Stage 1 & 2 Verification Report

Report for:

AvalonBay Communities Inc.

LRQA reference:	RMA10231A
Verification dates:	April - June, 2017
Verification location:	Arlington, VA
Verification criteria:	WRI/WBCSD GHG Protocol (reporting), ISO 14064-3 & LRQA's Verification Approach (verification)
Verification team:	Derek Markolf – Lead Verifier
LRQA Client Facing Office:	Houston

Lloyd's Register LRQA

Contents

Attachments
N/A

This report was presented to and accepted by:

Name: Mark Delisi

Job Title: Sr. Director of Corporate Responsibility

1. Executive report

Verification outcome:

LRQA, Inc. (LRQA), a member of the Lloyd's Register group of entities, was contracted by AvalonBay Communities Inc. (AvalonBay) to verify its Scope 1 (direct emission), Scope 2 (energy indirect emissions), and Scope 3 (other indirect) greenhouse gas (GHG) emissions; energy consumption for Scope 1 and Scope 2; waste generation and water consumption for calendar year 2016 (CY2016). The Scope 3 emissions verified by LRQA were limited to emissions from business travel.

Water consumption and waste generation data verified by LRQA did not include data from AvalonBay construction operations. This is in alignment with the Global Real Estate Sustainability Benchmark (GRESB) Guidance document.

The verification was conducted to a limited level of assurance and at a materiality level based on the professional judgment of the verifier. The final quantities verified are as follows:

Item	Quantity	Units
Scope 1 Emissions	18,748	MT CO2e
Scope 2 Emissions Location-Based	63,407	MT CO2e
Scope 2 Emissions Market-Based	63,407	MT CO2e
Total Scope 1 Energy	102,927	MWh
Total Scope 2 Energy	191,533	MWh
Scope 3 Emissions (business travel)	309	MT CO2e
Water Consumption (Communities only)[1]	11,543,186	M^3
Subset of Waste Generated (Communities only)[2,3]	53,558	MT

1. Water consumption does not include water consumed by the AvalonBay construction division.
2. Waste generation does not include waste generated by the AvalonBay construction division.
3. Waste generation data is only representative of 80% of AvalonBay communities.

AvalonBay excluded refrigerant emissions from HVAC systems and combustion of diesel fuel in emergency generators.

Based on LRQA's approach, nothing has come to our attention that would cause us to believe that the total Scope 1, Scope 2, and Scope 3 GHG emissions, and Environmental Data disclosed by AvalonBay in the Reports for CY 2016, as summarized in Table 1 below, are not materially correct and that the GHG Emissions Inventory and Environmental Data Assertion have not been prepared in conformance with WRI/WBCSD GHG Protocol, the 2017 GRESB Real Estate Reference Guide, and AvalonBay environmental data management processes, except for the following qualifications:

- Some transposition errors were noted in the calculations of waste data for one of the construction waste properties. This misstatement is not material.

LRQA confirms that the contents of this report, together with any evidence or notes taken during this verification will be treated in the strictest confidence and will not be disclosed to any third party, without the prior consent of the client, except as required by the accreditation authorities.

Areas for senior management attention:

- Measurabl should consider applying more rigorous quality controls to ensure that adjustments to the calculations in the Measurabl system are implemented as intended, per spreadsheet calculations performed prior to implementation in Measurabl.
- Consider expansion of the AvalonBay GHG Emissions and Environmental Data Inventory Management Plan to include coverage of:
  - Organizational boundaries (i.e. operational control or financial control),
  - Operational boundaries (i.e. Scope1, Scope2 and Scope 3 emissions sources to be included & excluded), and
  - Base year selection and re-calculation policies.
- Ensure the AvalonBay travel vendor fully implements the correction to air travel calculations in their database prior to reporting of CY 2017 GHG emissions data.

2. Verification summary

Visit objective

This report records the outcome of the LRQA verification of Greenhouse Gas (GHG) emissions and environmental data parameters for AvalonBay conducted in February to June 2017.

Introduction

The verification activities were conducted by Derek Markolf, Lead Verifier for LRQA with assistance from other LRQA staff where appropriate. This report includes the outcome of LRQA verification activities for the following data:

- Scope 1 and 2 greenhouse gas (GHG) emissions
- Scope 3 GHG emissions from business travel
- Energy inventory – Scope 1 Total Energy (consumptions of natural gas, propane and fuel oil) and Scope 2 Total Energy (consumption of electricity and steam).
- Water consumption
- Waste generation

The reporting criteria used to evaluate the CY 2016 emissions report was the WBCSD/WRI Greenhouse Gas (GHG) Protocol and the 2017 GRESB Real Estate Reference Guide. LRQA used verification criteria from ISO 14064 Part 3:2006 for the GHG data and LRQA's verification approach for the environmental data to perform the verification.

The Stage 1 verification activities included:

- Initial review and discussions – to confirm scope, objectives, criteria, level of assurance, materiality and their appropriateness for the verification
- Review of the GHG Inventory and systems in place for its derivation
- Strategic Analysis and Risk Analysis
- Verification Planning for Stage 2

The Stage 2 verification activities included:

- Assessment of Criteria Conformance
- Implementation of the data review based on the LRQA sampling plan
- Verification of Data and Information for GHG emissions sources and environmental data sets
- Development of issues log and findings

This report includes a discussion of the items listed above, together with the Verification Schedule, the Verification Plan, and the findings and their resolution.

