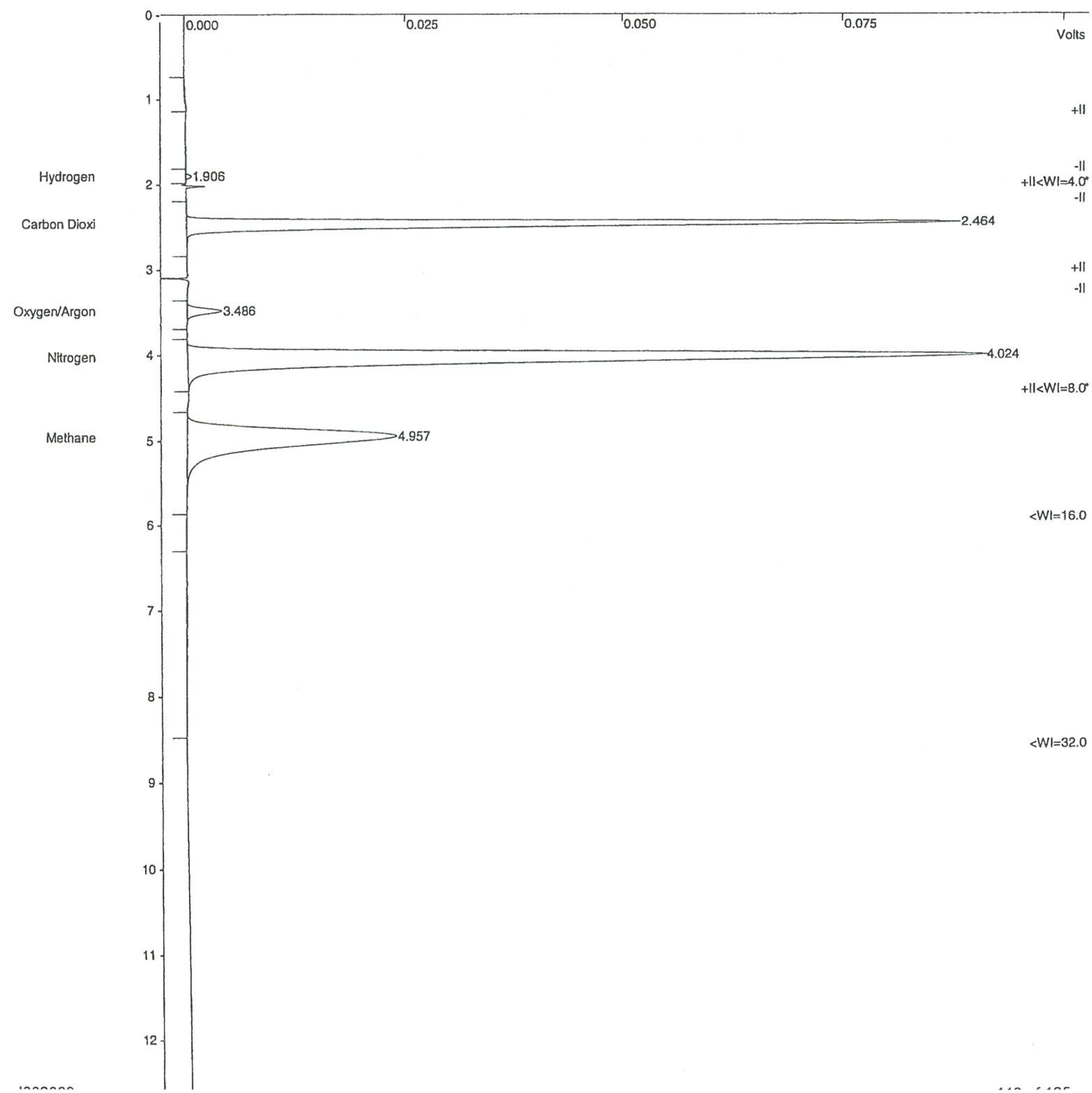
ile : Fixed Gas from TCD
ı File : i:\gc8a\2018\aug\23aug058.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ıple ID : 25% CH4 CO2 7% H2

jection Date: 8/24/2018 03:55   Calculation Date: 8/24/2018 04:08

rator : AS   Detector Type: 3800 (10 Volts)
rkstation: DATAPART1   Bus Address : 44
strument : GC8A   Sample Rate : 10.00 Hz
ınnel : Front = TCD   Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

ırt Speed = 1.53 cm/min   Attenuation = 43   Zero Offset = 2%
art Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



rint Date: Fri Aug 24 04:08:11 2018 Page 1 of 1

Verification Report

itle : Fixed Gas from TCD
un File : i:\gc8a\2018\aug\23aug058.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : 25% CH4 CO2 7% H2

njection Date: 8/24/2018 03:55 Calculation Date: 8/24/2018 04:08

perator : AS
orkstation: DATAPART1
nstrument : GC8A
hannel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

un Mode : Verification
eak Measurement: Peak Area
alculation Type: External Standard
evel : 3
olerance : 25.0%

Peak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Hydrogen	7.000000	6.690673	4.4	1.906	-0.024	1605	
2	Carbon Dioxi	25.000000	23.117918	7.5	2.464	0.019	430389	
3	Oxygen/Argon	10.900000	1.264839	88.4	3.486	0.030	18417	V
4	Nitrogen	39.099998	47.969131	22.7	4.024	0.091	739422	
5	Methane	25.000000	25.515512	2.1	4.957	-0.040	329708	
	Totals:		104.558073			0.076	1519541	

tatus Codes:
 - Out of verification tolerance

otal Unidentified Counts : 3998 counts

etected Peaks: 7 Rejected Peaks: 1 Identified Peaks: 5

ultiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

aseline Offset: -6 microVolts LSB: 1 microVolts

oise (used): 4 microVolts - monitored before this run

anual injection

erification Failure; No Recovery Action Specified

evision Log:

/24/2018 04:08: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
tream: 3, Advance Time: 03:53:20

riginal Notes:

****

tle : Fixed Gas from FID/NMOC
n File : i:\gc8a\2018\aug\23aug059.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : 300 PPMV NMOC

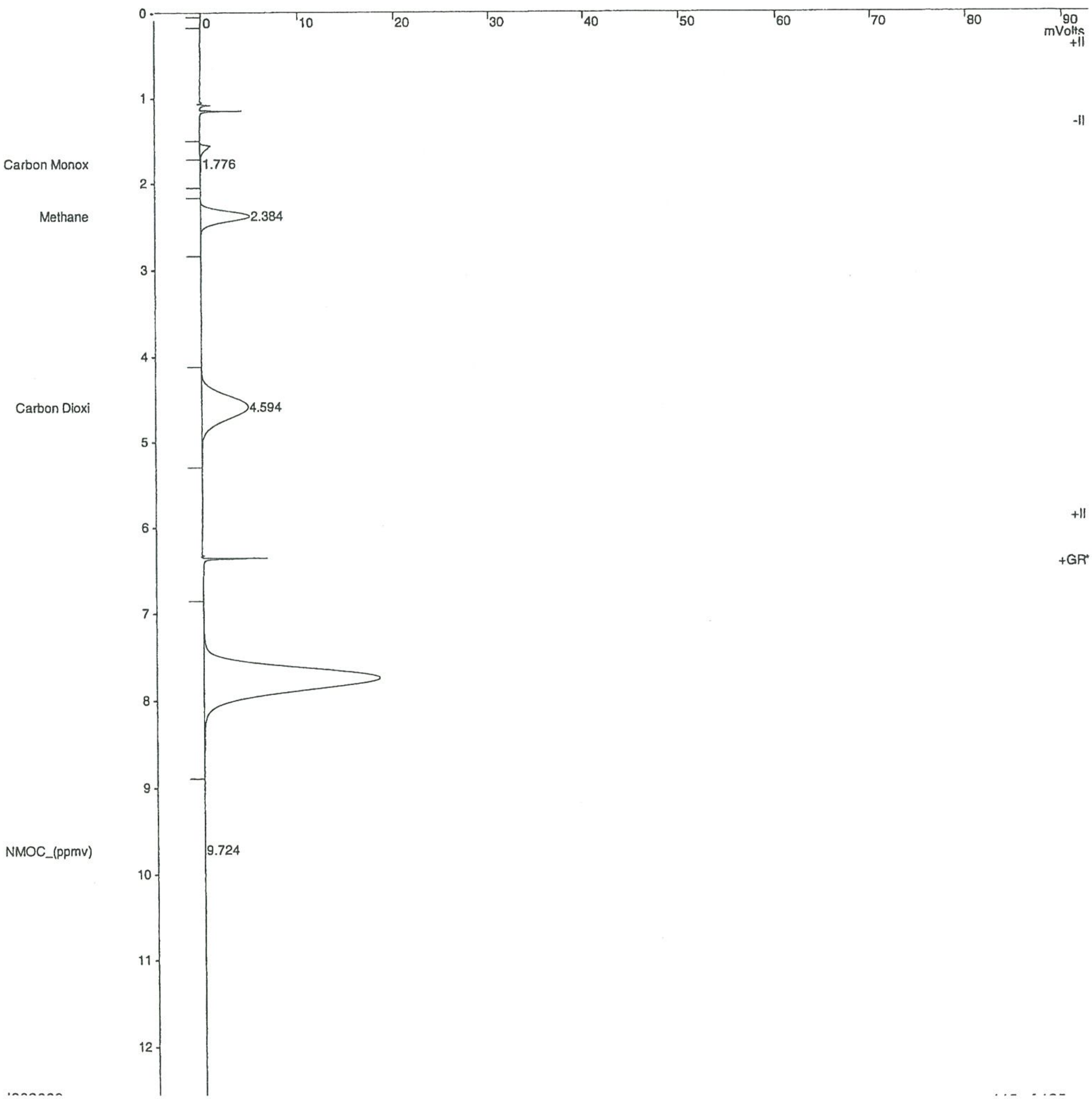
njection Date: 8/24/2018 04:09 Calculation Date: 8/24/2018 04:22

erator : AS
rkstation: DATAPART1
nstrument : GC8A
annel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

art Speed = 1.53 cm/min Attenuation = 40 Zero Offset = 5%
art Time = 0.000 min End Time = 13.088 min Min / Tick = 1.00



Verification Report

itle : Fixed Gas from FID/NMOC
un File : i:\gc8a\2018\aug\23aug059.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : 300 PPMV NMOC

njection Date: 8/24/2018 04:09 Calculation Date: 8/24/2018 04:22

perator : AS
orkstation: DATAPART1
nstrument : GC8A
hannel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

un Mode : Verification
eak Measurement: Peak Area
alculation Type: External Standard
evel : 2
olerance : 25.0%

Peak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000077	92.3	1.776	0.008	784	V
2	Methane	0.001000	0.004026	302.6	2.384	0.015	41678	V
3	Carbon Dioxi	0.001000	0.009031	> 500	4.594	0.036	92961	V
4	NMOC_(ppmv)	299.700012	301.884003	0.7	9.724	0.001	345319	
	Totals:		301.897137			0.060	480742	

tatus Codes:
' - Out of verification tolerance

otal Unidentified Counts : 4561 counts

etected Peaks: 6 Rejected Peaks: 0 Identified Peaks: 4

ultiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

aseline Offset: -43 microVolts LSB: 1 microVolts

oise (used): 7 microVolts - monitored before this run

anual injection

erification Failure; No Recovery Action Specified

evision Log:

/24/2018 04:22: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
tream: 4, Advance Time: 04:07:56

riginal Notes:

****

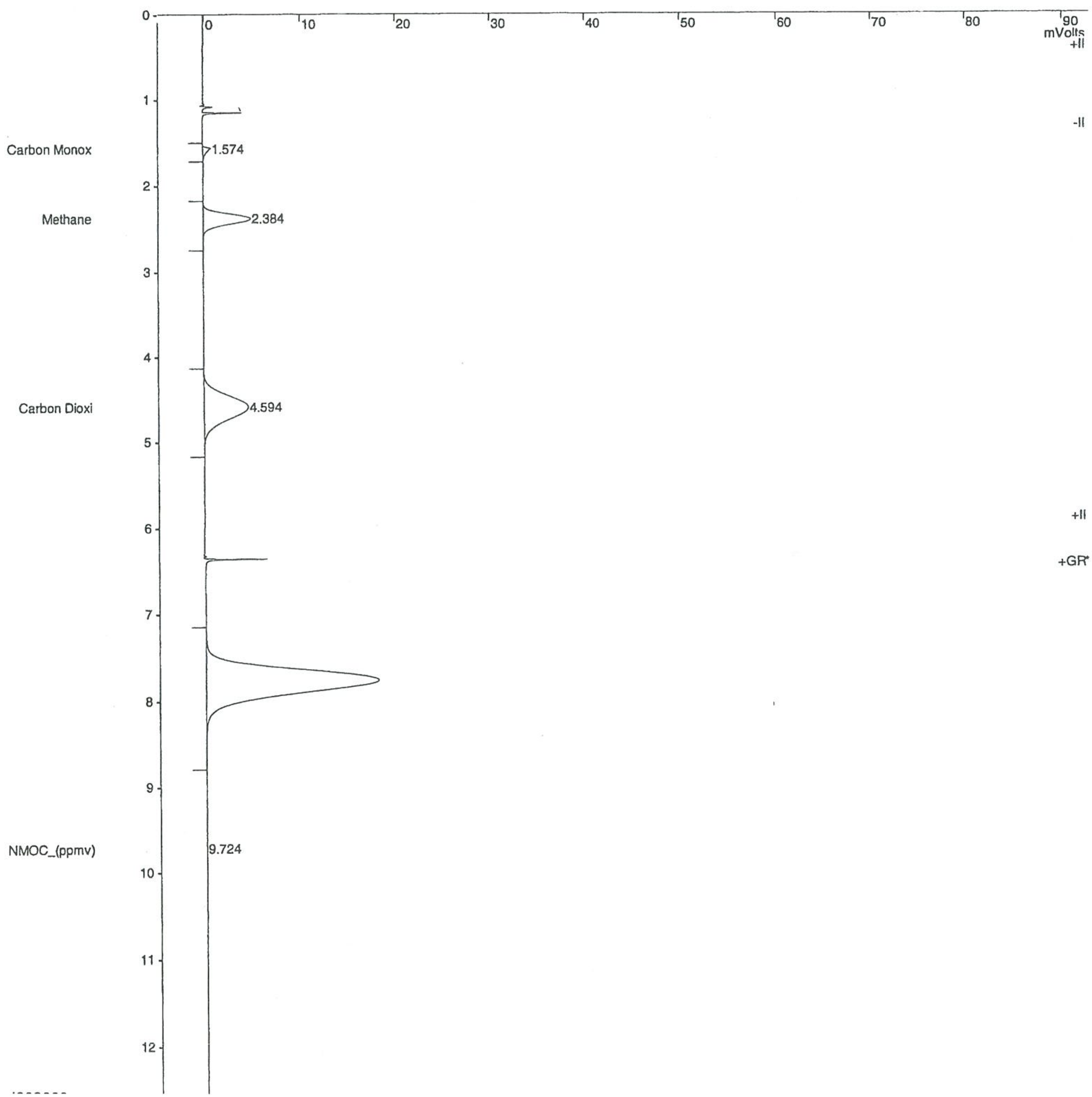
tle : Fixed Gas from FID/NMOC
n File : i:\gc8a\2018\aug\23aug060.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ple ID : 300 PPMV NMOC

jection Date: 8/24/2018 04:24   Calculation Date: 8/24/2018 04:37

erator : AS   Detector Type: 3800 (10 Volts)
rkstation: DATAPART1   Bus Address : 44
strument : GC8A   Sample Rate : 10.00 Hz
annel : Middle = FID   Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

art Speed = 1.53 cm/min   Attenuation = 40   Zero Offset = 5%
art Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



Verification Report

itle : Fixed Gas from FID/NMOC
un File : i:\gc8a\2018\aug\23aug060.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : 300 PPMV NMOC

njection Date: 8/24/2018 04:24 Calculation Date: 8/24/2018 04:37

perator : AS
orkstation: DATAPART1
nstrument : GC8A
hannel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

un Mode : Verification
eak Measurement: Peak Area
alculation Type: External Standard
evel : 2
olerance : 25.0%

Peak No.	Peak Name	Expected Result (% v/v)	Calculated Result (% v/v)	Dev. %	Ret. Time (min)	Time Offset (min)	Area (counts)	Status Codes
1	Carbon Monox	0.001000	0.000305	69.5	1.574	-0.194	3118	V
2	Methane	0.001000	0.003939	293.9	2.384	0.015	40783	V
3	Carbon Dioxi	0.001000	0.008726	> 500	4.594	0.036	89817	V
4	NMOC_(ppmv)	299.700012	299.374817	0.1	9.724	0.001	342449	
	Totals:		299.387787			-0.142	476167	

tatus Codes:
 - Out of verification tolerance

otal Unidentified Counts : 0 counts

etected Peaks: 4 Rejected Peaks: 0 Identified Peaks: 4

ultiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

aseline Offset: -43 microVolts LSB: 1 microVolts

oise (used): 12 microVolts - monitored before this run

anual injection

erification Failure; No Recovery Action Specified

evision Log:

/24/2018 04:37: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
tream: 4, Advance Time: 04:22:31

riginal Notes:

****

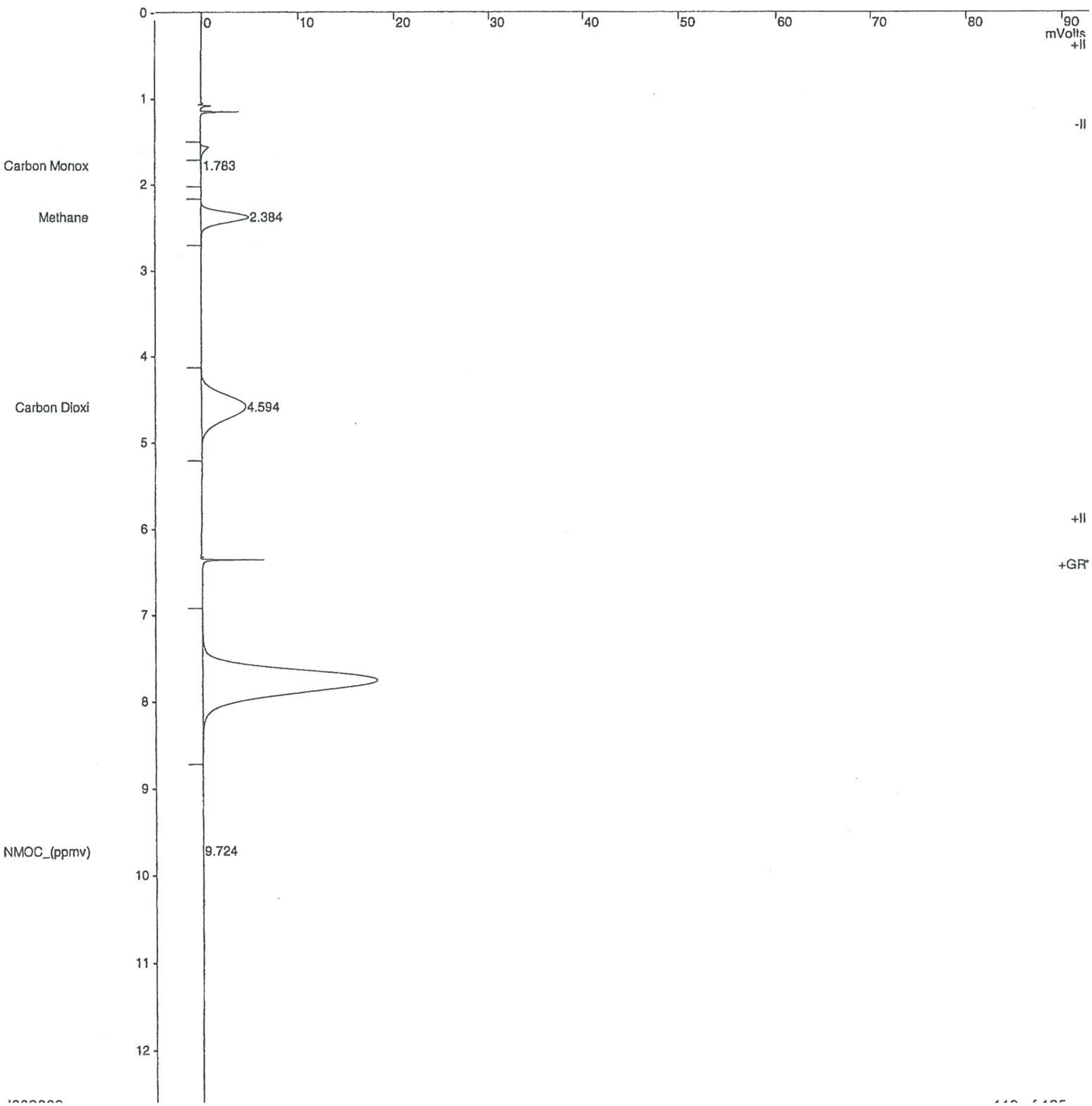
tle : Fixed Gas from FID/NMOC
n File : i:\gc8a\2018\aug\23aug061.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : 300 PPMV NMOC

njection Date: 8/24/2018 04:38   Calculation Date: 8/24/2018 04:51

erator : AS   Detector Type: 3800 (10 Volts)
rkstation: DATAPART1   Bus Address : 44
nstrument : GC8A   Sample Rate : 10.00 Hz
annel : Middle = FID   Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

art Speed = 1.53 cm/min   Attenuation = 40   Zero Offset = 5%
art Time = 0.000 min   End Time = 13.088 min   Min / Tick = 1.00



