Southern Urban Containment Boundary Prefeasibility Study: Final Report

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

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Executive Summary

A pre-feasibility study scopes out the future urban land development potential of a defined area (**See Figure 1**). It identifies the natural values present, the general development suitability for different land uses, along with the opportunities, constraints and technical challenges the City of Whitehorse must consider. The report also provides a high level overview to facilitate discussion during the upcoming review of the Official Community Plan on where the City should focus next after Whistle Bend is built-out. This area is one of the options available.

A key tenet of sustainable urban development is the pursuit of a compact urban form. Densification reduces the urban footprint and promotes efficient service deliver including the viability of, alternative transportation modes, allowing more land to be retained in its natural state and/or utilized for parks and recreation. The City identified two broad Urban Containment Boundary (UCB) study areas in the 2010 Official Community Plan (OCP).

This report examines the viability of new residential development in an area south of Copper Ridge known as the Southern Urban Containment Boundary (SUCB) study area.

Highlights

- Urban service level feasible; on-site costs $439.3M ($985,000/ha) + off-site costs $111.4M = $551M (2016)
- Gross area 792.3ha - 49ha unsuitable (6%) = 743.3ha of which 452ha (61%) have no constraints, 170ha (23%) may encounter near surface bedrock and 122.3ha (16.5%) could be reused by reclaiming Lobird sewage lagoons and McLean Lake quarries once mined out.
- Net useable area 446ha (56%) @ 16units/ha = 7,136 units and 16,000 people @2persons/unit which is equivalent to an existing low density subdivision like Copper Ridge.
- Minimum recovery cost $76,456/unit at 16 units/ha
- Key to densification – increase ratio of high to low density housing units. Double density consumes half land area for same population/unit yield while reducing minimum recovery cost threshold and providing more flexibility to accommodate other values present
- Key issues – near surface bedrock, integration of private land (Lobird/KDFN/country residential properties), McLean Lake Regional Park and estimated McLean Lake area quarry life.

The gross SUCB study area is just under 800 ha in size and is located west of the Alaska Highway immediately south of the Copper Ridge subdivision. The Logan-Arkell wetland comprises the western boundary while Canyon Creek (and Canyon Crescent subdivision) is the southern limit.