Grading of Findings

The following definitions apply to the grading of findings in this report:

Misstatement (MIS)	A misstatement (omissions, misrepresentations and errors) in an assertion, data or information that, in the professional judgment of the verifier, is unlikely to affect the decision of the intended user. If such a finding is outstanding at the end of the verification, a positive Assurance Statement will be possible, although qualifications, limitations, and/or recommendations may be included in the Assurance Statement.
Material Misstatement (MMIS)	A misstatement, (omissions, misrepresentations

	and errors) in an assertion, data, or information that, in the professional judgment of the verifier, could affect the decision of the intended user. If such a finding is left outstanding at the end of the verification then the misstatement **must** be corrected or a positive Assurance Statement will not be possible.
Non-conformity (NCN)	A nonconformity with the requirements of the assurance criteria (including the terms of engagement) that, in the professional judgment of the verifier, is unlikely to affect the decision of the intended user. If such a finding is outstanding at the end of the verification, a positive Assurance Statement will be possible, although qualifications, limitations, and/or recommendations may be included in the Assurance Statement.
Material Non-conformity (MNCN)	A nonconformity with the requirements of the assurance criteria (including the terms of engagement) that, in the professional judgment of the verifier, could affect the decision of the intended user. If such a finding is left outstanding at the end of the verification then the nonconformity **must** be corrected or a positive Assurance Statement with regard to the assurance criteria will not be possible.
Opportunity for Improvement (OFI)	An opportunity for improvement is a suggestion from the verifier to improve the operator's performance in monitoring and reporting.
LRQA	A 'follow up' item for the LRQA Verifier to track ongoing issues within the Findings Log where required.

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3. Findings Log

1. Grading of the finding *	2. New, Open, Closed	3. Description of the LRQA finding	4. Review by LRQA	5. Process, aspect, department or theme
6. Date of the finding	7. YYMM<Initials>seq.#	8. Clause of the applicable standard		

* MIS = Misstatement MMIS = Material Misstatement NCN = Nonconformity MNCN = Material Nonconformity OFI = Opportunity for Improvement xLRQA = LRQA Follow Up

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Closed	Of the 16 eGRID emissions factors (EFs) sampled in the Measurabl EF file entitled "CDP Emissions Factors (CC7.4)", LRQA noted that the following one EF did not match the currently published eGRID factor: NPCC NYC/Westchester. The line item variance was approximately 13%.	MSR: Our system had 'NPCC New England' and 'NPCC NYC/Westchester' emissions factors reversed. We have corrected these emissions factors in our system. Factors are now: NEWE 2.62E-04; NYCW 3.03E-04 **LRQA 6-12-17:** Confirmed closed	Scope 2 Emissions Factors	5/15/17	1705DM01	GHG Protocol, Ch. 6 Calculating Emissions
OFI	Open	The Scope 1 emissions factor (EF) used in Measurabl for determination of total CO_2e (CO_2 equivalent of CO_2 + CH_4 + N_2O) emissions from combustion of natural gas only includes emissions of CO_2.	MSR: Working with Derek on confirming 0.182 t CO2e/MWH for conversion factor **LRQA 6/12/17:** Check of updated Data Quality report results in the natural gas emissions factor now being approximately 0.2% higher than the emissions factor referenced above. This is very minor, so will be downgraded from an MIS to an OFI.	Scope 1 Natural Gas Emissions Factor	5/18/17	1705DM03	GHG Protocol, Ch. 6 Calculating Emissions

