MOTT MACDONALD

Queenstown Lakes District Council Long Term Plan Carbon Baseline

FINAL REPORT

June 2023

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Queenstown Lakes District Council Long Term Plan Carbon Baseline

FINAL REPORT

June 2023

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Executive summary

To achieve Aotearoa/New Zealand's objective of reducing emissions to net zero by 2050, profound changes and rapid reductions will be needed across every sector of the economy.

This report focusses on the "capital carbon" from Queenstown Lakes District Council's (QLDC's) planned infrastructure over the next 10 years (2021-2031). Capital carbon refers to emissions associated with the extraction and processing of raw materials, manufacturing of products, transport of such materials/products to site, and on-site construction activities. Given the anticipated scale of investment in the years ahead, the potential for cutting emissions by focussing on capital carbon is substantial.

A capital carbon baseline for investment in QLDC's Long Term Plan

A key component of best practice approaches to infrastructure carbon management is to develop a "baseline" – a scenario for what emissions would have been in the absence of planned measures to reduce emissions.[1] A baseline then becomes a common reference point for setting targets, taking action to reduce emissions, and monitoring progress.

We have analysed QLDC's Long Term Plan (LTP) and found that the baseline capital carbon emissions for the 329 projects with planned physical works over the next 10 years is approximately **225,000 tCO_2eq**.[2] This represented around $1.1BN investment.

Methodologically, to develop this baseline estimate, we focussed on the 67 highest value physical projects in the LTP and modelled these using the Moata Carbon Portal (MCP), based on information provided by QLDC's project managers. The capital carbon baseline for these 67 projects is approximately **187,000 tCO_2eq** for a total investment of $947MN. This equates to an average carbon/cost factor of 0.197$kgCO_2eq$/$.

Carbon hotspots

A detailed analysis of the 67 projects modelled in the MCP reveals the following:

- The water sector is responsible for 55% of total baseline capital carbon, which is to be expected as the water sector comprises of the highest proportion of capital carbon, followed by the Transport (24%) and Built Environment (21%) sectors.
- A consistent relationship between cost and carbon can be seen across the baseline, however, the water sector has a slightly higher ratio than other sectors. The Built Environment sector has a lower ratio, due to the lower emissions intensity of the assets modelled.
- The highest proportion of carbon is predicted to occur between 2022 and 2023 (47% of total carbon). A second peak is also predicted in 2030 (9% of total carbon).
- The three projects with the highest carbon emissions in the baseline combined comprise of approximately 20% of total carbon.
- Within the Water sector, the highest proportion of carbon is associated with services (such as pipes) (35% of total carbon), followed by water storage (8% of total carbon). It was found that across the three water projects with the highest carbon, the construction materials

[1] It is noted that prior to the preparation of the baseline, carbon accounting and reduction exercises had already been undertaken for some projects (e.g., Luggate Hall) .This is reflected in the Moata Carbon Portal modelling and the baseline.

[2] Please note that the emissions figures provided in this Executive Summary are estimates within uncertainty boundaries. See main report for more detail. tCO_2eq refers to tonnes of greenhouse gases expressed in carbon dioxide equivalent.

associated with pipelines are the largest carbon source, followed by contributions from construction plant.

- Within the Transport sector, the highest proportion of carbon is associated with roads (21% of total carbon), followed by bridges (2% of total carbon). It was found that construction materials and construction plant associated with roads and road safety elements are the largest carbon source across three highest carbon projects.
- Within the Built Environment sector, the asset type responsible for the highest proportion of carbon is buildings (11% of total carbon), followed by recreational areas (6% of total carbon).
- The asset types identified above indicate the areas with the highest potential to drive down emissions going forward.

Recommended next steps

A capital carbon baseline is only the beginning of a process; an important step towards developing and embedding a wider approach to infrastructure carbon management.

We have identified some potential next steps for consideration. These are based on our experience supporting other Councils and infrastructure providers to quantify and reduce infrastructure emissions

1. Integrate carbon assessment and reduction into QLDC's capital delivery process.

As QLDC delivers its LTP it will be important to consider carbon throughout the capital delivery process and maximise opportunities to reduce emissions, focussing on the hotspots identified in this baseline. This process should involve a cycle of carbon assessment, monitoring and reporting at each key stage of project delivery. It will also be important to engage the supply chain, develop the required tools and guidance, and incentivise good carbon performance. Ultimately emissions should be assessed on a whole-life basis (not just capital carbon).

2. Embed carbon thinking at strategic and leadership levels.

Often the best opportunities for reducing infrastructure emissions come at a very early stage, by challenging the need for new infrastructure in the first place or by identifying a different type of solution to meet a defined need. In addition, embedding carbon management at the leadership level is a key principle behind the PAS2080 carbon management process. For QLDC, a potential next step would be to undertake a gap analysis against PAS2080 to help identify areas for improvement and inform the development of a carbon implementation plan.

3. Develop a net zero strategy and transition plan.

Reducing infrastructure capital and operational emissions to net zero by 2050 will require sustained effort and investment over decades. To support this objective, it could be valuable for QLDC to develop sectoral emissions reductions pathways through to 2050, engaging with stakeholders to identify and analyse decarbonisation options and different levels of ambition. This can then inform the development of a net zero strategy and action plan. This should be aligned with any wider QLDC climate change strategies and emissions reduction targets and plans.

4. Consider climate resilience and broader outcomes alongside carbon.

The recent extreme weather events in Aotearoa/New Zealand have revealed how vulnerable our infrastructure assets and systems are to the impacts of climate change, and how this in turn impacts the critical services infrastructure provides to society. As QLDC develops and delivers its long-term plan, and the governance processes that support this delivery, it will be important to ensure that carbon reduction is considered alongside resilience to the physical impacts of climate change and broader social and environmental outcomes.

1 Introduction

1.1 Background

Queenstown Lakes District Council (QLDC) have commissioned Mott MacDonald (MM) to deliver a capital carbon baseline for QLDC's programme of future capital works projects outlined in QLDC's 2021-2031 Long Term Plan (LTP). The baseline was developed using MM's proprietary software, the Moata Carbon Portal (MCP), which has been used to develop carbon baselines for organisations across infrastructure sectors in Aotearoa/New Zealand. The objective of the baseline is to be a starting point, a snapshot in time, from which to drive down infrastructure carbon emissions.

1.2 QLDC Long Term Plan

The carbon baseline was developed for QLDC's 2021-31 LTP. This LTP outlines the council's planned 10-year capital programme of works between 2021 and 2031 amounting to around $1.6 billion investment. The LTP consists of the following sectors:

- Built environment: consisting of buildings, open spaces and solid waste projects
- Transport
- Water: consisting of storm water, wastewater, and water supply projects

The LTP includes both new capital projects and renewals of existing facilities and outlines project budgets from years 1 to 10, with individual project budgets ranging from thousands to millions of dollars.

As part of the carbon baseline, the projects in the LTP were filtered taking into consideration timeline, scope and nature of the projects (e.g., physical or non-physical). For a more streamlined carbon baseline, projects with similar scope of works were combined into collated projects. This resulted in the 627 projects in the LTP being filtered to a total of 67 projects (including collated projects). This selection focusses on the projects which are representative of the LTP and also projects which are likely to have the largest footprint over the next 10 years – and therefore offer the largest opportunity for carbon reductions.

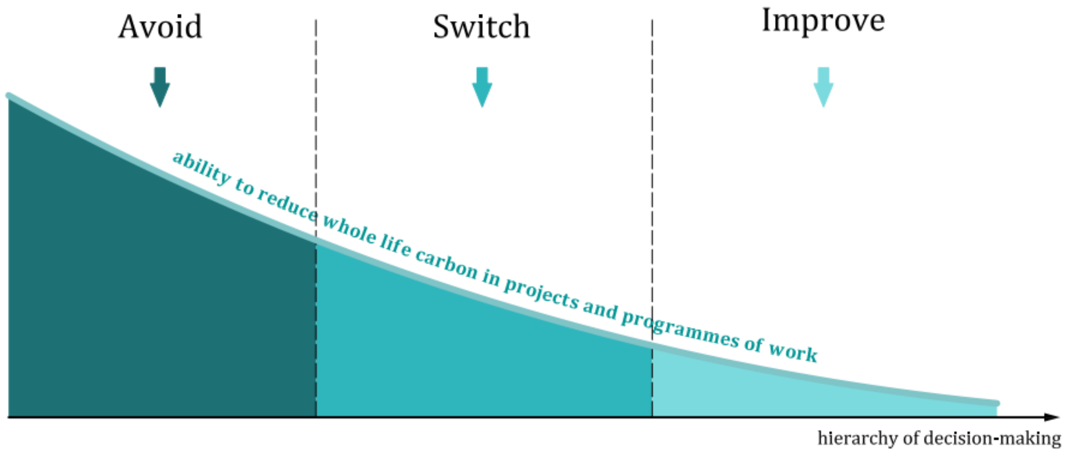
1.3 What is a carbon baseline and how is it used?

A carbon baseline is a key component of good practice in infrastructure carbon management. It presents a scenario for what carbon emissions would have been in the absence of planned measures to reduce emissions. It is a starting point which helps asset owners to identify carbon hotspots and prioritise carbon reduction efforts. It also enables carbon reduction targets to be set and progress to be tracked at both project and programme levels.

As outlined in the PAS 2080 Carbon Reduction Hierarchy (Figure 1.1), the greatest opportunity for reducing capital carbon emissions is often in the early project planning stages, when there may be opportunities to avoid emissions by reducing demand on or using existing assets differently to achieve the same project outcomes. The carbon reduction opportunity typically reduces throughout the project delivery process.

QLDC are at the start of their capital carbon management journey. For this initial baselining exercise it is not the objective to be 100% accurate, especially given that the accuracy of scoping and cost information varies across the programme of works, depending on the stage of different projects. Instead, it is more important to identify key emissions hotspots and - given the baseline will be used to compare future carbon reductions - to maintain consistency of measurement (i.e. quantification methods, assumptions, sources of data, scope and boundaries). In the future, if needed, the baseline can be updated and improved to reflect changing circumstances and better data quality.

Figure 1.1: Carbon Reduction Hierarchy



Source: PAS 2080: 2023 Carbon Management in buildings and infrastructure

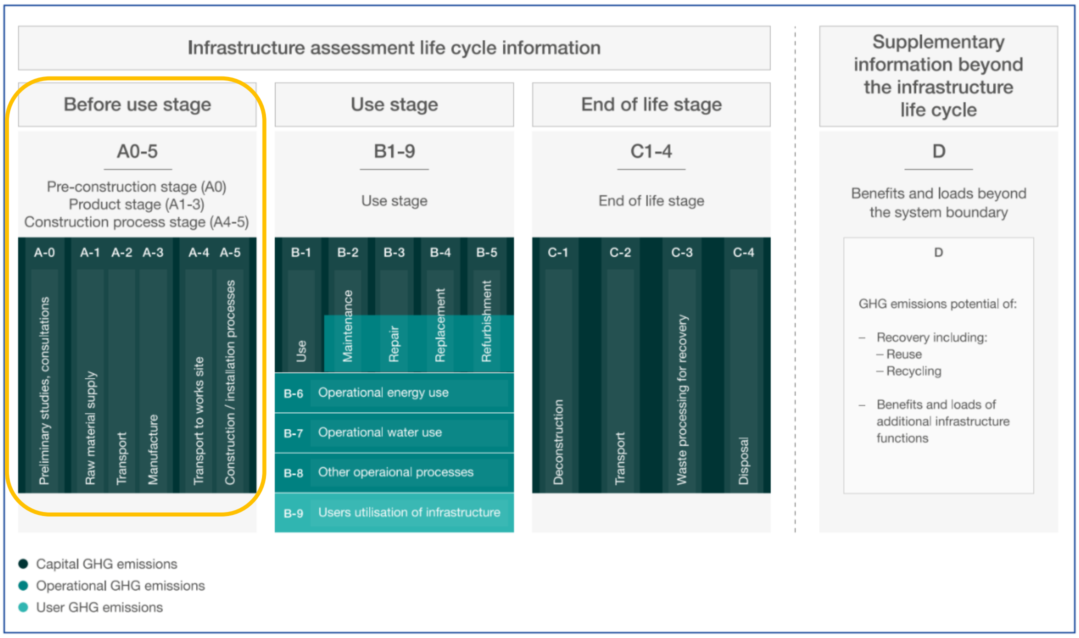
1.4 Focus on capital carbon

The focus of the baseline is capital carbon emissions in the "before use" or "cradle to built asset" stage as shown in Figure 1.2 (the A1-A5 life-cycle modules). This covers emissions associated with the extraction and processing of raw materials, manufacturing of products, transport of such materials/products to site and construction activities.[3]

Emissions associated with demolition of existing assets, the operation of assets, and end of life were excluded from the carbon baseline. Ultimately a best practice whole-life-approach to measuring and managing infrastructure carbon should be taken, with capital carbon being a critical part of this.

[3] Throughout this report the term 'carbon' refers to all greenhouse gases.

Figure 1.2: Infrastructure assessment life cycle information: modelling boundary



Source: PAS 2080: 2016

1.5 Scope and structure of the report

This report provides the findings and analysis of QLDC's carbon baseline and presents recommendations for next steps to continue QLDC's carbon reduction journey. The report is structured as follows:

- Section 2 sets out the approach and methodology of the carbon baseline development.
- Section 3 provides general assumptions and data sources used.
- Section 4 provides the results of the carbon baseline with a breakdown by service area, asset type and life-cycle modules. It also highlights the key carbon hotspots.
- Section 5 provides recommendations for next steps and related steps for carbon reduction in line with international best practice.
- Appendix A provides a list of projects that were baselined.
- Appendix B provides a list of projects that were collated in order to be baselined
- Appendix C-E provides project-specific assumptions for each of the sectors.

2 Approach and methodology

The baseline was developed using a standard Mott MacDonald approach which has been used successfully for asset owners in Aotearoa/New Zealand and the UK. It has been adapted to suit the QLDC LTP and desired outcomes.

The key stages are:

- Stage 1: Screening of the LTP
- Stage 2: Collating projects
- Stage 3: Develop list of projects to include in the baseline - 95% capital spend exclusion
- Stage 4: Information gathering
- Stage 5: Develop the baseline in Moata Carbon Portal
- Stage 6: Analysis of results and identification of carbon hotspots

Stage 3, 4, and 5 were carried out in parallel in tranches to manage the project timeline and information availability.

The following sections outline the steps taken to determine which projects in the LTP would be included in the carbon baseline.

2.1 Stage 1: Screening of the LTP

The QLDC LTP consists of 627 projects proposed to be delivered between 2021 to 2031, with a capital value of approximately $1.6 billion. The first stage of the carbon baseline involved a two-step screening approach as follows:

- **Level 1:** Screening out projects due to timeline and scope factors:
  a. Timeline:
     i. **Project in construction:** limited capacity to drive down future embodied carbon emissions
     ii. **Project completed:** no capacity to drive down future embodied carbon emissions
  b. Scope:
     i. **No budget:** no budget in the LTP and therefore no associated future carbon emissions
     ii. **No/minor physical works:** unlikely to have a large carbon footprint and therefore limited capacity to drive down future embodied carbon emissions
- **Level 2:** Additional screening of projects unsuitable to be baselined
  – Scope:
    - **No/minor scope:** unlikely to have a large carbon footprint, for example: tree planting - likely to result in a carbon offset.
    - **Not enough information available:** unlikely to be able to undertake a meaningful baseline of the project at this stage
  – Other:
    - **Project has been baselined previously:** additional baseline not required
    - **Developer lead:** Led by a developer and therefore QLDC have no capacity to influence embodied carbon.

The screening process resulted in 329 at the conclusion of Level 1 and 254 projects at the conclusion of Level 2 remaining to be included in the baseline.

2.2 Stage 2: Collating projects

For a more streamlined carbon baseline, projects with similar scope of works were combined into collated projects. A total of 166 individual projects were combined into 19 collated projects, as summarised in Appendix B.

Additional collated projects (not outlined in Appendix B) were also developed, however these were subsequently excluded in Stage 3 (refer to Section 2.3), and therefore have not been outlined in this report.

The screening and collating process resulted in 88 projects (including collated projects) remaining to be included in the baseline.

2.3 Stage 3: Develop list of projects to include in the baseline - 95% capital spend exclusion

As an initial allocation of approximately 70 projects had been agreed between QLDC and MM, given time and budget constraints, an additional step was required to reduce the number of projects.

A 95% capital spend exclusion exercise was undertaken which involved, for each sector, determining 95% of the sector's capital spend and then summing the capital spend of the projects (starting from highest budget to lowest) until the 95% value was reached. Any project that did not sit within the 95% value (e.g., projects with the lowest capital spend) were then excluded.

This resulted in the final list of projects to be baselined in the MCP which consisted of 67 projects. The final list of projects to be baselined is provided in Appendix A.

2.3.1 Overview of projects to be baselined

Figure 2.1 shows the screening process applied to the LTP and the projects selected for the baseline. From a capital cost perspective, the selected 67 projects represent 83% of the Level 1 screened list (projects able to be baselined that aligned with the selected timeline) and 60% of the LTP, and are considered representative of the LTP from a cost perspective.

