November 2, 2006

HITH-ALIS LAX GWA-YAS-DUMS: FROM CRISIS TO HOPE

Physical Development Aspects of the Comprehensive Community Planning Process

Gwa-yas-dums Village -- Gilford Island, BC

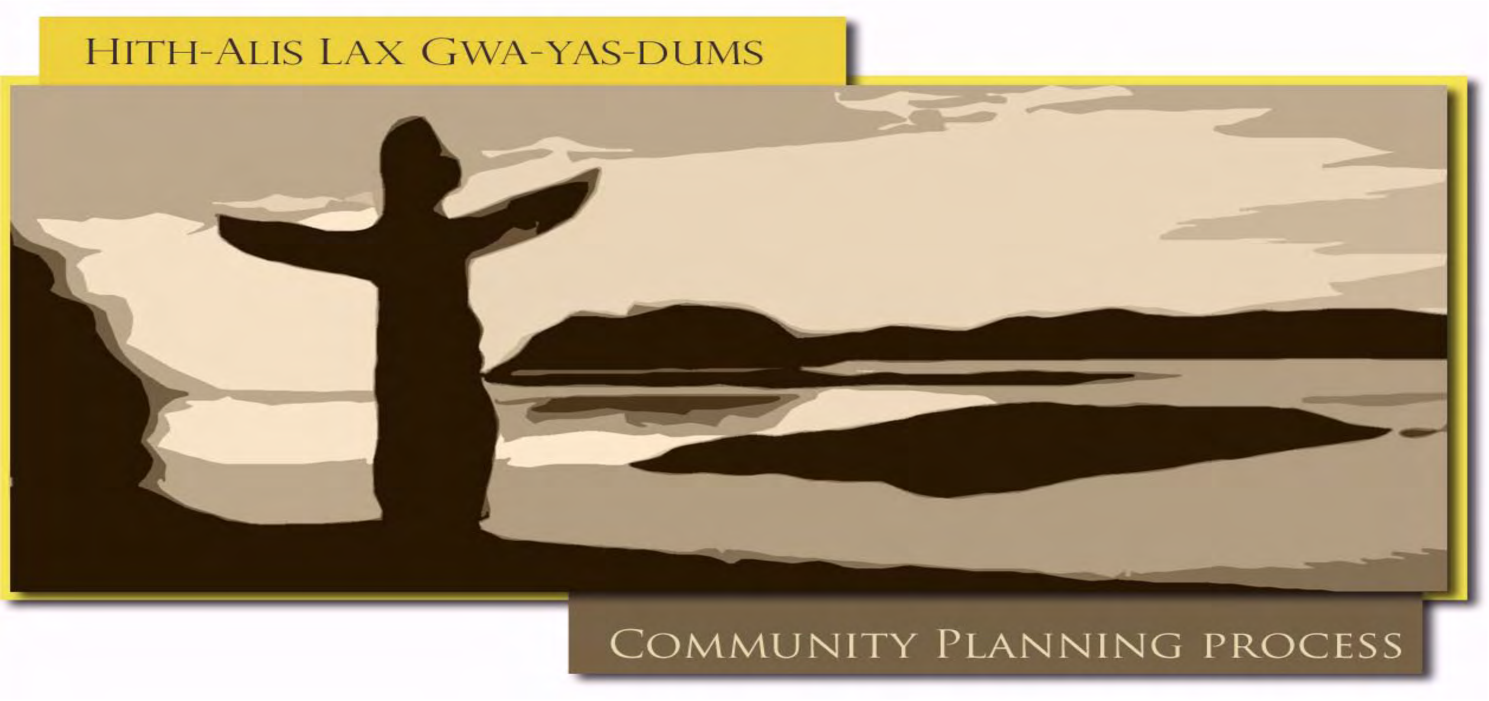

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Table of Contents

SECTION I:
Summary: Community Site Plan, Energy Plan, Housing and Related Infrastructure

SECTION II:
Appendix A: Community Site Plan Report – EcoPlan International

SECTION III:
Appendix B: Community Housing, Energy and Infrastructure Plan – EcoPlan International

SECTION IV:

Appendix C: Terrain and Geologic Hazards Overview – Cordilleran Geoscience

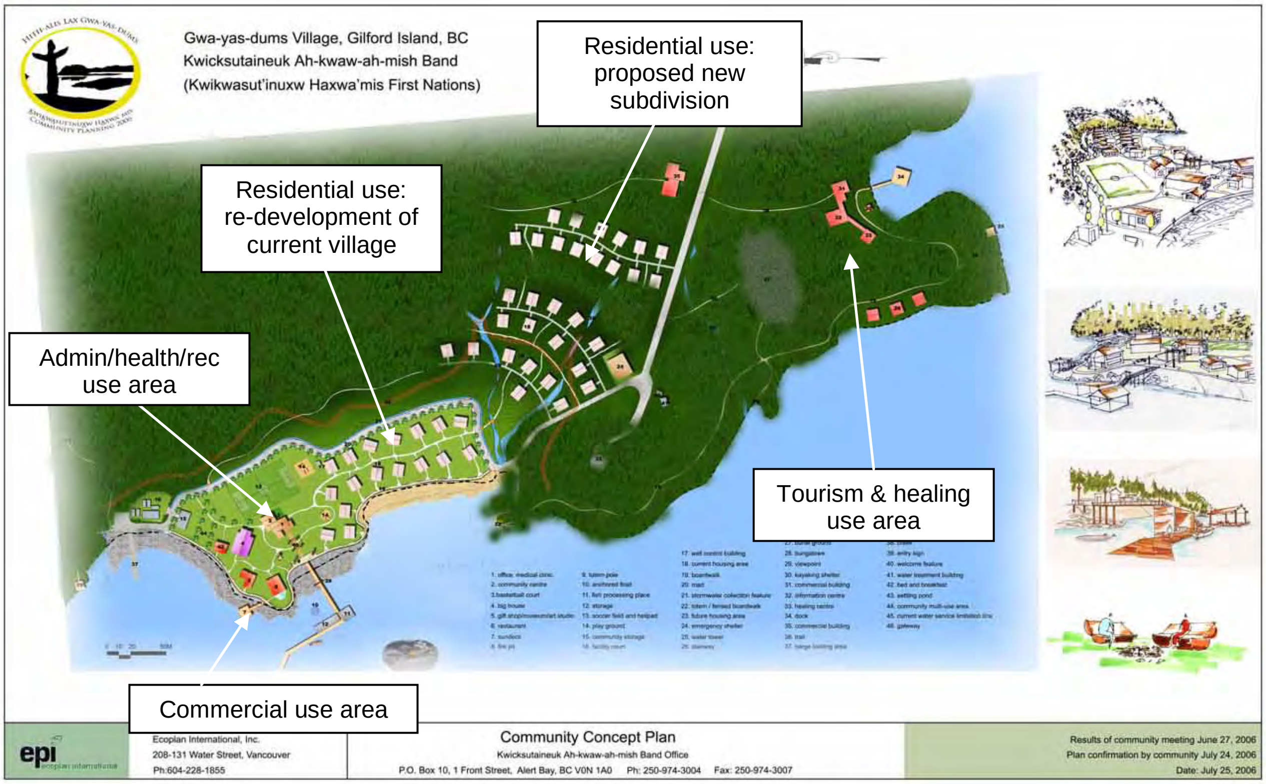
Note: This report represents interim output of the comprehensive community planning process and, along with the associated community energy plan, housing analysis and related infrastructure report, concludes the physical site planning stage of the CCP process. This report and the associated community energy planning, housing and related infrastructure report were prepared to facilitate the urgent need to move forward on the physical development of the village of Gwa-yas-dums. Next steps of the development process require engineering design and implementation. The CCP process also includes other non-physical aspects of the comprehensive plan will be included in a future planning sessions, subject to remaining budget constraints.

Introduction

In November 2005 the Kwicksutaineuk Ah-kwaw-ah-mish First Nation (Kwik'wasut'inuxw Haxwa'mis First Nations or KHFN)[1] initiated a comprehensive community planning process with the support of EcoPlan International. The community planning process focused on key physical development issues of site planning, community energy and housing. Related analysis was also conducted on domestic water/wastewater, fire protection and solid waste management. By June 2006, KHFN reached consensus on a conceptual site plan for the Village of Gwa-yas-dums on Gilford Island, BC. In October 2006 the community reached consensus on two additional aspects of the community plan: community energy and housing. This summary provides an overview of the primary findings, conclusions and next steps for the community site plan, energy and housing. Please refer to ***Appendix A: Community Site Plan Report, Appendix B: Energy, Housing and Related Infrastructure Report*** and ***Appendix C: Terrain and Geologic Hazards Overview*** for detail. Additional aspects of the community planning process are still in progress including a strategic level analysis of territorial planning, economic development, health, social and governance issues. Once implemented, this new village plan will significantly and positively change the future of these First Nations.

The community planning process was community driven, with community members participating at every level of decision-making and direction setting. Working with planning, design, and engineering specialists from EcoPlan, a community plan was crafted to respect site constraints and take advantage of opportunities. The final plan, shown below, is instrumental to delivering the KHFN vision of becoming a healthy, sustainable community that is culturally vibrant and economically stable.

Figure 1: Conceptual Site Plan for the Village of Gwa-yas-dums, Gilford Island



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[1] Officially known as the Kwicksutaineuk Ah-kwaw-ah-mish Band.

In all, the community agreed on a site plan with a strong sense of place and cultural identity which harmonizes seven distinct land use designations: residential, commercial, industrial/utilities (powerhouse, drinking water), administration/health/community, tourism, entry, and outdoor space/recreation.

The site development plan has four phases:

- *Phase 1* – Housing (upper and lower village), infrastructure (and associated industrial/utility use) and Big House rehabilitation;
- *Phase 2* – Admin/ health/ recreation multiplex, entry, outdoor space/ recreation (e.g., boardwalk, totem poles, cultural icons);
- *Phase 3* – Economic development in village commercial zone – gift shop, restaurant, tourism;
- *Phase 4* – Tourism and healing center development of “Sawmill Bay” in the southern reserve area (note that small scale, ecotourism use is encouraged in the village, and also at Sawmill Bay area with tent platforms as a near term activity)

To achieve KHFN’s vision and implement the community plan, much needs to be done. Currently, the community of Gwa-yas-dums is in crisis, with basic needs of water/ sewer, housing and energy not currently being adequately met – although action is underway in all of these basic need areas. Implementing the site plan and related physical infrastructure is one of the critical actions needed to overcome this crisis and move towards a more positive and fulfilling future. This summary describes the key findings and next steps of the community planning process to date.

Implementing Urgent Actions: Water, Electricity, Housing

- The ***water*** in Gwa-yas-dums is not potable and is one of the most pressing concerns facing the community. KHFN, working with Kerr Wood Leidal Consulting Engineers, are in the process of implementing a reverse osmosis and chlorination system of water treatment to address this crisis. The implementation of this project is scheduled for installation of the pilot treatment facility in the fall of 2006.
- An associated issue of implementing the new water system is providing ***electricity*** to operate it. The current gensets are worn out and will not meet the requirements of the new water treatment system. The installation of a 300 KW genset upgrade was identified as the best immediate solution to address operation of the new water treatment system as well as servicing the community needs.
- The current ***housing*** situation in Gwa-yas-dums is desperate, thus housing is a priority issue for the village residents. Inadequate and moldy housing, causing ill-health and abandonment, affect many of the houses on Gilford Island[2] and have put great pressure on the need for an immediate response. In discussions between KHFN and INAC, it was decided that it was more sensible to spend the money on constructing new houses, rather than repairing the existing houses. Eight homes have been demolished in anticipation of the site plan being implemented, and based on need (i.e. greatest level of mold and deterioration) rather than rebuild logistics.
- To help meet immediate housing needs for those in the homes which have been demolished, KHFN installed five temporary trailer homes. These homes were delivered and set up on site during the summer of 2006, through a project managed by Jacques Whitford Environmental Limited.
- The community planning process has moved forward in a parallel process to these urgent infrastructure activities.

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[2] Housing condition and mold assessments were completed in 2002 on fourteen of the existing houses by Jacques Whitford Environmental Limited.

Key Findings

Site Planning

- One of the most significant findings of the community planning process was related to geotechnical risk. Geotechnical investigations revealed that there is a moderate debris slide hazard affecting the north portion of the village.[3] Buildings for institutional, assembly, commercial or residential uses need to be sited at least 50 m from the toe of the steep rock slope.
- **Debris slide hazard affectively removes approximately one-third of the village from development.** To put this in perspective, under the current land use plan, six home sites need to be relocated away from the debris slide hazard.
- Erosion of the current village land area from ocean activity is a concern, requiring the relocation of one current home and an erosion control seawall. Additional hazards identified are flooding and tsunami hazards, especially for the southern half of the current village site. Addressing these requires further engineering analysis and mitigation.
- The community has also identified a fundamental need to generate economic development. Tourism was identified as one of the few opportunities available to the village, although the community would like to explore other opportunities as well. The need for, and importance of, economic development is reflected by the fact that the most desirable land area in the village for housing (based primarily on views and access) was dedicated to commercial and tourism use, with the entry into the village from the dock and the new administration and commercial buildings designed to incorporate traditional cultural imagery.
- Village residents made this possible due to admirable concessions that made the overall plan possible. In particular, village resident Beatrice Smith agreed to move to a new home in the proposed upper village on the hill, and Calvin Johnson agreed to relocate to where Beatrice Smith's home currently is located. ***Without this agreement, which is dependant on giving implementation priority to the proposed upper village, the consensus site plan would not be possible***.
- Contiguous to the identified commercial area in the village will be the location of administration/ health/ recreation/ cultural use.
- The land area dedicated to economic development and administration/ health/ recreation/ cultural use requires relocation of four existing home sites.

In all, the current "lower village" will allow for seventeen homes of the twenty-six replacement homes. At least nine of the urgently needed 26 homes must be relocated elsewhere on Gwa-yas-dums IR1 reserve. This is true even with closer high efficiency lot spacing (a minimum of 23 feet) agreed to by the community.

New land for housing is urgently needed. The only contiguous area available for new housing development is on the gently sloping hill to the south of the existing village, which is commonly referenced to as the "upper village". The upper village will also provide land for future housing, essential for achieving the vibrancy desired for the village and accommodating KHFN members that currently live off-reserve but would like to move home.

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[3] Cordilleran Geoscience, Terrain and Geologic Hazards Overview, Gwayasdums IR 1, Gilford Island, BC. Draft Report April 24, 2006. (Final Report October 23, 2006 no significant no changes).

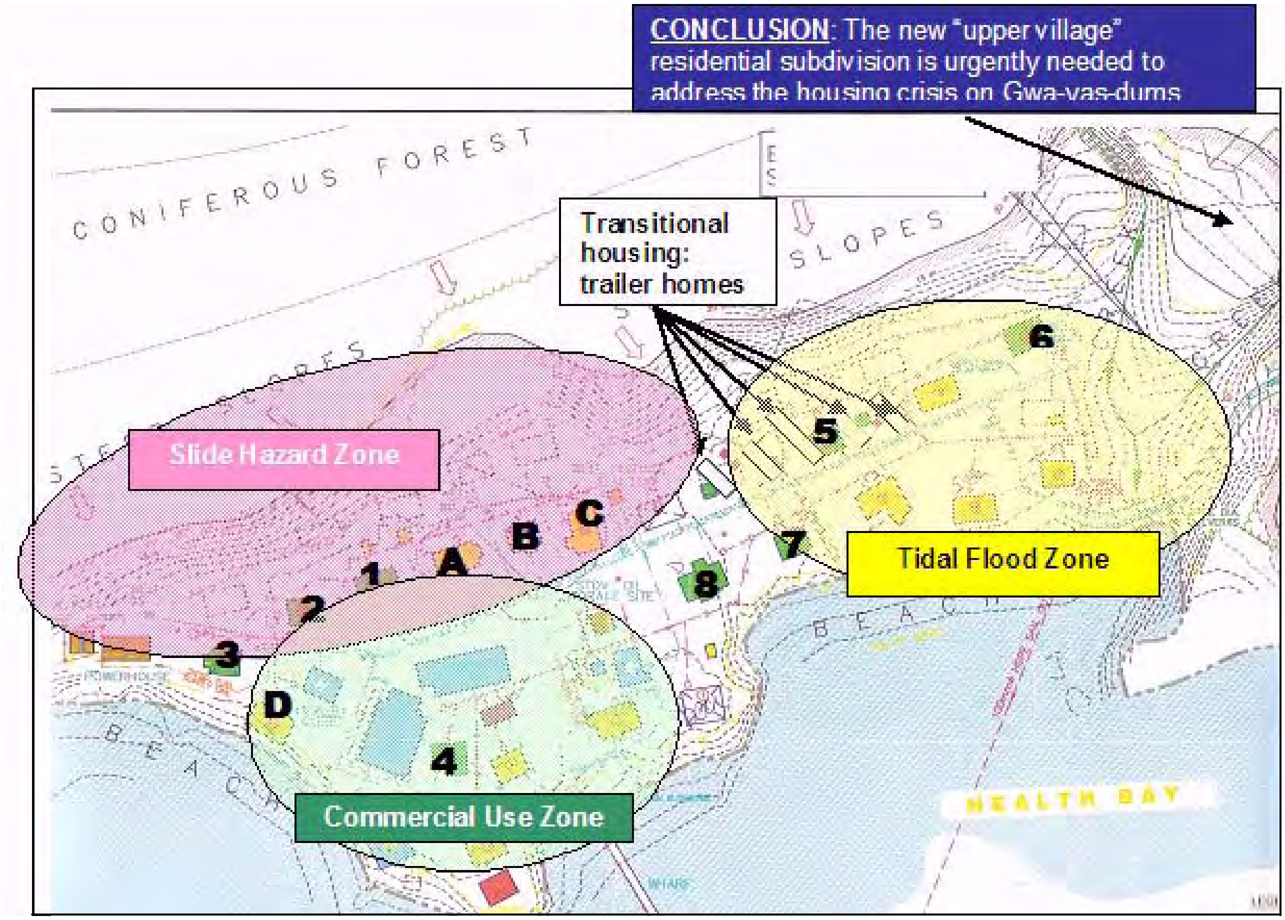
Housing Transition Plan

The proposed new subdivision in the upper village is an urgent priority, as it must accommodate the first round of replacement homes. Due to natural hazards and land use designations, there is available land in the current village to immediately accommodate only one or (possibly) two replacement homes. The reason for this situation is described below.

As a first step in the housing transition, eight of the most unhealthy homes, based on with mold or rot, have been demolished and five trailer-homes have been moved to the village to provide transitional housing. Note that these homes were demolished based on immediate health concerns, not on housing transition logistics or future site plans, which had not been completed at the time of demolition. Referencing the figure below, the current situation is explained. All homes in green have been demolished and have been given numbers for explanatory purposes. Additional concern in the transition plan is health and safety. Homes that are exposed to health and safety risk are identified by capital letters.

- Demolished homes # 1, #2, and #3 are located in the debris slide zone and are unavailable for residential housing.
- Demolished home #4 is located in the future commercial zone (see Figure 1).
- Demolished home #5 is located where transitional trailer-homes now stand.
- Demolished homes #6 and #7 are located in the tidal flooding area and require further engineering and mitigation (i.e., flood control diking or elevated foundations).
- Demolished home #8 allows land area for one or two immediate replacement homes.
- In addition, homes “A” and “B” are currently standing and occupied, with human health at risk from debris slide hazard. These homes should be relocated out of the slide hazard zone as soon as possible. Note that home site “C”, while not available for future housing is currently an empty lot with a totem pole in respect to a suicide that took place there.
- Home “D” is also occupied and in danger from erosion hazard. This home should be relocated as soon as possible, but will need to be relocated out of the commercial use zone.
- **With only one to two residential building sites available in the current village area, and with eight homes already demolished, three others occupied but exposed to identified hazards, the proposed new subdivision located in the upper village, to the south of the current village site, is an urgent priority. It must accommodate the first round of replacement homes.**

Figure 2: Transitional Housing Issues, analysis of current village



Housing Design Guidelines

- Housing design guidelines that incorporate both community values and technical recommendations have been developed around building type, durability, indoor air quality, energy performance, roofing and cladding, water efficiency, and fire protection.
- Sample floor plans and housing perspectives have also been completed as a transition step to engaging the services of an architect by initiating thinking about possible designs. In October the community agreed to move forward with engaging the services of an architect or designer to take these plans forward and oversee the transition to implementation. This architect should also assist the community in developing architectural designs and specifications for the other buildings (commercial, administrative, health, recreation) identified in the site plan.
- Energy efficient housing design was explored as part of the housing analysis and overall physical development plan. The costs and benefits of housing designed to an energy performance level of "Energuide 80" were evaluated. Energy efficient housing would have significant operating cost savings, with the additional benefits of improved indoor air quality and building longevity/ durability if heat recovery ventilation is incorporated into the designs.
- The community desires energy efficient housing for the health, environmental and building longevity/ durability benefits and because it could have long term cost saving benefits of up to $1,000 per year per house. Similar to community energy cost savings, it was understood by the community that they may be able to negotiate flow-back to the band of the annual cost savings after the payback period.

- The major issue with incorporating energy efficient housing design is the up-front capital costs of approximately $5,000 per house. The band and its members are very limited in what they can spend on housing and, despite the important benefits, it is unlikely they could support the additional costs. There would also be some additional maintenance required for the ventilation systems.
- Some funding support is available through a provincial program that KFHN could qualify for that would put $3,500 towards the construction cost of each house, but there is no guarantee that this program will be around for the duration of the new home construction. Additional financing would need to be negotiated with INAC to incorporate this aspect.

Housing Construction Methods

- Four methods of construction were evaluated for their benefits and drawbacks, including pre-manufactured trailers, on site construction with band member labour, construction on site with outside labour, and construction combining partially pre-manufactured components with on site construction.
- Based on the current construction climate in BC, new houses are estimated to cost between $100,000 and $175,000 per 1000 sq ft house depending on how they are designed and the method used for construction. The band has secured funding of approximately $80,000 per house from INAC to build 26 replacement and new homes at Gwa-yas-dums Village. The community has not decided how they will cover the remainder of the construction costs, whether through contributions from the band, mortgages, or other outside sources.
- KFHN has reviewed this analysis and decided to engage the services of an architect or home designer to help facilitate the development of construction drawings and construction tendering process based on these construction methods.

Community Energy

- An analysis of over 10 long-term community energy options was developed and evaluated by the community. A total of 15 community-based criteria, including costs, maintenance requirements, ease of construction, safety, and environmental impacts, among others were used to evaluate options.
- Base on this analysis KHFN chose, as their preferred system, a propane grid system in conjunction with the upgraded electrical gensets.
- Capital costs and long term operating cost savings were critical criteria in choosing the system.
- The propane grid is expected to save approximately $38,000 per year in energy costs compared to the current system of electric and oil space heating and hot water heating. Initial estimates for capital cost are approximately $150,000, and will take approximately four years to payback this initial expenditure relative to the current energy system.
- It is important to note that the community weighted this option highest under the understanding that they may be able to negotiate flow-back to the band of the annual cost savings after the capital costs are paid off through operating cost savings.

Potential Cost Savings

- **There is an annual long term energy cost saving of $64,000 under the recommended plan.** This cost saving is after payback on capital cost calculated as follow: an annual total of $38,000 from the proposed propane grid and $26,000 from energy efficient housing design (or $1,000 per house built under the current plan).

Next Steps: Implementation – The Integration of Design and Development

Planning and Development Coordination

Given the complexity of translating the conceptual development plan into a physical reality, it is critical that overall project coordination is integrated and accounted for so that implementation is executed as a sensitive iterative process of place making. Following from this, it is recommended that a coordinating professional be retained to ensure that the project proceed into and through the implementation phase as efficiently as possible. The role of this position would be to mange the integration of the technical and qualitative aspects of the village design and construction program. The professional would be responsible for quality control and quality assurance in the coalescing of project components from current conceptual stage to project completion.

Integrated Planning

Of particular importance is consideration of the village plan as one integrated development program. This will ensure seamless integration of the various components and avoid a problematic, piecemeal approach to the coordination and implementation of the project. Developing a funding strategy that is complementary to the overall integrated development schedule is also essential.

Engineering Analysis

Several key issues have been identified for immediate analysis. Other issues are expected to arise during the implementation process. In any case, further engineering analysis and design is required evaluate the feasibility of constructing the buildings in locations shown on the site plan, design of the new subdivision, design of mitigation measures for flood and slide hazards, evaluation of alternative options for cost savings, and creating an overall project budget and individual project budgets to present to INAC for funding.

Some of the key actions that have been identified are:

- There is urgent need to implement the new “upper village” residential subdivision as first round transitional housing. Feasibility, pre-design and design must be completed for roads and pathways, house foundations, expansion of water supply, wastewater, and power systems, stormwater drainage, and pollution control abatement on the old dumpsite located in the new subdivision. The process has already commenced with KWL conducting preliminary analysis for a funding submission.
- Survey work must be completed for the current village. In particular in order to specify the 50m hazard zone from the toe of the slope and to delineate elevations exposed to tidal and/or tsunami flooding.
- Engineering follow-up analysis is required to evaluate flood response options, such as diking in coordination with the sea-wall erosion or raised foundations. Other options may also be possible.
- A stormwater management plan is required for the entire site, including the upper and lower village.
- A road upgrade and access analysis is required for a road through the existing village to the new subdivision.
- Additional engineering work is required to determine soil stability in the existing village for buildings.

Home and Building Design

- The community has decided to hire an architect or designer to assist with residential home design and other buildings in the village. EcoPlan has agreed to assist with the process of identifying an architect by providing a short list and developing an RFP.

Housing Transition Plan

- The community must complete their internal housing transition plan that is consistent with timing of the new upper village sub-division and how/who will be constructing the homes. This plan will include who will have access to the new houses and in what order. The housing transition plan should be part of a comprehensive housing policy.

Energy System

- The community has decided on a propane grid to complete their energy system requirements. This system will need to be designed and integrated with housing and site plan, then tendered and implemented. Funding has not yet been determined.

Economic & Market Analysis

- Economic and market analysis is required to determine the feasibility of commercial aspects of the conceptual community plan. This should be done in coordination with an overall economic development strategy for the KHFN.

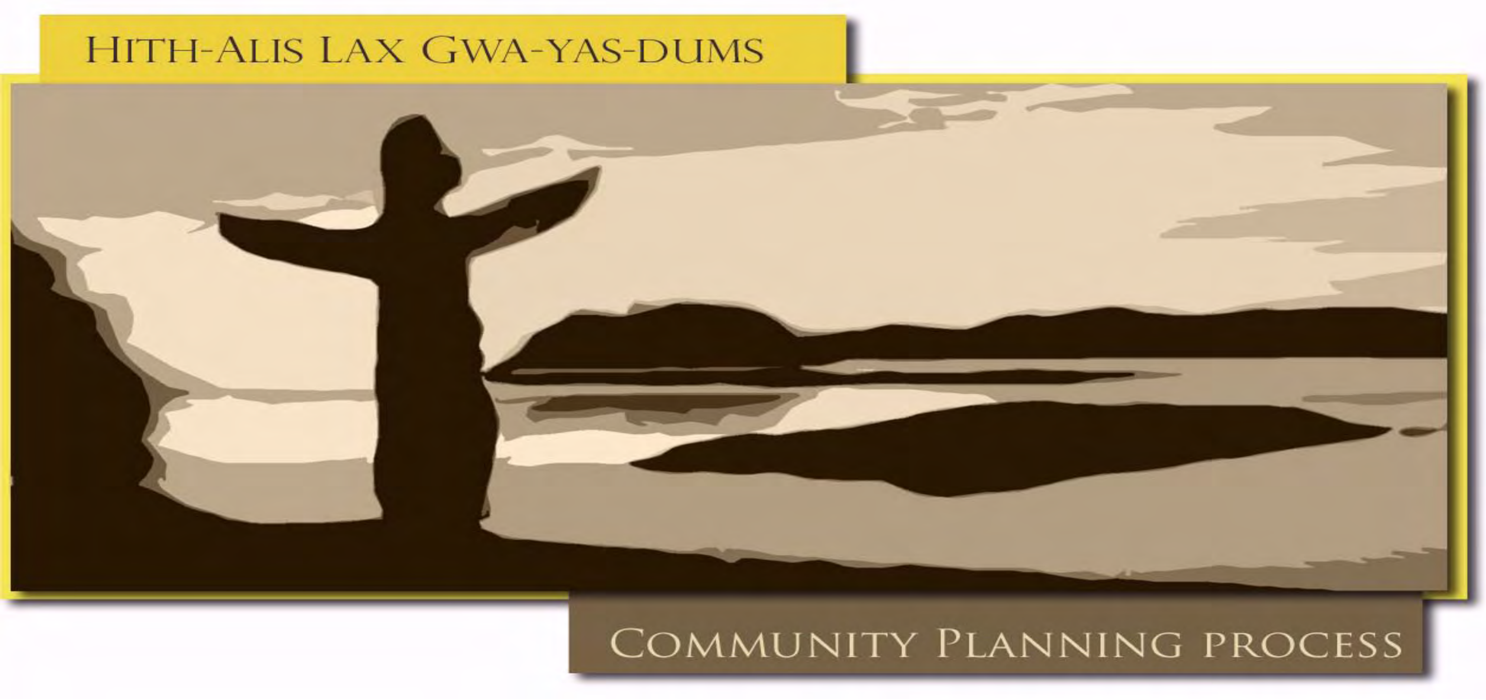
Proposal Writing and Funding Strategy

- An integrated funding strategy to implement the site plan is needed. As part of EcoPlan's terms of reference community planning, EcoPlan will provide technical support to KHFN for four proposals or grant submissions. One economic development grant proposal has been completed and submitted, although not funded. EcoPlan has discussed providing KHFN with a request for proposal for an architect which will be developed in conjunction with discussions/ proposal to INAC fund the architect. EcoPlan will also assist in developing a proposal to implement the community energy plan propane grid. A final proposal is expected to be generated following the final phase of EcoPlan's terms of reference that will examine non-physical aspects of successful community planning (e.g., economic development, health, governance, social, cultural).
- Note that these are the physical aspects of the community village planning work. The associated site planning, community energy, housing, and related infrastructure reports conclude EcoPlan's terms of reference under the current scope of services in this area. Additional detail concerning can be found in these reports.

November 2, 2006

Appendix A: **Community Site Planning Report**

Gwa-yas-dums Village -- Gilford Island, BC



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1. Introduction

In June 2006, the K̲wik̲wa̲sut'inux̲w Ha̲xwa'mis First Nations (KHFN)[1] reached consensus on a new conceptual site plan for the Village of Gwa-yas-dums on Gilford Island. Once implemented, this new site plan will significantly and positively change the future of these First Nations. This site planning process was community driven, with community members participating at every level of decision-making and direction-setting. Working with planning, design, and engineering specialists from EcoPlan, a site plan was crafted to respect site constraints and take advantage of opportunities. The final plan, shown below, is instrumental to delivering the KHFN vision of becoming a healthy, sustainable community that is culturally vibrant and economically stable.[2]

For example, health and safety objectives manifest themselves in the site plan by avoiding construction of buildings in natural hazard zones, such as the 50m slide hazard setback from the base of the hill on the north end of the village. Instead the community agreed to put in a soccer field where exercise will promote healthy living and community pride. Other examples include relocating houses from some of the most highly desired areas of the village in order to make space for successful tourism and economic development in the village, essential to a self-sufficient community. Finally, other places in the village were identified as sacred and will be protected.

To achieve KHFN's vision and implement the site plan, much needs to be done. Currently, the community of Gwa-yas-dums is in crisis, with basic needs of water/sewer, housing and energy not being met. The site planning process and resulting plan are critical in overcoming this crisis and moving towards a brighter future.

This report, specifically, is about the community planning process related to site plan. It describes the approach taken, the findings and conclusions required to make the planning a reality.

Photo 1: Community Site Planning Workshops

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[1] Officially recognized at INAC as the Kwicksutaineuk Ah-kwaw-ah-mish Band.
[2] Note that corresponding CAD drawings were also developed in order for conceptual plans to be as specific as possible.

Figure 1: Concept Site Plan for Gwa-yas-dums Village, Gilford Island BC

(see poster size map in report folder)

2. Project Background

The Kwikwasut'inuxw Haxwa'mis First Nations village of Gwa-yas-dums is a small community of between 27 and 70 permanent residents located on Gilford Island.[3] The KHFN are currently addressing a number of urgent issues such as: lack of potable water (requiring the importation of bottled water); failing septic tanks (requiring on-going pump outs); inadequate electrification (due to worn-out diesel-electric generator); and housing (mould, causing health problems). In addition, the KHFN face a host of interrelated social issues such as: lack of employment; an aging permanent population; a transient population (higher during the summer months); limited administration capacity; and a lack of comprehensive health and recreational facilities (fostering an environment for health problems and related social concerns). The KHFN Council recognizes these concerns and, with the support of INAC, has entered into a comprehensive community planning (CCP) process to address the numerous issues affecting the Nations.

In 2005 KHFN retained EcoPlan to assist them with their CCP initiative aimed at the improving community of health and livelihoods. Funded by the KHFN through INAC, the project's goal is to establish and integrate both short- and long-term plans for five key areas: site planning, housing, water/ sewer, energy and solid waste. Important social, economic, cultural and governance issues will also be examined.

The CCP process was initiated at the same time KHFN was addressing the priority area of water. Working with Kerr Wood Leidal Consulting Engineers (KWL), the Council and community members have established a water management plan that will provide the KHFN with a three-phase reverse osmosis and chlorination system of water purification.[4] The implementation of this project is scheduled for the fall of 2006. Paralleling this water planning process and with the assistance of EcoPlan, the KHFN have identified an approach to address the critical issue of energy/ electricity. The installation of a 300 KW genset upgrade was identified as the best short-term solution, required for the operation of the new water system as well as servicing the community needs. This is also to be installed in the fall of 2006.

EcoPlan was working concurrently with KHFN on a long-term community energy plan for the village. On October 5, 2006, with the technical support of EcoPlan, the community came to a consensus decision to implement a propane grid energy system to complete the energy requirements for the community. This decision is complementary to the power requirements related to the water treatment system. Also being considered, and consistent with sustainable energy goals of the community, are individual household solar systems and a potential harnessing of wind energy to complement the genset/ propane grid system. EcoPlan also assisted with housing related analysis, solid waste management and other infrastructure issues (see *Appendix B: Community Energy, Housing and Related Infrastructure Report* for more detail).

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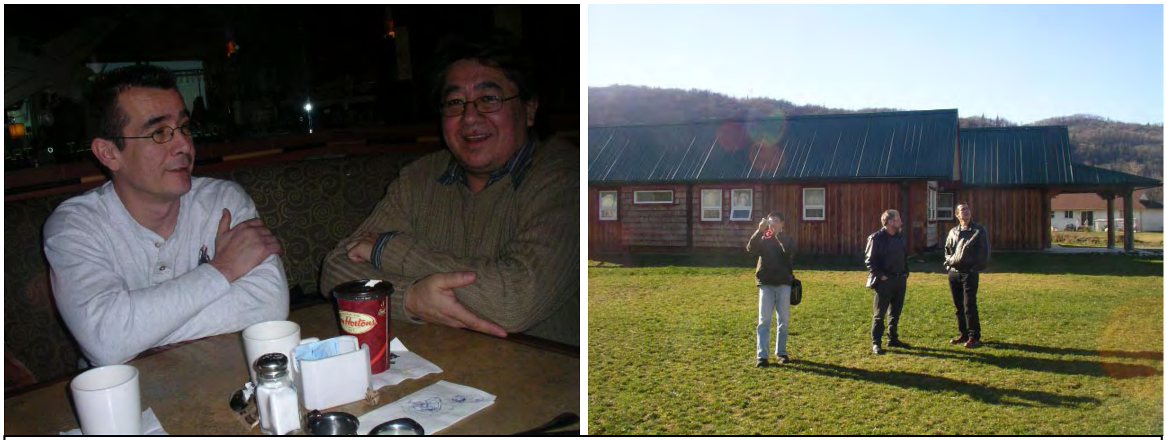
[3] The number of people actually resident in the village varies annually and seasonally and is different from the INAC official resident figure of 66. Resident population has been in decline due to the unhealthy state of housing and water supply, also limited economic development opportunities and educational facilities.
[4] Represent the interpretation of the writer.

3. Approach Summary

The approach to community planning has been a collaborative, internally driven planning process. Working with Chief and Council, residents of Gwa-yas-dums Village and off-reserve members, local values and preferences were identified and used to drive the process. Technical information also played a critical role in the final plan. Most significant, was the results of a geotechnical assessment that effectively removed approximately one-third of the current village site from possible construction. In all, over 10 community meetings were held to discuss the community plan, supported by a face-to-face survey of every house in the village as well as individual surveys for off-reserve members. Further, regular meetings with Chief and Council, study tours, information packages and informal discussions, provided the essential learning and background information for the community to make informed, value driven choices.