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Closed	When comparing the electricity activity data (KWh) for property VA032-Avalon Potomac Yards in the AvalonBay 2016 Electric Data file and the Measurabl system, LRQA noted a variance of approximately 10%.	I see that the electric file, Energy Star and Measurabl monthly data all match. I looked at the Measurabl monthly data by going to Trends > VA032 > List **LRQA 6/12/17:** This finding is still open, as LRQA has not received an explanation of why data in the AvalonBay file entitled "2016 Electric Data", which LRQA understands to be the source of the data in Energy Star and Measurabl, differs from the data in Measurabl. **LRQA 6/21/17:** This finding is still open, LRQA just downloaded and checked the latest Data Quality Report and cell H:29 of the Property Trends tab is still showing 1,289 MWh, while the AvalonBay 2016 Electric Data file is showing 1,433,747 KWh (1,434 MWh). **LRQA 6/22/17:** AvalonBay explained that the discrepancy was due to the proration of data by Measurabl based on the AvalonBay buy date of 2/17/16. This is now closed.	Electricity use and Scope 2 GHG Emissions	5/23/17	1705DM04	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MIS	Closed	For the following 2 properties, LRQA noted that there was zero water consumption reported even though AvalonBay records show the property was functional during CY 2016: MD007 Eaves Washingtonian Center 2, and MA006 Avalon Essex.	MD007 – Water usage is included as part of MD006 (eaves Washingtonian Center I). This is another meter configuration issue, but the water usage for both sites is accounted for. The reason that it is not allocated is because we don't perform the allocation for our financials. MA006 – Was able to retrieve the data from the old Cass system. It was not transferred to the new system because it is an inactive site. Water data only covered through 3/1/2016. **LRQA 6-12-17:** Confirmed closed	Water Consumption	5/23/17	1705DM05	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MIS	Closed	For the following 4 properties, LRQA noted that there was zero activity data reported for all environmental parameters, even though AvalonBay records show the property was functional during part of CY 2016: CT001 Eaves Trumbull, CAB04 eaves Rancho San Diego, NYC40 Avalon Kips Bay, FLC37 Archstone Boca Town Center.	CT001 – Data retrieved and entered CAB04 – Data retrieved and entered NYC40 – Data retrieved and entered FLC37 – No data available for 2016. Property was officially disposed on 1/14/2016, but no January utility bills are available **LRQA 6-12-17:** Confirmed closed	All Environmental Activity Data	5/24/17	1705DM06	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MIS	Closed	For the CT005 Avalon Wilton 1 property, the 2016 Gas Data file shows zero therms, but the Measurabl data shows fuel combustion activity data. Please explain.	The data in the gas file matches Energy Star and Conservice. Sent Brianna the gas data file. **LRQA 6-12-17:** This one has been graded as an MIS, as it is not corrected in Measurabl. **LRQA 6-21-17:** AvalonBay clarified that the gas use isl zero for NG, but the site includes Propane use, which is documented in a separate tab in the 2016 Gas Data file. LRQA confirmed this is the case, so this finding is now closed.	Fuel Combustion	5/25/17	1705DM07	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MIS	Closed	For the MA006 Avalon Essex property, the Scope 1 GHG emissions are approximately 7% lower than expected based on the therms data reported in the 2016 Gas Data file.	MSR: The property was sold on 2016-06-17, but data continued to come in after the sold date. Our system automatically limits the data reported in the surveys (CDP/GRESB) to the time when the property is under the control of the entity. **LRQA 6-12-17:** Determined to be in line with operational control boundaries, so confirmed closed.	Scope 1 Emissions	5/25/17	1705DM08	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MIS	Closed	For the MA040 AVA Back Bay property, the electricity activity data in the 2016 Electricity Data file and in Measurabl match, but the Scope 2 GHG emissions are approximately 50% higher than expected based on LRQA's application of the NPCC New England eGRID emissions factor.	MSR: This is related to 1705DM01 where the New England and NYC egrid factors were swapped. That issue has now been corrected. **LRQA 6-12-17:** Confirmed closed	Scope 2 Emissions	5/25/17	1705DM09	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
OFI	Open	The AvalonBay GHG Emissions and Environmental Data Inventory Management Plan does a good job of describing responsible parties and the process for gathering and reporting data and information. Another common function of IMPs is to document the Organizational Boundaries (i.e. Operation Control, or Financial Control), Operational Boundaries (i.e. Scope 1, Scope 2 and Scope 3 emissions source categories to be included and/or excluded), and Base Year selection and re-calculation policies. LRQA recommends the expansion of this document to include the definition of AvalonBay boundaries mentioned above (GHGs and Environmental Data), and merging the existing Base Year selection and re-calculation policy into this document.	Mark will update the AvalonBay GHG Emissions and Environmental Data Inventory Management Plan to include the recommended LRQA expansion items. **LRQA 6-12-17:** Understood that this will be updated at a later date.	Inventory Management Plan	5/26/17	1705DM10	GHG Protocol Chapters 3, 4 and 5.
NCN	Closed	In the CDP questionnaire, Question CC8.4 Excluded Scope Sources is incorrectly answered. This is where the following exclusions should be listed: • Fugitive release of refrigerant gas; and • Combustion emissions from burning diesel fuel in emergency generators.	Mark has updated the CDP questionnaire, Question CC8.4 to answer correctly and include: • Fugitive release of refrigerant gas; and • Combustion emissions from burning diesel fuel in emergency generators. **LRQA 6-12-17:** Confirmed closed	Exclusions	5/27/17	1705DM11	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MMIS	Closed	When reviewing the CDP report through Measurabl (downloaded 5/27/17) with the Data Quality Report 2015-16 (downloaded 5/25/17), LRQA noted that the Scope 2 Market-based GHG emissions differ from the Scope 2-location based GHG emissions. This raises two concerns: (1) LRQA has not seen any record in the Measurabl system of a methodology for reporting market-based emissions differently than location-based emissions; and (2) The reported market-based emissions are extremely low.	MSR: Measurabl does include additional calculations to support market-based emissions. 100% renewable meters are deducted from market-based emissions. Obviously, AvalonBay doesn't have much renewable, and so the emissions should be similar between location and market-based. We reviewed our code and found an error that has now been corrected. AvalonBay's market-based figures now match the location-based. **LRQA 6-12-17:** Confirmed closed	Scope 2 Emissions	5/27/17	1705DM12	GHG Protocol, Ch. 6 Calculating Emissions, and GHG Protocol Scope 2 Guidance