A sector breakdown of the projects to be baselined is provided in Table 2.1. The highest number of projects are in the water sector, followed by built environment and then transport. The sector proportion breakdown for the projects selected for the baseline remained almost unchanged from the screened list, as shown in Figure 2.2

Figure 2.1: Screened list and projects to be baselined, compared to the LTP

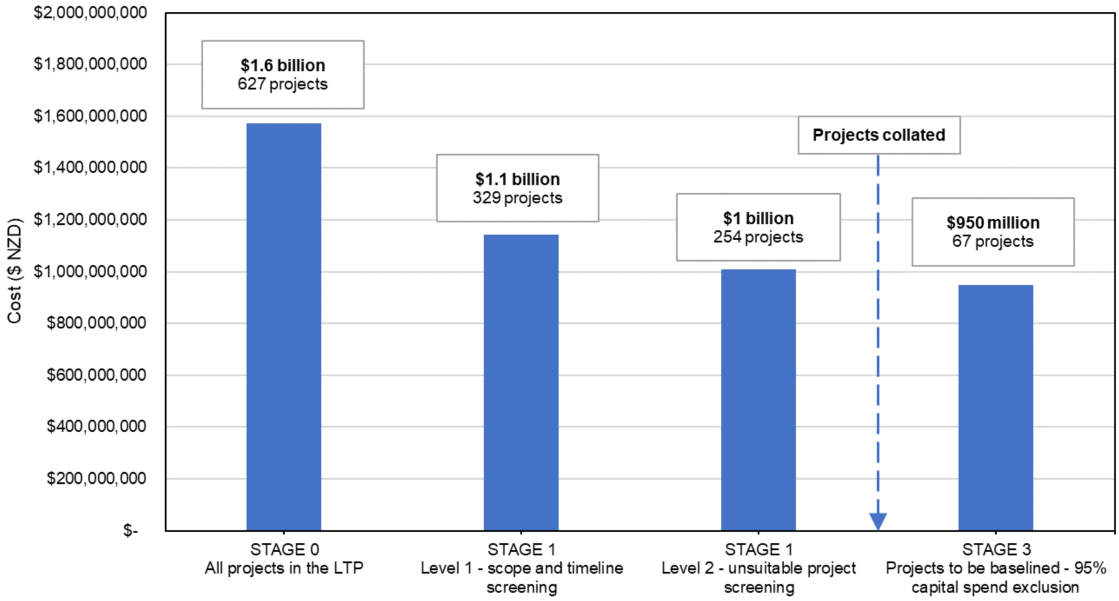
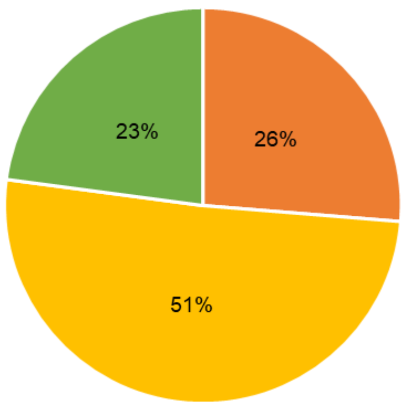


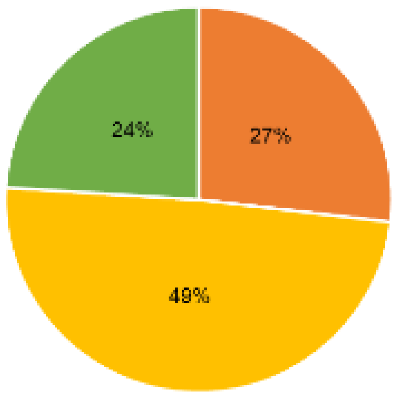
Table 2.1: Breakdown based on service area

	Screened list (Stage 1, Level 1)			Projects selected for baseline			
Sector	**Number of projects**	**Capital cost ($)**	**% of total cost**	**Number of individual projects**	**Number of projects**	**Capital cost ($)**	**% of total cost**
Built Environment	144	$300,161,707	26%	92	26	$254,430,393	27%
Water	115	$580,178,657	51%	85	30	$465,670,708	49%
Transport	70	$261,400,675	23%	44	11	$227,342,547	24%
Total	**329**	**$1,141,741,039**	**100%**	**221**	**67**	**$947,443,648**	**100%**

Figure 2.2: Proportion of project capital costs – Level 1 screened list (left) and baselined projects list (right)

Level 1 screened list	Baselined project list





▪ Built Environment ▪ Water ▪ Transport

2.4 Stage 4: Information gathering

We engaged with QLDC project managers for each of the 67 projects selected to be baselined and requested data according to the following hierarchy:

1. Bill of quantities or pricing schedule
2. Drawings and design reports
3. Feasibility reports, early studies
4. For renewals – historical bill of quantities for similar projects.
5. Where information isn't available – similar historical projects or high-level estimates

Project managers were asked to provide relevant information which was then collated by MM to input into the MCP. The project data supplied by QLDC is summarised in Appendix F. Detailed information was used wherever available and gaps in information were filled with either assumptions based on previous work with water utilities, professional judgement, or manufacturer data.

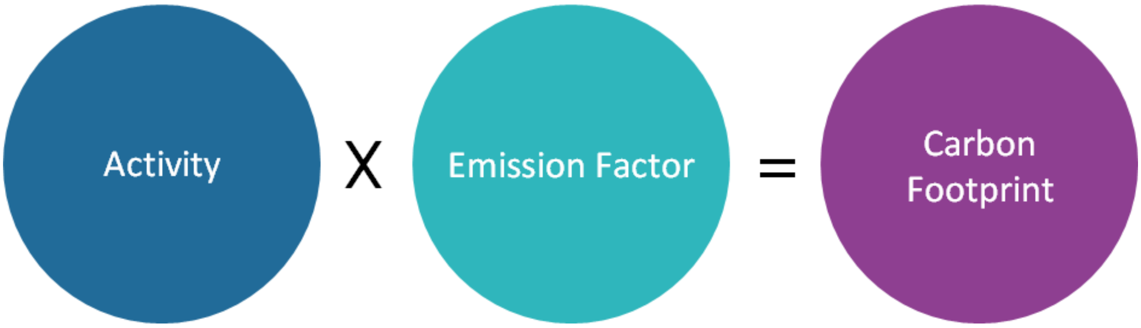
General assumptions for each sector were made as well as specific assumptions for each project (see Section 3).

2.5 Stage 5: Develop the baseline in Moata Carbon Portal

The baseline projects were modelled in the MCP, a propriety tool developed by Mott MacDonald to calculate capital carbon emissions for assets across infrastructure sectors.

Carbon emissions are quantified as a product of activity or material and the corresponding emissions factor as shown in Figure 2.3. The MCP hosts emissions factor databases and carbon libraries developed for organisations in Aotearoa/New Zealand.

Figure 2.3: Carbon quantification



2.5.1 Stage 5.1 Development of libraries and models

The MCP carbon models were originally developed based on UK engineering standards and typical UK water company asset standards. The data in MCP has since been adapted to match the Aotearoa/New Zealand context and will continue to be updated as more information becomes available. However, in some cases existing models were not available in the MCP. As a result two new carbon libraries were developed for QLDC using local carbon factors and scope details, as follows:

- NZ Transport, which includes QLDC specific models related to:
  - Public transport

  - Traffic signs
  - Roads
  - Shared paths and footpaths
  - Kerbs and channels
  - Retaining walls
- NZ Water, which includes QLDC specific models related to:
  - Gravity sewers
  - Sewer manholes
  - Plastic valve chambers

Libraries and models that have been developed by others and the new models developed specifically for QLDC will be available for sharing through MCP subscription. This means models developed by QLDC will be available for other MCP users and vice versa. This avoids rework and encourages a collaborative working approach across Aotearoa/New Zealand. It should be noted that the models do not contain sensitive information relating to specific project or programme models.

2.6 Stage 6: Analysis of results and identification of carbon hotspots

The MCP presents the results as a carbon emissions quantity and a breakdown based on folders in the design, design scope, and materials (only for selected libraries). The results of QLDC's carbon baseline have been presented in Moata Insights which is a live carbon dashboard that visually presents the capital carbon baseline and has the capability to track projects over their lifecycle achieving a programme-wide view.

The results presented in Moata Insights have been reproduced in this report.

3 Assumptions and uncertainties

This section outlines the main assumptions, uncertainty factors and corresponding sources of information that were used to develop the programme scope and model the capital carbon baseline. Assumptions are recorded in the MCP against the associated carbon design for each project.

3.1 Assumptions

3.1.1 General assumptions

The following assumptions were made across the programme of works to allow for consistency in the carbon baseline. These took precedence over all other assumptions.

Table 3.1: General programme level assumptions

Item	Assumption	Comment
Information	Project information that was used to develop the LTP was relied upon. Any project budgets or narratives amended after the commencement of the baseline (November 2022) were excluded.	This allows the baseline to be created for an identifiable point in time. The MCP allows projects to be updated as further information is available.
Emissions scope	Scope of emissions is limited to capital emissions (A1-A5) and any activities that sit outside this boundary are excluded. Emissions associated with demolition of existing assets, operation of assets and end of life were excluded from the carbon baseline.	It will be important to consider a whole of life carbon management approach as QLDC progress their carbon reduction journey. In some circumstances there may be trade-offs between capital and operational carbon emissions.
Emissions factors	Carbon emissions factors for materials and activities have been derived from various industry standard data bases including the Building Research Association of New Zealand (BRANZ) database for buildings and the New Zealand Infrastructure Sustainability Council (NZ ISC) database for linear infrastructure. Environmental Product Declarations (EPDs) supplied by manufacturers were also used.	The databases and emissions factors differ depending on the component used for creating the carbon design in the MCP. This can be viewed in the MCP.
Travel distances	For all projects a 50km average travel distance (one way) has been assumed for import and export of earthworks.	This has been assumed based on the typical locations for imports and exports (such as: Victoria Flats landfill and Parkburn quarry).
Exclusions	Where minimal carbon emissions are anticipated, the following items were excluded from the baseline: ● Internal fit out ● Internal paintwork and finishes ● Fire protection ● Steel connections, baseplates, shear studs ● Paint ● Traffic management ● Accessories (nuts, bolts, sockets, screws etc) ● Water use and water truck fuel	The uncertainty factors described in Section 3.2 will include the uplift on the predicted carbon to account for these items (as well as accounting for other uncertainties).

3.1.2 Sector specific carbon emission factors

This section outlines the assumptions associated with the use of carbon emission factors for each sector.

3.1.3 Built Environment

Built Environment sector-wide assumptions are presented in the following section. Refer to Appendix C for Built Environment project specific assumptions.

3.1.3.1 Built Environment scope

The folder structure of Built Environment assets in MCP is categorised according to the Ministry of Business, Innovation and Employment's (MBIE's) Technical Methodology (refer Figure 3.1) This scoping is in line with common practice of the Life Cycle Association of New Zealand (LCANZ) Practitioners. The highlighted items below have been included in the carbon baseline:

- Blue - Substructure
- Purple - Superstructure
- Yellow – Internal finishes and partitions
- Green - Facade
- Red – Miscellaneous (building services & miscellaneous other items)

Figure 3.1: MBIE embodied carbon scope

Building System	Mandatory: must be included in the assessment	Voluntary: may be reported independently within the assessment
Ground work	• Substructure/foundations • Earth retaining structures • Basements	• Vegetation • Hard landscaping • Ancillary buildings • External services, including drainage
Structure	• Ground floor structure • Upper floor(s) structure • Load bearing systems: gravity and lateral structural frames and walls • Roof structure	• Temporary works (formwork, scaffold etc.) used during construction that are not reused • Stairs • Lifts and escalators
External envelope	• Cladding/façade primary elements (weather exposed layer, structural support system) • External wall insulation • Roof covering and insulation • External windows and doors	• Cladding/façade secondary elements (seals, brackets etc.)
Non-structural internal elements	• Non-loadbearing walls • Internal doors • Floor and wall finishes	• Ceilings • Fixtures, fittings and furniture
Building services	• HVAC[4] equipment	• Water, drainage, electrical services • Other building systems such as fire and security systems

[4] Heating Ventilation Air Conditioning

Source: MBIE, Whole-of-Life Embodied Carbon Assessment: Technical Methodology, February 2022

The following comments are made in relation to the scope shown in Figure 3.1:

- On ground works (e.g. slab on grade and pathways) are considered part of substructure.
- Excavation and earthworks are considered as a subfolder of the substructure category.
- The façade support system includes elements other than the primary structure (so excludes studs, girts, purlins etc as these are captured under the Structure category).
- HVAC equipment and building services, in general, will be accounted for by an estimated percentage contribution to the overall project, as described in Section 3.1.3.3.
- Additional carbon for 'Other' items has been included on a project-by-project basis in the Misc folder. This placeholder impact is to account for items that have a contribution to overall carbon but do not have sufficient information to be carbon modelled or are difficult to carbon quantify. Please see Section 3.1.3.4 for details.

The following exclusions are made in relation to the scope shown in Figure 3.1:

- Fire protection for structural elements is not included within this carbon baselining assessment.
- Additional steel connections, baseplates, shear studs are not included within this carbon baselining assessment unless specified in the resource provided. At further iterations of carbon baselining, steel volume should be increased by 10% to account for an estimate of connection material.
- Building internal fit-out equipment such as furniture and fittings are not included within this carbon baselining assessment.
- Internal paintwork and finishes are not included within this carbon baselining assessment.
- Items from cost estimates that have a capital cost but do not contribute to upfront carbon are excluded from the carbon baseline. I.e. only physical building elements have been taken. Some examples of excluded items include:
  - Cost margins (such as: administration costs, engineering costs etc.)
  - 'Builder's work to Security and Access Control'
  - 'Allow for site clearance,' 'Allowance to make good,' 'Allowance for fitted joinery' & other allowance type items

3.1.3.2 Built Environment analysis, assumptions, exclusions and limitations

The following assumptions are made for the carbon baselining assessment, unless noted otherwise:

Materials

- All concrete is assumed 30MPa Ordinary Portland Cement (OPC), that is: no cement replacements considered such as GGBS or PFA
- All steel superstructure is assumed BlueScope steel
- All steel bars, coils, wires and rods are assumed Pacific Steel
- All timber and engineered wood products are assumed procured from suppliers following sustainable forest management practices. In the NZ Building Materials library in the MCP this then allocates a net-sequestering value to the timber components for their upfront carbon impact within a project, which means their impact shows up as negative in the material impact breakdown. The national NZ approach to accounting for the sequestering effect of timber components during their life (and within what LCA Stage) has not yet been clearly set by MBIE, so we have followed the BRANZ A1-3 allocation approach for this baseline.

- Generic carbon factors have been used as at this level of project stage, specific material choices and associated impacts are yet to be confirmed. EPDs are only used where the is some knowledge of the intended procurement routes.

Reinforcement rates

Reinforcement rates have been assumed as per the below table:

Table 3.2: Reinforcement rate table

Element	Reinforcement rate (kg/m^3)
Columns	250
Footings	100
Pathways	30
Piles	200
Pile caps	300
Raft slab	200
Slabs on grade	50
Suspended floor slabs	150
Walls	100

Façade assets

Façade assets as per below:

- All insulating glass units (IGU) glass thickness 14mm (glass thickness only, excluded IGU spacer thickness)
- All glass windows and doors are assumed to be aluminium framed, where the aluminium framing volume can be estimated as 20% of the glass volume.
- All corrugated steel cladding is assumed 0.55mm thickness Endura Colorsteel
- All timber weatherboard/cladding assumed 20mm thickness
- Roof insulation is assumed 140mm thick Pink Batts Ultra R3.6

Interior finishes and partitions assets

Interior finishes and partitions as per below:

- All ceilings assumed to be 13mm standard GIB
- All suspended ceilings assumed to be Rondo 310
- All walls assumed:
  - RAB 9-10mm thick (or 9-10mm plasterboard for internal walls);
  - Interior acoustic plasterboard 13mm GIB
  - Timber - 15% of the wall area; Insulation - 85% of the wall area (this comes from assuming timber framing for walls as 140mmx45mm studs at 300crs); and timber and insulation is assumed 140m deep.

Accounting for Upfront Carbon A4-A5 component in BRANZ

Currently the NZ Building Materials (BRANZ) 2019 library in the Moata Carbon Portal only accounts for lifecycle assessment product stage carbon (i.e. Stages A1-A3).

To estimate the contribution of lifecycle assessment construction process carbon (i.e. Stages A4-A5), we have used the BRANZ v3.5 LCA Play/ Quick tool for these values. The construction process contribution of carbon has been added to each project by assigning the A4-A5 as a percentage of A1-A3 per material type (in a folder called 'LCA A1-A3 – Product stage carbon') to a folder called 'LCA A4-A5 – Construction stage carbon.'

QLDC can use this method to calculate upfront carbon (stages A1-A5) for their own future projects if they were to use the Moata Carbon Portal BRANZ 2019 library. Please see table below for proportion used for the baseline.

Table 3.3: A4-A3 as a percentage of A1-A3

Material Type:	A4-A5 as a percentage of A1-A3
Concrete	7%
Steel (incl. bars, sections and sheeting)	6%
Softwood timber, sustainably sourced	5%
Hardwood timber, sustainably sourced	20%
MDF (particle board)	15%
Plasterboard	50%
Fibre cement board	50%
Vinyl	45%
Tiles (ceramic)	35%
Carpet	15%
Insulation	25%
Glass	10%
Aluminium	Negligible

Source: Mott MacDonald adaption of A4-A5 component from LCAQuickV3.5

The above methodology is only applicable to Built Environment projects that use the NZ Building Materials (BRANZ) 2019 assets.

3.1.3.3 Building service elements upfront carbon

The contribution of building services elements to the upfront carbon of project is generally not well-documented. This is in part due to the fine-grain analysis needed across a suite of components, a wide variety of options and solutions for any given building, as well as a historical focus within the building services field on measuring and reducing operational carbon impacts rather than embodied carbon impacts.

As a result, the few international studies / guides on this topic generally apply an approximate additional percentage of the total building upfront carbon or a gross floor area (GFA) rate. Until the dataset for building services systems grows this may remain the industry-adopted method.

For this assessment, Mott MacDonald has reviewed several key international and local research sources and applied our knowledge of the project types to estimate a contribution of total building services upfront carbon that may be appropriate per project (excluding refrigerant loses).

The contribution of building services elements has also been informed by information provided by the Ministry of Education's Whole-of-life Embodied Carbon Assessment Report Template – Life Cycle Assessments (LCA) for New Built Projects in Schools (Issued: Version 1.0 September 2022). This source provided a placeholder value for building service elements in schools for stage A1-A5 of 15kgCO2eq/m^2 GFA. The allocation of upfront carbon allocated to building service elements for each project has been scaled based on the building's likely intensity of building service elements around this value. This results in a building service element square metre GFA rate ranging between 5-30kgCO2eq/m^2.

Refer to Appendix C for the building services elements allocation for each project.

3.1.3.4 Placeholder carbon for miscellaneous items

Some additional carbon impacts have been added to the upfront carbon baseline. This is for items that do not have sufficient information to be modelled or are difficult to carbon quantity at early level of design stages, however, are within scope of the design. These miscellaneous items have been allocated a placeholder carbon value to the baseline models. The contribution of miscellaneous items contribution is based on percentage of total calculated upfront carbon and ranges between 5-20% or as an overall absolute increase of CO2eq based on engineering judgement of the unmodelled items category. When further information becomes available, these placeholder carbon values are to be updated accordingly.

See table of miscellaneous items allocation per project in Appendix C.

3.1.4 Transport

Transport sector-wide assumptions are presented in the following section. Refer to Appendix D for Transport project specific assumptions.

3.1.4.1 Transport analysis, assumptions, exclusions and limitations

The following assumptions are made for the carbon baselining assessment, unless noted otherwise:

- Paint has been excluded
- Traffic management has been excluded
- Accessories such as nuts, bolts, sockets, screws, etc. have been excluded
- UK fuel emission factors are considered representative of local fuel emission factors for machinery/construction processes
- Kerb and channel dimensions used were taken from QLDC standard infrastructure drawings (No1 Kerb and channel)
- All aggregates are assumed to be deposited and compacted

Densities

- The following densities for conversion between tonnes and m^3 were used:
  - Concrete 2.4 tonnes/m^3
  - Asphalt 2.4 tonnes/m^3
  - Basecourse or AP40 1.7 tonnes/m^3
  - Subbase 1.68 tonnes/m^3
  - Bitumen 1.03 tonnes/m^3
  - Glass 2.5 tonnes/m^3
  - Steel 7.8tonnes/m^3
  - Aluminium 2.7 tonnes/m^3

Materials

- Chipseal:
  - A single layer has a thickness of 15mm
  - A spray rate of bitumen for chipseal is 0.9L/m^2

- The chip application rate is 80m²/m³
- Concrete:
  - For all concrete, 0% SCM has been assumed
  - The emissions from fuel associated with the placing of concrete is assumed to be negligible and therefore has been excluded
- Steel mesh
  - Unit weight of 3.5kg/m2 was used

Traffic and shared path signs

- Traffic signs
  - White powder coating has been excluded
  - Use of bolts, screws, sockets, showerproof cap have been excluded
  - 20 mPa concrete, 600mm depth, 300mm by 300mm has been assumed for the standard sign foundation
  - A pole length of 3.15m, 0.5m buried, 3m height above ground was assumed for the standard sign
  - 29.3% has been assumed for traffic sign construction plant carbon, based on similar UK component.
- Shared path signs
  - A 400mm by 600mm aluminium sign was assumed
- Roundabout signs:
  - 866mm by 750mm triangle with 600mm by 250mm supplementary

3.1.5 Water

Water sector-wide assumptions are presented in the following section. Refer to Appendix E for Water project specific assumptions.

