Guide to calculating a base case carbon footprint for land transport infrastructure projects: a case study

Sustainability initiatives and how this impacts a base case carbon footprint

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NZ TRANSPORT AGENCY
WAKA KOTAHI

Te Kāwanatanga o Aotearoa
New Zealand Government

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More information

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1. Purpose

The purpose of this case study is to support the NZ Transport Agency Waka Kotahi (NZTA) *Guide to calculating a base case carbon footprint for land transport infrastructure projects* (referred to as 'the Guidance' throughout this document). This case study will outline recommended approaches for base case calculations when a sustainability initiative is identified during project delivery. It will use a worked example to illustrate how the base case calculations can be undertaken. It provides worked examples using 'Project A', based on the Guidance.

2. Scenario

NZTA has confirmed funding to proceed with Project A. The key features of Project A include:

- A new 16-kilometre highway, comprising of four lanes (two lanes in each direction).
- Two bridges, which span 400m and 200m respectively.
- Four grade-separated interchanges.
- A shared user pathway (SUP) spanning the length of the road, including a 20-metre bridge.
- A river with significance to local mana whenua.

Project A is progressing towards 10% detailed design. The Project will be receiving a cost estimate for the 10% design, and this will include a schedule of quantities (eg a breakdown of the material types and quantities).

User Tip: *To use the schedule of quantities within a cost estimate to calculate a base case, it would need to contain a sufficient breakdown of material types and quantities. This would need to be in alignment with the data entry cells within the PEET tool. If the schedule of quantities does not contain a sufficient amount of detail to input into the PEET tool, there are a number of options a project could take:*

1. *Rely on the second order of the PEET Tool to calculate the base case.*
2. *Extract material types and quantities from the design models.*
3. *Liaise with the cost estimator to produce a sufficient breakdown during the next phase of design.*

2.1. Sustainability Initiative

Prior to the 10% detailed design being completed, Project A identified an opportunity to implement an optimised bridge solution (beyond the 'business-as-usual' design that was included in the consented design issued for the tender) to reduce the project's carbon footprint. Despite this occurring early in the design phase and before the base case design was finalised, this sustainability initiative should be captured as a carbon-reduction initiative.

3. Assessment

User Tip: *It is suggested that all Project's use the second order estimate within the PEET tool early in the design phase regardless of formal base case approach adopted. This will assist the Project team to understand what data is available and any gaps in data. This can help shape discussions with the Quantity Surveyor / Cost Estimator as Project's will understand what data they need. In addition, this can assist to identify any high-level carbon hotspots.*

As a result of the optimised bridge solution, the overall material quantity required to construct Project A decreased, as well as ratios of steel and concrete changing. This situation reflects a design optimisation as opposed to the alteration of material consumption described in the scope change case study. In this situation:

- The base case should reflect standard engineering design practice for the project context.
- Project A should be fairly recognised and rewarded for all initiatives and opportunities to reduce the carbon footprint, including the optimised bridge solution which is an example of best-practice design.

Figure 1 was used to inform what base case approach was appropriate for Project A.

Section 4 of this case study document outlines two different worked examples for how Project A calculated their base case.

