Compliance Test Report
Utility Flare Performance Test

Oakland Heights Development, Inc.
Auburn Hills, Michigan

April 2, 2018

Prepared for:
Oakland Heights Development, Inc.
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EXECUTIVE SUMMARY

Republic Services, Inc. (Republic) retained Air Quality Specialist, Inc. (AQSI) to conduct a performance evaluation of one utility (open) flare located at Oakland Heights Development, Inc. in Auburn Hills, Michigan. The utility flare controls landfill gas (LFG) emissions from the municipal solid waste landfill.

The purpose of the test program was to demonstrate that the utility flare meets the performance requirements of 40 Code of Federal Regulations (CFR), §60.18, and thus is also in compliance with 40 CFR 60, Subpart WWW, 60.752(b)(2)(iii).

AQSI conducted the fieldwork on February 6, 2018, and in accordance with the Test Plan, dated December 12, 2017. Mr. Andrew Secord, Mr. Jeremy Chrobak, and Mr. Alex Schreiber conducted the tests. Mr. Pete Campbell with Monitoring Control and Compliance Inc. provided on-site coordination of the tests with landfill operations. Mr. Robert Joseph with Michigan Department of Environmental Quality (MDEQ) reviewed the test plan and had no comments. The results of the performance evaluation were:

Parameter	Applicable Requirement	Average Test Result
Flare Exhaust Smoke Emissions (Visual Emissions in a 2-hour Period)	<5 minutes over 2 hours [1]	0 minutes, 23 seconds
Flare Inlet Gas Net Heating Value (MJ/scm)	>7.45 [2]	15.53
Flare Exhaust Gas Exit Velocity (feet per second)	<60 [3]	44.07
Maximum Permitted Velocity (V_{max}, feet per second)	<82.1 [4]	44.07

MJ: megajoules
scm: standard cubic meter

[1] 40 CFR 60.18(c)(1)
[2] 40 CFR 60.18(c)(3)(ii)
[3] 40 CFR 60.18(c)(4)(i)
[4] 40 CFR 60.18(c)(4)(iii)

1.0 INTRODUCTION

Republic Services, Inc. (Republic) retained Air Quality Specialist, Inc. (AQSI) to conduct a performance evaluation of one utility (open) flare located at Oakland Heights Development, Inc. in Auburn Hills, Michigan. The utility flare controls landfill gas (LFG) emissions from the municipal solid waste landfill.

The purpose of the test program was to demonstrate that the utility flare meets the performance requirements of 40 Code of Federal Regulations (CFR), §60.18, and thus is also in compliance with 40 CFR 60, Subpart WWW, 60.752(b)(2)(iii).

AQSI conducted the test program with methodologies outlined in 40 CFR 60.18, except that United States Environmental Protection Agency (USEPA) Method 3C, *"Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources,"* was employed for net heating value determination in lieu of Method 18 and ASTM D1946. Method 3C is the applicable method for utility flares at landfills, in accordance with Subpart WWW, 60.754(e).

AQSI conducted the fieldwork on February 6, 2018, and in accordance with the Test Plan, dated December 12, 2017. Mr. Andrew Secord, Mr. Jeremy Chrobak, and Mr. Alex Schreiber conducted the tests. Mr. Pete Campbell with Monitoring Control and Compliance Inc. provided on-site coordination of the tests with landfill operations. Mr. Robert Joseph with Michigan Department of Environmental Quality (MDEQ) reviewed the test plan and had no comments.

The name, address, and telephone number of the primary contact for further information about the tests and this test report is:

Name and Title	Company	Telephone
Mr. Andrew Secord Environmental Scientist	Air Quality Specialist, Inc. 672 N. Milford Road, Suite 152 Highland, Michigan 48357	(248) 887-7565

The name, address, and telephone number of the primary contact for further information about the flare and associated operations is:

Name and Title	Company	Telephone
Mr. Robb Moore, P.E. Environmental Manager	Republic Services, Inc. 2361 West Grand Blanc Road Grand Blanc, Michigan 48439	(810) 655-6906

2.0 SUMMARY OF RESULTS

On February 6, 2018, the utility flare operated at an average inlet volumetric flow rate of approximately 3,705 standard cubic feet per minute (scfm) as measured by USEPA Methods 1 and 2, or 3,106 scfm as averaged from recorded process flow meter data.

The average test results were:

1) visible emissions: 0 minutes, 23 seconds (accumulated, total),
2) average net heating value of the gas being combusted: 15.53 megajoules per standard cubic meter (MJ/scm), and
3) average exhaust gas exit velocity: 44.07 feet per second (fps).