3.1.5.1 Water analysis, assumptions, exclusions and limitations

The following assumptions are made for the carbon baselining assessment, unless noted otherwise:

Pump stations

- Where not specified an 80.7m head has been assumed from aerial imagery and advice from QLDC.

Reservoirs

- Where reservoir components were not available on the portal, carbon was scaled from existing components
- 6mm Steel wall and roof thickness was assumed for all reservoirs.
- In situ-concrete 50MPa, 20 percent SCMs was assumed for base slab and ring beams.
- Structural steel, plate – Australian was assumed for steel walls, roof, and base of the reservoirs.
- Steel, bar (Pacific Steel) was assumed for the reinforcement mesh within the concrete for the reservoir at an assumed density of 100 kg/m3.
- 300mm concrete floor slab thickness was assumed.
- Where not specified:
  - 1.5ML (1,500m^3) reservoirs were assumed to be 7.26m high with 14.16m in diameter.

  - 0.25ML (250m^3) reservoirs were assumed to be 6m high and 8.52m in diameter.
  - 4ML (4,000m^3) reservoirs were 26.5m in diameter.
  - 2.5ML (2,500m^3) reservoirs were 6m high and 20m in diameter.
- Otherwise, heights and diameters for certain reservoirs were given by QLDC such as the 4ML reservoir and 3.4ML reservoir.

Trench depths

- Pipe depth assumed to be 1m (as advised by QLDC) as a common depth, unless otherwise specified

Networks

- Open cut or trenched methodology was assumed where methodology was not defined
- Where valves were not explicitly mentioned, assumptions have been made for allowance for air and scour valves and corresponding chambers
- Air (nominal bore = 50 mm) and scour valves (same diameter as pipeline) were assumed for every 500 m of the pipe length
- The following diameters were assumed for manhole chambers:
  - 1050mm for pipe diameters less than 300mm
  - 1200mm for pipe diameters between 300mm and 500mm
  - 1500mm for pipe diameters above 500mm

3.2 Uncertainties

The baseline has different levels of uncertainty associated with:

- **Scoping**: has the scope been accurately defined and is this likely to change or expand in future design stages
- **Modelling**: whether the carbon footprint of specific supplier products and emissions factors are accurately reflected

Typically, scoping uncertainties at the business planning phase are much greater than carbon modelling uncertainties. To improve the visibility of these uncertainties, all projects have been categorised using the six design phases in the MCP and allocated scoping and modelling uncertainties.

As with cost modelling, it is important to allow appropriate levels of uncertainty for the carbon baseline to allow for both uncertainty types. These are applied as a combined percentage uncertainty to each project individually and presented as a range of the carbon baseline.

As each project is being developed and delivered over time it is important to consider reductions in applied uncertainty factors and how this impacts progress against carbon reduction against the baseline. As with cost, a project during delivery will have lower uncertainty as the quantities and construction activities definition are better known. However, a lower applied uncertainty allowance during the design stage when compared to the business planning stage does not mean that the actual capital carbon has been reduced. It is therefore important for any uncertainties allowed during the baseline stage to be clearly understood and revisited as each project is being delivered to ensure that any reductions in the carbon footprint are not simply because the level of scoping uncertainty has reduced.

3.2.1 Scoping uncertainties

There are no formal or recognised methodologies for accounting for uncertainty in carbon modelling – both for scoping and carbon model uncertainties - and how uncertainty changes over time. Some asset owners adopt a similar approach to cost modelling.

The QLDC cost estimation framework was used as a basis to derive uncertainly factors to be applied at each project stage, as outlined in Table 3.4.

Table 3.4: Scoping uncertainty %

MCP design stage	Carbon baseline scoping uncertainty
Not started / brief	+ 40%
Concept	+ 35%
Definition	+ 30%
Design	+ 15%
Build and commission	+ 10%

3.2.2 Modelling uncertainties

The MCP models and emission factors used are Aotearoa/New Zealand specific but in some instances have not been updated from their origin organisations to reflect variations in QLDC's design practice. As more supplier information is made available after projects are delivered, the models and emission factors used for baselining can be further updated to closer represent assets typically built by QLDC.

The modelling uncertainties are provided below in Table 3.5, and summarised below:

- Water:
  - For Networks and storage schemes, the design and production method between suppliers for major assets, pipes, and tanks, is generally similar. The contribution to carbon from supplier and construction specific differences is estimated to be relatively small and typically below 5% of the major assets in the project.
  - For pump stations and treatment projects, the uncertainty is higher. This is due to greater variability in carbon emissions for carbon dominating assets. Process plants can vary widely between suppliers in materials used, required ancillary assets and installation requirements (base slabs and kiosks etc). As projects progress, it is suggested that QLDC update the carbon designs with specific information from their preferred suppliers to increase the representativeness of the models.
  - Where the project was not classified as a network, pump station, reservoir or treatment model, standard modelling uncertainty values were adopted which are based on Mott MacDonald experience from previous projects, outlined in Table 3.5.
- Built Environment:
  - For Built Environment projects, modelling uncertainty was ascertained based on the level of design of the information provided and used in MCP for each project. This is due to the level of design and information for modelling being different from the level of design for scope at a project level. The level of design for modelling uncertainty correlates with the percentages of the standard modelling uncertainty in Table 3.5. Please refer Appendix C for modelling uncertainty and the corresponding combined uncertainty for each of the Built Environment projects.
- Transport:
  - The standard modelling uncertainty values were adopted for the Transport sector which are based on Mott MacDonald experience from previous projects, outlined in Table 3.5.

Table 3.5: Modelling uncertainty %

MCP design stage	Modelling uncertainty				
	Standard	Network	Pump station	Reservoir	Treatment model
Not started / brief	+50%	+5%	+20%	+5%	+20%
Concept	+40%	+5%	+20%	+5%	+20%
Definition	+30%	+2%	+15%	+2%	+15%
Design	+25%	+1%	+10%	+1%	+10%
Build and commission	+5%	+1%	+10%	+1%	+10%

3.2.3 Combined / total uncertainty

The scoping and modelling uncertainties were combined to produce the total uncertainty as outlined in Table 3.6 The total uncertainties were applied to the baselined projects.

Table 3.6: Combined uncertainty %

MCP design stage	Combined uncertainty					
	Standard	Network	Pump station	Reservoir	Treatment model	Built Environment
Not started / brief	+90%	+45%	+60%	+45%	+60%	Refer to Appendix C
Concept	+75%	+40%	+55%	+40%	+55%	
Definition	+60%	+32%	+45%	+32%	+45%	
Design	+40%	+16%	+25%	+16%	+25%	
Build and commission	+15%	+11%	+20%	+11%	+20%	

4 Results and analysis

This section presents the results of the capital carbon baseline analysis. It is important to note that all these values are valid for use as a baseline and are an estimate of carbon dioxide equivalent capital emissions, based on design information provided by QLDC and information available to reflect the scope as of the beginning of 2023.

Results are provided with estimated capital carbon emissions from the MCP as well as a range with upper and lower uncertainties.

4.1 Baseline capital carbon emissions

The total net capital carbon of the baselined projects (67 projects) is 186,668 tCO_2eq. Modelled carbon sequestration activities have been subtracted from this value (e.g., 'negative' carbon emissions associated with the use of timber).
This equates to a carbon/cost factor of 0.197$kgCO_2eq$/$.

The total gross capital carbon of the baselined projects (67 projects) is 187,996 tCO_2eq. Modelled carbon sequestration activities have not been subtracted from this value.
This equates to a carbon/cost factor of 0.198$kgCO_2eq$/$.

The total net capital carbon values have been considered in this section and throughout this report.

The base estimate and the upper uncertainty limit are provided below in Table 4.1.

Table 4.1: Baseline capital carbon results (67 projects)

Capital carbon parameter	Built Environment	Water	Transport	Total
Base estimate (tCO_2eq)	38,917	102,211	45,540	186,668
With upper uncertainty limit (tCO_2eq)	64,895	170,370	85,648	320,913
Carbon/cost factor associated with base estimate ($kgCO_2eq$/$)	0.153	0.219	0.200	0.197

As described in Section 2 the 67 baselined projects – modelled in the MCP - represent 83% by value of the level 1 screened list of 329 projects and 60% of the 627 projects in the LTP. By applying the carbon-cost factor, the total capital carbon can be estimated to be approximately **225,000 tCO_2eq** and **310,000 tCO_2eq,** respectively (without uncertainty percentages).

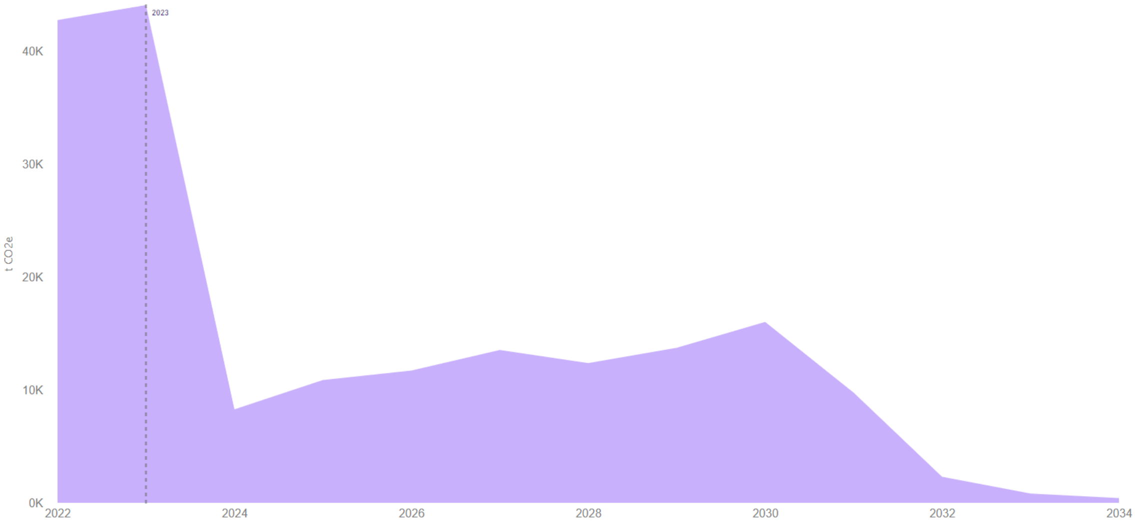
It is important to note that the carbon-cost ratio provided in this report are based on the specific inputs provided by QLDC and other agreed assumptions and hence do not necessarily reflect broader practice across Aotearoa/New Zealand. The true correlation between cost and upfront carbon, in each sector and as an overall average for infrastructure, is not well-established. However, this baselining exercise is an important contributing piece of work to help establish this correlation on a broader Aotearoa/New Zealand level. As such, the 0.197$kgCO_2eq$/$ factor and other factors mentioned in this report should be interpreted with care and awareness that it may not apply outside of the context of this QLDC baseline exercise.

4.2 Carbon emissions over the LTP timeframe

We have proportioned the capital carbon of the baselined projects according to the cost allocation over project lifetimes, as shown in Figure 4.1. From Figure 4.1 it can be seen that the highest proportion of carbon is predicted to occur between 2022 and 2023 (47% of total carbon). A second peak can also be seen in 2030 (9% of total carbon).

Given the scale of capital build and associated capital carbon over the next 10 years, there is now a real opportunity to target carbon reduction in project design, development, and delivery to reduce these emissions.

Figure 4.1: Total capital carbon of the baselined projects over the LTP timeframe (67 projects)



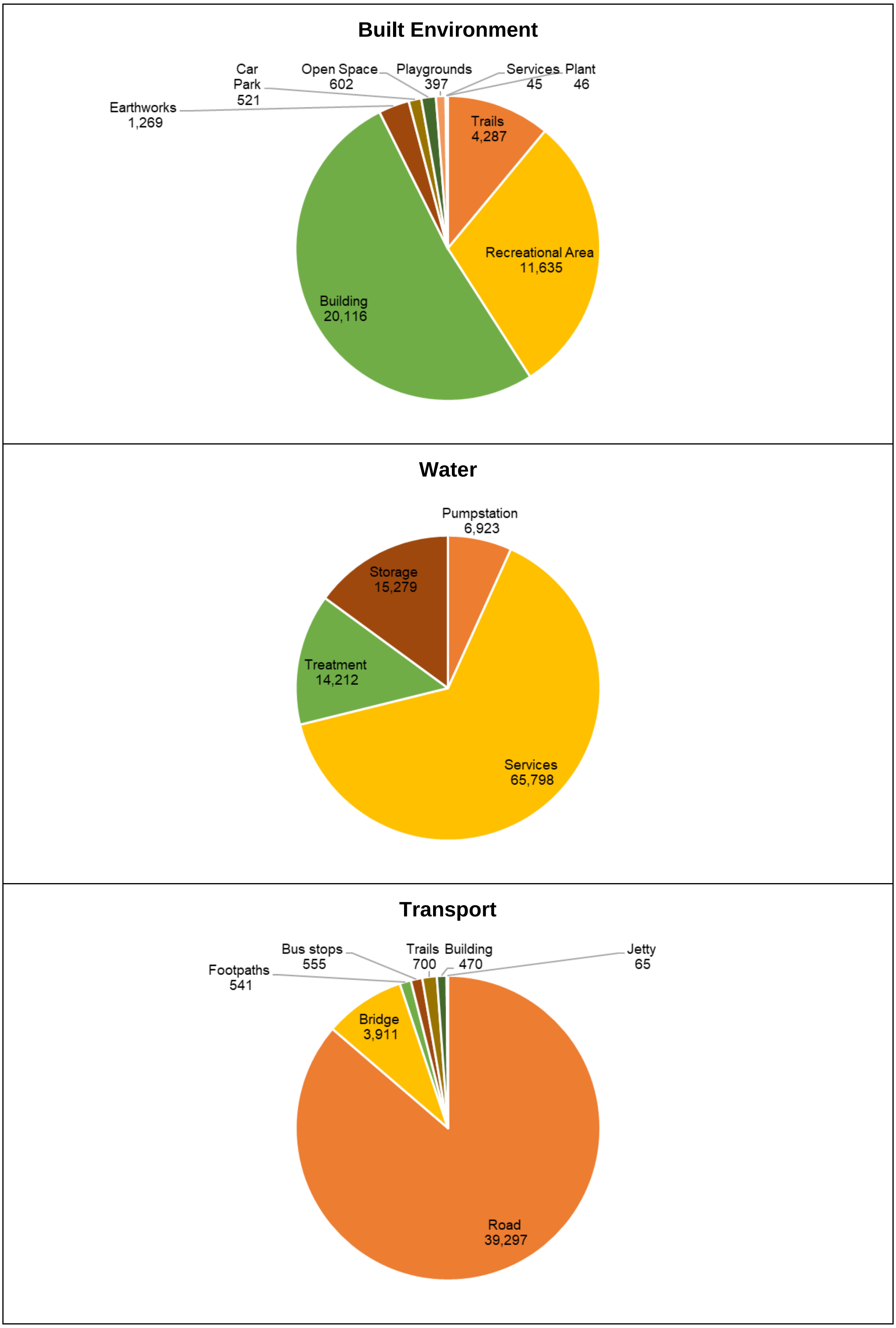
4.3 Asset type breakdown

Table 4.2 and Figure 4.2 shows the capital carbon breakdown by asset type for the baselined projects. The largest source of emissions is from water services assets including pipes (which also comprise of the largest capital cost) (35% of total carbon), followed by road (21% of total carbon), building (11% of total carbon) and water storage assets (8% of total carbon).

Table 4.2: Capital carbon breakdown by asset types

Capital carbon parameter	Built Environment (tCO_2eq)	Water (tCO_2eq)	Transport (tCO_2eq)	Total (tCO_2eq)	Proportion of total carbon
Services	45	65,798		65,842	35%
Road			39,297	39,297	21%
Building	20,116		470	20,586	11%
Storage		15,279		15,279	8%
Treatment		14,212		14,212	8%
Recreational Area	11,635			11,635	6%
Pumpstation		6,923		6,923	4%
Trails	4,287		700	4,987	3%
Bridge			3,911	3,911	2%
Earthworks	1,269			1,269	1%
Open Space	602			602	0.3%
Bus stops			555	555	0.3%
Footpaths			541	541	0.3%
Car Park	521			521	0.3%
Playgrounds	397			397	0.2%
Jetty			65	65	0.03%
Plant	46			46	0.02%
Total	**38,917**	**102,211**	**45,540**	**186,668**	**100%**

Figure 4.2: Capital carbon breakdown by asset types (tCO_2eq)



4.4 Sector breakdown

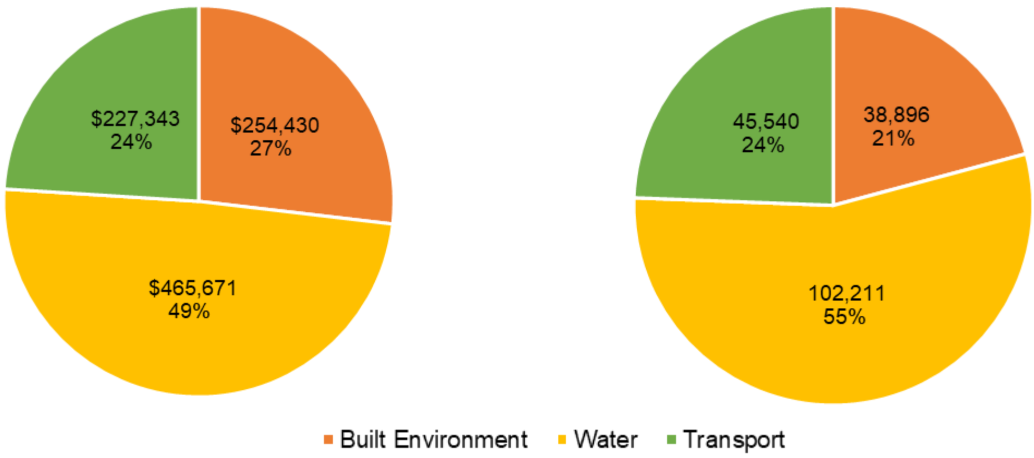
4.4.1 Sector cost

As discussed previously, cost can be considered a proxy for carbon and typically, the cost split between service areas is reflected in the corresponding carbon emissions. The correlation varies depending on the complexity of the asset e.g., the cost/carbon relationship for treatment plants will be different to pipelines.

The comparison between cost and capital carbon by service area for the 67 baselined projects is shown below in Figure 4.3. From the figures a consistent relationship between cost and carbon can be seen, however, water sector has a slightly higher proportion of carbon compared to cost, which is also reflected Table 4.1. Equally, the Built Environment sector has a lower carbon to cost, due to the lower emissions intensity of the assets we have modelled.

A summary of each sector's carbon breakdown is provided in the following sections.