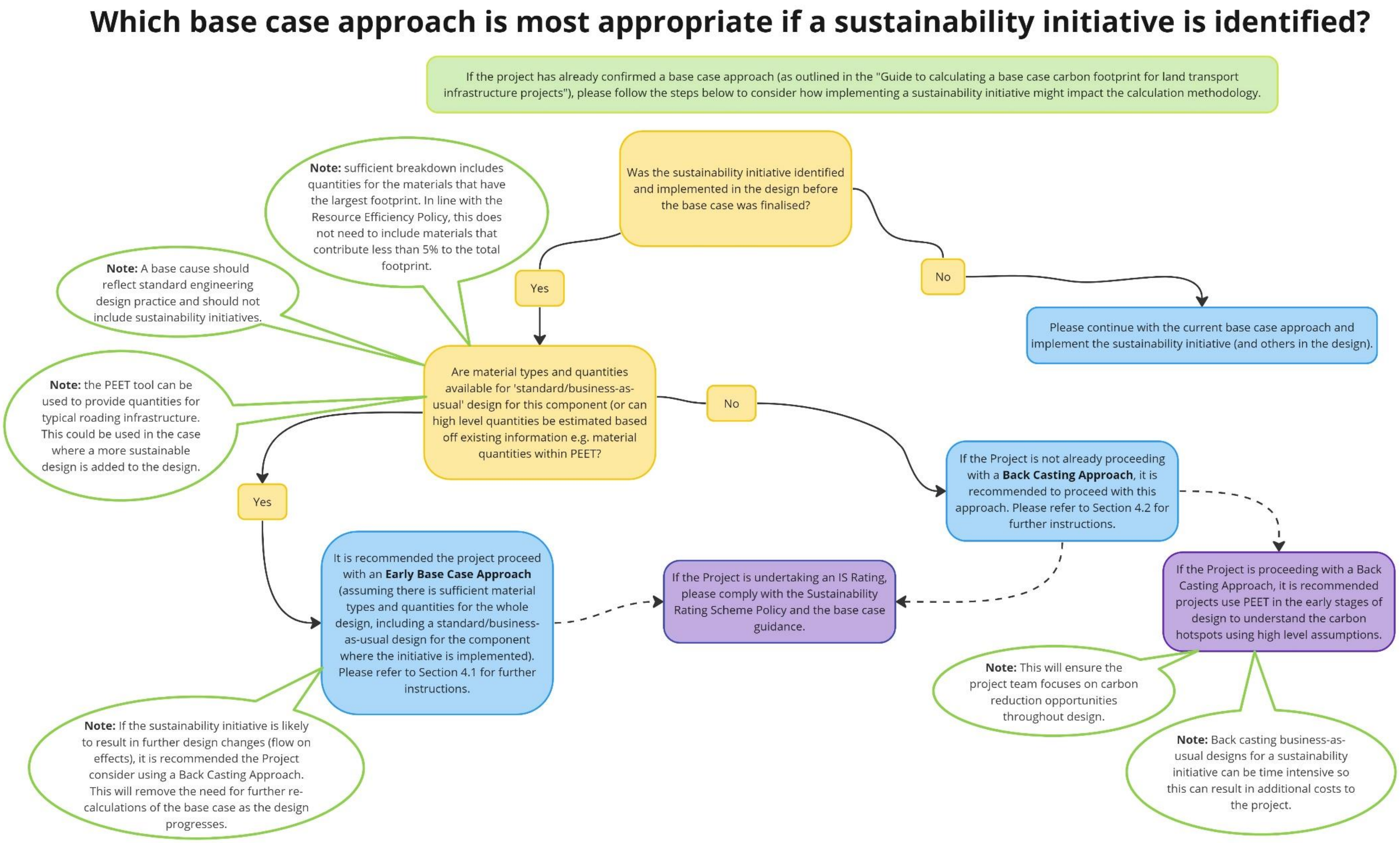


Figure 1 Approach for calculating a base case when a sustainability initiative is identified

4. Next steps

Sections 4.1 and 4.2 outline the two pathways for how Project A could calculate their base case using an early base case and a back casting approach respectively. Please note the numbers in this example are purely indicative.

> **User Tip:** Section 3.4.1 and 3.4.2 from the *Guide to calculating a base case carbon footprint for land transport infrastructure projects* should be used to supplement the instructions detailed below.

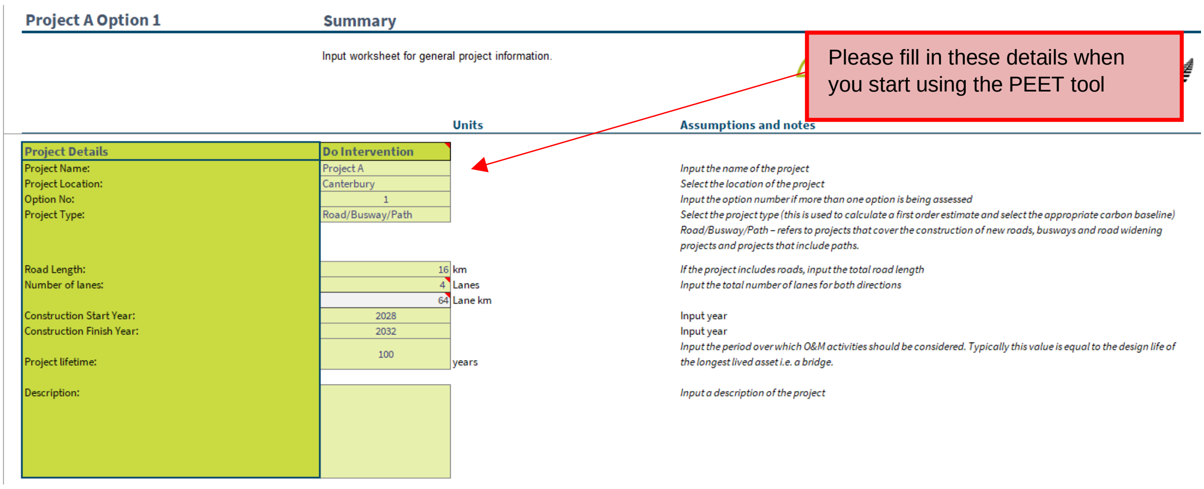
Note that both of the pathways below have a similar methodology for the sustainability initiative and require 'ring fencing' to occur as soon as possible. The recommended pathway will be determined by the data a Project has available for the remainder of the design and the design stage at which the initiative is identified. Sustainability initiatives should also continue to be identified during the construction phase.