The performance criteria are less than 5 minutes visible emissions in a 2-hour period, a net heating value of greater than 7.45 MJ/scm, and an exit velocity less than 60 fps (or less than the maximum permitted velocity (V_{max}), calculated to be 82.1 fps).

The test results demonstrate that the utility flare meets the performance requirements of §60.18, and thus also satisfies the requirements of 60.752(b)(2)(iii)(B), at the test flow rate.

3.0 SOURCE DESCRIPTION

Oakland Heights Development, Inc. is a municipal solid waste (MSW) landfill. Anaerobic bacteria decompose the emplaced waste. The primary by-products of decomposition are methane (~45-55%, typical) and carbon dioxide (~40-45%, typical), with the remainder balance gases nitrogen, oxygen and trace amounts of non-methane organic compounds.

Oakland Heights Development, Inc. employs a gas collection and control system to meet the requirements of Subpart WWW. Gas collection wells are installed in a grid pattern about the landfill. The wells are connected to a common header system. A blower produces a vacuum on the well field. Collected gas is routed to a third party gas developer. The utility flare is used to control landfill gas emissions in the event the gas developer experiences downtime; the flare is otherwise at reduced capacity.

Oakland Heights Development, Inc. installed the utility flare in July 2015 and conducted an initial performance test on September 25, 2015. The flare is designed to meet the requirements of 60.753(b)(2)(iii) at a flow rate up to 4,500 scfm. The landfill gas flow rate to the flare has increased since 2015, and was expected to be approximately 3,800 scfm for this test event. The landfill gas flow is variable, and depends on gas production in the landfill. The composition of the landfill gas varies, but the average Method 3C values obtained on February 6, 2018, may be considered 'typical:' methane, 46.7%; carbon dioxide, 38.1%; oxygen, 1.4%; and nitrogen, 14.0%. The landfill gas temperature at the flare inlet averaged 141°F.

The utility flare is equipped with a thermocouple to monitor for the presence of a flame. The utility flare is equipped with an automatic shutdown that activates if the presence of flame cannot be verified by the sensor.

4.0 SAMPLE AND ANALYTICAL PROCEDURES

AQSI conducted measurements in accordance with USEPA Reference Test Methods, as presented in 40 CFR 60, Appendix A. The sample collection and analytical methods used in the test program are listed in the table below. Figure 1 depicts the sample site.

Sample Method	**Parameter**	**Analysis**
USEPA Methods 1A & 2C	Stack Gas Velocity and Volumetric Flow Rate	Field Data
USEPA Method 3C	Carbon Dioxide, Methane, Nitrogen, Oxygen, and moisture fraction	Gas Chromatography / Thermal Conductivity Detector (GC/TCD)
USEPA Method 22	Visible Emissions	Field Observation

4.1 Stack Gas Velocity and Volumetric Flow Rate (USEPA Methods 1A and 2C)

AQSI used Method 1A to determine the appropriate number and location of traverse points on the utility flare inlet duct. AQSI selected traverse points based on division of the stack cross-section into equal areas, and the number of upstream and downstream stack diameters from the sample ports to the nearest flow disturbance. Figure 2 depicts the flare inlet cross-section and traverse point locations.

AQSI used Method 2C to measure stack gas velocity pressure and temperature at each traverse point. AQSI positioned a standard pitot tube, with a baseline coefficient of 0.99, at each traverse point. The velocity pressure and temperature were measured and recorded. Velocity pressure measurements were read from a digital manometer with increments of 0.1 inches of water column. The raw field data, and computer-generated velocity and volumetric flow rate spreadsheets are presented in Appendix A.

The average stack gas velocity is a function of the average velocity pressure, absolute stack gas pressure, average stack gas temperature, stack gas wet molecular weight, and pitot tube coefficient. AQSI derived the average stack gas velocity from equations presented in Method 2. AQSI calculated the stack gas flow rate by multiplication of the stack gas velocity and the cross-sectional area of the stack.

AQSI used the measured inlet flow rate from each individual test to calculate the corresponding exhaust gas exit velocity for that test.

4.2 Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources (Method 3C)

AQSI used Method 3C to determine the net heating value of the landfill gas. AQSI collected three, 30-minute, integrated tank samples of landfill gas from the inlet to the utility flare (downstream of the blower).

AQSI submitted the samples to Triangle Environmental Services, Inc. (TES), Durham, North Carolina for analysis. TES analyzed each tank for carbon dioxide (CO_2), methane (CH_4), nitrogen (N_2), and oxygen (O_2) concentration and moisture fraction. Figure 3 depicts the Method 3C sample train.