Figure 4.3: Cost split by service area ($1000NZD) (left) and Capital carbon split by service area (tCO_2eq) (right)

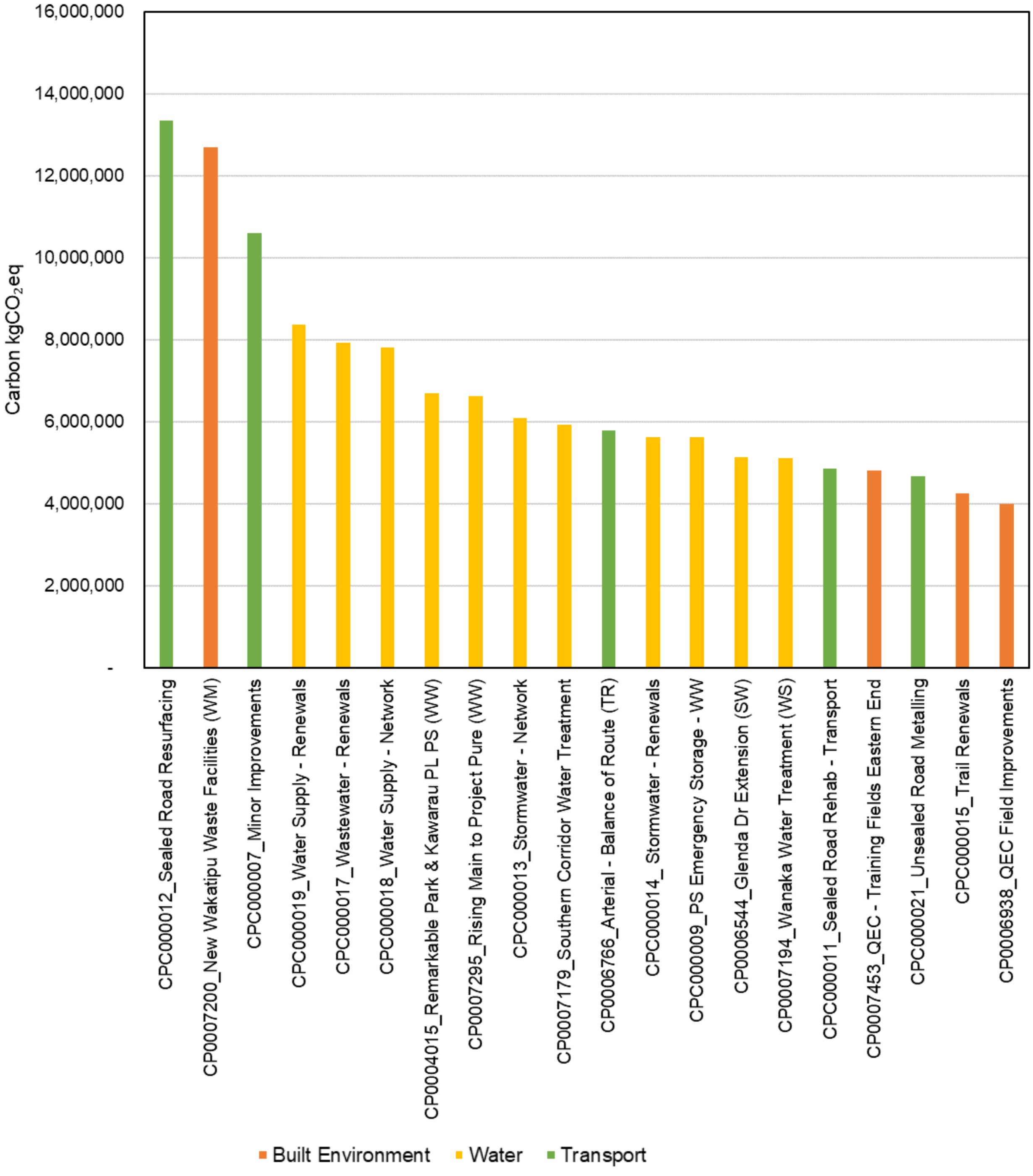


4.4.2 Projects with the highest predicted carbon

Of the 67 baselined projects, the 20 projects with the highest predicted carbon are shown in Figure 4.4. It can be seen that of these 20 projects, 11 of them are from the water sector, 4 are from the built environment sector and 5 are from the transport sector. The project with the highest carbon is Sealed Road Resurfacing (CPC000012), from the transport sector, followed by New Wakatipu Waste Facilities (WM) (CP0007200), from the built environment sector and Minor Improvements (CPC000007) was the third highest, which is from the transport second. These three projects, discussed further in the following sections, combined comprise of approximately 20% of the total carbon accounted for in the baseline.

Within each sector, the three projects with the highest predicted carbon are outlined in the following sections.

Figure 4.4: Top 20 projects with highest predicted carbon



4.4.3 Water

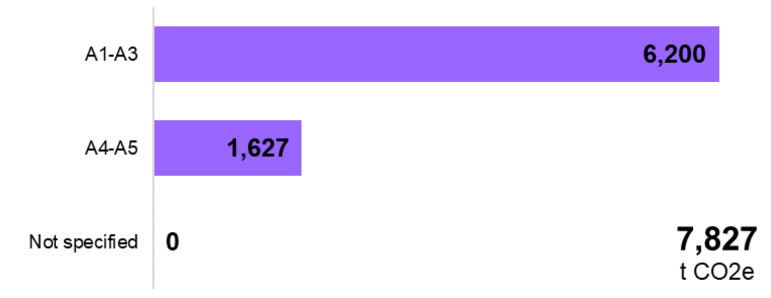
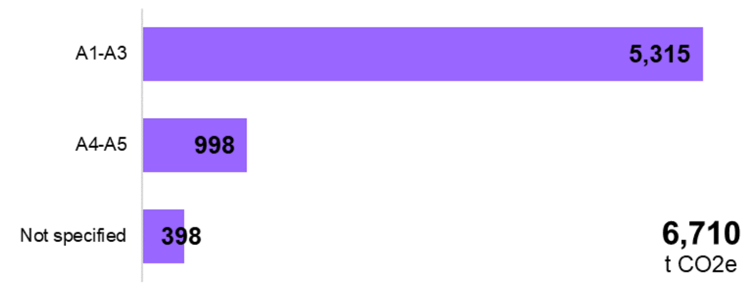
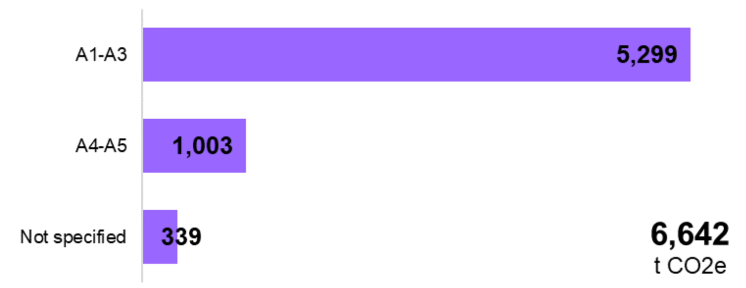
Within the water sector, the asset responsible for the highest proportion of carbon is services (such as pipes), followed by water storage (discussed in Section 4.3).

The following three capital projects (i.e., excluding renewals) have the highest water sector carbon and combined comprise of 24% of the total water sector carbon:

- CPC000018: Water Supply - Network (8% of water sector carbon)
- CP0004015: Remarkable Park & Kawarau PL PS (WW) (7% of water sector carbon)
- CP0007295: Rising Main to Project Pure (WW) (6% of water sector carbon)

An overview of the emission and project asset breakdown for these three projects is provided in Figure 4.5. The emission breakdown in shown as stages A1-A3 (raw material supply, transport of raw material, and transport) and A4-A5 (transport to worksite and construction/installation processes). This shows that stage A1-A3 (in particular construction materials) associated with pipelines are the largest carbon source across these three projects.

Figure 4.5: Water project carbon breakdown (for the 3 highest capital carbon water projects – excluding renewals)

Project	Emission breakdown	Project asset breakdown
Water Supply - Network		
Remarkable Park & Kawarau PL PS (WW)		
Rising Main to Project Pure (WW)		

4.4.4 Transport

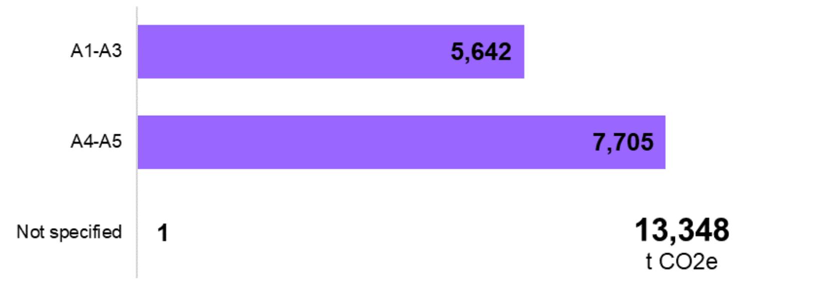
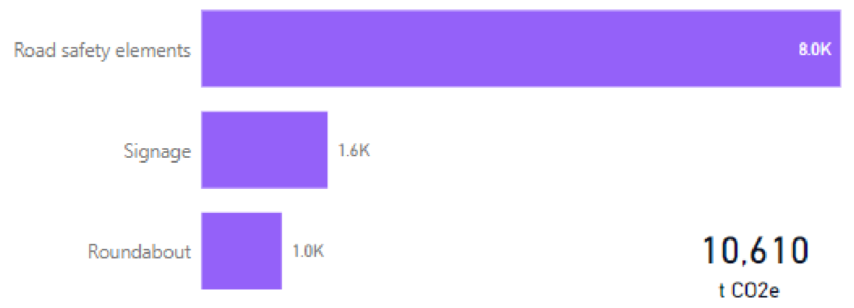
Within the transport sector, the asset responsible for the highest proportion of carbon is roads, followed by bridges (discussed in Section 4.3).

The following three capital projects (i.e., excluding renewals) have the highest transport sector carbon and combined comprise of 65% of the total transport sector carbon:

- CPC000012: Sealed Road Resurfacing (29% of transport sector carbon)
- CPC000007: Minor Improvements (23% of transport sector carbon)
- CP0006766: Arterial - Balance of Route (TR) (13% of transport sector carbon)

An overview of the emission and project asset breakdown for these three projects is provided in Figure 4.6. The emission breakdown in shown as stages A1-A3 (raw material supply, transport of raw material, and transport) and A4-A5 (transport to worksite and construction/installation processes). This shows that the A1-A3 (construction materials) are the largest carbon source across the Minor Improvements and Arterial - Balance of Route (TR) projects. The A4-A5 (construction plant) stage is the largest source in the Sealed Road Resurfacing project – in particular associated is the largest carbon source.

Figure 4.6: Transport project carbon breakdown (for the 3 highest capital carbon transport projects – excluding renewals)

Project	Emission breakdown	Project asset breakdown
Sealed Road Resurfacing		
Minor Improvements		
Arterial - Balance of Route (TR)		

4.4.5 Built Environment

Within the built environment sector, the asset responsible for the highest proportion of carbon is buildings, followed by recreational areas (discussed in Section 4.3).

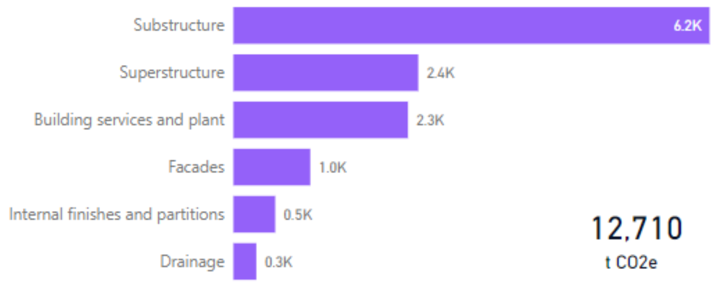
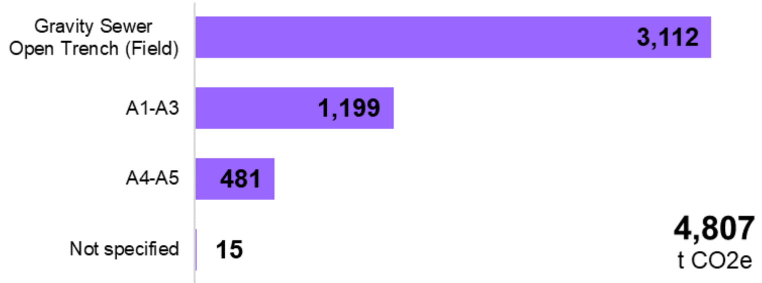
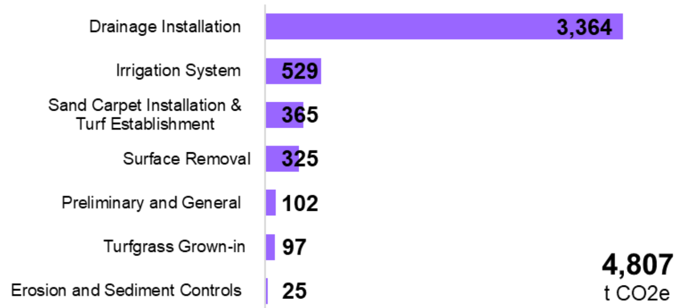
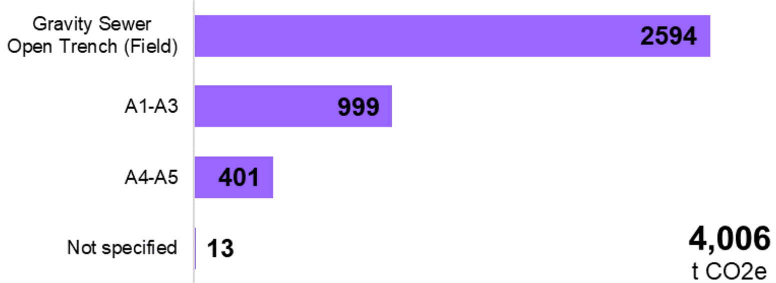
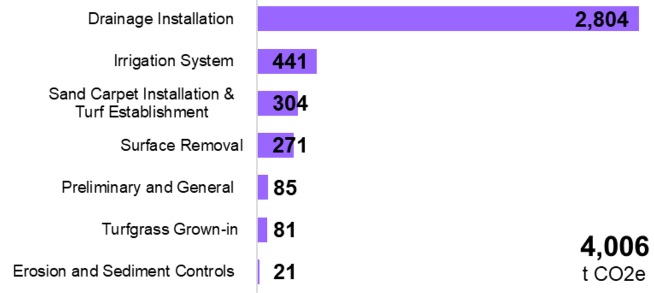
The following three capital projects (i.e., excluding renewals) have the highest built environment sector carbon and combined comprise of 55% of the total built environment sector carbon:

- CP0007200: New Wakatipu Waste Facilities (WM) (33% of built environment sector carbon)
- CP0007453: QEC - Training Fields Eastern End (12% of built environment sector carbon)
- CP0006938: QEC Field Improvements (10% of built environment sector carbon)

An overview of the emission and project asset breakdown for these three projects is provided in Figure 4.7. The emission breakdown in shown as stages A1-A3 (raw material supply, transport of raw material, and transport) and A4-A5 (transport to worksite and construction/installation processes). The New Wakatipu Waste Facilities (WM) project has majority of emissions associated with the A1-A3 stage, related to the construction of substructure and superstructure of the building.

The QEC - Training Fields Eastern End and QEC Field Improvements projects are both sports field projects and an additional column has been included on the emission breakdown stage graph for these two projects, namely “Gravity Sewer Open Trench (Field)”. This asset is unable to be broken down in to LCA stage due to issues associated with legacy data in the MCP. This is discussed further in Section 5.2. This asset is comprised of: the pipe material (used and wastage), pipe transport to site, excavation, pipe installation, backfill and reinstatement, commissioning and material disposal. It is likely that this asset follows a similar A1-A3 and A4-A5 breakdown as majority of the projects included in the baseline, with the A1-A3 stage comprising of majority of emissions. Looking at the assets within these two projects, the drainage installation is associated with majority of the emissions, followed by the irrigation system.

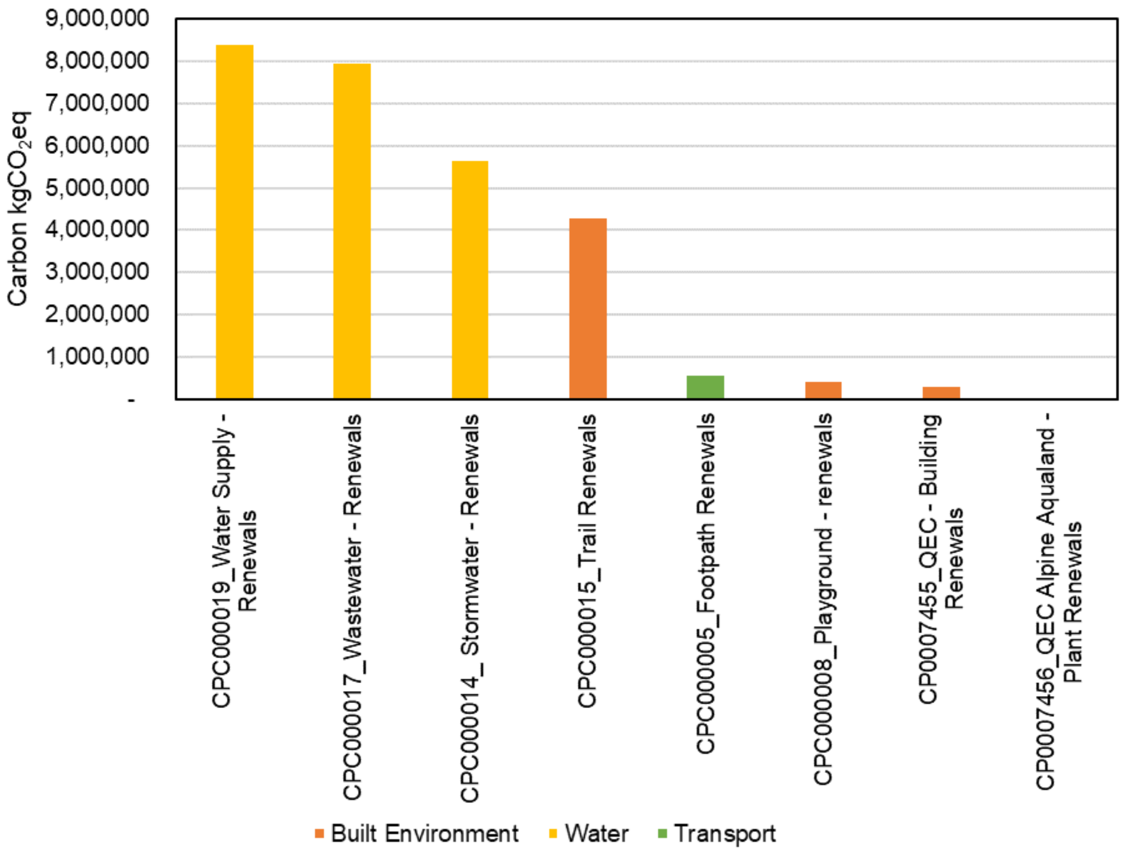
Figure 4.7: Built Environment project carbon breakdown (for the 3 highest capital carbon built environment projects – excluding renewals)

Project	Emission breakdown	Project asset breakdown
New Wakatipu Waste Facilities (WM)		
QEC - Training Fields Eastern End		
QEC Field Improvements		

4.5 Renewals

Within the baseline, 8 of the 67 projects were renewals of existing facilities. The carbon associated with these projects is 27,485 tCO_2eq, which is approximately 14% of the baseline. A summary of the carbon associated with the renewals projects is provided in Figure 4.8

Figure 4.8: Renewals projects predicted carbon



4.6 Carbon scope breakdown

The carbon breakdown by LCA module for each asset type per sector is shown in Figure 4.9. The figure shows that most of the carbon associated with the baselined projects is from materials. Construction materials (A1-A3) category includes emissions from the materials themselves including emissions from material waste, imported backfill, and material reinstatement. Finding lower carbon emission materials is one of the most effective ways of reducing capital carbon emissions. But in addition, solutions without substantial material requirements will also create opportunities for significant impacts on emissions – "building less" and repurposing assets.