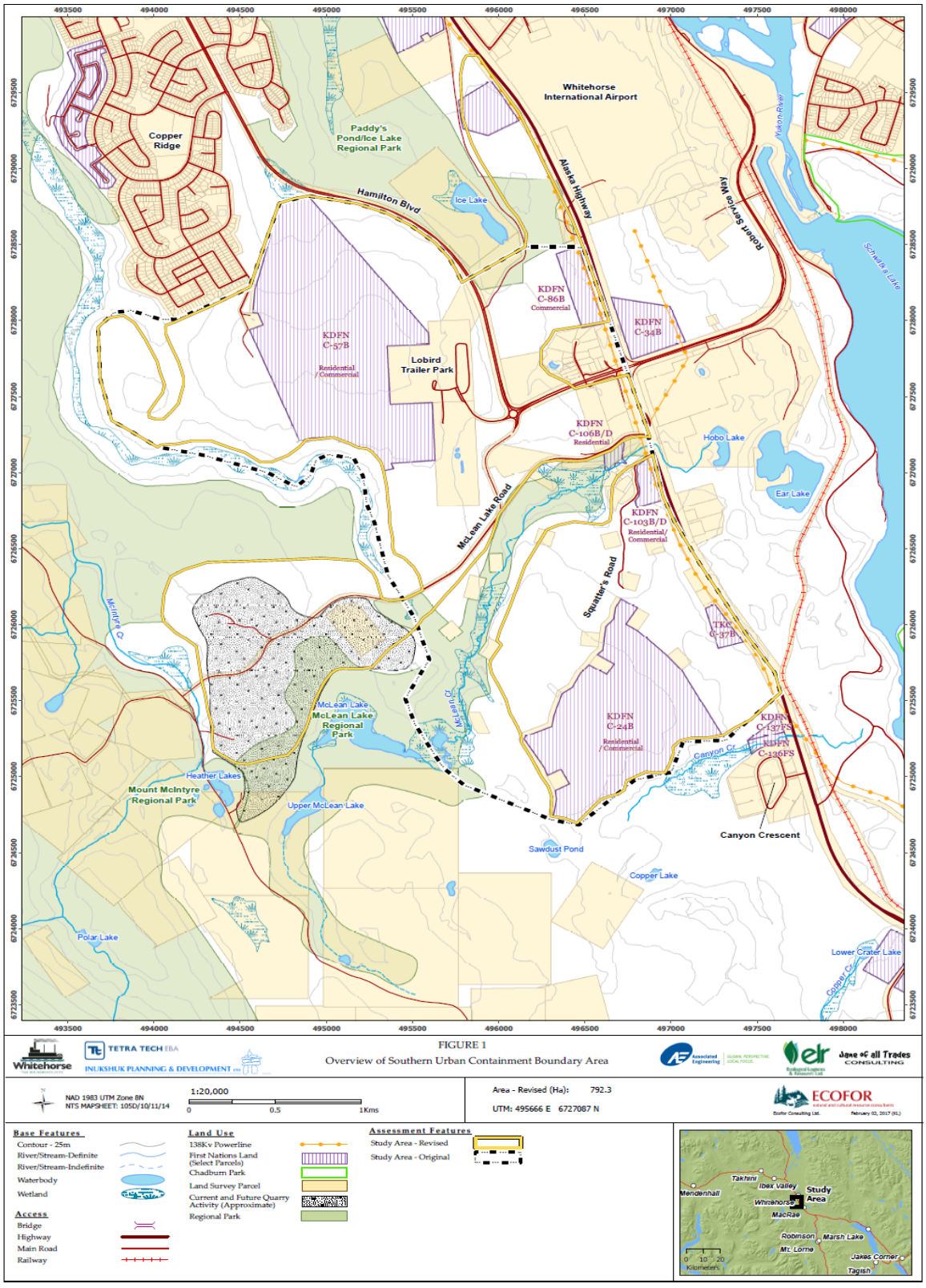

Figure 1: Overview of Southern Urban Containment Boundary Area

The objective of the resulting pre-feasibility study was to determine the SUCB area's general suitability for urban development based on discipline-specific investigation and analysis of:

- Geotechnical and terrain considerations;
- Hydrogeological conditions;
- Ecological/environmental values, including fisheries and wildlife considerations;
- Heritage and cultural values present;
- Recreational uses and values;
- Infrastructure and engineering issues, including transportation, communications, water distribution, and waste water collection;
- Servicing constraints and costs; and,
- General stakeholder issues and interests.

The project team drew heavily from previous investigations and supplemented existing data with targeted fieldwork to arrive at a high-level identification of development issues, opportunities, and constraints sufficient to inform a determination of development feasibility at a broad scale.

Land Ownership

Much of the area is undeveloped Commissioner's land. There are a number of private land holdings, including:

- Kwanlin Dun First Nation (KDFN) Type 2 settlement parcels C-57B, C-24B and C-103B/D (zoned for residential/commercial use), C-106B/D (zoned for residential use) and C-86B (zoned for commercial use);
- Ta'an Kwäch'än Council (TKC) Category B-C lands C-37B;
- The privately owned Lobird subdivision/mobile home park;
- Approximately 20 private titled residential properties accessed from Squatter's Road and/or McLean Lake Road; and,
- Approximately 20 private commercial-residential properties immediately northwest of the Alaska Highway and Hamilton Boulevard intersection, collectively called the Yukon Gardens Business Park.

Surficial Geology & Drainage

Surficial geology mapping in the SUCB shows sediments to be primarily sandy silt or silty sand morainal till deposits with cobbles and boulders throughout. Test pits and mapping have also identified discontinuous permafrost in some areas where low-lying and poorly drained soils have led to an accumulation of organic soil and significant thicknesses of organic root mat.