4.1. Early base case approach

In this worked example, Figure 1 identified an early base case approach as most appropriate for Project A.

The following steps describe how Project A calculated their base case, using an early base case approach.

1. Project A confirmed they would use the PEET tool as the base case calculation tool. The Sustainability Advisor set up the PEET tool summary tab as described in the instructions 'READ ME' tab.



2. The Sustainability Lead and Design Manager confirmed that due to a number of design changes that occurred between the consented design and 10% detailed design (which were not classed as sustainability initiatives), the 10% design was more reflective of the 'base case'.
3. As the 10% detailed design included the optimised bridge solution, the Sustainability Team worked with the Lead Bridge Engineer to 'ring fence' material types and quantities related to the new bridge design. The 'ring fencing' was required to understand the material types and quantities

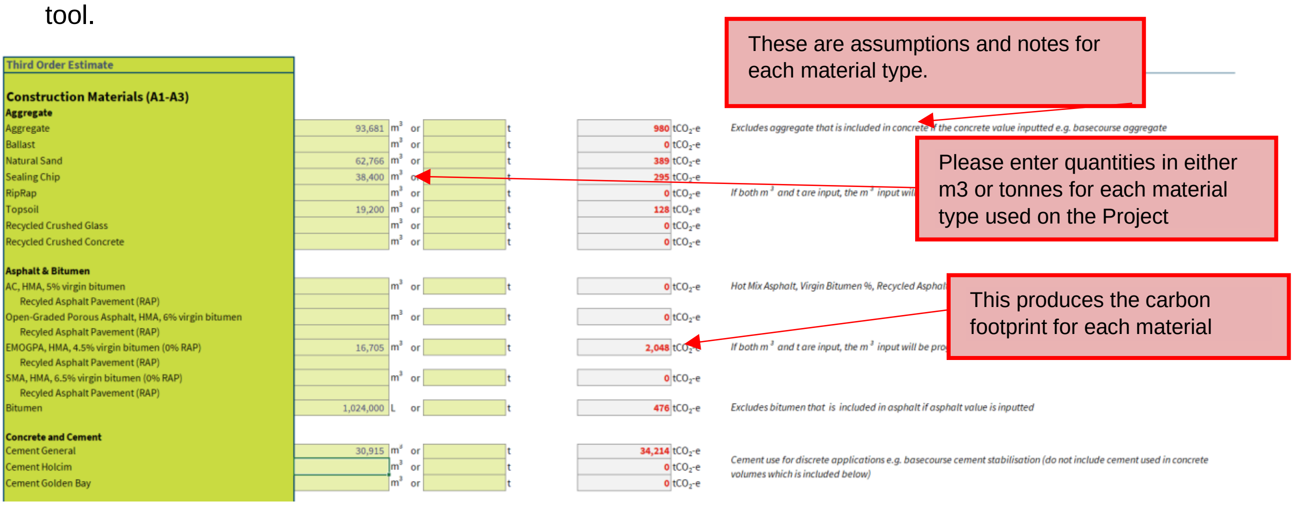
> **User Tip:** *If the sustainability initiative was included in the base case design, the project team will need to calculate the material types and quantities for the initiative so it can be excluded. The Project Team will need to replace the initiative with a business-as-usual design.*
>
> **User Tip:** *Ring fencing can be difficult if there are many flow on impacts to other disciplines. It is recommended this is completed as early as possible. This can also be a time intensive activity so please discuss this with your Design Manager (or equivalent) to ensure they are onboard with the approach.*

associated with the initiative so it could be excluded from the base case and a business-as-usual design could be used in its place.