Given that a large portion of the capital carbon emissions are from water services (pipes) and roads and within that from construction materials, there is opportunity to reduce capital carbon by targeting such assets. For example, optioneering based on installation methodology such as using trenchless technology and recycled pipes where available can reduce emissions across the capital programme. As asset owners, QLDC can play a key role in driving innovation in new low-carbon materials and technologies through the supply chain for these carbon-intensive areas.

Please note that the “not specified” category refers to miscellaneous items that have not been allocated to a LCA module type in the MCP. This mostly impacts the Recreational Area / Trails asset as discussed in Section 4.4.5 and some water sector assets.

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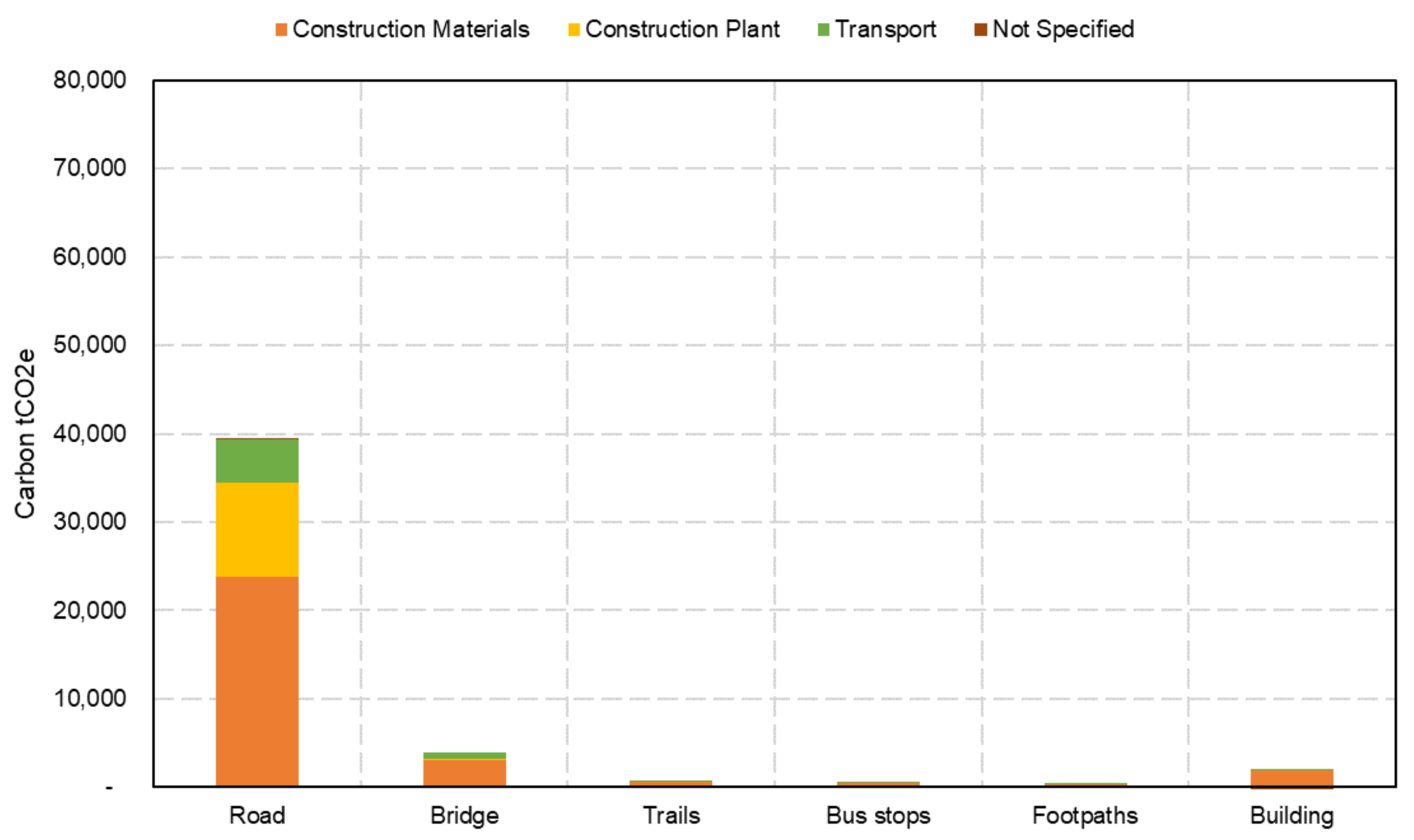
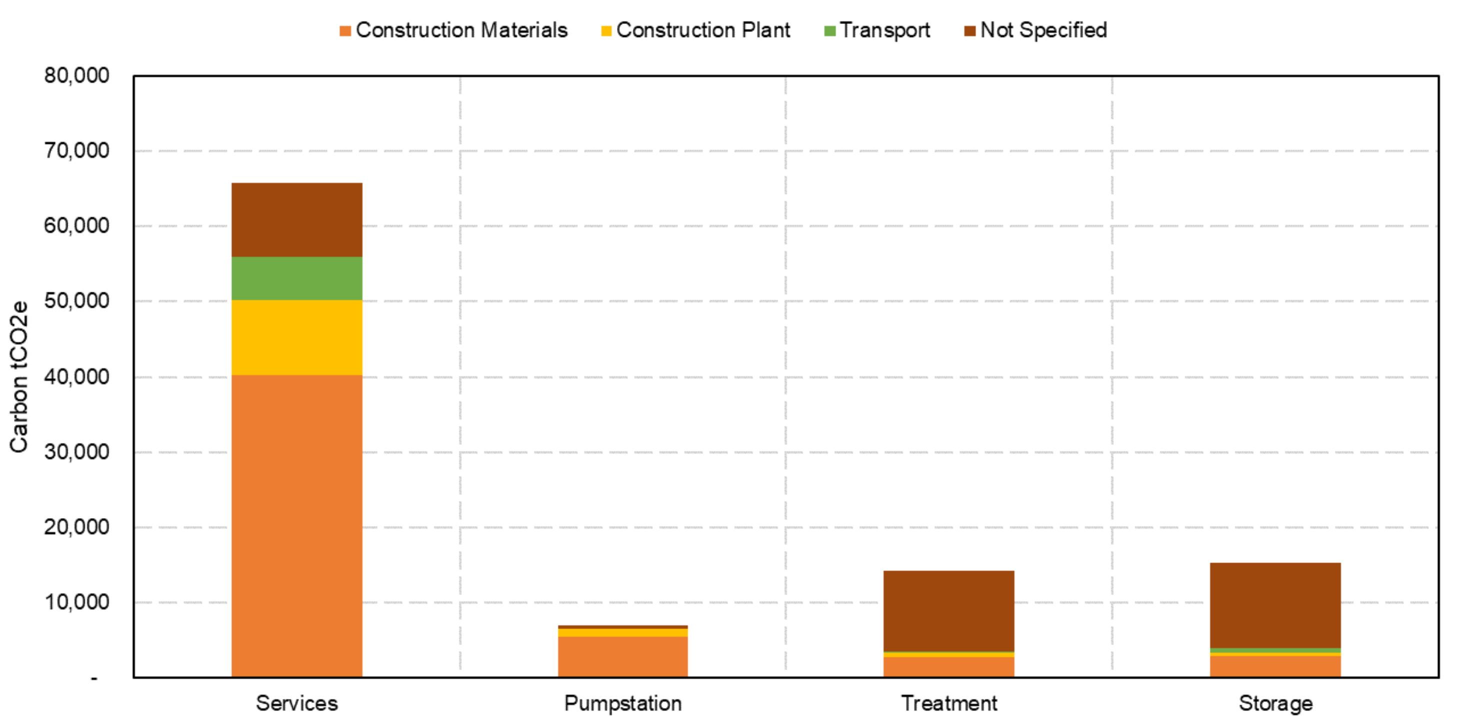
Figure 4.9: Capital carbon breakdown by asset type and LCA module

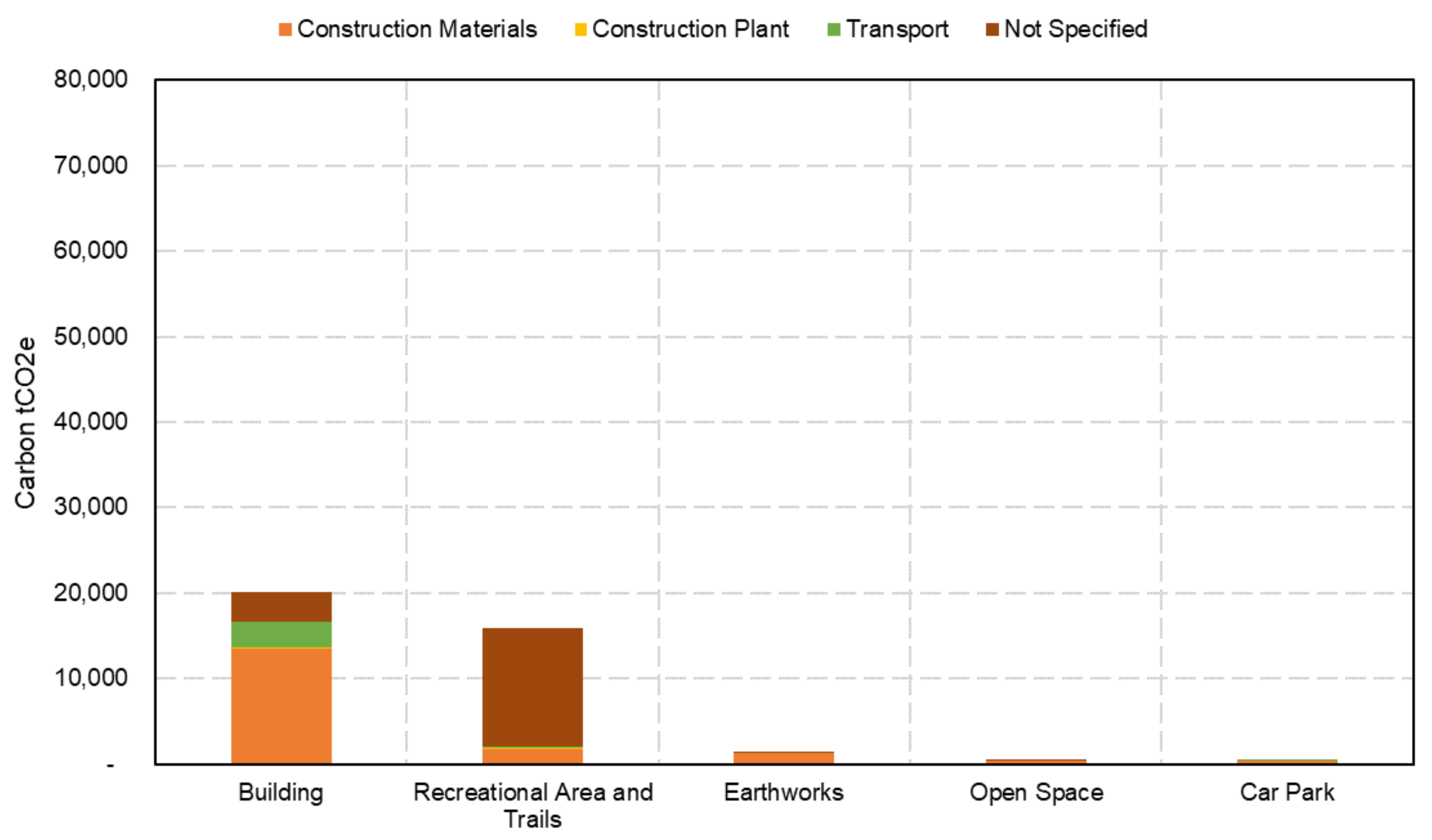
TRANSPORT



WATER



BUILT ENVIRONMENT



4.7 Summary of results

A summary of the results is as follows:

- The total capital carbon of the baselined projects (67 projects) is 186,668 tCO_2eq. This equates to a carbon/cost factor of 0.197$kgCO_2eq$/$.
- The water sector is responsible for 55% of total capital carbon, which is to be expected as the water sector comprises of the highest proportion of capital carbon, followed by the Transport (24%) and Built Environment (21%) sectors.
- A consistent relationship between cost and carbon can be seen across the baseline, however, the water sector has a slightly higher proportion of carbon compared to cost. Equally, the Built Environment sector has a lower carbon to cost, due to the lower emissions intensity of the assets modelled.
- The highest proportion of carbon is predicted to occur between 2022 and 2023 (47% of total carbon). A second peak is also predicted in 2030 (9% of total carbon).
- The three projects with the highest carbon emissions in the baseline combined comprise of approximately 20% of the total carbon accounted for in the baseline
- Within the Water sector, the highest proportion of carbon is associated with services (such as pipes) (35% of total carbon), followed by water storage (8% of total carbon). It was found that across the three water projects with the highest carbon, the construction materials associated with pipelines are the largest carbon source, followed by contributions from construction plant.
- Within the Transport sector, the highest proportion of carbon is associated with roads (21% of total carbon), followed by bridges (2% of total carbon). It was found that construction materials and construction plant associated with roads and road safety elements are the largest carbon source across three highest carbon projects.
- Within the Built Environment sector, the asset type responsible for the highest proportion of carbon is buildings (11% of total carbon), followed by recreational areas (6% of total carbon).
- The asset types identified above indicate the areas with the highest potential to drive down emissions going forward, discussed further in Section 6.2.

5 Functionality and limitations of the carbon baseline

The carbon design for each project (see list of projects in Appendix A) is available to QLDC on the MCP. The portal shows a breakdown for each carbon design. The result figures in this report and additional information are planned to be supplementary to the carbon designs.

5.1 Functionality

The carbon baseline and carbon designs have a level of functionality to allow QLDC to:

- Assess carbon at a project level. A breakdown of LCA module as well as a breakdown of carbon by folders is available within the carbon designs on the MCP.
- View the assumptions behind carbon designs and what conditions they are applicable under where available.
- Investigate impact on emissions by changing parameters within the carbon design (diameters, lengths of pipelines, number of assets, kW ratings, volumes, etc.).
- Freeze the carbon baseline. This will be done by transferring ownership of the baseline to a selected representative from QLDC. New design phases would copy a carbon design and update that for future design changes. This can be repeated at each design stage to track carbon over time.

5.2 Limitations

The main limitations of the carbon baseline are as follows:

- **Use of the baseline.** The accuracy of baselines has a margin of uncertainty. For this reason, the baseline should not be used as a tool to provide commercial incentives to QLDC's delivery partners without thorough and aligned cost modelling. Uncertainty has not been applied on the MCP so the carbon value for each carbon design is the base estimate.
- **Breakdown for excluded projects.** Projects from the screened list which have been excluded from this carbon baseline were not modelled in detail. Their emissions contribution has been calculated using a carbon/cost approximation. This limits the ability to understand the breakdown in terms of service area, asset type, and LCA module of these projects.
- **Data variability.** Each of the 67 projects had different quality and level of data available. This means that the assumptions made, and accuracy of carbon design vary.
- **Breakdown by material and LCA module.** Results have been analysed based on sector area, asset type, and in some cases LCA module. However, we are limited in our ability to breakdown carbon by material and in some cases LCA module due to issues associated with legacy data in the MCP. Over time, more comprehensive breakdowns will be available.

6 Conclusions and next steps

6.1 Conclusion

The 2021-31 LTP was filtered to only include physical assets over the selected timeframe – resulting in the "screened list" of 329 projects. Of this list projects were further screened and collated where relevant and 67 projects were chosen to be baselined in detail using the MCP. This was done by focussing on the projects which are likely to have the largest footprint – and therefore the largest opportunity to target carbon reductions.

The total capital carbon for these 67 baselined projects is 186,668 tCO_2eq for a total cost of $947MN. This equates to a carbon/cost factor of 0.197kgCO_2eq/$. These projects accounted for 83% of the cost of the screened list of 329 projects and 60% of the 627 projects in the LTP. By applying the carbon-cost factor, the total capital carbon can be estimated to be 225,000 tCO_2eq and 310,000 tCO_2eq, respectively.

It is important to note that the carbon-cost ratio provided in this report are based on the specific inputs provided by QLDC and other agreed assumptions and hence do not necessarily reflect broader practice across Aotearoa/New Zealand. The true correlation between cost and upfront carbon, in each sector and as an overall average for infrastructure, is not well-established. However, this baselining exercise is an important contributing piece of work to help establish this correlation on a broader Aotearoa/New Zealand level. As such, the 0.197kgCO_2eq/$ factor and other factors mentioned in this report should be interpreted with care and awareness that it may not apply outside of the context of this QLDC baseline exercise.

A summary of the results is as follows:

- The water sector is responsible for 55% of total capital carbon, which is to be expected as the water sector comprises of the highest proportion of capital carbon, followed by the Transport (24%) and Built Environment (21%) sectors.
- A consistent relationship between cost and carbon can be seen across the baseline, however, the water sector has a slightly higher proportion of carbon compared to cost. Equally, the Built Environment sector has a lower carbon to cost, due to the lower emissions intensity of the assets modelled.
- The highest proportion of carbon is predicted to occur between 2022 and 2023 (47% of total carbon). A second peak is also predicted in 2030 (9% of total carbon).
- The three projects with the highest carbon emissions in the baseline combined comprise of approximately 20% of the total carbon accounted for in the baseline
- Within the Water sector, the highest proportion of carbon is associated with services (such as pipes) (35% of total carbon), followed by water storage (8% of total carbon). It was found that across the three water projects with the highest carbon, the construction materials associated with pipelines are the largest carbon source, followed by contributions from construction plant.
- Within the Transport sector, the highest proportion of carbon is associated with roads (21% of total carbon), followed by bridges (2% of total carbon). It was found that construction materials and construction plant associated with roads and road safety elements are the largest carbon source across three highest carbon projects.
- Within the Built Environment sector, the asset type responsible for the highest proportion of carbon is buildings (11% of total carbon), followed by recreational areas (6% of total carbon).
- The asset types identified above indicate the areas with the highest potential to drive down emissions going forward, discussed further in Section 6.2.

6.2 Next steps

A capital carbon baseline can be seen as the beginning of a process; an important step towards developing and embedding a wider approach to infrastructure carbon management.

Below we have identified some potential next steps for consideration. These are based on our experience supporting other Councils and infrastructure providers to quantify and reduce infrastructure emissions. They are intended to build on the baseline by embedding carbon reduction into QLDC's capital programme delivery and governance, and to move from a capital carbon to whole-of-life carbon approach in support of wider net zero and resilience objectives.

We would be pleased to discuss these in more detail with QLDC.