TES followed the analytical procedures of Method 3C by using a gas chromatograph (GC), with appropriate separation column for the expected parameters, equipped with a thermal conductivity detector (TCD). Attachment B presents the TES laboratory analytical report.

AQSI used the Method 3C analytical results to calculate stack gas molecular weight (for use in stack gas velocity calculation), and to calculate the net heating value of the gas being combusted per §60.18(f)(3). The reported net heating value is the arithmetic average of three valid test runs.

AQSI calculated the dry molecular weight of the stack gas based on the assumption that the primary constituents were methane, carbon dioxide, nitrogen, and oxygen (other compounds present have a negligible relative concentration). The stack gas dry molecular weight is equal to the sum of stack gas constituent concentrations (%) multiplied by the corresponding molecular weight of that constituent.

TES calculated stack gas moisture content by Equation 3C-1 of Method 3C.

4.3 Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares (Method 22)

AQSI conducted a single, 120-minute, non-continuous observation of the utility flare exhaust for smoke emissions. AQSI observed continuously for 15 to 20 minutes, then took a break for at least 5 – but no more than 10 minutes, and then resumed observation in this pattern until a full 120-minute period of observation time had accrued. A copy of the Method 22 observation data is presented in Appendix A.

5.0 RESULTS AND DISCUSSION

On February 6, 2018, AQSI observed an accumulated total of 0 minutes, 23 seconds of visible emissions from the utility flare exhasut. The limit for visible emissions is less than 5 minutes per 2-hour time period [60.18(c)(1)].

On February 6, 2018, the average net heating value of the gas being combusted was 15.53 MJ/scm. The requirement for net heating value is >7.45 MJ/scm [60.18(c)(3)(ii)].

On February 6, 2018, the average stack gas exit velocity, calculated from field data, was 44.1 fps. The limit is <60 fps [60.18(c)(4)(i)], or less than the Maximum Permitted Velocity, V_{max}, calculated to be 82.1 fps [60.18(c)(4)(iii)].

The February 6, 2018 results demonstrate that the utility flare meets the performance requirements of §60.18, and thus satisfies 40 CFR 60.752(b)(2)(iii).

AQSI did not note any variations and/or anomalies in normal sample collection procedures.

AQSI did not note any control equipment upset conditions over the test period.

MDEQ did not provide any audit samples for analysis. AQSI quality assurance (QA) procedures included:

1) leak-check of the velocity measurement system (pitot tube through manometer),
2) verification of sufficient evacuation of each Method 3C canister prior to initiation of each sample collection, and,
3) leak-check of the Method 3C sample train prior to each test.

Raw field and computer-calculated data used in the determination of the utility flare average exit velocity and net heating value, visible emissions observation data, and available process flow meter data, are presented in Appendix A. The Method 3C laboratory analytical results and chain-of-custody forms are presented in Appendix B. Sample calculations, including the determination of V_{max}, are presented in Appendix C.

This report prepared by: [signature]
Andrew D. Secord
Environmental Scientist

This report reviewed by: [signature]
FOR Dana A. Oleniacz
President

April 2, 2018

TABLES

Table 1

Utility Flare Inlet Volumetric Flow Rate and Flare Exit Velocity
Oakland Heights Development, Inc.
Auburn Hills, Michigan
AQSI Project No. 17F1007
February 6, 2018

Parameter	Test 1	Test 2	Test 3	Average
Inlet Volumetric Flow Rate (scfm) – Measured Field Data	3,749	3,665	3,662	3,705
Exit Tip Diameter (inches)	16	16	16	
Exit Tip Cross-Sectional Area (ft^2)	1.396	1.396	1.396	
Allowable Exit Velocity (fps)[1]	**60**	**60**	**60**	**60**
Maximum Permitted Velocity, V_{max} (fps) [2]	**81.7**	**81.7**	**82.8**	**82.1**
Exit Velocity (fps)	**44.8**	**43.7**	**43.7**	**44.1**

[1] 40 CFR 60.18(c)(4)(i)
[2] 40 CFR 60.18(c)(4)(iii)
scfm: standard cubic feet per minute
ft^2: square feet
fps: feet per second

Table 2

Utility Flare Inlet Gas Net Heating Value
Oakland Heights Development, Inc.
Auburn Hills, Michigan
AQSI Project No. 17F1007
February 6, 2018

