Summary of AP-42 Chapter 2, Section 4 Changes since Draft

Location	Text	Change	Reason
Pg. 2.4-1, Top of the page	**Disclaimer: Emission factors in AP-42 are neither EPA-recommended emission limits (e.g., best available control technology or BACT, or lowest achievable emission rate or LAER) nor standards (e.g., National Emission Standard for Hazardous Air Pollutants or NESHAP, or New Source Performance Standards or NSPS). Use of these factors as source-specific permit limits and/or as emission regulation compliance determinations is NOT recommended by EPA. Because emission factors essentially represent an average of a range of emission rates, approximately half of the subject sources are expected to have emission rates greater than the emission factor, and the other half are expected to have emission rates less than the emission factor. As such, EPA does not recommend using emission factors as limits or standards. This could cause, for example, a permit limit using an AP-42 emission factor resulting in approximately half of the sources being in noncompliance. We recommend source testing be done for the best possible emission values. For more information on the use of emission factors, please refer to the AP-42 Introduction.**	Disclaimer added.	Disclaimer on the use of AP-42 emission factors added in response to several comments (5.2, 6.1, 8.8, 8.9).
Pg. 2.4-1, Section 2.4.1	References for this AP-42 section are available electronically here. The reader is referred to Sections 13.2.2 (Unpaved Roads), and	Paragraph moved from 2.4.4 and references to AP-42 3.1 and 13.5	Paragraph moved because it was in the section for controlled emissions and seemed more appropriate

	11.2.4 (Heavy Construction Operations) of the Electronic AP-42: Compilation of Air Emissions Factors from Stationary Sources, and Section II-7 (Construction Equipment) of Volume II, of the AP-42 document for determination of associated fugitive dust and exhaust emissions from these emission sources at MSW landfills. **In addition to this, Section 3.1 (Stationary Gas Turbines) and Section 13.5 (Industrial Flares) of the Electronic AP-42: Compilation of Air Emissions Factors from Stationary Sources also contains emission factors for LFG fired turbines and open flares, respectively.**	(bold text) were added.	under 'General'. References to AP-42 3.1 and 13.5 were added in response to several comments (4.2, 5.1, 7.1).
Pg. 2.4-2, Section 2.4.3	The original New Source Performance Standards (NSPS) and Emission Guidelines (EG) for air emissions from MSW landfills for certain new and existing landfills were published in the Federal Register on March ~~11~~**12**, 1996. Since then, the MSW NSPS/EG were updated on August ~~16~~**29**, 2016. Additionally, a National Emission Standard for Hazardous Air Pollutants (NESHAP) was promulgated on January 16, 2003, and the residual risk and technology review (RTR) was promulgated on March 26, 2020, with technical corrections to the RTR promulgated on February 3, 2022. ~~These regulations~~ **A history of MSW landfills can be found on the EPA's Municipal Solid Waste Landfills: New Source Performance Standards (NSPS), Emission Guidelines (EG) and Compliance Times website. The NSPS, EG, and NESHAP for MSW landfills** are similar in that they	Dates corrected, bold text added and strike through text were removed from the section.	Correction and additional text added for clarity.

	regulate emissions of landfill gas using non-methane organic compounds (NMOC) as an estimate for VOC emissions.		
Pg. 2.4-3, Section 2.4.4.1	~~To estimate uncontrolled emissions of the various compounds, present in landfill gas, total landfill gas emissions must first be estimated. Uncontrolled CH_4 emissions~~ **EPA notes that fugitive emissions include those emissions not gathered by collection devices (uncollected). Here, fugitive, uncollected, and uncontrolled emissions are synonymous terms. One way to estimate uncontrolled emissions of a pollutant in landfill gas is to begin by determining the annual volume of landfill methane generation, accounting for air infiltration as necessary, and to use the ideal gas law to provide pollutant mass per year. Methane generation** may be estimated for individual landfills by multiplying the result of Equation HH-1, found at 40 CFR 98.343(a)(1), by 1474.83 to obtain methane generation for the reporting year for which emissions are calculated in terms of cubic meters per year. […] ~~It should be noted that the equation above was designed to estimate methane generation and not methane emissions to the atmosphere.~~ The Landfill Gas Emissions Model (LandGEM) is an automated estimation tool with a Microsoft Excel interface that can be used to estimate **generation or** emissions rates for total landfill gas, methane, carbon dioxide, and	Bold text added to section. Strike through text was removed.	Edited in response to comment 2.4.