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MMIS	Closed	When reviewing the CDP report through Measurabl (downloaded 5/27/17) with the Data Quality Report 2015-16 (downloaded 5/25/17), LRQA noted none of the totals for the following data parameters matched: - Scope 1 GHG Emissions - Scope 2 GHG Emissions - Total Electricity Consumption (MWh) - Total Fuel Consumption (MWh) Variances are between 8% and 15%.	MSR: CDP and the Data Quality report are completely different in terms of methodology. The Data Quality report is a raw export of all the data in Measurabl--no logic applied. As such the bought/sold dates are not included and so if there's an instance like 1705DM08 where there is data outside of a sold/date area then the reports won't match. CDP also includes additional logic like estimations for sites without electric data and allocating tenant data to Scope 3, but I don't think much of that will apply to AvalonBay. Guessing that if you do a vlookup to take the bought/sold dates into account, that should be the majority of the discrepancy. **LRQA 6-12-17:** Upon further review, LRQA noted that the variance in MT CO2e matches the Scope 1 and Scope 2 emissions in the Data Quality Report line item entitled "Vacant Data(2016)". It's LRQA's understanding that vacant properties are considered to be under the operational control of AvalonBay, and therefore this data should be included in the CDP report. **LRQA 6-21-17:** LRQA confirmed that Measurabl updated the database parameters in order to include the vacant property GHG emissions and energy use in the data to be reported to CDP. This finding is now closed.	Totals in CDP Report	5/27/17	1705DM13	GHG Protocol, Ch. 6 Calculating Emissions
MIS	Closed	When reviewing the GRESB report through Measurabl (downloaded 5/27/17) with the Data Quality Report 2015-16 (downloaded 5/25/17), LRQA noted neither the Water or Waste totals matched. The variances were 2% for Whole Site Water and 36% for Non-hazardous waste.	MSR: The discrepancy is due to the construction waste and water. Construction waste and water is not included for GRESB. If you remove the construction site the totals in GRESB match the Data Quality report for waste and water. Water in GRESB is Whole Site 11,543,186 + Tenant Space 128,694 = 11,671,880. Total water in DQ report is 11,747,351.98 for difference of 75,471.98 m3. That 75,471 is the Construction site which is not included in GRESB operational reporting. **LRQA 6-12-17:** Confirmed closed.	Totals in GRESB Report	5/27/17	1705DM14	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
~~MMIS~~, Downgrade to OFI	Open	LRQA sampled the GHG emissions calculations for a number of the individual flights listed in the file entitled "GHG Air Emissions Report - Jan 2016-Dec 2016". LRQA used the following website to generate flight distances: http://www.travelmath.com/flying-distance. Most of the flights that meet the Long Haul criteria, per procedures included in the file entitled "CIS Carbon Estimation Methodology" were found to have line item variances of approximately 37%. The specific legs included in LRQA's sample with the 37% variance were: LAX-JFK LAX-DCA DCA-SEA LAX-DCA BWI-LAX DCA-SEA EWR-LAX DCA-LAX LRQA also noted that the comparison of calculations for the DCA-PHX leg resulted in a line item variance of 4.5%. The total variance noted in the sampled data was 19%.	Mark has emailed Peter at World Travel Service to resolve this issue. **LRQA 6-12-17:** Still waiting on resolution of this finding. **LRQA 6-16-17:** The AvalonBay travel vendor was unable to fully resolve the calculation errors within their system before closure of this year's verification. So, they performed the air travel calculations for AvalonBay in a spreadsheet outside of their database. LRQA verified that the travel data set was complete and that all calculations were preformed per the prescribed methodology. This finding is now downgraded to an OFI in order to ensure the vendor's database calculations have been corrected prior to next year's GHG reporting exercise.	Scope 3 Business Travel	6/2/17	1705DM17	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles
MIS	Open	LRQA noted a number of errors in the calculations for Sheepshead Bay waste totals. The main error was related to the conversion factor of 6.67 tons/yard. Based on the tonnage data provided for 20yds and 30yds, LRQA's calculations of tons per yard results in 0.15 tons/yard. The other errors in the Sheepshead Bay calculations were all related to transposition of data in the numerous steps of rolling up data for the calculations. The total variance related to transposition errors equated to 4% of the Sheepshead Bay records sampled by LRQA. As Sheepshead Bay was one of 5 construction waste properties sampled by LRQA, and the other 4 were found to have no errors, the overall materiality of the Sheepshead Bay errors is determined not to be material.	Mark will correct the conversion factor and recalculate Sheepshead Bay waste. **LRQA 6-12-17:** Confirmed the primary error due to the tons/yard conversion has been corrected. The remaining errors noted due to transposition are not material.	Construction Waste	5/30/17	1705DM18	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles

Grade 1	Status 2	Finding 3	Correction, root cause & corrective action review 4	Process / aspect 5	Date 6	Reference 7	Clause 8
MMIS	Closed	The percent coverage in Measurabl does not account for the 33 properties included in the "Missing in Measurabl 2016 Data" tab for the file entitled "Avalon Bay Location Analysis_Japan 622017". Taking these into account, LRQA's estimated coverage is 70%. LRQA's estimate of coverage is based on the 33 properties mentioned above + the 52 properties included in the "Missing in WM" tab of the same file divided by 280 active communities in 2016 (estimate provided by Parker).	**LRQA 6-12-17:** This finding remains open for a couple reasons: **1.** Please explain to me precisely how many more properties have had waste data added into Measurabl since the first report was run by Waste Management. Also, please send a written explanation of how the percent coverage for waste data is calculated, including the total number of 2016 AvalonBay properties included in the calculation. **2.** Q24 of the current GRESB report states that waste was monitored for 100% of the whole portfolio. **LRQA 6-21-17:** AvalonBay provided evidence that the properties included in the "Missing in Measurable" tab of the WM report are in fact all included in the Measurabl database. Accounting for this, LRQA's calculation of waste coverage in Measurabl now matches the waste coverage of 80% reported in the GRESB report.	Community Waste	6/2/17	1705DM20	GHG Protocol, Ch. 1 GHG Accounting & Reporting Principles