Photo 2: Study Tours



Study tours played an important part in the process. In all, four study tours were held including meeting with Council Member from Ouje-Bougoumou Cree Quebec and with CMHC at Seabird Island, BC

4. Site Constraints and Influences

The vision of the community for the future village design would necessarily be influenced or constrained by many factors such as geotechnical risk (e.g., slide hazards, flood hazards, debris flow, erosion), natural physical and environmental factors topography (wind/weather, erosion, stream setbacks, nesting grounds, solar orientation), infrastructure (power and water facilities, major utility mainlines) cultural factors (sacred locations, grave sites) and vehicle and people movement.

The main factors influencing the site are discussed below.

Geotechnical Hazards and Influences on the Process and Results

The geotechnical hazards uncovered throughout the community planning process proved to have a significant influence on the site planning options as well as the planning process (see

Appendix C: Terrain and Geologic Hazards Overview). After much preparation, a site planning community workshop was held on April 25th and 26th, 2006. This workshop utilized a draft geotechnical report dated April 13, 2006 by Cordilleran Geoscience. Several important constraints were identified in this report, but three were of critical importance: 1) a slide hazard on the northeast side of the village, 2) debris hazard on the north end of the village and 3) the tidal flood area for homes at lower elevations in the south portion of the village.

The April 13 report indicated that a 20m building setback from the toe of the hillside was required in order to achieve a reasonable safety for building. Peripheral to this is the issue of hazard trees on this hillside and how management of this issue should be addressed in order to enhance safety within the village. The geotechnical constraint alone eliminated a number of site planning options as it rendered a sizable area of the village uninhabitable. This meant that there was no longer the option to accommodate all of the existing homes within the footprint of the existing village site.

Furthermore, it precluded the opportunity to provide for new and returning members within the existing village footprint. New locations for residential buildings were tested utilizing the physical site model. The working group decided on one preliminary option that included a number of residential units on a narrow bench on the hillside behind the village. This conclusion acknowledged the difficulties in physically accessing the bench given the elevation of the bench.

The preliminary option also provided for a large number of residential units on the hillside at the south end of the site. The buildings were situated in an area bounded by the access road to the west, creek to the north and burial ground to the south. This area was referred to as the “upper village”. Conceptually, this area appeared to accommodate the residences that are required to be relocated from the lower village, while providing room for moderate level village growth. Given that the design scenario was conceptual, the feasibility of construction within the upper village would have to be tested in respect to geotechnical suitability and infrastructure design and would require survey work in order to ascertain the precise area available to accommodate buildings. Working with the geotechnical setback constraint and other physical site constraints, a number of design iterations were explored by the workshop participants. After two days of intensive work, the community came to a consensus decision on a preliminary site plan.

Subsequent to the village members and Band Council endorsing the plan that resulted from the April 25-26 Workshop, a follow-up report dated April 24th, 2006 was received and reviewed with one extremely significant change. In this report, the identified 20 meter geotechnical setback along a portion of the hillside was increased to 50 meters. Whereas the 20 meter setback created challenges for site planning and forced a number of new residential housing units to an upper village location, the 50 meter setback substantially exacerbated this constraint. *This new setback line meant that six existing houses would be required to relocate, most likely to a hillside location in the upper residential village. In addition, a seventh house would need to be relocated due to erosion concerns.* A second intensive site planning workshop, held on June 27, 2006, was required to address this major change which invalidated the April 25-26 site plan consensus.

Below is a summary of the key findings influencing and constraining the site plan. It is highly recommended that the final geotechnical report (final copy dated October 23rd, 2006) be reviewed for a full discussion of geotechncial findings and recommendations (see Appendix C). See Figure 3 for associated number referring to the associated comments below

1. Debris Slide Hazard

The steep slope behind [north half of] the village site presents a moderate debris slide hazard. Slides consisting mostly of uprooted trees could impact the base of slope and could severely damage or destroy a building. The best way to prevent risk to life, limb or property is to define a setback from the foot of slope. Consistent with the location of the existing power-house (containing diesel generators), located at the base of slope in the north part of the village, buildings *not* for institutional, assembly, commercial or residential uses could be sited between 20-50 m from the base of slope. In this instance, signs should be placed in the buildings to warn operations staff of the potential hazard, and buildings should be evacuated when rainfall exceeds 100 mm/24 hours. Buildings for institutional, assembly, commercial or residential uses should be sited at least 50 m from the base of the steep rock slope.

2. Debris Flow Hazard

A debris flow hazard area exists at the mouth of the creek at the north end of the village. The hazard is greatest during periods of intense wind and rainfall. A 50 m radius from the mouth of the creek should be established as the hazard area. The hazard area would include a sector extending from the base of the hillslope in the north rotating south to the existing beach-front of the village site. From there the hazard area would follow the top of bank back toward the hillslope to a line projecting perpendicular from the hillslope located 25 m south of the creek mouth. No critical infrastructure or residential housing should be established in this hazard area. It was mentioned by locals that it is a convenient place to bring a scow in to the beach. Temporary activities such as this are acceptable, but signs warning of a debris flow hazard should be posted. No temporary activities in this area should be allowed when rainfall exceeds 100 mm/24 hours.

3. Flood and Tsunami Hazard

The flood construction level for buildings anywhere on Gwa-yas-dums IR1 should be set at, or above 5.6 m geodetic. The joist box, or top surface of a slab on grade, should be set at or above the designated flood construction level. A maximum of 3 m tsunami run-up might be expected for Gwa-yas-dums IR1. A 3.0 m tsunami run-up added to maximum observed tide of 3.05 m geodetic yields a water level of 6.05 m geodetic. This is 0.4 m higher than the recommended flood control level. If the village wanted to be more conservative, they could use 6.05-m geodetic as a flood control level.

[Note: the south portion of the village site, due to its lower elevation, is at a higher risk of flooding. Interviews with residents suggest that some flooding has occurred to residences in this area.[5] *See area #3 in Figure 3]*

4. Erosion Hazard

Sea-wall reconstruction should be undertaken in consultation with a qualified engineer, and the design should consider impact from normal wave activity and tsunami run-up. The sea-wall is not intended to prevent flooding, only to prevent erosion, therefore it does not need to be constructed to the flood construction level. Its crest should be between the predicted 200-

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[5] Pers.Comm. Tim Willi, December 1, 2005.

year tide level (3.26 m geodetic) and the flood control level (FCL, 5.6 m geodetic). Foundations below 5.6 m geodetic should be resistant to erosion by waves overtopping the seawall. Foundation design should be determined in consultation with a qualified engineer.

5. Soil Stability

The existing village site foundation design needs to be based on bearing strength of shell-midden. This should to be determined in consultation with a qualified engineer.

In areas south of the village site, the terrain is gentle but there are some siting constraints. In the areas between the south end of the village and the existing dump there are three small creeks incised in glaciomarine mud. In this area proposed building sites need to be field verified to ensure they do not encroach on unstable creek sidewalls, and foundation design will need to be based on the bearing strength of marine clay. This needs to be determined in consultation with a qualified engineer. Elsewhere in the area to the south of the current village site, building sites should be located on well-drained soils. Rock or marine clay may be encountered, and foundation design needs to be determined in consultation with a qualified engineer.

6. Pollution Hazard

The existing dump location is in the watershed of a small creek that drains directly onto the village beach. To reduce beach contamination, the location of the dump should be reconsidered and the site remediated.

7. Gravesites and Burial Grounds

In addition to the formal cemetery, two additional burial locations were identified in the planning process. No building on these sites would be allowed and buffers as well as identifiers were recommended.

8. Storm Water Management

Storm water coming off the hill behind the village is a building construction and durability issue, as well as a site usability issue. In addition, seepage of water could contribute to mould development in houses.

8. Cultural

The village is situated on an archaeological resource. Since the village is under federal jurisdiction it is not subject to provincial legislation protecting archaeological sites. The midden is highly disturbed, but there are zones that could yield valuable information on the cultural history of the site. The band council may want to consider archaeological investigations as part of their village revitalization process.

The band has developed a cultural impact policy to address archeological or cultural issues that may arise during the re-development of the village site. It is oral and based on discussions with the community and respected elders.[6]

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[6] Pers. Comm. Chief Bob Chamberlin. October 25, 2006.

9. Environmental

In addition to the above related environmental constraints, the following existing or potential environmental issues were identified in the planning process. There is a tree hazard at the back of the village. Several tall trees are at risk of falling, putting human health and property at risk. At the time of this report, the band has consulted an arborist to address this issue. Band members in the proposed development area identified several important medicinal and berry plant species. However, it was agreed that these would not constitute a constraint to the village re-development process. In addition, one eagle nest was identified in a tree adjacent to the shoreline. This nest is adjacent to a burial site and has been protected.

In areas south of the village site, the terrain is gentle but there are some siting constraints. In the areas between the south end of the village and the existing dump there are three small creeks incised in glaciomarine mud. In this area proposed building sites need to be field verified to ensure they do not encroach on unstable creek sidewalls, and foundation design will need to be based on the bearing strength of marine clay. This needs to be determined in consultation with a qualified engineer. Building sites should be located on well-drained soils. Rock or marine clay may be encountered, and foundation design needs to be determined in consultation with a qualified engineer. (also see Point 6 above regarding pollution hazard).

10. Major Infrastructure (see infrastructure map below)

For cost reasons, siting of buildings was done with respect to major infrastructure. Individual housing hook-ups were not constrained by the current situation.

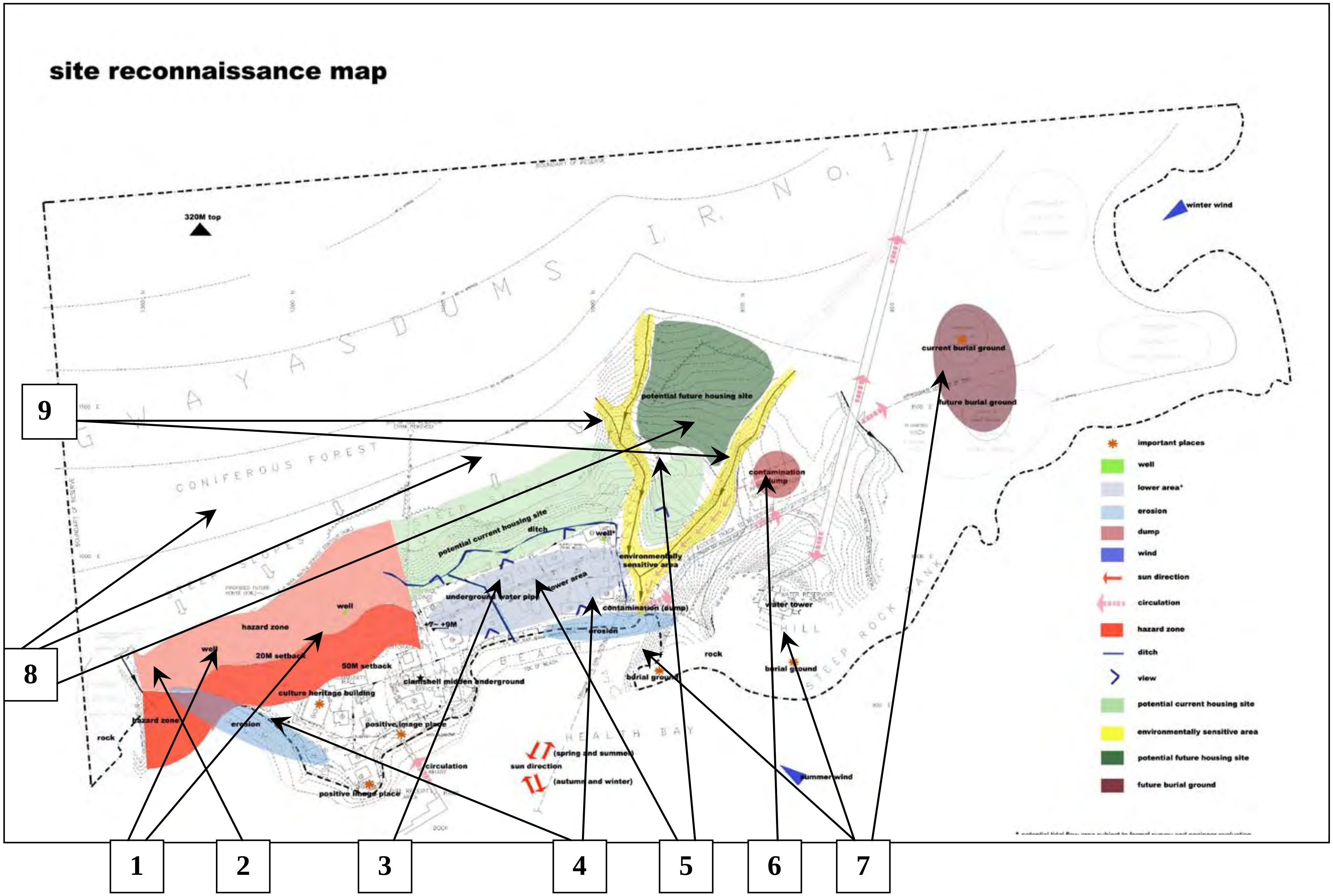
Figure 2: Major Infrastructure

Other Findings

In addition to the above findings and recommendations, the geotechical analysis did not find any aggregate resources on Gwa-yas-dums. Aggregate for concrete will have to be barged in or shot rock from local rock outcrops could be crushed. Shot rock from local rock outcrops could be used for sea-wall construction.

Finally, all housing and important infrastructure should be designed according to National Building Code standards for earthquake hazards considering the potential for great earthquakes. Hazard area setbacks and flood construction levels at Gwa-yas-dums Village will have to be established in the field according to the recommendations herein by a qualified surveyor as part of the feasibility, pre-design, design stages of the project.

Figure 3: Gwa-yas-dums Site Constraints and Influences

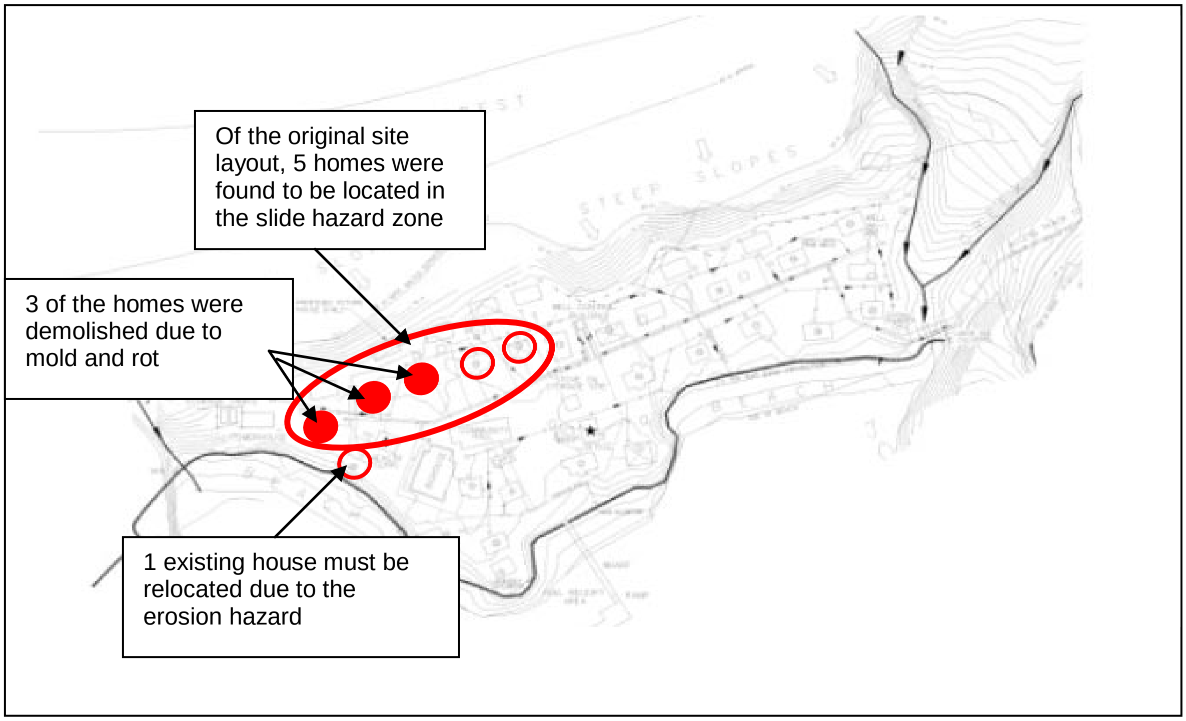


Key Findings from the Constraints and Influences Analysis

Many findings influenced the site planning work (e.g. locations of burial sites). However, several key findings have significant implications on the site planning process and outcomes, as noted below:

- Five existing homes would need to be relocated away from the debris slide hazard.
- One existing home would require relocation due to erosion hazards.
- In addition to standard engineering analysis, specific engineering work would be required to address tidal flooding, tsunami, soil stability in the existing village and in any new areas designated to accommodate the home that were forced to be relocated. Also cited were the need for pollution control on the old dumpsite and storm water management of the village as a whole.

Figure 4: Original Houses Required to be Relocated due to Hazards



Of the original site layout, 5 homes were found to be located in the slide hazard zone

3 of the homes were demolished due to mold and rot

1 existing house must be relocated due to the erosion hazard

5. Population, Households and Future Growth

The number of people living in Gwa-yas-dums, and the number of households, has varied over the course of recorded history. The population has varied from approximated 170 in the 1960s to between 27 and 70 in the first part of this decade. The numbers are dynamic and currently they are heavily impacted by health concerns related to moldy, rotten homes and non-potable water. However, it has always been an important location on a year-round basis, with an increasing population during claming season, something that continues today. In addition, increases are currently also noticeable in the summer months when children and families come to visit. Due to the lack of economic opportunity and lack of schools, many families are unable to reside full time in the village and the summer months affords a chance for children to visit relatives for extended periods of time.

Houses have varied from 10 in 1834 to 35 in 1951[7] to 21 at the initiation of the community planning process. During the course of the planning process, eight houses have been demolished and five trailers brought in for temporary transition housing. [8] The type of housing has also changed over time from long house style where many lived under the same roof to inheriting used, small, wood frame “single family” air-force houses in the 1960 from Port Hardy.[9]

Current, Historical and Projected Population

According to the official INAC census, the Kwicksutaineuk Ah-Kwah-Ah Mish Band has a population of 267 members, with 66 members or approximately 25% of the total membership currently living in Gwa-yas-dums Village on Gilford Island.[10] A majority of the remaining 201 live off-reserve in the surrounding region, especially in Alert Bay. Others are scattered throughout Vancouver Island and the lower Mainland.[11] Since 1972, the overall population has increased from 207 members to 267 (see Figure 5 below). This increase of 60 members over a 29 year period represents an overall increase in population of 29%. This represents an average yearly increase of 1% or 2 members per year.

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[7] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.

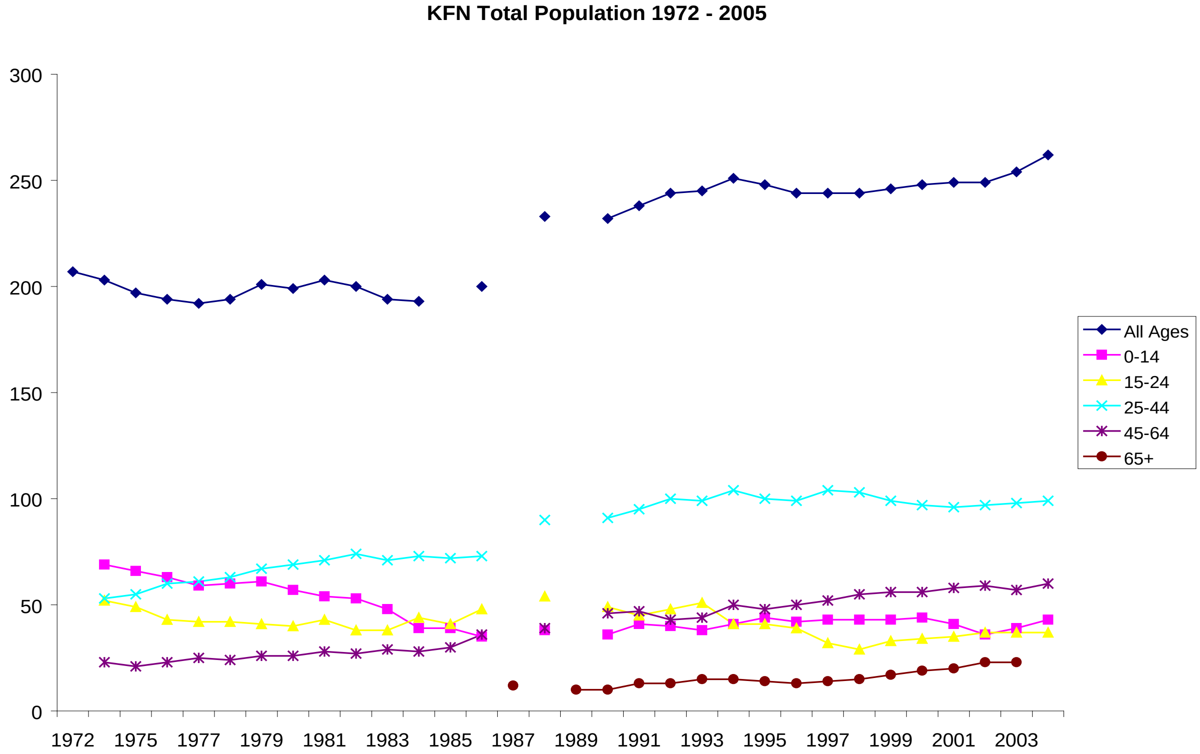
[8] A transition replacement housing strategy, including number of home and where they will be built, is underway. This replacement is dependant in part on how quickly the urgent need for developing a new subdivision on the hill to the south of the current village site can be achieved. This situation is explained further detail in Section 11.

[9] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.

[10] It is important to note that KHFN member roster is not consistent with INAC, and they are currently updating their member list.

[11] KHFN membership list is currently out of date and it is not known what the exact regional distribution of population is.

Figure 5: KHFN Total Population by Age Cohort 1972 - 2005



Over the past 40 years, the age profile of the village population has changed significantly. In 1963, 75% of the village population was under 30[12] whereas in recent years there is a much more even distribution of community members across the age cohorts. Observations suggest that the trend is tending towards an aging community as young families, concerned about the health and safety regarding housing an water, as well as the limited economic opportunities and distant schooling, live off of Gilford Island.

KHFN's annual population growth is expected to be between 1.5% and 3.5%, bringing the total population over the next 25 years to between 400 and 560 members respectively, or between 5 to 12 new members annually. [13]

Village Housing Needs and Projections: Population and In-Migration Influences

The immediate need for housing exceeds the current number of units in Gwa-yas-dums Village. Funding for 26 houses has been secured to meet part of the pent-up housing demand. Surveys undertaken as part of the community planning process suggest that there is additional pent-up demand for between 10-20 additional homes at Gwa-yas-dums.

Looking at population projections, and based on 2.3 people per household, the estimated population increase of between 5 to 12 people per year will require between 3-6 new houses

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[12] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967. P. 20

[13] These growth rates are based on five and three year historical averages.

per year for the total overall population. This represents a total 25-year housing demand of approximately 75-150 houses for the total membership.

It is impossible to accurately estimate the precise number of houses needed over the 25 year planning time horizon. However, it is clear that once local health issues are resolved (especially related to water), housing lots are made available, economic development is pursued and other social issues are confronted as indicated in the community plan, the demand for local housing will accelerate. A conservative estimate based on existing data indicates that in addition to the 26 homes already identified for implementation, there is pent-up demand from in-migration for an additional 10 homes. Annual demand from population pressure is anticipated to be 1 to 2 homes per year or an additional 25-50 homes over the 25 year planning period.

Water and power are currently being implemented for Gwa-yas-dums. These will represent significant site constraints to future housing, as will topography and buildable area. Depending on guidelines implemented for residential building design (e.g., energy conservation, low-flow appliances). It is currently estimated that between the proposed 26 and 80 houses could be serviced with existing infrastructure. Topographic and geological constraints will be determined during the pre-design and design phase.

A transition replacement housing strategy, including number of home and where they will be built, is underway. This replacement is dependent in part on how quickly the urgent need for developing a new subdivision on the hill to the south of the current village site can be achieved. This situation is explained further detail in Section 11.

Photo 3: Current Village with Temporary Trailers, April 26, 2006

6. Historical Perspectives

Visionary leadership, both formal and informal, recognized that the community planning process offered an unprecedented opportunity to positively change Gwa-yas-dums in a way that reflected the needs and desires of the community. It also offered a chance to empower community members to consider changes in their community and to take greater control of their future. This represents a new approach to planning and governance.

To assist the community in thinking about change, historical research and analysis was conducted and presented to the community, supported by visual aids. Photographs and written histories of how the village has evolved over time were presented. This stimulated a review of oral histories and discussion of values. Important historical issues that might affect current plans were noted, such as the 1856 (or1857) devastating attack on Gwa-yas-dums by the Bella Coola that lead to many local gravesites and the abandonment of the village by the Kwicksutaineuk; the historical importance of Gwa-yas-dums as a central gathering point in the region (especially to the Gwawaenuk and Tsawatainuk, in addition to the Ah-kwaw-ah-mish and Kwicksutaineuk); acknowledgement that even as long ago as 1948 the Kwicksutaineuk and Ah-kwaw-ah-mish bands were trying to get assistance to deal with the inadequacy of potable drinking water supply, the same year the formal joining of these two bands took place.

Photos were also used to initiate discussion about what was liked and disliked in the past, and how this information might be incorporated into future site plan alternatives. For example, the 1900 and 1933 photo series brought out the critical importance of architectural expressions of culture. The lack of privacy and crowding that was associated with living in these traditional long houses was particularly disliked. Reviewing the village 1963 suggested that close housing, the poor orientation of houses and the lack of privacy (with houses facing each other rather than the ocean) were all disliked and not practical. Below shows a sample of the photos that were used in the community planning process.

Photo 4: Gwa-yas-dums 1900

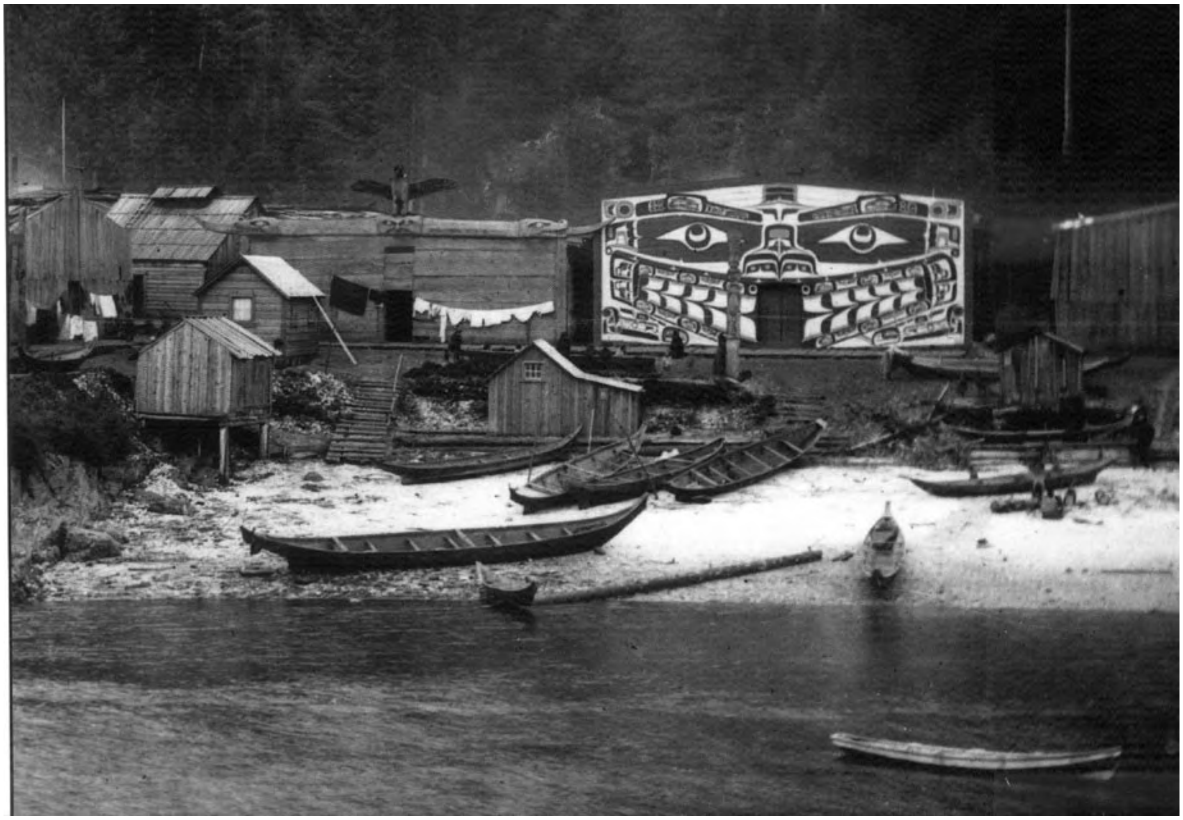
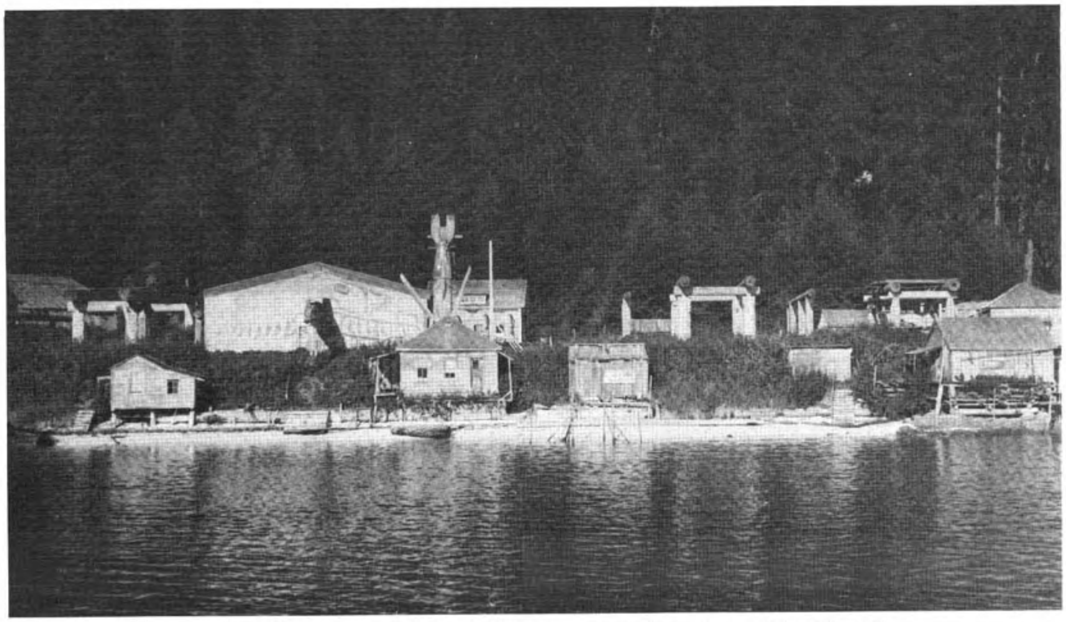


Photo 5: Gwa-yas-dums 1933



A portion of the village as it looked in 1933 (*Courtesy of the Provincial Museum, British Columbia*)

Photo 6: Gwa-yas-dums 1963

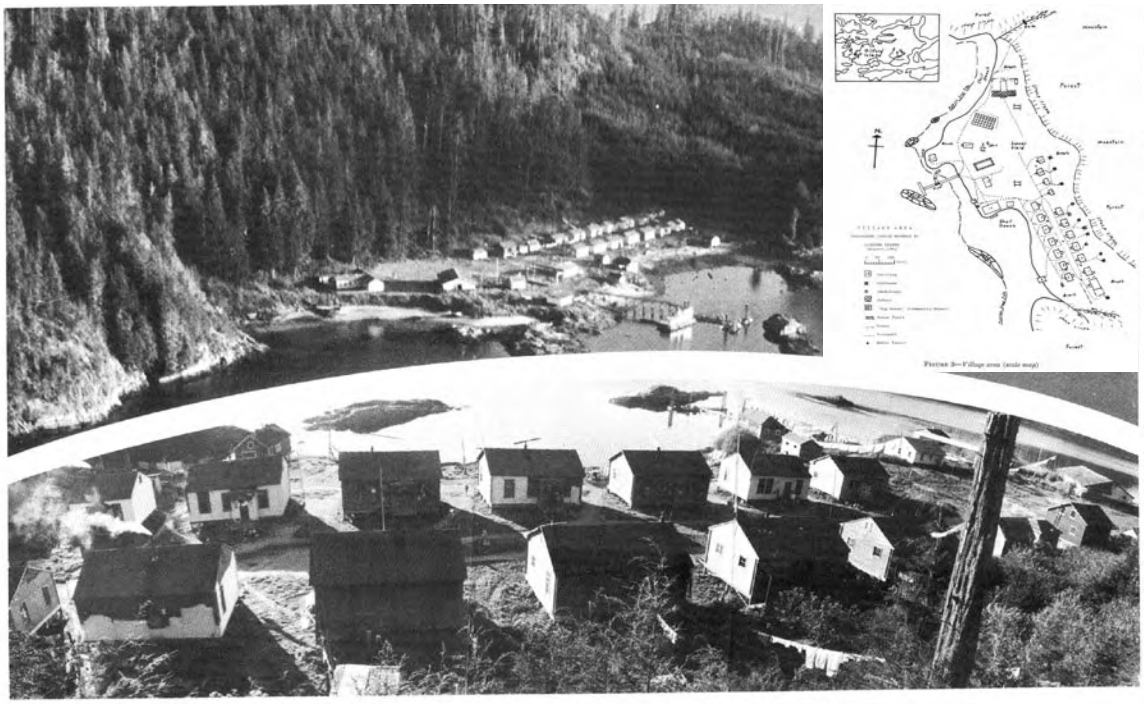


FIGURE 3—Village area (scale map)

FIGURE 2—*Aerial and panoramic photographs of the village*

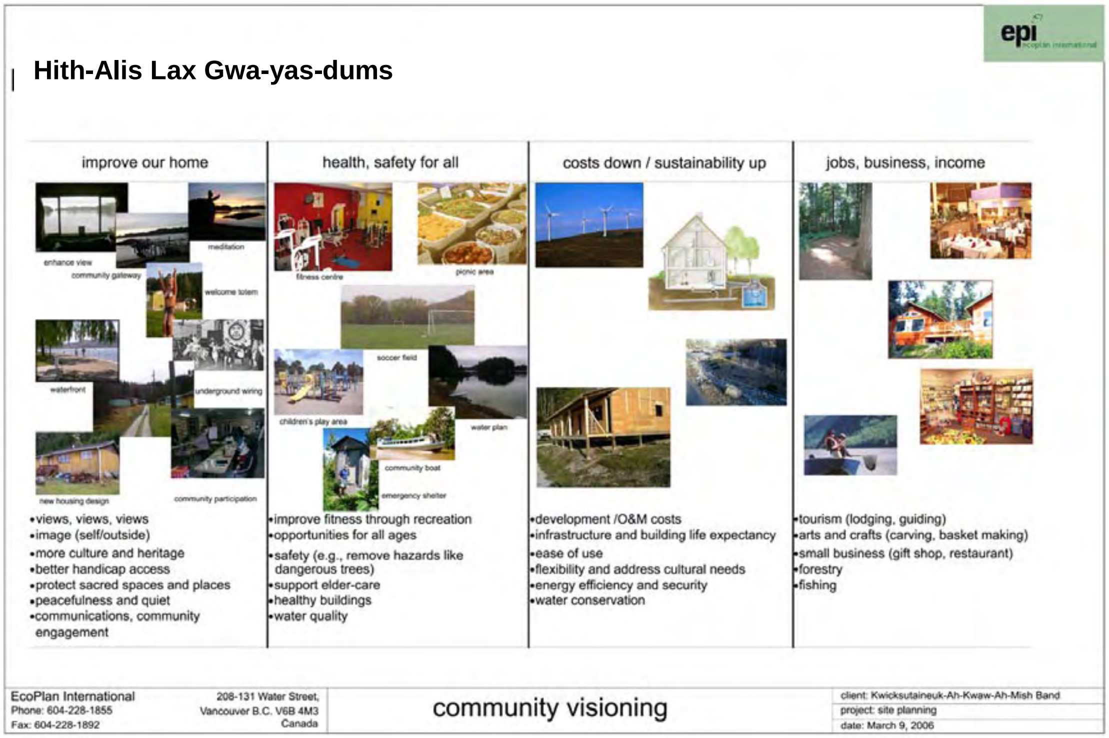
Photo 7: Gwa-yas-dums 2005

7. Values and Objectives

The community planning process should be a value driven process, not a technical exercise. Technical analysis should support and help focus what is important to the community. The values of the community need to be explicitly addressed in the final plan. Structuring the community values in an organized way facilitates their inclusion in site design. And, where conflicts and tradeoffs between community values arise, structuring them facilitates clear choices. The ultimate goal is to craft a design alternative that satisfies the community and ultimately achieves not only consensus, but generates excitement in the anticipation of design and implementation.