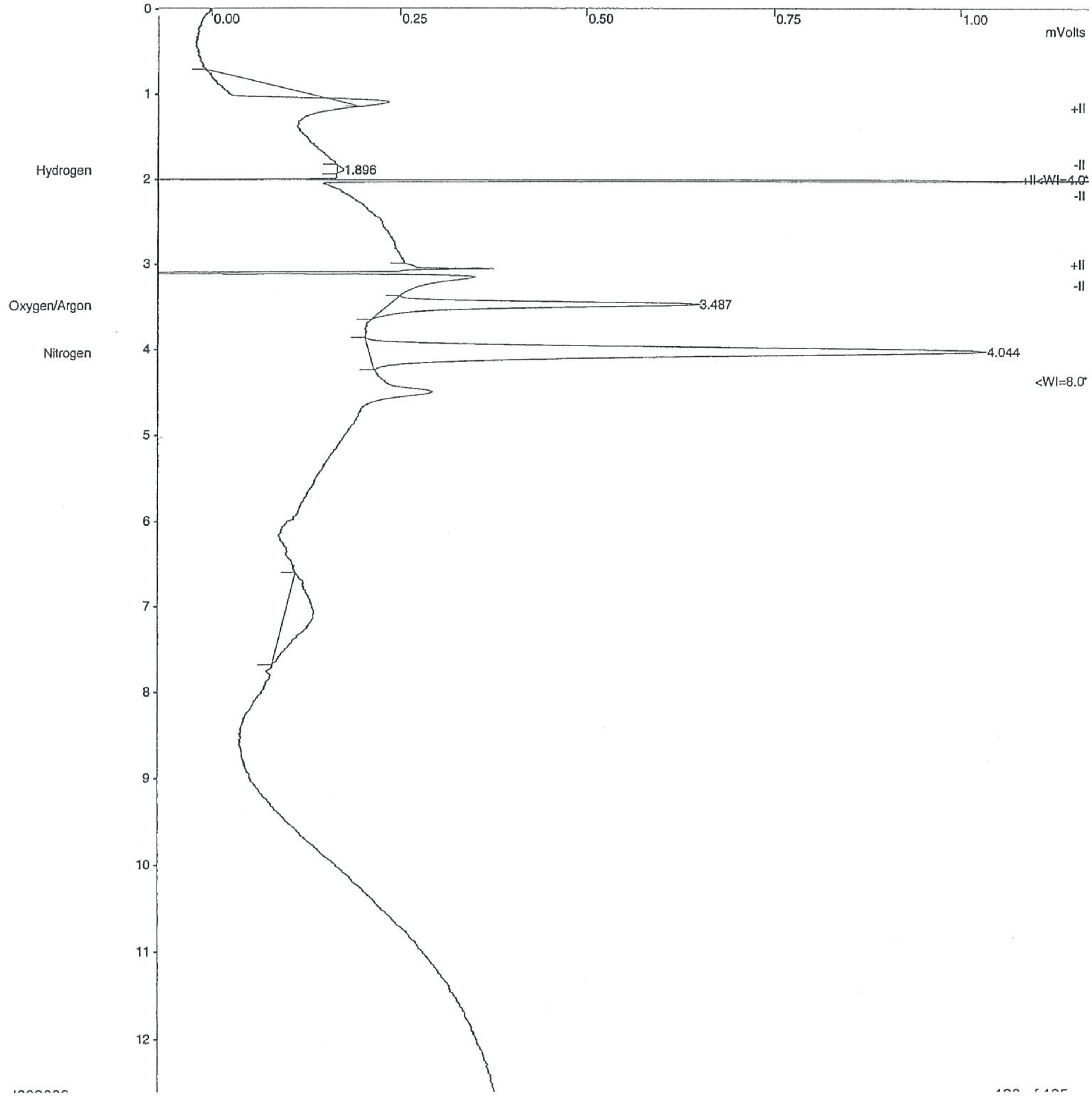
itle : Fixed Gas from TCD
un File : i:\gc8a\2018\aug\23aug009.run
ethod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID : METHOD BLANK

njection Date: 8/23/2018 15:58 Calculation Date: 8/23/2018 16:11

perator : AS	Detector Type: 3800 (10 Volts)
orkstation: DATAPART1	Bus Address : 44
nstrument : GC8A	Sample Rate : 10.00 Hz
hannel : Front = TCD	Run Time : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

hart Speed = 1.53 cm/min Attenuation = 1 Zero Offset = 2%
tart Time = 0.000 min End Time = 13.088 min Min / Tick = 1.00



int Date: Thu Aug 23 16:12:00 2018 Page 1 of 1

itle : Fixed Gas from TCD
n File : i:\gc8a\2018\aug\23aug009.run
thod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
mple ID : METHOD BLANK

njection Date: 8/23/2018 15:58 Calculation Date: 8/23/2018 16:11

erator : AS
rkstation: DATAPART1
nstrument : GC8A
nannel : Front = TCD

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

n Mode : Analysis
ak Measurement: Peak Area
lculation Type: External Standard

Peak No.	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Hydrogen	0.116291	1.896	-0.034	28	BB	3.6	
2	Carbon Dioxi		2.445					M
3	Oxygen/Argon	0.141045	3.487	0.031	2054	BB	4.3	
4	Nitrogen	0.425316	4.044	0.111	6556	BB	7.3	
5	Methane		4.997					M
	Totals:	0.682652		0.108	8638			

atus Codes:
- Missing peak

tal Unidentified Counts : 1375 counts

tected Peaks: 5 Rejected Peaks: 1 Identified Peaks: 5

ltiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

seline Offset: -1 microVolts LSB: 1 microVolts

ise (used): 5 microVolts - monitored before this run

nual injection

evision Log:

23/2018 16:11: Calculated results from channel Front using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
ream: 6, Advance Time: 15:57:12

iginal Notes:

****

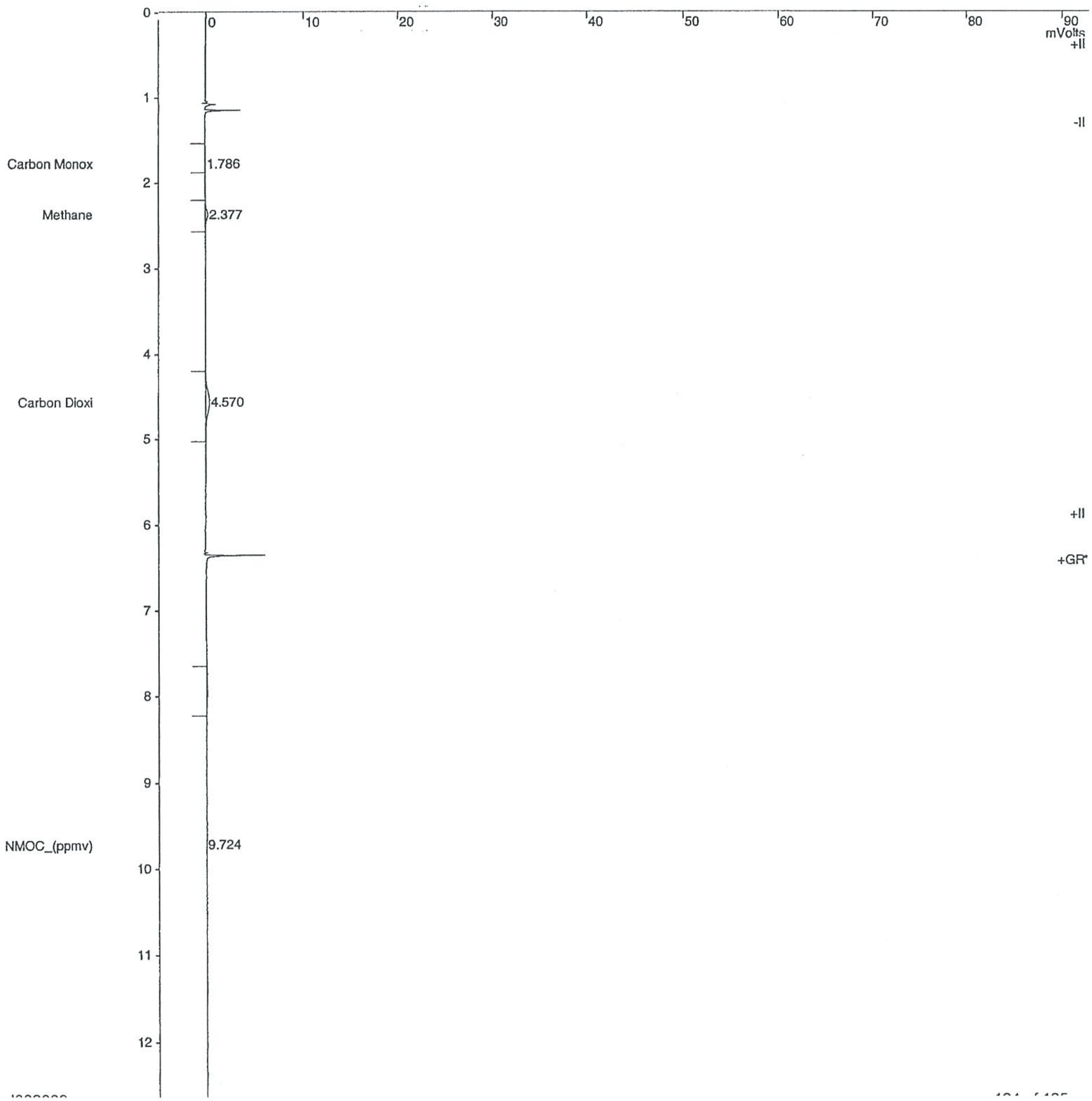
```
'itle        : Fixed Gas from FID/NMOC
un File      : i:\gc8a\2018\aug\23aug009.run
lethod File  : i:\gc8a\methods\nmoc fixed_180627-2.mth
ample ID     : METHOD BLANK

njection Date: 8/23/2018 15:58    Calculation Date: 8/23/2018 16:11

perator    : AS                   Detector Type: 3800 (10 Volts)
'orkstation: DATAPART1            Bus Address  : 44
nstrument  : GC8A                 Sample Rate  : 10.00 Hz
hannel     : Middle = FID         Run Time     : 13.088 min

* GC Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

hart Speed =    1.53 cm/min   Attenuation = 40          Zero Offset = 5%
tart Time  =   0.000   min     End Time    = 13.088  min   Min / Tick  = 1.00
```



ıt Date: Thu Aug 23 16:12:00 2018 Page 1 of 1

.e : Fixed Gas from FID/NMOC
File : i:\gc8a\2018\aug\23aug009.run
ıod File : i:\gc8a\methods\nmoc fixed_180627-2.mth
ɔle ID : METHOD BLANK

ection Date: 8/23/2018 15:58 Calculation Date: 8/23/2018 16:11

:ator : AS
:station: DATAPART1
:rument : GC8A
ınel : Middle = FID

Detector Type: 3800 (10 Volts)
Bus Address : 44
Sample Rate : 10.00 Hz
Run Time : 13.088 min

3C Workstation Multi Instrument Version 6.30 ** 01147-7588-C69-24B1 **

Mode : Analysis
: Measurement: Peak Area
:ulation Type: External Standard

ık).	Peak Name	Result (% v/v)	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
1	Carbon Monox	0.000031	1.786	0.018	322	BB	0.0	
2	Methane	0.000193	2.377	0.008	2002	BB	7.6	
3	Carbon Dioxi	0.000731	4.570	0.012	7524	BB	18.3	
4	NMOC_(ppmv)	1.013197	9.724	0.001	1159	GR	0.0	
	Totals:	1.014152		0.039	11007			

ıl Unidentified Counts : 0 counts

ected Peaks: 4 Rejected Peaks: 0 Identified Peaks: 4

:iplier: 1 Divisor: 1 Unidentified Peak Factor: 0

eline Offset: -11 microVolts LSB: 1 microVolts

se (used): 10 microVolts - monitored before this run

ıal injection

ision Log:

3/2018 16:11: Calculated results from channel Middle using method:
'i:\gc8a\methods\nmoc fixed_180627-2.mth'
eam: 6, Advance Time: 15:57:12

ginal Notes:

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Appendix D

LandGEM Model Results for Puerto Rico Dump

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LandGEM Model Output PRD

	Biodegradable waste									Total disposed waste					
Year	Total landfill gas				Methane				Year	Total landfill gas			Methane		
	(Mg/year)	(m3/year)	(av ft^3/mir	65% LFG (	(Mg/year)	(m3/year)	(av ft^3/mir	65% Methane Capture		(Mg/year)	(m3/year)	(av ft^3/mir	(Mg/year)	(m3/year)	(av ft^3/min
1975	0	0	0	0	0	0	0	0	1975	0	0	0	0	0	0
1976	84.97	69493.08	4.67	3.035	21.36	32022.41	2.15	1.398528	1976	110.87	90681.92	6.09	27.88	41786.23	2.81
1977	166.60	136261.29	9.16	5.950997	41.89	62789.20	4.22	2.742219	1977	217.40	177808.15	11.95	54.66	81934.00	5.51
1978	245.04	200411.49	13.47	8.752655	61.61	92349.61	6.20	4.033224	1978	319.75	261518.12	17.57	80.40	120507.55	8.10
1979	320.40	262046.32	17.61	11.44446	80.56	120750.94	8.11	5.273607	1979	418.09	341945.76	22.98	105.12	157568.61	10.59
1980	392.80	321264.42	21.59	14.03072	98.76	148038.64	9.95	6.465354	1980	512.57	419219.80	28.17	128.88	193176.48	12.98
1981	462.37	378160.54	25.41	16.51556	116.25	174256.37	11.71	7.610372	1981	603.34	493463.88	33.16	151.70	227388.15	15.28
1982	529.20	432825.73	29.08	18.90298	133.06	199446.10	13.40	8.710493	1982	690.56	564796.80	37.95	173.63	260258.37	17.49
1983	593.42	485347.47	32.61	21.19678	149.21	223648.11	15.03	9.767478	1983	774.36	633332.72	42.55	194.70	291839.72	19.61
1984	655.12	535809.80	36.00	23.40065	164.72	246901.15	16.59	10.78302	1984	854.87	699181.31	46.98	214.94	322182.75	21.65
1985	714.40	584293.47	39.26	25.51809	179.62	269242.43	18.09	11.75874	1985	932.22	762447.94	51.23	234.39	351336.01	23.61
1986	771.35	630876.08	42.39	27.55252	193.95	290707.70	19.53	12.6962	1986	1006.54	823233.85	55.31	253.08	379346.16	25.49
1987	826.08	675632.15	45.40	29.50717	207.70	311331.29	20.92	13.5969	1987	1077.95	881636.31	59.24	271.03	406258.01	27.30
1988	878.65	718633.31	48.28	31.38518	220.92	331146.23	22.25	14.46229	1988	1146.56	937748.78	63.01	288.28	432114.64	29.03
1989	929.17	759948.37	51.06	33.18955	233.62	350184.21	23.53	15.29374	1989	1212.48	991661.04	66.63	304.86	456957.41	30.70
1990	977.70	799643.45	53.73	34.92316	245.83	368475.70	24.76	16.09259	1990	1275.81	1043459.38	70.11	320.78	480826.08	32.31
1991	1024.33	837782.06	56.29	36.58881	257.55	386049.97	25.94	16.86012	1991	1336.66	1093226.67	73.45	336.08	503758.85	33.85
1992	1069.13	874425.23	58.75	38.18914	268.82	402935.15	27.07	17.59756	1992	1395.12	1141042.56	76.67	350.78	525792.41	35.33
1993	1112.18	909631.61	61.12	39.72672	279.64	419158.25	28.16	18.30607	1993	1451.29	1186983.56	79.75	364.90	546962.03	36.75
1994	1153.54	943457.52	63.39	41.20402	290.04	434745.23	29.21	18.98681	1994	1505.26	1231123.19	82.72	378.47	567301.57	38.12
1995	1193.27	975957.10	65.57	42.62339	300.03	449721.03	30.22	19.64086	1995	1557.11	1273532.08	85.57	391.51	586843.58	39.43
1996	1231.45	1007182.35	67.67	43.9871	309.63	464109.63	31.18	20.26926	1996	1606.93	1314278.10	88.31	404.04	605619.35	40.69
1997	1268.13	1037183.25	69.69	45.29734	318.85	477934.04	32.11	20.87301	1997	1654.80	1353426.44	90.94	416.07	623658.90	41.90
1998	1303.38	1066007.79	71.62	46.55621	327.71	491216.39	33.00	21.4531	1998	1700.78	1391039.75	93.46	427.64	640991.12	43.07
1999	1337.24	1093702.10	73.49	47.76571	336.23	503977.93	33.86	22.01044	1999	1744.97	1427178.22	95.89	438.75	657643.72	44.19
2000	1369.77	1120310.51	75.27	48.92779	344.41	516239.08	34.69	22.54593	2000	1787.42	1461899.68	98.22	449.42	673643.37	45.26
2001	1401.03	1145875.58	76.99	50.04431	352.27	528019.47	35.48	23.06042	2001	1828.21	1495259.70	100.47	459.68	689015.67	46.29
2002	1431.06	1170438.24	78.64	51.11704	359.82	539337.94	36.24	23.55473	2002	1867.40	1527311.64	102.62	469.53	703785.21	47.29
2003	1459.92	1194037.77	80.23	52.14771	367.07	550212.61	36.97	24.02967	2003	1905.05	1558106.82	104.69	479.00	717975.62	48.24
2004	1487.64	1216711.96	81.75	53.13797	374.04	560660.87	37.67	24.48598	2004	1941.23	1587694.50	106.68	488.09	731609.62	49.16
2005	1429.31	1169004.00	78.55	51.0544	359.38	538677.04	36.19	23.52587	2005	1865.11	1525440.11	102.49	468.95	702922.80	47.23
2006	1373.26	1123166.70	75.47	49.05253	345.29	517555.22	34.77	22.60341	2006	1791.98	1465626.74	98.48	450.57	675360.80	45.38
2007	1319.42	1079126.70	72.51	47.12915	331.75	497261.59	33.41	21.71711	2007	1721.72	1408158.70	94.61	432.90	648879.53	43.60
2008	1267.68	1036813.54	69.66	45.28119	318.74	477763.68	32.10	20.86557	2008	1654.21	1352944.00	90.90	415.92	623436.60	41.89
2009	1217.98	996159.50	66.93	43.50569	306.24	459030.30	30.84	20.04742	2009	1589.34	1299894.31	87.34	399.62	598991.30	40.25
2010	1170.22	957099.53	64.31	41.79981	294.23	441031.46	29.63	19.26135	2010	1527.02	1248924.73	83.92	383.95	575504.51	38.67
2011	1124.33	919571.12	61.79	40.16082	282.70	423738.37	28.47	18.5061	2011	1467.15	1199953.69	80.62	368.89	552938.66	37.15
2012	1080.25	883514.22	59.36	38.58609	271.61	407123.35	27.35	17.78047	2012	1409.62	1152902.83	77.46	354.43	531257.62	35.70
2013	1037.89	848871.13	57.04	37.07311	260.96	391159.82	26.28	17.08329	2013	1354.35	1107696.86	74.43	340.53	510426.71	34.30
2014	997.19	815586.42	54.80	35.61945	250.73	375822.22	25.25	16.41344	2014	1301.24	1064263.45	71.51	327.18	490412.60	32.95
2015	958.09	783606.82	52.65	34.22279	240.90	361086.02	24.26	15.76986	2015	1250.22	1022533.08	68.70	314.35	471183.24	31.66
2016	920.53	752881.15	50.59	32.8809	231.45	346927.64	23.31	15.15152	2016	1201.20	982438.99	66.01	302.02	452707.88	30.42
2017	884.43	723360.26	48.60	31.59162	222.38	333324.41	22.40	14.55742	2017	1154.10	943917.00	63.42	290.18	434956.95	29.22
2018	849.75	694996.90	46.70	30.35289	213.66	320254.57	21.52	13.98661	2018	1108.85	906905.49	60.93	278.80	417902.05	28.08
2019	816.43	667745.68	44.87	29.16274	205.28	307697.21	20.67	13.43819	2019	1065.37	871345.21	58.55	267.87	401515.87	26.98
2020	784.42	641563.00	43.11	28.01925	197.23	295632.23	19.86	12.91127	2020	1023.60	837179.28	56.25	257.37	385772.21	25.92
2021	753.66	616406.95	41.42	26.9206	189.50	284040.32	19.08	12.40501	2021	983.46	804353.01	54.04	247.28	370645.87	24.90
2022	724.11	592237.29	39.79	25.86503	182.07	272902.94	18.34	11.91861	2022	944.90	772813.88	51.93	237.58	356112.64	23.93
2023	695.72	569015.34	38.23	24.85085	174.93	262202.27	17.62	11.45127	2023	907.85	742511.41	49.89	228.26	342149.26	22.99
2024	668.44	546703.93	36.73	23.87643	168.07	251921.17	16.93	11.00226	2024	872.25	713397.12	47.93	219.31	328733.39	22.09
2025	642.23	525267.36	35.29	22.94022	161.48	242043.20	16.26	10.57085	2025	838.05	685424.42	46.05	210.71	315843.57	21.22
2026	617.05	504671.33	33.91	22.04072	155.15	232552.55	15.63	10.15637	2026	805.19	658548.55	44.25	202.45	303459.17	20.39
2027	592.85	484882.88	32.58	21.17649	149.06	223434.03	15.01	9.758129	2027	773.62	632726.49	42.51	194.51	291560.37	19.59
2028	569.61	465870.35	31.30	20.34615	143.22	214673.06	14.42	9.375507	2028	743.28	607916.93	40.85	186.89	280128.12	18.82
2029	547.27	447603.32	30.07	19.54837	137.60	206255.61	13.86	9.007888	2029	714.14	584080.16	39.24	179.56	269144.14	18.08
2030	525.81	430052.54	28.90	18.78187	132.21	198168.21	13.31	8.654684	2030	686.14	561178.05	37.71	172.52	258590.85	17.37
2031	505.20	413189.94	27.76	18.04542	127.02	190397.92	12.79	8.315329	2031	659.23	539173.95	36.23	165.75	248451.35	16.69
2032	485.39	396988.53	26.67	17.33785	122.04	182932.31	12.29	7.98928	2032	633.38	518032.63	34.81	159.25	238709.44	16.04
2033	466.35	381422.39	25.63	16.65802	117.26	175759.44	11.81	7.676016	2033	608.55	497720.28	33.44	153.01	229349.51	15.41
2034	448.07	366466.60	24.62	16.00485	112.66	168867.81	11.35	7.375035	2034	584.69	478204.39	32.13	147.01	220356.58	14.81
2035	430.50	352097.24	23.66	15.37729	108.24	162246.41	10.90	7.085856	2035	561.76	459453.73	30.87	141.25	211716.28	14.23
2036	413.62	338291.31	22.73	14.77434	104.00	155884.64	10.47	6.808015	2036	539.73	441438.29	29.66	135.71	203414.76	13.67
2037	397.40	325026.72	21.84	14.19503	99.92	149772.31	10.06	6.541069	2037	518.57	424129.25	28.50	130.39	195438.76	13.13
2038	381.82	312282.24	20.98	13.63843	96.00	143899.65	9.67	6.28459	2038	498.24	407498.90	27.38	125.27	187775.49	12.62
2039	366.85	300037.48	20.16	13.10366	92.24	138257.27	9.29	6.038168	2039	478.70	391520.64	26.31	120.36	180412.71	12.12
2040	352.46	288272.84	19.37	12.58986	88.62	132836.12	8.93	5.801408	2040	459.93	376168.90	25.27	115.64	173338.63	11.65
2041	338.64	276969.50	18.61	12.09621	85.15	127627.54	8.58	5.573931	2041	441.90	361419.11	24.28	111.11	166541.92	11.19
2042	325.36	266109.37	17.88	11.62191	81.81	122623.20	8.24	5.355374	2042	424.57	347247.66	23.33	106.75	160011.72	10.75
2043	312.61	255675.07	17.18	11.1662	78.60	117815.07	7.92	5.145387	2043	407.92	333631.88	22.42	102.57	153737.57	10.33
2044	300.35	245649.91	16.51	10.72837	75.52	113195.48	7.61	4.943634	2044	391.93	320549.99	21.54	98.54	147709.44	9.92