	NMOCs, and individual air pollutants from municipal solid waste landfills.		
Pg. 2.4-3, Section 2.4.4.1	Note that ~~to comply with other~~ **the regulatory defaults for the equations in LandGEM Version 3.03 must be used when required by** programs, such as NSPS 40 CFR Part 60 subpart ~~WWW~~**XXX** Emission Guideline ~~Cc~~**Cf**, or NESHAP 40 CFR Part 63 AAAA~~, the regulatory defaults for the equation found in LandGEM Version 3.03 must be applied.~~	Bold text added to section. Strike through text was removed.	Corrected and reworded for clarity.
Pg. 2.4-4, Section 2.4.4.1	For landfills, volatile organic compound (VOC) emissions are equivalent to NMOC emissions minus the emissions from compounds with low to no photochemical reactivity. Predominant compounds with low to no photochemical reactivity found in landfills include methyl chloroform, acetone, methylene chloride, tetrachloroethylene, chlorodifluoromethane, dichlorodifluoromethane, and ethane. When the contribution of emissions from these **compounds with** low to no photochemical reactivity is low, then NMOC emissions are a good surrogate for VOC emissions. Recent data review shows that the contribution of these seven predominant compounds **with low to not photochemical reactivity** ~~to be less than 0.005% of LFG and~~ less than 6.5**%** ~~0.25%~~ of NMOC.[11-38]	Bold text added to section. Strike through text was removed. References added** This change also impacts other reference citation numbers after this point, but those subsequent shifts are not all recorded in this document.	References added to enhance documentation of relevant sources. Paragraph was edited as a result of comments 1.5 and 6.2.
Pg. 2.4-4, Section 2.4.4.1	The current version of ~~the~~ LandGEM contains a regulatory default value for total NMOC of 4,000 ppmv, expressed as hexane. The regulatory default value for NMOC concentration was developed for regulatory compliance purposes **(40 CFR Part 60, Subpart XXX)** and to provide	Bold text added to section. Strike through text was removed.	Edited for clarity.

	the most cost-effective default values on a national basis.		
Pg. 2.4-4, Section 2.4.4.1	For emissions inventory purposes, site-specific information should be taken into account when determining the total NMOC concentration. In the absence of site-specific information, a value of ~~2,420~~ **2,400** ppmv as hexane is suggested for landfills known to have co-disposal of MSW and non-residential waste. If the landfill is known to contain only MSW or have very little organic commercial/industrial wastes, ~~then a total NMOC value of 600 ppmv as hexane should be used.~~ **then for default values before 1992, 600 ppmv as hexane should be used, and for default values on and after 1992, 550 ppmv as hexane should be used.**	Bold text added to section. Strike through text was removed.	Value was rounded to two significant figures to be consistent with the rest of chapter and in response to comments 1.2 and 1.6.
Pg. 2.4-4, Section 2.4.4.1	**According to NSPS (40 CFR Part 60, Subpart XXX) and Emission Guideline (40 CFR Part 60, Subpart Cf), the landfills with annual NMOC emissions greater than 34 megagrams must consider further emission measurement efforts or installation of a gas collection system.**	Bold text added to section.	Reminder added for landfill owners/operators to check emissions for gas collection system installation.
Pg. 2.4-4, Section 2.4.4.1	~~If a site-specific total pollutant concentration is available (i.e., as measured by EPA Reference Method 25C), it must be corrected reviewed for potential air infiltration~~**. Before a default pollutant concentration is used (e.g. from Table 2.4-1), it must be reviewed for potential air infiltration correction. Air infiltration** can occur by two different mechanisms:	Bold text added to section. Strike through text was removed.	Edited for clarity in response to comment 8.5.
Pg. 2.4-5, Section 2.4.4.1	Update to Equation 3	Multiplication factor 1.82 replaced with 1/F, where F is the fraction by volume	Edited in response to comment 8.6.