In preparation of the site planning workshops, EcoPlan worked with the community to draw out what they value in the community currently and what would make Gwa-yas-dums a better place. Using elicitation techniques through surveys, informal discussions and meetings, a list of core values was generated. The list itself was shared with the community members, but visual aids were also developed using drawings and photos to help describe what the members were indicating. The list acted as a ‘checklist’ during the site planning workshops, and was used to structure workshop agendas. Below is the list of site design relevant KHFN values that were elicited in meetings, surveys, interviews and workshops. These were validated and utilized as part of the site planning workshops. In addition to the lists, KHFN posters describing their values in graphics (photos, drawings) were hung around the meeting room and referred to during the process.

Photo 8: Visioning Poster – Graphic Representation of the Community Site Planning Objectives



Hith-Alis Lax Gwa-yas-dums

improve our home
- views, views, views
- image (self/outside)
- more culture and heritage
- better handicap access
- protect sacred spaces and places
- peacefulness and quiet
- communications, community engagement

health, safety for all
- improve fitness through recreation
- opportunities for all ages
- safety (e.g., remove hazards like dangerous trees)
- support elder-care
- healthy buildings
- water quality

costs down / sustainability up
- development /O&M costs
- infrastructure and building life expectancy
- ease of use
- flexibility and address cultural needs
- energy efficiency and security
- water conservation

jobs, business, income
- tourism (lodging, guiding)
- arts and crafts (carving, basket making)
- small business (gift shop, restaurant)
- forestry
- fishing

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Vancouver B.C. V6B 4M3
Canada

community visioning

client: Kwicksutaineuk-Ah-Kwaw-Ah-Mish Band
project: site planning
date: March 9, 2006

Table 1: Site Planning Objectives and Related Comments

Note: theses objectives are related to site planning only

Improve our Home (views, image, culture, social interaction, wide range of ages/vibrancy environment/sacred place protection)

Objective	Comments
Incorporate culture & heritage (“tangible expression of culture”)	• All major public buildings have cultural design aspects • Cultural entryway to village and visible cultural images from air and water • Cultural images (totems, canoes, public art, playground) throughout village • Shape of site layout is culturally significant • Signage/storyboards explaining teaching culture (on the walking trail e.g. plants)
Create positive image/beautify community	• Strong entrance to village -- welcome signage or symbols • Eliminate bad smells (e.g., sewage, exhaust) • Enhance good smells: Flowering plants – berries, other • Beautiful buildings made of local materials (shake roofs, cedar siding) • Beautification elements (sidewalks, focus points) • No litter

Improve wheelchair/handicap accessibility	• All of village accessible by wheelchair – including any waterfront walkway
Maintain /Maximize views	• Orientation and spacing gives all houses have a view to ocean through the windows of living room without unsightly visual disruptions • Electrical wiring underground or back of village
Enhance personal privacy (visual, sounds, smells)	• Noise, visual, housing spacing acceptable (enough manmade barriers or natural block to decrease visual disruptions and noises) • Functioning sewage system
Promote peacefulness	• Separate tourism sites from village • Reduced noise from genset
Encourage (Build) positive internal relationships & communications	• Community gathering places that are accessible to all (healing centre, alcohol & drug addiction/use centre, recreational options, elders & elders center, post office)
Improve communication and access to & from Village	• Upgrade existing dock • Add additional dock(s) • Improve barge loading area
Make Gwa-yas-dums a more affordable place to live for members	• Cogen/District heating to reduce energy costs
Protect (& Expand?) grave sites/burial grounds	• Unknown – needs to be determined • Widely accepted preservation of all cultural areas (clam midden, burial grounds) • NOTE: Uncertainty of quantity and location of sites as well as level of protection required – specifically the point. • (Note: currently there is no formal protection for grave sites outside of graveyard)

Maximize our health and safety

Objective	Comments
Improve fitness and recreation opportunities for all ages	• Waterfront walkway; complete circular loop through • Soccer field • Elders walkway w benches • Playground • Fitness center (weights, treadmill, etc.) • Redevelopment of rec center to meet current needs • Programs: cultural, art, food prep, sports, education classes etc. Swimming? • Other activities? Different times of year?
Address emergency and hazards	• Expanded Emergency Preparedness/Evacuation/Shelters

	• Improve fire response time • Address hazards through location, engineering, other (tidal flooding, fire, trees, landslides)
Support elder-care	• Build Elders facilities – Elders social center • Hospice care, terminal illness, end of life issues, care giving, and grief • (Note: Elders have some home care. Sick or dying elders must leave village for Alert Bay or Port Hardy)
Promote healthy buildings	• Buildings located or engineered above highest high tide level to avoid flooding, slope of land for good drainage, avoid swamp. • Building/house locations integrate positive natural elements (wind, solar etc) to buildings
Improved drinking water infrastructure	• Electrical wires to new water treatment plant preferably buried, or at least at back of community against hillside • Surface water treatment system (natural runoff, detention ponds, etc)

Encourage Business and Economic Development (Jobs, local residents, income, self esteem)

Objective	Comments
Promote nature & culture tourism	• Year round tourism activities, peaking in summer months • Commercial/retail area and welcome area at dock • Small multi-use guest accommodation • Development of eco-tourism site at sawmill bay • (Note: Currently there are minimal visitors to Guilford and no spending)
Promote micro and small enterprises	• Build on existing micro economy. • Smaller Arts/Carving House & Retail Centre for Artists & Carvers; Basket makers; Singers/Music • (Currently: No retail/commercial buildings or space, no business or stores.)

Keep costs down

Objective	Comments
Minimize development costs	Not yet estimated • Clustering buildings could reduce infrastructure costs • Developing new areas will increase development costs • Keeping houses below water tower will eliminate need for water pumping • Reduce district heating loop size by clustering close to genset • Don't move or bury overhead wires
Reduce O&M costs	Not yet estimated

Ensure Sustainability and Appropriateness of change

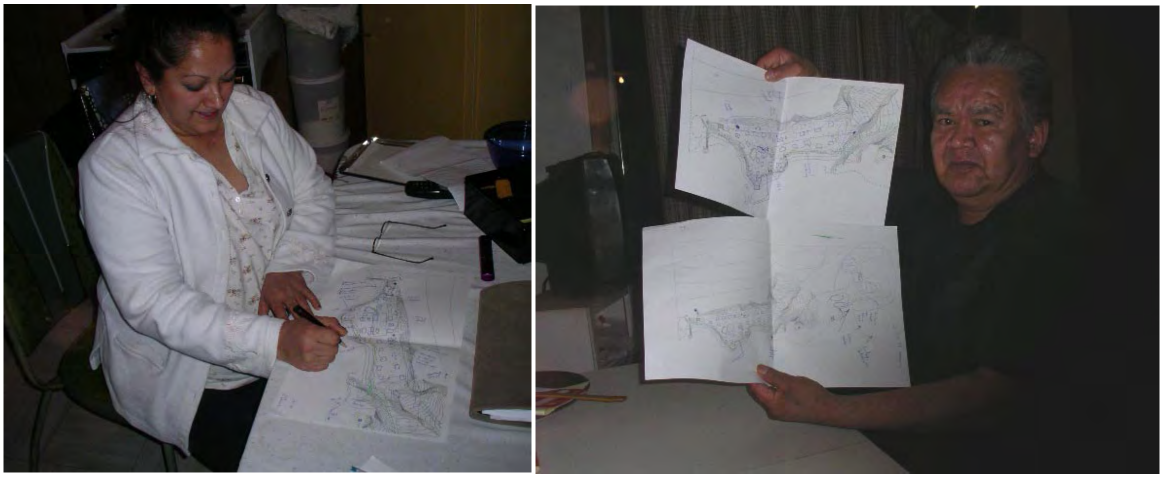
Objective	Comments
Ensure adequate protection of (minimize impact to) cultural areas/features	• Locate buildings and infrastructure so as to minimize cultural areas/features and sites such as clam middens (under entire existing community) and burial grounds (also under existing houses and in other locations). • Add protection to sacred sites and special features.
Ensure adequate protection of (minimize impact to) natural features/areas	• Locate buildings and infrastructure so as to minimize impact to natural/ecological areas/features and sites such as streams, trees, nesting areas. • Add protection where needed
Promote Energy efficiency	• Locate and orient buildings to maximize passive solar opportunities (windows facing south, reduced shading of adjacent buildings) • Reduce distance between buildings

8. Developing Alternatives

The next step in the process was translating the vision and objectives of the community into a tangible plan. This required many meetings, interviews, surveys, study tours and four specific site planning workshops.

To initiate the process, first EcoPlan asked each KHFN member interviewed to draw their own vision of what Gwa-yas-dums village could be site plan. This moved the discussion from objectives and values to what could be done (i.e. potential options) to achieve these objectives and satisfy community values.

Photo 9: Community Site Design Input

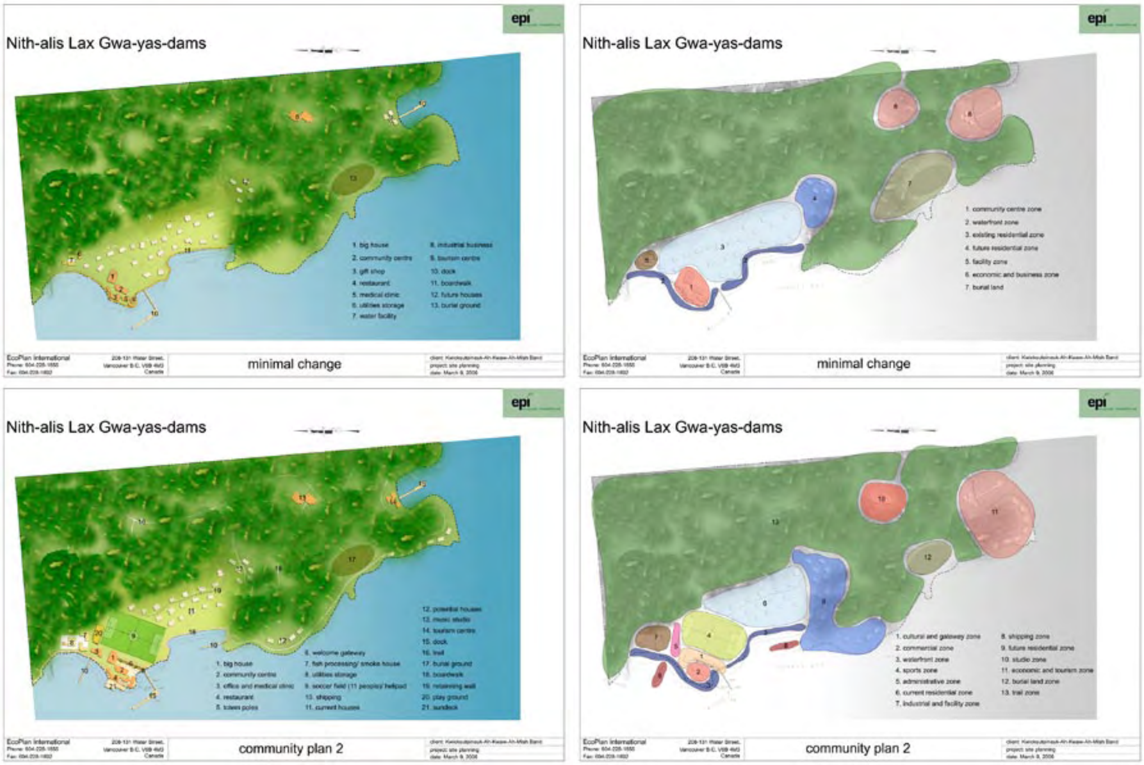


Councilor Lucy St. Germaine (left) and community resident Calvin Johnson (right) show their individual visions of what Gwa-yas-dums village could be

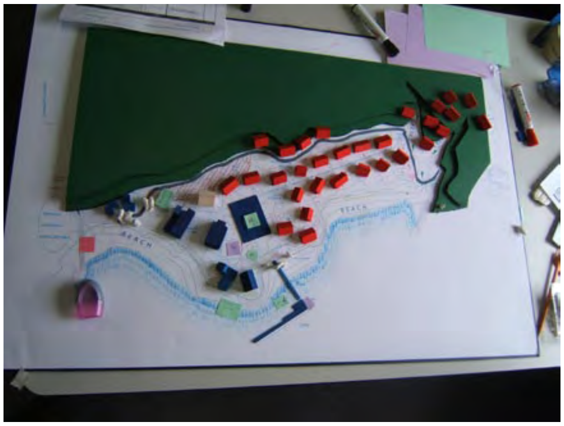
The planning team then analyzed the results of the community input, including the individual site plans and combined these individual visions into three alternative site plans. A fourth site plan was developed by the planning team to introduce new concepts in site design and new ideas from a site design professional's perspective. The ultimate goal of developing these alternatives was to expand the range of possible alternatives, make sure good ideas were represented, show that there are many form and character options for Gwa-yas-dums to achieve their objectives and to provide a starting place for the workshop.

On March 10th and11th, 2006 a study tour and the first site planning workshop were held. The alternatives developed from the individual interviews were presented to the community to initiate discussion in the community and thought about the broad range of potential options for the future of Gwa-yas-dums. Figure 6 below shows an example of two of the site plan options developed.

Figure 6: Examples of some of the many site design options developed by residents for Gwa-yas-dums.



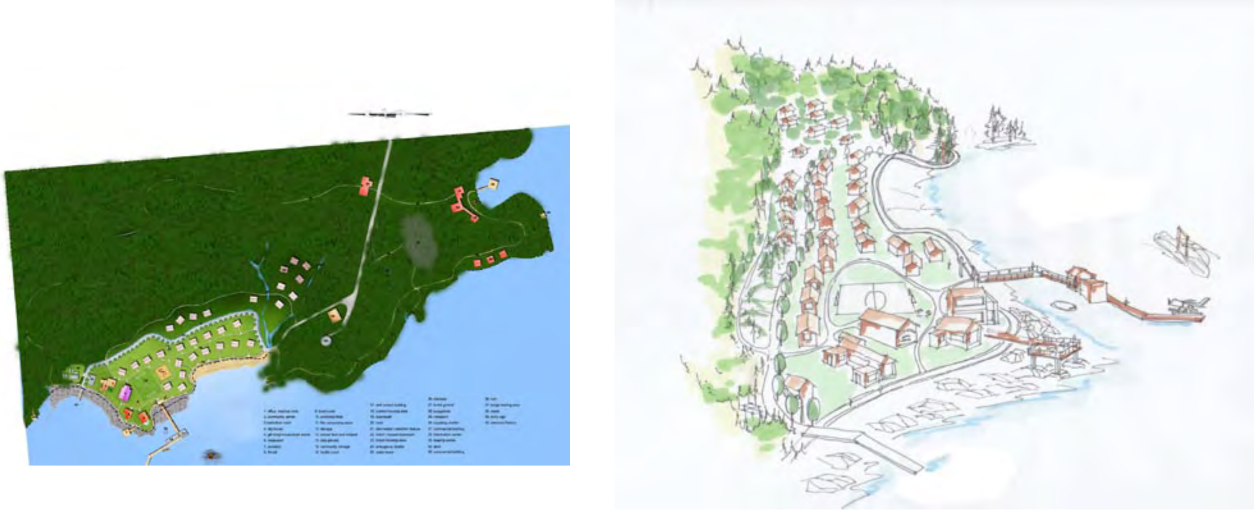
On April 25th and 26th, the second site planning workshop was held. This was an intensive two day meeting where analysis of the initial site plans took place and numerous new design iterations were developed. In addition, a physical model of the Gwa-yas-dums village was made. This model was developed to provide an alternative to drawing site plan alternatives and was used throughout the site planning and design process in conjunction with site maps and perspective drawings. All the core issues were addressed at this meeting and consensus was reached on a conceptual site plan.



A physical model of the site was constructed to support site maps and drawings. The model above shows the first consensus site plan.

A third site planning workshop was held on June 27th, 2006 to address the updated geotechnical report that moved the setback at the north end of the village from 20 meters to 50 meters and invalidated the site plan of April 25th and 26th. At the onset of the workshop the objective was to respond to the INAC request that two site plans be developed for a technical evaluation (engineering and economic). However, after new and challenging issues were overcome by the community and two options were developed, one option became the clear favorite and no community member wanted to pursue the alternative option. With consensus reached for a second time, it was agreed that one site plan would be presented to INAC for engineering review to assess options *internal* to the concept plan. The final meeting took place on July 24, 2006 and was to confirm and validate the plan. The following section discusses relevant issues and conclusions related to the final conceptual site plan.

Figure 7: Consensus Site Plan #1 and Perspective Drawing, invalidated by revised geotechnical analysis



9. Final Conceptual Site Plan for Gwa-yas-dums Village

This section explains the final site plan, reached by community consensus on June 27-28, validated and confirmed by the KHFN on July 24, 2006. In all, the community agreed on a site plan with seven distinct land use designations: residential, commercial, industrial/utilities (powerhouse, drinking water), administration, tourism, entry, outdoor space/recreation. In addition, cultural identity, storm water management, emergency shelter, and other issues were addressed. The discussion below articulates the key issues raised and the site planning responses. All numbers in this section in parenthesis reference corresponding numbers on the concept site plan. The estimate acres for the site are: Current/ Lower Village: 4.8 acres; Upper Village: greater than 6.0 acres, Side Hazard: 1 acre.

Residential

The current housing situation in Gwa-yas-dums is desperate, thus housing is a priority issue for the village residents. Inadequate and moldy housing, causing ill-health and abandonment, have put great pressure on a immediate response. To date, five homes have been demolished and residents moved to temporary trailers in the village. Homes are currently being demolished in anticipation of the site plan being implemented, and based on need (i.e. mold) rather than rebuild logistics. Based on the geotechnical analysis of the site, six existing homes need to be relocated away from the debris slide hazard and one existing home needs to be relocated due to erosion hazards.

The community identified a fundamental need to generate economic development. Tourism was identified as one of the few opportunities available to the village, although they would like to explore other opportunities as well. The need for, and importance of, economic development is reflected by the fact that the most desirable land area in the village for housing (based primarily on views and access) was dedicated to commercial and tourism use. Village residents made this possible due to admirable concessions. In particular, village resident Beatrice Smith agreed to move to a new home in the proposed upper village on the hill, and Calvin Johnson agreed to relocate to where Beatrice Smith's home currently is located. Without this agreement, which is dependant on giving implementation priority to the proposed upper village, the consensus site plan would not be possible. The land area dedicated to economic development and administration requires relocation of four existing homes.

In all, eleven of the twenty-six homes need to be relocated as designated in the conceptual site plan, due to the limited land area available in the village area after consideration of hazards, and administration, commercial and cultural use. There is only room for seventeen homes of the twenty-six replacement homes in the current, lower village. At least nine homes must be relocated elsewhere on Gwa-yas-dums IR1 reserve. This is true even with closer lot spacing, a minimum of twenty-three feet, agreed to by the community. New land for housing is urgently needed. The only contiguous area available for new housing development is on the gently sloping hill to the south of the existing village, what is commonly referenced as the "upper village".

To accommodate current housing, two areas have been designated for residential use (#18). The southern portion of the current village site, and the upper village located adjacent to the south of the current village. The upper village will also provide land for future housing, essential for achieving the vibrancy desired for the village and accommodating KHFN members who currently live off-reserve but would like to move home to the Village. Site analysis indicates that all 26 replacement homes will be able to be located below the 18m pressure zone (#45), a "jockey pump" or other method is required in order to facilitate development above this zone.

An issue that needs to be resolved prior to implementation of the site plan is the status of Dave Johnson's Veteran's Affairs housing allotment, apparently located in the south of the current village site. Questions still remain if it has been formally registered, and regardless, has it been formally resolved within the community.

Views and privacy were two values that the community emphasized in the planning process. The KHFN are a marine oriented culture and contact with the ocean, including visual, is of great important. Currently in the village many of the houses in the back row do not have a view of the ocean but instead look directly into neighbors houses or other buildings. The lot locations and house orientation were analyzed (see Figure 8). Under the proposed lot layout, all houses have as good or better view than the present situation. A basic orientation of housing was agreed to that suggests the front row of houses to be reoriented so that roof peaks are perpendicular to water creating better views for the back row.

Figure 8: View Shed Analysis

Two concepts were given serious consideration but were not included in the final site plan. First, an elder care facility was discussed and many community members agreed that it was a good idea. Upon closer analysis, it became apparent that no one would want to live in an elders care facility themselves. Therefore, the community agreed to not build dedicated elder care facilities on site, but instead to design all residential housing with elder care in mind and to use current age demographic statistics (from surveys) to garner funding for improved home care for elders in the village. This would allow for improve in-residence elder care, which is a priority issue for residents. Second, floating homes, including lodges were also considered in the planning process. Several locations were evaluated and deemed possible but in the end the community was not in favor of this type of housing.

Cultural identity

There is a pressing desire to reintroduce iconic or cultural motifs for the new village. The community felt that the physical cultural references once abundant in the village have been lost over time, which has lead to a loss in the sense of place and cultural identity. Influencing the discussion were study tours and interaction with other bands across Canada who have successfully incorporated cultural identity into village plans.[14] These interactions

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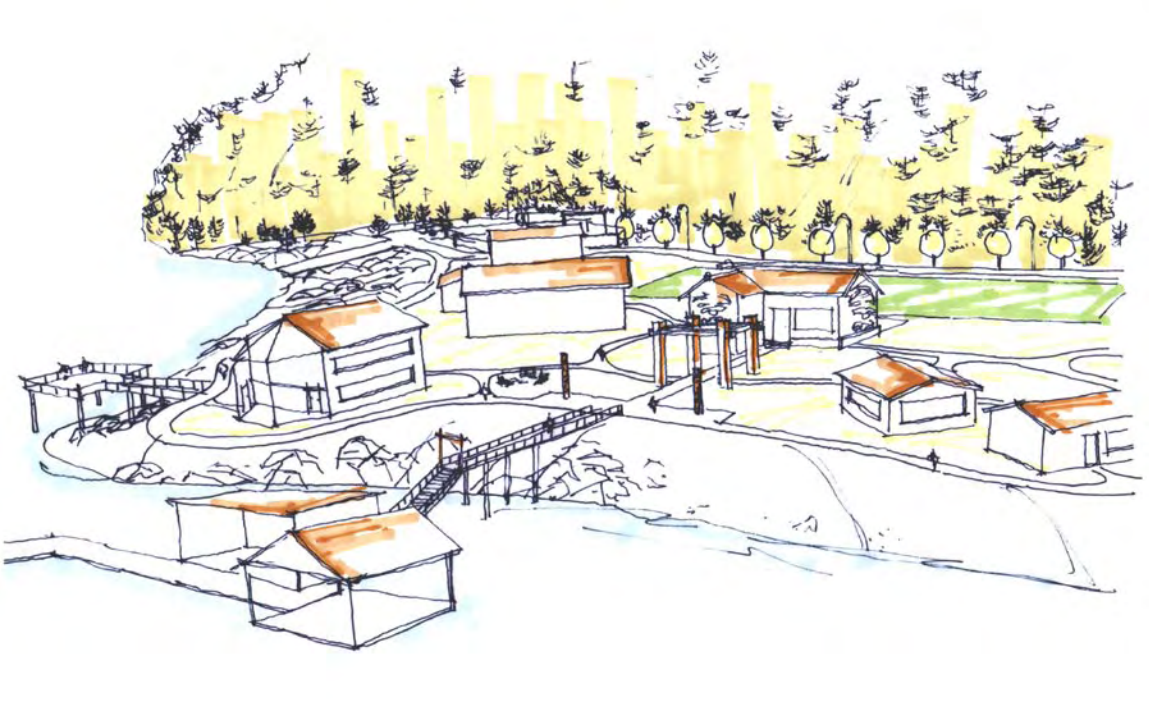
[14] Chief Bob Chamberlin meeting with the Chiefs from other nations at the World Planers Congress in Vancouver (June, 2006) and Council member from Oujé-Bougoumou Cree.

supported the concept that it is important to create a strong sense of place with the visual appearance of the band office at the entrance to the community and with impact issues such as community pride, negotiating with private sector and government, economic development opportunities, among others. The group explored how and where such cultural references could be accommodated.

In general, an application of traditional motifs should be incorporated into the design program of the overall village. Nowhere is the visual expression of culture more important than in the village entry.

Photo 10: View to West from Gwa-yas-dums Village, December 2005.

Figure 9: West to East Perspective of Gwa-yas-dums Village



Village Entry

It is important to create a sense of entry and flow through the village in a manner that reflects a sense of place to residents and communicates the history/ story of the people. The village entry experience sets the stage for achieving this. It is also a key component in attracting visitors and tourists into the village, which will be a cornerstone of the village economic development strategy. Community participants identified key words to describe feeling upon arrival: natural, welcoming, friendly, traditional, inviting, fulfilled, peaceful, tranquil, warm. Ideas of some key elements that would capture this and should be included in the entry way are described below (note that these are also key to aspects of cultural identity). Imagine entering the village, by sea or air, and experiencing these aspects of Gwa-yas-dums:

- A memorial totem/welcome sign on Southern point, possibly another totem on the Northern point for boats entering from that side.
- An culturally significant welcome feature on the rock island in front of the village which functions as the village front door (#40).
- All major buildings have visible cultural aspects (motifs, etc.). In particular, the building facing the ocean will incorporate art/design similar to and the Big House shown in the 1900 photo. Important buildings to incorporate these aspects would include the Big House (#4), the gift shop/ museum/ art studio (#5) and the restaurant

(#6).

- A totem pole located on the rocky point of land at the south portion of the village to show respect to a burial site located there. It was also agreed that this site should be fenced to protect it and to keep visitors using the proposed boardwalk from disturbing the site (#22).

- A properly maintained, repaired and expanded dock with storage (#12) and an open air but covered fish cleaning shelter (#11) and an additional angled dock for better float plane access.

- Entry archway at lower dock, a carved welcome sign (e.g. Sisiulth) at the top/end of the dock (#39).

- Totem poles, a feature representative of unity with the four tribes, with similar identifiers in each of the other villages (e.g. totem poles at the land end of the dock, beside walkway at top of dock) (#9).

- Big House poles that form striking gateway entry between dock and new administration/ health/ recreation building (#46).

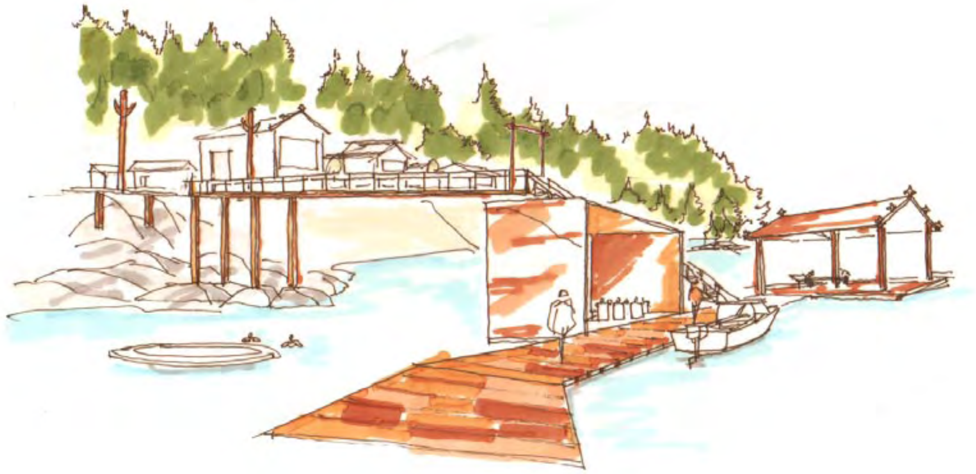
Improved dock with expanded float plan landing dock

- Architecturally impressive administration multiplex building with traditional cultural features (#1).

- A fire pit and open space, a traditional gathering area for the community and a central feature to the village (natural wood with convertible benches so people can face into the fire or out onto the water and stone fire pit (#8).

- An interpretive map (maybe include snapshot of village history) at entry way, this could act as community bulletin board as well.

Figure 10: Perspective of dock and entryway



Village Economic Development and Commercial

The area along the water from north of dock around to northern point was designated as commercial area (flanked by administration multiplex and open gathering space in entryway). The commercial area would include:

- A year-round restaurant (#6) with a seasonal sundeck (#7). This would target boat traffic in the summer months and special events and cultural use year-round. Rental rooms would be located above the restaurant for independent visitors or small visitor groups such as family visitors, consultants, tourists. Larger groups would stay in "Will Bay", discussed in the Ecotourism section below. Restaurant and associated buildings were envisioned to have exposed beam, post and beam construction with a solarium like space in front overlooking the water.

Cultural artists are active on Gilford. The left shows a totem pole being carved; the right is a canoe undergoing final painting

- A gift shop, museum and art studio (#5) where summer travelers and tourists could restock as well as purchase local crafts. The art studio would provide needed space for resident artists and carvers, who would also display their skills as a living heritage demonstration area for visitors. The studio should provide enough space, as does the ean-two on the outside, for bigger carving pieces.

- Finally, a bed and breakfast (#42) was suggested for the commercial area, located to capture the view, provide a local residence and business opportunity.

Figure 11: Perspective of the commercial area and Big House

Ecotourism and Healing Center

An area of the reserve known as “Sawmill Bay” or “Will Bay” located in the far southern part of the reserve was designated an eco-tourism zone during the tourism season, and a healing center and retreat area for the remainder of the year (#28-34). The location away from the village was important as it provides privacy for both the tourists and the local residents, minimizing the adverse impacts of tourism. The tourism zone would be connected to the main village and commercial area by a trail system linking to the boardwalk (#19).

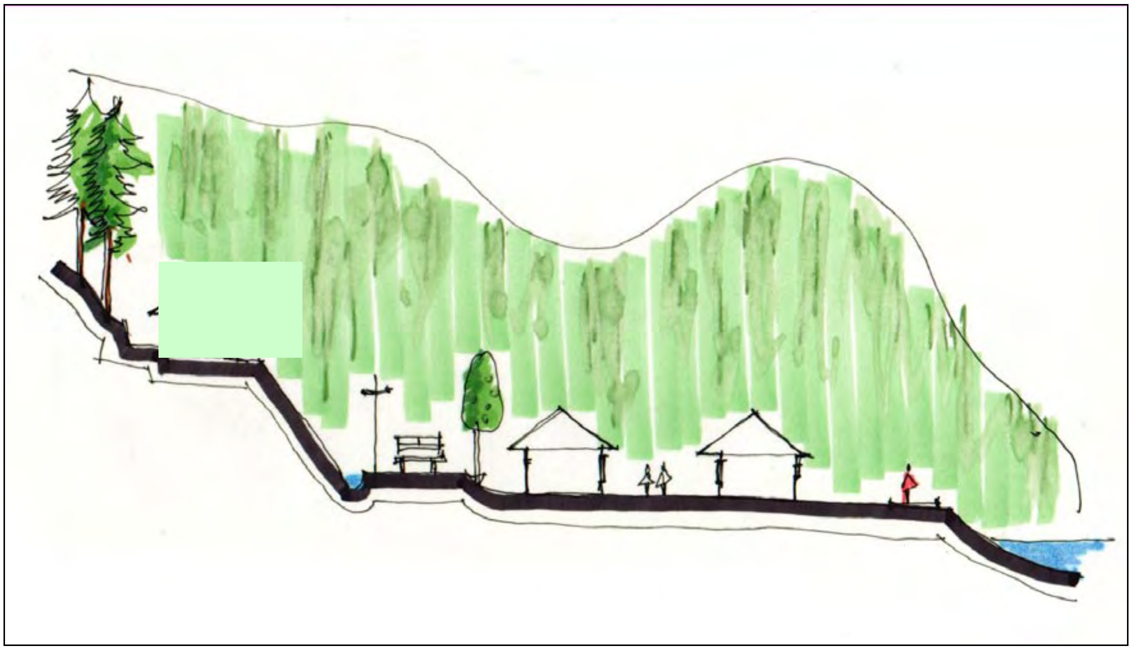
As an interim development, low impact tourism (e.g. kayaking tours) could begin immediately by building tent platforms in Will Bay. Longer term plans would include buildings. Longer term ideas included the development of a full kayak tripping service (water taxi from Port McNeill or Campbell River, outfitting, accommodation, meals) that could be tied into other services, cultural activities and showcasing, interpretive tours and hiking. The band was interested in considering partnerships with eco-tourism companies to fund the development of tourism facilities and services in the village/ in Will Bay. All of the tourism and commercial activity would need to be subject to economic analysis and strategic planning.

Utilities and Roads

There is a desire to relocate all above ground utilities to underground. There are several reasons justifying this. First is short and long term maintenance and reliability. Above ground utilities located in the slide hazard zone and exposed to falling trees and weather increase maintenance costs and exacerbate exposure to outages. Second, there has been discussion around approaching BC Hydro to assist with remote energy needs. BC Hydro prefers underground electrical utilities. Third, KHFN is determined to pursue economic development opportunities available to them at Gwa-yas-dums. One of the few opportunities available is tourism. Creating a visually attractive site by avoiding degradation of natural views and respecting the natural setting of the village is important. The above ground electric utilities located in the center of the village are not consistent with this vision. If below ground utilities are not possible, the community would like to relocate power poles to the back of the village (see Figure 12). Envisioned in association with this concept is moving all vehicle access to a rear corridor in back of the site (#20). Finally, the opportunity to address proper storm water management is another a factor related to this concept.

The site plan also took into consideration the development of the new water system (#41 and #43). The site plan attempted to respect the current water service limitation line, but it is anticipated that new homes will be required to be built above this line in the new upper village residential subdivision. The entire subdivision will be subject to engineering feasibility, pre-design and design and will address this and other related issues.

Figure 12: Perspective of possible back of village road, drainage ditch and above ground power



Stormwater Management

Stormwater management is a problematic issue for the village. Stormwater cascades off the mountain behind the village and settles at the rear of the village, making this area unusable and marshy. Water then finds its way under the village or enters into a pipe that empties into the south beach – assisting in the drainage of some of the water. Recently, a good intentioned heavy machinery worker associated with moving the trailers attempted to assist the community by making a temporary ditch at the back of the village. During one of our visits this ditch was already beginning to collapse and standing water had been collecting. A properly engineered, integrated stormwater management system is required, not only for the mountain behind the village but also for the proposed upper village and the lower village itself.

It was envisioned that control of the drainage from storm water within the village and off the hillside was possible by constructing an engineered receptor and drainage canal along the toe of the slope draining into the creek at the south end of the village (#21). It was felt necessary to consider this project in the context of an integrated stormwater management plan for the overall village – existing lower village and the new upper village area.

Left photo shows the current storm water management system for the village. Right photo shows the good intention effort of an earth-mover operator to fix the system with temporary trenching

Industrial, Barge Access and Helicopter Access

The powerhouse is currently located in the northern portion of the site (#16). Although this is in a designated debris slide zone, because it is established and is not high occupancy (e.g. residential, commercial or assembly) it is recommended that the powerhouse not be moved but that proper notification of the debris hazard be posted.

There is a need for a community storage area, and a staging area for the construction of new homes. Space has been designated in the industrial area for a storage facility/shed (#15).

There is an identified need to improve the barge-loading area (#37) combined with a road that leads from this deep-water port around the back of village and up to the logging road. This will ease flow of loading/ unloading with the barge and ensure vehicles/ machinery do not cause damage to the site. There is particular concern related to the construction phase of new homes where the current informal road located through the center of the village will be used and destroyed, causing massive mud in the winter and dust in the summer. This has been the case with the recent placement of the trailers.

Regular helicopter access is required for medical reasons. The current helicopter pad is located in front of the Big House (#4). While not a significant issue, as it does not block water view lines to the building, the community did envision re-locating the helicopter pad to the center of the soccer pitch.

Administration/Medical/Community Multiplex Center

A multiplex cluster of administration buildings (#1) was designated directly in front of the dock. This would orient visitors to the village as they would be greeted by the architecturally impressive and culturally relevant building. Based on preliminary measurements, the administrative multiplex is safely located outside of the 50 m slide zone. Administration and health portions are not to be within 50 m slide zone. However, if follow-up survey work concludes that a portion of the building is within slide zone the community agreed that this was acceptable, specifically if the portion of the building in the zone was the community/ recreational center. There was broad support for implementing a rainfall monitoring alarm to alert the community of 100 mm in 24 hr rainfall events per the geotechnical report.