4. The Lead Bridge Engineer used the reference design to collate material types and quantities for a ‘standard bridge design’ as a standard bridge needed to be included within the base case design.

> **User Tip:** *To calculate material types and quantities for a business-as-usual / standard design, the Project Team will need to liaise with the discipline lead. Schedule of quantities within cost estimates for a previous design e.g., reference or consent design, could be used to support this process.*
>
> **User Tip:** *Creating a ‘business-as-usual’ design can be time intensive and therefore cost intensive for a project. It is recommended discussing this approach early on with the Design Manager to confirm the approach. Other approaches to calculate a ‘business-as-usual’ design include:*
>
> 1. *Using the most applicable second order estimate within PEET for the ‘business-as-usual’ element.*
> 2. *Request the appropriate Design Discipline Lead derive material types and quantities for a standard design based on a previous project example.*

5. The Sustainability Lead worked with the Design Manager to extract material types and quantities from the models using the 10% detailed design (except for the optimised bridge design).
6. The Sustainability Lead entered the material types and quantities into the third order of the PEET tool.



7. The Sustainability Lead entered the material types and quantities for the standard bridge design into the third order of the PEET tool (using the same spreadsheet as Step 6).
8. The PEET tool produced the total tCO_2e for the Project A base case (based off the 10% detailed design, including the standard bridge design).
9. The Sustainability Lead continued to track and calculate other carbon reduction initiatives throughout the project life cycle using the third order estimate (e.g., the schedule of quantities) in the PEET tool. Material quantities were entered into separate versions of the PEET tool to ensure each initiative was tracked appropriately.
10. Project A’s IFC design was completed.
11. The schedule of quantities for IFC was completed and this was provided to the Sustainability Lead.
12. The Sustainability Lead derived material types and quantities from the IFC schedule of quantities and input these into the third order estimate within the PEET tool.

> **User Tip:** *If a project used the second order estimate for the base case and the third order for the actual case, please make sure you are comparing a design on a like-for-like basis. There may be a requirement for a project to re-baseline (e.g., update the base case calculation) using the third order (as opposed to the second order) to ensure you are comparing elements on a like-for-like basis).*

13. Project A compared their base case to the actual case to confirm the carbon reductions achieved for the Project.
14. The Sustainability Lead followed the reporting requirements within the resource efficiency guideline and reported the base case to NZTA.

General Tips:

Don't wait until completion to undertake the other sustainability initiative calculations – if left too late, the ability for the design team to provide support with quantifying the savings could be lost.

Project A chose to use the PEET Tool because it was not undertaking an IS Rating and it was more efficient to use an existing tool (as opposed to creating a bespoke spreadsheet).

For the reporting requirements, please refer to the NZTA specifications: P48 Resource Efficiency Specification and P49 Sustainability rating scheme application during tender and delivery of capital works project.

