John Kelly, MRM
[redacted]
South Pender Island

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Dear Trustees,

The purpose of this letter is to participate in the ongoing discussion on potential changes to South Pender Local Trust Area Bylaw 114, specifically the Local Trust Area Minor Land Use Bylaw (LUB) Amendments Project. My hope is to add information from the perspective of a citizen who is a qualified Resource Manager, including a scoping level overview of relevant research on the specific topic of how house size relates to carbon footprint and carbon budget implications.

At public meetings of the Local Trust Committee, I have listened to numerous comments stating there is a lack of evidence that reducing permitted house size achieves desirable community goals. As a resource manager, I have suspected that there is a link between buildings and carbon footprint; if so, there may well be worthy objectives. To do my part to fill in the evidence gap I have examined some of the current academic research on this topic and am pleased to present my results in this letter.

My personal questions related to this issue were: Is carbon footprint of new buildings sufficiently important that it should be a preoccupation of the community as we look at our land use plan? Is there a relationship between size of building and carbon footprint such that limiting house size has positive benefits? To answer these to my own satisfaction I did some basic web searches in the academic press and reviewed some of the prominent results. I then did a small amount of analysis to collate and compare some of the results. Rather than make a very long letter with all this information I have divided my submission into this letter that presents my recommendation to the Trustees and project participants, and an annex with bibliography that outlines my research.

As I review in the annex, actions towards climate change mitigation are strategic priorities of the Islands Trust. The Islands Trust Strategic Plan includes a call to action for local trust areas to act on climate change within their land use bylaws. Furthermore, South Pender Island's Official Community Plan supports the provincial target of significantly reducing greenhouse gas emissions. It also directs the Local Trust Committee to promote reductions in greenhouse gas emissions in their decision making.

In harmony with this concept, one of the stated aims of the South Pender Island Trustees when Bylaw 114 was last amended was to respond to that call. Reduced house sizes were presented as a key action toward that end.

It was not difficult to uncover research findings confirming the important contributions of new dwelling construction to greenhouse gas emissions (in the research the commonly used terms for this are: carbon-dioxide-equivalent emissions and carbon footprint). Findings point to a direct link

between dwelling size and emissions. Some of the authors are equally clear, both in the academic and popular press, that house size is correlated to carbon footprint, enough to justify recommending all communities strive toward smaller house size.

The research I did also reacquainted me with the goals of the Islands Trust, the mandate of the Local Trust Committee and the South Pender Official Community Plan. I noted the priority on protection of the ecology and amenities of the Islands of the Trust area in the mission and mandate of the Islands Trust and in the 2018-2022 Strategic Plan. If the Local Trustees and the participants in this project propose amendments to Bylaw 114, I call on them to ensure that the amended bylaw leaves both the ecology and amenities of South Pender Island improved.

I have found the evidence I gathered in this process, even though it was at the scoping level of complexity, to be transformational in my own thinking on house size regulation. In contrast to previous statements at Local Trust Area meetings I am now supportive of restrictions on house size within our land use Bylaw. For expediency, in recognition of the vast amounts of time and effort already spent on this issue, **I am in favour of retaining the current house size restrictions as written in the 2022 amended bylaw 114**.

My personal conclusions aside, the most compelling arguments are provided by the research. I invite you to review the literature for yourselves and form your own conclusions. To this end I am providing the attached annex containing an overview of my journey and conclusions, and a bibliography of the research I perused.

Best Regards,

John Kelly,
Master of Resource Management (SFU, 2015)

ANNEX 1. SCOPING LEVEL OVERVIEW OF RESEARCH RELATED TO CLIMATE CHANGE IMPACTS OF HOUSE SIZE

Prepared by: J.G. Kelly, MRM. January, 2024

Background

Changes to the South Pender Land Use Bylaw No. 114 were implemented in 2022 after approximately 15 information and consultation meetings. The amendments to Bylaw 114 included items related to the siting and size of housing, both becoming more restrictive. There were also provisions related to agricultural land, and protection for existing buildings or structures related to any changes induced by the amendment. The trustees at the time cited that the reasons for implementing changes included conformity with the Agricultural Land Commission, alignment with the Island trust strategic plan goals (Island Trust Strategic Plan 2018-2022), and consistency with the values of the citizens of South Pender Island as articulated in our official community plan.