Year	Biodegradable waste								Year	Total disposed waste					
	Total landfill gas				Methane					Total landfill gas			Methane		
	(Mg/year)	(m3/year)	(av ft^3/mir	65% LFG C	(Mg/year)	(m3/year)	(av ft^3/mir	65% Methane Capture		(Mg/year)	(m3/year)	(av ft^3/mir	(Mg/year)	(m3/year)	(av ft^3/min
2045	288.57	236017.84	15.86	10.30771	72.56	108757.02	7.31	4.749791	2045	376.56	307981.05	20.69	94.68	141917.67	9.54
2046	277.26	226763.45	15.24	9.903535	69.71	104492.60	7.02	4.563549	2046	361.79	295904.94	19.88	90.97	136352.99	9.16
2047	266.39	217871.92	14.64	9.515212	66.98	100395.38	6.75	4.38461	2047	347.61	284302.34	19.10	87.40	131006.52	8.80
2048	255.94	209329.04	14.06	9.142115	64.35	96458.82	6.48	4.212687	2048	333.98	273154.68	18.35	83.97	125869.68	8.46
2049	245.91	201121.13	13.51	8.783648	61.83	92676.62	6.23	4.047505	2049	320.88	262444.14	17.63	80.68	120934.26	8.13
2050	236.26	193235.06	12.98	8.439236	59.40	89042.72	5.98	3.8888	2050	308.30	252153.55	16.94	77.52	116192.36	7.81
2051	227.00	185658.21	12.47	8.108329	57.08	85551.30	5.75	3.736318	2051	296.21	242266.46	16.28	74.48	111636.39	7.50
2052	218.10	178378.44	11.99	7.790397	54.84	82196.79	5.52	3.589815	2052	284.60	232767.07	15.64	71.56	107259.06	7.21
2053	209.55	171384.13	11.52	7.484931	52.69	78973.81	5.31	3.449056	2053	273.44	223640.14	15.03	68.75	103053.38	6.92
2054	201.33	164664.06	11.06	7.191443	50.62	75877.20	5.10	3.313817	2054	262.72	214871.08	14.44	66.06	99012.60	6.65
2055	193.44	158207.49	10.63	6.909462	48.64	72902.01	4.90	3.18388	2055	252.42	206445.87	13.87	63.47	95130.26	6.39
2056	185.85	152004.08	10.21	6.638538	46.73	70043.48	4.71	3.059038	2056	242.52	198351.01	13.33	60.98	91400.15	6.14
2057	178.56	146043.92	9.81	6.378238	44.90	67297.04	4.52	2.939092	2057	233.01	190573.56	12.80	58.59	87816.29	5.90
2058	171.56	140317.45	9.43	6.128143	43.14	64658.28	4.34	2.823848	2058	223.87	183101.06	12.30	56.29	84372.97	5.67
2059	164.84	134815.53	9.06	5.887855	41.45	62123.00	4.17	2.713124	2059	215.09	175921.56	11.82	54.08	81064.66	5.45
2060	158.37	129529.34	8.70	5.656989	39.82	59687.12	4.01	2.606741	2060	206.66	169023.58	11.36	51.96	77886.07	5.23
2061	152.16	124450.42	8.36	5.435175	38.26	57346.75	3.85	2.504529	2061	198.56	162396.07	10.91	49.92	74832.11	5.03
2062	146.20	119570.65	8.03	5.222059	36.76	55098.15	3.70	2.406325	2062	190.77	156028.43	10.48	47.97	71897.90	4.83
2063	140.46	114882.21	7.72	5.017299	35.32	52937.72	3.56	2.311972	2063	183.29	149910.47	10.07	46.09	69078.74	4.64
2064	134.96	110377.62	7.42	4.820568	33.93	50862.01	3.42	2.221318	2064	176.10	144032.40	9.68	44.28	66370.13	4.46
2065	129.66	106049.65	7.13	4.631551	32.60	48867.68	3.28	2.134219	2065	169.20	138384.80	9.30	42.54	63767.72	4.28
2066	124.58	101891.38	6.85	4.449945	31.32	46951.55	3.15	2.050535	2066	162.56	132958.66	8.93	40.87	61267.35	4.12
2067	119.69	97896.17	6.58	4.27546	30.10	45110.55	3.03	1.970132	2067	156.19	127745.27	8.58	39.27	58865.02	3.96
2068	115.00	94057.60	6.32	4.107817	28.92	43341.74	2.91	1.892882	2068	150.07	122736.31	8.25	37.73	56556.89	3.80
2069	110.49	90369.55	6.07	3.946747	27.78	41642.29	2.80	1.818661	2069	144.18	117923.75	7.92	36.25	54339.26	3.65
2070	106.16	86826.11	5.83	3.791993	26.69	40009.47	2.69	1.74735	2070	138.53	113299.90	7.61	34.83	52208.59	3.51
2071	102.00	83421.61	5.61	3.643307	25.65	38440.68	2.58	1.678836	2071	133.10	108857.34	7.31	33.47	50161.46	3.37
2072	98.00	80150.60	5.39	3.500451	24.64	36933.40	2.48	1.613008	2072	127.88	104588.99	7.03	32.15	48194.60	3.24
2073	94.16	77007.85	5.17	3.363196	23.67	35485.22	2.38	1.549761	2073	122.86	100487.99	6.75	30.89	46304.87	3.11
2074	90.46	73988.33	4.97	3.231323	22.75	34093.82	2.29	1.488994	2074	118.05	96547.80	6.49	29.68	44489.23	2.99
2075	86.92	71087.21	4.78	3.104621	21.85	32756.98	2.20	1.43061	2075	113.42	92762.11	6.23	28.52	42744.78	2.87
2076	83.51	68299.84	4.59	2.982888	21.00	31472.57	2.11	1.374515	2076	108.97	89124.85	5.99	27.40	41068.73	2.76
2077	80.23	65621.76	4.41	2.865927	20.17	30238.51	2.03	1.320619	2077	104.70	85630.22	5.75	26.32	39458.40	2.65
2078	77.09	63048.70	4.24	2.753552	19.38	29052.84	1.95	1.268837	2078	100.59	82272.61	5.53	25.29	37911.22	2.55
2079	74.07	60576.52	4.07	2.645584	18.62	27913.66	1.88	1.219085	2079	96.65	79046.65	5.31	24.30	36424.70	2.45
2080	71.16	58201.28	3.91	2.541849	17.89	26819.15	1.80	1.171284	2080	92.86	75947.19	5.10	23.35	34996.47	2.35
2081	68.37	55919.18	3.76	2.442182	17.19	25767.56	1.73	1.125357	2081	89.22	72969.26	4.90	22.43	33624.23	2.26
2082	65.69	53726.56	3.61	2.346422	16.52	24757.20	1.66	1.081231	2082	85.72	70108.09	4.71	21.55	32305.81	2.17
2083	63.11	51619.91	3.47	2.254418	15.87	23786.45	1.60	1.038836	2083	82.36	67359.12	4.53	20.71	31039.08	2.09
2084	60.64	49595.86	3.33	2.166021	15.25	22853.77	1.54	0.998102	2084	79.13	64717.93	4.35	19.90	29822.02	2.00
2085	58.26	47651.18	3.20	2.08109	14.65	21957.66	1.48	0.958966	2085	76.03	62180.30	4.18	19.12	28652.68	1.93
2086	55.98	45782.75	3.08	1.999489	14.07	21096.69	1.42	0.921365	2086	73.05	59742.18	4.01	18.37	27529.19	1.85
2087	53.78	43987.58	2.96	1.921088	13.52	20269.48	1.36	0.885237	2087	70.18	57399.65	3.86	17.65	26449.76	1.78
2088	51.67	42262.81	2.84	1.845761	12.99	19474.70	1.31	0.850527	2088	67.43	55148.98	3.71	16.95	25412.65	1.71
2089	49.65	40605.66	2.73	1.773388	12.48	18711.09	1.26	0.817177	2089	64.79	52986.56	3.56	16.29	24416.21	1.64
2090	47.70	39013.49	2.62	1.703852	11.99	17977.41	1.21	0.785135	2090	62.24	50908.92	3.42	15.65	23458.83	1.58
2091	45.83	37483.75	2.52	1.637043	11.52	17272.51	1.16	0.75435	2091	59.80	48912.76	3.29	15.04	22539.00	1.51
2092	44.03	36013.99	2.42	1.572854	11.07	16595.25	1.12	0.724771	2092	57.46	46994.86	3.16	14.45	21655.23	1.46
2093	42.31	34601.86	2.32	1.511182	10.64	15944.54	1.07	0.696352	2093	55.21	45152.17	3.03	13.88	20806.12	1.40
2094	40.65	33245.10	2.23	1.451927	10.22	15319.34	1.03	0.669048	2094	53.04	43381.72	2.91	13.34	19990.30	1.34
2095	39.05	31941.54	2.15	1.394996	9.82	14718.66	0.99	0.642814	2095	50.96	41680.70	2.80	12.81	19206.47	1.29
2096	37.52	30689.10	2.06	1.340298	9.43	14141.54	0.95	0.617609	2096	48.96	40046.38	2.69	12.31	18453.37	1.24
2097	36.05	29485.76	1.98	1.287744	9.06	13587.04	0.91	0.593392	2097	47.04	38476.14	2.59	11.83	17729.80	1.19
2098	34.64	28329.61	1.90	1.237251	8.71	13054.28	0.88	0.570125	2098	45.20	36967.47	2.48	11.36	17034.61	1.14
2099	33.28	27218.79	1.83	1.188737	8.37	12542.42	0.84	0.54777	2099	43.43	35517.95	2.39	10.92	16366.67	1.10
2100	31.97	26151.52	1.76	1.142126	8.04	12050.62	0.81	0.526292	2100	41.72	34125.27	2.29	10.49	15724.93	1.06
2101	30.72	25126.11	1.69	1.097343	7.72	11578.11	0.78	0.505656	2101	40.09	32787.20	2.20	10.08	15108.34	1.02
2102	29.52	24140.90	1.62	1.054316	7.42	11124.13	0.75	0.485829	2102	38.52	31501.60	2.12	9.68	14515.94	0.98
2103	28.36	23194.32	1.56	1.012975	7.13	10687.94	0.72	0.466779	2103	37.01	30266.40	2.03	9.30	13946.76	0.94
2104	27.25	22284.86	1.50	0.973256	6.85	10268.86	0.69	0.448476	2104	35.55	29079.64	1.95	8.94	13399.90	0.90
2105	26.18	21411.06	1.44	0.935094	6.58	9866.21	0.66	0.430891	2105	34.16	27939.41	1.88	8.59	12874.48	0.87
2106	25.15	20571.52	1.38	0.898428	6.32	9479.35	0.64	0.413996	2106	32.82	26843.89	1.80	8.25	12369.66	0.83
2107	24.17	19764.90	1.33	0.863201	6.08	9107.66	0.61	0.397763	2107	31.53	25791.33	1.73	7.93	11884.64	0.80
2108	23.22	18989.90	1.28	0.829354	5.84	8750.55	0.59	0.382166	2108	30.30	24780.03	1.66	7.62	11418.64	0.77
2109	22.31	18245.30	1.23	0.796835	5.61	8407.43	0.56	0.367181	2109	29.11	23808.39	1.60	7.32	10970.91	0.74
2110	21.43	17529.89	1.18	0.76559	5.39	8077.77	0.54	0.352784	2110	27.97	22874.85	1.54	7.03	10540.73	0.71
2111	20.59	16842.53	1.13	0.735571	5.18	7761.04	0.52	0.338951	2111	26.87	21977.92	1.48	6.76	10127.42	0.68
2112	19.79	16182.13	1.09	0.706729	4.97	7456.72	0.50	0.325661	2112	25.82	21116.15	1.42	6.49	9730.32	0.65
2113	19.01	15547.62	1.04	0.679018	4.78	7164.34	0.48	0.312891	2113	24.81	20288.18	1.36	6.24	9348.79	0.63
2114	18.26	14937.99	1.00	0.652393	4.59	6883.42	0.46	0.300623	2114	23.83	19492.67	1.31	5.99	8982.22	0.60
2115	17.55	14352.26	0.96	0.626812	4.41	6613.52	0.44	0.288835	2115	22.90	18728.35	1.26	5.76	8630.02	0.58

Appendix E

LandGEM Model Results for Marpi Solid Waste Facility

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LandGEM Model Output MSWF

Biodegradable waste

Year	(Mg/year)	Total landfill gas (m3/year)	(av ft^3/min	75% LFG C	(Mg/year)	Methane (m3/year)	(av ft^3/min	75% Metha	Btu
2003	0	0	0	0	0	0	0	0	0
2004	199.46	151621.21	10.19	7.640558	60.69	90972.72	6.11	4.584335	3557.444
2005	386.87	294076.69	19.76	14.81923	117.72	176446.01	11.86	8.89154	6899.835
2006	549.91	418013.00	28.09	21.06468	167.33	250807.80	16.85	12.63881	9807.716
2007	689.52	524135.80	35.22	26.41247	209.81	314481.48	21.13	15.84748	12297.64
2008	821.97	624818.85	41.98	31.48613	250.11	374891.31	25.19	18.89168	14659.94
2009	926.28	704104.02	47.31	35.4815	281.85	422462.41	28.39	21.2889	16520.19
2010	1008.11	766311.15	51.49	38.61626	306.75	459786.69	30.89	23.16976	17979.73
2011	1089.95	828523.54	55.67	41.7513	331.65	497114.12	33.40	25.05078	19439.4
2012	1170.18	889507.42	59.77	44.82442	356.06	533704.45	35.86	26.89465	20870.25
2013	1210.32	920019.03	61.82	46.36197	368.27	552011.42	37.09	27.81718	21586.14
2014	1287.71	978849.97	65.77	49.32661	391.82	587309.98	39.46	29.59596	22966.47
2015	1365.00	1037597.34	69.72	52.28703	415.34	622558.40	41.83	31.37222	24344.84
2016	1441.87	1096032.37	73.64	55.23171	438.73	657619.42	44.19	33.13903	25715.88
2017	1557.47	1183902.62	79.55	59.6597	473.90	710341.57	47.73	35.79582	27777.56
2018	1672.94	1271680.27	85.44	64.08303	509.04	763008.16	51.27	38.44982	29837.06
2019	1756.68	1335333.62	89.72	67.29068	534.52	801200.17	53.83	40.37441	31330.54
2020	1838.18	1397285.70	93.88	70.41259	559.32	838371.42	56.33	42.24756	32784.1
2021	1917.54	1457608.78	97.94	73.45242	583.46	874565.27	58.76	44.07145	34199.45
2022	1994.85	1516372.34	101.88	76.41365	606.99	909823.40	61.13	45.84819	35578.2
2023	2070.19	1573643.17	105.73	79.29967	629.91	944185.90	63.44	47.5798	36921.93
2024	2143.65	1629485.48	109.48	82.1137	652.27	977691.29	65.69	49.26822	38232.14
2025	2215.32	1683961.00	113.15	84.85885	674.07	1010376.60	67.89	50.91531	39510.28
2026	2285.26	1737129.08	116.72	87.53812	695.35	1042277.45	70.03	52.52287	40757.75
2027	2353.56	1789046.80	120.21	90.15438	716.14	1073428.08	72.12	54.09263	41975.88
2028	2420.29	1839769.01	123.61	92.71039	736.44	1103861.41	74.17	55.62624	43165.96
2029	2485.51	1889348.48	126.95	95.20882	756.29	1133609.09	76.17	57.12529	44329.23
2030	2549.30	1937835.93	130.20	97.65222	775.69	1162701.56	78.12	58.59133	45466.87
2031	2611.71	1985280.16	133.39	100.043	794.69	1191168.09	80.03	60.02583	46580.04
2032	2672.82	2031728.06	136.51	102.3837	813.28	1219036.84	81.91	61.4302	47669.84
2033	2732.67	2077224.76	139.57	104.6764	831.49	1246334.85	83.74	62.80582	48737.31
2034	2791.33	2121813.64	142.56	106.9233	849.34	1273088.18	85.54	64.15398	49783.49
2035	2848.85	2165536.43	145.50	109.1266	866.84	1299321.86	87.30	65.47596	50809.34
2036	2905.28	2208433.27	148.38	111.2883	884.01	1325059.96	89.03	66.77296	51815.82
2037	2960.68	2250542.76	151.21	113.4103	900.87	1350325.65	90.73	68.04616	52803.82
2038	3015.09	2291902.03	153.99	115.4945	917.42	1375141.22	92.40	69.29668	53774.22
2039	3068.55	2332546.82	156.72	117.5427	933.69	1399528.09	94.03	70.52559	54727.86
2040	3121.13	2372511.49	159.41	119.5566	949.69	1423506.89	95.65	71.73394	55665.54
2041	3172.85	2411829.09	162.05	121.5379	965.43	1447097.45	97.23	72.92273	56588.04
2042	3223.77	2450531.44	164.65	123.4882	980.92	1470318.86	98.79	74.09291	57496.1
2043	3273.91	2488649.15	167.21	125.409	996.18	1493189.49	100.33	75.24542	58390.44
2044	3323.33	2526211.68	169.74	127.3019	1011.21	1515727.01	101.84	76.38113	59271.76
2045	3372.05	2563247.36	172.22	129.1682	1026.04	1537948.42	103.33	77.50093	60140.72
2046	3420.12	2599783.49	174.68	131.0094	1040.66	1559870.09	104.81	78.60561	60997.95
2047	3467.56	2635846.31	177.10	132.8266	1055.10	1581507.79	106.26	79.69599	61844.09
2048	3514.41	2671461.10	179.50	134.6214	1069.36	1602876.66	107.70	80.77282	62679.7
2049	3560.70	2706652.19	181.86	136.3947	1083.44	1623991.31	109.12	81.83683	63505.38
2050	3421.09	2600522.84	174.73	131.0466	1040.96	1560313.70	104.84	78.62797	61015.3
2051	3286.94	2498554.88	167.88	125.9082	1000.14	1499132.93	100.73	75.54492	58622.86
2052	3158.06	2400585.14	161.30	120.9713	960.93	1440351.08	96.78	72.58276	56324.22
2053	3034.23	2306456.85	154.97	116.2279	923.25	1383874.11	92.98	69.73675	54115.72
2054	2915.26	2216019.38	148.89	111.6706	887.05	1329611.63	89.34	67.00233	51993.81
2055	2800.95	2129128.02	143.06	107.2919	852.27	1277476.81	85.83	64.37513	49955.1
2056	2691.12	2045643.72	137.45	103.0849	818.85	1227386.23	82.47	61.85095	47996.34
2057	2585.60	1965432.88	132.06	99.0429	786.74	1179259.73	79.23	59.42574	46114.37
2058	2484.22	1888367.15	126.88	95.15937	755.89	1133020.29	76.13	57.09562	44306.2
2059	2386.81	1814323.22	121.90	91.42812	726.25	1088593.93	73.14	54.85687	42568.93
2060	2293.22	1743182.59	117.12	87.84317	697.78	1045909.55	70.27	52.7059	40899.78
2061	2203.31	1674831.42	112.53	84.39879	670.42	1004898.85	67.52	50.63927	39296.08
2062	2116.91	1609160.34	108.12	81.08947	644.13	965496.21	64.87	48.65368	37755.26
2063	2033.91	1546064.26	103.88	77.9099	618.87	927638.56	62.33	46.74594	36274.85
2064	1954.16	1485442.22	99.81	74.85501	594.61	891265.33	59.88	44.91301	34852.49
2065	1877.53	1427197.19	95.89	71.9199	571.29	856318.32	57.54	43.15194	33485.91
2066	1803.91	1371235.99	92.13	69.09988	548.89	822741.59	55.28	41.45993	32172.91
2067	1733.18	1317469.06	88.52	66.39044	527.37	790481.44	53.11	39.83426	30911.39
2068	1665.22	1265810.36	85.05	63.78723	506.69	759486.21	51.03	38.27234	29699.34
2069	1599.93	1216177.22	81.71	61.2861	486.82	729706.33	49.03	36.77166	28534.81
2070	1537.19	1168490.23	78.51	58.88304	467.73	701094.14	47.11	35.32982	27415.94