		of methane in landfill gas from measurement data.	
Pg. 2.4-6, Section 2.4.4.2	To estimate controlled emissions of CH_4, NMOC, and other constituents in landfill gas, the collection efficiency of the system ~~must~~ **should** first be estimated. ~~Reported collection efficiencies typically range from 60~~ **Different models exist** to ~~85%, with an average~~ **provide a better estimate for uncontrolled emissions that are more appropriate for emission inventory development (e.g. LandGEM) that incorporates waste degradation parameters which include the potential to generate methane and the waste degradation decay rate. The potential to generate methane is a function** of ~~of 75% most commonly assumed.~~ **waste type, and age of waste. The waste degradation decay rate is a function of waste type, age of waste, and waste moisture. Waste moisture might be changed by leachate recirculation and rainfall rates**. Higher collection efficiencies may be achieved at some sites (i.e., those engineered to control gas emissions). If site-specific collection efficiencies are available (i.e., through a comprehensive surface sampling program), then they should be used instead ~~of the 75% average~~. **If a user lacks site-specific collection efficiencies, determined by a comparison of measured methane collected to predicted methane generation, use the appropriate values in Table HH-3 to Subpart HH of Part 98 - Landfill Gas Collection Efficiencies for calculations. See section III.T.2 of the preamble of**	Bold text added to section. Strike through text was removed.	Edited in response to comment 3.1.

	the GHGRP final rule for more information on the finalized collection efficiencies in Table HH-3 and default collection efficiency.		
Pg. 2.4-6, Section 2.4.4.2	Controlled emission estimates **should** also ~~need to consider~~ **take into consideration** the control efficiency of the control device.	Bold text added to section. Strike through text was removed.	Edited for clarity.
Pg. 2.4-6, Section 2.4.4.2	**For convenience, emission factors are also presented for NMOC, although most of this NMOC is presumed to be from incomplete combustion of NMOC generated from the landfill rather than NMOC generated by combustion**	Bold text added to section.	Added clarifying text.
Pg. 2.4-9, Section 2.4.5	Added several SCCs, removed SCC 20300802	Added missing SCCs for municipal solid waste landfills and removed SCC 20300802 which is for internal combustion engines and is covered in AP42 Chapter 3.1.	Updated SCCs based on comment 4.1.
Pg. 2.4-12, Section 2.4.6	Updated changes made since the 1998 version	Updated changes made since the 1998 version.	General update.
Pg. 2.4-14, Table 2.4-1	(SCC 50100402, 50300603, **50600601, 50700601)**	SCCs added to include all relevant SCCs.	Correction.
Pg. 2.4-14, Table 2.4-1	Default concentration values	Concentration values rounded to two significant figures.	Values were rounded to two significant figures to be consistent with the rest of chapter and in response to comment 1.2
Pg. 2.4-14, Table 2.4-1	Carbon monoxide factor	Default concentration changed, emission factor rating	Updated as result of comment 1.1.

		updated and corresponding footnotes added.	
Pg. 2.4-15, Table 2.4-1	Footnote b: **Carbon monoxide can exist in LFG, typically in small quantities. This default value should be used with caution. Just 2 of 18 sites showed detectable levels of CO.** ~~Carbon monoxide is not a typical constituent of LFG, but does exist in instances involving landfill (underground) combustion. Therefore, this default value should be used with caution. Of 18 sites where CO was measured, only 2 showed detectable levels of CO.~~ **Note that large values – on the order of 1,000 ppm and greater – can indicate underground combustion or other atypical conditions**.	Text in bold added, struck out text removed.	Updated as result of comment 8.4.
Pg. 2.4-15, Table 2.4-1	Footnote e: **Reference 98**	Added reference.	Added with CO factor.
Pg. 2.4-15, Table 2.4-1	Footnote f: **Emission factor is minimally representative of the population. Emission factor quality ratings based on the Emissions Factors Procedures Document (January 2023).**	Added representativeness description.	Added with the CO factor.
Pg. 2.4-16, Table 2.4-2	(SCC 50100402, 50300603, **50600601, 50700601)**	SCCs added to include all relevant SCCs.	Correction.
Pg. 2.4-16, Table 2.4-2	Default concentration values	Concentration values rounded to two significant figures.	Values were rounded to two significant figures to be consistent with the rest of chapter and in response to comment 1.2.