The Island Trust Strategic Plan 2018-2022 includes a call to action relevant to the bylaw changes that was cited by Trustee Wright as motivational towards introducing reduced dwelling sizes:

> *Strategy 11: "Amend Official Community Plans and land use bylaws to foster climate change resilience, including measures to protect Coastal Douglas fir, foreshore and nearshore environments and groundwater."*

The Islands Trust's object and guiding principles as articulated in the Islands Trust Policy Statement Consolidated - April, 2003, include principles that clearly set out the priority of environmental integrity within the Islands Trust scope of work:

> *"The primary responsibility of the Islands Trust Council is to provide leadership for the preservation, protection and stewardship of the amenities, environment and resources of the Trust Area."*
>
> *"When making decisions and exercising judgment, Trust Council will place priority on preserving and protecting the integrity of the environment and amenities in the Trust Area."*

The South Pender Island Official Community Plan includes a goal and a policy supporting reduction in greenhouse gas emissions:

> *South Pender Island OCP Goal 2.2.7:*
> *"To support the provincial target of reducing greenhouse gas emissions by 33% by 2020 from 2007 levels."*

> *South Pender Island OCP General Policies 2.4.4:*
> *"In its decision-making, the Local Trust Committee will ensure that land use planning and development promote reductions in greenhouse gas emissions, support efforts to adapt to climate change impacts, and recognize the role of existing rural and natural areas in the absorption of carbon."*

The current South Pender Local Trustees, elected after the passage of the amending bylaw, have indicated a desire to rescind its changes or amend any or all of its provisions and the current project is the result. Their stance has been supported by many voices, both in written submission to the Local Trust Committee and at public hearings. House size restrictions, in particular, have been the topic of considerable discussion. One of the frequent contentions with the amendment's reduction in permitted house size is that there is a lack of supportive evidence presented to date.

Motivations and approach

My motivation in this submission is to fill in some gaps in the discussion within the South Pender Island community about limiting house size, as enacted in the amendments to LTA Bylaw 114. Many voices have spoken of missing information on why the changes were needed. I agree that there has not been ample evidence presented to date about why reduction in permitted house size is a worthy goal of land use regulation. But as it turns out there is in fact a significant amount of research available and readily accessible through simple web searches. The information presented here is a summary of selected research that met my personal standards of quality, relevance and timeliness.

My approach was to search through academic literature to see current high priority research in quality journals that relate house size to carbon footprint and then to examine the conclusions and corollaries of the literature to see if there are relevant points that support or contradict the adoption of limits on house size within land use bylaws.

I have coded the findings in the following section with a number enclosed in square brackets. Each of these numbers indicates a specific numbered reference, as recorded in the References section of this document, where the information is drawn from.

What the literature reveals

Greenhouse gas emissions include a variety of different gases that are added to the atmosphere through human activity. These gases share the common property that they promote the retention of heat within the atmosphere such that the temperature of the planet increases. The main greenhouse gases are comprised of seven gases referred to as the "Kyoto gases" plus water vapour. [13] Each gas has a different global warming potential; when the amount of gas emitted is multiplied by its global warming potential, its carbon-dioxide-equivalent emission is the result. [13] In the context of this annex, carbon footprint is used as a proxy for carbon-dioxide-equivalent emission amount.

There is recently produced material in Resource Conservation, Engineering, and Applied Energy fields of study that relate buildings to carbon footprint. The body of work is sufficiently developed that aggregating summaries are beginning to appear where a group of authors present results based on a number of previous studies. One of these papers: *Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation*, in the Journal Applied Energy, [6] summarizes 625 life cycle assessment case studies of the carbon footprint of buildings. I found this paper to be particularly useful.

Buildings accounted for 37% of global carbon-dioxide-equivalent emissions in 2020 [12]. This amount includes both emissions generated due to construction of a building which is called an embodied carbon footprint, and emissions due to the ongoing operation of the building over time. Construction of dwellings is by all accounts a major contributor to carbon-dioxide-equivalent emissions in the atmosphere and climate change. [6][3][1][8][9]

Embodied carbon footprint is of extra importance in calculating climate change impacts because the embodied carbon footprint is a sunk cost at time of construction. The non-embodied carbon footprint of operation of a dwelling, for instance heating with fossil fuel, can be modified over time, but the sunk cost of the embodied carbon cannot be recovered. [6] Embodied carbon footprint represents a significant and increasing share of the carbon footprint of residential buildings. [6] There is even evidence that high energy efficiency construction designed to mitigate overall carbon footprint increases the embodied quotient of a building in relative amount and can result in increase of total amount. [6] This means that the embedded carbon footprint of a house at time of construction is both important, and *increasingly* important as an issue in climate change mitigation. It is also important *now*.

