



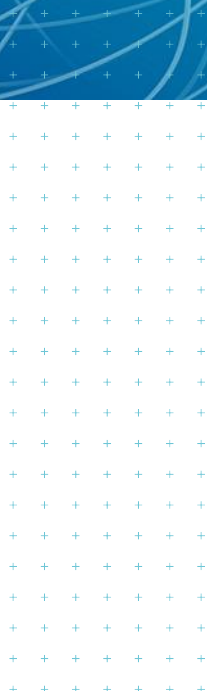
**Green House Gas  
Community Inventory for  
the Queenstown Lakes  
District**

**Prepared for**  
Queenstown Lakes District Council

**Prepared by**  
Tonkin & Taylor Ltd

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### Appendix A: Assumptions, Limitations and data sources



## Abbreviations

AFOLU	Agriculture, Forestry and Other Land Use
BOD	Biochemical Oxygen Demand
CO <sub>2</sub>	Carbon Dioxide
CH <sub>4</sub>	Methane
GHG	Greenhouse Gas
GPC	Global Protocol
HFCs	Hydrofluorocarbons
IPPU	Industrial Processes and Product Use
kgCO <sub>2</sub> e	Kilogrammes of carbon dioxide equivalent
kWh	Kilowatt hour
LPG	Liquid Petroleum Gas
MAI	Mean Annual Increment
MfE	Ministry for the Environment
MPI	Ministry of Primary Industries
NF <sub>3</sub>	Nitrogen trifluoride
NO <sub>2</sub>	Nitrogen dioxide
N <sub>2</sub> O	Nitrous oxide
PFCs	Perfluorocarbons
QAC	Queenstown Airport Cooperation
QLDC	Queenstown Lakes District Council
SF <sub>6</sub>	Sulphur hexafluoride
tCO <sub>2</sub> e	Tonnes of carbon dioxide equivalent
T&D	Transmission and Distribution
VKT	Vehicle Kilometres Travelled
WERF	Water Environment Research Foundation
WRI	World Resource Institute

## 1 Introduction

The Queenstown Lakes District Council (QLDC) commissioned Tonkin & Taylor Ltd (T+T) to assist in the development of a *high-level* Greenhouse Gas (GHG) Emission Inventory for the QLDC area. Access to good quality emissions data is key to a city's ability to take action on mitigating climate change, and monitoring progress for national and global GHG Emission targets.

The QLDC GHG inventory follows the guidance outlined in the *Global Protocol (GPC) for Community-Scale Greenhouse Gas Emissions Inventories*<sup>1</sup> and includes the following sectors: Stationary Energy, Transport, Waste, and Agriculture and Forestry (Table 1.1). Not all the GPC sectors and sub-categories were included within the QLDC inventory and Appendix A includes explanations as to why each sector and sub-category was or was not included.

This report summarises the total QLDC GHG emissions by sector for the calendar year 2017, based on the data collected and calculations prepared. It is noted that this is a high-level assessment, limited by the availability and quality of data for the district.

**Table 1.1: Included Sectors and Sub-sectors of city GHG emissions, adapted from (WRI, 2015) (see appendix A for full list of sectors)**

Sectors and Sub-sectors	
STATIONARY ENERGY	TRANSPORTATION
Electricity Consumption	On-road
LPG Use	Aviation
WASTE	AGRICULTURE, FORESTRY, AND LAND USE (AFOLU)
Solid waste disposal	Livestock
Septic Tanks	Forestry
Wastewater treatment and discharge	

### 1.1 Methodology

Under the GPC, a city must define their inventory/reporting boundary, which in the case of QLDC, is their administrative boundary. The GPC is designed to account for GHG emissions over a single year and includes the seven gases covered by the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>) (WRI, 2015). However, due to the nature of emissions and the activities that occur within the QLDC boundary, this report focuses on CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O only. The GPC requires a city to create a GHG inventory using one of two complementary approaches; the **scopes** approach or the **city-induced frameworks** approach (WRI, 2015).

The **city-induced framework** was selected at a **BASIC+** level (as per WRI, 2015), as the appropriate reporting method for QLDC. This was because data was available across three related scopes of sub-categories within the QLDC area. This approach allows for an activity within the QLDC area that creates GHG emissions, however does not necessarily release the gas within the reporting boundary

<sup>1</sup> (2015) Developed by the World Resources Institute, C40 Cities Climate Leadership Group and ICLEI – Local Governments for Sustainability (ICLEI).

(such as air travel where some emissions will be released within the boundary and the rest along the route of the journey). These emissions are included within the city-induced framework and this means the inventory covers GHG emissions at a *BASIC+* level. Figure 1.1 (WRI, 2015) below provides a representation of the types of emissions that can occur within and outside of the reporting boundary and their equivalent scope.