Pg. 2.4-16, Table 2.4-2	NMOC (as hexane)[c] - Co-disposal **(pre 1992)** [d]	Bold text added.	Added as a result of the new NMOC as hexane for post 1992, which is a result of comments 1.1, 1.5, and 1.6.
Pg. 2.4-16, Table 2.4-2	NMOC (as hexane)[c] - No or Unknown co-disposal **(pre 1992)** [d]	Bold text added.	Added as a result of the new NMOC as hexane for post 1992, which is a result of comments 1.1, 1.5, and 1.6.
Pg. 2.4-16, Table 2.4-2	NMOC (as hexane) - No or Unknown co-disposal (1992+) factor added	Added additional factor for NMOC and associated footnotes.	Created in response to several comments (1.1, 1.5, 1.6).
Pg. 2.4-16, Table 2.4-2	Footnote c: For NSPS/Emission Guideline compliance purposes, the default concentration for NMOC as specified in the final rule must be used. **For other purposes, users should develop and use their own-site specific data.** ~~For purposes not associated with NSPS/Emission Guideline compliance, the default VOC content at co-disposal sites = 85% by weight (2,060 ppmv as hexane); at No or Unknown sites = 39% by weight 235 ppmv as hexane).~~	Text in bold added, strike through text removed.	Edited in response to comment 1.5.
Pg. 2.4-16, Table 2.4-2	Footnote d: **Emission factors are split into pre 1992 and 1992 or later (1992+) to account for co-disposal in landfills. The 1992+ factor is based on data from landfills that did not accept co-disposed waste and from landfills that opened in 1992 or later because current landfills do not allow co-disposal. The pre 1992 factors are based on data from landfills that opened before and during 1992, when some landfills allowed co-disposal.**	Footnote added to describe new factor added.	New factor added as result of several comments (1.1, 1.5, 1.6).

Pg. 2.4-16, Table 2.4-2	Footnote e: **Reference 113**	Footnote added – reference for new factor.	New factor added as result of several comments (1.1, 1.5, 1.6).
Pg. 2.4-16, Table 2.4-2	Footnote f: **Emission factor is moderately representative of the population. Emission factor quality ratings based on the Emissions Factors Procedures Document (January 2023).**	Footnote added – describes the quality rating of new factor.	New factor added as result of several comments (1.1, 1.5, 1.6).
Pg. 2.4-17, Table 2.4-3	Additional SCCs added	SCCs added to include all relevant SCCs.	Correction.
Pg. 2.4-18, Table 2.4-4	Additional SCCs added	SCCs added to include all relevant SCCs.	Correction.
Pg. 2.4-18, Table 2.4-4	Flare Factors: NOx Factor: ~~613~~ **610** NMOC factor**: 663** CO Factor: **920**~~630~~	Factors rounded to be consistent with rest of chapter; NMOC and CO factors updated as a result of comments.	Edited in response to comments 1.3 and 1.1.
Pg. 2.4-18, Table 2.4-4	IC Engine Factors: NOx: ~~4,000~~ **1,500; Highly Representative** CO: ~~7,000~~ **4,600, Highly Representative**	Updated NOx and CO IC engine factors based on additional data.	Edited in response to comments 1.1 and 5.1.
Pg. 2.4-18, Table 2.4-4	IC Engine Factors NMOC, as hexane (VOC) – 100% Load NMOC, as hexane (VOC) – 80% Load NMOC, as hexane (VOC) – 60% Load NMOC, as hexane (VOC) – 30% Load	Factors added for varying percent loads.	Factors added in response to comment 5.4.