The thickness of the surficial sedimentary cover is highly variable with shallow bedrock and surface exposures found throughout the area. The general terrain is highly variable.

A preliminary geophysical investigation of the SUCB area utilizing ground penetrating radar (GPR) determined that about 69% of the infill area immediately south of Copper Ridge may have

bedrock at a minimum 2.0m depth, with the remainder likely having bedrock at 2.0m or less below grade. About 75% of the expansion area around McLean Lake is predicted to have bedrock at a minimum 2.0m depth, with the remainder likely having bedrock at 2.0m or less.

The overall regional groundwater flow and discharge is east towards the Yukon River; however, complex topography in the SUCB means there are local groundwater discharge areas south of the Lobird mobile home park and around McLean and Canyon creeks. Shallow groundwater is expected to occur where topographic troughs and subsurface conditions (such as low hydraulic conductivity bedrock or silt) are present. The anticipated presence of shallow bedrock adds complexity and will increase development cost. There are two site-specific challenges located in the SUCB: the Lobird sewage lagoon and McLean Lake/ Creek watershed.

Highlights

- Presence of near surface bedrock increases development cost and servicing complexity;
- Full extent of shallow bedrock unknown; and,
- Local groundwater discharge concerns south of Lobird and in McLean and Canyon Creek drainages.

Environment & Wildlife Considerations

The key environmental considerations for the SUCB are:

- Environmentally sensitive areas are found in the McLean Creek/Lake drainage, the Logan-Arkell wetland which is part of the McIntyre Creek watershed system, a spruce bog found adjacent to the Copper Ridge subdivision, and the Canyon Creek drainage;
- More than 20 mammal species and an estimated 78 species of birds potentially occur in the area; however, no Wildlife Key Areas overlap with the SUCB boundaries;
- The McLean Creek corridor and its associated wetlands support a greater diversity of wildlife species and habitats than most other areas within the study area;
- McLean Creek does not function as a good wildlife movement corridor because of the poor habitat connectivity at the eastern, downstream end of the creek at the Alaska Highway. In contrast, wildlife habitat connectivity is good along the western boundary of the SUCB; and,
- The existing residential, commercial and recreational activities in and around McLean Lake and McLean Creek also act as a deterrent to use by larger mammal species.

Highlights

Two species of birds listed under the federal *Species at Risk Act* are known to occur in the SUCB. They are:

- Rusty Blackbird; and,
- Bank Swallow.

Culture & Heritage Resource Potential

A GIS analysis identified more than 100 discrete areas of high heritage resource potential within the SUCB; totaling 70.82 ha (8.2% of the study area).

Old growth forest (defined as trees greater than 70 years old) makes up 343ha or 40% of the study area. There is also a correlation between the presence of old growth forest and the potential for culturally modified trees (CMTs). Other findings of note include:

- Fourteen archaeological sites with Borden numbers have been recorded within the study area, as well as nine located just outside of it; and,
- Seven Historic Period sites are recorded in the Yukon Historic Sites Inventory (YHSI) in this area and three more have been recorded immediately adjacent to it.

Trails & Recreation Use

Trails are the predominant recreational resource within the SUCB study area. Numerous trails have been designated and adopted by the City, including the motorized multi-use TransCanada Trail (TCT) connector that runs from Copper Ridge over to the Copper Haul Road and various non-motorized singletrack trails south of Copper Ridge frequently used and highly valued by walkers, runners, and mountain bikers:

- The "Rock Gardens", a granite canyon located east of Hamilton Boulevard, is a well-used climbing crag that acts as a venue for both instruction and organized events;
- The McLean Lake area trails are predominantly double-track and attract only local use; and,
- Fish stocking efforts in the 1950s and 1960s in McLean Lake have resulted in a naturally reproducing population of rainbow trout; current use is low to moderate and some have observed a significant decrease in visitation since the TCT connector was rerouted several years ago.