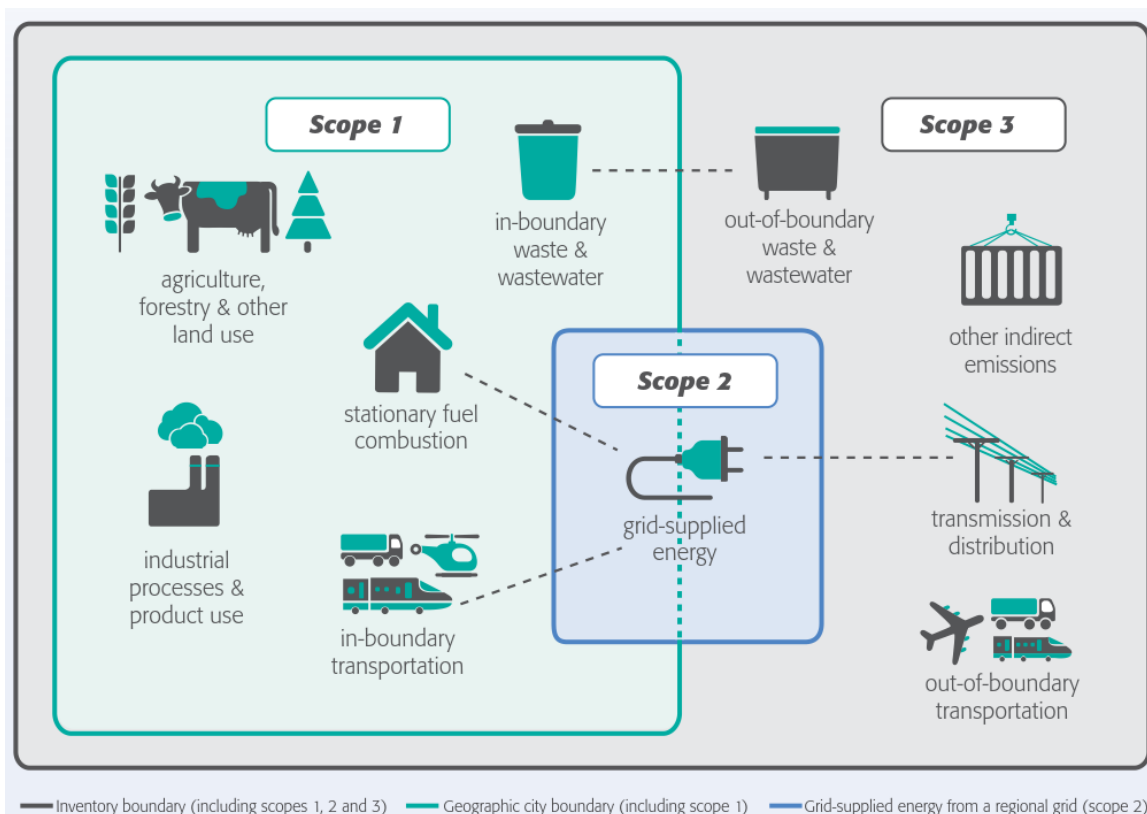


Figure 1.1: Sources and boundaries of city GHG emissions (WRI, 2015)

- *Scope 1* includes emissions that physically occur within the reporting boundary.
- *Scope 2* includes those that occur from the use of electricity, steam, and/or heating/cooling supplied by grids, which may or may not cross-reporting boundaries.
- *Scope 3* includes emissions that occur outside the city but are driven by activities taking place within the reporting boundary.

The emissions for each sector and sub sector have been calculated using a range of data sources and emissions factors which are detailed within the sections below.

## 2 Total emissions

### 2.1 Gross emissions

For the 2017 calendar year, the QLDC area produced gross emissions of approximately **685,020 tCO<sub>2</sub>e** through the stationary energy, transport, waste and livestock sectors<sup>2</sup>. Figures 2.1 and 2.2 below provide an overview of the distribution of the GHG emissions from each sector, as well as a breakdown of the emissions by subsector. In 2017 the QLDC area residential population (not including tourists) was 37,100 (Stats NZ, 2017), resulting in a per capita emissions of approximately 18 tCO<sub>2</sub>e/person. Transport represented the largest contribution of GHG emissions in 2017 at 341,980 tCO<sub>2</sub>e (50%) followed by livestock at 235,880 tCO<sub>2</sub>e (35%), then waste at 63,310 tCO<sub>2</sub>e (9%), and stationary energy at 43,850 tCO<sub>2</sub>e making up the remaining 6%.