Total disposed waste

Year	(Mg/year)	Total landfill gas (m3/year)	(av ft^3/mir	(Mg/year)	Methane (m3/year)	(av ft^3/min
2003	0	0	0	0	0	0
2004	263.86	200575.52	13.48	80.29	120345.31	8.09
2005	511.84	389072.49	26.14	155.74	233443.50	15.69
2006	733.54	557598.52	37.46	223.20	334559.11	22.48
2007	938.82	713638.85	47.95	285.66	428183.31	28.77
2008	1130.85	859612.03	57.76	344.09	515767.22	34.65
2009	1261.80	959151.88	64.45	383.94	575491.13	38.67
2010	1359.81	1033652.23	69.45	413.76	620191.34	41.67
2011	1467.70	1115661.43	74.96	446.59	669396.86	44.98
2012	1574.29	1196685.79	80.41	479.02	718011.47	48.24
2013	1632.37	1240836.36	83.37	496.69	744501.82	50.02
2014	1718.47	1306283.60	87.77	522.89	783770.16	52.66
2015	1796.54	1365632.00	91.76	546.65	819379.20	55.05
2016	1893.85	1439600.10	96.73	576.26	863760.06	58.04
2017	2052.74	1560383.80	104.84	624.60	936230.28	62.91
2018	2183.73	1659950.64	111.53	664.46	995970.39	66.92
2019	2292.97	1742991.57	117.11	697.70	1045794.94	70.27
2020	2399.30	1823813.32	122.54	730.05	1094287.99	73.53
2021	2502.83	1902510.16	127.83	761.55	1141506.10	76.70
2022	2603.68	1979172.73	132.98	792.24	1187503.64	79.79
2023	2701.97	2053888.13	138.00	822.15	1232332.88	82.80
2024	2797.81	2126740.14	142.90	851.31	1276044.09	85.74
2025	2891.30	2197809.29	147.67	879.76	1318685.57	88.60
2026	2982.55	2267173.00	152.33	907.52	1360303.80	91.40
2027	3071.66	2334905.70	156.88	934.64	1400943.42	94.13
2028	3158.71	2401078.97	161.33	961.13	1440647.38	96.80
2029	3243.80	2465761.64	165.67	987.02	1479456.98	99.40
2030	3327.02	2529019.87	169.92	1012.34	1517411.92	101.95
2031	3408.45	2590917.31	174.08	1037.12	1554550.39	104.45
2032	3488.17	2651515.15	178.15	1061.37	1590909.09	106.89
2033	3566.26	2710872.23	182.14	1085.13	1626523.34	109.29
2034	3642.79	2769045.17	186.05	1108.42	1661427.10	111.63
2035	3717.83	2826088.38	189.88	1131.25	1695653.03	113.93
2036	3791.45	2882054.23	193.64	1153.65	1729232.54	116.19
2037	3863.73	2936993.08	197.34	1175.65	1762195.85	118.40
2038	3934.71	2990953.36	200.96	1197.25	1794572.02	120.58
2039	4004.47	3043981.69	204.52	1218.47	1826389.01	122.71
2040	4073.07	3096122.87	208.03	1239.34	1857673.72	124.82
2041	4140.55	3147420.06	211.47	1259.88	1888452.04	126.88
2042	4206.98	3197914.74	214.87	1280.09	1918748.84	128.92
2043	4272.40	3247646.84	218.21	1300.00	1948588.10	130.93
2044	4336.88	3296654.79	221.50	1319.61	1977992.87	132.90
2045	4400.44	3344975.56	224.75	1338.96	2006985.33	134.85
2046	4463.15	3392644.73	227.95	1358.04	2035586.84	136.77
2047	4525.05	3439696.56	231.11	1376.87	2063817.94	138.67
2048	4586.18	3486164.02	234.23	1395.47	2091698.41	140.54
2049	4646.59	3532078.85	237.32	1413.85	2119247.31	142.39
2050	4706.30	3577471.59	240.37	1432.02	2146482.95	144.22
2051	4765.37	3622371.67	243.39	1450.00	2173423.00	146.03
2052	4823.83	3666807.41	246.37	1467.78	2200084.45	147.82
2053	4881.71	3710806.11	249.33	1485.39	2226483.66	149.60
2054	4939.05	3754394.02	252.26	1502.84	2252636.41	151.35
2055	4995.88	3797596.46	255.16	1520.14	2278557.88	153.10
2056	5052.24	3840437.81	258.04	1537.29	2304262.69	154.82
2057	5108.16	3882941.56	260.89	1554.30	2329764.93	156.54
2058	5163.66	3925130.33	263.73	1571.19	2355078.20	158.24
2059	5218.78	3967025.95	266.54	1587.96	2380215.57	159.93
2060	5273.53	4008649.44	269.34	1604.62	2405189.66	161.60
2061	5327.96	4050021.05	272.12	1621.18	2430012.63	163.27
2062	5382.08	4091160.33	274.88	1637.65	2454696.20	164.93
2063	5435.92	4132086.12	277.63	1654.03	2479251.67	166.58
2064	5489.50	4172816.58	280.37	1670.33	2503689.95	168.22
2065	5542.85	4213369.24	283.10	1686.57	2528021.54	169.86
2066	5595.99	4253761.00	285.81	1702.73	2552256.60	171.49
2067	5648.93	4294008.18	288.51	1718.84	2576404.91	173.11
2068	5701.71	4334126.53	291.21	1734.90	2600475.92	174.73
2069	5478.14	4164183.00	279.79	1666.88	2498509.80	167.87
2070	5263.34	4000903.05	268.82	1601.52	2400541.83	161.29

Year	Biodegradable waste									Year	Total disposed waste					
	Total landfill gas				Methane						Total landfill gas			Methane		
	(Mg/year)	(m3/year)	(av ft^3/mir	75% LFG C	(Mg/year)	(m3/year)	(av ft^3/mir	75% Metha	Btu		(Mg/year)	(m3/year)	(av ft^3/mir	(Mg/year)	(m3/year)	(av ft^3/min
2071	1476.92	1122673.08	75.43	56.5742	449.39	673603.85	45.26	33.94452	26340.95	2071	5056.96	3844025.39	258.28	1538.72	2306415.24	154.97
2072	1419.01	1078652.43	72.47	54.35589	431.77	647191.46	43.48	32.61354	25308.1	2072	4858.68	3693299.00	248.15	1478.39	2215979.40	148.89
2073	1363.37	1036357.87	69.63	52.22457	414.84	621814.72	41.78	31.33474	24315.76	2073	4668.17	3548482.68	238.42	1420.42	2129089.61	143.05
2074	1309.91	995721.69	66.90	50.17681	398.58	597433.02	40.14	30.10609	23362.32	2074	4485.12	3409344.68	229.07	1364.72	2045606.81	137.44
2075	1258.55	956678.89	64.28	48.20935	382.95	574007.33	38.57	28.92561	22446.27	2075	4309.26	3275662.36	220.09	1311.21	1965397.42	132.05
2076	1209.20	919166.97	61.76	46.31904	367.93	551500.18	37.06	27.79142	21566.14	2076	4140.29	3147221.81	211.46	1259.80	1888333.08	126.88
2077	1161.79	883125.92	59.34	44.50284	353.51	529875.55	35.60	26.70171	20720.52	2077	3977.95	3023817.47	203.17	1210.40	1814290.48	121.90
2078	1116.23	848498.06	57.01	42.75786	339.64	509098.83	34.21	25.65472	19908.06	2078	3821.97	2905251.89	195.20	1162.94	1743151.14	117.12
2079	1072.46	815227.97	54.78	41.0813	326.33	489136.78	32.87	24.64878	19127.45	2079	3672.11	2791335.34	187.55	1117.34	1674801.20	112.53
2080	1030.41	783262.43	52.63	39.47048	313.53	469957.46	31.58	23.68229	18377.46	2080	3528.12	2681885.51	180.20	1073.53	1609131.31	108.12
2081	990.01	752550.27	50.56	37.92282	301.24	451530.16	30.34	22.75369	17656.87	2081	3389.78	2576727.28	173.13	1031.44	1546036.37	103.88
2082	951.19	723042.35	48.58	36.43585	289.43	433825.41	29.15	21.86151	16964.53	2082	3256.87	2475692.36	166.34	990.99	1485415.41	99.80
2083	913.89	694691.45	46.68	35.00718	278.08	416814.87	28.01	21.00431	16299.34	2083	3129.16	2378619.07	159.82	952.14	1427171.44	95.89
2084	878.06	667452.21	44.85	33.63452	267.17	400471.33	26.91	20.18071	15660.23	2084	3006.47	2285352.08	153.55	914.80	1371211.25	92.13
2085	843.63	641281.04	43.09	32.3157	256.70	384768.62	25.85	19.38942	15046.19	2085	2888.58	2195742.15	147.53	878.93	1317445.29	88.52
2086	810.55	616136.05	41.40	31.04858	246.63	369681.63	24.84	18.62915	14456.22	2086	2775.32	2109645.87	141.75	844.47	1265787.52	85.05
2087	778.77	591977.01	39.77	29.83115	236.96	355186.20	23.86	17.89869	13889.38	2087	2666.50	2026925.47	136.19	811.36	1216155.28	81.71
2088	748.23	568765.26	38.22	28.66145	227.67	341259.15	22.93	17.19687	13344.77	2088	2561.94	1947448.58	130.85	779.54	1168469.15	78.51
2089	718.89	546463.65	36.72	27.53762	218.74	327878.19	22.03	16.52257	12821.52	2089	2461.49	1871088.03	125.72	748.98	1122652.82	75.43
2090	690.71	525036.51	35.28	26.45785	210.17	315021.90	21.17	15.87471	12318.78	2090	2364.97	1797721.62	120.79	719.61	1078632.97	72.47
2091	663.62	504449.53	33.89	25.42043	201.93	302669.72	20.34	15.25226	11835.75	2091	2272.24	1727231.95	116.05	691.39	1036339.17	69.63
2092	637.60	484669.78	32.56	24.42368	194.01	290801.87	19.54	14.65421	11371.66	2092	2183.14	1659506.21	111.50	664.28	995703.73	66.90
2093	612.60	465665.61	31.29	23.46601	186.40	279399.36	18.77	14.07961	10925.77	2093	2097.54	1594436.05	107.13	638.24	956661.63	64.28
2094	588.58	447406.60	30.06	22.5459	179.09	268443.96	18.04	13.52754	10497.37	2094	2015.30	1531917.31	102.93	613.21	919150.39	61.76
2095	565.50	429863.53	28.88	21.66186	172.07	257918.12	17.33	12.99712	10085.76	2095	1936.28	1471849.98	98.89	589.17	883109.99	59.34
2096	543.33	413008.34	27.75	20.81249	165.32	247805.01	16.65	12.48749	9690.293	2096	1860.35	1414137.91	95.02	566.06	848482.75	57.01
2097	522.02	396814.05	26.66	19.99642	158.84	238088.43	16.00	11.99785	9310.331	2097	1787.41	1358688.77	91.29	543.87	815213.26	54.77
2098	501.56	381254.75	25.62	19.21235	152.61	228752.85	15.37	11.52741	8945.268	2098	1717.32	1305413.82	87.71	522.54	783248.29	52.63
2099	481.89	366305.54	24.61	18.45902	146.63	219783.32	14.77	11.07541	8594.519	2099	1649.98	1254227.82	84.27	502.05	752536.69	50.56
2100	462.99	351942.49	23.65	17.73523	140.88	211165.50	14.19	10.64114	8257.523	2100	1585.29	1205048.84	80.97	482.37	723029.30	48.58
2101	444.84	338142.63	22.72	17.03982	135.35	202885.58	13.63	10.22389	7933.741	2101	1523.13	1157798.20	77.79	463.45	694678.92	46.68
2102	427.40	324883.87	21.83	16.37168	130.05	194930.32	13.10	9.823008	7622.655	2102	1463.41	1112400.28	74.74	445.28	667440.17	44.85
2103	410.64	312144.99	20.97	15.72974	124.95	187286.99	12.58	9.437843	7323.766	2103	1406.02	1068782.44	71.81	427.82	641269.47	43.09
2104	394.54	299905.61	20.15	15.11297	120.05	179943.37	12.09	9.06778	7036.597	2104	1350.89	1026874.88	69.00	411.05	616124.93	41.40
2105	379.07	288146.14	19.36	14.52038	115.34	172887.69	11.62	8.712227	6760.688	2105	1297.92	986610.54	66.29	394.93	591966.33	39.77
2106	364.20	276847.77	18.60	13.95103	110.82	166108.66	11.16	8.370616	6495.598	2106	1247.03	947924.99	63.69	379.44	568754.99	38.21
2107	349.92	265992.42	17.87	13.404	106.47	159595.45	10.72	8.042399	6240.902	2107	1198.13	910756.32	61.19	364.57	546453.79	36.72
2108	336.20	255562.70	17.17	12.87842	102.30	153337.62	10.30	7.727052	5996.192	2108	1151.16	875045.05	58.79	350.27	525027.03	35.28
2109	323.02	245541.95	16.50	12.37345	98.29	147325.17	9.90	7.42407	5761.078	2109	1106.02	840734.05	56.49	336.54	504440.43	33.89
2110	310.35	235914.11	15.85	11.88828	94.43	141548.47	9.51	7.132968	5535.183	2110	1062.65	807768.39	54.27	323.34	484661.04	32.56
2111	298.18	226663.78	15.23	11.42213	90.73	135998.27	9.14	6.85328	5318.146	2111	1020.98	776095.34	52.15	310.66	465657.21	31.29
2112	286.49	217776.17	14.63	10.97427	87.17	130665.70	8.78	6.584559	5109.618	2112	980.95	745664.21	50.10	298.48	447398.53	30.06
2113	275.26	209237.04	14.06	10.54396	83.76	125542.23	8.44	6.326375	4909.267	2113	942.49	716426.30	48.14	286.78	429855.78	28.88
2114	264.47	201032.74	13.51	10.13052	80.47	120619.65	8.10	6.078314	4716.772	2114	905.53	688334.82	46.25	275.53	413000.89	27.75
2115	254.10	193150.14	12.98	9.733301	77.32	115890.08	7.79	5.83998	4531.825	2115	870.02	661344.83	44.44	264.73	396806.90	26.66
2116	244.13	185576.61	12.47	9.351652	74.28	111345.97	7.48	5.610991	4354.129	2116	835.91	635413.12	42.69	254.35	381247.87	25.62
2117	234.56	178300.05	11.98	8.984969	71.37	106980.03	7.19	5.390981	4183.402	2117	803.13	610498.22	41.02	244.38	366298.93	24.61
2118	225.36	171308.80	11.51	8.632663	68.57	102785.28	6.91	5.179598	4019.368	2118	771.64	586560.24	39.41	234.79	351936.14	23.65
2119	216.53	164591.69	11.06	8.294172	65.88	98755.01	6.64	4.976503	3861.766	2119	741.39	563560.89	37.87	225.59	338136.53	22.72
2120	208.04	158137.96	10.63	7.968953	63.30	94882.77	6.38	4.781372	3710.344	2120	712.32	541463.35	36.38	216.74	324878.01	21.83
2121	199.88	151937.28	10.21	7.656485	60.82	91162.37	6.13	4.593891	3564.86	2121	684.39	520232.27	34.95	208.24	312139.36	20.97
2122	192.04	145979.73	9.81	7.35627	58.43	87587.84	5.89	4.413762	3425.079	2122	657.55	499833.67	33.58	200.08	299900.20	20.15
2123	184.51	140255.79	9.42	7.067827	56.14	84153.47	5.65	4.240696	3290.78	2123	631.77	480234.91	32.27	192.23	288140.94	19.36
2124	177.28	134756.28	9.05	6.790693	53.94	80853.77	5.43	4.074416	3161.747	2124	607.00	461404.63	31.00	184.70	276842.78	18.60
2125	170.33	129472.41	8.70	6.524427	51.83	77683.44	5.22	3.914656	3037.773	2125	583.19	443312.69	29.79	177.45	265987.62	17.87
2126	163.65	124395.72	8.36	6.2686	49.79	74637.43	5.01	3.76116	2918.66	2126	560.33	425930.15	28.62	170.50	255558.09	17.17
2127	157.23	119518.10	8.03	6.022805	47.84	71710.86	4.82	3.613683	2804.218	2127	538.36	409229.19	27.50	163.81	245537.52	16.50
2128	151.07	114831.72	7.72	5.786647	45.97	68899.03	4.63	3.471988	2694.263	2128	517.25	393183.09	26.42	157.39	235909.85	15.85
2129	145.14	110329.11	7.41	5.55975	44.16	66197.47	4.45	3.33585	2588.619	2129	496.97	377766.16	25.38	151.22	226659.70	15.23
2130	139.45	106003.04	7.12	5.341749	42.43	63601.83	4.27	3.205049	2487.118	2130	477.48	362953.74	24.39	145.29	217772.24	14.63
2131	133.98	101846.60	6.84	5.132296	40.77	61107.96	4.11	3.079377	2389.597	2131	458.76	348722.12	23.43	139.59	209233.27	14.06
2132	128.73	97853.14	6.57	4.931055	39.17	58711.88	3.94	2.958633	2295.899	2132	440.77	335048.53	22.51	134.12	201029.12	13.51
2133	123.68	94016.26	6.32	4.737706	37.63	56409.76	3.79	2.842624	2205.876	2133	423.49	321911.09	21.63	128.86	193146.65	12.98
2134	118.83	90329.83	6.07	4.551938	36.16	54197.90	3.64	2.731163	2119.382	2134	406.88	309288.77	20.78	123.80	185573.26	12.47
2135	114.17	86787.95	5.83	4.373454	34.74	52072.77	3.50	2.624072	2036.28	2135	390.93	297161.39	19.97	118.95	178296.83	11.98
2136	109.70	83384.95	5.60	4.201968	33.38	50030.97	3.36	2.521181	1956.436	2136	375.60	285509.52	19.18	114.29	171305.71	11.51
2137	105.39	80115.38	5.38	4.037207	32.07	48069.23	3.23	2.422324	1879.723	2137	360.87	274314.53	18.43	109.81	164588.72	11.06
2138	101.26	76974.01	5.17	3.878906	30.81	46184.40	3.10	2.327343	1806.018	2138	346.72	263558.51	17.71	105.50	158135.10	10.63
2139	97.29	73955.81	4.97	3.726812	29.60	44373.49	2.98	2.236087	1735.203	2139	333.13	253224.23	17.01	101.36	151934.54	10.21
2140	93.48	71055.96	4.77	3.580681	28.44	42633.58	2.86	2.148409	1667.165	2140	320.06	243295.16	16.35	97.39	145977.10	9.81
2141	89.81	68269.82	4.59	3.440281	27.33	40961.89	2.75	2.064168	1601.795	2141	307.51	233755.42	15.71	93.57	140253.25	9.42
2142	86.29	65592.92	4.41	3.305385	26.26	39355.75	2.64	1.983231	1538.987	2142	295.46	224589.74	15.09	89.90	134753.85	9.05
2143	82.91	63020.99	4.23	3.175779	25.23	37812.59	2.54	1.905468	1478.643	2143	283.87	215783.45	14.50	86.38	129470.07	8.70