Infrastructure & Site Servicing

Servicing the SUCB area at an urban service level is feasible using a combination of new infrastructure and upgrades to the existing infrastructure. The existing Hillcrest and Copper Ridge reservoirs combined can only service about 2000 additional residents.

Highlights

- Water distribution and sewage collection is feasible to the SUCB based on desktop review;
- Updates to the 2003 Water & Sewer Master Plan are required; and,
- Incorporation of Lobird sewage collection into a future SUCB system is strongly recommended

Extending the existing Alaska Highway water transmission main south from the airport with a secondary connection to the Copper Ridge distribution system is possible. Sewage collection would best be achieved through the construction of a sanitary sewer main that ties into the Downtown trunk system and associated lift stations; however, major upgrades would be required to accommodate the additional flows:

- On-site water supply and sewage disposal could be challenging in the service area due to near surface bedrock;
- The ad hoc layout of the McLean Lake residences also creates challenges in establishing a looped system in that portion of the SUCB;

- Installation of power and communications infrastructure in the SUCB does not pose any significant challenges;
- The potential costs for deep and shallow utility construction are of concern due to the suspected presence of shallow bedrock throughout portions of the area; and,
- The areas proximity to the McLean Lake quarries on the other hand is fortuitous and will likely result in some cost savings.

Residential Development Feasibility

The feasibility of residential development in the SUCB must be considered in the broader context of the City's strategic goals, objectives, policies, and urban planning/design principles.

The inter-relationship between the SUCB and the adjacent McIntyre Creek, McLean Lake, and Ice Lake/Paddy's Pond regional parks needs to be considered along with the highest and best use of the McLean Lake quarries upon depletion. Other private landholder considerations include the integration of significant undeveloped First Nation lands and the existing Lobird mobile home park as well as the existing country-residential lots in the McLean Lake area created through the squatter legitimization program.

Feasibility is a subjective term. The context is important because it shaped the study's approach and focus. The UCB intent is accommodating future urban growth in a compact form; thus development suitability looked at access, terrain conditions, proximity to existing services and the expected general planning and engineering requirements to achieve that aim.

To advance an understanding of potential engineering and financial feasibility, the team modestly adjusted the study area boundary to facilitate basic quantitative analysis taking into account known and strongly suspected technical constraints, incompatible land uses, and significant environmental, heritage and recreational values present. Approximately 61% of the revised area is deemed readily developable without serious constraints while 23% has the potential to encounter near surface bedrock.

Highlights

- Weighing the costs/benefits of various location and value trade-offs is a complex challenge involving technical input, public feedback and intergovernmental consultation; and,
- This study identifies those trade-offs at a broad scale for consideration in the upcoming OCP public review.

In addition, 16.5% is contingent on the depletion of the McLean gravel quarries and re-use for residential expansion while 1% is reclaimable by eliminating the Lobird sewage lagoons.

The distribution of near surface bedrock is a more complex servicing challenge because of the additional installation costs involved to install underground services. The challenge has two parts. The first part involves confirming the depth and spatial extent of near surface bedrock while the second, involves developing a subdivision concept and servicing plan that works with the findings.

Tetra Tech EBA did some exploratory testing using ground penetrating radar (GPR) in November 2016 which confirmed this complexity, but the results were insufficient to more accurately predict its spatial extent. Further, more detailed geophysical investigation will be required.

The general industry land development standard ratio aims to achieve a 60/40 split of the gross area less land set aside for environmental reserve. This means that 40% of the remaining area is expected to be consumed by roads, parks, schools, utility easements etc.

The study area has the potential to house 15,700 people or approximately 7,136 housing units at 16 units/ha. This far exceeds projected needs.

This does not negate the importance of maintaining an urban containment boundary. It does mean that the gross area can be reduced and there is more flexibility to accommodate other values present and avoid less desirable areas where servicing costs will be higher.