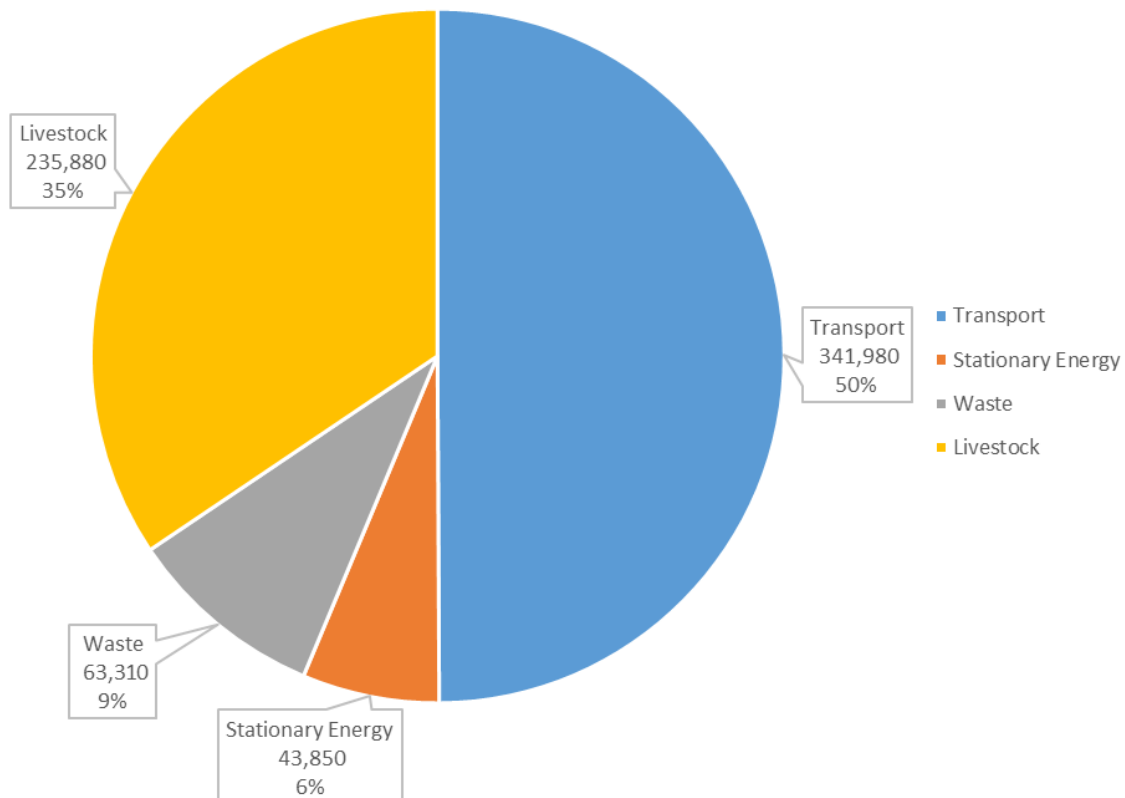


Figure 2.1: Gross GHG emissions for the QLDC area by sector (tCO<sub>2</sub>e)

<sup>2</sup> Gross emissions exclude forestry related offsets, whilst net emissions also consider the effects of forestry.



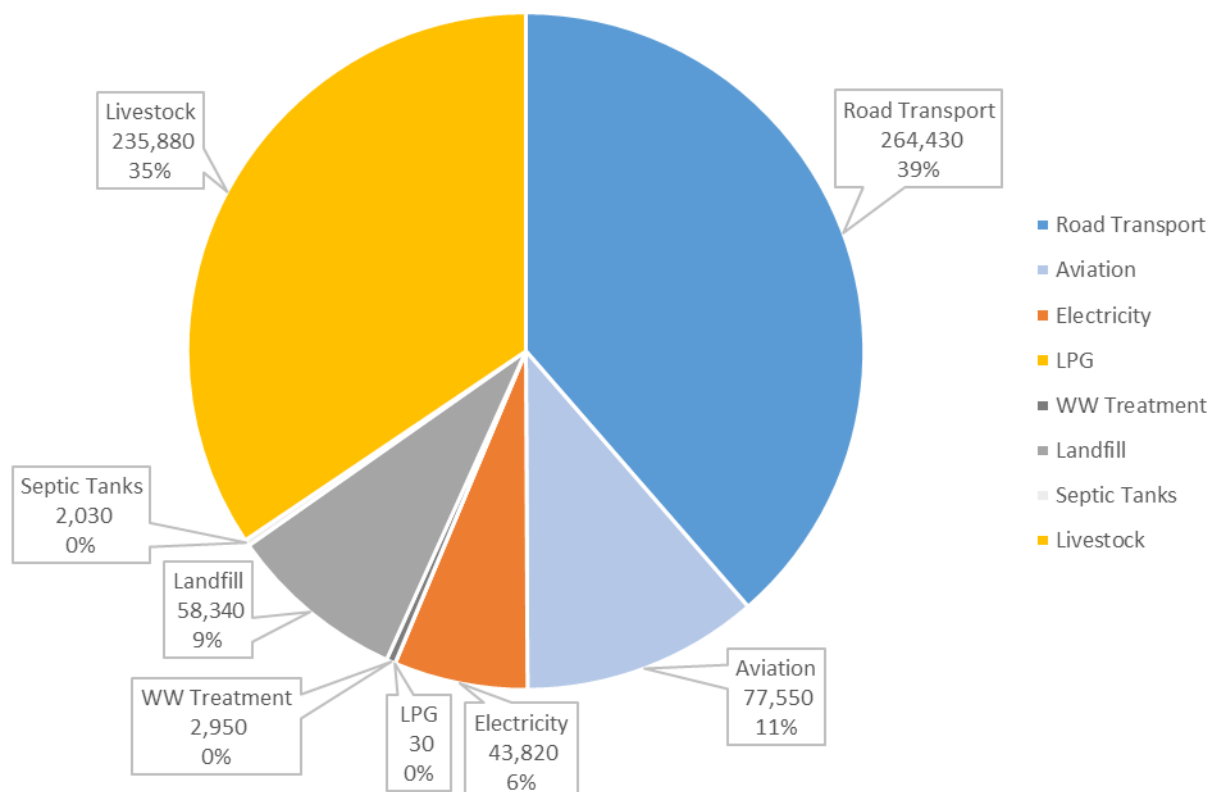


Figure 2.2: Gross GHG emissions for the QLDC area by sub-sector (tCO<sub>2</sub>e)

## 2.2 Net emissions (including forestry offsets)

Forestry offsets were estimated as **-22,140 tCO<sub>2</sub>e** (based on exotic forestry offsets only), resulting in a NET estimate of carbon emissions of **662,890 tCO<sub>2</sub>e**.