LandGEM Model Output MSWF

Inventory conventional until 2019

Year	Total landfill gas (Mg/year)	Total landfill gas (m3/year)	Total landfill gas (av ft^3/mir	Methane (Mg/year)	Methane (m3/year)	Methane (av ft^3/min)
2003	0	0	0	0	0	0
2004	199.4635	151621.2	10.18741	60.69231	90972.72	6.112446
2005	386.8692	294076.7	19.75898	117.7157	176446	11.85539
2006	549.9122	418013	28.08624	167.326	250807.8	16.85175
2007	689.5208	524135.8	35.21662	209.8058	314481.5	21.12997
2008	821.9732	624818.9	41.9815	250.1081	374891.3	25.1889
2009	926.2759	704104	47.30866	281.8451	422462.4	28.3852
2010	1008.112	766311.1	51.48835	306.7459	459786.7	30.89301
2011	1089.955	828523.5	55.6684	331.6489	497114.1	33.40104
2012	1170.181	889507.4	59.7659	356.0601	533704.5	35.85954
2013	1210.32	920019	61.81597	368.2735	552011.4	37.08958
2014	1287.715	978850	65.76881	391.8229	587310	39.46129
2015	1364.999	1037597	69.71604	415.3388	622558.4	41.82962
2016	1441.873	1096032	73.64228	438.7297	657619.4	44.18537
2017	1557.469	1183903	79.54627	473.9032	710341.6	47.72776
2018	1672.944	1271680	85.44404	509.0397	763008.2	51.26643
2019	1756.683	1335334	89.7209	534.5194	801200.2	53.83254
2020	1838.183	1397286	93.88346	559.3181	838371.4	56.33007
2021	1766.107	1342497	90.20223	537.387	805498.4	54.12134
2022	1696.857	1289857	86.66535	516.3157	773914.4	51.99921
2023	1630.322	1239281	83.26716	496.0707	743568.7	49.96029
2024	1566.396	1190688	80.0022	476.6195	714413	48.00132
2025	1504.977	1144001	76.86527	457.931	686400.5	46.11916
2026	1445.966	1099144	73.85134	439.9752	659486.3	44.31081
2027	1389.269	1056046	70.95559	422.7236	633627.5	42.57335
2028	1334.795	1014638	68.17338	406.1483	608782.6	40.90403
2029	1282.457	974853.2	65.50026	390.223	584911.9	39.30016
2030	1232.171	936628.6	62.93196	374.9222	561977.2	37.75918
2031	1183.857	899902.9	60.46436	360.2213	539941.7	36.27862
2032	1137.437	864617.2	58.09352	346.0968	518770.3	34.85611
2033	1092.838	830715.1	55.81564	332.5261	498429	33.48939
2034	1049.987	798142.3	53.62708	319.4876	478885.4	32.17625
2035	1008.816	766846.6	51.52433	306.9603	460108	30.9146
2036	969.26	736778.2	49.50403	294.9242	442066.9	29.70242
2037	931.2548	707888.7	47.56295	283.3601	424733.2	28.53777
2038	894.7397	680132	45.69798	272.2494	408079.2	27.41879
2039	859.6565	653463.6	43.90614	261.5743	392078.2	26.34368
2040	825.9489	627840.9	42.18456	251.3178	376704.6	25.31073
2041	793.563	603222.9	40.53048	241.4635	361933.8	24.31829
2042	762.4469	579570.2	38.94125	231.9956	347742.1	23.36475
2043	732.5509	556845	37.41434	222.8989	334107	22.44861
2044	703.8272	535010.8	35.94731	214.1589	321006.5	21.56838
2045	676.2297	514032.7	34.53779	205.7616	308419.6	20.72268
2046	649.7144	493877.2	33.18355	197.6936	296326.3	19.91013
2047	624.2387	474512	31.8824	189.9419	284707.2	19.12944
2048	599.762	455906.1	30.63227	182.4942	273543.7	18.37936
2049	576.245	438029.8	29.43117	175.3385	262817.9	17.6587
2050	553.6501	420854.4	28.27715	168.4634	252512.6	16.96629
2051	531.9412	404352.4	27.16839	161.8578	242611.5	16.30103
2052	511.0834	388497.5	26.1031	155.5113	233098.5	15.66186
2053	491.0436	373264.3	25.07959	149.4136	223958.6	15.04775
2054	471.7895	358628.4	24.0962	143.555	215177.1	14.45772
2055	453.2904	344566.4	23.15138	137.9262	206739.8	13.89083
2056	435.5166	331055.8	22.2436	132.518	198633.5	13.34616
2057	418.4397	318074.9	21.37141	127.3219	190844.9	12.82285
2058	402.0325	305603	20.53343	122.3295	183361.8	12.32006
2059	386.2686	293620.1	19.7283	117.5329	176172.1	11.83698
2060	371.1228	282107.1	18.95474	112.9244	169264.3	11.37285
2061	356.5708	271045.5	18.21152	108.4966	162627.3	10.92691
2062	342.5895	260417.7	17.49743	104.2423	156250.6	10.49846
2063	329.1564	250206.6	16.81135	100.1549	150123.9	10.08681
2064	316.2499	240395.8	16.15217	96.22781	144237.5	9.6913
2065	303.8496	230969.8	15.51883	92.45467	138581.9	9.311299
2066	291.9355	221913.3	14.91033	88.82947	133148	8.946197
2067	280.4885	213212	14.32569	85.34641	127927.2	8.595412
2068	269.4904	204851.8	13.76397	81.99993	122911.1	8.258381
2069	258.9236	196819.5	13.22428	78.78467	118091.7	7.934565
2070	248.771	189102.1	12.70574	75.69548	113461.2	7.623446
2071	239.0166	181687.3	12.20754	72.72742	109012.4	7.324527
2072	229.6446	174563.2	11.72888	69.87573	104737.9	7.037328
2073	220.6401	167718.5	11.26898	67.13587	100631.1	6.76139
2074	211.9887	161142.1	10.82712	64.50343	96685.29	6.496273
2075	203.6765	154823.7	10.40258	61.97422	92894.2	6.24155
2076	195.6902	148752.9	9.994692	59.54417	89251.77	5.996815
2077	188.0171	142920.3	9.602795	57.20941	85752.16	5.761677
2078	180.6448	137316.3	9.226264	54.9662	82389.77	5.535758
2079	173.5617	131932	8.864497	52.81094	79159.22	5.318698
2080	166.7562	126758.9	8.516915	50.7402	76055.34	5.110149
2081	160.2176	121788.6	8.182962	48.75065	73073.17	4.909777

Reachate recirculation from 2020

Year	Total landfill gas (Mg/year)	Total landfill gas (m3/year)	Total landfill gas (av ft^3/mir	Methane (Mg/year)	Methane (m3/year)	Methane (av ft^3/min)
2020	0	0	0	0	0	0
2021	1928.677	1466074	98.50533	586.8533	879644.4	59.1032
2022	2899.93	2204367	148.1112	882.3841	1322620	88.8667
2023	3395.835	2581327	173.4391	1033.277	1548796	104.0634
2024	3655.785	2778927	186.7158	1112.374	1667356	112.0295
2025	3798.658	2887531	194.0129	1155.847	1732519	116.4077
2026	3883.49	2952016	198.3456	1181.659	1771209	119.0073
2027	3939.596	2994664	201.2111	1198.731	1796799	120.7267
2028	3981.535	3026544	203.3531	1211.492	1815927	122.0119
2029	4016.538	3053151	205.1409	1222.143	1831891	123.0845
2030	4048.195	3077216	206.7577	1231.776	1846329	124.0546
2031	4078.292	3100093	208.2949	1240.933	1860056	124.9769
2032	4107.713	3122458	209.7975	1249.886	1873475	125.8785
2033	4136.901	3144644	211.2883	1258.767	1886787	126.773
2034	4166.074	3166821	212.7783	1267.644	1900092	127.667
2035	4195.344	3189070	214.2732	1276.55	1913442	128.5639
2036	4224.764	3211434	215.7758	1285.502	1926860	129.4655
2037	4254.364	3233934	217.2876	1294.508	1940360	130.3726
2038	4284.158	3256581	218.8093	1303.574	1953949	131.2856
2039	4314.153	3279382	220.3413	1312.701	1967629	132.2048
2040	4344.356	3302340	221.8838	1321.891	1981404	133.1303
2041	4374.768	3325458	223.4371	1331.144	1995275	134.0623
2042	4405.392	3348737	225.0012	1340.463	2009242	135.0007
2043	4436.23	3372178	226.5762	1349.846	2023307	135.9457
2044	4467.284	3395784	228.1623	1359.295	2037470	136.8974
2045	4498.555	3419554	229.7594	1368.81	2051732	137.8557
2046	4530.045	3443491	231.3677	1378.392	2066095	138.8206
2047	4561.755	3467595	232.9873	1388.04	2080557	139.7924
2048	4593.687	3491869	234.6182	1397.757	2095121	140.7709
2049	4625.843	3516312	236.2606	1407.541	2109787	141.7563
2050	2297.126	1746149	117.3235	698.9642	1047689	70.39411
2051	1140.719	867111.8	58.26114	347.0953	520267.1	34.95668
2052	566.4642	430595	28.93162	172.3624	258357	17.35897
2053	281.2978	213827.1	14.36702	85.59266	128296.3	8.620212
2054	139.6884	106183.4	7.134451	42.50406	63710.05	4.28067
2055	69.36719	52729.12	3.542863	21.10689	31637.47	2.125718
2056	34.44673	26184.51	1.759334	10.48137	15710.7	1.0556
2057	17.10574	13002.84	0.873659	5.204895	7801.705	0.524196
2058	8.494458	6457.02	0.433846	2.584674	3874.212	0.260308
2059	4.218223	3206.461	0.215442	1.283511	1923.877	0.129265
2060	2.094708	1592.282	0.106985	0.637373	955.3689	0.064191
2061	1.040201	790.7036	0.053127	0.31651	474.4222	0.031876
2062	0.516549	392.6518	0.026382	0.157174	235.5911	0.015829
2063	0.25651	194.9851	0.013101	0.07805	116.9911	0.007861
2064	0.127379	96.82674	0.006506	0.038759	58.09604	0.003903
2065	0.063255	48.08274	0.003231	0.019247	28.84964	0.001938
2066	0.031411	23.87718	0.001604	0.009558	14.32631	0.000963
2067	0.015598	11.85706	0.000797	0.004746	7.114234	0.000478
2068	0.007746	5.88804	0.000396	0.002357	3.532824	0.000237
2069	0.003847	2.923914	0.000196	0.00117	1.754349	0.000118
2070	0.00191	1.451973	9.76E-05	0.000581	0.871184	5.85E-05
2071	0.000949	0.721028	4.84E-05	0.000289	0.432617	2.91E-05
2072	0.000471	0.358052	2.41E-05	0.000143	0.214831	1.44E-05
2073	0.000234	0.177803	1.19E-05	7.12E-05	0.106682	7.17E-06
2074	0.000116	0.088295	5.93E-06	3.53E-05	0.052977	3.56E-06
2075	5.77E-05	0.043846	2.95E-06	1.76E-05	0.026307	1.77E-06
2076	2.86E-05	0.021773	1.46E-06	8.72E-06	0.013064	8.78E-07
2077	1.42E-05	0.010812	7.26E-07	4.33E-06	0.006487	4.36E-07
2078	7.06E-06	0.005369	3.61E-07	2.15E-06	0.003222	2.16E-07
2079	3.51E-06	0.002666	1.79E-07	1.07E-06	0.0016	1.07E-07
2080	1.74E-06	0.001324	8.9E-08	5.3E-07	0.000794	5.34E-08
2081	8.65E-07	0.000657	4.42E-08	2.63E-07	0.000394	2.65E-08

Total

Year	Total landfill gas (Mg/year)	Total landfill gas (m3/year)	Total landfill gas (av ft^3/mir	Methane (Mg/year)	Methane (m3/year)	Methane (av ft^3/mir
2003	0	0	0	0	0	0
2004	199.4635	151621.2	10.18741	60.69231	90972.72	6.112446
2005	386.8692	294076.7	19.75898	117.7157	176446	11.85539
2006	549.9122	418013	28.08624	167.326	250807.8	16.85175
2007	689.5208	524135.8	35.21662	209.8058	314481.5	21.12997
2008	821.9732	624818.9	41.9815	250.1081	374891.3	25.1889
2009	926.2759	704104	47.30866	281.8451	422462.4	28.3852
2010	1008.112	766311.1	51.48835	306.7459	459786.7	30.89301
2011	1089.955	828523.5	55.6684	331.6489	497114.1	33.40104
2012	1170.181	889507.4	59.7659	356.0601	533704.5	35.85954
2013	1210.32	920019	61.81597	368.2735	552011.4	37.08958
2014	1287.715	978850	65.76881	391.8229	587310	39.46129
2015	1364.999	1037597	69.71604	415.3388	622558.4	41.82962
2016	1441.873	1096032	73.64228	438.7297	657619.4	44.18537
2017	1557.469	1183903	79.54627	473.9032	710341.6	47.72776
2018	1672.944	1271680	85.44404	509.0397	763008.2	51.26643
2019	1756.683	1335334	89.7209	534.5194	801200.2	53.83254
2020	1838.183	1397286	93.88346	559.3181	838371.4	56.33007
2021	3694.784	2808571	188.7076	1124.24	1685143	113.2245
2022	4596.787	3494225	234.7765	1398.7	2096535	140.8659
2023	5026.157	3820609	256.7062	1529.348	2292365	154.0237
2024	5222.181	3969615	266.718	1588.993	2381769	160.0308
2025	5303.635	4031532	270.8781	1613.778	2418919	162.5269
2026	5329.456	4051159	272.1969	1621.635	2430696	163.3181
2027	5328.865	4050710	272.1667	1621.455	2430426	163.3
2028	5316.33	4041182	271.5265	1617.641	2424709	162.9159
2029	5298.995	4028005	270.6411	1612.366	2416803	162.3847
2030	5280.366	4013844	269.6897	1606.698	2408307	161.8138
2031	5262.148	3999996	268.7592	1601.154	2399998	161.2555
2032	5245.15	3987075	267.8911	1595.982	2392245	160.7346
2033	5229.738	3975359	267.1039	1591.293	2385216	160.2624
2034	5216.061	3964963	266.4054	1587.131	2378978	159.8432
2035	5204.16	3955916	265.7975	1583.51	2373550	159.4785
2036	5194.024	3948212	265.2799	1580.426	2368927	159.1679
2037	5185.619	3941822	264.8506	1577.868	2365093	158.9103
2038	5178.897	3936713	264.5073	1575.823	2362028	158.7044
2039	5173.81	3932846	264.2474	1574.275	2359707	158.5485
2040	5170.304	3930181	264.0684	1573.208	2358109	158.441
2041	5168.331	3928681	263.9676	1572.608	2357208	158.3806
2042	5167.839	3928307	263.9425	1572.458	2356984	158.3655
2043	5168.781	3929023	263.9906	1572.745	2357414	158.3943
2044	5171.111	3930794	264.1096	1573.454	2358477	158.4658
2045	5174.785	3933587	264.2972	1574.572	2360152	158.5783
2046	5179.759	3937368	264.5513	1576.085	2362421	158.7308
2047	5185.994	3942107	264.8697	1577.982	2365264	158.9218
2048	5193.449	3947775	265.2505	1580.251	2368665	159.1503
2049	5202.088	3954341	265.6917	1582.88	2372605	159.415
2050	2850.776	2167003	145.6007	867.4276	1300202	87.3604
2051	1672.66	1271464	85.42953	508.9532	762878.5	51.25772
2052	1077.548	819092.5	55.03473	327.8738	491455.5	33.02084
2053	772.3414	587091.5	39.4466	235.0063	352254.9	23.66796
2054	611.4778	464811.8	31.23065	186.0591	278887.1	18.73839
2055	522.6575	397295.5	26.69424	159.033	238377.3	16.01654
2056	469.9633	357240.3	24.00293	142.9994	214344.2	14.40176
2057	435.5455	331077.7	22.24507	132.5268	198646.6	13.34704
2058	410.5269	312060	20.96727	124.9142	187236	12.58036
2059	390.4868	296826.6	19.94374	118.8164	178096	11.96625
2060	373.2175	283699.4	19.06173	113.5618	170219.6	11.43704
2061	357.611	271836.2	18.26464	108.8131	163101.7	10.95879
2062	343.106	260810.3	17.52382	104.3995	156486.2	10.51429
2063	329.4129	250401.6	16.82445	100.233	150240.9	10.09467
2064	316.3773	240492.7	16.15867	96.26657	144295.6	9.695203
2065	303.9129	231017.9	15.52206	92.47391	138610.7	9.313237
2066	291.9669	221937.2	14.91193	88.83903	133162.3	8.94716
2067	280.5041	213223.8	14.32648	85.35116	127934.3	8.59589
2068	269.4982	204857.7	13.76436	82.00229	122914.6	8.258618
2069	258.9274	196822.4	13.22447	78.78584	118093.4	7.934683
2070	248.7729	189103.5	12.70584	75.69606	113462.1	7.623505
2071	239.0175	181688	12.20759	72.72771	109012.8	7.324556
2072	229.6451	174563.6	11.7289	69.87588	104738.1	7.037342
2073	220.6403	167718.7	11.269	67.13594	100631.2	6.761398
2074	211.9888	161142.2	10.82713	64.50347	96685.34	6.496276
2075	203.6765	154823.7	10.40259	61.97423	92894.23	6.241552
2076	195.6902	148753	9.994694	59.54418	89251.78	5.996816
2077	188.0171	142920.3	9.602796	57.20942	85752.16	5.761677
2078	180.6448	137316.3	9.226264	54.9662	82389.77	5.535759
2079	173.5617	131932	8.864497	52.81094	79159.22	5.318698
2080	166.7562	126758.9	8.516915	50.7402	76055.34	5.110149
2081	160.2176	121788.6	8.182962	48.75065	73073.17	4.909777

2082	153.9354	117013.2	7.862103	46.83911	70207.93	4.717262
2083	147.8995	112425.1	7.553826	45.00252	67455.03	4.532296
2084	142.1003	108016.8	7.257636	43.23794	64810.08	4.354582
2085	136.5284	103781.4	6.97306	41.54256	62268.85	4.183836
2086	131.1751	99712.08	6.699643	39.91365	59827.25	4.019786
2087	126.0316	95802.31	6.436946	38.34862	57481.39	3.862168
2088	121.0899	92045.85	6.18455	36.84495	55227.51	3.71073
2089	116.3419	88436.68	5.94205	35.40023	53062.01	3.56523
2090	111.78	84969.03	5.709059	34.01217	50981.42	3.425435
2091	107.3971	81637.35	5.485203	32.67853	48982.41	3.291122
2092	103.186	78436.3	5.270126	31.39719	47061.78	3.162075
2093	99.13999	75360.77	5.063481	30.16609	45216.46	3.038089
2094	95.25265	72405.83	4.864939	28.98326	43443.5	2.918963
2095	91.51774	69566.76	4.674182	27.84681	41740.06	2.804509
2096	87.92928	66839.01	4.490905	26.75492	40103.4	2.694543
2097	84.48153	64218.21	4.314814	25.70585	38530.93	2.588888
2098	81.16896	61700.18	4.145628	24.69791	37020.11	2.487377
2099	77.98628	59280.88	3.983075	23.72949	35568.53	2.389845
2100	74.92839	56956.44	3.826897	22.79904	34173.87	2.296138
2101	71.99041	54723.15	3.676842	21.90508	32833.89	2.206105
2102	69.16762	52577.43	3.532671	21.04617	31546.46	2.119602
2103	66.45552	50515.83	3.394153	20.22093	30309.5	2.036492
2104	63.84976	48535.08	3.261066	19.42806	29121.05	1.95664
2105	61.34618	46631.99	3.133198	18.66628	27979.2	1.879919
2106	58.94076	44803.53	3.010343	17.93436	26882.12	1.806206
2107	56.62966	43046.75	2.892306	17.23114	25828.05	1.735384
2108	54.40918	41358.87	2.778897	16.5555	24815.32	1.667338
2109	52.27576	39737.16	2.669935	15.90635	23842.3	1.601961
2110	50.226	38179.05	2.565245	15.28265	22907.43	1.539147
2111	48.25661	36682.02	2.464661	14.68341	22009.21	1.478796
2112	46.36444	35243.7	2.36802	14.10767	21146.22	1.420812
2113	44.54647	33861.78	2.275169	13.5545	20317.07	1.365101
2114	42.79978	32534.04	2.185958	13.02302	19520.42	1.311575
2115	41.12157	31258.36	2.100245	12.51238	18755.02	1.260147
2116	39.50917	30032.7	2.017894	12.02176	18019.62	1.210736
2117	37.96	28855.1	1.938771	11.55038	17313.06	1.163262
2118	36.47156	27723.68	1.862751	11.09748	16634.21	1.11765
2119	35.04149	26636.62	1.789711	10.66235	15981.97	1.073827
2120	33.6675	25592.18	1.719535	10.24427	15355.31	1.031721
2121	32.34738	24588.7	1.652112	9.842586	14753.22	0.991267
2122	31.07902	23624.56	1.587331	9.456652	14174.74	0.952399
2123	29.86039	22698.23	1.525091	9.085852	13618.94	0.915055
2124	28.68955	21808.22	1.465291	8.72959	13084.93	0.879175
2125	27.56461	20953.1	1.407837	8.387298	12571.86	0.844702
2126	26.48379	20131.52	1.352635	8.058427	12078.91	0.811581
2127	25.44535	19342.15	1.299597	7.742452	11605.29	0.779758
2128	24.44762	18583.74	1.248639	7.438866	11150.24	0.749183
2129	23.48902	17855.06	1.199679	7.147184	10713.03	0.719808
2130	22.568	17154.95	1.152639	6.866939	10292.97	0.691583
2131	21.68309	16482.3	1.107443	6.597682	9889.378	0.664466
2132	20.83289	15836.02	1.06402	6.338984	9501.61	0.638412
2133	20.01602	15215.08	1.022299	6.090428	9129.046	0.61338
2134	19.23118	14618.49	0.982214	5.851619	8771.091	0.589329
2135	18.47711	14045.29	0.943701	5.622174	8427.172	0.566221
2136	17.75262	13494.56	0.906698	5.401725	8096.738	0.544019
2137	17.05653	12965.43	0.871146	5.189921	7779.26	0.522688
2138	16.38773	12457.05	0.836988	4.986421	7474.231	0.502193
2139	15.74516	11968.6	0.804169	4.790901	7181.162	0.482501
2140	15.12778	11499.31	0.772637	4.603047	6899.585	0.463582
2141	14.53461	11048.41	0.742342	4.422559	6629.048	0.445405
2142	13.9647	10615.2	0.713234	4.249148	6369.119	0.42794
2143	13.41714	10198.97	0.685268	4.082536	6119.383	0.411161