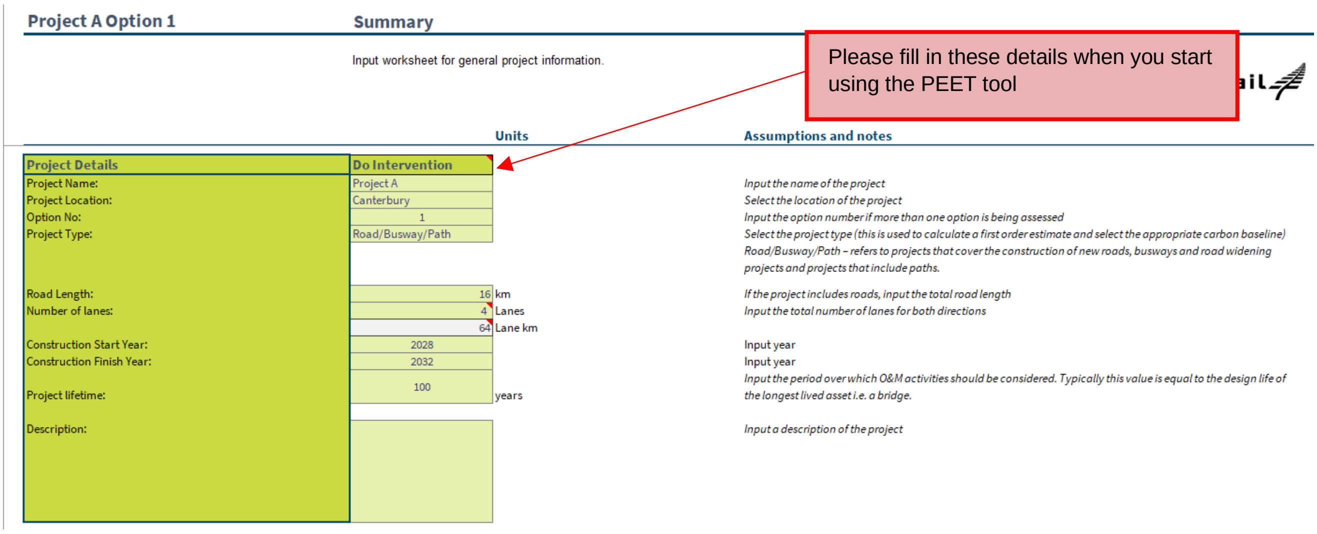
4.2. Back casting approach

The Sustainability Lead spoke with the Design Manager to understand if material types and quantities for the Project could be readily provided by the design team and/or through the models early on. The Design Manager confirmed that apart from the optimised bridge, the models did not currently contain sufficient material quantities to calculate the scope change.

Following the process outlined in Figure 1 for this worked example, a back casting approach was identified as the most appropriate method for Project A.

The following steps describe how Project A calculated their base case, using the back casting approach.

1. The optimised bridge solution was identified as a sustainability initiative for Project A and the Design Team progressed with this solution.
2. Project A confirmed they would use the PEET tool as the base case calculation tool. The Sustainability Advisor set up the PEET tool summary tab as described in the instructions 'READ ME' tab.



3. The Sustainability Lead continued to track and calculate other sustainability initiatives associated with carbon reduction throughout the project life cycle using the third order estimate in the PEET tool. Material quantities for a 'business-as-usual' design were quantified and entered into separate versions of the PEET tool to ensure each initiative was tracked appropriately.

4. The Sustainability Lead engaged with the external Cost Estimator to outline the material types and quantities required to calculate the base case. This included outlining the types of materials within the PEET Tool and the volumes required. This ensured that when Project A received the revised schedule of quantities, the information could be more easily transferred into the PEET tool.

> **User Tip:** *Engage with your Cost Estimator (within your organisation or an external company) to ensure the schedule of quantities associated with the cost estimate contain a breakdown of materials and units to calculate the base case in line with the data entry cells for PEET. Line items within the schedule of quantities often comprise of one component e.g., "bus shelter" and "road bridge", without breaking down all the separate materials. The units are also often in m^2 or per unit e.g., 5 x 3m piles. This can make it difficult for the Sustainability Team to calculate the carbon footprint.*

5. The Sustainability Team worked with the Lead Bridge Engineer to ‘ring fence’ material types and quantities related to the new bridge design. The ‘ring fencing’ was required to understand the material types and quantities associated with the initiative so it could be excluded from the base case.

> **User Tip:** *If the sustainability initiative was included in the base case design, the project team will need to calculate the material types and quantities for the initiative so it can be excluded.*
>
> **User Tip:** *Ring fencing can be difficult if there are many flow on impacts to other disciplines. It is recommended this is completed as early as possible. This can also be a time intensive activity so please discuss this with your Design Manager (or equivalent) to ensure they are onboard with the approach.*