Parameter	Test 1	Test 2	Test 3	Average
Flare Inlet Gas Methane Content (ppm)	465,086	464,832	470,235	466,718
Flare Inlet Gas Methane Content (%)	46.51	46.48	47.02	46.67
Methane, Molecular Weight (lb/lb mole)	16	16	16	
Methane, Heating Value (kcal/g)[1]	11.9533	11.9533	11.9533	
Methane, Heating Value (kcal/g mole)	191.25	191.25	191.25	
Minimum Net Heating Value (MJ/scm)[2]	**7.45**	**7.45**	**7.45**	**7.45**
Flare Inlet Gas Net Heating Value (MJ/scm)	**15.48**	**15.47**	**15.65**	**15.53**

[1] USEPA Office of Air Quality Planning And Standards' Control Cost Manual
[2] 40 CFR 60.18(c)(3)(ii)
ppm: parts per million
%: percent
lb/lb mole: pounds per pound-mole
kcal/g: kilocalories per gram
kcal/g mole: kilocalories per gram-mole
MJ/scm: megajoules per standard cubic meter

FIGURES

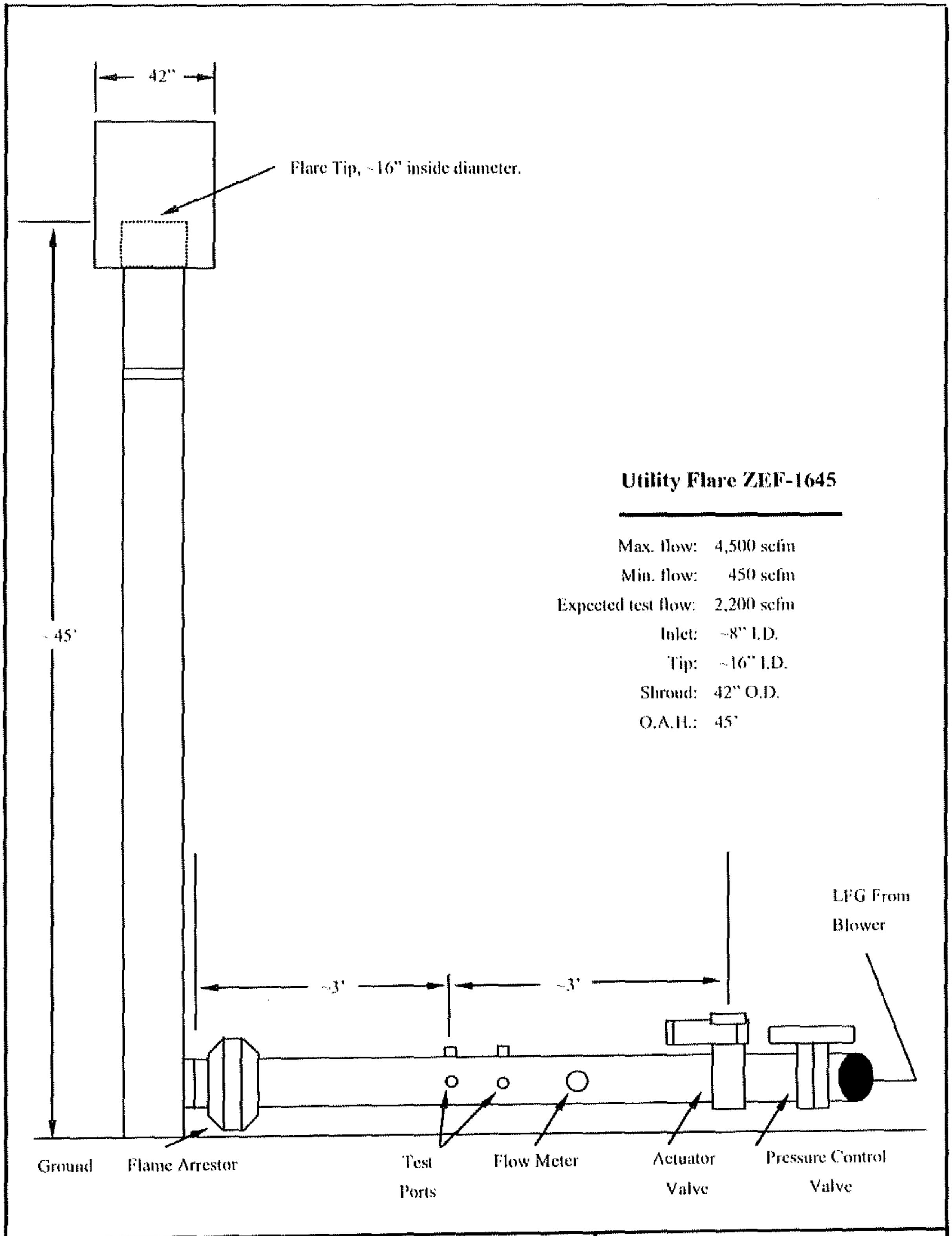

Figure 1

Utility flare duct and stack arrangement, approximate dimensions, and test locations, Oakland Heights Development, Inc. in Auburn Hills, Michigan.