Verifier:	Derek Markolf

Verification of:	Terms of Engagement - Contract Conditions Confirmation	**Auditee(s):**	Mark Delisi, Parker Smith and Kevin Mulcahy

Audit trails and sources of evidence:

Contract Condition Confirmation

Evaluation and conclusions:

Scope: Data Verification of the following items:

- Scope 1 (direct) GHG emissions: natural gas, fuel oil, and propane (operational control)
- Scope 2 (indirect) GHG emissions: purchased electricity and steam (operational control)
- Scope 3 (Other indirect) GHG emissions: business travel
- Energy Consumption:
  - Scope 1: total MWh (operational control)
  - Scope 2: total MWh (operational control)
- Water consumption (financial control)
- Waste generation (financial control)

Objectives: Verification of AvalonBay's GHG emissions, energy consumption, water consumption and waste generation for CY2016. The verification is intended to provide AvalonBay with an independent opinion on the completeness and accuracy of the data provided.

Criteria:

- World Resource Institute / World Business Council for Sustainable Development (WRI/WBCSD) GHG Protocol;
- 2017 GRESB Real Estate Reference Guide;
- Verification protocol follows ISO 14064-3: Specification with guidance for validation and verification of greenhouse gas assertions and LRQA verification approach
- AvalonBay GHG Emissions and Environmental Data Inventory Management Plan v5, and supporting policies and procedures

Level of Assurance: Limited Assurance

Materiality: Qualitative materiality based on the professional judgment of the verifier

Changes to Terms of Engagement: None

In completing this report, the LRQA verifiers confirm their independence from the client and that there was no known conflict of interest during the engagement.

Verification of:	Strategic Analysis and Risk Analysis (SARA)	Auditee(s):	

Strategic Analysis:

Through the Strategic Analysis, the Verifier determined the significance of the items of information and data to be verified. This judgement of significance is based on the nature and scale of the information and data as they relate to the scheme requirements.

Information or Data Source	Significance	Basis of Significance
Natural gas	M	Accounts for ~22% of Scope 1&2 GHG emissions
Fuel oil	L	Accounts for <1% of Scope 1&2 GHG emissions
Propane	L	Accounts for <1% of Scope 1&2 GHG emissions
Electricity	H	Accounts for ~76% of Scope 1&2 GHG emissions
Steam	L	Accounts for 1% of Scope 1&2 GHG emissions
Scope 3 business travel - air	H	Accounts for 92% of Scope 3 GHG emissions
Scope 3 business travel - car	L	Accounts for 2% of Scope 3 GHG emissions
Scope 3 business travel - hotel	L	Accounts for 6% of Scope 3 GHG emissions

NOTE: Much of the environmental data to be verified are activity data for the GHG emissions quantification, so the above Strategic Analysis is also applicable to this data.

Each of the environmental data parameters included in the Environmental Data Assertion was assessed separately for materiality.

Information or Data Source	Significance	Basis of Significance
Total Scope 1 Energy	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Total Scope 2 Energy	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Water Consumption	H	Separate materiality for each environmental data parameter leads to each being highly significant.
Waste Generation	H	Separate materiality for each environmental data parameter leads to each being highly significant.

Risk Analysis:

Through the Risk Analysis, the Verifier determined the potential risk of an omission, misrepresentation or error in relation to information and data sources. This determination included, but was not necessarily limited to, a judgement based on:

- the inherent risk associated with the data / information management
- the level of control applied to the data / information management
- the control of monitoring and metering used to gather data
- the number of personnel involved in the data management, their competence, attitude, and commitment.

Information or Data Source	Significance	Data Gathering	Measuring Equipment	People	OVERALL RISK
Natural gas	M	L	L	L	M
Fuel oil	L	L	M	L	L
Propane	L	L	M	L	L
Electricity	H	L	L	L	M
Steam	L	M	L	L	L
Scope 3 business travel - air	H	M	L	L	M
Scope 3 business travel - car	L	M	L	L	L
Scope 3 business travel - hotel	L	M	L	L	L

NOTE: The energy data to be verified are activity data for the GHG emissions quantification, so the above Risk Analysis is also applicable to this data.

Information or Data Source	Significance	Data Gathering	Measuring Equipment	People	OVERALL RISK
Water Consumption	H	L	L	L	M
Waste Generation	H	M	M	L	M

Client note: Generally, the outputs of the Risk Analysis influence the Verification Plan to manage the risk of LRQA detecting omissions, misrepresentations and errors in the following way:
High Overall Risk – detailed verification and data sampling
Medium Overall Risk – verification and data sampling to a lesser extent than High Overall Risk
Low Overall Risk – limited verification, simple checks only.
The Verifier will manage the degree of sampling through their Data and Information Sampling Plan.