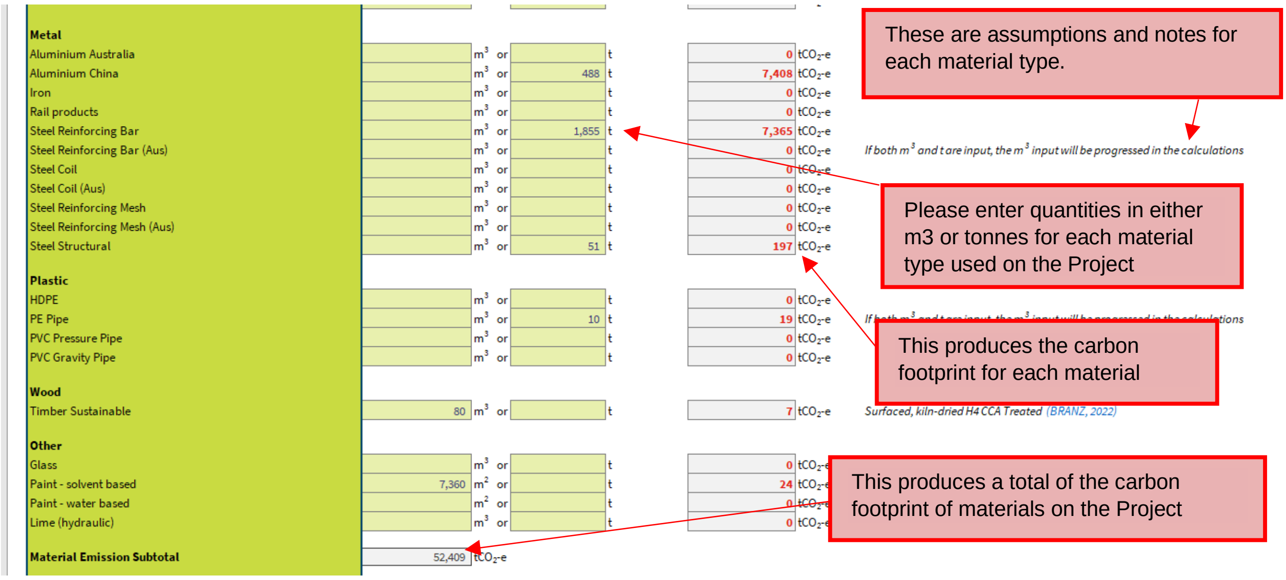
6. The Lead Bridge Engineer used the reference design to collate material types and quantities for a ‘standard bridge design’ as a standard bridge needed to be included within the base case design.

> **User Tip:** *To calculate material types and quantities for a business-as-usual / standard design, the Project Team will need to liaise with the discipline lead. Schedule of quantities within cost estimates for a previous design e.g., reference or consent design, could be used to support this process.*
>
> **User Tip:** *Creating a ‘business-as-usual’ design can be time intensive and therefore cost intensive for a project. It is recommended discussing this approach early on with the Design Manager to confirm the approach. Other approaches to calculate a ‘business-as-usual’ design include:*
>
> 1. *Using the most applicable second order estimate within PEET for the ‘business-as-usual’ element.*
> 2. *Request the appropriate Design Discipline Lead derive material types and quantities for a standard design based on a previous project example.*

7. Project A’s ‘Issued for Construction’ (IFC) design was completed.

> **User Tip:** *Discuss any timeframe requirements for your base case with your Cost Estimator prior to IFC, as this can take a month (or longer) to be received. If you are completing an Infrastructure Sustainability Rating, receiving the schedule of quantities associated with the cost estimate may be time critical for your ISC submission.*

8. The schedule of quantities for IFC was completed and this was provided to the Sustainability Lead.
9. The Sustainability Lead derived material types and quantities from the IFC schedule of quantities and input these into the third order estimate within the PEET tool. This produced Project A’s actual IFC design case.



10. Using separate versions of the PEET tool, the Sustainability Lead replaced the carbon reduction initiatives (from Step 3) with a business-as-usual designs and added this to the actual footprint to calculate the project's base case. This produced Project A's base case.

User Tip: *The material types and quantities associated with 'business-as-usual design' should be added to the third order in the PEET Tool. This will produce the total carbon footprint (tCO2-e) for each business-as-usual design.*

11. The Sustainability Lead followed the reporting requirements within the resource efficiency guideline and reported the base case to NZTA.

General Tips:

Don't wait until completion to undertake the 'sustainability initiatives' calculations – if left too late, the ability for the design team to provide support with quantifying the savings could be lost.

Based on the current functionality of PEET, it will be easier for projects to track initiatives in a separate version of the PEET tool.

To calculate the total footprint, it is recommended you use a blank spreadsheet where you can add all the totals from each PEET tool.

Project A chose to use the PEET Tool because it was not undertaking an IS Rating and it was more efficient to use an existing tool (as opposed to creating a bespoke spreadsheet).

For the reporting requirements, please refer to the NZTA specifications: P48 Resource Efficiency Specification and P49 Sustainability rating scheme application during tender and delivery of capital works project.