Through personal communication with Peter Beets (Scion), it was assumed there is very little replanting of native trees within the QLDC area, and therefore the current mature/established natives contribute a negligible amount of carbon uptake due to their age.

It is noted that the level of understanding and accuracy around carbon sequestration from native and exotic forestry is subject to ongoing research. As such, this number may vary significantly as understanding develops and improves. It is noted that QLDC have significant areas of native forestry - estimated as around 135,000ha (from LINZ).

The sections below summarise each individual sector and sub-sector in more detail.

### 3 Stationary emissions

Stationary emissions for the QLDC area include GHG emissions produced through electricity consumption and LPG use. Stationary emissions contributed approximately **43,850 tCO<sub>2</sub>e** equating to 6% of the total emissions for the area.

#### 3.1 Electricity consumption

Electricity consumption within QLDC area produced **43,820 tCO<sub>2</sub>e** throughout 2017. The emissions factor used to calculate the total GHG emissions was 0.119 kgCO<sub>2</sub>e/kWh (kilowatt-hour). This emissions factor was taken from the Ministry for the Environment (MfE) *Summary of Emissions Factors for the Guidance for Voluntary Corporate Greenhouse Gas Reporting* (2016).

Emissions from electricity consumption were calculated using the total electricity consumed at grid exit points within the QLDC area (provided by local electricity lines companies via Steven Batstone QLDC). The exit points included Frankton, Wanaka, Cardrona and Camp Hill (Table 3.1).

**Table 3.1: Total consumption of electricity and carbon emissions across exit points**

Exit Point	KWh	Emissions (tCO <sub>2</sub> e)
FRANKTON	264,214,000	31,440
WANAKA	77,038,273	9,170
CARDRONA	6,791,431	810
CAMP HILL	20,229,689	2,410
<b>TOTAL</b>	<b>368,273,392</b>	<b>43,820</b>

#### 3.2 LPG

LPG use contributes on average **27 tCO<sub>2</sub>e** per year (rounded to 30 t). This is based on an annual average of 9 tonnes of LPG usage in the QLDC area<sup>3</sup>. The emissions factor used to calculate this was 3.02 tCO<sub>2</sub>e/t of LPG from the MfE *Summary of Emissions Factors for the Guidance for Voluntary Corporate Greenhouse Gas Reporting* (2016). LPG is distributed throughout the QLDC by four main providers Contact (Rockgas), Genesis (Nova), Ongas and Elgas. The annual LPG use is made up of bottled gas, bulk storage in industry, vehicles, BBQs, and reticulated supplies (Wanaka, Arrowtown, Queenstown, Arthurs Point). It is noted that the suppliers were approached to provide detailed quantities of LPG sold, however were not able to provide this. As such, the above estimate was used.

<sup>3</sup> Personal communication with Malcolm James, Contact Energy Ltd.

## 4 Transport

The total transport related emissions produced in the QLDC area has been estimated as **341,980 tCO<sub>2</sub>e** and represents approximately 50% of the total gross emissions. The transport emissions include those produced by both road and aviation transport.

### 4.1 Road transportation

Road transportation contributed approximately **264,430 tCO<sub>2</sub>e** in 2017 and was calculated based on the volume of fuel sold within the QLDC area. The volume sold was estimated from the Otago Regional Council Fuel Tax Summary<sup>4</sup> from 2017 for both diesel and petrol. This data was an aggregate total for QLDC, Central Otago District Council (CODC) and Clutha District Council. Resident and visitor population estimates were used as a basis for developing proportions for each Council. An emissions factor of 2.43 kgCO<sub>2</sub>e/L was used to calculate the emissions from the volume of petrol sold, and 2.72 kgCO<sub>2</sub>e/L for diesel. Both emissions factors were sourced from the MfE *Summary of Emissions Factors for the Guidance for Voluntary Corporate Greenhouse Gas Reporting* (2016).

**Table 4.1: Road transport summary (based on proportion of fuel sales)**

ITEM	VALUE	UNITS	SOURCE
TOTAL POPULATION FOR CODC, CLUTHA, QLDC	63,009		Stats NZ population for CODC, Clutha, QLDC.
ESTIMATED VISITOR POPULATION FOR CODC, CLUTHA, QLDC	30,225		AA Travel monitor and international visitor survey for CODC, Clutha, QLDC. Sourced from Fresh Info Ltd.
QUEENSTOWN POPULATION	28,224		Stats NZ.
ESTIMATED QLDC VISITOR POPULATION	25,663		AA Travel monitor and international visitor survey. Sourced from Fresh Info Ltd. Total visitor nights was estimated as 9.4M – converted to an equivalent population of 25,663.
QUEENSTOWN PROPORTION OF TOTAL	58%		Proportion of total regional population used to pro-rata fuel sales.
TOTAL PETROL SALES	69,134,747	L	Fuel tax summary for CODC, Clutha, QLDC.
TOTAL DIESEL SALES	106,438,361	L	Fuel tax summary for CODC, Clutha, QLDC.
QUEENSTOWN PETROL SALES	39,958,371	L	Based on QLDC proportion.
QUEENSTOWN DIESEL SALES	61,519,044	L	Based on QLDC proportion.
QLDC EMISSIONS	264,430	t co2e	Using emissions factors of 2.43 kg CO <sub>2</sub> /L for petrol, and 2.72 kg CO <sub>2</sub> / L for diesel.