2082	4.3E-07	0.000327	2.19E-08	1.31E-07	0.000196	1.32E-08
2083	2.13E-07	0.000162	1.09E-08	6.49E-08	9.73E-05	6.54E-09
2084	1.06E-07	8.05E-05	5.41E-09	3.22E-08	4.83E-05	3.25E-09
2085	5.26E-08	4E-05	2.69E-09	1.6E-08	2.4E-05	1.61E-09
2086	2.61E-08	1.99E-05	1.33E-09	7.95E-09	1.19E-05	8E-10
2087	1.3E-08	9.86E-06	6.62E-10	3.95E-09	5.92E-06	3.97E-10
2088	6.44E-09	4.9E-06	3.29E-10	1.96E-09	2.94E-06	1.97E-10
2089	3.2E-09	2.43E-06	1.63E-10	9.73E-10	1.46E-06	9.8E-11
2090	1.59E-09	1.21E-06	8.11E-11	4.83E-10	7.24E-07	4.87E-11
2091	7.89E-10	6E-07	4.03E-11	2.4E-10	3.6E-07	2.42E-11
2092	3.92E-10	2.98E-07	2E-11	1.19E-10	1.79E-07	1.2E-11
2093	1.95E-10	1.48E-07	9.93E-12	5.92E-11	8.87E-08	5.96E-12
2094	9.66E-11	7.34E-08	4.93E-12	2.94E-11	4.41E-08	2.96E-12
2095	4.8E-11	3.65E-08	2.45E-12	1.46E-11	2.19E-08	1.47E-12
2096	2.38E-11	1.81E-08	1.22E-12	7.25E-12	1.09E-08	7.3E-13
2097	1.18E-11	8.99E-09	6.04E-13	3.6E-12	5.39E-09	3.62E-13
2098	5.87E-12	4.46E-09	3E-13	1.79E-12	2.68E-09	1.8E-13
2099	2.92E-12	2.22E-09	1.49E-13	8.87E-13	1.33E-09	8.94E-14
2100	1.45E-12	1.1E-09	7.4E-14	4.41E-13	6.61E-10	4.44E-14
2101	7.19E-13	5.47E-10	3.67E-14	2.19E-13	3.28E-10	2.2E-14
2102	3.57E-13	2.71E-10	1.82E-14	1.09E-13	1.63E-10	1.09E-14
2103	1.77E-13	1.35E-10	9.06E-15	5.4E-14	8.09E-11	5.44E-15
2104	8.81E-14	6.69E-11	4.5E-15	2.68E-14	4.02E-11	2.7E-15
2105	4.37E-14	3.32E-11	2.23E-15	1.33E-14	1.99E-11	1.34E-15
2106	2.17E-14	1.65E-11	1.11E-15	6.61E-15	9.91E-12	6.66E-16
2107	1.08E-14	8.2E-12	5.51E-16	3.28E-15	4.92E-12	3.31E-16
2108	5.36E-15	4.07E-12	2.74E-16	1.63E-15	2.44E-12	1.64E-16
2109	2.66E-15	2.02E-12	1.36E-16	8.09E-16	1.21E-12	8.15E-17
2110	1.32E-15	1E-12	6.75E-17	4.02E-16	6.02E-13	4.05E-17
2111	6.56E-16	4.99E-13	3.35E-17	2E-16	2.99E-13	2.01E-17
2112	3.26E-16	2.48E-13	1.66E-17	9.91E-17	1.49E-13	9.98E-18
2113	1.62E-16	1.23E-13	8.26E-18	4.92E-17	7.38E-14	4.96E-18
2114	8.03E-17	6.11E-14	4.1E-18	2.44E-17	3.66E-14	2.46E-18
2115	3.99E-17	3.03E-14	2.04E-18	1.21E-17	1.82E-14	1.22E-18
2116	1.98E-17	1.51E-14	1.01E-18	6.03E-18	9.03E-15	6.07E-19
2117	9.83E-18	7.48E-15	5.02E-19	2.99E-18	4.49E-15	3.01E-19
2118	4.88E-18	3.71E-15	2.49E-19	1.49E-18	2.23E-15	1.5E-19
2119	2.43E-18	1.84E-15	1.24E-19	7.38E-19	1.11E-15	7.43E-20
2120	1.2E-18	9.15E-16	6.15E-20	3.66E-19	5.49E-16	3.69E-20
2121	5.98E-19	4.55E-16	3.05E-20	1.82E-19	2.73E-16	1.83E-20
2122	2.97E-19	2.26E-16	1.52E-20	9.04E-20	1.35E-16	9.1E-21
2123	1.47E-19	1.12E-16	7.53E-21	4.49E-20	6.73E-17	4.52E-21
2124	7.32E-20	5.57E-17	3.74E-21	2.23E-20	3.34E-17	2.24E-21
2125	3.64E-20	2.76E-17	1.86E-21	1.11E-20	1.66E-17	1.11E-21
2126	1.81E-20	1.37E-17	9.22E-22	5.5E-21	8.24E-18	5.53E-22
2127	8.97E-21	6.82E-18	4.58E-22	2.73E-21	4.09E-18	2.75E-22
2128	4.45E-21	3.39E-18	2.27E-22	1.36E-21	2.03E-18	1.36E-22
2129	2.21E-21	1.68E-18	1.13E-22	6.73E-22	1.01E-18	6.78E-23
2130	1.1E-21	8.35E-19	5.61E-23	3.34E-22	5.01E-19	3.37E-23
2131	5.45E-22	4.15E-19	2.79E-23	1.66E-22	2.49E-19	1.67E-23
2132	2.71E-22	2.06E-19	1.38E-23	8.24E-23	1.24E-19	8.3E-24
2133	1.34E-22	1.02E-19	6.87E-24	4.09E-23	6.13E-20	4.12E-24
2134	6.68E-23	5.08E-20	3.41E-24	2.03E-23	3.05E-20	2.05E-24
2135	3.32E-23	2.52E-20	1.69E-24	1.01E-23	1.51E-20	1.02E-24
2136	1.65E-23	1.25E-20	8.41E-25	5.01E-24	7.51E-21	5.05E-25
2137	8.18E-24	6.22E-21	4.18E-25	2.49E-24	3.73E-21	2.51E-25
2138	4.06E-24	3.09E-21	2.07E-25	1.24E-24	1.85E-21	1.24E-25
2139	2.02E-24	1.53E-21	1.03E-25	6.14E-25	9.2E-22	6.18E-26
2140	1E-24	7.61E-22	5.11E-26	3.05E-25	4.57E-22	3.07E-26
2141	4.97E-25	3.78E-22	2.54E-26	1.51E-25	2.27E-22	1.52E-26
2142	2.47E-25	1.88E-22	1.26E-26	7.51E-26	1.13E-22	7.57E-27
2143	1.23E-25	9.32E-23	6.26E-27	3.73E-26	5.59E-23	3.76E-27
2144	6.09E-26	4.63E-23	3.11E-27	1.85E-26	2.78E-23	1.87E-27
2145	3.02E-26	2.3E-23	1.54E-27	9.2E-27	1.38E-23	9.27E-28
2146	1.5E-26	1.14E-23	7.67E-28	4.57E-27	6.85E-24	4.6E-28
2147	7.46E-27	5.67E-24	3.81E-28	2.27E-27	3.4E-24	2.29E-28
2148	3.7E-27	2.82E-24	1.89E-28	1.13E-27	1.69E-24	1.13E-28
2149	1.84E-27	1.4E-24	9.39E-29	5.6E-28	8.39E-25	5.64E-29
2150	9.13E-28	6.94E-25	4.66E-29	2.78E-28	4.17E-25	2.8E-29
2151	4.53E-28	3.45E-25	2.32E-29	1.38E-28	2.07E-25	1.39E-29
2152	2.25E-28	1.71E-25	1.15E-29	6.85E-29	1.03E-25	6.9E-30
2153	1.12E-28	8.5E-26	5.71E-30	3.4E-29	5.1E-26	3.43E-30
2154	5.55E-29	4.22E-26	2.84E-30	1.69E-29	2.53E-26	1.7E-30
2155	2.76E-29	2.1E-26	1.41E-30	8.39E-30	1.26E-26	8.45E-31
2156	1.37E-29	1.04E-26	6.99E-31	4.17E-30	6.25E-27	4.2E-31
2157	6.8E-30	5.17E-27	3.47E-31	2.07E-30	3.1E-27	2.08E-31
2158	3.38E-30	2.57E-27	1.72E-31	1.03E-30	1.54E-27	1.03E-31
2159	1.68E-30	1.27E-27	8.56E-32	5.1E-31	7.65E-28	5.14E-32
2160	8.33E-31	6.33E-28	4.25E-32	2.53E-31	3.8E-28	2.55E-32

2082	153.9354	117013.2	7.862103	46.83911	70207.93	4.717262
2083	147.8995	112425.1	7.553826	45.00252	67455.03	4.532296
2084	142.1003	108016.8	7.257636	43.23794	64810.08	4.354582
2085	136.5284	103781.4	6.97306	41.54256	62268.85	4.183836
2086	131.1751	99712.08	6.699643	39.91365	59827.25	4.019786
2087	126.0316	95802.31	6.436946	38.34862	57481.39	3.862168
2088	121.0899	92045.85	6.18455	36.84495	55227.51	3.71073
2089	116.3419	88436.68	5.94205	35.40023	53062.01	3.56523
2090	111.78	84969.03	5.709059	34.01217	50981.42	3.425435
2091	107.3971	81637.35	5.485203	32.67853	48982.41	3.291122
2092	103.186	78436.3	5.270126	31.39719	47061.78	3.162075
2093	99.13999	75360.77	5.063481	30.16609	45216.46	3.038089
2094	95.25265	72405.83	4.864939	28.98326	43443.5	2.918963
2095	91.51774	69566.76	4.674182	27.84681	41740.06	2.804509
2096	87.92928	66839.01	4.490905	26.75492	40103.4	2.694543
2097	84.48153	64218.21	4.314814	25.70585	38530.93	2.588888
2098	81.16896	61700.18	4.145628	24.69791	37020.11	2.487377
2099	77.98628	59280.88	3.983075	23.72949	35568.53	2.389845
2100	74.92839	56956.44	3.826897	22.79904	34173.87	2.296138
2101	71.99041	54723.15	3.676842	21.90508	32833.89	2.206105
2102	69.16762	52577.43	3.532671	21.04617	31546.46	2.119602
2103	66.45552	50515.83	3.394153	20.22093	30309.5	2.036492
2104	63.84976	48535.08	3.261066	19.42806	29121.05	1.95664
2105	61.34618	46631.99	3.133198	18.66628	27979.2	1.879919
2106	58.94076	44803.53	3.010343	17.93436	26882.12	1.806206
2107	56.62966	43046.75	2.892306	17.23114	25828.05	1.735384
2108	54.40918	41358.87	2.778897	16.5555	24815.32	1.667338
2109	52.27576	39737.16	2.669935	15.90635	23842.3	1.601961
2110	50.226	38179.05	2.565245	15.28265	22907.43	1.539147
2111	48.25661	36682.02	2.464661	14.68341	22009.21	1.478796
2112	46.36444	35243.7	2.36802	14.10767	21146.22	1.420812
2113	44.54647	33861.78	2.275169	13.5545	20317.07	1.365101
2114	42.79978	32534.04	2.185958	13.02302	19520.42	1.311575
2115	41.12157	31258.36	2.100245	12.51238	18755.02	1.260147
2116	39.50917	30032.7	2.017894	12.02176	18019.62	1.210736
2117	37.96	28855.1	1.938771	11.55038	17313.06	1.163262
2118	36.47156	27723.68	1.862751	11.09748	16634.21	1.11765
2119	35.04149	26636.62	1.789711	10.66235	15981.97	1.073827
2120	33.6675	25592.18	1.719535	10.24427	15355.31	1.031721
2121	32.34738	24588.7	1.652112	9.842586	14753.22	0.991267
2122	31.07902	23624.56	1.587331	9.456652	14174.74	0.952399
2123	29.86039	22698.23	1.525091	9.085852	13618.94	0.915055
2124	28.68955	21808.22	1.465291	8.72959	13084.93	0.879175
2125	27.56461	20953.1	1.407837	8.387298	12571.86	0.844702
2126	26.48379	20131.52	1.352635	8.058427	12078.91	0.811581
2127	25.44535	19342.15	1.299597	7.742452	11605.29	0.779758
2128	24.44762	18583.74	1.248639	7.438866	11150.24	0.749183
2129	23.48902	17855.06	1.199679	7.147184	10713.03	0.719808
2130	22.568	17154.95	1.152639	6.866939	10292.97	0.691583
2131	21.68309	16482.3	1.107443	6.597682	9889.378	0.664466
2132	20.83289	15836.02	1.06402	6.338984	9501.61	0.638412
2133	20.01602	15215.08	1.022299	6.090428	9129.046	0.61338
2134	19.23118	14618.49	0.982214	5.851619	8771.091	0.589329
2135	18.47711	14045.29	0.943701	5.622174	8427.172	0.566221
2136	17.75262	13494.56	0.906698	5.401725	8096.738	0.544019
2137	17.05653	12965.43	0.871146	5.189921	7779.26	0.522688
2138	16.38773	12457.05	0.836988	4.986421	7474.231	0.502193
2139	15.74516	11968.6	0.804169	4.790901	7181.162	0.482501
2140	15.12778	11499.31	0.772637	4.603047	6899.585	0.463582
2141	14.53461	11048.41	0.742342	4.422559	6629.048	0.445405
2142	13.9647	10615.2	0.713234	4.249148	6369.119	0.42794
2143	13.41714	10198.97	0.685268	4.082536	6119.383	0.411161
2144	6.09E-26	4.63E-23	3.11E-27	1.85E-26	2.78E-23	1.87E-27
2145	3.02E-26	2.3E-23	1.54E-27	9.2E-27	1.38E-23	9.27E-28
2146	1.5E-26	1.14E-23	7.67E-28	4.57E-27	6.85E-24	4.6E-28
2147	7.46E-27	5.67E-24	3.81E-28	2.27E-27	3.4E-24	2.29E-28
2148	3.7E-27	2.82E-24	1.89E-28	1.13E-27	1.69E-24	1.13E-28
2149	1.84E-27	1.4E-24	9.39E-29	5.6E-28	8.39E-25	5.64E-29
2150	9.13E-28	6.94E-25	4.66E-29	2.78E-28	4.17E-25	2.8E-29
2151	4.53E-28	3.45E-25	2.32E-29	1.38E-28	2.07E-25	1.39E-29
2152	2.25E-28	1.71E-25	1.15E-29	6.85E-29	1.03E-25	6.9E-30
2153	1.12E-28	8.5E-26	5.71E-30	3.4E-29	5.1E-26	3.43E-30
2154	5.55E-29	4.22E-26	2.84E-30	1.69E-29	2.53E-26	1.7E-30
2155	2.76E-29	2.1E-26	1.41E-30	8.39E-30	1.26E-26	8.45E-31
2156	1.37E-29	1.04E-26	6.99E-31	4.17E-30	6.25E-27	4.2E-31
2157	6.8E-30	5.17E-27	3.47E-31	2.07E-30	3.1E-27	2.08E-31
2158	3.38E-30	2.57E-27	1.72E-31	1.03E-30	1.54E-27	1.03E-31
2159	1.68E-30	1.27E-27	8.56E-32	5.1E-31	7.65E-28	5.14E-32
2160	8.33E-31	6.33E-28	4.25E-32	2.53E-31	3.8E-28	2.55E-32

Appendix F

Puerto Rico Dump Conceptual Design

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Reference:
NSPS Background Information Document (BID). Appendix E. 1991

LandGEM – Landfill Gas Emissions Model, Version 3.02 U.S. Environmental Protection Agency (EPA). Model Output- October 2018.

Draft Closure Plan. Marpi Solid Waste Facility. Saipan, CNMI. Prepared by Harding ESE. October 25, 2002.

OBJECTIVE:

Determine the radius of influence for landfill gas (LFG) collection to establish the spacing between the LFG extraction wells. This will be calculated using the EPA method.

PROCEDURE:

Well spacing is determined by finding the radius of influence using the EPA method and using this radius to determine the spacing.

A. EPA Method – This analysis will be used to calculate the radius of influence of the landfill gas extraction wells.

$$R = 131.1\,(\frac{Q_w DC}{L\rho Q_{gen}\eta})^{1/2}$$

Where:

- R = Radius of influence (feet [ft])
- Q_w = Well flow (cubic feet per minute [ft^3/min])
- DC = Design capacity (tons)
- L = Length of perforations (ft)
- ρ = Waste density (pounds per cubic yard [lb/yd^3])
- Q_{gen} = LFG generation rate (ft^3/min)
- η = Extraction efficiency.

B. Spacing – Well spacing is found from the radius of influence:

$$spacing = R\sqrt{3}$$

Where:

R = Radius of Influence (ft)

Spacing = spacing of wells (ft)

Solution:

LandGEM model output was used to project LFG generation from Marpi Landfill and the peak LFG generation rate in 2049 was projected to be 182 cubic feet per minute (cfm). Due to heterogeneity of landfills not every well is going to be the same depth. To create an extraction well coverage of approximately 1 per acre, 25 extraction wells were assumed for the calculation. On average the landfill is 70 ft deep, therefore an average well would consist of 20 ft of solid pipe, 10 ft separation from the liner and 40 ft of perforated pipe. Minimally, it is assumed that 182 cfm total for Q_w is divided among the 25 extraction wells, therefore the Q_w is 7.3 cfm per well. DC is 1.25E06 tons (Harding, October 2002), ρ is 1000 lb/yd^3, Q_{gen} is 182 cfm and η is 75%. Completing this calculation yields:

$$R = 131.1\left(\frac{7.3 * 1.25E06}{40 * 1000 * 182 * 0.75}\right)^{1/2}$$

$$R = 153\ ft$$

$$spacing = 153 * \sqrt{3}$$
$$spacing = 265\ ft$$

Using the standard that 1 cfm of gas captured per foot of perforated pipe, the maximal spacing was determined. As before, DC is 1.25E06 tons, ρ is 1000 lb/yd^3, Q_{gen} is 182 cfm and η is 75%. Solving this calculation shows that the maximal spacing necessary is:

$$R = 131.1\left(\frac{40 * 1.25E06}{40 * 1000 * 182 * 0.75}\right)^{1/2}$$

$$R = 397\ ft$$

$$spacing = 397 * \sqrt{3}$$
$$spacing = 687\ ft$$

CONCLUSION:

Based on EA's recent project experience and professional judgment, the maximal calculation overestimates the LFG extraction well spacing. Therefore, being conservative, the wells are spaced at 260 ft with a radius of influence of 150 ft to balance the landfill gas extraction capacity with the cost of the system. Additionally, the spacing of 260 ft meets the design standard of 1 LFG extraction well per acre of landfill area. A total of 24 wells will be needed as per the estimated spacing of 260 ft requirement. The radius of influence for the future wells are presented on Figure 1.

Attachment 1: LandGEM Model Output

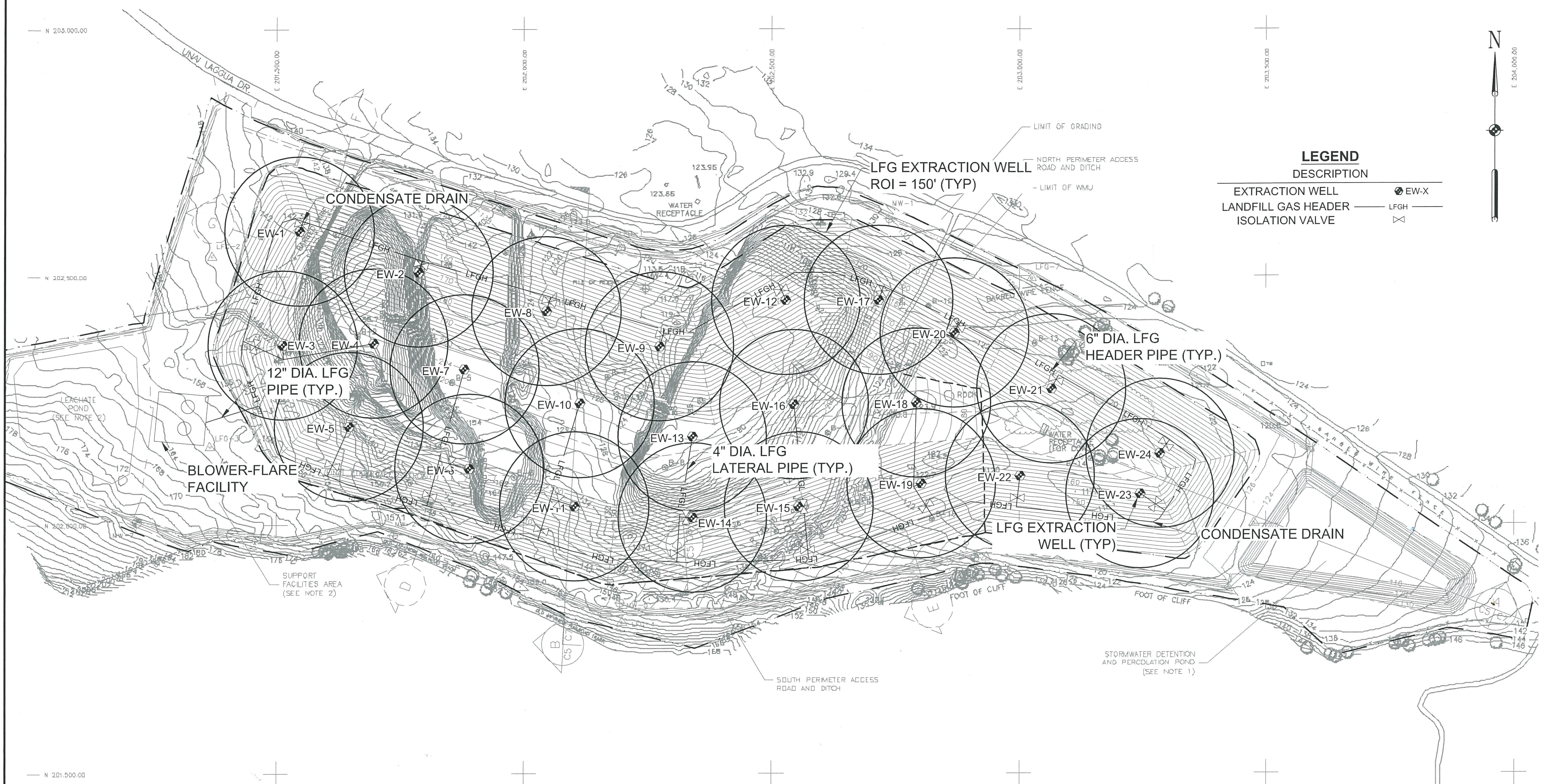
Figure 1: Active LFG Collection System at MSWF