Current life cycle estimates of embodied carbon-dioxide-equivalent emissions in new building construction range from approximately 0.17 to 1.0 tonnes of embodied emissions per square meter of dwelling space over a design lifespan of 50 years. [9] For a 1000 square foot house this would calculate to between 350 kg and 2150 kg annual carbon-dioxide-equivalent emissions.

Swiss and German estimates indicate that an annual per capita target of 1000 kg of carbon-dioxide-equivalent emissions by 2050 is required to meet the objective of keeping global warming below two degrees Celsius. Within this amount we can expect the budget of emissions related to our dwelling space to be about 360 kg carbon-dioxide-equivalent annually per person including both embodied and operational carbon footprint. [6]

Two recent papers (2023 and 2021) in the journal *Resources Conservation and Recycling* discuss the material intensity of new construction. Use of concrete in construction is a large component of the embodied and total carbon footprint of a dwelling over its life cycle [3]. There is a strong, nearly linear, correlation between building size and concrete use in residential structures across a wide variety of building types including single family wood constructed buildings. [3]

Regarding the concrete embodied carbon footprint of residential dwellings it is a significant factor if a dwelling includes a basement or not. Basements add considerably to the embodied carbon footprint of dwellings [2].

Overall, the literature was consistent, within the order of magnitude, in quantifying embodied carbon footprint and unanimous in situating this issue as a climate change priority. Concrete, steel, and aluminum are the main drivers of the footprint magnitude. [4]

Conclusion:

Climate change resilience actions within the Land Use Bylaw were requested by the Islands Trust Council within the Islands Trust Strategic Plan. Amendments to South Pender Local Trust Area Bylaw 114 that reduce permitted house size were the response of the Local Trust Committee in 2022. Without this action South Pender Island will not have done its part to further the strategic goals of the Island Trust on an issue that is also a top priority of provincial and national government and a worldwide preoccupation.

Embodied carbon footprint in new dwellings is strongly correlated to building size and that footprint is large enough to be a significant driver of climate change. Meeting an annual per capita target of 360 kg carbon-dioxide-equivalent for dwelling-related emissions seems to be a faint hope when compared to the actual carbon costs of construction, let alone operation of dwellings. In this light, reverting regulations in a land use bylaw from smaller permitted dwelling size to larger dwelling size does not make sense.

Confirming this perspective, one of the authors of research I reviewed stated in the popular press:

> *"'Simply put, you should build as small as you can for what you need, and if possible, you should avoid having a basement,' professor Shoshanna Saxe, told U of T Engineering News."*
>
> Shoshanna Saxe [7]
>
> *"People want to put solar panels on the roof or point out how they are using better insulation. Those are great, but it's also really important to think about how much of a difference you can make by building something that is reasonably sized, using a reasonable amount of material."*
>
> Shoshanna Saxe [5]

Another scholar speaking in the popular press, as well as within a publication, separately concurred with this clear direction:

> *"We need to also make houses more efficient (especially existing homes), and allow for smaller housing to be built/redeveloped!"*
>
> Peter Berril [10]

> *"Reducing the average size of new single-family housing and increasing the share of multifamily in new construction are two strategies that can reliably reduce material requirements and embodied emissions from housing stock growth. Both strategies would represent substantial departures from current trends, and would require policy changes to remove existing barriers and disincentives to multifamily and small single-family housing."*

Peter Berril [4]

Current research on the relationship of building size to carbon footprint is readily available and confirms that dwellings are a significant contributor to carbon-dioxide-equivalent emissions. Furthermore, the fact that building size is strongly correlated to those emissions offers the possibility that the blunt tool of house size restrictions within land use regulation can be effective in limiting them.

Limitations:

This is a very brief survey of readily available material on the topic of the relationship of carbon footprint to building size and not a literature review of this subject. Scholars will spend years on this specialty topic within resource management in order to provide professional opinions to decision makers. This annex and the work it shares is not provided by a subject matter expert and this is not a professional opinion.

I have included a list of references consulted in the preparation of this document and invite the Trustees and project participants to peruse them and form their own conclusions with the information they contain.

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