Verification Planning:

As a result of the completion of the Strategic Analysis and Risk Analysis, a Verification Plan was developed. The Verification Plan, included in Section 5, defines the key elements of the verification and when those elements will be covered. The Verification Plan is supported by a Data / Information Sampling Plan which defines all the specific items of data and information which the Verification Team has identified as relevant and the depth to which relevant data is to be verified.

The following changes to the original Verification Plan / Data and Information Sampling Plan took place:
The original schedule for the verification plan was delayed due to time necessary for AvalonBay to finalize the GHG and environmental data for verification.

Verification of:	Criteria Conformance	Auditee(s):	Mark Delisi Parker Smith Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)

Audit trails and sources of evidence:

Discussions with corporate representatives
Discussions with Measruabl representative overseeing AvalonBay data management within Measurable platform.
Overview of AvalonBay utility bill management through two third party services (Cass and Conservice)
Careful review of reporting boundaries with AvalonBay representatives
GHG Emissions and Environmental Data Inventory Management Plan v5

Evaluation and conclusions:

LRQA was pleased to note that AvalonBay actioned the LRQA opportunity for improvement from last year which suggested the development of an AvalonBay GHG and Environmental Data Management Plan.

No findings were raised related to conformance with criteria.

One opportunity for improvement was added related to suggested improvements to the GHG Emissions and Environmental Data Inventory Management Plan v5. Refer to item 1705DM10 in the findings log for more details.

Verification of:	Data & Information Verification	Auditee(s):	Mark Delisi Parker Smith Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)

Audit trails and sources of evidence:

Measurabl CDP and GRESB reports with final data to be verified
Measurable Data Quality Report 2015–16
Scope of activity data, references for EFs and GWPs and calculation methodologies within Measurabl software.
Utility bill (NG, electricity and water) data downloads from Cass and Conservice
2016 Waste Data.xls
2016 Electric Data.xls
2016 Gas Data.xls
Avalon Bay Location Analysis_Japan 5242017 (from Waste Management)
Email communications and waste hauler reports for construction waste

Evaluation and conclusions:

The revised Verification Plan and Data Sampling / Evidence Gathering Plan were followed to completion.

AvalonBay utilised a cloud based climate change and sustainability data management and reporting platform called Measurabl who caters primarily to the real estate sector. The two reports generated by Measurabl for AvalonBay are the CDP report and the GRESB report, both of which are intended to be uploaded directly to the CDP and GRESB in the form of completed questionnaires.

AvalonBay populates energy and water data for each of their 280 communities in the US EPA Energy Star platform. Measruabl is then populated by a direct automated transfer of data from Energy Star to Measurabl. For waste data, AvalonBay enters the data directly into Measurabl.

Scope 1, Scope 2 and Scope 3 GHG Emissions:
A high level review of Measurabl energy data and GHG emissions data reported to CDP and GRESB was performed to identify areas where the data differs. LRQA noted numerous differences and was then informed of the unique reporting criteria that GRESB has and how it differs from standard GHG emissions accounting principles.

The raw utility bill data for natural gas and electricity was checked against final data reported in Measruabl for a representative sample of facilities. During this check the emissions factors for natural gas combustion and electricity grid factors were checked for accuracy.

Three findings were raised related to natural gas combustion. Two were closed and one was downgraded to an OFI. See the findings log for details and resolution.

AvalonBay reported both location-based and market-based Scope 2 emissions. For market-based emissions, AvalonBay has opted to utilise the lowest tier on the GHG Protocol Scope 2 Guidance market-based hierarchy, which results in the same Scope 2 emissions data being reported for both location-based and market-based methods. See the sampling plan for details of the analysis performed on the Scope 2 data.

Four findings were raised related to Scope 2 emissions. All four were closed. See the findings log for details and resolution.

AvalonBay uses a third party travel service to book all travel and one of the services provided by the booking company is to track Scope 3 GHG emissions for AvalonBay and provide reports of the emissions upon request. AvalonBay received a report for CY2016 Scope 3 emissions from air travel, car travel and hotel room occupancy. LRQA sampled the data Scope 3 air travel data per the sampling plan. Errors were noted in the execution of the functions in the travel services database. In the end these errors were corrected and the finding was closed. See the findings log for details.

Verification of environmental data parameters included in Environmental Data Assertion:
The energy data reported by AvalonBay are closely related to GHG activity data. LRQA performed checks against the Measurabl GHG emissions reports to confirm all environmental data being verified was consistent with verified GHG emissions activity data.

For the other environmental data parameters related to water consumption and waste generation, LRQA gained an understanding of the processes and procedures in place through interviews with AvalonBay personnel whom oversee the respective data management systems. Key files from the system were sampled, and data was tracked from source to sink (Measurabl).

LRQA was only contracted to verify waste generation related to a subset of the AvalonBay communities (80%). LRQA verified the percentage of communities represented and will include clear documentation of the scope of the verification in the assurance statement. Also, the boundaries for AvalonBay waste and water data exclude waste and water data related to construction activities. This is in alignment with the GRESB reporting guidelines.