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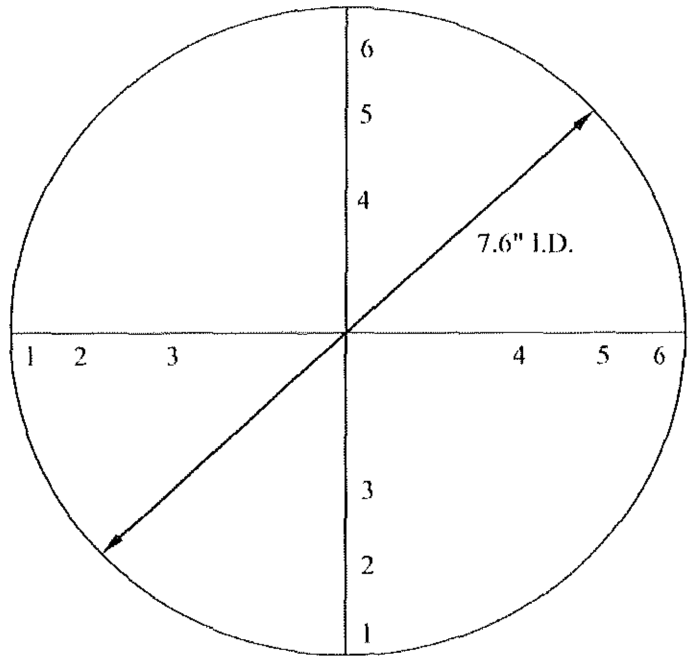
February 6, 2018



Traverse Point Number	Distance From Wall (percent of diameter)
1	4.4%
2	14.6%
3	29.6%
4	70.4%
5	85.4%
6	95.6%

Figure 2
Traverse point numbers and locations on the utility flare inlet at Oakland Heights Development, Inc. in Auburn Hills, Michigan.

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February 6, 2018

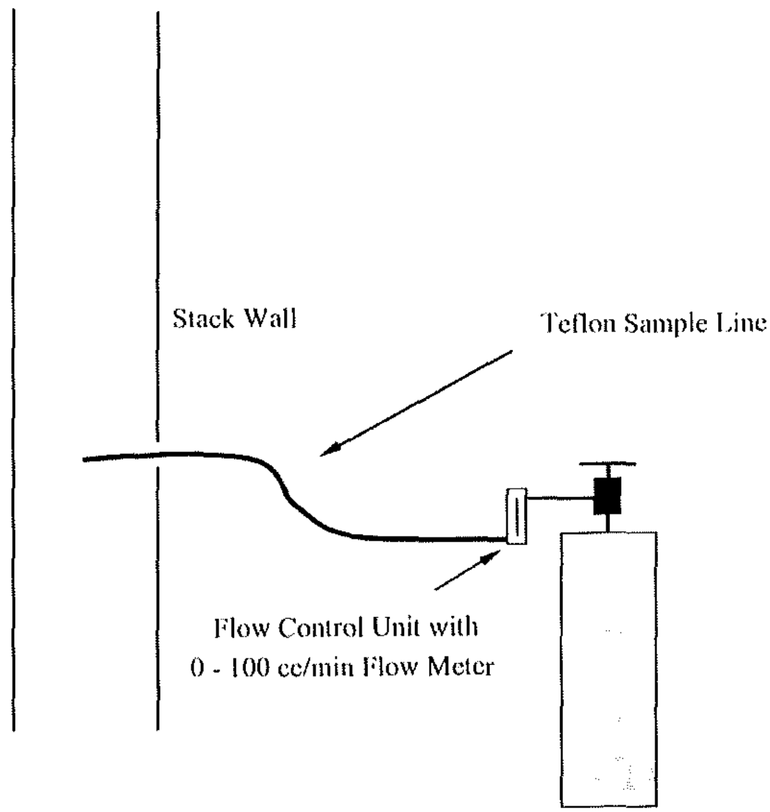

Figure 3
USEPA Method 3C sample train for the utility flare inlet duct at Oakland Heights Development, Inc. in Auburn Hills, Michigan.

Air Quality Specialist, Inc.
February 6, 2018