6.2.1 Integrate carbon assessment and reduction into QLDC's capital delivery process

As QLDC delivers its long-term plan it will be important to consider carbon at key stages throughout the capital delivery process and maximise opportunities to reduce emissions. We understand that QLDC is already embarking on some of the following steps:

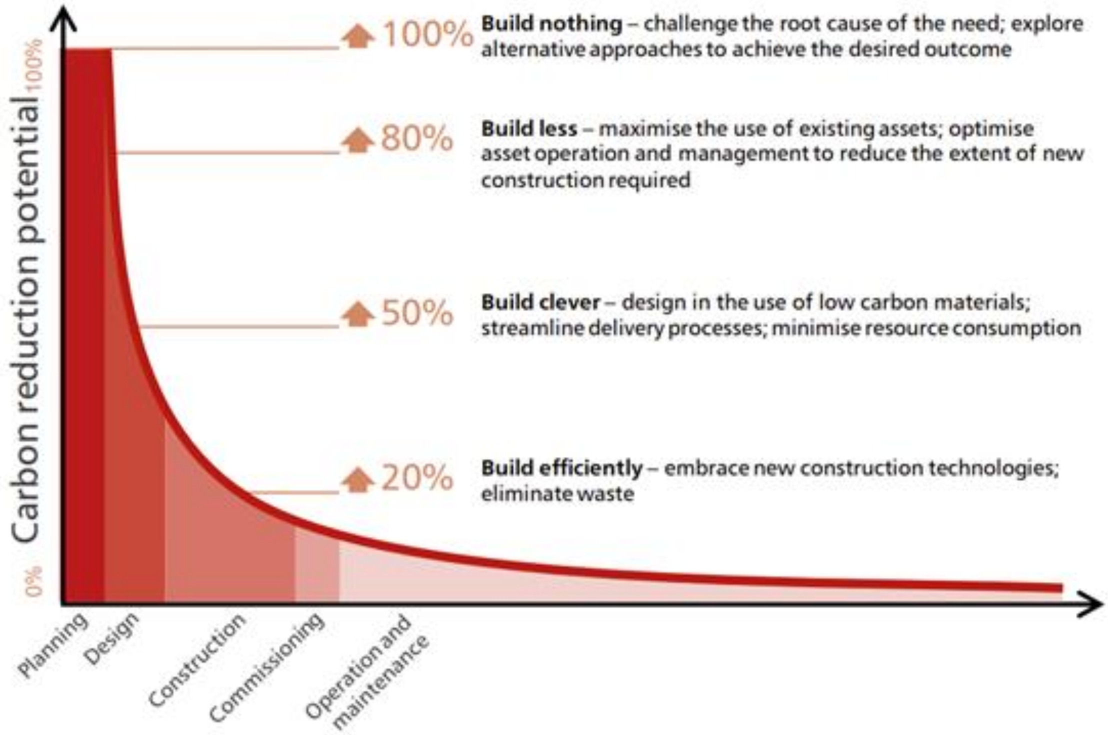
- **Assess, monitor, and report carbon**. Organisations typically track progress throughout the project delivery lifecycle against metrics such as cost and quality, feeding into stage-gate decisions. Introducing carbon assessments alongside these metrics is an important step for integrating emissions reduction into wider governance processes and for facilitating a culture of emissions reduction and continual improvement. At every stage, carbon impacts and reductions can be measured compared to the baseline. Where there are established delivery process, carbon assessments can be integrated within existing reporting requirements.
- **Set targets**. Setting targets for the reduction of infrastructure emissions can help to signal the direction of travel and align activities with wider climate change objectives. For example, Watercare has a target to reduce capital emissions by 40% by 2025.
- **Engage the supply chain and develop incentives**. Reducing emissions, particularly capital carbon, requires decisions and actions throughout the supply chain over a sustained period of time. Close collaboration is vital, and QLDC as an asset owner have a critical role in making this happen. For example, Wellington Water has created a Carbon Community Group with its consultant and contractor panel to engage on approaches to reduce carbon. In addition, carbon reduction can be built into incentive and procurement frameworks.
- **Tools, guidance, and training**. Embedding carbon reduction into a new BAU for infrastructure delivery will require upskilling and behaviour change both within and outside of QLDC. Developing the tools to support carbon assessments and optioneering (e.g., the Moata Carbon Portal) alongside delivering training and guidance / handbooks will be required.
- **Go beyond capital carbon**. The current baseline focusses on capital carbon (before use stage) but ultimately emissions should be assessed on a whole-life basis, also considering use stage and end-of-life emissions alongside wider system level impacts on infrastructure and people.

6.2.2 Embed carbon thinking at strategic and leadership levels

Often the best opportunities for reducing infrastructure emissions come at a very early stage, by challenging the need for new infrastructure in the first place or by identifying a different type of solution to meet a defined need. Unlocking these opportunities requires carbon thinking to be embedded in strategy and planning, alongside other key drivers such as cost and feasibility.

This approach is reflected in the carbon management hierarchy shown in Figure 6.1 below.

Figure 6.1: Carbon management hierarchy

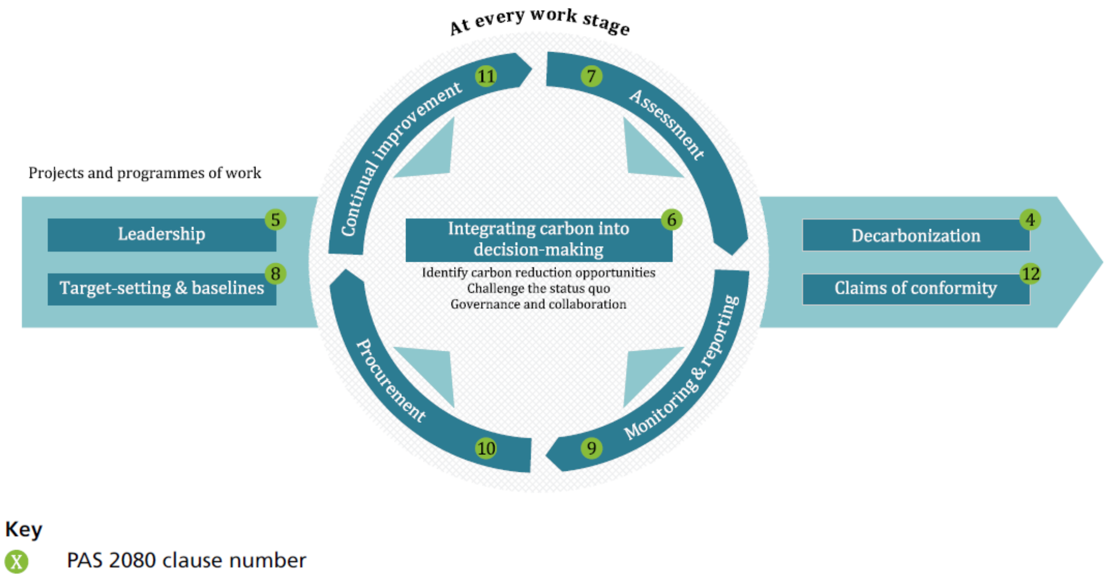


Source: Infrastructure Carbon Review, 2013; PAS 2080, 2016

In addition, embedding carbon management at the leadership level within infrastructure delivery organisations is a key principle behind the PAS2080 carbon management process – see **Figure 6.2**. PAS 2080 is a carbon management standard for infrastructure, updated in 2023. It provides a common language to all parts of the infrastructure value chain to reduce carbon and cost in infrastructure projects and programmes.[4]

[4] PAS 2080 | BSI (bsigroup.com)

Figure 6.2: PAS 2080 Carbon Management Process



***NOTE** The circled numbers are cross-references to the relevant clauses in this PAS.*

Source: PAS 2080:2023

For QLDC, a potential next step to embed carbon thinking into strategy and leadership would be to undertake a gap analysis to review the current situation and identify areas for improvement. This could then be developed into an implementation plan.

Globally, multiple asset owners have integrated the carbon management process outline in PAS 2080 into their management systems to help them deliver low-carbon and low-cost assets, whilst meeting project and programme outcomes. For example, Mott MacDonald have helped infrastructure owners in the UK such as Anglian Water, National Highways, Heathrow, National Grid and Yorkshire Water, and internationally including Abu Dhabi Sewer Services develop a carbon management strategy and action plans to show the steps needed to maximise whole life carbon reductions across a programme of work.

6.2.3 Develop a net zero strategy and transition plan

Increasingly, Councils and infrastructure asset providers are developing long-term strategies to reduce their emissions to net zero by 2050 or before. This is driven by many factors: Aotearoa's national climate change targets and evolving regulatory framework, requirements for climate risk disclosure and transition plans, awareness of the need to manage the risks associated with climate change, and the increasing expectations from civil society and businesses. Standards for setting targets and developing decarbonisation plans are becoming more stringent and require organisations to address both direct and indirect emissions from their activities.

For QLDC this means there is a need to consider not just emissions associated with new capital works (as per the baseline), but also the emissions associated with current infrastructure and activities. In the water sector these emissions can result from a wide variety of activities including biogenic methane (CH_4) and nitrous oxide (N_2O) from wastewater treatment, sludge disposal and effluent discharge; carbon dioxide (CO_2) from energy use (e.g., electricity, gas for drying, fuel for fleet vehicles); and the embodied emissions associated with water treatment chemicals and other purchased products. In the transport sector user emissions over the lifetime of assets are often the largest contributor, along with emissions associated with major renewals. In the buildings sector operational energy use – both gas and electricity – is where much of the opportunity lies for reducing emissions (especially for existing buildings).

Across sectors, reducing capital and operational emissions to net zero will require sustained effort and investment over decades. To support these objectives, it will be valuable for QLDC to develop sectoral infrastructure emissions reductions pathways through to 2050, engaging with stakeholders to identify and analyse decarbonisation options and different levels of ambition. This can then inform the development of a net zero strategy and action plan. This should be aligned with any wider QLDC climate change strategies and emissions reduction targets and plans.

6.2.4 Consider climate resilience and broader outcomes alongside carbon

The recent extreme weather events in Aotearoa have revealed how vulnerable our infrastructure assets and systems are to the impacts of climate change, and how this in turn impacts the critical services infrastructure provides to society.

As QLDC develops and delivers its long-term plan, and the governance processes that support this delivery, it will be important to ensure that carbon reduction is considered alongside resilience to the physical impacts of climate change and broader social and environmental outcomes. To deliver infrastructure that is fit for the future, infrastructure investment decisions must take account of these multiple factors. This must happen at strategy and leadership levels and flow down to all aspects of infrastructure management, planning and delivery.

A. List of projects baselined

Project code	Name	Design stage	Total budget	Total carbon (kgCO_2eq)
Built Environment				
CP0007691	516 Ladies Mile Community Centre	Concept	$3,660,000	34,715
CP0007451	Arrowtown Pool Upgrade	Not started	$4,180,641	47,792
CP0007477	Ball Rd Rec Cen - Carparking & Access	Not started	$3,555,703	520,888
CP0007475	Ball Rd Rec Cen - WW Site preparation	Concept	$5,333,918	1,269,231
CP0007476	Ballantyne Rd Rec Cen - Inf & ext works	Not started	$3,859,934	44,839
CP0007474	Ballantyne Road Rec Cen - Sports fields	Not started	$9,212,806	1,127,138
CPC000002	Buildings - Upgrades	Brief	$11,316,659	754,500
CPC000003	Concrete recreational areas	Not started	$3,832,155	213,469
CP0006369	Frankton Golf Course - New spend	Not started	$3,081,553	49,050
CP0007410	Kelvin Heights Trail Hilton Gabion Replacement	Not started	$3,656,777	21,614
CP0007360	Lakeview Development Market Square/Plaza	Brief	$5,119,385	392,207
CP0007692	Mitre 10 Youth & Community Centre	Concept	$4,145,000	84,368
CP0007580	PAC - Performing Arts Centre	Concept	$45,600,882	2,263,230
CPC000008	Playground - renewals	Brief	$4,148,730	396,759
CP0007452	QEC - Clubrooms	Not started	$6,419,903	533,564
CP0007455	QEC - Renewals	Brief	$4,512,704	300,750
CP0007454	QEC - WW Heat Recovery System	Brief	$4,848,311	24,783
CP0007456	QEC Alpine Aqualand - Plant Renewals	Brief	$3,196,579	21,417
CP0007453	QEC - Training Fields Eastern End	Not Started	$6,163,107	4,807,396
CP0006938	QEC Field Improvements	Brief	$4,722,485	4,006,163
CP0006730	Queenstown One Office (Project Connect)	Concept	$52,463,319	2,981,858
CP0007493	Southern Corridor - New Hall	Not started	$4,006,019	60,119
CPC000015	Trail Renewals	Brief	$4,866,430	4,265,469
CP0006977	Two new courts added to current stadium	Concept	$14,001,631	1,384,095
CP0006534	Wanaka Lakefront Development Plan	Build & commissioning	$5,850,00	601,537
CP0007200	New Wakatipu Waste Facilities (WM)	Concept	$32,675,761	12,710,314
Transport				
CPC000001	Active Travel - Transport	Brief	$26,651,483	700,099
CP0006766	Arterial - Balance of Route (TR)	Concept	$25,423,857	5,782,930
CP0006296	Arthurs Point Bridge - Road Crossing (TR)	Brief	$11,348,369	3,910,818
CPC000005	Footpath Renewals - Transport	Not started	$7,466,366	540,982
CP0006770	Lake Wakatipu Ferry Infrastructure Improvements (TR)	Concept	$6,040,089	64,623
CPC000007	Minor Improvements - Transport	Brief	$65,262,910	10,609,571
CPC000010	Public Transport	Brief	$11,530,786	555,462
CP0006773	QTN Public Transport Interchange (TR)	Not started	$18,082,346	470,430
CPC000011	Sealed Road Rehab - Transport	Brief	$18,874,403	4,874,717
CPC000012	Sealed Road Resurfacing - Transport	Brief	$20,547,901	13,348,325
CPC000021	Unsealed Road Metalling - Transport	Brief	$16,114,037	4,681,700
Water				
CP0006851	Aubrey Rd Rec Reserve SW detention pond	Design	$6,386,859	456,493
CP0006831	Kingston HIF New Scheme (SW)	Design	$6,455,084	608,184
CP0006544	SH6 - Glenda Dr Extension (SW)	Brief	$9,939,156	5,139,372
CPC000013	Stormwater - Network	Brief	$22,256,940	6,092,434
CPC000014	Stormwater - Renewals	Brief	$26,462,122	5,642,456
CP0004017	Frankton Beach to Shotover Conveyance (WW)	Concept	$9,687,391	1,913,921
CP0004028	Glenorchy Wastewater Scheme (WW)	Not started	$18,822,277	1,934,593
CP0007009	Kingston HIF New Scheme (WW)	Design	$20,185,746	1,316,238
CP0005931	Lake Esplanade Catchment Diversion (WW)	Not started	$6,624,445	213,375
CP0006284	Project Pure Upgrade (WW)	Construction	$21,729,217	2,892,497
CPC000009	PS Emergency Storage - WW	Brief	$26,234,118	5,637,649
CP0004015	Remarkables Park & Kawarau Pl PS (WW)	Brief	$7,026,983	6,709,793
CP0007295	Rising Main to Project Pure (WW)	Not started	$13,175,594	6,641,544
CP0007029	Southern Conveyance Network (WW)	Not started	$36,402,103	3,675,293
CPC000016	Wastewater - Pressure Network	Brief	$7,019,529	2,310,558
CPC000017	Wastewater - Renewals	Brief	$47,022,078	7,940,204
CP0006981	Arrowtown Water Storage (WS)	Not started	$6,274,092	2,235,867
CP0007182	Beacon Point Intake & Rising Main (WS)	Not started	$17,532,000	986,311
CPC000020	Glenorchy Reservoir upgrade (WS)	Design	$6,897,234	657,595
CP0007157	Hawea Reservoir Capacity (WS)	Brief	$6,987,969	1,409,207
CP0004050	Kingston HIF New Scheme (WS)	Concept	$11,674,056	1,449,382
CP0006988	Ladies Mile New Scheme (WS) HIF	Not started	$6,478,966	1,280,538
CP0006821	Ladies Mile Storage & Mains (WS) HIF	Not started	$7,459,966	1,687,967
CP0004629	Luggate Water Supply Scheme (WS)	Design	$6,355,729	629,832
CP0005920	Quail Rise Reservoir (WS)	Design	$16,145,816	3,650,732
CP0007179	Southern Corridor Water Treatment (WS)	Not started	$5,783,346	5,939,900
CP0004244	Two Mile WTP (WS)	Brief	$20,677,670	1,831,150
CP0007194	Wanaka Water Treatment (WS)	Brief	$35,756,350	5,124,261
CPC000018	Water Supply - Network	Brief	$15,404,156	7,826,963
CPC000019	Water Supply - Renewals	Brief	$16,813,716	8,376,942
Total	**-**	**-**	**$947,443,647**	**186,668,169**

B. Collated projects

Project code	Name	Number of projects	Total budget
Built Environment			
CPC000002	Buildings - Upgrades	53	$11,316,659
CPC000003	Concrete recreational areas	6	$3,832,155
CPC000008	Playground - renewals	2	$4,148,730
CPC000015	Trail Renewals	9	$4,866,430
Transport			
CPC000001	Active Travel - Transport	5	$26,651,483
CPC000005	Footpath Renewals - Transport	6	$7,466,366
CPC000007	Minor Improvements - Transport	8	$65,262,910
CPC000010	Public Transport	3	$11,530,786
CPC000011	Sealed Road Rehab - Transport	11	$18,874,403
CPC000012	Sealed Road Resurfacing - Transport	3	$20,547,901
Water			
CPC000009	PS Emergency Storage - WW	4	$26,234,118
CPC000013	Stormwater - Network	9	$22,256,940
CPC000014	Stormwater - Renewals	4	$26,462,122
CPC000016	Wastewater - Pressure Network	2	$7,019,529
CPC000017	Wastewater - Renewals	13	$47,022,078
CPC000018	Water Supply - Network	20	$15,404,156
CPC000019	Water Supply - Renewals	8	$16,813,716
Total	**-**	**166**	**$335,710,482**

C. Built Environment project specific assumptions

Project specific assumptions (please also refer to the MCP designs for more detail):