Highlights

- The Yukon Bureau of Statistics population growth forecast expects Whitehorse to grow by 6,237 people between 2017 and 2030 requiring 2,835 housing units; and,
- Between Whistle Bend, infill redevelopment and modest increases in densification, the need to develop a new area can quite likely be postponed by 10-15 years.

Assuming the conventional 150-200 lot development phase approach continues to be used as a benchmark based on the two-year supply principle. Some portions of the development can be phased sequentially, while some roads, underground and stormwater management infrastructure may need to be constructed in advance of the population that will ultimately rely on them when residing there.

The integration of Lobird and KDFN lands presents another challenge that may affect development timing and infrastructure. It is likely development would proceed from north to south and then westward once the McLean Lake quarries are depleted.

Based on the available data for Whistle Bend Phases 1 & 2 development and the calculated net development area, the team estimates a total investment of $552.38M will be required through to build-out. The total onsite costs are estimated at $439.28M ($984,977/ha).

The $113.1 million offsite costs include new capital investments and upgrades for existing road, water and sewer infrastructure, a $2.1M allowance for further studies, a 30% contingency, 15% for engineering, 10% for developer costs, and 5% for permitting.

The timing, budgeting and funding for these improvements need to be weighed in conjunction with other city asset management needs and capital planning priorities.

Highlights

- 16 units/ha is a conventional low density subdivision. It represents the minimum lot yield to facilitate macro-level cost comparisons assuming full land utilization; and,
- Densification changes the ratio between lower and higher density housing types. Double the above 16 units/ha density and only half the land is required to generate the same unit yield and population growth.

A detailed cost recovery analysis was not practical at this point without a conceptual subdivision plan to work from. The long-term development horizon and need for multiple iterative phases of subdivision design to incorporate evolving market needs also makes it difficult to develop a meaningful forecast. For those reasons a Whistle Bend "benchmark" approach was used.

A straight-forward but basic analysis distributed development costs in 2016 dollars across all housing units using a 16 ha/unit density yielded an average lot price of $77,412 to recover on and off-site costs. The average price of 2015 Whistle Bend lot sales weighted between single family, duplex and townhouse lots was $103,040 in comparison.

Several more iterations of detailed site investigation and data gathering will be required should residential development in the SUCB be pursued, including:

- Further testing and modelling of groundwater supply and demand including any downgradient impacts from the Lobird sewage lagoon and McLean Lake/Sleeping Giant quarry operations;
- Additional detailed geotechnical evaluation of the McLean Creek crossing to inform pile design/installation;
- Additional detailed geophysical evaluation to determine depth to bedrock and spatial extent throughout the study area for detailed design purposes;
- Re-estimation of McLean Lake Quarry reserve volumes will be needed at ten-year intervals;
- Traffic modelling and updating of the 2006 City-Wide Transportation Master Plan;
- Updating of the City Wide Water & Sewer Master Plan to account for estimated population growth in development of servicing options for SUCB[1];
- Completion of more detailed ecosystem mapping, rare plant and wildlife studies, fish and fish habitat assessments (e.g. McLean Lake), targeted wildlife and plant surveys, and studies aimed at a more complete understanding of potential residential impacts on wildlife presence and use with the objective of mitigating impacts to the extent possible;
- Further discussion with KDFN and TKC regarding heritage and traditional use and conformance with the *Yukon Archaeological Sites Regulation* in future heritage assessment work and/or in the event of unanticipated heritage resource discoveries;
- More detailed trail planning integrated with subdivision-level planning and design, which may result in the construction of new trails, decommissioning of others and/or potential re-routing - preceding the arrival of new residents; and,
- Work with the Government of Yukon to more accurately monitor, quantify and track on and off-site Whistle Bend development costs to provide more effective "benchmark" data for future planning purposes.

[1] Although it is highly unlikely that both the NUCB and SUCB areas would proceed at the same time, the updates to the city-wide Transportation, Sewer and Water Master Plans should consider the implications of all possibilities as well as the consequences of concentrating future development in one area before the other.