Recreation /Outdoor Spaces/ Circulation

Essential to improved health and social well-being for village residents are opportunities for recreation and gathering. The community examined developing opportunities for all ages. The physical site opportunities are discussed below.

- Youth and Adult: The back of the multiplex would be a community center (#2) that would have indoor recreational facilities (e.g., a weight and exercise room) and would tie into the outdoor basketball court (#3) and soccer pitch (#13) behind the building.

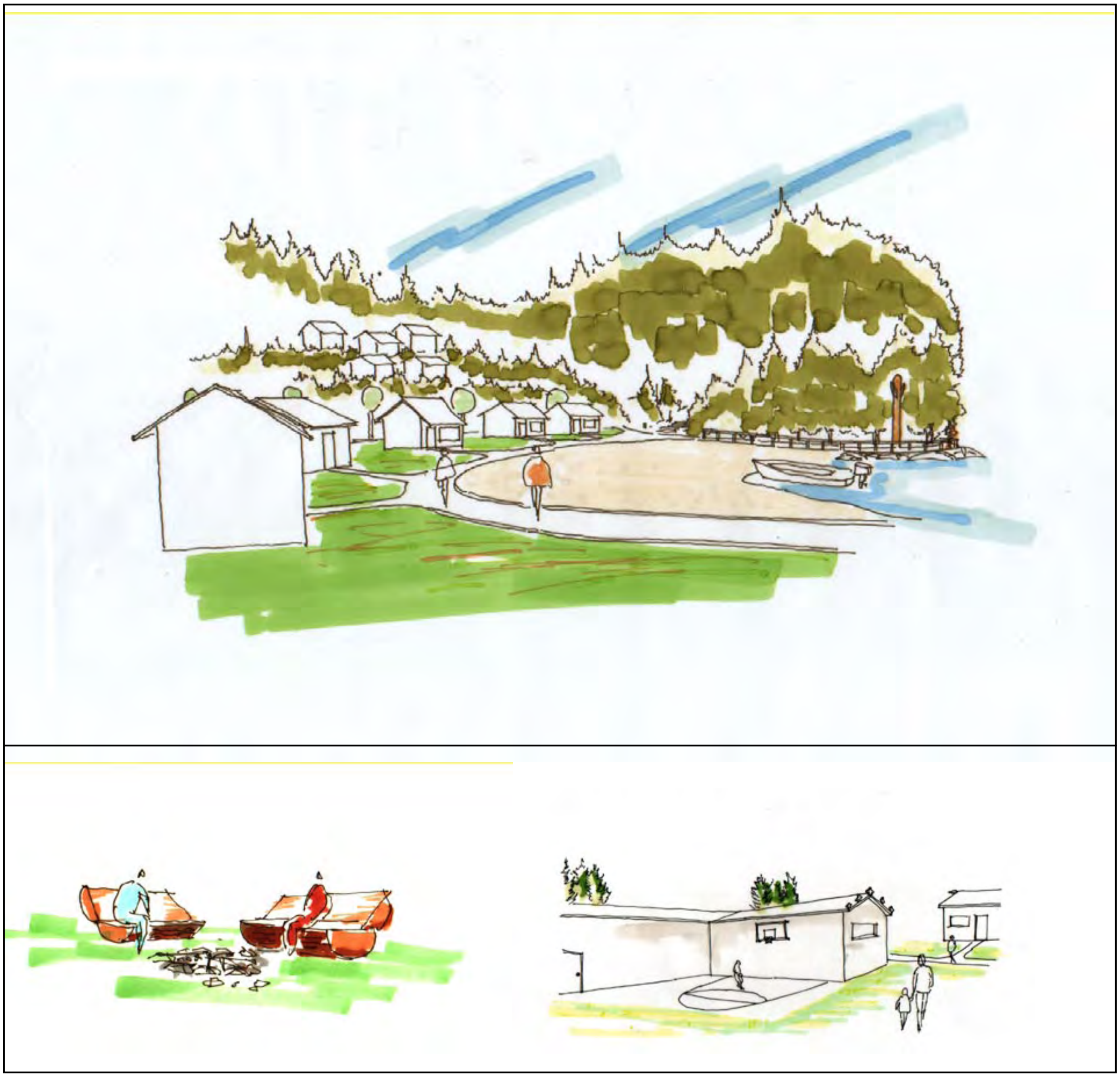
- All Ages: Soccer is central to the KHFN recreation and social life. The *Breakers* soccer team is much heralded and being able to practice and host games would provide health benefits and be an important entertainment/ social experience. Furthermore, the soccer pitch takes advantage or utilizes a portion of the village that would otherwise be un-used due to the debris slide hazard.

- Children and Youth: The long-term vision of the community is to have more families move back to the village. Economic development is of course essential to this, but considering the youth and providing recreation for them is also important. Furthermore, families with children do visit, sometimes for extended periods especially during the summer. Therefore two areas have been designated a play yards (#14).

Example of a boardwalk from Gwa-yas-dums 1917

- All Ages, including visitors: Another important recreational component, which also ties in with the pedestrian flow and access, is the boardwalk (#19) and trail system (#36). Currently there is limited opportunity for exercise and having an enjoyable and accessible walkway was considered to be very important to the residents. This should be wheelchair accessible and have benches to provide opportunities for resting and enjoying the views. Also, interesting key gathering places, destinations and specific viewpoints should be linked by the boardwalk such as the viewpoint to the north of the village (#29). The walkway should be made of traditional materials such as broken clamshells. The use of cedar planks should be limited to minimize long-term maintenance due to rotting and to avoid slipping when wet. The walkway would also tie into a larger and more challenging trail system.
- All ages: swimming is important to the community. A dedicated area should be provided for this activity. Historically swimming has happened inside the elbow of the dock. The community recommended that an anchored floating dock for swimming use be built (#10).

Figure 13: Perspective of boardwalk, fire pit and basketball court



In the long term, it is envisioned that trees/ greenery will be planted and act as a way to separate the industrial area from the rest of the village (#44). In the near term this area could act as a staging area for new construction.

Emergency

Tsunami's, slide debris and other hazards are a threat that the community must address, especially due to their rural location and need for self-sufficiency during an emergency situation. In the case of tsunamis, run-up hazard is conventionally managed on the basis of sufficient warning through the tsunami warning system in conjunction with evacuation to higher ground following receipt of the warning. This method assumes the warning will be received and that the community has a response plan in place and a place to go. For Gwa-yas-dums Village, there is a designated person with a radio who is responsible for receiving and broadcasting the tsunami warning throughout the community. Other emergencies would be dealt with on an event-by-event basis. Although formal and informal systems of communication and response exist, they are based on communication only. There is no infrastructure to support the community in the event of an emergency. Therefore the community has designated space in the proposed upper village for an emergency shelter that would be able to service the community (#24). On word of warning is that if the designated hazard response person, with the communication to the tsunami warning center away from the village, it is not clear that the warning will be received and effectively communicated in time. Thus there may be a weakness in the warning and response system.

Pollution Abatement

The existing dumpsite up the hill to the south of the lower village is located in the watershed of a small creek that drains directly onto the main village beach. While no longer the primary source of waste, some dumping and burning still goes on there. For the purpose of developing the proposed upper village and to reduce beach contamination, waste should all be removed consistent with solid waste management plan, and the contaminated dump site should be remediated.

Cemetery and Other

There is a need to protect and expand gravesites and burial grounds, Only 6 graves remain unused and these gravesites have been cleared but not finished (#27).expansion could occur adjacent to the existing cemetery. There is also a need to protect a mark other burial areas within the village (e.g., #22).

Figure 14: North to south perspective of the proposed re-development of Gwa-yas-dums Village

Figure 15: Conceptual plan overview of the re-development of Gwa-yas-dums Village

10. Conclusions

The conceptual land use plan developed through the participatory community based process resulted in a consensus decision on the creation of a new village concept that reflects collective community values, lifestyles, and vision. This conceptual site plan also respects important site considerations and constraints (geotechnical risk, social, economic, cultural, orientation). There are a series of next steps necessary to ground truth the conceptual design and determine whether adjustments are required and how they are to be accommodated within the sprit of the design program as the plan moves to the implementation phase.

11. Next Steps: Implementation – The Integration of Design and Development

In order to translate the conceptual development plan into a physical reality, the site plan needs a technical evaluation (engineering and economic) so feasibility can be tested and trade-offs internally consistent with the site plan can be made by the community and INAC (such as short and long term cost issues, community values) and complementary components be integrated. The process has already been initiated with KWL researching a funding submission for the new subdivision.[15]

Given the associated complexity of such a process, it is critical that overall project coordination is accounted for. This will ensure seamless integration of the various components and avoid a problematic, piecemeal approach to the coordination and implementation of the project. Of particular importance is consideration of the village plan as one integrated development program. For example, pre- and post-construction issues such as stormwater drainage, roads, trails and pedestrian flow, utilities and housing transition all need to be integrated and coordinated between the current lower village and the proposed upper village. It is critical that the overall design development consider and account for all of these issues and as such be executed as a sensitive iterative process of place making.

Integration of design and development services is considered critical through the implementation phases of the village redevelopment program. Caution must be exercised to ensure that specific infrastructure design considerations or short-term efficiencies do not take precedence over the overall vision and experience of place that resulted from the visioning process. For example, the geotechnical report indicated that a flood control level of 5.6-m geodetic level is required for the site, but that a tsunami crest level of 6.05m would also be prudent. The geotechnical report also indicated that the sea wall would be for erosion control only and that flood control should be addressed in the housing foundations, subject to engineering review. Engineers have commented that a seawall should act as a flood control dike as well. These issues have many tradeoffs associated with them, such as cost, impacts on views both to and from the village and how they tie-in with other site features. Both scenarios require trade-off consideration by community members. If this is to be constructed, preliminary input suggests that this would be a new capital project with a funding submission required by INAC.

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[15] Stated at July 10 meeting with KHFN, INAC, KWL and EcoPlan and confirmed at a Aug 15 meeting.

Through coordinated integration, necessary tradeoffs associated with infrastructure requirements can be identified and resolved while being consistent with the village design direction developed through the community visioning/ workshop process. It is expected this will become more acute in association with finalizing the location of buildings. It is imperative that there is sufficient flexibility through all components of the infrastructure design process to ensure that incremental and complementary changes can be achieved without compromising key village design principles (e.g. adherence to this process will ensure that the quality of the spatial relationship between buildings and the corresponding quality of place will not be compromised in favor of below or above ground infrastructure).

Housing design is the final major consideration that concludes the design phase of the project. This can occur through the use of a housing designer or qualified architect.

New Subdivision Requirement – The Upper Village

One of the most significant conclusions to arise from the community site planning process is the need for a new subdivision. The site plan developed through the community consultation process resulted in the designation of a hillside residential village area in order to accommodate existing community residents and future village members. Because of its importance, the rationale is reviewed below.

- One of the most significant findings of the community planning process was related to geotechnical risk. Geotechnical investigations discovered that there is a moderate debris slide hazard affecting the north portion of the village.[16] Buildings for institutional, assembly, commercial or residential uses need to be sited at least 50m from the toe of the steep rock slope.

- **Debris slide hazard affectively removes approximately one-third of the village from development.** To put this in perspective, under the current land use plan, six home sites need to be relocated away from the debris slide hazard.

- Erosion of the current village land area from ocean activity is a concern, requiring the relocation of one current home and an erosion control seawall. Additional hazards identified are flooding and tsunami hazards, especially for the southern half of the current village site. Addressing these requires further engineering analysis and mitigation.

- The community has also identified a fundamental need to generate economic development. Tourism was identified as one of the few opportunities available to the village, although the community would like to explore other opportunities as well. The need for, and importance of, economic development is reflected by the fact that the most desirable land area in the village for housing (based primarily on views and access) was dedicated to commercial and tourism use, with the entry into the village from the dock and the new administration and commercial buildings designed to incorporate traditional cultural imagery. Village residents made this possible due to

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[16] Cordilleran Geoscience, Terrain and Geologic Hazards Overview, Gwayasdums IR 1, Gilford Island, BC. Draft Report April 24, 2006. (Final Report October 23, 2006 no significant changes).

admirable concessions. In particular, village resident Beatrice Smith agreed to move to a new home in the proposed upper village on the hill, and Calvin Johnson agreed to relocate to where Beatrice Smith's home currently is located. Without this agreement, which is dependant on giving implementation priority to the proposed upper village, the consensus site plan would not be possible. Contiguous to the identified commercial area in the village will be the location of administration/health/recreation/cultural use.

- The land area dedicated to economic development and administration/ health/ recreation/ cultural use requires relocation of four existing home sites.

In all, the current "lower village" will allow for seventeen homes of the twenty-six replacement homes. At least nine of the urgently needed twenty-six homes must be relocated elsewhere on Gwa-yas-dums IR1 reserve. This is true even with the closer, high efficiency lot spacing (a minimum of 23 feet) agreed to by the community.

New land for housing is urgently needed. The only contiguous area available for new housing development is on the gently sloping hill to the south of the existing village, which is commonly referenced as the "upper village". The upper village will also provide land for future housing; essential for achieving the vibrancy desired for the village and accommodating KHFN members that currently live off-reserve but would like to move home.

Housing Transition Plan

The proposed new subdivision in the upper village is an urgent priority, as it must accommodate the first round of replacement homes. Due to natural hazards and land use designations, there is available land in the current village to immediately accommodate only one or (possibly) two replacement homes. The development of a **proposed new subdivision located to the south of the current village site, is an urgent priority and essential for a successful housing transition plan.** The reason for this situation is described below.

As a first step in the housing transition, eight of the most unhealthy homes, based on mold or rot, have been demolished and five trailer-homes have been moved to the village to provide transitional housing. Note that the existing homes were demolished based on immediate health concerns, not on housing transition logistics or future site plans, which had not been completed at the time of demolition. Referencing the Figure 16 below, the current situation is explained. All homes in green have been demolished and have been given numbers for explanatory purposes. Additional concern in the transition plan is health and safety. Homes that are exposed to health and safety risk are identified by capital letters.

- Demolished homes #1, #2, and #3 are located in the debris slide zone and are unavailable for residential housing.

- Demolished home #4 is located in the future commercial zone (see Figure 1).

- Demolished home #5 is located where the transitional trailer-homes now stand.

- Demolished homes #6 and #7 are located in the tidal flooding area and require further engineering and mitigation (i.e., flood control diking or elevated foundations).

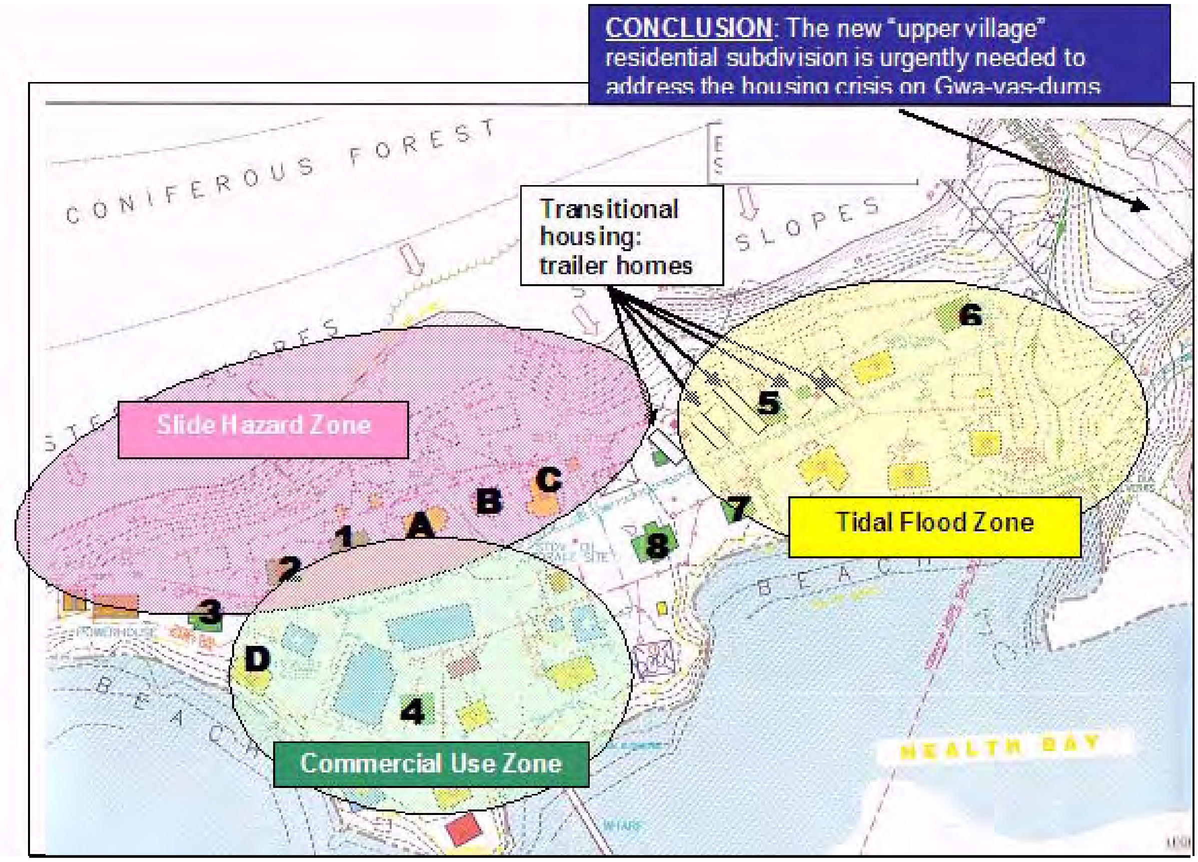
- Demolished home #8 allows land area for one or two immediate replacement homes.

- In addition, homes “A” and “B” are currently standing and occupied, with human health at risk from debris slide hazard. These homes should be relocated out of the slide hazard zone as soon as possible. Note that home site “C”, while not available for future housing is currently an empty lot with a totem pole in respect to a suicide that took place there.

- Home “D” is also occupied and in danger from erosion hazard. This home should be relocated as soon as possible, but will need to be relocated out of the commercial use zone.

- **With only one to two residential building sites available in the current village area, and with eight homes already demolished, three others occupied but exposed to identified hazards, the proposed new subdivision located in the upper village, to the south of the current village site, is an urgent priority. It must accommodate the first round of replacement homes.**

Figure 16: Transitional Housing Issues, analysis of current village



CONCLUSION: The new "upper village" residential subdivision is urgently needed to address the housing crisis on Gwa-yas-dums

Transitional housing: trailer homes

However, given that the conceptual framework which the site plan was created, it is necessary that the concept plan be ground-truthed to ensure that it is viable and, if not, to what degree it is viable, what choices face the community and what, if any, mitigation strategies would be necessary. Within the proposed development area, there are a number of physical features that should be assessed in order to determin the potential unit yield that could be achieved.

Of specific concern is the watercourse at the base of the slope, the north-south creek bed, and general topographic considerations. In order to finalize the buildable area and the ultimate potential housing yield, a geotechnical review is required to determine soil stability and necessary setback requirements. In association with this, a topographic and boundary survey is necessary to tie in key points on site. This will be important through the engineering design phase. The boundary survey should be extended to include the lower village to tie in key reference points such as the high water mark, top of bank, toe of slope etc. This information will then be used through the design phase for the installation/ relocation/ replacement of shallow utilities/ infrastructure. It will also be necessary for development of the lotting layout for both the upper and lower village areas. This work will confirm the overall development scheme as currently agreed to by village members.

Coordinating Professional

Given the complexity of the various design-build programs and the potential overlap of design-build elements as discussed above, it is recommended that a coordinating professional be retained to ensure that the project proceed into and through the implementation phase as efficiency as possible.[17] Without this position, there is the potential that some of the design subcomponents may conflict. Furthermore, in the interests of time and/or efficiency, the spirit of the village design program may be compromised or lost due to inadequate consideration of the guiding values and principals.

The role of this position would be to mange the integration of the technical and qualitative aspects of the village design program. The professional would be responsible for quality control and quality assurance in the coalescing of project components. This will ensure that the program comes together seamlessly and that any gaps in process are resolved and necessary tradeoffs occur in compliance with the vision of the village. In so doing, the project has a greater likelihood of proceeding without unforeseen surprises and will better translate the vision of community members into final built form.

It is important to underscore the fact that the village design program has been developed utilizing strategic place making principles, and driven by the community itself, to create opportunities for positive social interactions and positive identity with place. This has been achieved through the careful juxtaposition of physical site elements and the overall

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[17] The BC Building Code requires a "coordinating registered professional" for Part 3 (large or assembly type) buildings to coordinate all design work and field reviews of the registered professionals required for the project. The BC Building Code does not require this for Part 9 buildings (ie the new houses on Gilford), however KHFN would benefit from someone playing a similar role to "coordinate all design work and field reviews of the registered professionals required for the project", and to keep everything on track. They wouldn't necessarily have to be a registered professional. The BC Building code would require a "coordinating registered professional" for larger assembly type buildings such as the admin/health/rec multiplex center.

relationship of parts; through the careful arrangement of buildings and space all of which comprise a carefully crafted design program intend to promote KHFN values and to enhance the quality of life and daily experience for the residents and visitors to the village. As such, adjustments to the physical design concept must be considered carefully in this context and weighed against the potential loss or compromising of the critical linkage or network of design elements.

12. Physical Development Task List

A Task List was prepared to identify some of the necessary next steps required to move the project forward sequentially and in a way that ensures that the values underlying the design program are adhered to through the implementation phase. This task list was developed by EcoPlan to facilitate the transition from planning to engineering and implementation. It was circulated to KHFN, INAC and other consultants working on the physical development plan (KWL, Jacques Whitford) for their input. It is anticipated that this list will act as a starting point to help organize and coordinate professionals and KHFN. Ultimately, this list is seen as a jumping off point for the proposed coordinating professional, as discussed above.

Kwikwasut'inuxw Haxwa'mis First Nation

Gwa-yas-dums Village Physical Development Plan

Task List | Original - July 31, 2006 | Revised October 23, 2006

Task		Start	Length	Type (sequential or parallel)	Dependent on	Funding	Responsible	Comments
Site Planning								
1	Development of Community Based Conceptual Site Plan for village			-	1	✓	EPI	Conceptual phase completed. Ground truthing is required next step to confirm buildability.
2	Housing Analysis			P	-	✓	EPI	EPI has conducted "how to" analysis on housing. Decision to develop an RFP for architect/designer and assist with proposal is underway as well as development of design guidelines.
3	Community Energy Analysis			P	1	✓	EPI	This has been a participatory, community decision, developed with the technical support of EcoPlan and in coordination with KWL. On Oct 5, 2005 the community chose a propane grid. A draft energy analysis report has been completed.
4	Solid waste analysis			P	-	✓	EPI	EPI has conducted an analysis of recycling and solid waste options
5	Waste water analysis			P	-	✓	KWL	KWL is doing analysis of conformance to revised requirements for existing permit and for subdivision expansion.
6	Commercial development area analysis			S	1	✓	EPI	Ground truth and detail the economic aspects of the site plan – part of KHFN economic development strategy.

								An economic development proposal was prepared by KHFN with the assistance of EcoPlan in response to a call by INAC, but will not be submitted until march, 2007 due to limited INAC funds.
Policy and Finance								
7	Develop housing transition plan for village residents			P	1		KFHN Housing Committee	This is primarily dependant on the development and timing of the proposed upper village residential subdivision, however internal issues are now being dealt with by the community. For example, the order of transition (who, when, how), ownership issues, development issues with the upper village and other outstanding housing issues need to be resolved.
8	Develop housing policy			P			KHFN	Assistance from consultants may be available.
9	Develop Village Renewal Finance Plan			P			INAC, KHFN, Subs	On-going planning (e.g. economic development strategy), art and engineering feasibility work
Architectural								
10	Coordination of pre-design/ design phases with project architect or designer			S	1	?	Sub	Need to provide input into infrastructure issues as they might affect housing design and community surroundings. EcoPlan has offered to develop an RFP and architect proposal for INAC, subject to discussions with INAC.
11	Building design by an architect or designer			P	9	?	Sub	
12	Building design guidelines (particularly for energy efficiency and indoor air quality)			P	9	?	Sub	October note: In response to a request by KHFN, EPI has completed this in addition to initial floor plans and perspectives for discussion and to help with the transition to an architect or designer.

Geotechnical Investigation								
13	Housing in existing village needs foundations designed for bearing strength of shell-midden, and flood height			P	9	✓	KWL	KWL will confirm if this will be addressed by proposed geotech and survey work
14	Geotechnical investigation/ mitigation particularly of the upland area – the new proposed upper village residential subdivision, -- to determine location of suitable building sites			S	1	✗	Sub	This is critical in assessing to what degree the upland area is buildable. In the areas between the south end of the village and the existing dump there are three small creeks incised in glaciomarine mud. In this area proposed building sites need to be field verified to ensure they do not encroach on unstable creek sidewalls, and foundation design will need to be based on the bearing strength of marine clay. This needs to be determined in consultation with a qualified engineer. Elsewhere in the area to the south of the current village site, building sites should be located on well-drained soils. Rock or marine clay may be encountered, and foundation design needs to be determined in consultation with a qualified engineer
15	Debris flow hazard risk and slide risk			?	?	✗	KWL	This is currently proposed by a KWL funding submission for feasibility level analysis of debris flow and slide risk mitigation. Scope of submission should be checked with final conceptual site plan of KHFN, which complies with Cordilleran Geoscience report recommendations on passive mitigation (i.e. no occupied buildings are in slide path).
Engineering								
16	Preparation of a storm water management plan for construction and post construction phase.			S	1			This will include engineering design for storm water/ slope water collection swale along toe of the slope and discharging into the creek. This will also include

								sustainable stormwater strategies such as discharging roof leaders into the swale on the flatland and uplands sites.
17	Develop full rationale for underground electrical wiring			P	-	✓	EPI/KWL	Initial rationale is included in EPI site report, final should assessed in engineering analysis and engineering drawings. Verbal confirmation has been given (June 28 meeting with INAC, KWL, KHFN, EPI) that any changes to overhead electrical wiring is temporary. Rationale being developed for justifying underground wiring (hazard, site plan, BC Hydro preference, long term maintenance)
18	Community decision on preferred energy option (nothing, propane grid, district heating)			P	-	✓	EPI	October note: On Oct 3, 206 the community decided on a propane grid. The energy report has been completed.
19	Feasibility study of district heating system (if chosen as preferred option)			P	-	?	SUB	N/A
20	Development of a site grading plan for the upland site (including creek crossing design)			S	1	?	KWL?	
21	Pre-design/ design for overall road system			S	1	?	KWL?	Need to ensure road profiles are acceptable and can be easily and cost-effectively maintained in the long term
22	Pre-design/ design for trail system			S	1	?	KWL?	
23	Hazard areas and flood construction levels need to be determined by engineer			P	-	✗	KWL	This will be addressed by KWL funding submission but only for Items C and D above with respect to Hazard Areas but flood construction levels only for the subdivision (not existing community). We expect that flood issues related to the existing community would be part of the Sea Wall as per #1

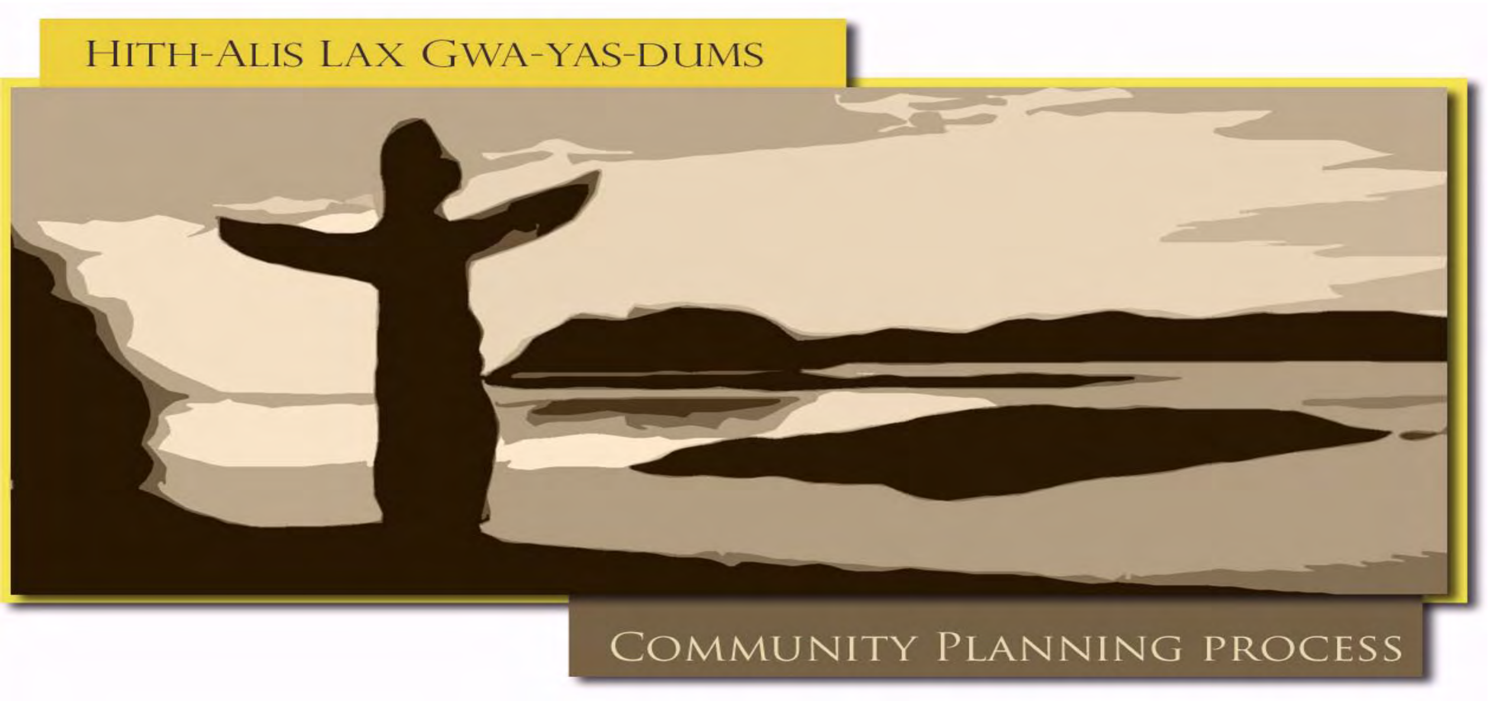
24	Sea wall design and construction			P	-	×		If this is to be constructed, this would be a new capital project with a funding submission required by INAC. Analysis should be done to confirm the role of the sea wall. Is it for erosion control only for also for flood control? If erosion only (per Cordilleran Geoscience report), then housing foundations would need to be adjusted. What are the tradeoffs between these two (costs, views, aesthetics, and visibility to village)? Also Should a 5.6-m geodetic level be used or 6.05? What are the cost implications? A flood control seawall was not recommended by the geotech, is this an engineering option?
25	Foundation design below 5.6 m geodetic should be engineered for wave erosion protection			S	23			See sea wall comments above (#24).
26	Subdivision site feasibility and pre-design/ design			S	1, 13	×		This will be addressed by KWL funding submission per July 10, 2006 meeting (attending: INAC, KWL, EPI, KHFN)
27	Construction of WTP			P	-	×	KWL	
28	Feasibility level analysis of wastewater system			P	-	×	KWL	
Technical Background/ Other								
29	Comprehensive topographic survey from shoreline through upland development site.			S	1	×	KWL?	Essential for enabling community to position preferred locations for houses
30	Environmental assessment of two creek corridors			S	1	×	Sub	Need to assess prefer streamside setbacks. DFOC, although they do not have jurisdiction over FN lands, would like comments and do have influence over approval process.

31	Vegetation retention management strategy for upland site			S	1	×	Sub	Need to retain as much natural vegetation as possible from an aesthetic and storm water perspective
32	Construction management plan including materials sourcing			P	1, 2, 6,8, 9, 10	×	KHFN and Project Manager	KHFN has developed some contacts with logging companies for reduced cost supply of cedar shingles and possible cedar siding
33	Confirm status of Dave Johnson's Veteran's Affairs housing allotment			P	7,8		KHFN	This might have been completed. Need to ascertain ASAP as there could be implications for the conceptual site design.
34	Detailed coordination of site design with infrastructure design - this includes managing potential trade-off strategy			P	-	×	EPI	Completed regarding the WTP, suggested that an overall project manager be designated to coordinate overall project – no funding currently exists for this.
35	**Identify an overall project manager to coordinate/ integrate activities of all consultants/subs through to construction phase.**			**P**	**-**	×	**?**	**Considered critical**
36	Consider remediation and relocating dump site location			P	1	?	KHFN/EPI/KWL	Does Jacques Whitford have dump site cleanup included in their scope of services with hazardous disposal of first houses?
37	Seek input on conceptual site plan from other actors and technical groups							This could include health, transportation (dock upgrades, helipad location issues, barge docking issues, etc)

November 2, 2006

Appendix B: **Community Housing, Energy and Infrastructure Plan**

Gwa-yas-dums Village -- Gilford Island, BC



Kwicksutaineuk Ah-kwaw-ah-mish Band
(Kwikwasut'inuxw Haxwa'mis First Nations)

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1. Introduction

The K̲wik̲wa̲sut'inux̲w Ha̲xwa'mis First Nations (KFN) Village of Gwa-yas-dums is a small community of between 27 and 70 permanent residents located on Gilford Island.[1] The KFN are currently addressing a number of urgent issues such as: lack of potable water (requiring the importation of bottled water); odour from the sewage treatment system; inadequate electrification (due to worn diesel-electric generator gensets); and housing (mould, causing health problems). In addition, the KFN face a host of interrelated social issues such as: lack of employment; an aging permanent population; a transient population (higher during the summer months); limited administration capacity; and, a lack of comprehensive health and recreational facilities (fostering an environment for health problems and related social concerns). The KFN Council recognizes these concerns and, with the support of INAC, has entered into a comprehensive community planning (CCP) process to address the numerous issues affecting the Nations.

As part of the broader comprehensive community planning process, a long-term land use plan has been developed for the community.[2] The land use plan identifies the need for a new housing subdivision located up the hill to the southeast of the village. This subdivision accommodates the replacement of existing houses in locations that have unacceptably high risk from terrain and geologic hazards, new land use designations, and increased housing needs based on future growth. Energy, water, wastewater, and other infrastructure now require expansion to service the new subdivision.

This report examines the options to address the physical needs of the community as they relate to housing, energy, and infrastructure systems such as water, wastewater, and solid waste. Options were examined that best meet the long-term objectives of the community, as well as addressing the need for immediate short term physical repairs or replacements relating to housing, energy, water, sewer, and solid waste management.

The process used to develop the housing, energy, and infrastructure options preferred by the community included:

- Site visits by the consultants to the community
- One-on-one survey interviews with Council members and the majority of permanent residents in the village
- Study tours to local island based communities with a group of 9 members from the KFN housing committee. Locations visited include:
    - Alert Bay Recreation Center - Tour of First Nation community buildings in Alert Bay with a presentation by a local Namgis band member and employee of the construction company that built the recreation center
    - Alert Bay houses – Tour of houses constructed by a small Namgis Band construction crew

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[1] The number of people actually resident in the village varies annually and seasonally and is different from the INAC official resident figure of 66. Resident population has been in decline due to the unhealthy state of housing and water supply included limited economic development opportunities and educational facilities.

[2] See ***Appendix A: Community Site Planning Report.***

  - Sointula post and beam house – Tour of a post and beam house constructed on Malcolm Island by an island based local contractor, providing suggestions for construction methods in local remote communities
  - New Vancouver Houses – Tour of new community being constructed on a neighbouring island
- Tour of the Seabird Island sustainable community by CMHC
- Development of short and long term community objectives from survey results and through community meetings
- Development of alternative options in conjunction with the community
- Comparison of options against community objectives
- Presentations to the community and community meetings to discuss and decide on options

2. Housing

2.1 Current Status – Housing

Only one of the ten small reserves accessible to the KFN is currently occupied.[3] The number of people living in Gwa-yas-dums (IR1), and the number of households, has varied over the course of recorded history. The population has varied from approximately 170 in 1960s to between 27 and 70 in the first part of this decade. The numbers are dynamic and currently they are heavily impacted by health concerns related to moldy, rotten homes and non-potable water. However, it has always been an important location on a year-round basis, with an increasing population during claming season, something that continues today. In addition, increases are currently also noticeable in the summer months when children and families come to visit. Due to the lack of economic opportunity and lack of schools, many families are unable to reside full time in the village and the summer months afford a chance for children to visit relatives for extended periods of time.