Built Environment		
Project code	**Name**	**Project Assumption**
CP0007691	516 Ladies Mile Community Centre	Quantities based on architectural concept drawings received. Based on the retrofit/upgrade works for the existing Ladies Mile Community Centre (retrofit covers approximately 275m2 of the total 440m2 building area) as well as the backfill and repave of the 270m2 pool area.
CP0007451	Arrowtown Pool Upgrade	Quantities based on architectural concept drawings received.
CP0007477	Ball Rd Rec Cen - Carparking & Access	Based on architectural masterplan received. Assumed sports fields based on QEC Field Improvements Sports fields (pro rata'd for area)
CP0007475	Ball Rd Rec Cen - WW Site preparation	Based on architectural masterplan received. Assumed concrete and top fill for Community Space Assumed 75% grass establishment and 25% Numat wetpour for green play spaces. Assumed grass establishment for all other areas and no buildings decided yet.
CP0007476	Ballantyne Rd Rec Cen - Inf & ext works	Based on architectural masterplan received. Assumed changing room is part of this project. Change room is assumed 2.5x Arrowtown change room (pro rata'd for area). No other buildings decided yet. Infrastructure and additional external works to be added once decided at future stage.
CP0007474	Ballantyne Road Rec Cen - Sports fields	Based on architectural masterplan received. Assumed sports fields based on QEC Field Improvements Sports fields (pro rata'd for area)
CPC000002	Buildings - Upgrades	Assumed GFA based on cost Assumed $3000 per m2 GFA of building renewal Assume 200kgCO2eq/m2 for building renewals
CPC000003	Concrete recreational areas	Based on description provided by QLDC: 8 x tennis courts in area i.e., 260sqm x 8. Concrete pad of 200mm thick. 20mpa concrete, 1 layer of steel reinforcement. Assume 4m high perimeter fencing.
CP0006369	Frankton Golf Course - New spend	Based on 2.5x Arrowtown change room (pro rata'd for area)
CP0007410	Kelvin Heights Trail Hilton Gabion Replacement	Based on cross sectional detail of wall. 255m of new rock revetment.
CP0007360	Lakeview Development Market Square/Plaza	Quantities based on cost estimate for concept design for the building.
CP0007692	Mitre 10 Youth & Community Centre	Quantities based on cost estimate received based on developed design information for the building. Assumed that this is a retrofit/upgrade for the existing Mitre 10 Building to convert into a Youth and Community Centre. Assumed GFA = 3350m2.
CP0007580	PAC - Performing Arts Centre	Based on 0.69x Queenstown One (pro rata'd for area) Uplift of 10% on calculated carbon to account for difference between commercial office versus theatre space in terms of likely complexity of design

CPC000008	Playground - renewals	Quantities based on Tender Package for Queenstown Play space. Assumed the capital cost of the project= capital cost for Queenstown Play space
CP0007452	QEC - Clubrooms	Based on description provided by QLDC: Two story building extension (add on to existing building) to gym and new clubrooms. Steel building. 2000sqm over both floors. Based on 0.25x Queenstown One (pro rata'd for area) Lowered rate of 10% on calculated carbon to account for difference between commercial office versus clubroom in terms of likely complexity of design
CP0007455	QEC - Renewals	Assumed GFA based on cost Assumed $3000 per m2 GFAof building renewal Assume 200kgCO2/eq/m2 for building renewals
CP0007454	QEC - WW Heat Recovery System	Assumed Heat Pump Option 5 selected (over 10 years). Total Cost of Option 5 = $3,367,188 where construction cost = $2,155,000 and margins = $1,212,188 (50% of construction cost). Assumed a plant renewal rate of 15% over 10 years (percentage of construction cost). Therefore, this project Total carbon = 1.15 x cost rate Assumed 10kgCO2eq/$1000 (0.01kgCO2eq/$) rate for construction cost of initial plant equipment & plant renewals.
CP0007456	QEC Alpine Aqualand - Plant Renewals	Assumed total project is plant renewals only (over 10 years). Assumed budget is 50% margins (based on cost estimate for QEC - WW Heat Recovery System). I.e., construction cost of plant renewals = total budget/1.5. Therefore, total carbon = total budget/1.50 x cost rate Assumed 10kgCO2eq/$1000 (0.01kgCO2eq/$) rate for construction cost of plant equipment renewals
CP0007453	QEC - Training Fields Eastern End	Based on Sports fields calculated for CP0006938_QEC Field Improvements project. Pro rata'd for cost per field. This project is approx. 12 fields. Multiplier of 6x on the 2 Sports fields to account for a total of 12 fields
CP0006938	QEC Field Improvements	Quantities based on cost estimates received for each of the fields. Approximate cost of 1 field renewal is $500,000 (approx. 22,000sqm of field) This project folder has been pro rata'd to account for total capital cost of the field improvements i.e., $4,755,485/ (2 fields x $500,000) = 4.75 fields = 5 field improvements. Multiplier of 2.5x on the 2 Sports fields to account for total of 5 fields.
CP0006730	Queenstown One Office (Project Connect)	Quantities based on cost estimate received for the Civic Administration Building (CAB).
CP0007493	Southern Corridor - New Hall	Quantities based on architectural drawings received for the structure of Luggate Hall (memorial centre) - assumed Southern Hall will be of the same size and scale
CPC000015	Trail Renewals	The baseline is based on 81 km of track renewal that is 2.5m wide. The entire track is assumed to be Detailed Trail Grade Specification 1.
CP0006977	Two new courts added to current stadium	Quantities based on a Revit model provided, which did not include the building Structure or Foundations. MM therefore undertook our own high-level structural system estimates for superstructure and foundation for the building. In the next phase, the quantities for these estimates must be updated by the project structural designer.
CP0006534	Wanaka Lakefront Development Plan	Quantities based on cost estimate received based on concept design information for the lakefront.
CP0007200	New Wakatipu Waste Facilities (WM)	Quantities based on cost estimate received based on preliminary design information for the waste facility. Carbon for Specific Plant: Waste Management Plant & Equipment has been estimated - Specific supplier information is required for carbon calculation at the next phase.

See below table for building service elements estimate for each project:

Project code	Name	Usage	Placeholder Impact
Reference	Ministry of Education	School	GFA rate = 15kgCO2eq/m2.
CP0007451	Arrowtown Pool Upgrade	Change rooms & kiosk	Estimate as a GFA rate = 20kgCO2eq/m2.
CP0007477	Arrowtown Pool Upgrade	Pool plant room	Estimate as a GFA rate = 40kgCO2eq/m2.
CP0007475	Arrowtown Pool Upgrade	Shelter and storage	Estimate as a GFA rate = 15kgCO2eq/m2.
CP0007360	Lakeview Development Market Square/Plaza	Market square	Estimate as a GFA rate = 10kgCO2eq/m2.
CP0007692	Mitre 10 Youth & Community Centre	Youth and Community Centre (retrofit)	Estimate as a GFA rate = 10kgCO2eq/m2.
CP0007454	QEC - WW Heat Recovery System	Heat recovery system	Estimate as a cost rate = 0.01kgCO2eq/$
CP0007456	QEC Alpine Aqualand - Plant Renewals	Plant Renewal	Estimate as a cost rate = 0.01kgCO2eq/$
CP0006730	Queenstown One Office (Project Connect)	Commercial 4 storey steel building	Estimate as a GFA rate = 20kgCO2eq/m2.
CP0007493	Southern Corridor - New Hall	Memorial centre 1 storey timber building	Estimate as a GFA rate = 25kgCO2eq/m2.
CP0006977	Two new courts added to current stadium	2 Indoor Sports Courts + Change Room	Estimate as a GFA rate = 20kgCO2eq/m2.
CP0006534	Wanaka Lakefront Development Plan	Stage 4 upgrade works	Estimate as a total carbon rate = 20% on Stage 4 total calculated carbon.
CP0006534	Wanaka Lakefront Development Plan	Stage 5 upgrade works	Estimate as a total carbon rate = 10% on Stage 5 total calculated carbon.
CP0007200	New Wakatipu Waste Facilities (WM)	Waste Facility	Estimate as a GFA rate = 15kgCO2eq/m2.

See below table for miscellaneous items for each project:

Project Code	Project	Description	Placeholder Impact
CP0007451	Arrowtown Pool Upgrade	Other (in each Misc folder of the 2 buildings)	Estimate as a percentage = 10% of total calculated carbon
CP0007692	Mitre 10 Youth & Community Centre	Other	Estimate as a percentage = 10% of total calculated carbon
CP0007580	PAC - Performing Arts Centre	Other (uplift for converting commercial to theatre use)	Estimate as a percentage = 10% of total calculated carbon
CP0006730	Queenstown One Office (Project Connect)	Other	Estimate as a percentage = 10% of total calculated carbon
CP0007493	Southern Corridor - New Hall	Other	Estimate as a percentage = 10% of total calculated carbon
CP0007452	QEC - Clubrooms	Other (lowered rate for converting commercial to clubroom use)	Estimate as a percentage = -10% of total calculated carbon

CP0006534	Wanaka Lakefront Development Plan	Other (drainage, allowance for make good, markings, rain gardens, services etc.)	Estimate as a percentage = 20% on Stage 4 (Superstructure + Substructure) total calculated carbon
CP0006534	Wanaka Lakefront Development Plan	Other (balustrades, irrigation system, services, pavement lining etc.)	Estimate as a percentage = 10% on Stage 5 (Superstructure + Substructure) total calculated carbon
CP0007692	New Wakatipu Waste Facilities (WM)	Other (Specific Plant: Waste Management Plant & Equipment)	Estimate as a percentage = 20% of total calculated carbon

See below table for combined/total uncertainty for each project:

Project code	Project	Scoping stage	Scoping Uncertainty	Modelling Stage	Modelling Uncertainty	Combined Uncertainty
CP0007691	516 Ladies Mile Community Centre	Concept	35%	Definition	30%	**65%**
CP0007451	Arrowtown Pool Upgrade	Not started	40%	Definition	30%	**70%**
CP0007477	Ball Rd Rec Cen - Carparking & Access	Not started	40%	Not started / brief	50%	**90%**
CP0007475	Ball Rd Rec Cen - WW Site preparation	Concept	35%	Not started / brief	50%	**85%**
CP0007476	Ballantyne Rd Rec Cen - Inf & ext works	Not started	40%	Not started / brief	50%	**90%**
CP0007474	Ballantyne Road Rec Cen - Sports fields	Not started	40%	Not started / brief	50%	**90%**
CPC000002	Buildings - Upgrades	Brief	40%	Not started / brief	50%	**90%**
CPC000003	Concrete recreational areas	Not started	40%	Not started / brief	50%	**90%**
CP0006369	Frankton Golf Course - New spend	Not started	40%	Not started / brief	50%	**90%**
CP0007410	Kelvin Heights Trail Hilton Gabion Replacement	Not started	40%	Definition	30%	**70%**
CP0007360	Lakeview Development Market Square/Plaza	Brief	40%	Definition	30%	**70%**
CP0007692	Mitre 10 Youth & Community Centre	Concept	35%	Design	25%	**60%**

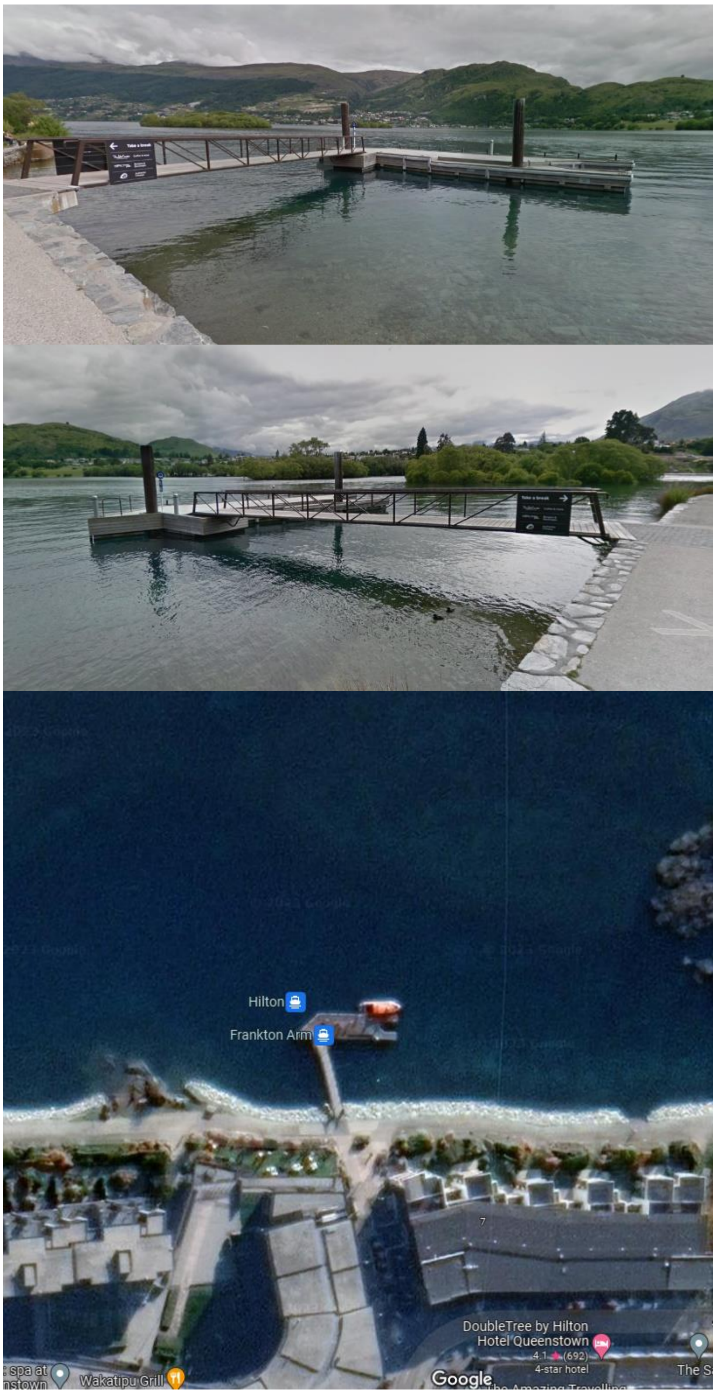
Project code	Project	Scoping stage	Scoping Uncertainty	Modelling Stage	Modelling Uncertainty	Combined Uncertainty
CP0007580	PAC - Performing Arts Centre	Concept	35%	Not started / brief	50%	**85%**
CPC000008	Playground - renewals	Brief	40%	Concept	40%	**80%**
CP0007452	QEC - Clubrooms	Not started	40%	Not started / brief	50%	**90%**
CP0007455	QEC - Renewals	Brief	40%	Not started / brief	50%	**90%**
CP0007454	QEC - WW Heat Recovery System	Brief	40%	Not started / brief	50%	**90%**
CP0007456	QEC Alpine Aqualand - Plant Renewals	Brief	40%	Not started / brief	50%	**90%**
CP0007453	QEC - Training Fields Eastern End	Not Started	40%	Definition	30%	**70%**
CP0006938	QEC Field Improvements	Brief	40%	Design	25%	**65%**
CP0006730	Queenstown One Office (Project Connect)	Concept	35%	Design	25%	**60%**
CP0007493	Southern Corridor - New Hall	Not started	40%	Concept	40%	**80%**
CPC000015	Trail Renewals	Brief	40%	Concept	40%	**80%**
CP0006977	Two new courts added to current stadium	Concept	35%	Definition	30%	**65%***
CP0006534	Wanaka Lakefront Development Plan	Build & commissioning	15%	Definition	30%	**45%**
CP0007200	New Wakatipu Waste Facilities (WM)	Concept	35%	Design	25%	**60%**

* Unique combined uncertainty for the CP0006977 project due to possible structural system quantity refinement at next design stages.

D. Transport project specific assumptions

Project specific assumptions (please also refer to the MCP designs for more detail)

Transport		
Project code	**Name**	**Project Assumption**
CP0006296	Arthurs Point Bridge - Road Crossing (TR)	Assume 15% of earthworks is required to be taken off site Timber quantity has been taken as 25% of the operations and maintenance amount (as this is stated in the assumptions of the WSP report). Retaining wall assumed to be on average 0.35m thick. Steel reinforcement for retaining wall assumed to be 15% of concrete volume.
CP0006766	Arterial - Balance of Route (TR)	For the arterial road, pavement layers were assumed as following: -Asphalt 100mm -Basecourse 200mm -Subbase 250mm -Subgrade 300mm For the roundabout: Road pavement reconstruction assumed to be 150m2. Pavement layers were assumed as follows: -Asphalt 100mm -Basecourse 150mm -Subbase 250mm -Subgrade 300mm Centre island was assumed to be 15m in diameter and 150mm thick. Four splitter islands were assumed to be total 300m2 in area and 150mm thick. Roundabout sign: Triangle 866mm wide and 750mm high with supplementary 600mm by 250mm Shared path specifications were modelled the same as the shared path in the Active travel project.
CP0006770	Lake Wakatipu Ferry Infrastructure Improvements (TR)	Jetty assumptions based on these images:



Jetty: 6mx25m in size

2 piles for each jetty, 400mm diameter, 7 length, made of 30mpa concrete and steel.

150m2 of timber boardwalk assumed for one jetty, made out of 30mpa concrete, steel bars, AP40 fill, sand, damp proof membrane.

Timber deck structure made out of hardwood timber, 50mm depth. Timber edges made out of sections 50Wx185H. Timber softwood assumed for Nogs (100x50) @1200crs. Timber softwood assumed for bottom plate (90x45 H4 SG8) @1200crs. Timber softwood assumed for joists (140x45) @500crs.

		Polyethylene floats assumed to be 500mm x 500mm along the perimeter of the jetty. Assume 15% of total volume is plastic. 10% uplift assumed for miscellaneous items.
CP0006773	QTN Public Transport Interchange (TR)	Assumed to be 17% of Queenstown One Office. Multiplier calculated by: (3floors*450sqm)/(4floors*2000sqm) = 0.168
CPC000001	Active Travel - Transport	Kerb and channel is only on one side for the new shared path. The retrofit shared path is 1.2m wide (assumes existing path is 1.8m and therefore 1.2m to be added on for 3m width) For the retrofit shared path, kerb and no channel has been assumed.
CPC000005	Footpath Renewals - Transport	Assumed addition of 50mm of basecourse (as this is a renewal)
CPC000007	Minor Improvements - Transport	The minor improvements costing consists of the following:

Type of works	% of capital work	Total capital works	~ cost per unit	No. units	Unit
Small painted roundabout with RSPs on approach	6%	$3,915,775	$180,000	22	Each
Curb island crossings and curb build outs	3%	$1,957,887	$15,000	131	Each
Guardrails	35%	$22,842,019	$200	114,210	m
Medium semi mountable roundabout	13%	$8,484,178	$400,000	21	Each
Raised safety platforms and signals	10%	$6,526,291	$60,000	109	Each
Signage	8%	$5,221,033	$400	13053	Each
VMS school signs and static school signs and RSPs	**4%**	**$2,610,516**	**-**	**-**	**-**
VMS school signs	*19%*	*$495,998*	*$15,000*	*33*	*Each*
Static School Signs	*1%*	*$26,105*	*$350*	*75*	*Each*
RSPs	*80%*	*$2,088,413*	*$15,000*	*139*	*Each*
Small roundabout with semi mountable island	21%	$13,705,211	$120,000	114	Each
Total	**100%**	**$65,262,910**			

- Steel pole 4m
- Large sign (1900mm by 2700 mm) - 870 units.
  - Two concrete foundations per sign, 600mm by 500mm by 500mm each
  - Steel pole 5m each (two poles)

VMS School signs and static school signs and RSPs

- VMS school signs
  - School speed flashing with kura school supplementary
  - https://www.hmi.co.nz/en-nz/products/road-traffic-systems/school-zone-sign
  - Includes solar panel area (assumed 0.16m2 area and 1.44kg total weight)
  - Concrete foundation 600mm by 400mm by 400mm
- Static school signs
  - Standard school signs (600mm by 600mm with supplementary 600mm by 400mm)
    - Standard concrete foundation
    - 3.5m steel pole
  - Speed limit + kura (650mm by 130mm)
    - 600mm by 400mm by 400mm concrete foundation
    - 5m steel pole
  - Kura Static variable (860mm by 1740mm)
    - 600mm by 400mm by 400mm concrete foundation
    - 5m steel pole
- RSPs
  - 5m3 concrete volume for one platform
  - Double layer of steel mesh assumed
  - 2 Hump + speed sign included

CPC000010	Public Transport	Excluded timber ski rack, timber bench, mains power for lights, tactile pavers, rubbish bins. Bus shelter: Based on this image: https://arashelters.co.nz/products/portal_shelters/#group_1154-3 10mm thickness of glass assumed for Bus shelter. Perforated aluminium panels assumed 1.6mm thickness and 40% holes. https://meshstore.co.nz/perforated-metal/r06440-perforated-metal-sheet6-4mm-round-40-open-area/ Roof assumed to be Colorsteel Endura 0.5mm BMT (NZ Steel). Aluminium frame assumed to be 100mm square hollow sections, 5mm walls, unit weight 5.13kg/m. Column total length = 17m. Top, middle, bottom bar total length = 25.3m. Road pavement reconstruction assumed thicknesses: -Asphalt 40mm -Basecourse 100mm

		-Subbase 250mm Bike rack: based on this product: https://www.securabike.com/Shop/Bike-Racks/Compact-Flat-Pack-4-Bike-Rack-Galvanised 30kg mass of steel per unit (stated at link above)
CPC000011	Sealed Road Rehab - Transport	For non-standard rehabilitation: -Foam bitumen stabilisation of existing basecourse is assumed to be at 3% by mass of the existing basecourse (assumed to be 150mm)
CPC000012	Sealed Road Resurfacing - Transport	Assume 30mm of existing seal is milled and disposed. A double coat of chipseal has been assumed (30mm total)
CPC000021	Unsealed Road Metalling - Transport	Assumed basecourse thickness of 200mm.