One finding was raised related to water and 2 related to waste data. The water finding and one of the

waste findings were fully closed, the other waste finding remained open. See the findings log for details and resolution.

Verification of:	Errors and Corrections	Auditee(s):	Mark Delisi Parker Smith Kevin Mulcahy Sondra Tosky (Measurabl) Brianna Jackson (Measurabl)

Audit trails and sources of evidence:

2017-CDP-Response-v1-6-21-17
2017-GRESB-Response-v1-6-21-17
AvalonBay Scope 3 Travel Emissions Data Summary (6-16-2017)
Data Quality Report 2015–16 - 6-21-17-DM
AvalonBay - CY16 Workbook

Evaluation and conclusions:

During the verification activities AvalonBay provided clarification regarding discrepancies noted by LRQA between various data sources. LRQA confirmed that appropriate amendments were made to the GHG emissions inventory and the environmental data assertion.

Verification of:	Materiality Conclusion	Auditee(s):	

Audit trails and sources of evidence:

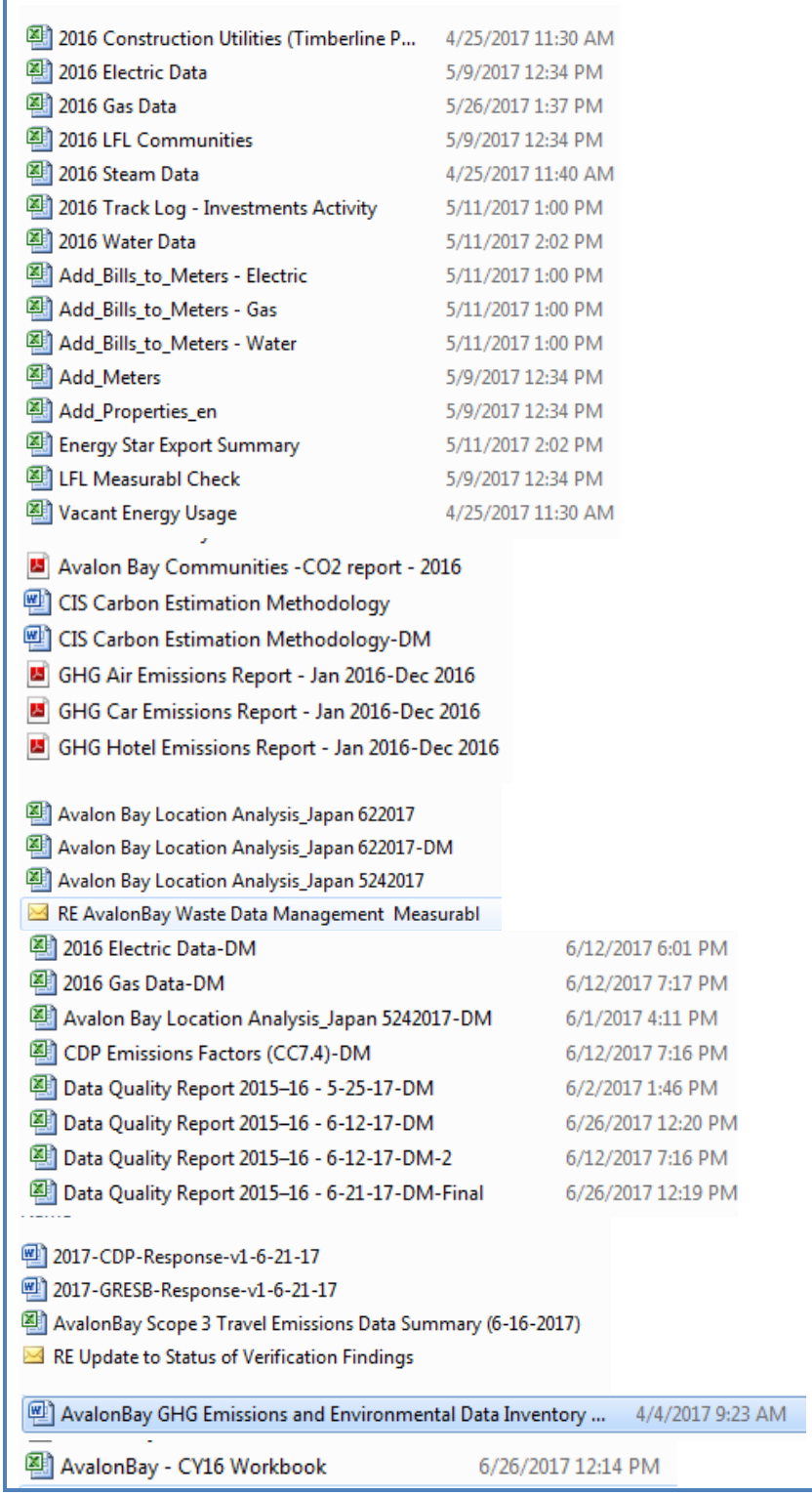
2017-CDP-Response-v1-6-21-17
2017-GRESB-Response-v1-6-21-17
AvalonBay Scope 3 Travel Emissions Data Summary (6-16-2017)
Data Quality Report 2015–16 - 6-21-17-DM
AvalonBay - CY16 Workbook

Evaluation and conclusions:

Based on LRQA's approach, nothing has come to our attention that would cause us to believe that the total Scope 1, Scope 2, and Scope 3 GHG emissions, and Environmental Data disclosed by AvalonBay in the Reports for CY 2016, as summarized in Table 1 below, are not materially correct and that the GHG Emissions Inventory and Environmental Data Assertion have not been prepared in conformance with WRI/WBCSD GHG Protocol, the 2017 GRESB Real Estate Reference Guide, and AvalonBay environmental data management processes, except for the following qualifications:

- Some transposition errors were noted in the calculations of waste data for one of the construction waste properties. This misstatement is not material.