The Way Forward

The following process-oriented recommendations are proposed to facilitate the decision-making process that will ultimately determine whether or not to proceed with development in the SUCB and when:

Highlight

Engage the Government of Yukon and First Nations in the greater Whitehorse area around the development of a regional growth strategy that aligns with sustainability objectives

- Review the results and conclusions of the two pre-feasibility studies for the Northeastern and Southern Urban Containment Boundary areas together with the affected partner governments (City/YG/TKC/KDFN) comparing and contrasting the merits of each. Include a review of Whistle Bend build-out projections and density and add in an analysis of infill potential;
- Consider reframing public input during the next OCP review around the following questions:

  - *Which* currently undeveloped areas within the Urban Containment Boundary – all of which hold high ecological, recreational, or other values – may be most suitable for future development, versus *whether* one or both should be developed at all;

  - The fiscal merits of densification including its contribution towards housing affordability are known and the use of urban containment boundaries is generally accepted as a valid "best management" growth management practice. The question for public debate *is where and how* densification should be applied especially if it reduces the city's urban footprint to accommodate other values present and *whether* the presently defined urban containment boundary can be reduced;
- Should the SUCB area be retained as a future residential development option by the City, work with government partners to identify the key conditions precedent upon which a future determination to proceed would be based and address the information gaps outlined in **Section 6** accordingly; and,
- Continue and prioritize discussions with the Government of Yukon and First Nation governments around creating an action-oriented, collaborative approach to optimize and integrate the development of First Nation settlement lands within the City of Whitehorse in an efficient and cost effective manner.

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1.0 INTRODUCTION

A key tenet of sustainable urban development is the pursuit of a compact urban form. Densification promotes servicing efficiencies, improves the viability of alternative transportation modes, and reduces the urban footprint, allowing more land to be retained in its natural state and/or utilized for parks and recreation purposes. The 2010 Official Community Plan (OCP) introduced the concept of the Urban Containment Boundary (UCB) as the focal point for the containment of future urban growth. Several infill possibilities were identified as well as future expansion areas.

In March 2016, Inukshuk Planning and Development Ltd., in partnership with others, was retained by the City of Whitehorse to conduct a pre-feasibility study for residential development within the infill portion of the UCB located immediately south of the Copper Ridge subdivision and a potential expansion area located between the McLean Lake Road and Canyon Crescent, collectively referred to as the Southern Urban Containment Boundary (SUCB) study area.

The objective of the pre-feasibility study was to determine the general suitability of the SUCB for urban development based on discipline-specific assessments of servicing feasibility, biophysical characteristics, recreational usage and values, heritage resources and values, and land use suitability. This initial determination of technical and economic feasibility will inform the City's consideration of the SUCB in its upcoming OCP review.

The following report highlights the results of the discipline-specific assessments conducted by the project team and offers a synthesis of their collective implications for potential future residential development of this area within the broader context of policy, best practice, and City objectives. It recommends principles and benchmarks to be applied to the next stage of development planning. It also describes the nature and significance of trade-offs likely involved in a future development scenario. Finally, it makes a broad determination of development feasibility and outlines next steps for the City and potential partners.

The background geotechnical, heritage, ecology, and recreation assessments are summarized herein with the full reports included as appendices to this report. The servicing and cost assessments are incorporated directly into the main report.

1.1 Study Scope, Limitations/Assumptions

The scope of the pre-feasibility study included an investigation and analysis of the following:

- Geotechnical and terrain considerations;
- Hydrogeological conditions;
- Ecological/environmental values, including fisheries and wildlife considerations;
- Heritage and cultural values present;
- Recreational uses and values;
- Infrastructure and engineering issues, including transportation, communications, water distribution, and waste water collection;
- Servicing constraints and costs; and,

- Identification of general stakeholder issues and interests.

The analysis is based largely on review of previously gathered data and information for the SUCB, supplemented by targeted fieldwork and investigation. The objective was to arrive at a high-level identification of issues, opportunities, and constraints sufficient to inform a determination of development feasibility at a broad scale.