E. Water project specific assumptions

Project specific assumptions (please also refer to the MCP designs for more detail)

Water		
Project code	**Name**	**Project Assumption**
CP0004015	Remarkables Park & Kawarau Pl PS (WW)	Assumptions detailed in MCP
CP0004017	Frankton Beach to Shotover Conveyance (WW)	Assumptions detailed in MCP
CP0004028	Glenorchy Wastewater Scheme (WW)	Assumptions detailed in MCP
CP0004050	Kingston HIF New Scheme (WS)	Assumptions detailed in MCP
CP0004244	Two Mile WTP (WS)	The supporting report provided states the flow as 20.4MLD, which was applied in the MCP. DAF - Have not included coagulant therefore a poly electrolyte was added. Pumps were not included and therefore the submersible pumps have been included separately.
CP0004629	Luggate Water Supply Scheme (WS)	Assumptions detailed in MCP
CP0005920	Quail Rise Reservoir (WS)	Assumptions detailed in MCP
CP0005931	Lake Esplanade Catchment Diversion (WW)	Assumptions detailed in MCP
CP0006284	Project Pure Upgrade (WW)	Assumptions detailed in MCP
CP0006544	SH6 - Glenda Dr Extension (SW)	Assumptions detailed in MCP
CP0006821	Ladies Mile Storage & Mains (WS) HIF	Assumptions detailed in MCP
CP0006831	Kingston HIF New Scheme (SW)	Assumptions detailed in MCP
CP0006851	Aubrey Rd Rec Reserve SW detention pond	Assumptions detailed in MCP
CP0006981	Arrowtown Water Storage (WS)	Assumptions detailed in MCP
CP0006988	Ladies Mile New Scheme (WS) HIF	Assumptions detailed in MCP
CP0007009	Kingston HIF New Scheme (WW)	Assumptions detailed in MCP
CP0007029	Southern Conveyance Network (WW)	Assumptions detailed in MCP

CP0007157	Hawea Reservoir Capacity (WS)	Assumptions detailed in MCP
CP0007179	Southern Corridor Water Treatment (WS)	Assumptions detailed in MCP
CP0007182	Beacon Point Intake & Rising Main (WS)	Assumptions detailed in MCP
CP0007194	Wanaka Water Treatment (WS)	Assumptions detailed in MCP
CP0007295	Rising Main to Project Pure (WW)	Assumptions detailed in MCP
CPC000009	PS Emergency Storage - WW	Assumptions detailed in MCP
CPC000013	Stormwater - Network	Assumptions detailed in MCP
CPC000014	Stormwater - Renewals	Assumptions detailed in MCP
CPC000016	Wastewater - Pressure Network	Assumptions detailed in MCP
CPC000017	Wastewater - Renewals	Assumptions detailed in MCP
CPC000018	Water Supply - Network	Assumptions detailed in MCP
CPC000019	Water Supply - Renewals	Assumptions detailed in MCP
CPC000020	Glenorchy Reservoir upgrade (WS)	Assumptions detailed in MCP

F. Project data supplied by QLDC

Project code	Name	Design stage	Total budget	Project data provided by QLDC
Built Environment				
CP0007691	516 Ladies Mile Community Centre	Concept	$3,660,000	Information provided in external folder
CP0007451	Arrowtown Pool Upgrade	Not started	$4,180,641	17m x 9m building (male & female changing rooms + kiosk and staff room) concrete floor slab, corrugate iron galvanised cladding roofing. New shade structure - 4x12m slatted timber on steel portal frame, concrete slab. New plant room - 16 x 4.5m. Pit trenches as required, pool equipment and domestic HWC for showers (heated by new boiler)
CP0007477	Ball Rd Rec Cen - Carparking & Access	Not started	$3,555,703	800m of 7m wide carriageway. asphalt surfacing with 200mm of AP40 and 300mm of AP65). Est carparks 150.
CP0007475	Ball Rd Rec Cen - WW Site preparation	Concept	$5,333,918	Masterplan in progress. 20 hectares of contaminated land. Removal and disposal - controlled landfill. Potentially cap half the area .
CP0007476	Ballantyne Rd Rec Cen - Inf & ext works	Not started	$3,859,934	Provision for sports fields. 6 sports fields (10,000sqm per pitch = 65,000sqm) + community facility/changing room. Likely timber frame, single story, 300sqm.
CP0007474	Ballantyne Road Rec Cen - Sports fields	Not started	$9,212,806	Information provided in external folder
CPC000002	Buildings - Upgrades	Brief	$11,316,659	Split 61% - Structural/Building, 15% electrical, 2% plumbing, 4% HVAC, 6% painting, 12% furniture.
CPC000003	Concrete recreational areas	Not started	$3,832,155	Assume 8 x tennis courts in area, i.e. 260sqm x 8. Concrete pad of 200mm thick. 20mpa concrete, 1 layer of steel reinforcement. Assume 4m high perimeter fencing.
CP0006369	Frankton Golf Course - New spend	Not started	$3,081,553	Remodelling and new clubhouse. Demolition of existing building. Single story, prefab, same size building as current. 350m²
CP0007410	Kelvin Heights Trail Hilton Gabion Replacement	Not started	$3,656,777	255m of new rock revetment, semi-submerged along the shore of Lake Whakatipu. Details of wall in provided in external folder
CP0007360	Lakeview Development Market Square/Plaza	Brief	$5,119,385	Information provided in external folder
CP0007692	Mitre 10 Youth & Community Centre	Concept	$4,145,000	Information provided in external folder
CP0007580	PAC - Performing Arts Centre	Concept	$45,600,882	New 3 storey, steel frame building, 1200m² floor area
CPC000008	Playground - renewals	Brief	$4,148,730	Renewals program is informed by Weekly, quarterly and annual inspections carried out on the playground assets across the district. This could mean undersurface top ups to meet NZS Standards, replacement of specific play features (swings) or full playground replacement. Information provided in external folder
CP0007452	QEC - Clubrooms	Not started	$6,419,903	Two story building extension (add on to existing building) to gym and new clubrooms. Steel building. 2000sqm over both floors.
CP0007455	QEC - Renewals	Brief	$4,512,704	Split 61% - Structural/Building, 15% electrical, 2% plumbing, 4% HVAC, 6% painting, 12% furniture.
CP0007454	QEC - WW Heat Recovery System	Brief	$4,848,311	Information provided in external folder
CP0007456	QEC Alpine Aqualand - Plant Renewals	Brief	$3,196,579	Year 2 works in folder, similar works to be completes across the LTP
CP0007453	QEC - Training Fields Eastern End	Not Started	$6,163,107	Based on QEC Field improvements
CP0006938	QEC Field Improvements	Brief	$4,722,485	Information provided in external folder
CP0006730	Queenstown One Office (Project Connect)	Concept	$52,463,319	4 storey steel frame building, 2000m² per floor
CP0007493	Southern Corridor - New Hall	Not started	$4,006,019	Information provided in external folder, Southern corridor new hall will be based on Luggate Hall building
CPC000015	Trail Renewals	Brief	$4,866,430	Scope based on collated budget for Trail Renewals, $4,866,430. Scope based on QLDC Grade 1 Premier trail standard. 81km of trail renewal.
CP0006977	Two new courts added to current stadium	Concept	$14,001,631	4000sqm steel frame building. 10m pitch roof. Changing rooms included.
CP0006534	Wanaka Lakefront Development Plan	Build & commissioning	$5,850,00	Information provided in external folder. Budget has been updated from $11m to $5,850,00 to reflect stages 4 & 5 only.
CP0007200	New Wakatipu Waste Facilities (WM)	Concept	$32,675,761	Information provided in external folder
Transport				
CPC000001	Active Travel - Transport	Brief	$26,651,483	Assume total network is 50km long. Approximately 50% of network has been delivered under Low Cost, Low Risk package already. Therefore approximately 25km remains in LTP under noted budget. Assume 30% budget will be spent on new infrastructure, assume 70% budget spent on retrofitting existing infrastructure. Scope for new shared path is 7.5km 3m wide AC including: 100mm deep AP40 basecourse, 30mm DG10 and kerb and channel along full length. Scope for retrofit shared path is 13.5km, 3m wide including 7km of new raised kerb and paint marking along length. Appropriate signage should be included also, assume 1nr. new sign every 400m.
CP0006766	Arterial - Balance of Route (TR)	Concept	$25,423,857	1.5km of arterial road with 500m of 5m high retaining, 9m wide carriageway with 3m shared path and roundabout. 10000m³ earthworks. - inc. haulage distances, etc. Demolition of Memorial Hall. 600m of WW rising main DN375 PN16 PE100, 600m W rising main DN450 PN16 PE100
CP0006296	Arthurs Point Bridge - Road Crossing (TR)	Brief	$11,348,369	Steel vehicle bridge with concrete abutments, 65m long, 2 lane carriageway deck 4m wide lanes, 2nr. footpaths, guard rails.
CPC000005	Footpath Renewals - Transport	Not started	$7,466,366	41.5km of DG10 surfacing footpath at a width of 1.8m.
CP0006770	Lake Wakatipu Ferry Infrastructure Improvements (TR)	Concept	$6,040,089	3nr. New jetties with floating deck. 2nr. 400mm dia steel driven piles with polyethelene jackets, 7m in length. Rectangular timber deck with steal frame structure, 4m wide and 15m long in total. Deck underside fixed with polyethelene floats and deck fixed to piles with cylindrical fixings to allow movement. Timber lean-to waiting building. Timber frame with 1nr. open side and corrugated roofing. 5m x 3m in plan.
CPC000007	Minor Improvements - Transport	Brief	$65,262,910	Refer to scope split in 'Transport - Minor Improvements'.
CPC000010	Public Transport	Brief	$11,530,786	62nr. Bus stop shelters, aluminium shelters 3.2m, toughened glass, bike racks galv 4 slot, slab 150mm thick with 663 reo mesh 10x4m, 50mpa, timber ski rack, timber bench, mains power for lights, tactile pavers, rubbish bins alu (optional). Kerb realignment (15m) and pavement construction for all bus stop pull off areas. 60m2 each.
CP0006773	QTN Public Transport Interchange (TR)	Not started	$18,082,346	Demolition of existing Liquor King building. Construction of 3 storey building for waiting, ticketing, convenience, etc. Steel frame building. 1500m2 of pavement upgrade. include for structural AC surfacing 200mm deep, 150mm AP40. Building footprint assumed to extend length of liquor king and from Stanley Street through to Athol Street.
CPC000011	Sealed Road Rehab - Transport	Brief	$18,874,403	Standard rehab = existing seal and basecourse (assume 150mm deep) milled and relaid. 150mm AP40 basecourse and chipseal (2 coats). Non-standard rehab = existing seal milled and Foam Bitumen Stabilisation of existing basecourse material with new chipseal (2 coats) laid. Assume 70% budget spent on 'standard' rehab. Assume 30% of budget spent on 'non-standard' rehab. Assume carriageway width of 8m. Assume haulage route of 50km for material disposal. Scope is 15km of standard rehab and 8.8km of non-standard rehab.
CPC000012	Sealed Road Resurfacing - Transport	Brief	$20,547,901	Assume carriageway width of 8m. Existing seal will be milled prior to new seal laid. Assume haulage route of 50km for disposal. Scope is 155km of chipseal surfacing.
CPC000021	Unsealed Road Metalling - Transport	Brief	$16,114,037	Carriageway width of 8m, 200mm depth of AP40, 97.3km of 'metalling'. Assume haulage of 50km for imported material and no disposal required of existing material.
Water				
CP0006851	Aubrey Rd Rec Reserve SW detention pond	Design	$6,386,859	Information provided in external folder. Open cut method for pipe laying.
CP0006831	Kingston HIF New Scheme (SW)	Design	$6,455,084	400m of DN1500 PE100 SN8 profile wall pipe with 5nr. 1000mm NB risers at 3.5m depth. 40m x 8m x 3m deep outlet basin filled with imported clean rock (D50 125mm), with 3nr 1050 RC manholes 3m deep and 40m of DN1200 PE100 SN8 perforated pipe.
CP0006544	SH6 - Glenda Dr Extension (SW)	Brief	$9,939,156	Information provided in external folder

Project code	Name	Design stage	Total budget	Project data provided by QLDC
CPC000013	Stormwater - Network	Brief	$22,256,940	15.7km of DN450 UPVC gravity pipe with 197nr. concrete 1050 manholes. Pipe at 1m cover and mh IL <2m. 11km renewed in road, 4.7km renewed in berm.
CPC000014	Stormwater - Renewals	Brief	$26,462,122	13.3km of DN450 UPVC gravity pipe with 166nr. concrete 1050 manholes. Pipe at 1m cover and mh IL <2m. 10km renewed in road, 3.3km renewed in berm.
CP0004017	Frankton Beach to Shotover Conveyance (WW)	Concept	$9,687,391	2km of DN710 PE rising main at 1m depth in berm, 1km in road. 1nr. Replacement concrete discharge manhole. 1800 dia.
CP0004028	Glenorchy Wastewater Scheme (WW)	Not started	$18,822,277	WW treatment plant to service 500 DUE 0.9 MLD. DN150 5km DN225 1km, 80 concrete mhs, PS 0.9MLD, PVC gravity reticulation DN200 1m depth in road
CP0007009	Kingston HIF New Scheme (WW)	Design	$20,185,746	Information provided in external folder
CP0005931	Lake Esplanade Catchment Diversion (WW)	Not started	$6,624,445	Pump station capable of 30L/s. 500m DN300 PE100 PN16 rising main at 1m depth in road. 1200 dia concrete discharge manhole.
CP0006284	Project Pure Upgrade (WW)	Construction	$21,729,217	Information provided in external folder
CPC000009	PS Emergency Storage - WW	Brief	$26,234,118	Combined total of 5426m² of storage provided via FRP underground cylindrical tanks with associated pipe work and connection to existing WWPSs. Assume 1m cover to crown of tank and minimal excavation for storage volume.
CP0004015	Remarkables Park & Kawarau Pl PS (WW)	Brief	$7,026,983	7km DN710 PE100 PN16 rising main with PS for 1000L/s. Alignment in road, 1m cover. Allow for air valves and scour valves every 500m.
CP0007295	Rising Main to Project Pure (WW)	Not started	$13,175,594	7km DN710 PE100 PN16 rising main with PS for 1000L/s. Alignment in road, 1m cover. Allow for air valves and scour valves every 500m.
CP0007029	Southern Conveyance Network (WW)	Not started	$36,402,103	7.2km DN560 PN16 PE100 pipe. 3.5km in berm, 3.7km in road. Standard QLDC trench.
CPC000016	Wastewater - Pressure Network	Brief	$7,019,529	Data based solely on renewing pressure infrastructure. 9km of DN355 PE100 PN12.5 pressure pipe with 30nr. air valves (300mm bore), 30nr. scour valves and associated manholes (1050 concrete) and 15nr. odour filter units. Pipe at 1m cover and mh IL <2m. 7km renewed in road, 2.3km renewed in berm.
CPC000017	Wastewater - Renewals	Brief	$47,022,078	Data based solely on renewing gravity infrastructure. 31.8km of DN300 UPVC gravity pipe with 398nr. concrete 1050 manholes. Pipe at 1m cover and mh IL <2m. 23km renewed in road, 8.8km renewed in berm.
CP0006981	Arrowtown Water Storage (WS)	Not started	$6,274,092	Steel reservoir 4000m³, 7m high. Associated earthworks (can be estimated). Foundation and local pipework to be included.
CP0007182	Beacon Point Intake & Rising Main (WS)	Not started	$17,532,000	Lake intake and pump station for 2.5km rising main DN450 PE100 PN16 rising main, 1km in road, 1.5km in berm at 1m cover.
CPC000020	Glenorchy Reservoir upgrade (WS)	Design	$6,897,234	Construction of 2 x 250m³ storage, plus associated pipe works.
CP0007157	Hawea Reservoir Capacity (WS)	Brief	$6,987,969	2nr 1500m³ steel reservoirs + ancillaries, pump station, access track (hardpack 4m wide), earthworks
CP0004050	Kingston HIF New Scheme (WS)	Concept	$11,674,056	Information provided in external folder
CP0006988	Ladies Mile New Scheme (WS) HIF	Not started	$6,478,966	3.4km DN315 PE100 PN 16 pipe 1m depth, valves every 300m road
CP0006821	Ladies Mile Storage & Mains (WS) HIF	Not started	$7,459,966	2nr. 1500m³ steel reservoirs + ancillaries, 300m 150mm deep 4m wide access track, Earthworks
CP0004629	Luggate Water Supply Scheme (WS)	Design	$6,355,729	Information provided in external folder
CP0005920	Quail Rise Reservoir (WS)	Design	$16,145,816	Information provided in external folder
CP0007179	Southern Corridor Water Treatment (WS)	Not started	$5,783,346	Water treatment plant servicing 10000 DUE, 10MLD, 5000m3 storage (2x 2500 tanks), DN560 PN16 PE100 3km, PS 150 l/s, 2nr. Bores 50m deep with headworks, decommissioning of K Heights lake intake
CP0004244	Two Mile WTP (WS)	Brief	$20,677,670	Information provided in external folder
CP0007194	Wanaka Water Treatment (WS)	Brief	$35,756,350	70MLD WWTP, 2.5km DN500 PE100 PN16 falling main and trunk main. 950m with 1m cover in berm. 1550m with 1m cover in road. Standard QLDC trench bedding.
CPC000018	Water Supply - Network	Brief	$15,404,156	21km PE Pipe DN355 PE100 PN12.5. 70nr. air valves, 30nr. scour valves. 1m cover to pipe. 15km in road, 6km in berm.
CPC000019	Water Supply - Renewals	Brief	$16,813,716	22.7km of PE Pipe DN355 PE100 PN12.5. 76nr. air valves, 46nr. scour valves. 1m cover to pipe. 16km in road, 6.7km in berm.

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