<sup>4</sup> Obtained from Central Otago District Council

## 4.2 Aviation – Local and transboundary

Aviation was estimated to contribute approximately **77,550 tCO<sub>2</sub>e** to the total 2017 emissions. This included emissions both from the aircrafts in the air and standing emissions from the aircrafts on the ground, as well as airport vehicles. The in-air emissions were estimated as approximately 75,950 tCO<sub>2</sub>e. This was calculated by determining the proportion of the emissions produced by the Queenstown Airport in relation to the total national emissions and airport passenger numbers<sup>5</sup> from the Ministry of Transport's *NZ Aviation Emissions Reduction Plan* (2016). The national total includes domestic emissions plus emissions from international outbound flights sold in NZ.

The standing emissions from grounded aircrafts was provided by the Queenstown Airport Corporation (QAC) and were calculated to be 1,419 tCO<sub>2</sub>e. The QAC also provided the emissions for the airport vehicles in 2017, which were calculated to be 183 tCO<sub>2</sub>e.

## 5 Waste

In 2017, the total solid waste produced in the QLDC area was estimated as **63,050 tCO<sub>2</sub>e**, representing 9% of the total emissions. The sub-sectors that produce significant emissions within the reporting boundary include solid waste (landfills), wastewater and septic tanks.

### 5.1 Solid waste

Municipal solid waste generated within QLDC in 2017 was disposed of at the Victoria Flats Landfill (VFL). The VFL produced **58,340 tCO<sub>2</sub>e** throughout 2017 which is based on the volume of waste generated, multiplied by an emissions factor.

Information on the VLF emissions factor was sourced from *Analysis of Solid Waste in Queenstown Lakes District* (Waste Not Consulting, 2012). The VFL receives waste from the Cromwell, Frankton, Wanaka and Alexandra transfer stations, as well as Council domestic collection, general waste and special waste from Queenstown.

Using the data for the overall waste stream being disposed of at VFL, the emissions factor was calculated as 1.19 tCO<sub>2</sub>e/t (Waste Not Consulting, 2012). The methodology for calculating emissions in S23B of the *Climate Change Unique Emissions Factor Amendment Regulations 2010*<sup>6</sup> was applied to calculate the emissions factor, using data on the overall waste stream. The factor calculation included waste from eight categories and is summarised below in Table 5.1. The total amount of waste generated at the VFL was 49,022 tonnes in 2017.

**Table 5.1: Emissions factor for VFL – 25 February to 5 March 2012 (Waste Not Consulting, 2012)**

TOTAL WASTE VOLUME (t)	EMISSIONS FACTOR (tCO <sub>2</sub> e/t)	TOTAL EMISSIONS (tCO <sub>2</sub> e )	EMISSIONS FACTOR SOURCE
49,022	1.19	<b>58,340</b>	Waste Not Consulting

<sup>5</sup> Sourced from <https://www.queenstownairport.com/assets/documents/ZQN-monthly-passengers-2016-to-2018-June.pdf>. Queenstown airport has approximately 5% of total NZ passenger numbers for 2017.

<sup>6</sup> <http://www.legislation.govt.nz/regulation/public/2010/0337/latest/DLM3252801.html> .

## 5.2 Wastewater treatment

The total emissions produced from wastewater treatment across the QLDC area is estimated to be **2,950 tCO<sub>2</sub>e** per year (Bloomberg, Lovett, & Rissmann, 2018). The QLDC operates two medium-scale wastewater treatment plants, Project Shotover in Queenstown (contributing 2,682 tCO<sub>2</sub>e per year) and Project Pure in Wanaka (contributing 268 tCO<sub>2</sub>e per year) (Bloomberg, Lovett, & Rissmann, 2018). Wastewater in Project Shotover is continually processed through Modified Luznick-Ettinger tanks and transferred to aerations ponds, whereas Project Pure is processed through a Sequencing Batch Reactor, where tanks are filled, and a cycle of treatment is completed before wastewater is removed. The primary contribution of emissions is from the aeration ponds (averaged at 2,120 tCO<sub>2</sub>e per year), compared to the treatment plants that contribute an averaged 830 tCO<sub>2</sub>e per year (Bloomberg, Lovett, & Rissmann, 2018). It is noted that the emissions from the aeration ponds are primarily methane emissions (which have been converted to CO<sub>2</sub> equivalent numbers).

**Table 5.2: Summary of GHG emissions, mean tCO<sub>2</sub>e per year, (adapted from Bloomberg, Lovett, & Rissmann, 2018)**

Project	Unit	Plant	Ponds	Total (tCO <sub>2</sub> e)
PROJECT SHOTOVER (QUEENSTOWN)	Total tCO <sub>2</sub> e per year	562	2,120	2,682
PROJECT PURE (WANAKA)	Total tCO <sub>2</sub> e per year	268	NA	268
TOTAL		830	2,120	<b>2,950</b>

## 5.3 Septic tanks

The total emissions produced by septic tanks in the QLDC area was calculated to be **2,030 tCO<sub>2</sub>e** in 2017. There are approximately 3,526 septic tanks within the QLDC area<sup>7</sup> with an average of 2.5 persons per household (Stats NZ, 2013). The emissions factor used was at 0.23 tCO<sub>2</sub>e per capita year (representing the entire septic system), and was sourced from the Water Environment Research Foundation (WERF) in *The Evaluation of Greenhouse Gas Emissions from Septic Tank Systems* (2010).