Year	Biodegradable waste	Total landfill gas			Methane	
	(Mg/year)	(m3/year)	(av ft^3/min)	(Mg/year)	(m3/year)	(av ft^3/min)
2003	0	0	0	0	0	0
2004	199.46	151621.21	10.19	60.69	90972.72	6.11
2005	386.87	294076.69	19.76	117.72	176446.01	11.86
2006	549.91	418013.00	28.09	167.33	250807.80	16.85
2007	689.52	524135.80	35.22	209.81	314481.48	21.13
2008	821.97	624818.85	41.98	250.11	374891.31	25.19
2009	926.28	704104.02	47.31	281.85	422462.41	28.39
2010	1008.11	766311.15	51.49	306.75	459786.69	30.89
2011	1089.95	828523.54	55.67	331.65	497114.12	33.40
2012	1170.18	889507.42	59.77	356.06	533704.45	35.86
2013	1210.32	920019.03	61.82	368.27	552011.42	37.09
2014	1287.71	978849.97	65.77	391.82	587309.98	39.46
2015	1365.00	1037597.34	69.72	415.34	622558.40	41.83
2016	1441.87	1096032.37	73.64	438.73	657619.42	44.19
2017	1557.47	1183902.62	79.55	473.90	710341.57	47.73
2018	1672.94	1271680.27	85.44	509.04	763008.16	51.27
2019	1756.68	1335333.62	89.72	534.52	801200.17	53.83
2020	1838.18	1397285.70	93.88	559.32	838371.42	56.33
2021	1917.54	1457608.78	97.94	583.46	874565.27	58.76
2022	1994.85	1516372.34	101.88	606.99	909823.40	61.13
2023	2070.19	1573643.17	105.73	629.91	944185.90	63.44
2024	2143.65	1629485.48	109.48	652.27	977691.29	65.69
2025	2215.32	1683961.00	113.15	674.07	1010376.60	67.89
2026	2285.26	1737129.08	116.72	695.35	1042277.45	70.03
2027	2353.56	1789046.80	120.21	716.14	1073428.08	72.12
2028	2420.29	1839769.01	123.61	736.44	1103861.41	74.17
2029	2485.51	1889348.48	126.95	756.29	1133609.09	76.17
2030	2549.30	1937835.93	130.20	775.69	1162701.56	78.12
2031	2611.71	1985280.16	133.39	794.69	1191168.09	80.03
2032	2672.82	2031728.06	136.51	813.28	1219036.84	81.91
2033	2732.67	2077224.76	139.57	831.49	1246334.85	83.74
2034	2791.33	2121813.64	142.56	849.34	1273088.18	85.54
2035	2848.85	2165536.43	145.50	866.84	1299321.86	87.30
2036	2905.28	2208433.27	148.38	884.01	1325059.96	89.03
2037	2960.68	2250542.76	151.21	900.87	1350325.65	90.73
2038	3015.09	2291902.03	153.99	917.42	1375141.22	92.40
2039	3068.55	2332546.82	156.72	933.69	1399528.09	94.03
2040	3121.13	2372511.49	159.41	949.69	1423506.89	95.65
2041	3172.85	2411829.09	162.05	965.43	1447097.45	97.23
2042	3223.77	2450531.44	164.65	980.92	1470318.86	98.79
2043	3273.91	2488649.15	167.21	996.18	1493189.49	100.33
2044	3323.33	2526211.68	169.74	1011.21	1515727.01	101.84
2045	3372.05	2563247.36	172.22	1026.04	1537948.42	103.33
2046	3420.12	2599783.49	174.68	1040.66	1559870.09	104.81
2047	3467.56	2635846.31	177.10	1055.10	1581507.79	106.26
2048	3514.41	2671461.10	179.50	1069.36	1602876.66	107.70
2049	3560.70	2706652.19	181.86	1083.44	1623991.31	109.12
2050	3421.09	2600522.84	174.73	1040.96	1560313.70	104.84
2051	3286.94	2498554.88	167.88	1000.14	1499132.93	100.73

Year	Biodegradable waste (Mg/year)	Total landfill gas (m3/year)	(av ft^3/min)	(Mg/year)	Methane (m3/year)	(av ft^3/min)
2052	3158.06	2400585.14	161.30	960.93	1440351.08	96.78
2053	3034.23	2306456.85	154.97	923.25	1383874.11	92.98
2054	2915.26	2216019.38	148.89	887.05	1329611.63	89.34
2055	2800.95	2129128.02	143.06	852.27	1277476.81	85.83
2056	2691.12	2045643.72	137.45	818.85	1227386.23	82.47
2057	2585.60	1965432.88	132.06	786.74	1179259.73	79.23
2058	2484.22	1888367.15	126.88	755.89	1133020.29	76.13
2059	2386.81	1814323.22	121.90	726.25	1088593.93	73.14
2060	2293.22	1743182.59	117.12	697.78	1045909.55	70.27
2061	2203.31	1674831.42	112.53	670.42	1004898.85	67.52
2062	2116.91	1609160.34	108.12	644.13	965496.21	64.87
2063	2033.91	1546064.26	103.88	618.87	927638.56	62.33
2064	1954.16	1485442.22	99.81	594.61	891265.33	59.88
2065	1877.53	1427197.19	95.89	571.29	856318.32	57.54
2066	1803.91	1371235.99	92.13	548.89	822741.59	55.28
2067	1733.18	1317469.06	88.52	527.37	790481.44	53.11
2068	1665.22	1265810.36	85.05	506.69	759486.21	51.03
2069	1599.93	1216177.22	81.71	486.82	729706.33	49.03
2070	1537.19	1168490.23	78.51	467.73	701094.14	47.11
2071	1476.92	1122673.08	75.43	449.39	673603.85	45.26
2072	1419.01	1078652.43	72.47	431.77	647191.46	43.48
2073	1363.37	1036357.87	69.63	414.84	621814.72	41.78
2074	1309.91	995721.69	66.90	398.58	597433.02	40.14
2075	1258.55	956678.89	64.28	382.95	574007.33	38.57
2076	1209.20	919166.97	61.76	367.93	551500.18	37.06
2077	1161.79	883125.92	59.34	353.51	529875.55	35.60
2078	1116.23	848498.06	57.01	339.64	509098.83	34.21
2079	1072.46	815227.97	54.78	326.33	489136.78	32.87
2080	1030.41	783262.43	52.63	313.53	469957.46	31.58
2081	990.01	752550.27	50.56	301.24	451530.16	30.34
2082	951.19	723042.35	48.58	289.43	433825.41	29.15
2083	913.89	694691.45	46.68	278.08	416814.87	28.01
2084	878.06	667452.21	44.85	267.17	400471.33	26.91
2085	843.63	641281.04	43.09	256.70	384768.62	25.85
2086	810.55	616136.05	41.40	246.63	369681.63	24.84
2087	778.77	591977.01	39.77	236.96	355186.20	23.86
2088	748.23	568765.26	38.22	227.67	341259.15	22.93
2089	718.89	546463.65	36.72	218.74	327878.19	22.03
2090	690.71	525036.51	35.28	210.17	315021.90	21.17
2091	663.62	504449.53	33.89	201.93	302669.72	20.34
2092	637.60	484669.78	32.56	194.01	290801.87	19.54
2093	612.60	465665.61	31.29	186.40	279399.36	18.77
2094	588.58	447406.60	30.06	179.09	268443.96	18.04
2095	565.50	429863.53	28.88	172.07	257918.12	17.33
2096	543.33	413008.34	27.75	165.32	247805.01	16.65
2097	522.02	396814.05	26.66	158.84	238088.43	16.00
2098	501.56	381254.75	25.62	152.61	228752.85	15.37
2099	481.89	366305.54	24.61	146.63	219783.32	14.77
2100	462.99	351942.49	23.65	140.88	211165.50	14.19

Biodegradable waste

Year		Total landfill gas			Methane	
	(Mg/year)	(m3/year)	(av ft^3/min)	(Mg/year)	(m3/year)	(av ft^3/min)
2101	444.84	338142.63	22.72	135.35	202885.58	13.63
2102	427.40	324883.87	21.83	130.05	194930.32	13.10
2103	410.64	312144.99	20.97	124.95	187286.99	12.58
2104	394.54	299905.61	20.15	120.05	179943.37	12.09
2105	379.07	288146.14	19.36	115.34	172887.69	11.62
2106	364.20	276847.77	18.60	110.82	166108.66	11.16
2107	349.92	265992.42	17.87	106.47	159595.45	10.72
2108	336.20	255562.70	17.17	102.30	153337.62	10.30
2109	323.02	245541.95	16.50	98.29	147325.17	9.90
2110	310.35	235914.11	15.85	94.43	141548.47	9.51
2111	298.18	226663.78	15.23	90.73	135998.27	9.14
2112	286.49	217776.17	14.63	87.17	130665.70	8.78
2113	275.26	209237.04	14.06	83.76	125542.23	8.44
2114	264.47	201032.74	13.51	80.47	120619.65	8.10
2115	254.10	193150.14	12.98	77.32	115890.08	7.79
2116	244.13	185576.61	12.47	74.28	111345.97	7.48
2117	234.56	178300.05	11.98	71.37	106980.03	7.19
2118	225.36	171308.80	11.51	68.57	102785.28	6.91
2119	216.53	164591.69	11.06	65.88	98755.01	6.64
2120	208.04	158137.96	10.63	63.30	94882.77	6.38
2121	199.88	151937.28	10.21	60.82	91162.37	6.13
2122	192.04	145979.73	9.81	58.43	87587.84	5.89
2123	184.51	140255.79	9.42	56.14	84153.47	5.65
2124	177.28	134756.28	9.05	53.94	80853.77	5.43
2125	170.33	129472.41	8.70	51.83	77683.44	5.22
2126	163.65	124395.72	8.36	49.79	74637.43	5.01
2127	157.23	119518.10	8.03	47.84	71710.86	4.82
2128	151.07	114831.72	7.72	45.97	68899.03	4.63
2129	145.14	110329.11	7.41	44.16	66197.47	4.45
2130	139.45	106003.04	7.12	42.43	63601.83	4.27
2131	133.98	101846.60	6.84	40.77	61107.96	4.11
2132	128.73	97853.14	6.57	39.17	58711.88	3.94
2133	123.68	94016.26	6.32	37.63	56409.76	3.79
2134	118.83	90329.83	6.07	36.16	54197.90	3.64
2135	114.17	86787.95	5.83	34.74	52072.77	3.50
2136	109.70	83384.95	5.60	33.38	50030.97	3.36
2137	105.39	80115.38	5.38	32.07	48069.23	3.23
2138	101.26	76974.01	5.17	30.81	46184.40	3.10
2139	97.29	73955.81	4.97	29.60	44373.49	2.98
2140	93.48	71055.96	4.77	28.44	42633.58	2.86
2141	89.81	68269.82	4.59	27.33	40961.89	2.75
2142	86.29	65592.92	4.41	26.26	39355.75	2.64
2143	82.91	63020.99	4.23	25.23	37812.59	2.54



GENERAL NOTE

1. THE EXISTING CONDITION SHOWN HEREON WERE TAKEN FROM DRAFT LANDFILL DEVELOPMENT PLANS FOR THE MARPI SOLID WASTE FACILITY LANDFILL DEVELOPMENT PLAN, PREPARED BY HARDING ESE, DATED 10-02-02.

EA Engineering, Science, and Technology, Inc., PBC Hunt Valley Center 225 Schilling Circle, Suite 400 Hunt Valley, Maryland 21031 (410) 584-7000	PROJECT NUMBER: 6330601	DESIGNED BY: SS	DRAWN BY: SS	FIGURE: FIGURE 1	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS LANDFILL GAS EXTRACTION FEASIBILTY STUDY MARPI LANDFILL SAIPAN, CNMI
	DATE: DECEMBER 2018	CHECKED BY: RCI	PROJECT MGR.: MJG	SHEET NUMBER: -	ACTIVE LFG COLLECTION SYSTEM AT MSWF

FILE PATH: Q:\PROJECTS\6330601 - CNMI LFG EXTRACTION\CAD\EXTERNAL REFERENCES\6330601-MARPI VOL CALC_RECOVER.DWG [LAYOUT1] 10/12/18

Appendix G

Marpi Solid Waste Facility Conceptual Design

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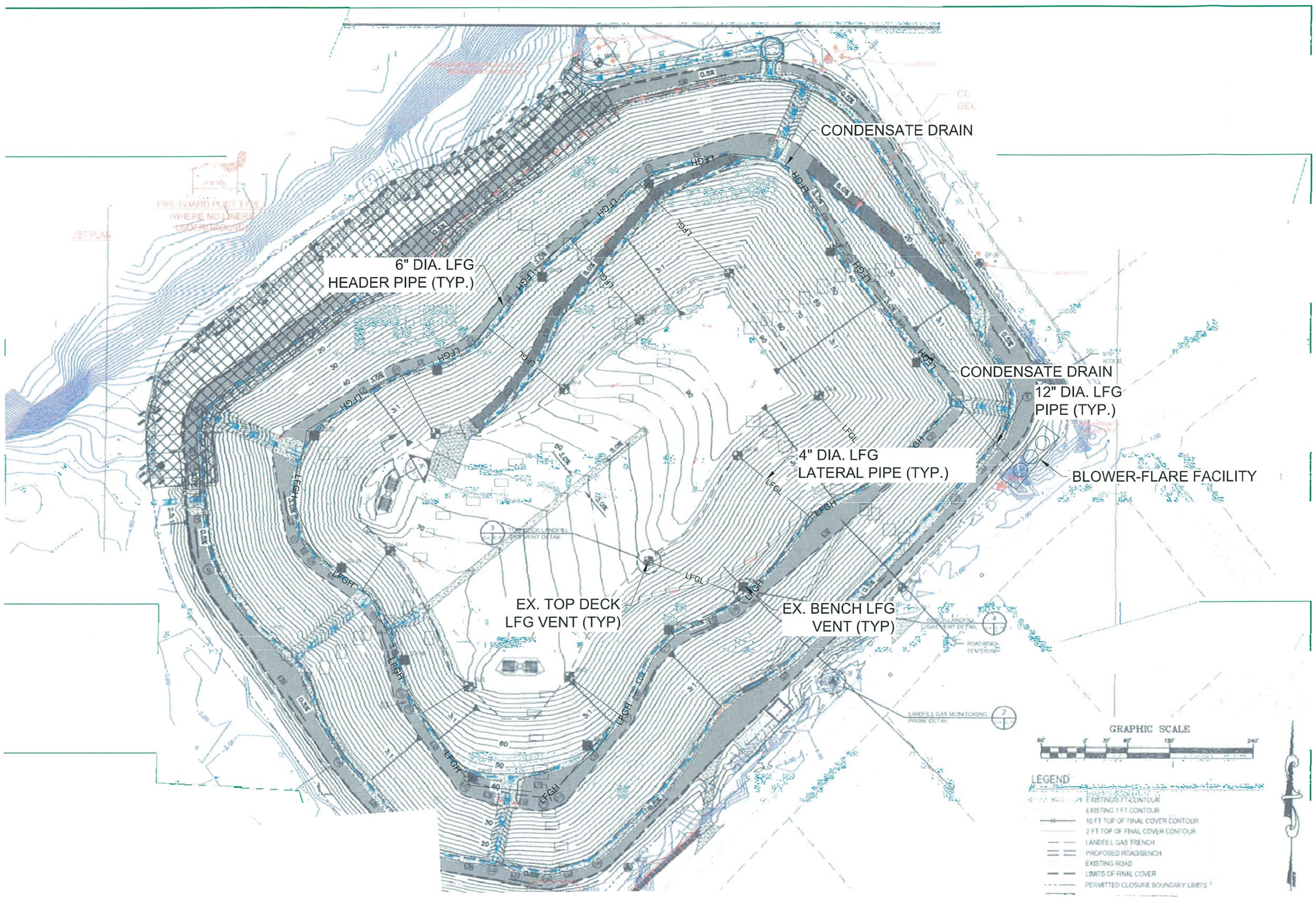

GENERAL NOTE

1. THE EXISTING CONDITION SHOWN HEREON WERE TAKEN FROM AS-BUILT DRAWINGS OF PUERTO RICO DUMP CLOSURE PROJECT, PREPARED BY GHD INC. AND GEO-LOGIC ASSOCIATES, DATED 17-03-25.

EA® EA Engineering, Science, and Technology, Inc., PBC Hunt Valley Center 225 Schilling Circle, Suite 400 Hunt Valley, Maryland 21031 (410) 584-7000	PROJECT NUMBER: 6330601	DESIGNED BY: SS	DRAWN BY: SS	FIGURE: FIGURE 8-1	COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS LANDFILL GAS EXTRACTION FEASIBILTY STUDY ELOY S. INOS PEACE PARK (FORMERLY PRD) SAIPAN, CNMI	ACTIVE LFG COLLECTION SYSTEM AT PRD
	DATE: DECEMBER 2018	CHECKED BY: RCI	PROJECT MGR.: MJG	SHEET NUMBER: 1 of 1		

FILE PATH: Q:\PROJECTS\6330601 - CNMI LFG EXTRACTION\CAD\EXTERNAL REFERENCES\6330601-PRD ROI_RECOVER.DWG [FIG 8-1] 11/27/18

Appendix H

EPA LFG Energy Cost Model

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C&F: Collection and Flaring System	
Typical components include	▸ Engineering, permitting, and administration; ▸ Wells and wellheads; ▸ Pipe gathering system (includes additional fittings/installations); ▸ Condensate knockout system; ▸ Blowers; ▸ Instrument controls; ▸ Flare; and ▸ Site survey, preparation, and utilities.
Drilling and pipe crew mobilization	$20,000
Installed capital cost of vertical gas extraction wells	$\left(\begin{matrix}\text{average waste} \\ \text{depth (ft)}\end{matrix} - 10\,\text{ft}\right) * \$85/\text{ft} = \$X/\text{well},$ ($4,675 * number of wells) for default average waste depth of 65 feet
Installed capital cost of wellheads and pipe gathering system	$17,000 * number of wells
Installed capital cost of knockout, blower, and flare system	$(\text{ft}^3/\text{min})^{0.61} * \$4{,}600$
Engineering, permitting, and surveying	$700 * number of wells
Annual O&M cost (excluding energy costs)*	($2,600 * number of wells) + $5,100 for flare
Electricity usage by blowers	0.002 kWh / ft^3

Note: Raw cost data are in 2013$'s.

* Annual O&M for wells include the cost for monthly wellhead monitoring for gas quality and wellhead adjustment purposes as well as the cost to maintain each well.

SENG: Small Reciprocating Engine-Generator Set	
Typical components include	▸ Gas compression and treatment (includes dehydration equipment and filtration); ▸ Reciprocating engine and generator (includes motor controls, switch-gear, radiators, exhaust silencers, and all wiring and plumbing; ▸ Electrical interconnect equipment; and ▸ Site work, housings, utilities, and total facility engineering, design, and permitting. (Includes all equipment downstream of collection and flaring system.)
Installed capital cost	$2,300 * kW capacity
Annual O&M cost (excluding energy)	$0.024 * kWh generated/yr (before parasitic uses)
Parasitic loss efficiency	92% of capacity due to parasitic electrical needs of compression and treatment
Fuel use rate	36 ft^3/kWh generated (before parasitic uses)
Gross capacity factor*	Assume 93%

Note: Raw cost data are in 2008$'s.

* Gross capacity factor accounts for loss of energy production due to problems in the gas collection system, problems with project equipment, weather related interruptions of the local utilities, and shut-downs at the energy consumer end of the system.

MTUR: Microturbine-Generator Set	
Typical components include	▸ Gas compression and treatment (includes dehydration equipment, siloxane adsorbers, and filtration); ▸ Microturbine and generator (includes exhaust silencers and all wiring and plumbing); ▸ Electrical interconnect equipment; and ▸ Site work, housings, utilities, and total facility engineering, design, and permitting. (Includes all equipment downstream of collection and flaring system.)
Installed capital cost	$\$19,278 * (\text{kW capacity})^{0.6207}$
Annual O&M cost (excluding energy)	($0.0736 – (0.0094 * ln(kW capacity))) * kWh generated/yr (before parasitic uses), includes gas cleanup system O&M and microturbine overhauls
Parasitic loss efficiency	83% of rated capacity due to parasitic electrical needs of boost compressor and cooling water pumps, fans, and dryer system
Fuel use rate	14,000 Btu/kWh generated (HHV) (before parasitic uses)
Gross capacity factor*	Assume 93%

Note: Raw cost data are in 2006$'s.

* Gross capacity factor accounts for loss of energy production due to problems in the gas collection system, problems with project equipment, weather related interruptions of the local utilities, and shut-downs at the energy consumer end of the system.

LCH: Leachate Evaporator	
Typical components include	▸ Leachate evaporation unit; ▸ Leachate surge tank; ▸ Process control instruments; and ▸ Site work, housings, utilities, and total facility engineering, design, and permitting.
Annualized capital and O&M costs*	$\$320{,}000 * \left(\frac{\text{gallons evaporated / yr}}{3{,}467{,}500}\right)^{0.19}$
Fuel use rate	80 Btu/gallon evaporated
Electricity usage	0.055 kWh/gallon evaporated
Leachate evaporation limit	No more than 95% of the available leachate can be evaporated

Note: Raw cost data are in 2008$'s.

* Competitive rental costs were found for leachate evaporation, and were used to develop a combined capital and operating cost.