According to the official INAC census, the Kwicksutaineuk Ah-kwah-ah mish Band has a population of 267 members, with 66 members or approximately 25% of the total membership currently living in Gwa-yas-dums Village on Gilford Island.[4] A majority of the remaining 201 live off-reserve in the surrounding region, especially in Alert Bay. Others are scattered throughout Vancouver Island and the lower Mainland.[5] Since 1972, the overall population has increased from 207 members to 267. This increase of 60 members over a 29 year period represents an overall increase in population of 29%. This represents an average yearly increase of 1% or 2 members per year.

Houses have varied from 10 in 1834 to 35 in 1951[6] to 21 at the initiation of the community planning process. During the course of the planning process, eight houses have been demolished and five trailers brought in for temporary transition housing.[7] The type of housing has also changed over time from long house style where many lived under the same roof to inheriting used, small, wood frame “single family” air-force houses in the 1960 from Port Hardy.[8]

Refer to Figure 1 below for housing numbers and location. Houses are listed as viewed in a clockwise rotation starting with house #1. Table 1 (page 9) lists the number of rooms, size, and the permanent residents in each house at Dec. 1st, 2005.

Housing condition and mold assessments were completed in 2002 on fourteen of the existing houses by Jacques Whitford Environmental Limited. They found building and site

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[3] See Section 5 of *Appendix A: Community Site Planning Report* titled “Population, Households and Future Growth” for more detailed information on population and housing.

[4] It is important to note that KFN member roster is not consistent with INAC, and they are currently updating their member list.

[5] KFN membership list is currently out of date and it is not known what the exact regional distribution of population is.

[6] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.

[7] A transition replacement housing strategy, including number of home and where they will be built, is underway. This replacement is dependant in part on how quickly the urgent need for developing a new subdivision on the hill to the south of the current village site can be achieved. This situation is explained further detail in Section 11.

[8] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.

design deficiencies leading to moisture damage in the buildings and evidence of mold in some houses. They concluded that “all 14 houses assessed on KFN lands will likely require some form of remediation/corrective action to remove existing mold and/or mitigate future occurrences of mold” (Jacques Whitford report July 4, 2002). They provided a budget cost estimate for a mold abatement program of $873,483, resulting in an average per house cost of approximately $43, 381.

In subsequent discussions between the KFN and INAC it was decided that it would make more sense to spend the money on constructing new houses, rather than repairing the existing houses.

Figure 1: Existing Buildings

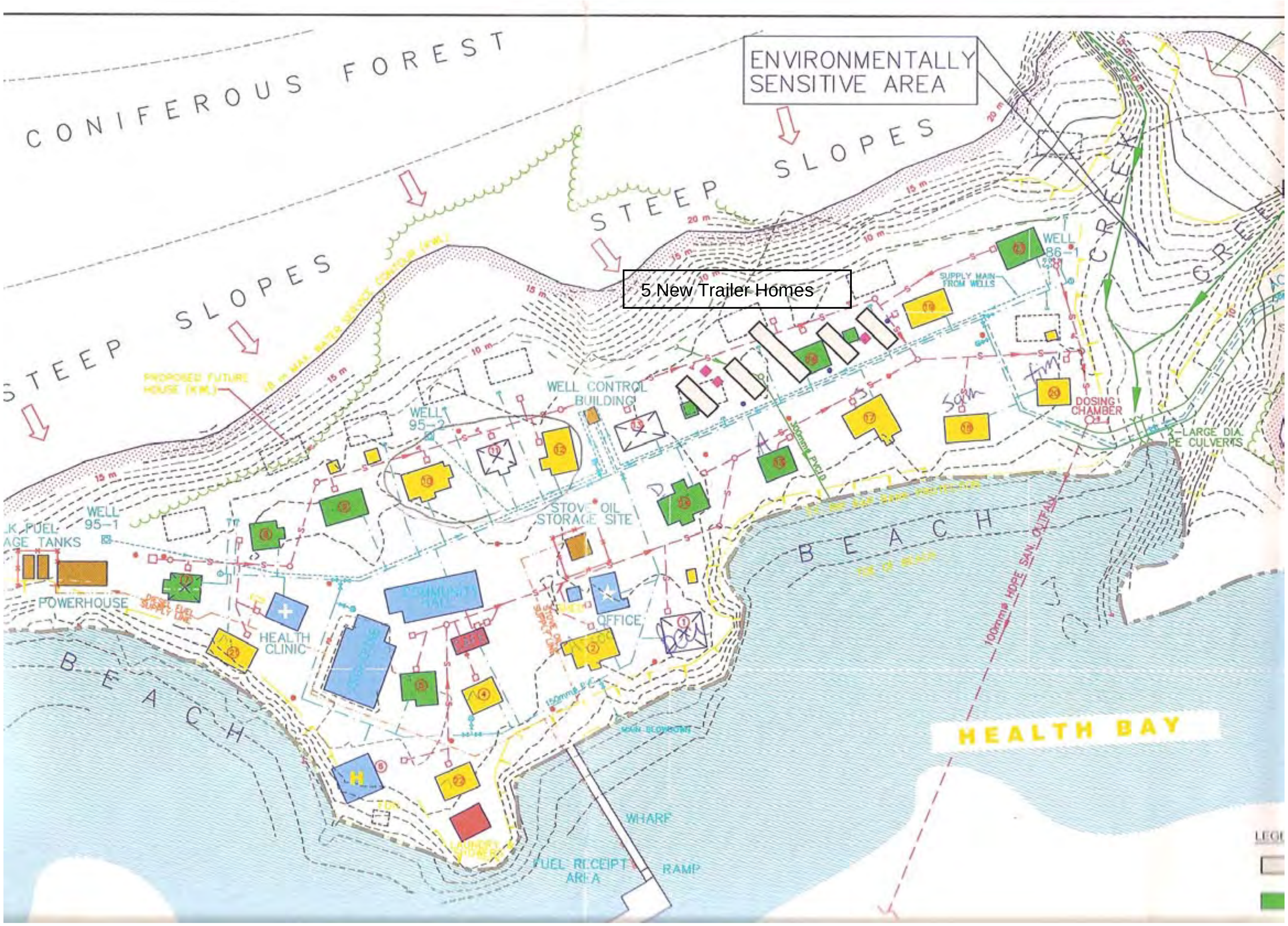

Table 1: Housing Occupancy and Size (Occupant Source: Councilor Lucy St. Germaine, December 1, 2005)

House #	# Permanent Occupants	Occupant/owner	# Bed Rooms	Size (ft^2)	Year Built
1	2	Beatrice Smith and Mary Glacer (Beatrice's niece)	4	1000	1957
2	1	Arnold Smith	6	1113	1975
4	1	Harry James	2	720	1970
5	0	ABONDONED (Alfred Smith's House)	2	832	Unknown
22	1	Calvin Johnson	2	768	1989
21	2	Caroline and Graham Scow	3	800	1982
7	0	ABANDONED			
8	1	Joel Johnson (4 daughters left, girl friend left also)	2	625	1950
9	5	Cathy Williams and Dean Coon (Cathy's son) Tiana and baby, and Percy Williams	3	1237	Unknown
10	2	Charlie Williams and Joanne Charlie (3 kids, Port Hardy Joline – Joanne Charlie's kid – Allen & Preston, Campbell River –Charlie's kids)			
11	1	Herb Chamberlin (renting from Douglas Scow)			
13	1	Lucy St. Germaine	4	960	Unknown
16	0	ABANDONED (Roy Nelson's house, Dennis Johnson, Roy's grandson, last to live there	2	768	1972
19	2	Alfred and Leonard Smith	2	750	1972
23	2	David Johnson, Terry Teringa	4	1,960	1992
20	1	Tim Willi	2	735	1982
18	4	Sam Johnson's house, Sandy Johnson lives there also with daughter Crista and her daughter Orianna	3	980	1960
17	1	Silas Coon (future? Daughter Edna Coon; granddaughter Carrie (2 weeks old) and Keith?	3	1,060	1972
15	1	Albert Wilson (he is on oxygen for health reasons)	2	720	Unknown
14	1	Doris Smith	3	1020	Unknown

To help meet immediate housing needs for those living in houses with the greatest level of mold and deterioration, INAC paid for the purchase and installation of five temporary trailer homes. These were delivered and set up on site during the summer of 2006 through a project managed by Jacques Whitford Environmental Limited. Four 560 sq ft two bedroom trailer homes and one 924 sq ft three bedroom trailer home were installed on site. The project also consisted of the demolition of eight existing houses to make way for the installation of trailers and for the construction of future housing including the removal and disposal of asbestos containing floor tile in three of the houses demolished, and the removal and disposal off island of all material in the existing but no longer used landfill.

2.2 Options – Housing

Through negotiations with INAC, the KFN have secured a commitment from INAC to provide grants of approximately $80,000 per house towards the construction of 26 new houses on Reserve. This funding consists of approximately $40,000 per house from INAC's On-Reserve Housing Program, $40,000 per house in lieu of money that INAC would have spent on remediation of existing houses, and $10,000 per house for infrastructure. The KFN are also planning to contribute approximately $20,000 per house.

This section first analyses the costs, benefits, and drawbacks associated with different methods for constructing new housing. An analysis of the costs and benefits of energy efficient housing is then presented in order to evaluate its potential. Finally, housing design guidelines, sample floor plans and building perspectives developed by the community to meet community objectives are presented.

2.2.1 Housing Construction Methods

Overview

Rebuilding the community housing is a significant task facing KFN. A key choice that will affect next steps is choosing *how* the new houses are to be constructed. While there are many ways to build a house, four options have been organized:

- **Option 1** – Pre-manufactured trailers similar to the five temporary trailers recently installed
- **Option 2** – On Site Construction with Outside Labour
- **Option 3** – On Site Construction with Local Labour
- **Option 4** – Combination Pre-manufactured Components and On Site Construction

Each of the four housing construction methods is described below. The costs, benefits, and drawbacks for each option are evaluated in Table 3: Housing Construction Options Matrix. Areas highlighted in green have significant positive impacts, and areas highlighted in red have significant negative impacts.

Housing Construction Method Options

The following four options regarding the method of constructing new houses were evaluated in terms of cost, benefits and drawbacks.

Option 1 – Emergency trailers

Option 1 - Prefabricated homes (Trailers)

Prefabricated homes similar to the five emergency trailers recently set up on site were evaluated. Construction costs and building design features are based on the actual costs incurred to supply, transport and set up the five trailers recently installed in the community.

Example – New emergency trailers shown in top photo

Option 2 – On-site construction with outside labor

Option 2* - On Site Construction with Outside Labour

Option 2 consists of outside construction crews constructing houses on site. Costs are based on current lower mainland BC construction costs for low income housing plus an allowance for barging, crew transportation and lodging, and other remote construction costs.

Example – New Vancouver

Option 3 – Local labor

Option 3* - On Site Construction with Local Labour

Option 3 consists of houses built on site by a Band based construction crew. Costs are based on construction costs reported by Namgis First Nation Band in Alert Bay, plus an allowance for barging and other transportation costs.

Examples – Namgis First Nation, Oujé-Bougoumou

Option 4 – Combination

Option 4* - Combination Pre-manufactured Components and On Site Construction:

Building block portions of buildings are pre-manufactured in an existing manufactured housing plant and assembled on site by outside construction crews.

Example – Kluskus Band with Ib Hanson Architects

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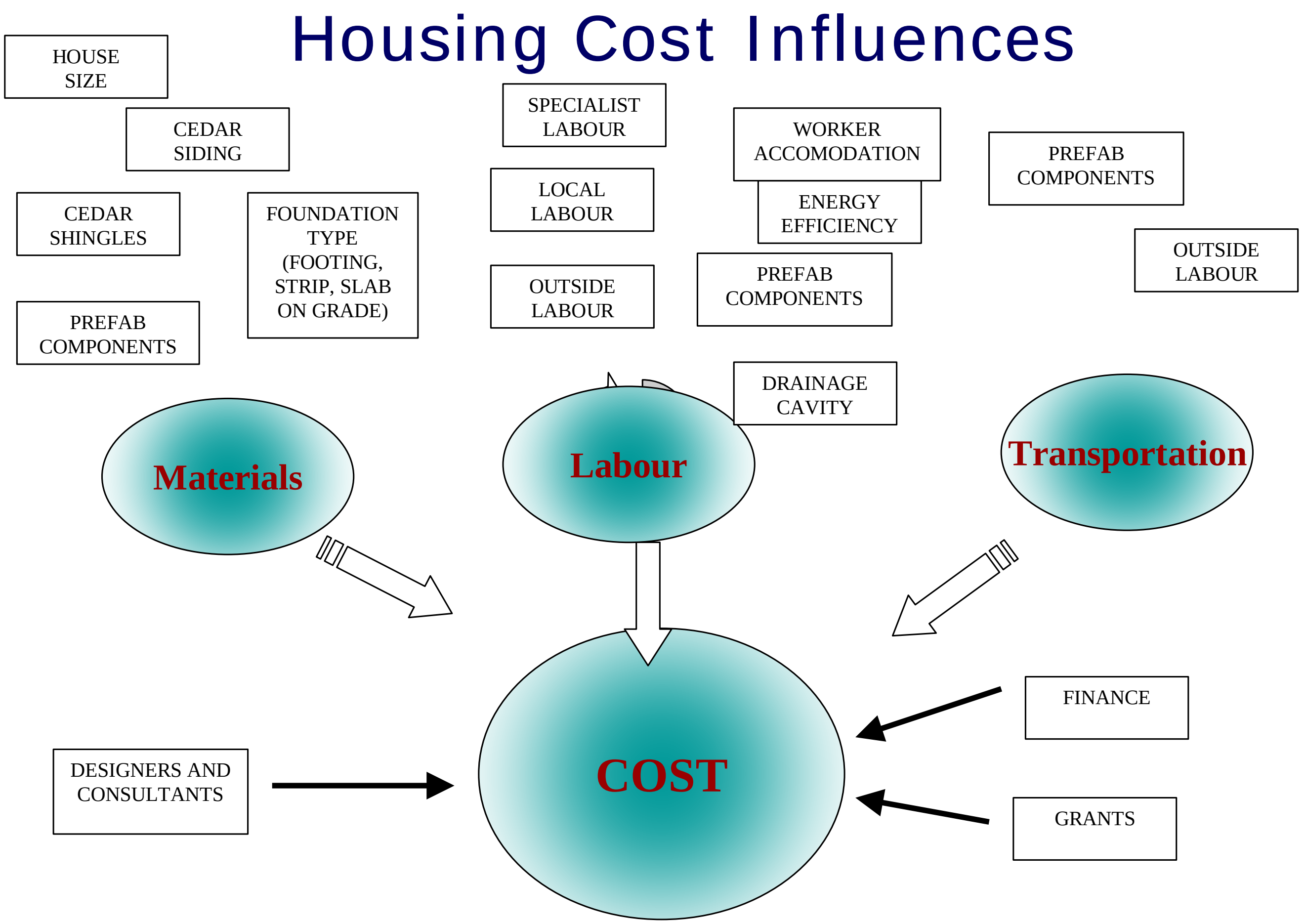
[*] Note: Except for the case of trailers, the method of construction does not affect the type of house that is constructed. Home design is a separate issue.

Table 2: Housing Construction Method Options Matrix

	Objective	Measurement	Option 1	Option 2	Option 3	Option 4
1	Reduced Capital Cost	Cost per 1,000 sq ft House ($)	$125,917	$174,979	$99,979	$150,000
2	Reduce O&M costs		same	same	same	same
3	Create Employment Opportunities	# Full time band member jobs (Job years)	2	2	10	5
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	Low	Medium	High	Med High
5	Fast Speed of Construction	# Houses constructed per year	26	10	4	13
6	Increased Durability	House Life Expectancy (Years)	20	50	50	50
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	No	Yes	Yes	Yes
8	Increase Energy Security	Ability to accommodate different fuel types (Yes/No)	No	Yes	Yes	Yes
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	No	Yes	Yes	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	Maybe	Yes	Yes	Yes
11	Ease of Remote On-Site Construction	Prefabricated components	Yes	No	No	Yes
12	Reduce O&M Effort		same	same	same	same
13	Reduce Site Impacts		same	same	same	same
14	Increase Self Sufficiency		same	same	same	same

15	Safety		same	same	same	same

Figure 2: Housing Construction Cost Influences



Housing Construction Method Recommendation

There are significant tradeoffs between the four options. For example, trailers (Option #1) have the advantage that they are easy and fast to construct and are the least expensive option, estimated at $125,000 per 1,000sq ft trailer fully installed. But trailers have a short life expectancy and are limited in their design options. The least expensive way to get custom homes built is on-site construction with local labor (Option #3), estimated at $100,000 per house for a 1,000sq ft house. This has the advantage of creating the most local jobs (10), but also has the highest risk of not being completed on time and on budget.

Option #4: Combination Pre-manufactured Components and On Site Construction is one of the better options across all objectives. It is estimated that this option will cost approximately $150,000 per 1000 sq ft house, employ about 5 community members, is fairly fast to build this and there is a medium to low relative risk of project delays.

Option #3: On Site Construction with Local Labour is a construction method that the community could aim towards in the long term, as community members can gain construction skills and capture employment benefits. For example, options for local participation could be considered once emergency housing needs have been met.

2.2.2 Energy Efficient Housing Design

Overview
There are two options available to the community in terms of incorporating energy efficient housing design into the new home construction: either (a) do it or (b) don't do it.

For the most part, incorporating energy efficiency into the housing design is sensible in terms of operational efficiency, occupant health, and reducing environment impacts. It has long term cost saving benefits of approximately $1,000 per year per house. Because INAC is currently paying the full costs for energy used in the community the cost savings would be realized by INAC. However there have been discussions between the KFN and INAC about the possibility of returning energy cost savings back to the KFN. Energy efficient housing also has health benefits of improved indoor air quality, and the durability and longevity of the house by removing excess moisture through improved ventilation systems. Finally, it is better for the environment, with less local air pollution, and lower emission of green house gas emissions. The drawback is that it would cost up to $5,000 more per house in up-front construction costs and there would be some additional maintenance of the ventilation system.

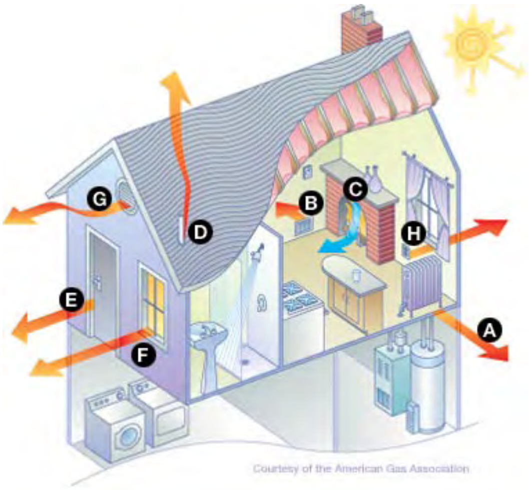
Currently there is a provincial program that KFN could qualify for that would put $3,500 towards the construction cost of each house. However, there is no guarantee that this program will be around for the duration of the new home construction.

With the limited housing budget of KFN, there is the possibility of this option not being incorporated despite its benefits. Therefore, KFN should negotiate additional funding from INAC based on long term benefits.

Cost effective methods for the design of energy efficient housing are described below. The additional costs, benefits and drawbacks are evaluated against community objectives in Table 2. Areas with significant benefits are highlighted in green.

Description:

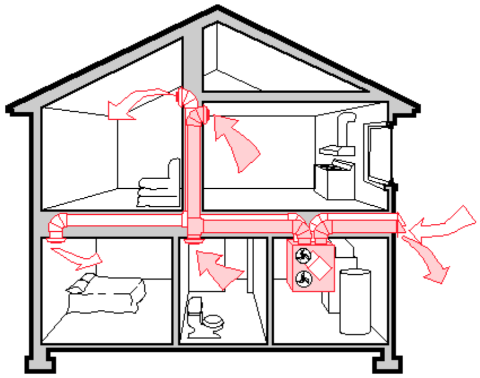
- An energy efficient house will reduce heating, hot water, and electricity costs, while being more comfortable and durable.
- A good target to aim for is design to "Energuide 80" level of energy performance. "Energuide" is a commonly used rating system developed by Natural Resources Canada (NRCan)
- Typical energy efficiency measures required to meet "Energuide 80" include:
    - High efficiency space heating furnace or boiler and hot water boiler
    - Double pane low e argon filled windows
    - Higher insulation levels in walls and attic
    - Heat recovery ventilation
    - Increase air tightness



Courtesy of the American Gas Association

Pros:

- Reduced energy costs.
- Increased comfort (reduced drafts, warmer walls and windows, no window sweating)
- Improved air quality from continuous heat recovery ventilation.
- Increased building durability from reduced indoor moisture levels
- Government grants available to offset increased capital costs



Heat Recovery Ventilation

Cons:

- Increased capital cost - most of the increased cost is for heat recovery ventilation system which also provides ventilation and durability benefits
- Increase maintenance – filter changes on heat recovery ventilators

Table 3: Energy Efficient Housing Design Options Decision Matrix

	Objective	Measurement	Energy Efficient Design	Standard Design
1	Reduced Capital Cost	Cost per 800 sq ft House ($) (Based on Option 4)	$155,000	$150,000
2	Reduce O&M costs	Annual Energy and Maintenance Costs (Based on propane grid energy system)	$1,950	$2,925
		Simple Payback Compared to Option 2 (Years)	5.1	
3	Create Employment Opportunities	# Full time band member jobs (Job years)	same	same
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	same	same
5	Fast Speed of Construction	# Month Extras	+ 2 weeks'	0 Weeks
6	Increased Durability	House Life Expectancy (Years)	same	same
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	Yes	No
8	Increase Energy Security	Ability to accommodate different fuel types (Yes/No)	same	same
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	Yes (But HRV required)	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	same	same
11	Ease of Remote On-Site Construction	Easy/medium/difficult	same	same
12	Reduce O&M Effort	Operating and Maintenance Effort (High/Medium/Low)	Medium	Low
13	Reduce Site Impacts	Impacts to Clam Midden (High/Medium/Low)	same	same
14	Increase Self Sufficiency	Increase in Self Sufficiency (High/Medium/Low)	Medium	Low
15	Safety	Safety Risk (High/Medium/Low)	same	same

Energy Efficient Housing Recommendation

Due to the benefits of health, home longevity and long term operating cost savings, the KFN should pursue negotiations with INAC to support any extra cost associated with construction of energy efficient housing.

Efficient Housing Next Steps

1. Apply for funding from BC Ministry of Energy Mines and Petroleum Resources ($3000 per house that meets Energuide 80 level of energy performance plus $500 per house with high efficiency furnace
2. Develop design guidelines
3. Incorporate energy efficiency features into house design and construction

2.2.3 Housing Design Guidelines

The following housing design guidelines were developed based on results of the community survey, discussions during community meetings, and recommendations from the consultants to meet long term community objectives:

General

1. Housing type and size – All single family houses, single story, approximately 1000 ft^2 per house, depending on size of owner's current house. House sizes will have to be kept as small as possible to reduce construction costs.
2. View – Every house should have a view of the ocean if possible.
3. Privacy –The community has agreed to a minimum 23ft separation between houses for visual and noise separation. Less than this requires consultation with the community.
4. Accessibility - Wheelchair accessible interior design recommended for all units, and external wheelchair access required for some units.
5. Interaction - Covered front porches desired to accommodate community interaction.

Durability

1. Large Overhangs – Minimum 2 ft all sides, preferably 4 ft each side plus covered porches.
2. Rain screen cladding – ¾" vertical strapping forming drainage cavity between the moisture barrier (building paper or Tyvek) and the cladding. Rainscreen cladding is required by new BC Building Code about to be released and the new National Building Code.
3. Foundations – Either insulated slab on grade or insulated concrete strip foundation. No pier support foundations with open crawl spaces due to concerns with moisture. If a concrete strip foundation is used then the floor of the crawl space should be covered with a thin slab of concrete over a polyethylene sheet to keep moisture out of crawl space. The crawl space should be insulated on its walls and below the concrete slab and heated (no insulation under the wood floor) to keep it dry.
4. Drainage – Footing drains and free draining fill around foundations. Grading sloped away from houses.

Indoor Air Quality

1. Continuous ventilation to reduce moisture build-up in houses – Continuous exhaust from bathrooms, and fresh air supply to bedrooms and other occupied areas of houses. If the houses have forced air furnaces the furnace ductwork and fan can be used to supply fresh air. A heat recovery ventilator should be incorporated into the continuous ventilation system (See Energy Efficiency)
2. Hard flooring preferred to carpet (carpet traps dirt).
3. Low VOC paints and cabinet glues.
4. Mold resistant drywall.
5. Use of local wood products for interior trim etc.

Energy Performance

1. Energy performance of each house to meet “Energuide 80” level of performance according to Natural Resource Canada’s energy performance rating system.
2. Insulation levels – 2x6 wall construction with R22 batt insulation, R40 attic insulation.
3. Furnaces or boilers – Space heating propane furnaces or boilers to be condensing type with a minimum efficiency of AFUE 90%.
4. Windows – Double pane vinyl windows with “low e” coating and argon fill.
5. Heat recovery ventilation – Heat recovery ventilator (HRV) recovers heat from continuous exhaust from bathrooms and kitchen (but not the range hood), and heats continuous incoming fresh air to bedrooms and other occupied areas of houses. If the houses have forced air furnaces the HRV system can use the furnace ductwork and fan to supply fresh air. If not, then a separate ventilation system of ductwork is required.
6. Air tight construction to reduce air leakage through the building envelope.
7. Energy Star appliances.
8. Compact fluorescent lighting.

Roofing and Cladding

1. Roofing – Sloped roofs with cedar shingles or shakes. Cedar shingles and shakes are available to the community at a reduced cost, and its look is preferred because it is a traditional construction material.
2. Cladding – Cedar siding. Cedar siding is available to the community at a reduced cost, and its look is preferred because it is a traditional construction material. Horizontal lapped cedar siding is recommended for ease of attachment to the vertical rainscreen strapping.

Water Efficiency

1. Low flow toilets – Maximum 6 L/flush. Dual flush toilets preferred (3.3L/flush and 6L/flush)
2. Consider rainwater barrels at each house for irrigation of landscaping and gardens.

Fire protection

1. All new buildings should have sprinkler systems for fire protection.

2.2.4 Sample Floor Plans

Basic floor plan options and perspective views of houses have been developed based on community objectives and design guidelines to initiate discussion and thought regarding home construction. The goal is to provide information that will assist the community in articulating their vision of a home to an architect or designer. This individual will then be able to assist the community in moving to construction.

The following four sample floor plan layouts have been developed:

1. 800 sq ft 2 bedroom home, designed for spacious private space
2. 800 sq ft 2 bedroom home, designed for spacious living space
3. 1000 sq ft 3 bedroom home, with a close relationship between indoor space and outdoor space
4. 1000 sq ft 3 bedroom home with split living/private space

Floor Plan 1

800 sq ft, 2 bedroom house
This design is aiming for spacious private space. Two bedrooms are located at the back, guest bedroom 160 sqft, and the master one 190 sqft. Kitchen, dining and living space, 320 sqft, is set within a long stretch so that residents can enjoy the smoothness moving through the whole living area. A long, horizontal bay window lights up the living space and frames a panorama view of the ocean.

Floor Plan 2

800 sq ft, 2 bedroom house
This design is aiming for spacious living space. Kitchen, dining and living space, 385 sqft, is set within almost a square.
There is more fleibility for residents to arrange their furniture.
Two bedrooms are located at the back, guest bedroom 120 sqft, and the master one 175 sqft.
Bay window extends the living space to the landscape and frames the ocean view ahend.

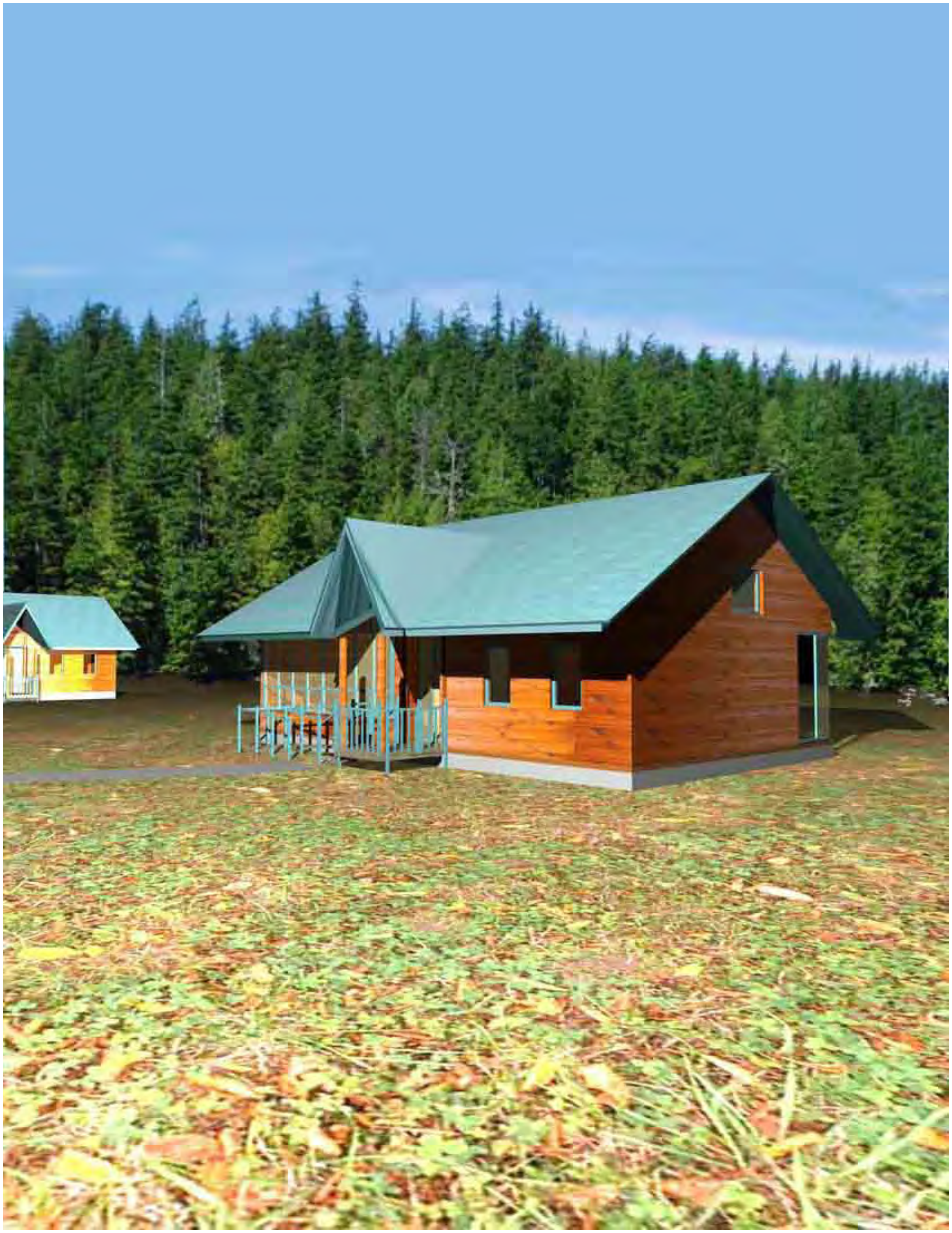
Floor Plan 3

1000 sq ft, 3 bedroom house
This design is aiming for a close relationship between indoor space and out door space. A veranda wraps around the house, connected the front and the back.
The living room can be totally open to the closer landscape and the further ocean with floor-to-ceiling sliding doors.
A dining counter sitting between kitchen and outdoor deck makes you have an alternative choice to dine outdoor.
Three bedrooms are 110 sqft, 120 sqft, and 140 sqft, respectively. Total living space is 500 sqft.

Floor Plan 4

1000 sq ft, 3 bedroom house
A straightforward design, with living space on the left and private space on the right.
Spacious kitchen, dining and living space, 570 sqft, is set all the way from front to the back. Residents have great flexibility to arrange their home.
A dining counter sitting between kitchen and outdoor deck makes you have an alternative choice to dine outdoor.
Three bedrooms, slightly compact, are 95 sqft, 95 sqft, and 130 sqft, respectively.

2.2.5 Sample Housing Perspectives



2.3 Next Steps – Housing

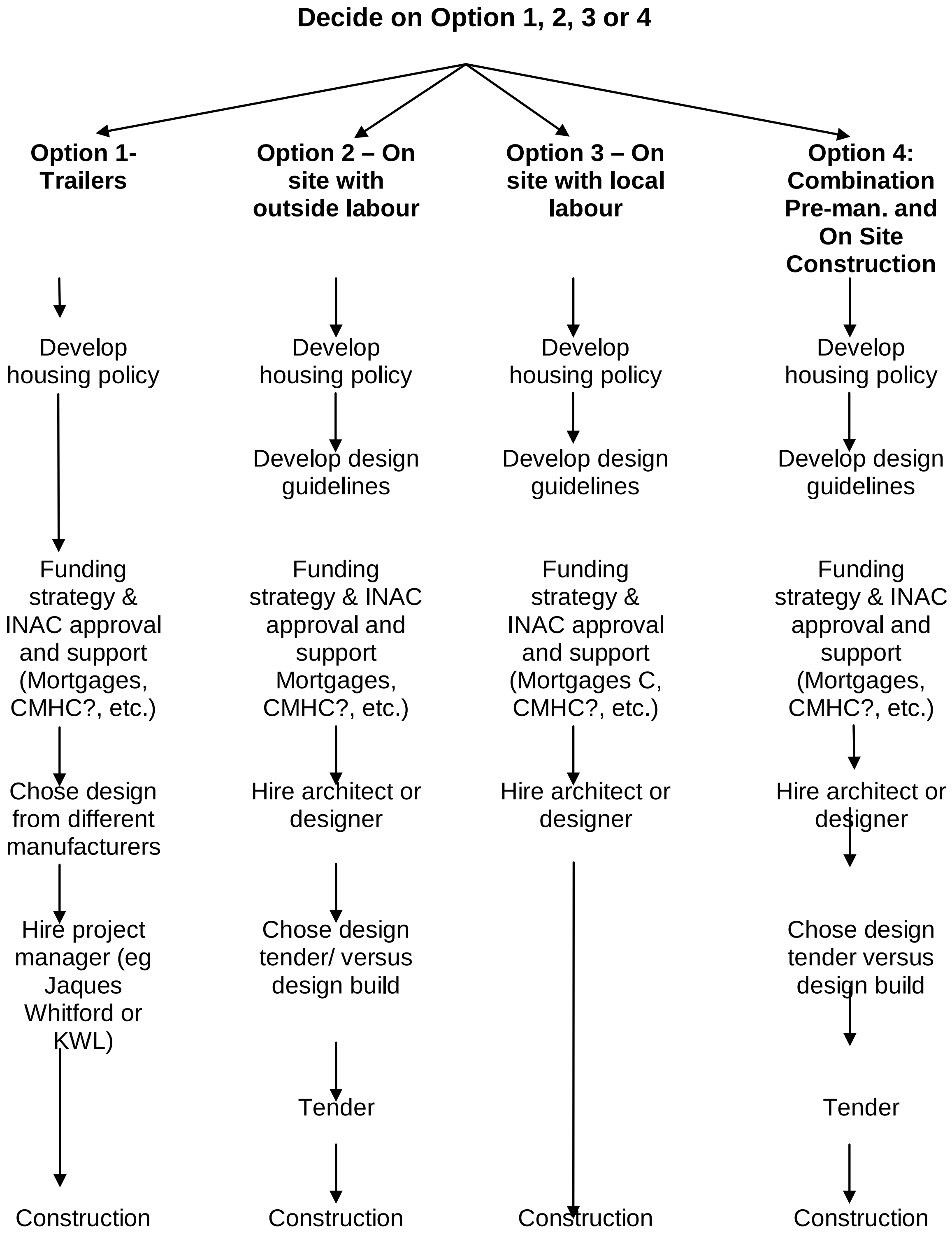
Community Choices

Figure 3 below outlines the next steps required by the community to complete the construction of new houses, broken down by building construction method.

The community has partially completed the first steps:

- At a community meeting on October 5, 2006, the community decided that they are not interested in Option #1, prefabricated trailers similar to the five recently set up on site as emergency housing. They are open to exploring further any of the other three options.
- This document contains an initial set of design guidelines which can be used to aid a designer.
- The community is currently working on developing their housing policy to decide who will get what type and size of house, and where they fit in terms of priority for new housing.
- They are also in the process of discussing options for obtaining funding for the additional construction costs over INAC contributions, either through individual mortgages, community based mortgages, or securing additional funding from INAC or outside sources.
- An RFP for hiring an architect is underway. The KFN will have to pay for design services, or an application for funding will have to be made to INAC. The architect or designer should then design the buildings, assist the KFN to apply for building permits, and oversee housing construction.