<sup>7</sup> Email correspondence with Mark Baker of QLDC

## 6 Agriculture, forestry and other land use

The following sections outline emissions produced/removed by livestock and forestry within the QLDC area. Livestock and forestry are the only sub-sectors within the reporting boundary under agriculture, forestry and other land use (AFOLU) that produce significant GHG Emissions and carbon uptake.

### 6.1 Livestock

Livestock including sheep, dairy, beef and deer contributed approximately **235,880 tCO<sub>2</sub>e** in 2017 (Table 6.1 below). Livestock emissions were calculated by obtaining livestock numbers from the Beef and Lamb New Zealand Economic Service and determining the proportion of the *national* emissions that the number of animals contribute to. National emissions values were obtained from the MfE *National GHG Emissions Inventory* (MfE, 2017).

**Table 6.1: Livestock Calculations Using Proportion of National Data**

Animal	National stock totals	Enteric Emissions (1990-2015 Inventory) kt CO <sub>2</sub>	QLDC stock	Pro-rated QLDC Enteric Emissions (t CO <sub>2</sub> e)
DAIRY	6,474,000	13,665	2,680	5,660
BEEF	3,600,000	5,199	22,589	32,620
SHEEP	27,300,000	8,695	351,818	112,050
DEER	850,000	489	37,376	21,510
TOTAL		28,048		171,840
	<b>Total emissions allowing for non-enteric fermentation sources*</b>			<b>235,880</b>

\*Factored by 1.4 to allow for non-enteric fermentation sources. This was based on information within the National GHG inventory (MfE, 2017)

### 6.2 Forestry

The total carbon removals from *exotic* forest sequestration was **-22,140 tCO<sub>2</sub>e**. The amount is documented as a negative as it refers to the amount of CO<sub>2</sub>e taken out of the atmosphere by the trees. The area and average age of exotic trees in the QLDC area was sourced from the *National Exotic Forest Description* (MPI, 2016). The mean annual increment (MAI) (CO<sub>2</sub> sequestration rate divided by age) was sourced from Tane's Tree Trusts' *Carbon Sequestration by Planted Native Trees and Shrubs* (2014) and averaged to be 30 tCO<sub>2</sub>e/ha/year. Through personal communication with Peter Beets (an author of the Tanes Tree Trusts' report), it has been assumed that there is very little replanting on native trees within the QLDC and therefore the current established natives contribute a negligible amount of carbon uptake due to their age.

It is noted that the level of understanding and accuracy around carbon sequestration from native and exotic forestry is subject to ongoing research. As such, this number may vary significantly as understanding develops and improves. It is noted that QLDC have significant areas of native forestry - estimated as around 135,000ha (from LINZ).

## 7 Comparison of per capita emissions

In this section the gross emissions from QLDC are compared with other NZ cities on a per capita basis. It is noted that comparisons are inherently difficult due to the assumptions, methodologies and data sources used within the various assessments.

Figure 7.1 shows that if the resident population (37,100 – Stats NZ) is used, QLDC’s total emissions are significantly higher than most other NZ cities - at approximately **18.5 tCO<sub>2</sub>e/capita/year**.

Given the high number of visitors to the District, a combined resident + visitor population estimate (62,763<sup>8</sup>) was also used to generate per capita figures. This resulted in per capita emissions of **10.8 tCO<sub>2</sub>e/capita/year** for the total gross emissions.

In terms of road transport emissions, QLDC per capita emissions are relatively high when compared to other NZ cities – at around **7 tCO<sub>2</sub>e/capita/year** based on resident only population and **4.2 tCO<sub>2</sub>e/capita/year** based on a combined resident + visitor population equivalent.

It is noted that aviation emissions make up around one quarter of the total transport sector per capita emissions which, again, is relatively high compared to other NZ cities.

Agricultural per capita emissions are in a similar order to that of Dunedin, and waste emissions per capita are at the upper end, when compared to other NZ cities. Stationary energy emissions per capita are low in comparison.