The project team endeavored to make the discipline assessments as comprehensive and accurate as possible based on the limitations of the data available. The methods employed provide a relatively coarse resolution of conditions in the study area because of the limited field time available and size of the area. Some information was condensed, generalized or interpolated for use in the September 2016 workshop.

Highlights

- Much of the available information relevant to infrastructure and servicing feasibility is out of date, limiting the engineering team in scoping serviceability at this stage;
- Data gaps were encountered with respect to the heritage, recreation and ecological values present; and,
- Servicing cost is influenced by the level of service standard applied, density, proximity to existing services, and threshold capacity.

Without additional subsurface technical investigation, there is potential for variability and higher margins of error in the geotechnical and hydrological investigations. In general, the Team drew preliminary conclusions based on the available data and their respective first-hand knowledge of conditions in, and/or adjacent to the SUCB, as well as similar areas.

Two levels of servicing were initially considered: full urban and partially serviced (e.g. country residential) on the assumption that there might be areas where only an alternate form of servicing might be cost effective. However, as the study evolved and government partners had the opportunity to weigh in it became clear that such a comparison was impractical and confusing because a country residential option was contrary to the intent of creating UCB's. This does not mean that the option may not be considered in the future at the detailed subdivision design stage to maximize developable land utilization.

For comparison purposes, Whistle Bend actual costs and density are used as the proxy for the purposes of projecting servicing costs and ultimately - potential revenue generation from lot sales. A 5-to-7-year lead time is also assumed to be the minimum required to complete the final design, permitting process, and installation of key off-site infrastructure. Two factors will affect the start date. They are the time to build-out of the last phase of Whistle Bend and the amount of infill development that occurs elsewhere throughout the city.

1.2 Approach and Methodology

The general steps taken in the project team's approach and methodology are summarized below. For more discipline-specific detail, please refer to the report appendices.

1.2.1 Desktop Review

Each discipline team compiled and reviewed previous studies and information pertinent to the study area, including relevant reports and past studies commissioned by the City of Whitehorse and Government of Yukon. This information included the following:

- City of Whitehorse and other studies and information relevant to municipal servicing and transportation;
- City of Whitehorse 2015-2050 Sustainability Plan and 2010 Official Community Plan;
- McLean Lake Planning Area Study (Inukshuk, 2000);
- McLean Lake Quarry Assessment Update (Inukshuk 2015);
- Geotechnical and hydrological data gathered within and/or adjacent to the study area (TetraTech EBA SUCB Feasibility Level Geotechnical Assessment 2014);
- Wildlife, conservation data and ecosystem mapping and data previously collected (SUCB Expansion Area Fish and Wildlife Baseline Conditions and Issues Scoping, (EDI 2014);
- Previous heritage resource management research, including archaeological studies, historic records and ethnographic accounts, conducted within the study area and adjacent lands;
- Inventory of physical/environmental attributes that could serve as predictors of human occupation;
- Collection and review of recreational mapping resources for the area, including City of Whitehorse trail data, Yukon Orienteering Association mapping, and other sources; and,
- Miscellaneous secondary research using online and hard copy sources.

1.2.2 Personal Interviews

Interviews were held with key informants with expertise and/or interests related to the study area. A project meeting with representatives of the Kwanlin Dün First Nation (KDFN) was held on April 13, 2016, followed by a meeting with Ta'an Kwäch'än Council (TKC) on April 15, 2016. Other interviews were held with the following:

- City of Whitehorse and Yukon Government technical staff;
- Selected recreational groups and commercial operators; and,
- Local residents with insight into recreational use and other values present.

City of Whitehorse Engineering staff provided feedback on initial reports through written comments and throughout the process on specific topics.