Pg. 2.4-18, Table 2.4-4	Footnotes c and d	Switched footnotes c and d.	Footnotes switched as a result of redoing the order of the table and putting the flare factors below the boiler factors.
Pg. 2.4-18, Table 2.4-4	Footnote e: Factors were converted from lb/mmbtu. To convert back to lb/mmbtu, divide by 16.02 **and then divide by the heat content of methane in ft^3/Btu.**	Added bold text.	Added text to correct the footnote.
Pg. 2.4-18, Table 2.4-4	Footnote j: NMOC = VOC because review of data from references **11-21, 23-24, 26,27, 29, 30, 32,36,38,102-109** ~~74-104~~ affirm the effect of compounds with low or no photochemical reactivity is less than 50 ppm LFG.	Updated references in bold.	Added new references used in analysis and updated old reference numbering.
Pg. 2.4-18, Table 2.4-4	Footnote k: Reference 110 Footnote l: Reference 111 Footnote m: Reference 112	References added.	References for added emission factors.
Pg. 2.4-19, Table 2.4-4	Footnote n: Emission factor is moderately representative of the population. Emission factor quality ratings based on the Emissions Factors Procedures Document (January 2023).	Representativeness added.	Representativeness description for added NMOC IC Engine emission factors.
Pg. 2.4-19, Table 2.4-4	Footnote o: During its review, the EPA investigated whether the NMOC emission factors at varying loads could be combined but found that they should remain separate. All per-load heat input values were found to be from differing data sets via a two sample t-test at a 95% confidence coefficient	Footnote added for varying load emission factors.	Footnote for added NMOC IC Engine emission factors.
Pg. 2.4-20,	Additional SCCs added	SCCs added to include all relevant SCCs.	Correction.

Table 2.4-5			
Pg. 2.4-20, Table 2.4-5	Flare Factors: NMOC factor: ~~0.2~~ **4.1** CO Factor: ~~39~~ **58**	NMOC and CO factors updated as a result of comments.	Edited in response to comments 1.3 and 1.1.
Pg. 2.4-20, Table 2.4-5	IC Engine factors: NOx: ~~250~~ **96, Highly Representative** CO: ~~470~~ **290, Highly Representative**	Updated NOx and CO IC engine factors based on additional data.	Edited in response to comments 1.1 and 5.1.
Pg. 2.4-20, Table 2.4-5	IC Engine Factors NMOC, as hexane (VOC) – 100% Load NMOC, as hexane (VOC) – 80% Load NMOC, as hexane (VOC) – 60% Load NMOC, as hexane (VOC) – 30% Load	Factors added for varying percent loads.	Factors added in response to comment 5.4.
Pg. 2.4-20, Table 2.4-5	Footnotes c and d	Switched footnotes c and d.	Footnotes switched as a result of redoing the order of the table and putting the flare factors below the boiler factors.
Pg. 2.4-20, Table 2.4-5	Footnote j: NMOC = VOC because review of data from references 11-21, 23-24, 26,27, 29, 30, 32,36,38,102-109 ~~74-104~~ affirm the effect of compounds with low or no photochemical reactivity is less than 50 ppm LFG.	Updated references in bold	Added new references used in analysis and updated old reference numbering
Pg. 2.4-20, Table 2.4-5	Footnote k: Reference 110 Footnote l: Reference 111 Footnote m: Reference 112	References added	References for added emission factors
Pg. 2.4-21,	Footnote n: Emission factor is moderately representative of the population. Emission	Representativeness added	Representativeness description for added NMOC IC Engine emission factors

Table 2.4-5	factor quality ratings based on the Emissions Factors Procedures Document (January 2023).		
Pg. 2.4-21, Table 2.4-5	Footnote o: During its review, the EPA investigated whether the NMOC emission factors at varying loads could be combined but found that they should remain separate. All per-load heat input values were found to be from differing data sets via a two sample t-test at a 95% confidence coefficient	Footnote added for varying load emission factors	Footnote for added NMOC IC Engine emission factors
Pg. 2.4-22 to end	Updated references based on changes made in text	Reordered references and the addition of new references (Ref. 104-108)	Adding additional references used to update factors and reordered to include references and updates made to footnote j of Tables 2.4-4 and 2.4-5
Pg. 2.4-28	Updated link to references	Updated link to references	Updated link to final references