Figure 3: Housing Next Steps



3. Energy Infrastructure

3.1 Current Status – Energy Infrastructure

The KFN have secured partial funding to construct 26 new houses and are planning to replace all existing houses. The long-term plan also includes a number of new commercial buildings including a new administration/ recreation center /healthcare building, a restaurant, a gift shop/ museum building, and a bed and breakfast. With the new community plan they have a great opportunity to develop a new system of energy infrastructure that costs less to operate and has lower impact on the environment. The new land use plan developed by the community only allows for the (re)construction of 17 houses in the existing village. As a result, a new subdivision up the hill is required to accommodate the remaining 9 houses in the short term, with room for expansion to a maximum of 40 houses in the long term. Any new energy infrastructure must be designed to accommodate both the existing village site and this new subdivision.

Electricity Generation and Distribution

The community is served electricity by a community-operated electrical power system. The system consists of a diesel genset powerhouse with three 75 kW diesel electric generator sets and an automatic paralleling control panel.

All three generators are at the end of their useful life and require replacement or major overhaul. Harry Baxter, P.Eng. completed a report dated June, 2003 entitled “Project Brief and Management Plan for Immediate Major Generator Repairs and Preliminary Design for Subsequent Equipment Replacement in the Diesel-Electric Powerhouse Serving Gwa-yas-dums I.R. #1, B.B.”. In this report he notes that the electric system was installed in 1996, with two of the three generators installed in the previous powerhouse, and that the logged hours and review of equipment indicate that all generator sets are nearing the end of their useful life, and only one unit was operational at the time. He also noted in the report that components of the control system were damaged and required repair and recalibration.

In a meeting with Kerr Wood Leidal Associates in March 2006, the engineering firm that designed the original electrical generation and distribution system confirmed that all generators are at the end of their useful life and indicated that one generator was not repairable because significant parts had been removed. They also indicated that the Village’s generator maintenance staff reports that typical electrical average demand is between 45-50kW and that a second generator has not automatically come on line to accommodate a demand load larger than the capacity of a single generator set (automatic set points are between 75kW and 80kW). The maintenance employee has been on staff for approximately 2 years. In addition the engineer noted that during the February 24, 2006 site visit, 47kW was the peak demand, the community population was 8 on that date, and the café was not open. This amounts to a very high demand per person.

Village electrical loads include power supply to each residence and community building, as well as community infrastructure including street lighting and the existing well pumps. Many of the residences and community buildings use electric baseboard heaters for space heating. Typical electricity use in each house includes incandescent lighting, a refrigerator, freezer, washer, electric dryer, and plug loads such as microwaves, stereos, televisions, other entertainment equipment, kitchen appliances, etc.

The distribution system is a high voltage single phase distribution system with power poles and above ground transformers and power lines throughout the village site. The number and location of above ground power lines are unattractive and community members have requested that power lines be buried if possible.

Kerr Wood Leidal Associates is in the process of replacing all three 75 kW diesel generators with three new 100 kW air cooled diesel generators as part of the project to install a water treatment plant for the community. Replacement of the diesel generators was required to provide sufficient reliable power for the water treatment plant.

The size of the generators were increased from 75 kW each to 100 kW each to meet the increased power requirements of the water treatment equipment and to allow for reserve capacity for housing expansion up to a maximum foreseeable number of 40 houses. At the encouragement of EcoPlan International, the feasibility of adding heat recovery to the new diesel gensets was reviewed. However, it was determined by Kerr Wood Leidal that modifying the design to water cooled with heat recovery was a process that would create an unacceptable delay in the design and installation of the water treatment plant.

Table 4 projects anticipated electrical requirements based on: known loads such as the street lights, water treatment process and well pumps, as well as unknown loads such as residential and facility building averages. Electrical load projections include that required for the present community with a new water treatment plant, a short term projection with 26 new houses, and a ten year projection with 40 new houses. Projections assume that electric baseboard heating will not be used for space heating.

Table 4: Current and Projected Electricity Loads

Facility Load Type	Connected (kW)	Coincident (kW)	Average (kW)
Water Well Pumps (3 x 2 HP)	5.6	2.7	1.4
Water Treatment Facility	30	20	15
Street Lights (0.3 kW each) ▪ 8 existing ▪ 8 existing + 2 (water treatment building) ▪ 8 existing + 2 (water treatment building) + 4 future	2.4 3.0 4.2	2.4 3.0 4.2	1.2 1.5 2.4
Generator Building	6.5	4.5	1.8
Community Wash House	10	3	1.5
Band Office	3	2	1
Café	25	19	9
Community Hall	10	5	2
Long House	10	5	2
Residential Homes (3 kW each) ▪ 17 - existing ▪ 26 - short term projection ▪ 40 - 10 year projection	51 78 120	51 78 120	25.5 39 60

Scenarios	Connected Load (kW)	Demand Capacity (kW)	Consumption Average (kW)
Existing plus water treatment process; 17 residences, community facilities plus water treatment process	153.5	114.6	60.4
Short Term Projection; 26 residences, community facilities and water treatment process	180.5	142.2	74.2
10 Year Projection; 40 residences, community facilities and water treatment process	222.5	185.4	96.1

Source – Kerr Wood Leidal Associates, Interim Water Treatment Facility, Draft Preliminary Design Report, May 2006

Space Heating

Residential and communal buildings within the community are currently heated with either electric baseboard heaters, low efficiency heating oil stoves, wood stoves, or the heat from propane kitchen ranges.

Approximately 5 out of 17 occupied houses use oil stoves. A large oil tank in the center of the community is filled from a barge at the dock through an underground pipe. Oil tanks on the outside of houses are filled by transferring oil from the central tank into a mobile oil tank and then pumping oil from the mobile tank into house tanks. Environmental damage from oil spills are a concern for the community.

Many of the buildings are poorly heated. The big house has no source of heating and the community hall does not have heating in most of its spaces. Some houses are reported to have no heating except for the heat from propane kitchen ranges. Wood is collected for wood stoves from the forest and clearcuts on the island on an as needed basis.

The cost of diesel fuel for the diesel gensets, heating oil, and propane are all currently paid for by INAC.

Hot Water Heating and Appliances

Hot water heating is primarily provided by electric water heaters at each house, plus at the band office, community center and health center.

Many houses have propane stoves with 20 lb propane tanks on the outside of houses. The propane tanks are transported to the dock where they are refilled by a propane truck on a barge.

The remainder of appliances in most houses are electric. A typical list of electric appliances and plug loads includes:

- Electric clothes dryer and washer
- Electric refrigerator and freezer
- Electric kitchen stove (many propane)
- Microwave
- TV
- Stereo
- Approximately 16 – 60 watt incandescent lights per house

Current Energy Costs

Energy costs for the year 2005 are shown in Table 4 below. As shown the majority of expenditures went towards the purchase of diesel oil for electricity generation. Assuming typical diesel genset efficiency of 30% and current diesel costs, the cost of producing electricity on the island is approximately $0.38 per kWhr, or approximately six times the price of electricity charged to BC Hydro customers on Vancouver Island.

Table 5: 2005 Energy Expenditures

Fuel Type	Expenditure
Fuel – Diesel	$120,840
Fuel – Propane	$7,022
Fuel - Stove Oil	$11,107
Generator Service and Materials	$8,500
Total	**$147,469**

Maintenance

Operation and maintenance of the diesel gensets and other energy related systems is carried out by a community member who is paid for 3hrs per day, seven days per week.

3.2 Options – Energy Infrastructure

3.2.1 Overview

The community has three basic community energy system options available to consider, plus several optional systems that could be added on to provide benefits to any of the three main systems. It is important to note that INAC is currently paying all costs for energy including diesel fuel for gensets, oil for wood stoves, and propane for appliances, INAC has indicated that cost savings from improved energy efficiency could be negotiated to flow back to the community.

Option # 1: Existing Oil Stoves and Electric Baseboard Heat

This is a scenario looking at the expansion of the existing system to include new houses. It is relatively inexpensive and inefficient. This option is not practical from an operating cost perspective and is presented mainly for comparison purposes for more efficient options. The new diesel gensets are not being designed to meet electrical load requirements of electric baseboard heating required for planned community expansion.

Option # 2: A Propane Grid

A propane grid is a relatively efficient and low maintenance option that is common in BC in rural or remote areas. Although this option has a higher capital cost than Option #1, this would be paid back in energy cost savings in approximately 4 years. Once the system is paid off, there is potential for energy costs saving of ~ $40,000 per year compared to Option #1. INAC has indicated that these costs savings may be able to flow back to the community. There have been concerns expressed by community residents regarding fire and explosion risk, however a propane grid installed and maintained by qualified personnel would likely pose a lower risk than the current situation, where each house has individual propane bottles for appliances that are regularly disconnected and transported to the barge for refilling.

Option # 3: District Heating System

A district heating system is the most innovative and energy efficient option available, but also the most complex. This option has a higher capital cost than Option #1 or 2, and would be paid back in energy cost savings in approximately 5 years. Once the system is paid off, there is potential for energy costs saving of ~ $84,000 per year compared to Option #1, which INAC has indicated may be able to flow back to the community.

Because of this system's complexity in design and maintenance, it will require additional time to design and implement. There is an increased risk of maintenance related problems over time if the system is not properly operated and maintained.

One of the main advantages of a district heat system is the ability to incorporate any number of different heating sources, with different fuel types, and to incorporate "free" sources of heat such as waste heat from the diesel generator exhaust or solar energy, or wood waste. This allows the potential of a more efficient system while improving energy security due to the ability to use different fuel or energy supplies.

There are many options for sources of heat supplied to district heating systems and four are profiled in this package: a) Central Propane Boiler, b) Central Wood Pellet Boiler, c)

Cogeneration and Central Propane Boiler, d) “Energy Cabin” Wood Pellet Boiler with Solar Hot Water.

Add On Options: Wood Stoves (Option #4), Solar Hot Water (Option #5) and Wind (Option #6)

Wood Stoves, solar hot water heaters, and a wind generator are all practical options that could be added to any of the above options to reduce energy costs and improve self sufficiency. Wood stoves in particular would improve self-reliance in the event of a system failure due to the abundant supply of local wood resources.

Other Options Considered

A number of other energy options were considered. However they were deemed impractical for the community and therefore not explored in detail. These included:

1. Micro hydro – deemed not practical because there are no rivers or streams with year round flow within several kilometers of the village. The stream to the south of the existing village has very low flow even in the winter. One possibility that could still be explored is the potential for micro hydro at the Wakeman Sound reserve, where a larger river exists. It was not explored because the community has no plans for development at this site at the present time.
2. Ocean source or ground source heat pumps – This option was initially included in the list of options, however upon initial analysis it was determined that the return on investment was very poor due to the high cost of electricity from the diesel gensets. This type of technology can have a good return on investment in locations served by the main electricity grid, where current electricity prices are approximately $0.06 per kWhr compared to approximately $0.38 per kWhr from the diesel gensets.
3. Tidal energy – A review of tidal energy potential from BC Hydro studies shows a fairly good potential for tidal energy from current flowing past Gilford Island into Knight Inlet. Unfortunately it is not practical at this time because the distance to supply electricity to the grid is too far, and tidal generation technology is not yet developed sufficiently to be commercially viable. The development of tidal based electricity generation with the sale of electricity should be explored by the community in the future, particularly once it has been developed at other nearby locations.

Option # 1 - Existing Oil Stoves and Electric Baseboard Heat

Description:

- Electric baseboard heaters providing space heat using electricity generated by diesel gensets
- Inefficient oil stoves with oil tanks outside houses
- Small propane tanks at each house for appliances
- Analysis assumes 50% of new buildings heated with oil furnaces and 50% heated with electricity

Pros:

- Minimal capital cost

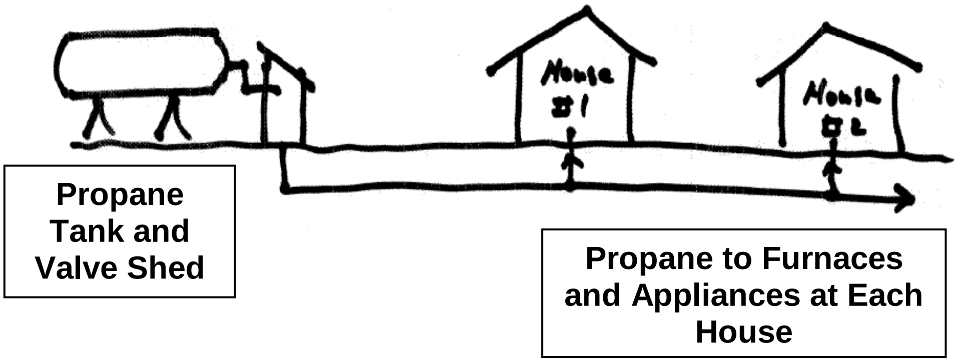
Cons:

- Very high energy costs - very inefficient production of electric heat using diesel generators, and high cost of heating oil.
- Environmental – possible oil spills from manual filling of tanks and transfer from central oil storage, increased air pollution
- High Maintenance – manual filling of oil tanks at each house, propane tanks transported to barge for filling
- Aesthetic – central oil storage tank must be moved so that it is not in the center of the community

Example:

- Current Situation at Gilford Island, oil tanks (left), electric baseboard heater (right)

Option # 2 - Propane Grid



Description:

- Underground propane pipes supply propane to propane furnaces and appliances in each building
- 5,000 gal propane tank & small valve shed located on a pad beside current genset building

Pros:

- Reduced energy costs – high efficiency propane furnaces are more efficient than electric or oil heat. Propane supply charges reduced for central filling of one tank
- Low maintenance – annual maintenance provided by superior propane
- Safety – hard piped propane system is safer than individual tanks being refilled at each house
- Fast speed of construction

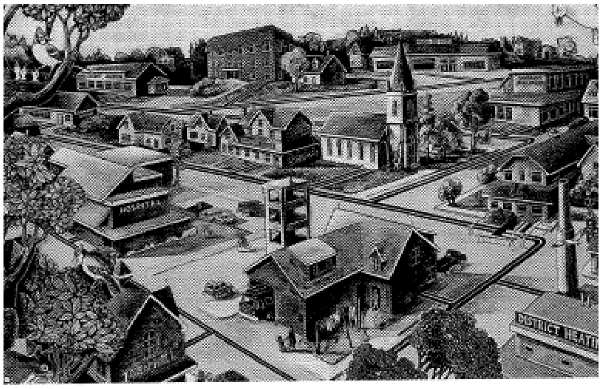
Cons:

- Increased capital cost compared to Option #1

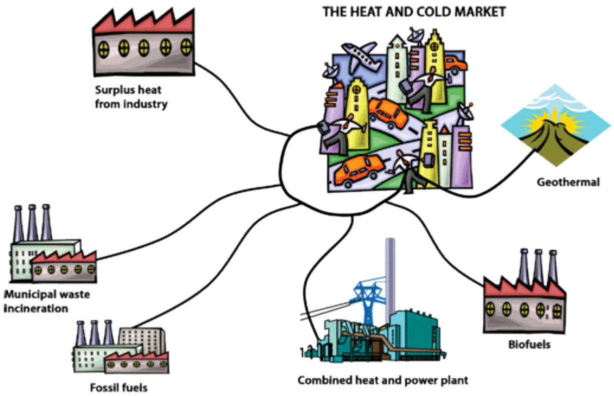
Example:

- Big White Ski Hill (Upper Photo), Lakeview subdivision (Lower Photo), Samahquam Nation Baptiste-Smith Community

Option # 3 - District Heating



District heat distribution network in a mid-sized community. (Illustration by P. John Burden, for the Prince Edward Island Department of Economy, Development and Tourism.)



Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- The hot water can provide space heating in buildings with in floor radiant heat, or hot water baseboards, or forced are furnaces.
- Central district heating plant produces hot water using:
  - central propane boiler, or
  - wood pellet boiler
- Other low cost energy sources can be added to district heating system to reduce energy costs including:
  - Waste heat recovery from diesel gensets (Cogeneration)
  - Solar hot water heating

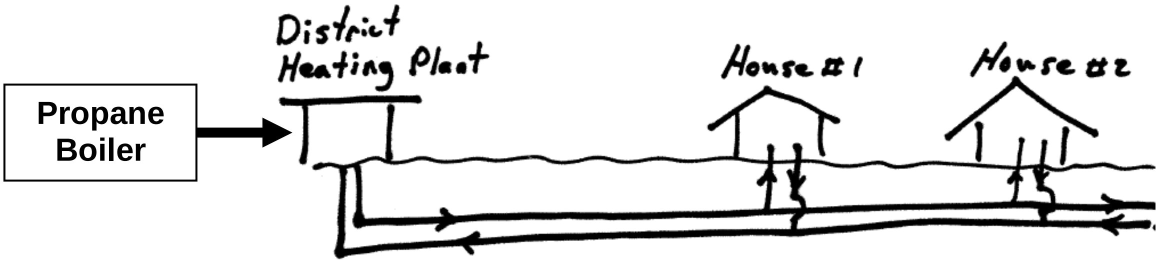
Option # 3A - District Heating with Central Propane Boiler

Description:
- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- District heating plant produces hot water using central propane boiler

Pros:
- Reduced energy costs (Same as propane grid) – high efficiency central propane boiler. Propane supply charges reduced for central filling of one tank.
- Energy Flexibility – can switch to other fuel types to generate heat, and use in combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance
- One central heating plant rather than individual furnaces and water heaters at each house (maintenance)

Cons:
- Increased capital cost compared to Option #1 and 2
- Higher maintenance – boiler operation and hot water grid requires monitoring and maintenance
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers

Examples:
- North Vancouver lower Lonsdale district heating system



Option # 3B - District Heating with Central Wood Pellet Boiler

Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- **District heating plant produces hot water using central wood pellet boiler**

Pros:

- **Reduced energy costs (Lower than 1, 2, & 3A) – wood pellet costs are lower than propane.**
- Energy Flexibility – can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance

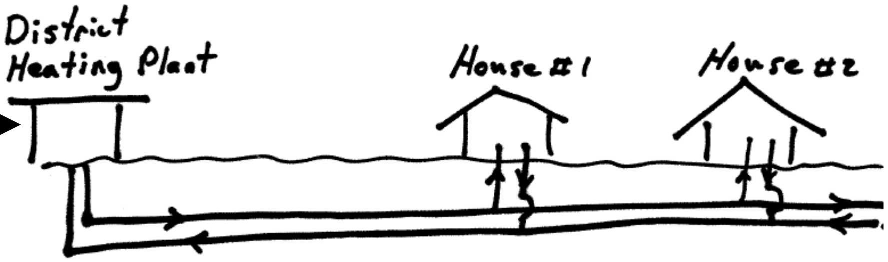
Cons:

- Increased capital cost compared to Option #1 and 2.
- **Higher maintenance – Wood pellet supply and boiler operation and hot water grid requires monitoring and maintenance**
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers

Examples:

- Oujé-Bougoumou (Quebec), Charlottetown (PEI), Green Acres Family Housing (Vermont)

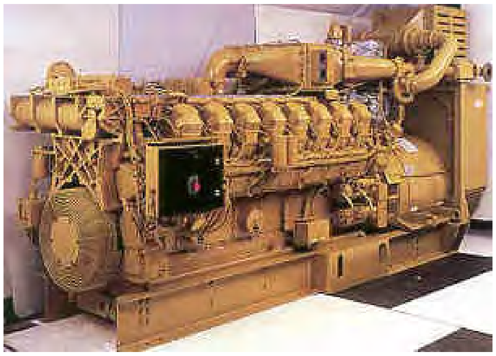
Wood Pellet Boiler



Option # 3C - District Heating with Cogeneration and Central Propane Boiler

Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- District heating plant produces hot water using central propane boiler
- **Cogeneration – waste heat recovery on diesel genset exhaust provides free heating to district heating grid**



Pros:

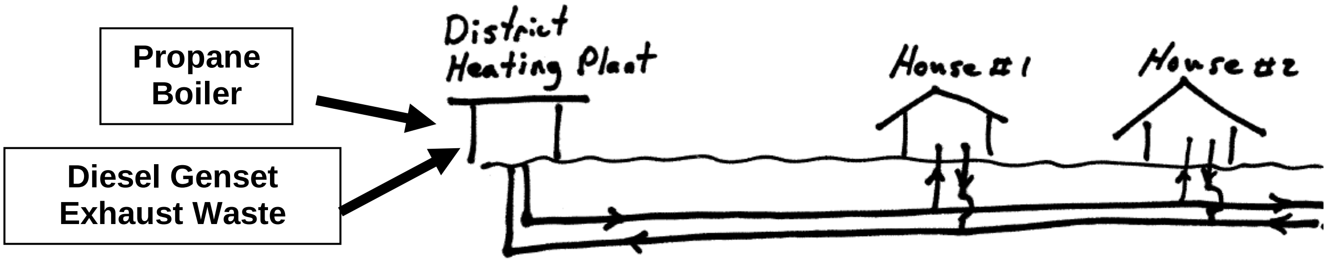
- **Reduced energy costs (Lower than 1, 2, & 3A, 3B) – free waste heat from genset exhaust.**
- Energy Flexibility – Can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – System will require monitoring and maintenance

Cons:

- **Increased capital cost compared to Option #1, 2, 3A, and 3B.**
- **Higher maintenance – Cogen system and boiler operation and hot water grid requires monitoring and maintenance**
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers.
- Existing diesel gensets are being replaced with air cooled gensets as part of the water treatment system upgrade – these have a much less potential for heat recovery than water cooled gensets.

Examples:

- Nitnat Fish Hatchery, Vancouver Island



Option # 3D - District Heating with “Energy Cabin” Wood Pellet Boiler with Solar Hot Water

Description:

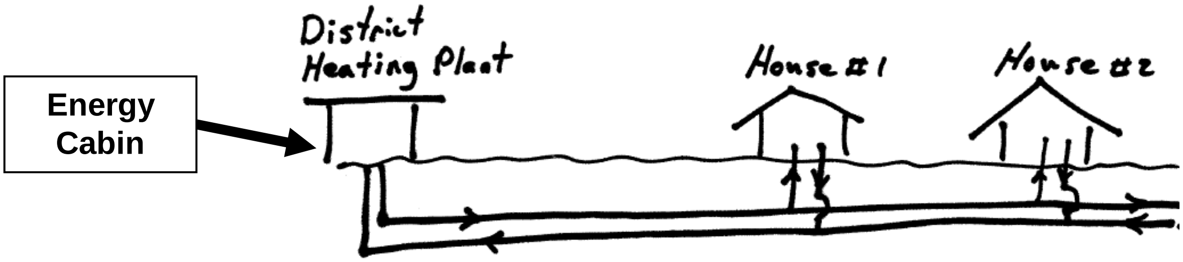
- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- **District heating plant produces hot water using “Energy Cabin” – self contained wood pellet boiler and solar hot water heating panels**
- **First American Scientific Corporation has indicated that they may be interested in installing system and operating it and selling heat to the community**

Pros:

- **Reduced energy costs (Lower than 1, 2, & 3A, 3B) – free solar heat (To be determined).**
- **No capital or maintenance costs – system is installed and maintained by seller**
- Energy Flexibility – can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance

Cons:

- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers



Option # 4 - Wood Stove Heating

Description:

- Wood stoves in each building to provide space heating

Pros:

- Reduced energy costs (lower than 1,2, 3A, 3B, 3C, or 3D) assuming wood is harvested locally
- Low capital cost
- Increased self sufficiency and energy security – independent of outside fuel supply and mechanical system failure
- Job creation opportunity for cutting and selling wood to community

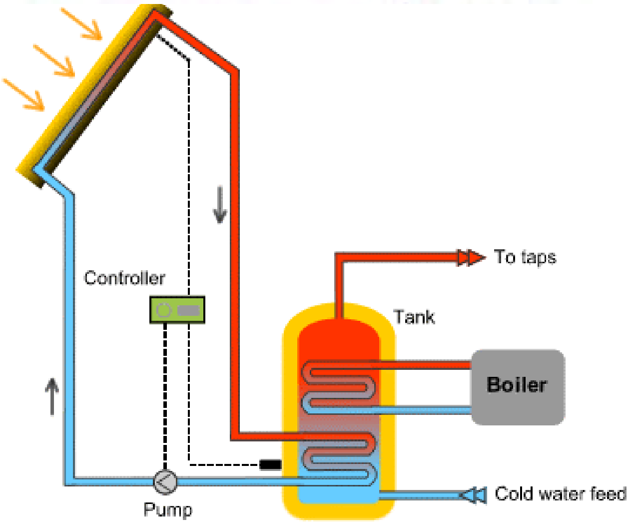
Cons:

- Increase effort required for operation and maintenance
- Limited heat distribution in large buildings
- Local air pollution

Option # 5 - Solar Hot Water Heating

Description:

- Individual solar panels on south facing sloped roofs are used to preheat domestic hot water in each house. Water is circulated in the system only when the temperature of the solar panels is high enough to heat water. "Drain back" system eliminates problems with freezing.
- Or, centralized solar hot water heating array that heats hot water in the district heating system



Pros:

- Reduced energy costs
- Increased self reliance
- Portrays and environmental image which would attract tourism

Cons:

- Increased capital cost
- Increased maintenance

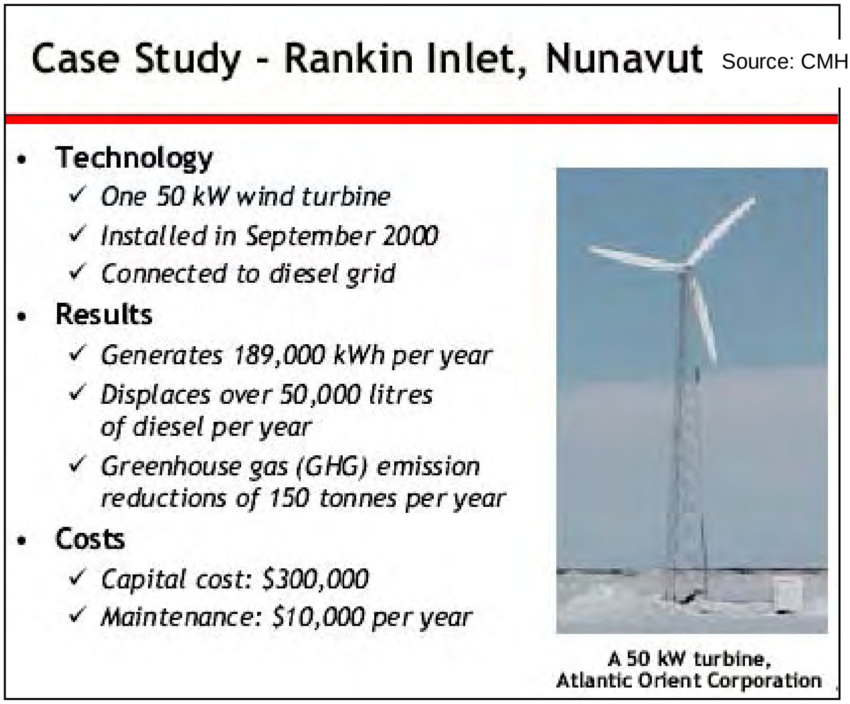
Examples:

- Chanterelle Inn, Nova Scotia,
- Vancouver International Airport,
- numerous single family houses in BC

Option # 6 - Wind Turbine

Description:

- A wind turbine could be installed on top of the 1,000 ft mountain directly above the community, and connected to the diesel gensets as a wind diesel hybrid system
- Electricity produced by the wind generator would offset diesel genset produced electricity



Case Study - Rankin Inlet, Nunavut

Source: CMHC

- **Technology**
  - ✓ *One 50 kW wind turbine*
  - ✓ *Installed in September 2000*
  - ✓ *Connected to diesel grid*
- **Results**
  - ✓ *Generates 189,000 kWh per year*
  - ✓ *Displaces over 50,000 litres of diesel per year*
  - ✓ *Greenhouse gas (GHG) emission reductions of 150 tonnes per year*
- **Costs**
  - ✓ *Capital cost: $300,000*
  - ✓ *Maintenance: $10,000 per year*

A 50 kW turbine, Atlantic Orient Corporation

Pros:

- Reduced energy costs for electricity production.
- Increase diesel genset life
- Reduced local air pollution
- Portrays and environmental image which would attract tourism

Cons:

- Increased capital cost.
- Increased operation and maintenance requirements.
- The top of the mountain is outside the reserve and a wind generation license would have to be obtained from the province

Examples:

- Ranken Inlet Wind Diesel Hybrid

Table 6: Energy Infrastructure Decision Matrix

	Objective	Measurement	Option 1	Option 2	Option 3A	Option 3B	Option 3C	Option 3D	Option 4	Option 5	Option 6
1	Reduced Capital Cost	System Cost ($) (Based on new community plan with 26 houses)	$0	$150,000	$390,725	$437,000	$424,475	$0	$52,000	$65,000	$350,000
2	Reduce O&M costs	Annual Energy and Maintenance Costs	$127,859	$89,712	$91,837	$44,128	$59,495	?	$32,590		
		Annual Energy and Maintenance Cost Savings ($/year)	$0	$38,147	$36,022	$83,731	$68,364	?	$95,269	$5,625	$55,000
		Simple Payback Compared to Option 1 (Years)		3.9	10.8	5.2	6.2	?	0.5	11.6	6.4
3	Create Employment Opportunities	# Full time band member jobs (Job years)	0.1	0.1	0.5	0.5	0.5	0.5	2	0.1	0.1
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	Low	Low	Med	Medium	Med	Med	Med	Med	Med
5	Fast Speed of Construction	Infrastructure Construction Time	Fast	Medium	Slow	Slow	Slow	Slow	Fast	med	Slow
6	Increased Durability	House Life Expectancy (Years)	same	same	same	same	same	same	same	same	same
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Increase Energy Security	Increase fuel options and or self sufficiency (Yes/No)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	Ease of Remote On-Site Construction	Prefabricated components	same	same	same	same	same	same	same	same	same
12	Reduce O&M Effort	Operating and Maintenance Effort (High/Medium/Low)	High	Low	High	High	High	High	High	High	High
13	Reduce Site Impacts	Impacts to Clam Midden, soil, water (High/Medium/Low)	High	Medium	Medium	Medium	Medium	Medium	Med/Low	Low	Low
14	Increase Self Sufficiency	Increase in Self Sufficiency (High/Medium/Low)	Low	Low	Low	High	Low	High	High	High	High
15	Safety	Safety Risk (High/Medium/Low)	Med High	Medium	Med High	Med High	Med High	M High	Med High	Med High	Med High

3.3 Next Steps – Energy Infrastructure

Community Choices

The community was presented with all of the previous options and through community meeting they have chosen the propane grid as their preferred option for delivering energy to the community for heating buildings, hot water heaters, and for appliances such as kitchen ranges and dryers. The following steps are required to implement this option.

1. Obtain an updated proposal from Superior Propane for design and construction of the propane grid. Superior Propane is the local propane supplier that delivers propane to the village. They have provided an estimate for installing a propane grid and providing maintenance to the system based on early versions of the community plan. They have been requested to provide more detailed cost estimated based on the final version of the land use plan including plans for future expansion.
2. Procure INAC Funding.
3. Integrate energy infrastructure with housing e.g. Match space heating type with energy system, size energy system capacity based on design and energy efficiency of housing.
4. Obtain competitive bids for design and construction.
5. Undertake construction.
6. Integrate solar, wind generation, and wood stove options into village.

4. Water

4.1 Current Status – Water

A new water treatment plant is currently under design by Kerr Wood Leidal Associates (KWL), and is scheduled to be installed and operating by the end of December 2006. Full funding for the project is being provided by INAC.

Existing System

The existing water supply system was installed in 1996 to 1997. The water system consists of three 150 mm diameter deep bedrock wells, a well control building, a 170,000 L bolted steel tank reservoir, and a piping distribution system. From the well control building, water is pumped to the water reservoir and then back to the village. Spray aeration is used at the reservoir to remove hydrogen sulphide.

The reservoir is designed to provide pressurization and storage for fire protection and for water delivery to buildings. The reservoir serves four fire hydrants located within the existing village. Storage is based on a 200 person design horizon and 270 L per person per day demand. The highest service elevation recommended is 18m geodetic, which means that development of a new subdivision up the hill would require either a new higher storage reservoir, or a booster pump to provide pressurization for fire protection and building water use.

Since 1999 the community has not used water from the groundwater well system for drinking or cooking due to aesthetic and health concerns. They have been supplied with bottled water which comes into the community by boat on a once a month basis.

Well PW86-1 is no longer used because it has produced water with hydrogen sulphide odours throughout its service life. The other two wells, PW 95-1 and PW 95-2 have produced water with unacceptably high salinity levels, from salt water intrusion due to their close proximity to the ocean and over-pumping from design levels.

No disinfection or other water treatment is used, and was not required for this type of system in the past, however disinfection is now required for all public water supply systems. Water from the various wells has historically had problems exceeding allowable limits for dissolved solids, turbidity, chloride, iron, manganese, or sodium.

Records of recent year water use from the log at the water control building (shown in table below) indicate an average total water use of the between 450 and 530 litres per person per day based on a population of 29 people. Total water use per day in 2005 was 15.5 cubic meters per day, which is 44% of the maximum allowable wastewater discharge under the current sewage disposal permit which allows 35m^3/day. The water system operator indicated that large amounts of water have been used to flush the water reservoir, distribution pipes, and water treatment distribution system. Therefore, the per capita water consumption is actually much less than this.

Table 7: Per Capita Water Consumption

Year	Total Water Use Per Year (Litres)	Liters/Person/Day
2004	4,724,003	450
2005	5,654,416	530

New Water Treatment Plant

In 2005 KWL evaluated the feasibility of four different water treatment systems including: 1) adding chlorination; 2) a new well plus chlorination; 3) reverse osmosis treatment plus chlorination; and 4) existing system with bottled water.

KWL recommended option 3, utilizing a reverse osmosis treatment system to remove contaminants and chlorination to disinfect the water. This option was accepted by the community and INAC has agreed to fund the project.

The new water treatment plant is being designed to accommodate water use for 200 people based on 270 litres per person per day. The new water treatment plant will consist of a treatment building, settling pond, and includes upgrading of the existing diesel gensets to meet the three phase power requirements of the new treatment plant. Three independent pilot treatment plants incorporating different pre treatment and treatment technologies are being incorporated into the treatment building in order evaluate their effectiveness. Operation and maintenance of the facility will be undertaken by an outside firm, EPCOR Water Services. The water treatment system will produce chemical backwash and waste water flows that will be sent to a settling pond, and then discharged to the sewage outflow.

The estimated project cost for the new water treatment system, including engineering, construction, monitoring, and operation and maintenance for the first year is $3,224,000 ($111,000 per person based on current population), and ongoing operation and maintenance costs are estimated at $282,000 per year.

4.2 Options – Water

Water Conservation

Water conservation technology should be incorporated into the design of new houses and community buildings to reduce the cost of operating the water treatment plant and to avoid exceeding the capacity of the existing wastewater disposal permit due to increased numbers of people living in the community. The following measures should be adopted which will reduce typical home water consumption by at least 50%

Water Efficiency:

1. Low flow toilets – Maximum 6 L/flush instead of standard 13 L/flush. Dual flush toilets preferred (3.3L/flush and 6L/flush). New low flow toilets actually reduce the incidence of clogging, rather than increase it as typically assumed.
2. Use low flow shower heads – Shower heads rated at 1.5 GPM with an excellent spray pattern are readily available to replace standard 2.5 GPM showerheads.
3. Specify 0.5 GPM aerators on bathroom water faucets instead of standard 2.2 GPM flowrates. No one will notice the lower flow rate.
4. Consider rainwater barrels at each house for irrigation of landscaping and gardens.

Water Treatment Operator Employment

Operation and maintenance of the new water treatment plant will be undertaken by an outside contractor using certified operators. A community member could be trained to become certified at operation of the water treatment plant.

Rainwater Collection

The village is located in a region with a very high rate of annual rainfall and throughout the history of the village the community has relied upon surface or rainwater collection for their water supply. Older community members talk about using "Cedar Water" from a seasonal creek at the north end of the village and a surface water collection system above the center of the village. This collection system consisted of a weir in a seasonal stream and cedar storage tank but was removed in 1996. Rainwater or surface collection was not evaluated as an option in the water supply feasibility study completed by KWL in 2005.

While rainwater collection is not practical for the entire community because construction of the new water treatment system has been funded and is underway, there still could be opportunities to use rainwater collection for outlying buildings such as the tourist buildings and bungalows at "Buddy Bay", or on new houses to offset water use through the water treatment plant, possibly reducing operating costs for the plant. Options include:

1. Incorporating rainwater collection into the design of new buildings in the tourist area – the future bungalows, information center, kayak shelter, or tourist center. Rainwater collection systems should be designed and constructed according to the "Guide for Regulating the Installation of Rainwater Harvesting Systems – Potable and Non Potable Uses".
2. Incorporating rainwater roof collection and cisterns into new houses for non potable uses such as toilet flushing or irrigation.