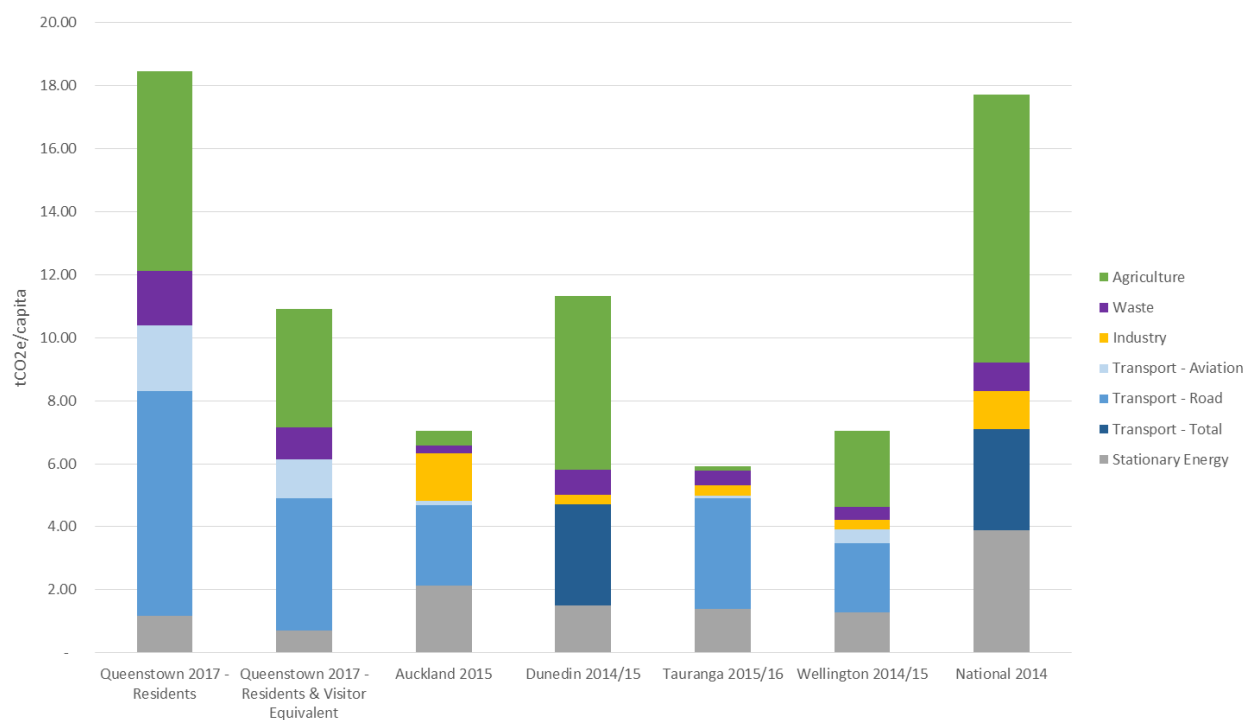


Figure 7.1: National comparison of gross emissions (tCO<sub>2</sub>e/capita/year)<sup>9</sup>

<sup>8</sup> Based on resident population of 37,100 plus estimated domestic and international visitor population equivalent of 25,663 (Sourced from Fresh Info Ltd via AA Travel Monitor and International Visitor Survey). Note, QLDC visitor nights for 2017 were estimated as approximately 9.4M (Fresh Info Ltd).

<sup>9</sup> Auckland data obtained from Auckland’s 2015 GHG Inventory, Wellington data obtained from The Wellington Community GHG Emission Inventory (AECOM,2016). Tauranga, Dunedin and National data obtained from the Tauranga City Council Community Carbon Footprint (AECOM, 2017)

## 8 Summary and next steps

This report presents an estimate of carbon emissions for QLDC. The analysis has shown that the total 2017 gross emissions are **685,020 tCO<sub>2</sub>e** - which is derived from the stationary energy, transport, waste and livestock sectors.

Forestry offsets were estimated as **-22,140 tCO<sub>2</sub>e** (based on exotic forestry offsets only) - resulting in a NET estimate of carbon emissions of **662,890 tCO<sub>2</sub>e**.

Comparatively, QLDC's per capita emissions are relatively high when compared to other NZ cities.

The various sectors presented have different levels of confidence associated with the data sources. Improvements in this data will, over time, allow further refinement and accuracy of the inventory. The transport (aviation in particular), agriculture, and forestry sectors would all benefit from improved data accuracy. National guidance and support in this regard would be beneficial, and may eventuate as a result of the establishment of the Climate Commission. The Commission will also likely provide direction around where responsibilities for emissions reductions best reside, and what local Councils should consider when developing their own plans.

This emissions inventory establishes a baseline, allowing QLDC to understand the relative contributions to their emissions profile and to then develop plans and strategies to manage/reduce these emissions over time.

Many cities internationally, and some in NZ, have developed comprehensive strategies, plans and toolkits to reduce emissions. Examples include [Melbourne](#), [Aspen](#), [Freiburg](#), [Auckland](#) etc. Refer Figure 8.1.

At some stage in the future, QLDC may wish to review what other cities are doing, and what may be possible in their communities, to enable and encourage a low carbon future.