Evidence list:



4. Verification plan

AvalonBay Communities, Inc. ISO 14064 Greenhouse Gas Emissions Inventory, CY 2016 Verification Plan 3/22/2017		
Verification Objectives:	To provide AvalonBay Communities, Inc. (Avalon Bay) with an independent opinion on the completeness of the data and information being submitted to CDP.	
Verification Criteria:		
	Protocols and Standards:	WRI/WBCSD GHG Protocol
		AvalonBay's Environmental Data Management Processes
		ISO 14064-3 (GHG Verification standard)
		LRQA Verification Approach - (Environmental data)
Verification Scope:		
	Description of Industry/Sources:	REIT which owns, operates, develops and re-develops multi-family communities.
	Geographic Boundaries:	North America
	Reporting Period:	CY 2016
	Greenhouse Gas Verified:	CO2, CH4, N2O, HFCs, PFCs, SF6, Energy use, Water use, Waste generated
	Scopes covered:	Scope 1, 2 and 3. Scope 3 includes business travel only.
	Reporting Basis:	**Operational Control:** GHG Emissions & Energy
		Financial Control: Water Consumption & Waste Generated
Level of Assurance:		Limited
Materiality Threshold:		
	Professional judgement of the verifier	
LRQA Verification Team:		
	Lead Verifier:	Derek Markolf
	Verifer:	Dresden Skees-Gregory
	Technical Reviewer (QA/QC):	Ivor John
Verification Activities and Schedules:		
	Scheduled for week of:	Task
	March 20, 2017	Kick-Off Meeting
	March 27, 2017	**Delivery of GHG Inventory & Environmental data plan**
	April 3, 2017	Strategic Review / Risk Assessment
	April 10, 2017	Initial Data Request
	April 17 - May 8, 2017	**Initial Data submitted to LRQA**
	May 15, 2017	LRQA data verification
	May 22, 2017	LRQA Final Review
	May 22, 2017	Delivery of Final List of Findings
	May 29 & Apr 5, 2017	**Client to address Findings**
	June 12, 2017	LRQA to conduct internal Technical Review and Assurance Statement Review
	June 12, 2017	Delivery of Final Verification Report and Verification Statement

Verification Plan approval:

Name:	Derek Markolf
Date:	March 22, 2017
Revision Date:	May 10, 2017
Revision Date:	

5. Data and Information Sampling Plan

Sampling Code #	Item to be Sampled	Data and Information Requirement (evidence gathering plan)	Lead Verifier Reasoning
01	Scope 2 GHG Emissions & Electricity Use	Check total CY 2016 elect. utility bill data against Measurabl GHG emissions for 30 communities. Divide Measurabl Scope 2 GHG emissions by utility bill electricity use and confirm results in correct eGRID EF.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting total GHG emissions (final tier of data aggregation). Will also confirm correct EFs used.
02	Scope 1 GHG Emissions from NG combution.	Check total CY 2016 NG utility bill data against Measurabl GHG emissions for 30 communities. Divide Measurabl Scope 1 GHG emissions by NG consumption and confirm results in correct EF for NG combustion.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting total GHG emissions (final tier of data aggregation). Will also confirm correct EFs used.
03	Scope 3 GHG emissions from business travel (Air, car and hotel)	Obtain copy of calculation methodology for travel emissions and check the line item air travel records against the calculation method to confirm accurate execution of calculations.	Air travel accounts for 92% of the Scope 3 emissions.
04	Water Data	Check total CY 2016 water utility bill data against Measurabl water consumption for 30 communities.	This will check revenue metered data from utility bills (first tier of data aggregation) against final data in Measurabl used for reporting.

05	Total GHG Emissions calculated in Measurabl	Confirm all GHG emisisons source categories are included in Measurabl calculated GHG emissions. Also, check reasoning for all properties with >100% year on year change between Cy2015 and CY2016.	High level check of aggregate Scope 1 and Scope 2 activity data against aggregate GHG emissions calculated in Measurabl. YOY change may indicate missing properties.
06	Waste	(1) Confirm Waste Management uploads to Measurabl are complete and accurate through interviews with Waste Management and Measurabl teams and sampling of Waste Management files. (2) Confirm construction waste summary calculations are performed accurately in the construction waste spreadsheet. (3) Confirm percent coverage of the waste data in Measurabl is accurately calculated.	Waste measured and billed by haulers is relatively straightforward, as the date is straight from the Waste Management billing system.
07	Boundaries	Confirm operational control (GHG emissions) and financial control (water & waste) are accurately applied throughout all communities.	There was some confusion during the CY2015 site visit about application of boundaries. For the most part the boundaries have been straightened out, but still need close attention.