4.3 Next Steps – Water

Community Choices

1. Incorporate water conservation technology into new building design.
2. Designate a community member as water system operator to provide assistance to the EPCOR certified operator and aim to certify the community member.
3. Incorporate rainwater collection into tourist buildings, or rain barrels on new houses, for irrigation and potentially for toilet flushing.

5. Wastewater

5.1 Current Status – Wastewater

The current wastewater disposal system for houses and community buildings was constructed in 1990. It consists of individual 750 Gallon septic tanks, and distribution via the community owned sewer system within the village to the outfall at the south end of the village. The outfall is a 100mm HDP pipe with its terminus approximately 25m below the surface and 440m in length into Retreat Passage waters. A dosing siphon that is used to deliver sewage through the outfall at low tide is located at the south end of the village. During all site visits by the planning consultants, a strong sewage odour was observed around the dosing chamber, and community members complain about the smell of sewage in the area. A broken sewage pipe near the siphon pump that has apparently been repaired may have been contributing to the odour.

According to Dave Johnson, who currently has the responsibility for maintaining the wastewater system, the septic tanks were pumped out in 2005 for the first time in 15 years. He indicates that the system is working well, and other than the odour problem, does not require any upgrade or modification.

Kerr Wood Leidal, who originally designed the system, indicates that the system is working well, has enough excess capacity to accommodate future expansion to 40 households, and has a good remaining life expectancy.

5.2 Options – Wastewater

Odour Control

Kerr Wood Leidal indicates that the foul odour observed around the siphon pump may be from air escaping due to a broken or loose cap on the dosing chamber. If that is not a problem and the odour is escaping through the vent, then they suggest either adding a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas.

Wastewater Treatment for New Subdivision

As part of the pre-design work for the new subdivision, Kerr Wood Leidal is reviewing whether or not the wastewater system needs upgrading to meet current requirements for sewage treatment systems that are more stringent than were in place when the system was installed in 1990. The village has a waste discharge permit for 35 cubic meters per day, which should be sufficient to meet future expansion needs, even with the increase in discharge from the water treatment plant. New houses should be constructed with low flow toilets, showers, and faucets to ensure that this maximum capacity is not exceeded.

5.3 Next Steps – Wastewater

Community Choices

1. Design new houses with low flow toilets, showers, and faucets to reduce the amount of wastewater flow going to the water treatment plant and avoid the need to increase the discharge flowrate allowed under the current wastewater discharge permit.

2. Investigate the source of odour at the dosing chamber and repair (repair broken or loose cap on the dosing chamber, or add a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas.
3. Design expansion of water treatment system to the new subdivision (underway by Kerr Wood Leidal)

6. Fire Protection

6.1 Current Status – Fire Protection

Fire protection to the village is provided by the four fire hydrants, fire fighting equipment, and community members. There is currently no fire pump in the village. Therefore, it may be difficult to draw the design fire flow from hydrants using just fire hoses. Building sprinkler systems has been recommended by previous consultants however, they have not been installed in any of the existing buildings.

6.2 Options – Fire Protection

New Buildings

All new buildings should be constructed with fire sprinklers. The water supply system for the existing village site is designed to be able to supply water to buildings equipped with sprinkler systems.

New Subdivision

The existing water reservoir is designed to provide pressurization and storage for fire protection and for water delivery to buildings. The reservoir serves four fire hydrants located within the existing village. The highest service elevation recommended is 18m geodetic, which means that development of a new subdivision up the hill would require either a new higher storage reservoir, or a booster pump to provide pressurization for fire protection and building water use.

6.3 Next Steps – Fire Protection

Community Choices

1. Incorporate sprinklers into new houses and other buildings.
2. Investigate the purchase of fire fighting equipment.

7. Solid Waste

7.1 Current Status – Solid Waste

In the recent past the community used a landfill up the hill southeast of the village to dispose of solid waste. It is no longer being used and all solid waste is currently being removed from the landfill and disposed of at the 7-Mile Landfill in the Mt Waddington Regional District.

The community currently transports all solid waste to Alert Bay for disposal. The system consists of 12 plastic garbage bins with wheels (garbage totes) that are located throughout the village. Once per week the totes are wheeled to the dock, loaded on a seiner, and transported to Alert Bay. From there the garbage is transported to the 7-Mile landfill north of Port McNeil.

They are currently shipping approximately 4 totes/ week of garbage out of the village. The boat picks up the garbage once per week at a cost of approximately $400 per trip. The cost to dispose of the garbage is $12.50 per tote (or $50/week).

7.2 Options – Solid Waste

Option 1 - Recycling
Alert Bay has a very good recycling program that should be used by the village to reduce solid waste disposal costs and negative environmental impacts. They accept glass, plastics, metals, and paper. There is no charge for recycling that comes to the municipal dock in Alert Bay, except a small charge for moving it from the dock to the recycling center.

The four totes per week of garbage could likely be reduced to one tote per week of garbage plus three totes per week of free recycling, resulting in a cost savings of approximately $38 per week, or $2,000 per year. More importantly it would result in a 75% reduction of waste going to the landfill and the negative environmental impacts associated with its transportation and disposal.

Option 2 - Recycling Plus Reduced Trips
If recycling was implemented and the number of barge trips to transport solid waste to Alert Bay was reduced to one every two weeks from once per week, the cost savings would be approximately $238 per week, or $12,375 per year.

Alert Bay also has a service to recycle washers and dryers (which are sent to Vancouver) and they are working on developing a Reuse Center.

Option 3 - Coordinate Transportation with Bottled Water Drop Off
Another option to reduce transportation costs associated with barging of the totes to Alert Bay is to coordinate garbage transportation with the transportation of bottled water into the community. This is currently happening on a once per month basis but will terminate when the new water treatment plant is up and running. The cost savings associated with a reduction of one trip per month is approximately $4800 per year.

Option 4 - Composting

On site composting is another option, however community members have concerns about attracting animals to the village. Site composting could probably be done in a secure storage facility far removed from the village.

7.3 Next Steps – Solid Waste

Community Choices

1) Develop a recycling system. Talk to the recycling coordinator out of Alert Bay, John Jollisse, Tel 604-974-2211 to arrange for recycling. Set up new recycling totes or dedicate existing totes to recycling
2) Consider reducing garbage barge trips to Alert Bay from once per week to once every two weeks. A secure storage location could easily be constructed for garbage if it is not picked up every week.
3) Coordinate water delivery with garbage disposal trips.
4) Consider developing a composting facility

8. Conclusions

This report examined options to address the physical needs of the community as they relate to housing, energy, and infrastructure systems such as water, wastewater, and solid waste. Options were examined that best meet the long-term objectives of the community, as well as addressing the need for immediate short-term physical repairs or replacements relating to housing, energy, water, sewer, and solid waste management. In summary, the following list highlights the main findings of the study:

Housing Construction Methods

- Four methods of construction were evaluated for their benefits and drawbacks, including pre-manufactured trailers, on site construction with community labour, construction on site with outside labour, and construction combining partially pre-manufactured components with on site construction.
- Based on the current construction climate in BC, new houses are estimated to cost between $100,000 and $175,000 per 1000 sq ft house depending on how they are designed and the method used for construction. The KFN have secured funding of approximately $90,000 per house from INAC to build 26 replacement and new homes at Gwa-yas-dums Village, and will be contributing approximately $20,000 per house themselves.
- KFN have reviewed this analysis and decided to engage the services of an architect or home designer to help facilitate the development of construction drawings and the construction tendering process based on these construction methods.

Housing Design Guidelines

- Housing design guidelines that incorporate both community values and technical recommendations have been developed around building type, durability, indoor air quality, energy performance, roofing and cladding, water efficiency and fire protection.
- Sample floor plans and housing perspectives have also been completed to initiate thinking and discussion as a transition step to engaging the services of an architect. In October, the community agreed to move forward with engaging the services of an architect or designer and to oversee the transition to implementation. This architect should also assist the community in developing architectural designs and specifications for the other buildings (commercial, administrative, health, recreation) identified in the site plan.
- Energy efficient housing design was explored as part of the housing analysis and overall physical development plan. The costs and benefits of housing designed to an energy performance level of “Energuide 80” were evaluated. Energy efficient housing would have significant operating cost savings of up to $100 per year per house, with the additional benefits of improved indoor air quality and building longevity/ durability if heat recovery ventilation is incorporated into the designs. Based on the long-term cost savings and other benefits of energy efficient housing

design, EcoPlan recommends that INAC support the extra costs associated with the construction of energy efficient housing to the “Energuide 80” level of performance.

- Water efficient housing design was explored and is recommended to be incorporated into the design of new buildings. This would reduce the operating cost of the new water treatment plant and enable community expansion without the need to increase the allowable discharge with the current wastewater discharge permit.

Community Energy

- An analysis of over 10 long-term community energy options was developed and evaluated by the community. A total of 15 community-based criteria, including costs, maintenance requirements, ease of construction, safety, and environmental impacts, among others were used to evaluate options.
- Based on this analysis, KFN chose as their preferred system, a propane grid system in conjunction with the upgraded electrical gensets.
- Capital costs and long-term operating cost savings were critical criteria in choosing the system.
- The propane grid is expected to save approximately $38,000 per year in energy costs compared to the current system of electric and oil space heating and hot water heating. Initial estimates for capital costs are approximately $150,000 and will take approximately four years to recover this initial expenditure relative to the current energy system.
- KFN should consider implementing other alternative energy options explored such as solar hot water systems, a wind turbine on top of the mountain above the village, and wood stoves or wood pellet boilers. These options would reduce operating costs and environmental impacts, including increased energy security and self sufficiency.

Water

- The water in Gwa-yas-dums is not potable and is one of the most pressing concerns facing the community. KFN, working with Kerr Wood Leidal Consulting Engineers, are in the process of implementing a reverse osmosis and chlorination system of water treatment to address this crisis. The implementation of this project is scheduled for installation of the pilot treatment facility in the fall of 2006.
- Water conservation methods incorporated into the new building design guidelines should be implemented to reduce the operating costs for water treatment, and reduce wastewater flows and the size of the expanded wastewater treatment system.
- There is an opportunity to capture a local employment opportunity resulting from the need for a certified water treatment system operator.

Wastewater

- The current waste water disposal system is meeting the needs of the existing houses with the exception of strong sewage odour from the dosing chamber. The community should investigate this source of odour at the dosing chamber and repair (repair broken or loose cap on the dosing chamber, or add a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas).

- The new subdivision will require expansion of the water treatment system. This may result in the need to upgrade the system to meet current requirements for sewage treatment systems that are more stringent than were in place when the system was installed in 1990. This process is currently being completed by KWL. All new buildings should be designed to reduce water consumption as much as possible to reduce the size and cost of expanding the wastewater disposal system.

Fire Protection

- The current water supply system is designed to provide fire protection flow rates. However, the community does not have fire pumps for fire fighting. All new buildings should be constructed with sprinklers and the community should acquire fire pumps for fire fighting. The new subdivision will require construction of either a new water reservoir above the height of the new subdivision, or a booster pump from the existing reservoir, to provide fire protection.

Solid Waste

- The community currently transports all solid waste to Alert Bay for disposal. A recycling program that uses the existing recycling facilities in Alert Bay could be implemented to reduce the cost and environmental impacts of solid waste disposal. The community could consider reducing solid waste barge trips to Alert Bay and implement an animal proof composting system on Gilford Island to reduce transportation and disposal costs.

Terrain and Geologic Hazards Overview, Gwayasdums IR 1, Gilford Island, BC.

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October 23, 2006

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Gwayasdums is a small village consisting of about 26 houses located on the west side of Gilford Island in the protected waters of the Broughton Archipelago (Figure 1). Ecoplan International is preparing a socio-economic revitalization plan for the village, which will include replacing existing housing and infrastructure, and the potential construction of cabins for ecotourism. The preliminary plans call for locating operational facilities, such as power generation systems, in the northern part of the village and residential structures in the south part of the village. Of concern also is the potential for shoreline erosion, and there is an expressed desire to re-construct the existing sea wall.

This study describes the terrain and discusses geologic hazards affecting Gwayasdums IR 1, so that planning can take these into account. The report presents an overview of the issues, provides recommendations and indicates where more detailed geotechnical studies will be required.

Field work for this study was conducted March 10-12, 2006, and consisted of extensive foot traverse of the reserve and the terrain immediately upslope, and included surveying a number of topographic profiles using hip-chain, clinometer and compass. Profiles were tied to chart datum using wrack lines of predicted tides.

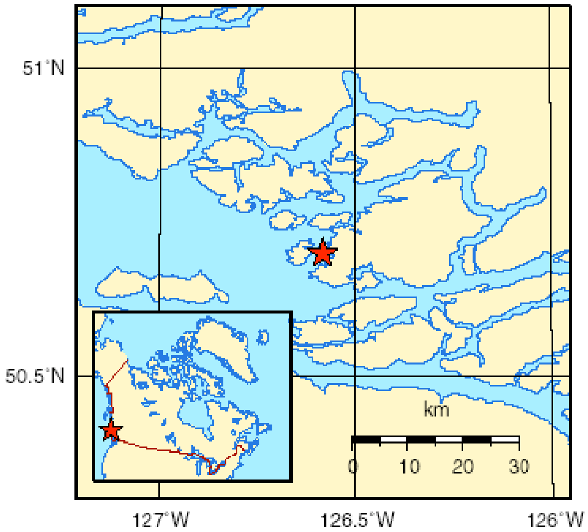

Figure 1. Location (red star) of Gwayasdums IR1, Gilford Island.

Figure 2 shows the local setting of Gwayasdums IR 1, the existing village site, terrain and hazard mapping, and distribution of surveyed profiles. Terrain mapping methodology follows Howes and Kenk (1988), with descriptions based on direct observations of slope, surface morphology, sediment textures from available exposures and windfall pits, and experience. No subsurface investigations were conducted.

2.0 The Setting

Gilford Island is located on the west side of the Coast Mountains within the low relief landscape of the Hecate Lowland. Local relief ranges from sea level to 600 m, with highest ridges reaching 750 m. Mt. Read, the sole peak on Gilford Island just reaches into the alpine at approximately 1500 m elevation. Bedrock consists of strong plutonic rocks (e.g., diorite, granodiorite, tonalite, gneiss) of the Coast Plutonic Complex. These rocks are typically coarsely jointed yielding blocky colluvium.

The entire area was glaciated leaving rounded ridges and U-shaped valleys. Valley sidewalls are typically very steep and rocky, while valley bottoms contain till or other glacial sediments such as outwash gravel (as on Malcolm Island) or glaciomarine mud. For example, due to depression of the land surface by ice, the sea flooded many low lying areas during deglaciation, and as a consequence marine sediments may be found up to perhaps 100 m elevation on Gilford Island (Clague et al 1982). During post-glacial time blocky rockfall deposits have accumulated below steep rock bluffs, debris flows have formed fans at the foot of steep confined channels, debris slides have mantled foot slopes, and rivers have formed floodplains along valley bottoms.

Climate in the area is very moist maritime (CWHvm1&2), with mean annual rainfall ranging from 1500-4500 mm (average 3000 mm): 80% occurs in the fall and winter months (Sep-Feb), with only 5% falling as snow (Oct-Apr). Maximum 24-hour rainfall can reach 155 mm, with values exceeding 75-mm/24 hr occurring in the months from September to April.

Prevailing winds are westerly in summer and easterly in winter, but become funneled by channels into northerly and southerly, respectively. Due to the limited fetch in Johnstone Straight, significant swell does not develop, but the combination of a strong ebb current flowing out of Johnstone Straight and westerly wind over 20 knots can lead to choppy seas more that 1-2 m high (Thomson 1981). The maximum unobstructed fetch at Gwayasdums IR 1 is about 2 km, so the limited fetch reduces the expected wave height accordingly.

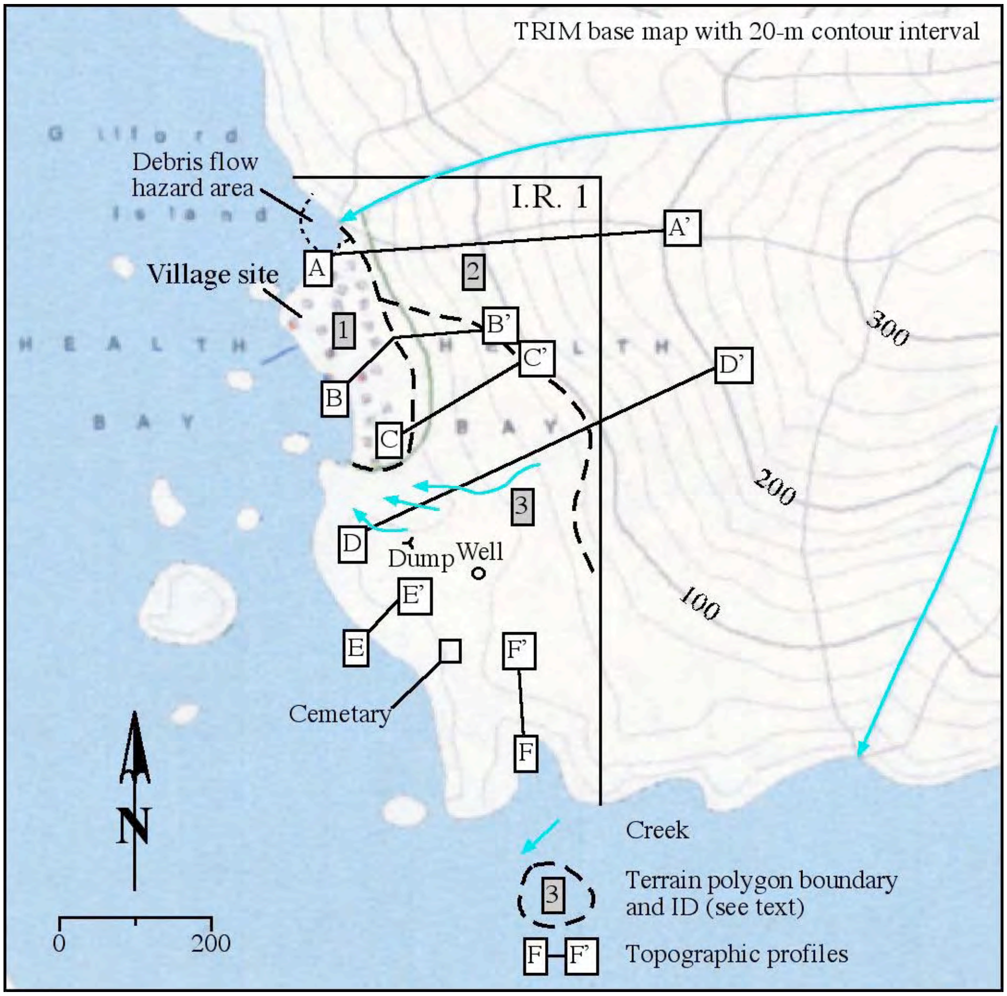

Figure 2. Location of Gwayasdums IR1, Gilford Island, showing topography, terrain polygons 1-3, and topographic profiles.

3.0 Terrain Description

The village site, located in Health Bay, is protected from large waves by a number of small islets. The village is situated on a low terrace 300-m long by 60-m wide (Polygon 1, Figure 2). North and south of the village the shoreline is rocky, but at the village site it is formed of a series of three beaches built out from the hillslope and anchored to small rocks. The site was occupied prehistorically due to its productive clam fishery, and the entire village area is underlain by clamshell midden (Figure 3), which extends from the highwater mark (~3.0 m geodetic) to 6-8 m geodetic. The midden is highly disturbed: in the 1960s, when the existing residential buildings were erected, the midden was bulldozed to create a level surface, a log-crib seawall was constructed and backfilled with midden material, and water and septic infrastructure has been installed in trenches. The seawall is now rotten and degraded.

Behind, or east of the village the slope rises to a small summit at about 320 m elevation (Figure 2). Average slopes are moderately steep (50-70%), but the surface expression is benched to irregular (Polygon 2, Figure 2). At the north end of the village site (Profile A-A’, Figure 4), the slope rises at 60-80% for about 200-m slope distance before breaking to moderate slopes (30-50%). On the slope, surface materials generally consist of rock with veneers of till and forest floor organics (folisol). At the south end of the village, the slope rises more gradually to a steep rock break at about 80-m elevation (Profile D-D’, Figure 3; Figures 4&5). The lower slopes in this area and to the south are mantled by glaciomarine mud with a few rock outcrops present (Polygon 3, Figure 2). Three small creeks are incised in this muddy deposit and have 3-10 m tall sidewalls prone to slumping.

Profile F-F’ (Figure 5) shows the beach and back beach at one of the proposed ecotourism sites. The existing shed (Sawmill shack) at the beach is built on a bench formed by wave activity. This is the only undisturbed back-beach landform at Gwayasdums IR 1. The height of this bench is 4.6-5.0 m geodetic, or about 2-m higher than maximum recorded high tide (3.0-m). Thus, storm wave runup may be expected to reach up to 2-m above high tide, or about 5-m geodetic.

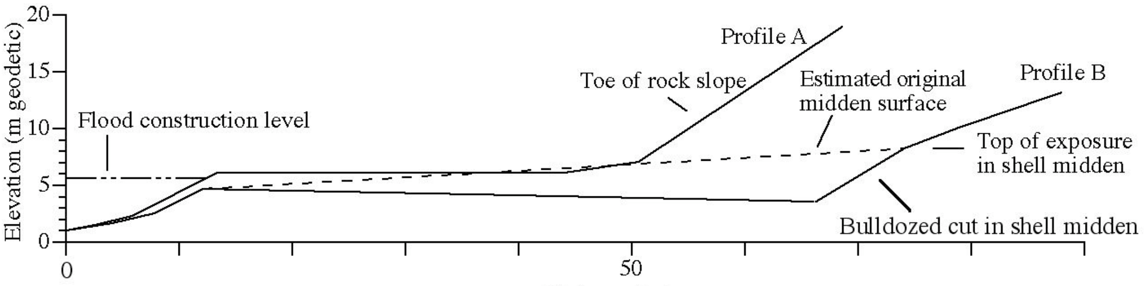

Figure 3. Topographic profiles of the village site. See Figure 2 for locations. The terrace top is 3-5 m above the predicted 200-year tide level. No vertical exaggeration.

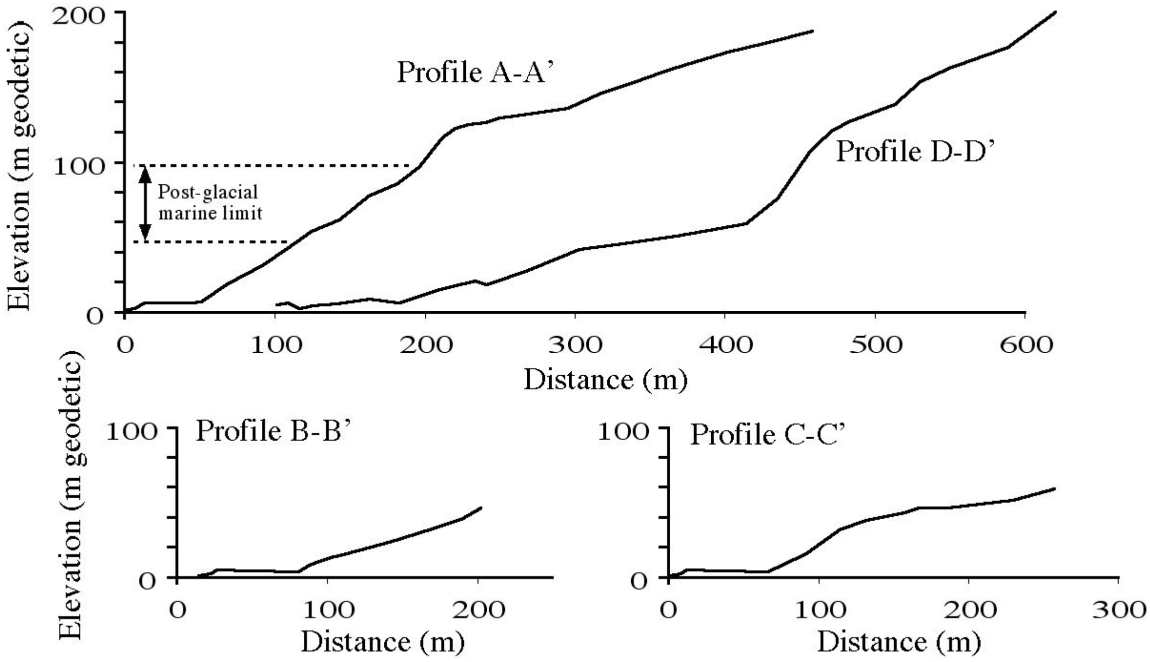

Figure 4. Topographic profiles of the hillslope behind the village site. See Figure 2 for locations. No vertical exaggeration.

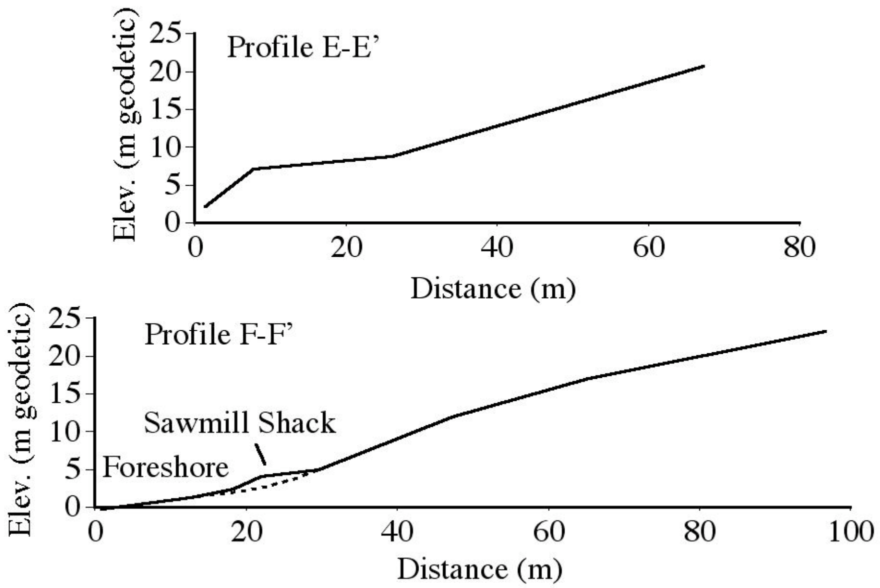

Figure 5. Topographic profiles of proposed ecotourism building sites. See Figure 2 for locations. No vertical exaggeration.

4.0 Geologic Hazard Frequency Categories

In the language of risk assessment “safe” implies an acceptable hazard level, not a complete absence of hazard or risk. Risk to life and limb, or property, results from the probability of a hazard occurrence multiplied by the consequence of the occurrence. Consequence varies with site vulnerability and duration of exposure of the elements at risk. For residential/commercial development in British Columbia, approvals for subdivision and building permits are typically based on probability of the hazard (Table 1), not on the full risk analysis.

Hazard acceptability thresholds vary for each type of hazard, and are scaled according to the damage potential: for earthquakes, the National Building Code (2005) design earthquake is that with an annual return frequency of 1/2475 years, or an occurrence probability of 2% in 50 years; for mass movement hazards, the Ministry of Transportation uses a design event with an annual return frequency of 1/475 years, or an occurrence probability of 10% in 50 years; while the design event for flooding is normally the 1/200 year return flood (MWLAP, 2004), with an occurrence probability of ~22% in 50 years. There are no existing guidelines for tsunami hazards.

In attempting to assess the hazard at a given site, where data are unavailable, quantitative hazard frequency estimates must be replaced by qualitative estimates based on expert judgment. Qualitative hazard frequency categories are presented in Table 1. Assignment of hazard frequency categories must be supported by well-reasoned argument.

Table 1. Qualitative hazard frequency categories (Source: MoE ,1999).

Qualitative frequency	Annual return frequency	Comments
Very high	>1/20	Hazard is well within the lifetime of a person or typical structure. Clear and relatively fresh signs of hazard activity are present.
High	1/100 to 1/20	Hazard could happen within the lifetime of a person or typical structure. Evidence of hazard is clearly identifiable from deposits and vegetation, but may not appear fresh.
Moderate	1/500 to 1/100	Hazard within a given lifetime is possible, but not likely. Signs of previous events may not be easily noted.
Low	1/2500 to 1/500	The hazard is of uncertain significance.
Very low	<1/2500	The occurrence of the hazard is remote.

For sites subject to specific hazards at frequencies within the acceptable hazard occurrence level, hazard mitigation is required. Mitigation may include passive measures (i.e., setbacks) or engineered structures (i.e., lift and erosion control for flooding; berms for debris flow), or other measures.

5.0 Geologic Hazards at Gwayasdums IR 1

Geologic hazards at Gwayasdums IR 1 include tides and storm surge, sea-level change, earthquakes, tsunamis and landslides. These are discussed in more detail below.

5.1 Tides and Storm Surge

Tides are produced by the gravitational forces of the sun and moon acting on the earth. In Johnstone Straight, the result is a tidal range of about 5.5-m (Table 2), with mixed-semidiurnal regime of two unequal high and low tides per day Thomson (1981). However, water levels are also affected by atmospheric pressure, tidal currents, wind and wave action, and may vary from predicted tide levels. Alert Bay, 25 km southwest, is the nearest location with a tide gauge. The gauge was operational between 1948-1978 providing a 30-year record considered representative of waters around Health Bay. Extreme monthly high water levels for the period of record were provided by Fred Stephenson (Pacific Geoscience Centre, Sydney, BC). The greatest difference between predicted and observed tides was 0.71 m on December 30, 1952; while the highest tide for the period of record was 3.05-m geodetic on November 30, 1951. An extreme value analysis, using the Gumbel distribution, indicates that the 200-year high tide would have a level of 6.11 m above chart datum, or 3.26-m above geodetic mean sea-level.

Table 2. Elevations (m) for Chart datum and Geodetic datum

	Predicted		Observed			200-year
Datum	HHWL	LLWL	High	Low	MWL	tide
Chart	5.5	0.0	5.9	-0.2	2.86	6.11
Geodetic	2.65	-2.86	3.05	-3.06	0	3.26

5.2 Relative Sea-level Change

Mean sea level is not fixed but is constantly changing. For example, analyses of tidal records from the east side of Vancouver Island (Wigen and Stephenson 1980) indicates that sea-level is falling on the order of 3 mm/yr at Campbell River, 2 mm/year at Alert Bay and 4.8 mm/yr at Port Hardy. Sea-level change is produced by the interaction of several factors including changes in the volume of water in the ocean (eustatic); crustal subsidence or rebound due to loading, such as by glaciers (isostatic); and tectonic effects, such as subduction of ocean plates beneath the continent. During deglaciation, and for several thousand years thereafter, eustatic and isostatic forces predominated (Clague et al 1982). Immediately following ice retreat in the study area, the ocean flooded the land surface to as high as 100-m above present sea level, but fell rapidly as the land rebounded due to glacial unloading. Presently tectonic forces are thought to be the dominant force driving sea-level change, causing Vancouver Island to be slowly uplifted (Emery and Aubry 1986). However, due to the effects of global warming there is expected to be a rapid eustatic rise of sea level, amounting to 45 cm by 2100 AD (Shaw et al 2001).

5.3 Earthquakes

There have been 9, Magnitude 6-7 earthquakes in southwest British Columbia and northern Washington since the late 1800s. Further, the southern British Columbia coast is located along the Cascadia subduction zone and is subject to great, or magnitude 8 or greater, earthquakes (Clague 1996). The ground motions produced during earthquakes can include sudden uplift or subsidence, surface rupture and strong shaking, and may cause building and other infrastructure damage, landslides, and tsunamis (Clague 1996; Adams and Basham 2001).

Great earthquakes have an average recurrence interval of 500-years, although the actual interval between events may vary from several hundred to a thousand years. The last great earthquake along the Cascadia subduction zone occurred about 300-years ago. The last large earthquake on Vancouver Island (M7) occurred in 1946 and resulted in hundreds of landslides and extensive building damage (Mathews 1979). The potential for a destructive earthquake is considered moderate.

According to the National Building Code (2005) seismic hazard calculation (Appendix 1), the site is located in an area potentially affected by a great earthquake. This would inflict strong ground motion, but coseismic subsidence is not expected. This is because the site is located at the extreme northern end of the Cascadia subduction zone, just north of the Nootka fault (Nootka Island), with geological evidence (Benson et al 1999) and modeling (Leonard et al 2004) indicating no coseismic subsidence north of this feature during the last great earthquake.

5.4 Tsunamis

Tsunamis are ocean waves typically produced by earthquakes or landslides. Earthquakes causing tsunamis may be local, great earthquakes or those from more distant sources in the Pacific Rim. Landslides causing tsunamis may be terrestrial landslides impacting the sea, or subaqueous landslides, such as slumps in deltaic sediments. Tsunami wave runup varies according to the source location and generating mechanism; and in the impact area, the shape of the sea floor, shape and orientation of the shoreline and other factors (Clague 2001). Tsunamis generated by great earthquakes on the Cascadia subduction zone have repeatedly destroyed low-lying native villages on the west coast of Vancouver Island (Hutchinson and McMillan 1997), with the last event about 300 years ago (Clague et al 2001). However, a tsunami from a Cascadia subduction earthquake will not likely have a large runup in Johnstone Straight because the source area is off the west coast of Vancouver Island, south of Nootka Sound, and waves will have to diffract around the northern tip of Vancouver Island before traveling south down Johnstone Straight. Modeling of tsunamis (Dunbar et al 1989) generated by distant earthquakes indicates that wave runup on the British Columbia coast varies from centimetres to 10-m. Generally runup is low on straight steep shorelines and is highest at the head of shallow, broad bays and inlets. For example, the March 27,1964 Alaska tsunami was recorded as a negative tide at Alert Bay because of wave resonance; however it caused considerable damage at the heads of numerous inlets, such as Hotsprings Cove and Port Alberni.

Earthquake induced tsunamis, typically generated at distant locations along the Pacific Rim, are relatively common phenomenon on the British Columbia coast; however, most are of small amplitude and are not noticed because runup does not exceed high tide level. Tsunamis will also be associated with great earthquakes on the Cascadia subduction zone. These have an average recurrence interval of about 500-years (Clague et al 2001). The hazard frequency of destructive tsunamis is considered moderate.

Dunbar et al (1989) did not provide runup estimates for Johnstone Straight, but the best analog to Gwayasdums IR1 is likely the Bella Bella area with modeled runup of 1.5-2.8 m. In the available literature, there is no map that indicates the potential tsunami runup hazard for the study area. The only map of this kind that I am aware of is Figure 13 in Clague (2001) showing high, moderate and low tsunami runup hazard zones for much of Vancouver Island, but Johnstone Straight is omitted. However, PEP brochures indicate Johnstone Straight is considered a tsunami hazard area, so there is a data gap for the region. Based on inference from Dunbar et al (1989), Gwayasdums IR 1 is likely to experience runup up to 3-m. This is consistent with a moderate runup hazard per Figure 13 in Clague 2001.

With the uncertainties in both the frequency and spatial variation of tsunami runup, it is not possible to provide a reliable runup prediction for all coastal sites, and in contrast to seismic design and engineering, there are no Canadian standards for the design of tsunami-resistant structures. In coastal communities in British Columbia that are vulnerable to tsunamis there is a tsunami warning system in place administered through the provincial emergency preparedness program (PEP; Alert Bay has a local coordinator). Risk reduction relies on warnings provided by the Pacific Early Warning system being broadcast to communities, with inhabitants coached to move to higher ground. This system requires ongoing education and effective communication of the warning. However, Gwayasdums IR1 is a remote site, and it is not certain that the village would receive sufficient warning (see Anderson and Gow 2004). Thus, some built in protection might be considered, such as additional freeboard added to flood construction levels of housing.

5.5 Landslides

The term landslide is used in a general sense, including processes such a slumping, debris slides, debris flows or torrents, rockfall, and rockslides. At Gwayasdums IR 1, the events of concern would include debris torrents channeled down the creek at the north end of the reserve, debris slides and rockfall from steep slopes behind the reserve, and slumps in glaciomarine mud in the gentle areas south of the village site.

With respect to debris flows, slides and rockfall hazards, the study area falls into Zone II of Guthrie and Evans (2005) classification. For this region, they report an average landslide frequency of 0.007/km^2/yr, or one slide every 142 years per square kilometer, but caution that actual failures are clustered in time and space. Typical triggers include storms with intense precipitation and wind, earthquakes and logging. Therefore, it is the spatial and temporal distribution of triggers that leads to the spatial and temporal clustering of slide activity.