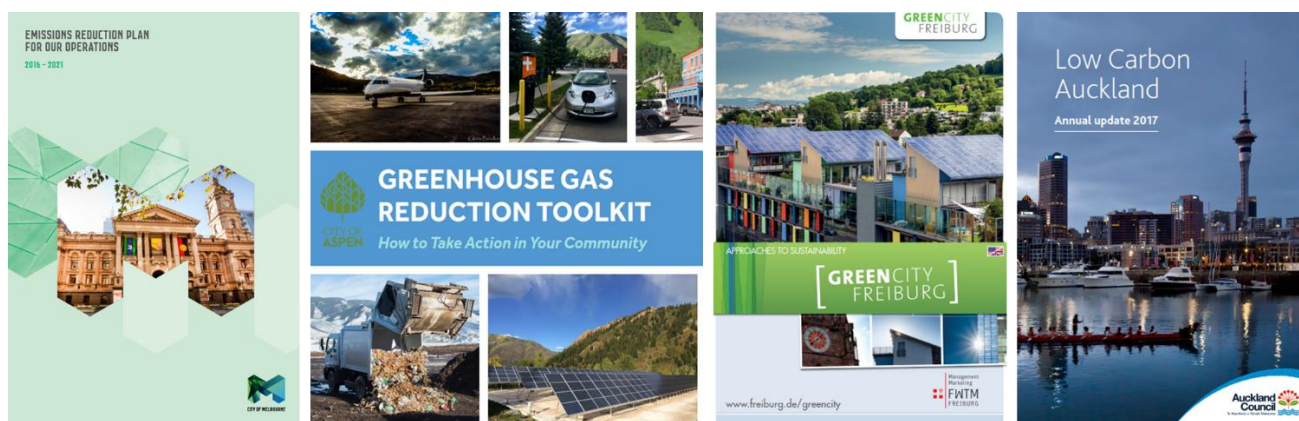


Figure 8.1: Example Emissions Reduction Plans

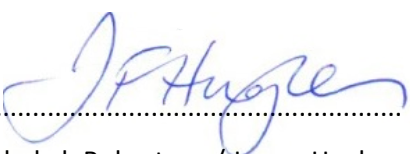


## 9 Applicability

This report has been prepared for the exclusive use of our client Queenstown Lakes District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

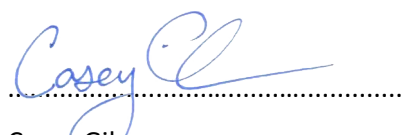
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## Appendix A: Assumptions, Limitations and data sources

The table below summarises all the sectors and sub-sectors as per WRI (2015) and indicates which were included within the QLDC assessment. The table also lists relevant assumptions, limitations and data sources.

Sector/Subsector	Assumptions, Limitations and Data Source
<b>STATIONARY ENERGY</b>	
Residential, commercial and institutional buildings and facilities	Excluded – this sub sector relates to coal burning at residential, commercial and institutional buildings and facilities. It is assumed no significant site level coal burning. Electricity and gas use are covered in categories below.
Electricity generation	Excluded – there is no electricity generation within the reporting boundary.
Electricity consumption (grid)	Included – Grid exit point data was provided by local lines companies Aurora Energy and also Electricity Southland (via Stephen Batstone, QLDC).
Electricity T&D loss	Excluded – as minor.
LPG	Included – An estimate of annual LPG sales was provided by Contact Energy (verbally from Malcolm James, Contact Energy).
Natural gas consumption	Excluded – no significant reticulated natural gas consumption within the reporting boundary.
Coal	Excluded – no significant coal burning within the reporting boundary.
Biofuel use	Excluded – no expected biofuel use within the reporting boundary.
Fugitive Emissions	Excluded – no expected production of oil and gas within the reporting boundary.
<b>TRANSPORT</b>	
On-road transportation	Included – Fuel sales tax data was used. Data provided was a total for QLDC, Clutha and Central Otago districts, so a proportion of the sales was calculated based on resident and visitor population equivalents.
Railways	Excluded – no rail transport within the reporting boundary.
Water transport	Excluded – cannot distinguish the difference between fuels bought for road transport vs water transport.

Aviation – Local (skydive, helicopter, sightseeing)	Included – Includes air travel, standing emissions and fuel used from airport vehicles. Travel emissions taken as a proportion of the national aviation emissions based on the numbers of passengers. Data was obtained from the Queenstown Airport Cooperation and National Aviation Emission Reduction Plan (Ministry of Transport, 2016)
Aviation - transboundary	Included – implicitly within the proportion of the nation aviation emissions.
Off-road transportation	Excluded – cannot distinguish the difference between fuels bought for on road vs off road.
<b>WASTE</b>	
Solid waste disposal	Included – Solid waste disposal was calculated using volumes of waste delivered to the Victoria landfill. Data was provided by QLDC.
Biological treatment	Excluded – Minor and therefore assumed do not contribute to net emissions (e.g. composting or burning firewood).
Incineration	Excluded – no expected burning of waste within the reporting boundary.
Wastewater treatment	Included – Wastewater treatment emissions were taken directly from the Queenstown and Wanaka wastewater treatment plant GHG emissions report (Bloomberg, Lovett, & Rissmann, 2018). Report was provided by the QLDC.
Septic tank	Included – Assumptions on the number of septic tanks based on the rates data indicating that QLDC has 993 more WW connections than water supply, and 20,676 rating units (SUIP) with a water rate and a district total of 25,195 general rating units. So $(25,195 - 20,676) - 993 = 3526$ septic tanks, as a rough number. Average number per household was also assumed based on a Queenstown average of 2.6 people and a Wanaka average of 2.4 people per household. Therefore, the overall average for the QLDC was taken as 2.5 people per household.
<b>IPPU</b>	
Industrial processes	Excluded – assumed minor or nil within the reporting boundary.
Product use HFC, PCFs and SF <sub>6</sub>	Excluded – assumed minor or nil within the reporting boundary.
<b>AFOLU</b>	
Livestock	Included – Livestock emissions were taken as a proportion of the national livestock emissions based on livestock numbers. Livestock numbers were provided by the NZ beef and lamb economic service.

Forestry

Included – Native forests in the area were assumed to be too old to up take any carbon therefore only exotic forests were included within the emissions. Exotic forest data was obtained from the National Exotic Forest Description report.