Appendix I

Cost-Benefit Analysis for Landfill Gas Beneficial Reuse Alternatives

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MSWF - Option 2 (Electricity Generation using Microturbine)

c Analysis

Year	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2
Year of operation	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Annual Return[(a)]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$
Installed Capital Cost LFG Collection System ($)[(b)]															
Installed Capital Cost Microturbine Energy System ($)[(b)]															
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$
Annual O&M Cost Energy System($)	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$ 45,300	$
Annual Debt Service[(c)]	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$ 215,400	$
Net income	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$
Cash flow	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$ (170,000)	$
Cumulative cash flow	$ (3,453,700)	$ (3,623,700)	$ (3,793,700)	$ (3,963,700)	$ (4,133,700)	$ (4,303,700)	$ (4,473,700)	$ (4,643,700)	$ (4,813,700)	$ (4,983,700)	$ (5,153,700)	$ (5,323,700)	$ (5,493,700)	$ (5,663,700)	$ (5
Present value of cash flow (NPV, i=3%)	$ (68,000)	$ (66,100)	$ (64,100)	$ (62,300)	$ (60,500)	$ (58,700)	$ (57,000)	$ (55,300)	$ (53,700)	$ (52,200)	$ (50,600)	$ (49,200)	$ (47,700)	$ (46,400)	$
Cumulative present value	$ (2,128,200)	$ (2,194,300)	$ (2,258,400)	$ (2,320,700)	$ (2,381,200)	$ (2,439,900)	$ (2,496,900)	$ (2,552,200)	$ (2,605,900)	$ (2,658,100)	$ (2,708,700)	$ (2,757,900)	$ (2,805,600)	$ (2,852,000)	$ (2

generation ($/kWh) $0.145

l Return was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.

l costs for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

l Debt Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 2 (Electricity Generation using Microturbine)

ic Analysis

Year	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	
Year of operation	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Annual Return[a]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$
Installed Capital Cost LFG Collection System ($)[b]															$
Installed Capital Cost Microturbine Energy System ($)[b]															$
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$
Annual O&M Cost Energy System($)	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$ 57,000	$
Annual Debt Service[c]	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$ 164,300	$
Net income	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$
Cash flow	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$ (130,600)	$
Cumulative cash flow	$ (1,467,000)	$ (1,597,600)	$ (1,728,200)	$ (1,858,800)	$ (1,989,400)	$ (2,120,000)	$ (2,250,600)	$ (2,381,200)	$ (2,511,800)	$ (2,642,400)	$ (2,773,000)	$ (2,903,600)	$ (3,034,200)	$ (3,164,800)	$ (3
Present value of cash flow (NPV, i=3%)	$ (81,400)	$ (79,100)	$ (76,800)	$ (74,500)	$ (72,400)	$ (70,200)	$ (68,200)	$ (66,200)	$ (64,300)	$ (62,400)	$ (60,600)	$ (58,800)	$ (57,100)	$ (55,500)	$
Cumulative present value	$ (1,145,100)	$ (1,224,200)	$ (1,301,000)	$ (1,375,500)	$ (1,447,900)	$ (1,518,100)	$ (1,586,300)	$ (1,652,500)	$ (1,716,800)	$ (1,779,200)	$ (1,839,800)	$ (1,898,600)	$ (1,955,700)	$ (2,011,200)	$ (2

/ generation ($/kWh) $0.145

al Return was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.

al costs for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

al Debt Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 2 (Electricity Generation using Microturbine)

ysis

Expected LFG energy project lifetime (yrs)	45														
Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Year of operation	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Annual Return[a]		$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100
Installed Capital Cost LFG Collection System ($)[b]	$ 1,079,000														
Installed Capital Cost Microturbine Energy System ($)[b]	$ 903,000														
Annual O&M Cost LFG Collection System ($)		$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400
Annual O&M Cost Energy System($)		$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100	$ 51,100
Annual Debt Service[c]		$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300	$ 128,300
Net Income		$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)
Cash Flow		$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)	$ (88,700)
Cumulative Cash Flow		$ (88,700)	$ (177,400)	$ (266,100)	$ (354,800)	$ (443,500)	$ (532,200)	$ (620,900)	$ (709,600)	$ (798,300)	$ (887,000)	$ (975,700)	$ (1,064,400)	$ (1,153,100)	$ (1,241,800)
Present Value of Cash Flow (NPV, i=3%)		$ (86,200)	$ (83,700)	$ (81,200)	$ (78,900)	$ (76,600)	$ (74,300)	$ (72,200)	$ (70,100)	$ (68,000)	$ (66,100)	$ (64,100)	$ (62,300)	$ (60,500)	$ (58,700)
Cumulative Present value		$ (86,200)	$ (169,900)	$ (251,100)	$ (330,000)	$ (406,600)	$ (480,900)	$ (553,100)	$ (623,200)	$ (691,200)	$ (757,300)	$ (821,400)	$ (883,700)	$ (944,200)	$ (1,002,900)
Net Present Value (NPV, i=3%)		$ (2,897,000)													

ation ($/kWh) $0.145

n was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.
for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.
Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 1 (Electricity Generation using Small Reciprocating Engine)

nalysis

Year	2055	2056	2057	2058	2059	2060	2061
Year of operation	31	32	33	34	35	36	37
Annual Return[a]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100
Installed Capital Cost LFG Collection System ($)[b]							
Installed Capital Cost Small Engine Energy System ($)[b]							
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400
Annual O&M Cost Energy System($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400
Annual Debt Service[c]	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400
Net Income	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)
Cash Flow	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)
Cumulative Cash Flow	$ (4,483,400)	$ (4,672,500)	$ (4,861,600)	$ (5,050,700)	$ (5,239,800)	$ (5,428,900)	$ (5,618,000)
Present Value of Cash Flow (NPV, i=3%)	$ (75,700)	$ (73,500)	$ (71,300)	$ (69,300)	$ (67,300)	$ (65,300)	$ (63,400)
Cumulative Present Value	$ (2,774,000)	$ (2,847,500)	$ (2,918,800)	$ (2,988,100)	$ (3,055,400)	$ (3,120,700)	$ (3,184,100)
Net Present Value (NPV, i=3%)							

Year	2062	2063	2064	2065	2066	2067	2068
Year of operation	38	39	40	41	42	43	44
Annual Return[a]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100 $
Installed Capital Cost LFG Collection System ($)[b]							
Installed Capital Cost Small Engine Energy System ($)[b]							
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400 $
Annual O&M Cost Energy System($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400 $
Annual Debt Service[c]	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400	$ 217,400 $
Net Income	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100) $
Cash Flow	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100)	$ (189,100) $
Cumulative Cash Flow	$ (5,807,100)	$ (5,996,200)	$ (6,185,300)	$ (6,374,400)	$ (6,563,500)	$ (6,752,600)	$ (6,941,700) $
Present Value of Cash Flow (NPV, i=3%)	$ (61,500)	$ (59,800)	$ (58,000)	$ (56,300)	$ (54,700)	$ (53,100)	$ (51,600) $
Cumulative Present Value	$ (3,245,600)	$ (3,305,400)	$ (3,363,400)	$ (3,419,700)	$ (3,474,400)	$ (3,527,500)	$ (3,579,100) $
Net Present Value (NPV, i=3%)							

ıeration ($/kWh) $0.145

:turn was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.

sts for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

:bt Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 1 (Electricity Generation using Small Reciprocating Engine)

ıic Analysis

Year	2040	2041	2042	2043	2044	2045	2046
Year of operation	16	17	18	19	20	21	22
Annual Return[(a)]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100
Installed Capital Cost LFG Collection System ($)[(b)]							
Installed Capital Cost Small Engine Energy System ($)[(b)]							
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400
Annual O&M Cost Energy System($)	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900
Annual Debt Service[(c)]	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800
Net Income	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)
Cash Flow	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)
Cumulative Cash Flow	$ (1,933,800)	$ (2,104,800)	$ (2,275,800)	$ (2,446,800)	$ (2,617,800)	$ (2,788,800)	$ (2,959,800)
Present Value of Cash Flow (NPV, i=3%)	$ (106,600)	$ (103,500)	$ (100,500)	$ (97,600)	$ (94,700)	$ (92,000)	$ (89,300)
Cumulative Present Value	$ (1,507,700)	$ (1,611,200)	$ (1,711,700)	$ (1,809,300)	$ (1,904,000)	$ (1,996,000)	$ (2,085,300)
Net Present Value (NPV, i=3%)							

Year	2047	2048	2049	2050	2051	2052	2053	2(
Year of operation	23	24	25	26	27	28	29	:
Annual Return[(a)]	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 1
Installed Capital Cost LFG Collection System ($)[(b)]								$ 2
Installed Capital Cost Small Engine Energy System ($)[(b)]								$ 2
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$
Annual O&M Cost Energy System($)	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$ 95,900	$
Annual Debt Service[(c)]	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 165,800	$ 1
Net Income	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (1
Cash Flow	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (171,000)	$ (1
Cumulative Cash Flow	$ (3,130,800)	$ (3,301,800)	$ (3,472,800)	$ (3,643,800)	$ (3,814,800)	$ (3,985,800)	$ (4,156,800)	$ (4,2
Present Value of Cash Flow (NPV, i=3%)	$ (86,700)	$ (84,200)	$ (81,700)	$ (79,300)	$ (77,000)	$ (74,800)	$ (72,600)	$
Cumulative Present Value	$ (2,172,000)	$ (2,256,200)	$ (2,337,900)	$ (2,417,200)	$ (2,494,200)	$ (2,569,000)	$ (2,641,600)	$ (2,6
Net Present Value (NPV, i=3%)								

:y generation ($/kWh) $0.145

ıal Return was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.

ıal costs for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

ıal Debt Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp) ysis

MSWF - Option 1 (Electricity Generation using Small Reciprocating Engine)

Expected LFG Energy Project Lifetime (yrs)	45														
Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Year of operation	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Annual Return[a]		$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100	$ 153,100
Installed Capital Cost LFG Collection System ($)[b]	$ 1,079,000														
Installed Capital Cost Small Engine Energy System ($)[b]	$ 921,000														
Annual O&M Cost LFG Collection System ($)		$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400
Annual O&M Cost Energy System($)		$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600	$ 77,600
Annual Debt Service[c]		$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400	$ 129,400
Net Income		$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300
Cash Flow		$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300)	$ (116,300
Cumulative Cash Flow		$ (116,300)	$ (232,600)	$ (348,900)	$ (465,200)	$ (581,500)	$ (697,800)	$ (814,100)	$ (930,400)	$ (1,046,700)	$ (1,163,000)	$ (1,279,300)	$ (1,395,600)	$ (1,511,900)	$ (1,628,200
Present Value of Cash Flow (NPV, i=3%)		$ (113,000)	$ (109,700)	$ (106,500)	$ (103,400)	$ (100,400)	$ (97,500)	$ (94,600)	$ (91,900)	$ (89,200)	$ (86,600)	$ (84,100)	$ (81,600)	$ (79,300)	$ (76,900
Cumulative Present Value		$ (113,000)	$ (222,700)	$ (329,200)	$ (432,600)	$ (533,000)	$ (630,500)	$ (725,100)	$ (817,000)	$ (906,200)	$ (992,800)	$ (1,076,900)	$ (1,158,500)	$ (1,237,800)	$ (1,314,700
Net Present Value (NPV, i=3%)		$ (3,629,100)													

ation ($/kWh) $0.145

n was calculated assuming consumption of 10 hours of continuous electricity per day from 290 kW capacity MSWF energy production system. Future demand may vary.

for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

PRD - Option 2 (Electricity Generation using Microturbine)

ysis

	2024	2025	2026	2027	2028	2029	2030	2031
Expected LFG energy project lifetime (yrs)	15							
Project Year	2024	2025	2026	2027	2028	2029	2030	2031
Year of operation	0	1	2	3	4	5	6	7
Annual Return[a]		$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700
Installed Capital Cost LFG Collection System ($)[b]	$ 617,000							
Installed Capital Cost Small Engine Energy System ($)[b]	$ 271,000							
Annual O&M Cost LFG Collection System ($)		$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800
Annual O&M Cost Energy System($)		$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000
Annual Debt Service[c]		$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500
Net Income		$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)
Cash Flow		$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)
Cumulative Cash Flow		$ (143,600)	$ (287,200)	$ (430,800)	$ (574,400)	$ (718,000)	$ (861,600)	$ (1,005,200)
Present Value of Cash Flow (NPV, i=3%)		$ (139,500)	$ (135,400)	$ (131,500)	$ (127,600)	$ (123,900)	$ (120,300)	$ (116,800)
Cumulative Present Value		$ (139,500)	$ (274,900)	$ (406,400)	$ (534,000)	$ (657,900)	$ (778,200)	$ (895,000)
Net Present Value (NPV, i=3%)		$ (1,715,000)						

	2032	2033	2034	2035	2036	2037	2038
Year of operation	8	9	10	11	12	13	14
Annual Return[a]	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700
Annual O&M Cost LFG Collection System ($)	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800
Annual O&M Cost Energy System($)	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000
Annual Debt Service[c]	$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500	$ 91,500
Net Income	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)
Cash Flow	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)	$ (143,600)
Cumulative Cash Flow	$ (1,148,800)	$ (1,292,400)	$ (1,436,000)	$ (1,579,600)	$ (1,723,200)	$ (1,866,800)	$ (2,010,400)
Present Value of Cash Flow (NPV, i=3%)	$ (113,400)	$ (110,100)	$ (106,900)	$ (103,800)	$ (100,800)	$ (97,800)	$ (95,000)
Cumulative Present Value	$ (1,008,400)	$ (1,118,500)	$ (1,225,400)	$ (1,329,200)	$ (1,430,000)	$ (1,527,800)	$ (1,622,800)

ation ($/kWh) $0.145

n was calculated assuming consumption of 10 hours of continuous electricity per day from 41 kW capacity PRD energy production system. Future demand may vary.

for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.

Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

PRD - Option 1 (Electricity Generation using Small Reciprocating Engine)

ysis

Expected LFG Energy Project Lifetime (yrs)	15							
Project Year	2024	2025	2026	2027	2028	2029	2030	2031
Year of operation	0	1	2	3	4	5	6	7
Annual Return[a]		$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700
Installed Capital Cost LFG Collection System ($)[b]	$ 617,000							
Installed Capital Cost Small Engine Energy System ($)[b]	$ 133,000							
Annual O&M Cost LFG Collection System ($)		$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800
Annual O&M Cost Energy System($)		$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200
Annual Debt Service[c]		$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300
Net Income		$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)
Cash Flow		$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)
Cumulative Cash Flow		$ (126,600)	$ (253,200)	$ (379,800)	$ (506,400)	$ (633,000)	$ (759,600)	$ (886,200)
Present Value of Cash Flow (NPV, i=3%)		$ (123,000)	$ (119,400)	$ (115,900)	$ (112,500)	$ (109,300)	$ (106,100)	$ (103,000)
Cumulative Present Value		$ (123,000)	$ (242,400)	$ (358,300)	$ (470,800)	$ (580,100)	$ (686,200)	$ (789,200)
Net Present Value (NPV, i=3%)		$ (1,513,000)						

Project Year	2032	2033	2034	2035	2036	2037	2038
Year of operation	8	9	10	11	12	13	14
Annual Return[a]	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700	$ 21,700
Annual O&M Cost LFG Collection System ($)	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800	$ 59,800
Annual O&M Cost Energy System($)	$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200	$ 11,200
Annual Debt Service[c]	$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300	$ 77,300
Net Income	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600
Cash Flow	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600)	$ (126,600
Cumulative Cash Flow	$ (1,012,800)	$ (1,139,400)	$ (1,266,000)	$ (1,392,600)	$ (1,519,200)	$ (1,645,800)	$ (1,772,400
Present Value of Cash Flow (NPV, i=3%)	$ (100,000)	$ (97,100)	$ (94,300)	$ (91,500)	$ (88,800)	$ (86,300)	$ (83,700
Cumulative Present Value	$ (889,200)	$ (986,300)	$ (1,080,600)	$ (1,172,100)	$ (1,260,900)	$ (1,347,200)	$ (1,430,900

ation ($/kWh) $0.145
n was calculated assuming consumption of 10 hours of continuous electricity per day from 41 kW capacity PRD energy production system. Future demand may vary.
for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.
Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 3 (Leachate Evaporator)

ysis

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Expected LFG Energy Project Lifetime (yrs)	45														
Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Year of operation	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Annual Return[(a)]		$ 50,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Installed Capital Cost LFG Collection System ($)[(b)]	$ 1,079,000														
apital and O&M Costs Leachate Evaporator System ($)[(b)]	$ 146,200														
Annual O&M Cost LFG Collection System ($)		$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,40
Annual O&M Cost Leachate Evaporator System ($)		$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,20
Annual Debt Service[(c)]		$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,300	$ 79,30
Net Income		$ (237,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,90
Cash Flow		$ (237,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,900)	$ (287,90
Cumulative Cash Flow		$ (237,900)	$ (525,800)	$ (813,700)	$ (1,101,600)	$ (1,389,500)	$ (1,677,400)	$ (1,965,300)	$ (2,253,200)	$ (2,541,100)	$ (2,829,000)	$ (3,116,900)	$ (3,404,800)	$ (3,692,700)	$ (3,980,60
Present Value of Cash Flow (NPV, i=3%)		$ (231,000)	$ (271,400)	$ (263,500)	$ (255,800)	$ (248,400)	$ (241,200)	$ (234,100)	$ (227,300)	$ (220,700)	$ (214,300)	$ (208,000)	$ (202,000)	$ (196,100)	$ (190,40
Cumulative Present Value		$ (231,000)	$ (502,400)	$ (765,900)	$ (1,021,700)	$ (1,270,100)	$ (1,511,300)	$ (1,745,400)	$ (1,972,700)	$ (2,193,400)	$ (2,407,700)	$ (2,615,700)	$ (2,817,700)	$ (3,013,800)	$ (3,204,20
Net Present Value (NPV, i=3%)		$ (7,397,400)													

n was calculated from the capital cost of additional leachate pond construction that would be replaced by the leachate evaporator system.
for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.
Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

MSWF - Option 3 (Leachate Evaporator)

ıic Analysis

Year	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2(
Year of operation	16	17	18	19	20	21	22	23	24	25	26	27	28	29	:
Annual Return[(a)]	$ 50,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Installed Capital Cost LFG Collection System ($)[(b)]															$ 2
ılized Capital and O&M Costs Leachate Evaporator System ($)[(b)]															$
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$
Annual O&M Cost Energy System($)	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 1
Annual Debt Service[(c)]	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 101,600	$ 1
Net Income	$ (260,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (3
Cash Flow	$ (260,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (310,200)	$ (3
Cumulative Cash Flow	$ (4,528,700)	$ (4,838,900)	$ (5,149,100)	$ (5,459,300)	$ (5,769,500)	$ (6,079,700)	$ (6,389,900)	$ (6,700,100)	$ (7,010,300)	$ (7,320,500)	$ (7,630,700)	$ (7,940,900)	$ (8,251,100)	$ (8,561,300)	$ (8,8
Present Value of Cash Flow (NPV, i=3%)	$ (162,200)	$ (187,700)	$ (182,300)	$ (177,000)	$ (171,800)	$ (166,800)	$ (161,900)	$ (157,200)	$ (152,600)	$ (148,200)	$ (143,900)	$ (139,700)	$ (135,600)	$ (131,700)	$ (1
Cumulative Present Value	$ (3,551,300)	$ (3,739,000)	$ (3,921,300)	$ (4,098,300)	$ (4,270,100)	$ (4,436,900)	$ (4,598,800)	$ (4,756,000)	$ (4,908,600)	$ (5,056,800)	$ (5,200,700)	$ (5,340,400)	$ (5,476,000)	$ (5,607,700)	$ (5,7
Net Present Value (NPV, i=3%)															

ıal Return was calculated from the capital cost of additional leachate pond construction that would be replaced by the leachate evaporator system.
tal costs for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.
ıal Debt Service was calculated based on a projected prime interest rate of 6% (http://mortgage-x.com/general/indexes/prime_rate_forecast.asp)

ic Analysis

Year	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	
Year of operation	31	32	33	34	35	36	37	38	39	40	41	42	43	44	
Annual Return[a]	$ 50,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$
Installed Capital Cost LFG Collection System ($)[b]															
lized Capital and O&M Costs Leachate Evaporator System ($)[b]															
Annual O&M Cost LFG Collection System ($)	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$ 62,400	$
Annual O&M Cost Energy System($)	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$ 146,200	$
Annual Debt Service[c]	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$ 133,200	$
Net Income	$ (291,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$
Cash Flow	$ (291,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$ (341,800)	$
Cumulative Cash Flow	$ (9,163,300)	$ (9,505,100)	$ (9,846,900)	$(10,188,700)	$(10,530,500)	$(10,872,300)	$(11,214,100)	$(11,555,900)	$(11,897,700)	$(12,239,500)	$(12,581,300)	$(12,923,100)	$(13,264,900)	$(13,606,700)	$(13
Present Value of Cash Flow (NPV, i=3%)	$ (116,800)	$ (132,800)	$ (128,900)	$ (125,100)	$ (121,500)	$ (118,000)	$ (114,600)	$ (111,200)	$ (108,000)	$ (104,800)	$ (101,800)	$ (98,800)	$ (95,900)	$ (93,200)	$
Cumulative Present Value	$ (5,852,400)	$ (5,985,200)	$ (6,114,100)	$ (6,239,200)	$ (6,360,700)	$ (6,478,700)	$ (6,593,300)	$ (6,704,500)	$ (6,812,500)	$ (6,917,300)	$ (7,019,100)	$ (7,117,900)	$ (7,213,800)	$ (7,307,000)	$ (7
Net Present Value (NPV, i=3%)															

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tal costs for both LFG collection systems and energy production systems included an additional 40% cost factor for on-island construction in Saipan.
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Any question relating to this article may be forwarded to the Division of Solid Waste Management Director Enreique Dela Cruz at 322-2745