Based on the writer’s experience conducting terrain stability assessments for forestry operations on the coast including Gilford Island, and supported by terrain attribute studies (Rollerson et al 1997), slopes over about 65% gradient should be considered potential debris slide areas. Thus, the steep slope behind the village site (Figure 3, 4), supporting veneers of weathered till, colluvium and organics derived from forest litter, is considered a potential slide initiation area. Slides would consist of uprooted trees and small amounts of mineral soil. Typical slide widths would be on the order of 10-30-m and slide lengths would travel to the base of slope. Slope lengths vary from 200-m on profile A-A’ to 70-m on profile D-D’. Such events could destroy a house if directly impacted.

Unfortunately, aside from the very general evaluation of Guthrie and Evans (2005), there is no data available to quantify the frequency of the slide hazard. Based on a rate of 0.007/km^2/yr, the average annual landslide frequency is 1/142; factoring in the area of the hillslope behind the village (~0.16 km^2)(including the more moderate slopes above) the annual return would be roughly one event in 900 years. This appears reasonable on the grounds that there is no evidence of landslide activity on the slope (slide scars), an indication that at least several centuries of forest revegetation have passed since the last slide. Based on this reasoning the potential landslide hazard for the steep slope behind the village is considered moderate.

There is no evidence that indicates a potential rockfall hazard exists on or below these slopes. Above the steep rock pitches the terrain breaks back to 30-60% slopes with an irregular surface expression. This upper slope terrain does not present a significant debris slide hazard to the village site.

Based on the observation that the concrete weir on the creek at the north end of the reserve is not filled with debris and remains intact, there has been no debris flow activity on the channel since the construction of the weir in the 1960s. However, the basin feeding this creek is a steep gully and the channel is a potential torrent. Therefore, the mouth of the channel is considered a moderate hazard area.

Glaciomarine sediments are potentially subject to slumping, especially on escarpment slopes and/or in areas subject to seepage. At the south end of the village site, the three small channels noted on profile D-D’ (Figure 4) have potentially unstable banks.

6.0 Aggregate Sources

No gravel or potential aggregate sources were identified on Gwayasdums IR1. There is a small stockpile of angular shot rock, produced during construction of the new water tower. The rock is located on either side of the water tower access road, and amounts to about 250 m^3. Material is between 0.5-1.5 m diameter, and could be used in seawall construction.

7.0 Conclusions and Recommendations

1. Sea-wall reconstruction should be undertaken in consultation with a qualified engineer, and the design should consider impact from normal wave activity and tsunami runup. The sea-wall is not intended to prevent flooding, only to prevent erosion, therefore it does not need to be constructed to the flood construction level. Its crest should be between predicted 200-year tide level (3.26 m geodetic) and the FCL (5.6-m geodetic).
2. The construction level for habitable space and infrastructure susceptible to damage by flooding is set by the following considerations: the estimated 200-year high tide was calculated as 3.26 m geodetic; to this should be added a freeboard accounting for storm wave runup and sea-level change. Since sea-level is falling at 2 mm/yr due to tectonic forces, and 45 cm of eustatic rise is expected in the next 100 years, 0.35 m should be added to account for sea-level change over the next 100-years; to this 2.0-m should be added for storm wave runup. This results in a minimum flood construction level of 5.6-m geodetic. Thus, the flood construction level for buildings anywhere on Gwayasdums IR1 should be set at, or above 5.6-m geodetic. The joist box, or top surface of a slab on grade, should be set at or above the designated flood construction level.

3. Tsunami runup hazard is conventionally managed on the basis of sufficient warning through the tsunami warning system in conjunction with evacuation to higher ground following receipt of the warning. This method assumes the warning will be received and that the community has a response plan in place. For Gwayasdums IR1, there is a designated person with a radio who is intended to receive and broadcast the tsunami warning throughout the community. If this person is away from the village, it is not clear that the warning will be received and effectively communicated in time. Thus there may be a weakness in the warning and response system.
4. Note that using Bella Bella as an analog site, a maximum of 3-m tsunami runup might be expected for Gwayasdums IR1. A 3.0-m tsunami runup added to maximum observed tide of 3.05-m geodetic yields a water level of 6.05-m geodetic. This is 0.4-m higher than the recommended FCL. If the village wanted to be more conservative, they could use 6.05-m geodetic as an FCL.
5. All housing and important infrastructure should be designed according to National Building Code (2005) standards for earthquake hazards considering the potential for great earthquakes.
6. In the existing village site (Polygon 1, Figure 2), foundation design needs to be based on bearing strength of shell-midden. This needs to be determined in consultation with a qualified engineer.
7. Foundations below 5.6-m geodetic should be resistant to erosion by waves overtopping the seawall. Foundation design should be determined in consultation with a qualified engineer.
8. A debris flow hazard area exists at the mouth of the creek at the north end of the village. The hazard is greatest during periods of intense wind and rainfall. A 50-m radius from the mouth of the creek should be established as the hazard area. The hazard area would include a sector extending from the base of the hillslope in the north rotating south to the existing beach-front of the village site. From there the hazard area would follow the top of bank back toward the hillslope to a line projecting perpendicular from the hillslope located 25-m south of the creek mouth. No critical infrastructure or residential housing should be established in this hazard area. It was mentioned by locals that it is a convenient place to bring a scow in to the beach. Temporary activities such as this are acceptable, but signs warning of a debris flow hazard should be posted. No temporary activities in this area should be allowed when rainfall exceeds 100 mm/24 hours.
9. The steep slope behind the village site (Polygon 2, Figure 2) presents a moderate (Table 1) debris slide hazard (see Appendix 2 for risk analysis). In the north half of the village site the downslope edge of the polygon borders the village, but at UTM location east 669512-m, north 5618794-m ±10-m the toe of the rock slope trends upslope away from the south half of the village. Slides consisting mostly of uprooted trees could impact the base of slope and could severely damage or destroy a building. The best way to prevent risk to life, limb or property is to define a setback from the foot of slope. For residential housing foot-slope setbacks are typically 50-m. However, since the village terrace is only 40-135 m wide, a setback of this distance would overly restrict development of the village site. Buildings *not* for institutional, assembly, commercial or residential uses could be sited between 20-50 m from the base of slope, consistent with the location of the existing power-house (containing

diesel generators), located at the base of slope in the north part of the village. In this instance, signs should be placed in the buildings to warn operations staff of the potential hazard, and buildings should be evacuated when rainfall exceeds 100 mm/24 hours. Buildings for institutional, assembly, commercial or residential uses should be sited at least 50 m from the base of the steep rock slope defined by Polygon 2 (Figure 2).

10. In areas south of the village site (Polygon 3, Figure 2), the terrain is gentle but there are some siting constraints. In the areas between the south end of the village and the existing dump there are three small creeks incised in glaciomarine mud. In this area proposed building sites need to be field verified to ensure they do not encroach on unstable creek sidewalls, and foundation design will need to be based on the bearing strength of marine clay. This needs to be determined in consultation with a qualified engineer. Elsewhere in Polygon 3, building sites should be located on well-drained soils. Rock or marine clay may be encountered, and foundation design needs to be determined in consultation with a qualified engineer.
11. No aggregate resources were identified on Gwayasdums IR1. Aggregate for concrete will have to barged in or shot rock from local rock outcrops could be crushed. Shot rock from local rock outcrops could be used for sea-wall construction.
12. The village is situated on an archaeological resource. Since the village is under federal jurisdiction it is not subject to provincial legislation protecting archaeological sites. The midden is highly disturbed, but there are zones that could yield valuable information on the cultural history of the site. The village council may want to consider archaeological investigations as part of their village revitalization process.
13. The existing dump location is in the watershed of a small creek that drains directly onto the village beach. To reduce beach contamination, the location of the dump should be reconsidered.
14. Hazard area setbacks and flood construction levels at Gwayasdums IR1 will have to be established in the field according to the recommendations herein by a qualified surveyor.

8.0 References

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9.0 Caveat

This report was prepared for use by for Ecoplan International Inc., including distribution as required for purposes for which the report was commissioned. The work has been carried out in accordance with generally accepted geoscience practice. Judgment has been applied in developing the conclusions stated herein. No other warranty is made, either expressed or implied to our clients, third parties, and any regulatory agencies affected by the conclusions.

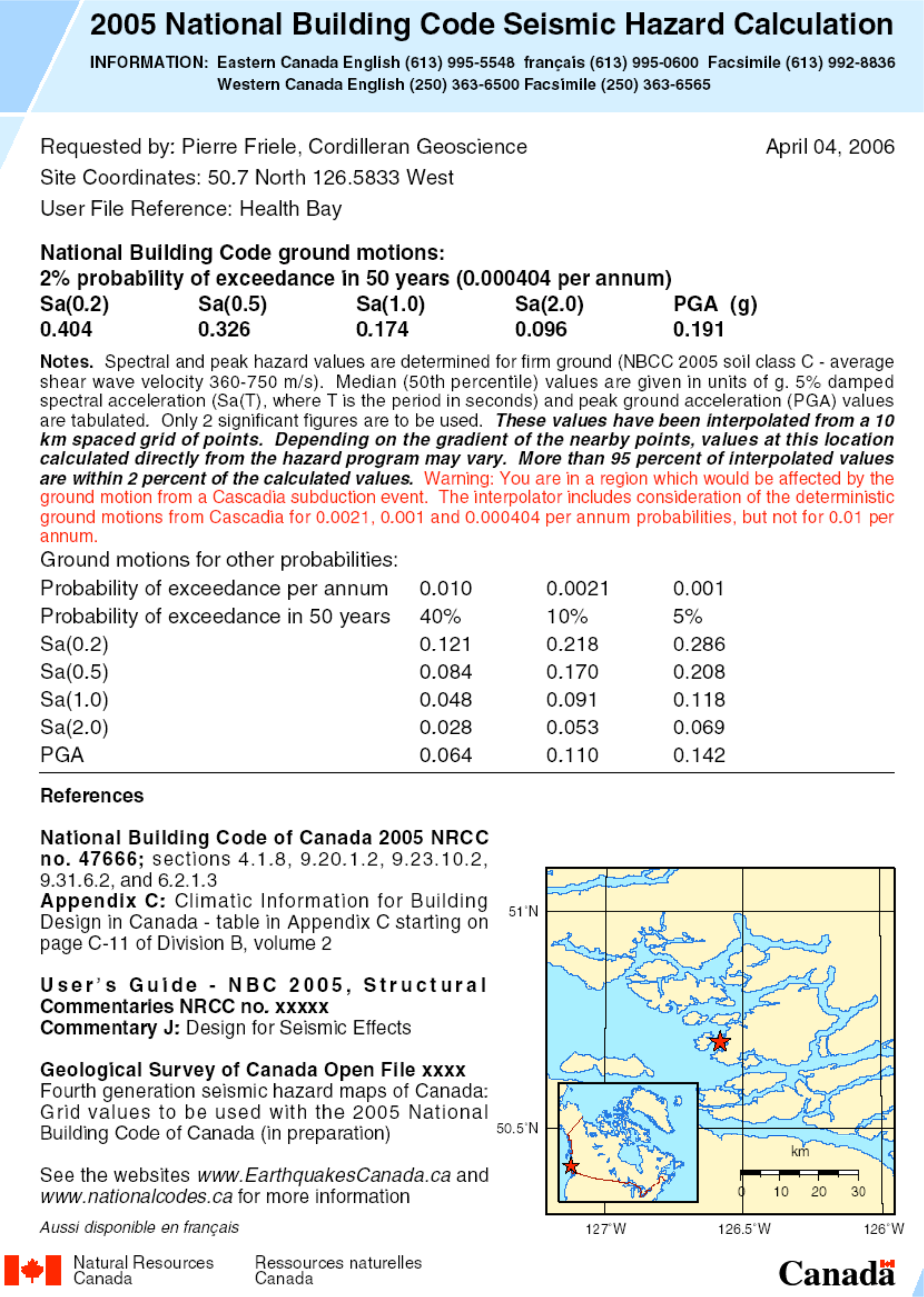
Should you have any questions please call.

Pierre Friele

P.A.M. FRIELE

Professional Geoscientist

Appendix 1



2005 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: Pierre Friele, Cordilleran Geoscience — April 04, 2006

Site Coordinates: 50.7 North 126.5833 West

User File Reference: Health Bay

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.404	0.326	0.174	0.096	0.191

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2005 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.*** Warning: You are in a region which would be affected by the ground motion from a Cascadia subduction event. The interpolator includes consideration of the deterministic ground motions from Cascadia for 0.0021, 0.001 and 0.000404 per annum probabilities, but not for 0.01 per annum.

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.121	0.218	0.286
Sa(0.5)	0.084	0.170	0.208
Sa(1.0)	0.048	0.091	0.118
Sa(2.0)	0.028	0.053	0.069
PGA	0.064	0.110	0.142

References

National Building Code of Canada 2005 NRCC no. 47666; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2005, Structural Commentaries NRCC no. xxxxx
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Grid values to be used with the 2005 National Building Code of Canada (in preparation)

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français

Natural Resources Canada — Ressources naturelles Canada

Canada

Appendix 2

Slope Hazard and Risk Calculations used to justify 50-m setback

Appendix 3 contains a section from the recent (March/06) landslide hazard/risk assessment guidelines issued by Association of Professional Engineers and Geoscientists (APEGBC) (Appendix 3) outlining the legislative background for landslide hazard/risk assessment. Essentially, there is no unifying landslide hazard legislation in British Columbia or Canada, just bits and pieces of legal precedent and legislation. Further, hazard acceptability standards may vary by jurisdiction.

In the appendix to the guidelines the following observation is made, which may have significant bearing on what Ecoplan and the Band decide to do in this case:

> "*Levels of landslide safety* are determined by society, not individuals. Therefore, for *residential development*, the levels must be established and adopted by the local or provincial government after consideration of a range of societal values. Some *Land Owners* may feel a government adopted *level of landslide safety* is too high, while others are willing to live with an unacceptable' *level of landslide safety*. A *Qualified Professional* should not be expected to establish a *level of landslide safety*, although he/she may provide a useful role in advising the local or provincial government that wishes to do so."

In light of the above discussion, the material presented herein attempts to clarify landslide hazard and risk, and justifies measures of avoidance, but ultimately the decision is with the Approving Officer/Agency for the Band, or the Band itself. It is the geoscientist's job to ensure they make a well-informed choice, recognizing they are deciding not for themselves but for future generations.

Hazard and Risk Assessment

With respect to the hazard and risk. Historically in British Columbia, land use decisions regarding geologic hazards considered hazard frequency only, not a full consideration of hazard and consequence to produce a quantitative risk analyses (Fell et al 2005). Therefore in the main report only the hazard level is discussed. However, a full risk analysis is presented here to clarify the issues.

Recently, following a landslide resulting in destruction of a house and one death in North Vancouver, a new precedent was set in landslide risk management in British Columbia. In that case a quantitative risk analysis was conducted (Bruce Geotechnical 2006) and was adopted by the District of North Vancouver. In the report, the thresholds for tolerable individual risk are 10^{-4}/annum for existing development and 10^{-5}/annum for new development. The 10^{-5}/annum threshold is rather onerous, as will become clear below.

A quantitative risk calculation can be presented as

$$P_{(LOL)} = P_{(L)} \text{ x } P_{(T:L)} \text{ x } P_{(S:T)} \text{ x } V_{(D:T)}$$

Where

$P_{(LOL)}$ is the probability of loss of life
$P_{(L)}$ is the frequency of landsliding (Table 1)
$P_{(T:L)}$ is the probability of the landslide reaching the element at risk
$P_{(S:T)}$ is the temporal probability of the element at risk
$V_{(D:T)}$ is the vulnerability of the person to the landslide event.

Values for the terms of the risk calculation will be explored in further detail below.

Slide Prone Terrain

Slide prone terrain is well characterized in the region (Rollerson et al. 1997; and others). Slope is the primary factor governing potential instability. Typically there is a marked increase in landslide density on slopes exceeding 60%. Other factors correlated with higher densities include uniform open or gullied slopes, south southeast to west northwest aspect, veneers of till and colluvium, and other factors. The area identified above the village has till veneer on uniform slopes of 60-80%, with west aspect, and meets the criteria for slide prone terrain.

Landslide Hazard Frequency: $P_{(L)}$

Normally for coastal terrain attribute studies (e.g., Rollerson et al 1997) there is no data available on landslide frequency, only density, so it is not possible to state a true frequency (i.e., landslides/year). However, in the forest industry, terrain steeper than 60-70% is considered to have a moderate (Table 1) potential for post-logging failure. Recently Guthrie and Evans (2005) presented a paper, based on time series analyses of air photos, indicating landslide frequencies for different regions of Vancouver Island. As indicated in the April 24/06 report, the landslide frequency for the Gilford area would be 1/143 per year/km^2. This value confirms the moderate hazard conventionally assumed for landslide prone terrain. Since there is no evidence of landslide scars on the slope behind the village, we can assume that there have been no slides for several centuries, and farther south along the slope, there have been no post-logging slides. Thus, the landslide frequency may be somewhat lower than 1/143/annum, say as low as 1/1000.

Table 1. Qualitative hazard frequency categories.

Qualitative frequency	Annual return frequency	Comments
Very high	>1/20	Hazard is well within the lifetime of a person or typical structure. Clear and relatively fresh signs of hazard activity are present.
High	1/100 to 1/20	Hazard could happen within the lifetime of a person or typical structure. Evidence of hazard is clearly identifiable from deposits and vegetation, but may not appear fresh.
Moderate	1/500 to 1/100	Hazard within a given lifetime is possible, but not likely. Signs of previous events may not be easily noted.
Low	1/2500 to 1/500	The hazard is of uncertain significance.
Very low	<1/2500	The occurrence of the hazard is remote.

Landslide travel and setback from the foot of slope: $P_{(T:L)}$

Assessment of landslide travel or runout for shallow hillslope slides and debris flows has been studied by a number of authors in coastal BC. Fannin and Rollerson (1996) differentiated between open slope (Type 1), gullied types (Type 2) and single versus multiple landslide types. At Gwayasdums, the concern is Type 1 slides. For a population of 158 open slope slides on the Queen Charlotte Islands, Fannin and Rollerson (1996) report a mean landslide slope length of 122 ± 99 m, with a mean runout on the deposition zone (slopes <27%) of 40±31 m.

Another method is to assess the landslide travel angle, which is defined as the angle from the top of the start zone to the toe of the deposit. Snow avalanches and landslides typically have travel angles between 36-51%.

To develop a data set specific to the class of slides of concern at Gwayasdums IR 1 (coarse woody debris slides on veneers over rock), I collected a sample of seven slides from a coastal area near Bella Bella (Figure 1; Photos 1-3).

Start angles, distance and angle of the runout zone, travel angle and other statistics from this sample are reported in Table 2. Slides typically start on slopes >65%, but sometimes as low as 50%. Excluding slides that became channelised (Type 2), the distance of the deposition zone (slopes <27%) ranged from 18-226 m, with a mean of 94±82; the mean travel angle was 44±4%. Based on slide length, the slides most akin to potential slides at Gwayasdums would be examples E & F (Figure 1). These had runout in the deposition zone of 18-40 m, widths of 10-40 m, and travel angles of 40-42%. The steepest travel angle in the population was about 50%.

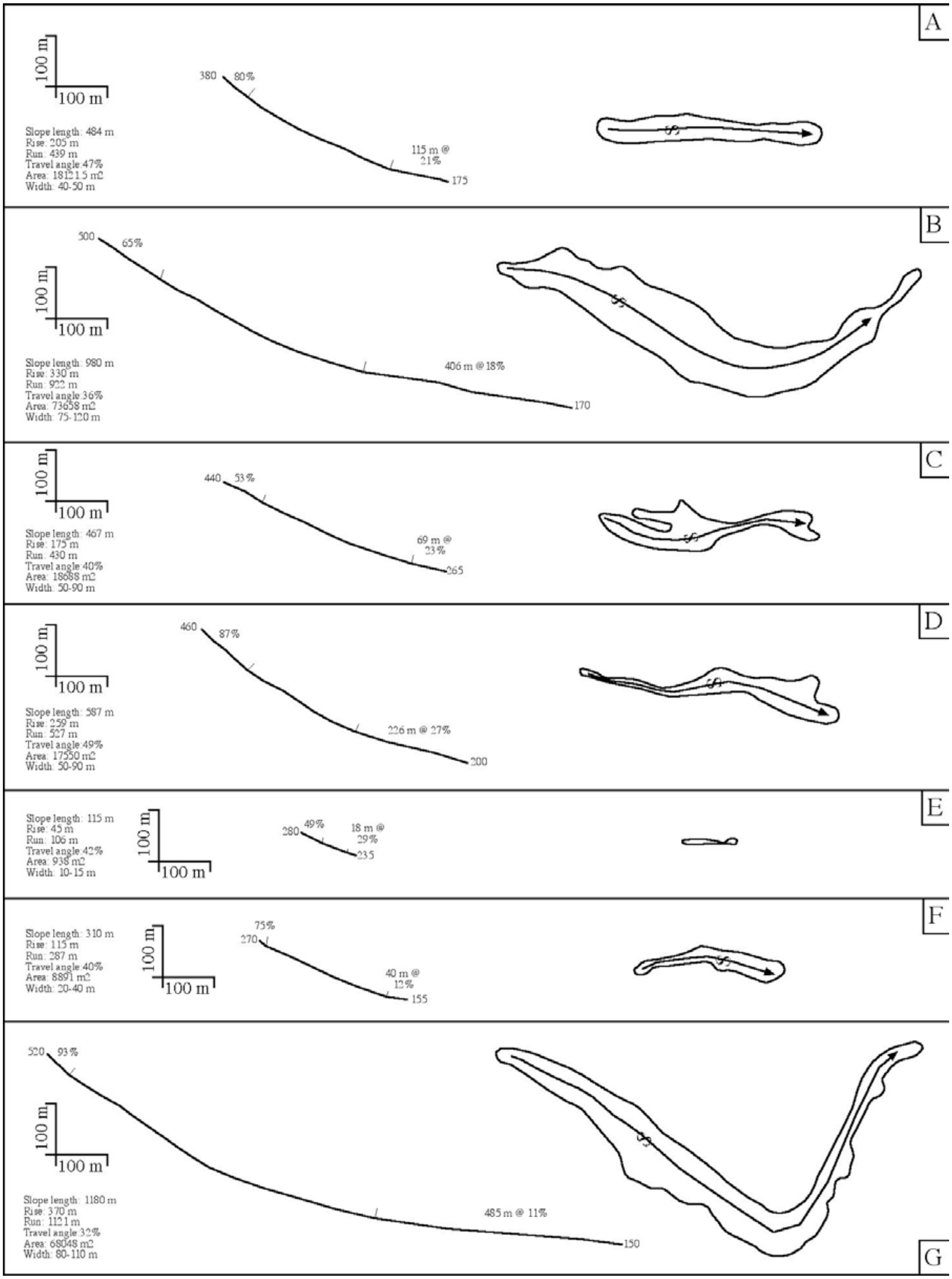


Figure 1. Snass Lake, Spiller channel, coarse woody debris slides on surficial veneer over rock.

Table 2. Statistics of a sample of coarse woody debris slides on surficial veneer over rock.

		Slope	Start	Deposition zone		Travel
Slide	Width	Distance	Angle	Distance	Angle	Angle
	(m)	(m)	(%)	(m)	(%)	(%)
A	40-50	484	80	115	21	47
[1]B	75-120	980	65	406	18	36
C	50-90	467	53	69	23	40
D	50-90	587	87	226	27	49
E	10-15	115	49	18	29	42
F	20-40	310	75	40	12	40
[1]G	80-110	1180	93	485	11	32
[2]Mean			69	94	22	44
[2]Std. Dev.			17	82	7	4

1. Slides became channelised (e.g., Type 2, Fannin and Rollerson 1996).
2. Excluding Type 2 slides.

Applying these travel angles (41-50%) to the slope profile (A-A') surveyed at Gwayasdums IR 1, assuming slides starting from the top of slope, then the angle's intercept at the base of slope defines potential runout area extending 50-100 m from the toe of slope (Figure 2). Locations within the 50-m setback have a high probability of landslide impact, while sites beyond the 50-m setback have a moderate to low probability of landslide impact.

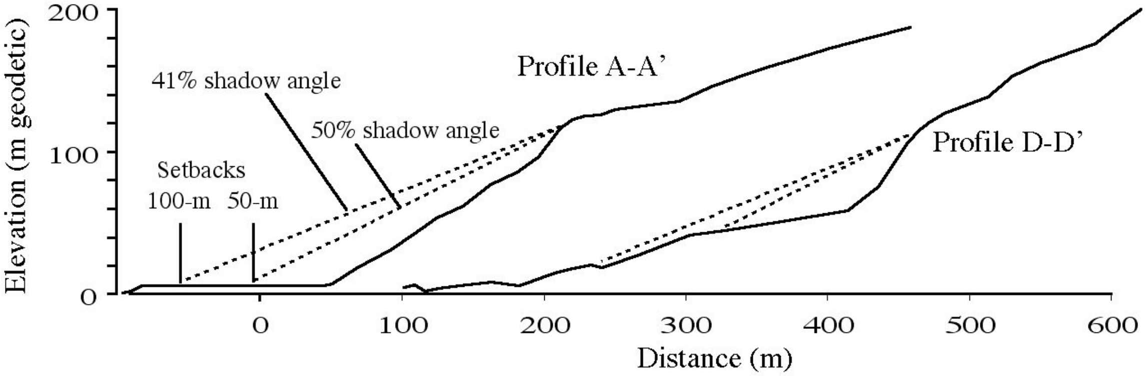


Figure 2. Landslide travel angles applied to slopes behind Gwayasdums. See April 24 report for locations of survey transects.

Temporal Probability of Element at Risk: $P_{(S:T)}$

This value is difficult to estimate without input from band members. Yet, assuming these are permanent residences, I will assume homes are occupied except for time people are away at work (10 hrs). This yields a probability of 0.6.

Vulnerability of Element at Risk: $V_{(D:T)}$

A coarse woody debris slide consists of a mass of 20-40 m long logs and other debris sliding down a steep slope at high velocity, on the order of 10-30 m/s (36-108 km/hr).

The width of the impact zone will be 20-40 m wide. Any conventionally built building directly impacted (i.e., within 50-m from foot of slope) by such a slide would be destroyed. Structures farther from the foot of slope would receive indirect impact and would be severely damaged. Persons in homes directly impacted by a slide will likely be killed, and vulnerability of death is 1.0. For those homes outside the 50-m setback, a vulnerability of 0.5 is assumed.

Probability of Loss of Life: $P_{(LOL)}$

Based on the above discussion, the probability of loss of life is explored using a risk matrix (Table 3). In the matrix the independent variables range as such:

$P_{(L)}$	would be in the range 1/143 per annum (Guthrie and Evans 2005) to something somewhat lower, say 1/1000 per annum, or moderate to low (Table 1);
$P_{(T:L)}$	for houses situated close to the base of slope (within 50-m) would be 1.0; for houses farther away the value is assumed to be 0.5;
$P_{(S:T)}$	is possibly 0.6 (the band would have to debate this value);
$V_{(D:T)}$	is 1.0 for homes within the 50-m, and 0.5 or less for those outside 50-m.

Table 3. Risk of loss of life, $P_{(LOL)}$ for residential structures with different estimates of $P_{(L)}$, $P_{(T:L)}$, and $V_{(D:T)}$. Red indicates unacceptable hazard, green indicates acceptable hazard, based on a tolerable risk threshold for individual loss of life of 10^{-4}.

Return interval					Risk (per annum)	
(yrs)	$P_{(L)}$	$P_{(T:L)}$	$P_{(S:T)}$	$V_{(D:T)}$	$P_{(LOL)}$	$1/P_{(LOL)}$
143	0.0070	**1.0**	0.6	1.00	**0.00420**	**238**
143	0.0070	0.5	0.6	0.50	**0.00105**	**953**
143	0.0070	0.5	0.6	0.25	**0.00052**	**1907**
143	0.0070	0.5	0.6	0.10	**0.00021**	**4767**
300	0.0033	**1.0**	0.6	1.00	**0.00200**	**500**
300	0.0033	0.5	0.6	0.50	**0.00050**	**2000**
300	0.0033	0.5	0.6	0.25	**0.00025**	**4000**
300	0.0033	0.5	0.6	0.10	**0.00010**	**10000**
1000	0.0010	**1.0**	0.6	1.00	**0.00060**	**1667**
1000	0.0010	0.5	0.6	0.50	**0.00015**	**6667**
1000	0.0010	0.5	0.6	0.33	**0.00010**	**10101**
1000	0.0010	0.5	0.6	0.25	**0.00008**	**13333**
1000	0.0010	0.5	0.6	0.10	**0.00003**	**33333**

Based on this analysis the following conclusions are drawn:

- The probability of loss of life is in the unacceptable range ($>1x10^{-4}$/annum, red) for landslide frequencies > 1/300 per annum, and with houses within the 50-m setback, and with individual vulnerability of 0.25 or greater;
- The probability of loss of life is in the acceptable range ($<1x10^{-4}$/annum, green) for landslide frequencies < 1/300 per annum, when houses are located outside the 50-m setback line, and when individual vulnerability is assumed to be 0.33 or less.

Since no landslide scars are visible in the unlogged or logged parts of the hillslope above the village, a landslide frequency between 1/300-1/1000 is a reasonable assumption. For houses outside the 50-m setback, a 30% chance of death, or less, given an indirect landslide impact also seems to be a reasonable assumption. Note that this example serves to illustrate the hazard and risk, but independent variables may be altered according to judgment. For example, the band may have a better feel for temporal probability (the time residences are occupied). Further, for buildings used for institutional, assembly, or commercial uses, risk could be managed by limiting occupancy during high hazard periods (i.e., storms). However, this may not be feasible.

Conclusion: Choice of a Setback Distance

Choosing the appropriate setback distance is a matter of judgment, supported by empirical data, such as presented above. The existing Gwayasdums village site has limited space for development, so the choice of a setback distance is critical: and a balance must be sought between safety and development. On reflection and review, it is clear that a 20-m setback is not tenable. A 50-m setback is an acceptable balance between what the above analyses indicates is a possible runout, a consideration of factors contributing to total risk, and the concerns about limited building space.

My justification is made on these grounds:

- For open slope slides, a report from the literature indicates slide runout of 40±30 m (at 1 stdev), while my own observations suggest a greater range (18-225 m), with slides most like those expected a Gwayasdums with runouts of 20-40 m.
- Using the travel angle method, slide travel of 50-100 m from the base of slope is also suggested.
- For a growing site consisting of shallow soils on steep rock, typical tree heights on Gilford Island are between 20-30 m for moderate growing sites, and 30-40 m for slightly better sites (Dave Wolfe, Area Forester, Interfor, Campbell River, pers comm.). Thus, slides stopping immediately at the toe of slope could throw trees out 40 m from the toe.
- Since the base of slope is flat, slides would likely loose momentum and stop quickly, thus suggesting a minimum 50-m setback might be acceptable.
- In the final analyses, 50-m was considered a good balance between landslide hazard and land use desires.

Note that hazard area setbacks at Gwayasdums IR1 will have to be established in the field by a qualified surveyor.

Other Risk Mitigation Options

Passive mitigation is preferred. However, reinforced walls, berms or other engineered solutions are possible. These require engineering advice. Also, as suggested in the April 24/06 report, signage and evacuation of buildings during high hazard periods is also a useful risk management measure for specific situations.

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Caveat

This report was prepared for use by for Ecoplan International Inc., including distribution as required for purposes for which the report was commissioned. The work has been carried out in accordance with generally accepted geoscience practice. Judgment has been applied in developing the conclusions stated herein. No other warranty is made, either expressed or implied to our clients, third parties, and any regulatory agencies affected by the conclusions.

Note, this letter is meant as an addendum to the April 24/06 report. Detail supporting this document will be found therein, as will more extensive conclusions and recommendations.

Should you have any questions please call.

Pierre Friele

P.A.M. FRIELE

Professional Geoscientist

Photos

Photo 1. Slide A on Figure 1.

Photo 2. Slides B (right) and C (left) on Figure 1.

Photo 3. Slide D on Figure 1.

Appendix 3

REVIEW OF LEVELS OF LANDSLIDE SAFETY

As used in these Guidelines, the term *level of landslide safety* includes levels of acceptable *landslide hazard* and *landslide risk*. *Levels of landslide safety* are determined by society, not individuals. Therefore, for *residential development*, the levels must be established and adopted by the local or provincial government after consideration of a range of societal values. Some *Land Owners* may feel a government adopted *level of landslide safety* is too high, while others are willing to live with an 'unacceptable' *level of landslide safety*. A *Qualified Professional* should not be expected to establish a *level of landslide safety*, although he/she may provide a useful role in advising the local or provincial government that wishes to do so. The following sub-sections briefly review some aspects of *levels of landslide safety* in British Columbia and nationally.

C.1 BRITISH COLUMBIA

This is not a thorough review of provincial and regional *levels of landslide safety*. If they exist, the *Qualified Professional* should obtain the current adopted *level of landslide safety* in the approving jurisdiction. The *Qualified Professional* should not assume that a *level of landslide safety* in one jurisdiction is applicable to another.

In British Columbia, the only province-wide adopted *level of landslide safety* is the statement "that the land may be used safely for the use intended" associated with the Land Title Act (Section 86) for subdivision approvals, the Community Charter (Section 56) for building permits and the *Local Government* Act (Section 910) for flood plain bylaw exemption. Although the statement has been included in various pieces of provincial legislation for over 30 years, the word 'safely' has never been defined.

For flood plain variances, the "Flood Hazard Area Land Use Management Guidelines" (Ministry of Water, Land and Air Protection, 2004), associated with the *Local Government* Act (Section 910(3)(a)), states that a *Qualified Professional* must indicate "that development may safely occur." The word 'safely' is not defined.

What is considered 'safe' in one jurisdiction may not be considered 'safe' in another. What is considered 'safe' at one point in time may not be considered 'safe' at another. What is considered 'safe' to one *Qualified Professional*, one *Client* or one *Approving Authority* may not be 'safe' to another. In addition, the term 'safe' can imply a total absence of hazard or risk, which is seldom the case.

The current edition of the BC Building Code (1998) and the edition in preparation (as of February 2006) does not mention *landslide* safety for buildings. It states only "Where a foundation is to rest on, in or near sloping ground, this particular condition shall be provided for in the design" (Section 4.2.4.7).

In 1973, BC Supreme Court Justice Thomas Berger ruled that the possibility of a major *landslide* between Squamish and Whistler was unacceptable to a proposed *residential development*. He based his judgment, in part, on a return period of 10,000 years for a major *landslide* (Berger 1973). The Berger ruling set a precedent of a *level of landslide safety* at an annual probability of less than 0.0001 for a major *landslide* affecting a *residential development*.

Sometime between 1978 and 1993 the *BC Ministry of Transportation* (*MOT*) began to ask *Qualified Professionals* who carry out *landslide assessments* for proposed subdivisions "to think in terms of a 10% probability in 50 years" (approximately equivalent to an annual probability of 1:475, or approximately 1:500, or a return period of 500 years or 0.002) (*MOT* 1993)[14].

MOT's web-based "Guide to Rural Subdivision Approval" (*MOT* 2005, Section 2.3.1.07) states that a *Professional Engineer* (a *Professional Geoscientist* is not included in this document, but is included in the governing Land Title Act) should:

- determine if there is a hazard
- determine extent of any hazard
- identify building sites free from hazard, or when risk could be rendered acceptable.

The *MOT* guide does not provide a *level of landslide safety* other than the phrase "free from hazard," which as noted previously is seldom the case.

In the 1990s, what is presently the Fraser Valley Regional District published *levels of landslide safety* for that *Regional District* for various types of natural hazards for a range of *residential development* (Cave 1992a, revised 1993). These *levels of landslide safety*, which are current today, were based on:

- Mr. Justice Thomas Berger's 1973 unacceptable *landslide* return period of 10,000 years for a proposed subdivision
- the 200-year return period for provincially sponsored flood-proofing[15], and
- the *MOT's* 1993 guideline of 10% probability in 50 years.

In 1999, the Regional District of Fraser-Fort George adopted a *level of landslide safety* similar to *MOT's* 1993 guideline.

C.2 CANADA

There is no nationally adopted *level of landslide safety*.

The National Building Code of Canada 2005 (NRCC 2005) provides nothing beyond the BC Building Code statement "Where a foundation is to rest on, in or near sloping ground, this particular condition shall be provided for in the design."

The Canadian Foundation Engineering Manual (Canadian Geotechnical Society ((CGS), 2006) is a companion document to the National Building Code of Canada 2005. Although the document emphasizes foundation engineering, not *landslides*, it contains several references to *landslides*:

- the possibility of *landslides* should always be considered, and it is best to avoid building in a *landslide* area or potential *landslide* area, and …