1.2.3 Field Investigation

The ecology team completed field reconnaissance of the SUCB on May 17 and 18, 2016 to review and field-check previously completed ecosystem mapping (AEM 2000) and gain an understanding of the terrain and ecosystem units not available at the resolution of the ecosystem maps (1:20,000). This included visits to known or potentially sensitive areas to look for any changes since AEM's (2000) initial work. ELR also visited areas of potential conflict with ecological values, such as the need for a McLean Creek Crossing, to assess biophysical values at those locations.

The recreation team carried out field work in the SUCB over several weeks between late May and early June 2016. This included collecting additional trail use and recreation activity information and assessing other recreation values present in the landscape.

The geotechnical consultants relied on a review of their records and air photo interpretation supplemented by several brief site inspections related to specific areas of concern. An exploratory subsurface investigation utilizing ground penetrating radar (GPR) was undertaken subsequent to this initial overview in an effort to develop a more accurate prediction of the depth and spatial extent of near surface bedrock in the area.

The lead planner used a combination of air photo interpretation and site visits supplemented by two brief aerial reconnaissance flights to examine the area.[2]

1.2.4 GIS Analysis

A GIS based heritage resource potential analysis was conducted to evaluate lands within the study area and identify specific areas of potential. The results of this analysis were then scrutinized by the archaeological team, which reviewed the predictions in relation to the hypothesized results. GIS analysis was also used to evaluate the potential for heritage resources including Culturally Modified Trees (CMTs), with the key parameters for this analysis being pine-dominant forests more than 70 years old.

[2] Both areas are within the airport control zone restricting flight options

2.0 DESCRIPTION & ANALYSIS OF STUDY AREA LAND VALUES

The study area is located within the City of Whitehorse municipal boundaries, west of the Yukon River, southwest of the Whitehorse International Airport and immediately south of the Copper Ridge subdivision. It covers 792ha, including a 50-metre buffer zone around its perimeter, all of which falls within the traditional territories of the Kwanlin Dün First Nation (KDFN) and Ta'an Kwäch'än Council (TKC). The study area is located within Boreal Cordillera Ecozone and the Yukon Southern Lakes Ecoregion**,** which is characterized by broad valleys and large lakes.

2.1 Land Tenure and Uses

The study area currently features a range of land tenure and uses, including the following:

- Lobird subdivision/mobile home park (privately owned);
- KDFN Type 2 settlement parcels C-57B, C-24B and C-103B/D (residential/commercial use), C-106B/D (residential use) and C-86B (commercial use);
- TKC Category B-C settlement parcel C-37B
- Approximately 20 private titled residential properties accessed from Squatter's Road and/or McLean Lake Road; and,
- Approximately 20 private commercial properties immediately northwest of the Alaska Highway and Hamilton Boulevard intersection, collectively called the Yukon Gardens Business Park.

The remainder of the study area is predominantly undeveloped Commissioner's lands managed by the City of Whitehorse as green space under the broad powers conferred by the *Municipal Act*. Existing land use and tenure is shown in the overview map (See Error! Reference source not found. page ii).

2.2 Geology and Terrain

Glaciation, deglaciation and the depositional and erosional forces of water and wind have shaped the surficial geology of the Whitehorse area resulting in variable soil conditions throughout the study area. Surficial geology mapping in the area has identified sediments to be primarily sandy silt or silty sand morainal till deposits with cobbles and boulders throughout. Test pits and mapping have identified discontinuous permafrost in areas where low-lying and poorly drained soils have led to an accumulation of organic soil and significant thicknesses of the organic root mat. The thickness of the surficial sedimentary cover is highly variable with bedrock exposures observed throughout the area.

The SUCB is underlain primarily by igneous rocks from the Whitehorse Batholith, which intrudes the Triassic aged rocks of the Aksala formation. 1:50,000 bedrock mapping in the area indicates granodiorite from the Whitehorse Plutonic suite and granite from the Mt. McIntyre Plutonic Suite, but exact bedrock contacts are unclear. It is possible that sedimentary rocks underlie parts of the south and western portions of the SUCB area; however, boreholes completed to date have all encountered igneous bedrock.

The relevant terrain and geotechnical considerations are shown in **Figure 2**.

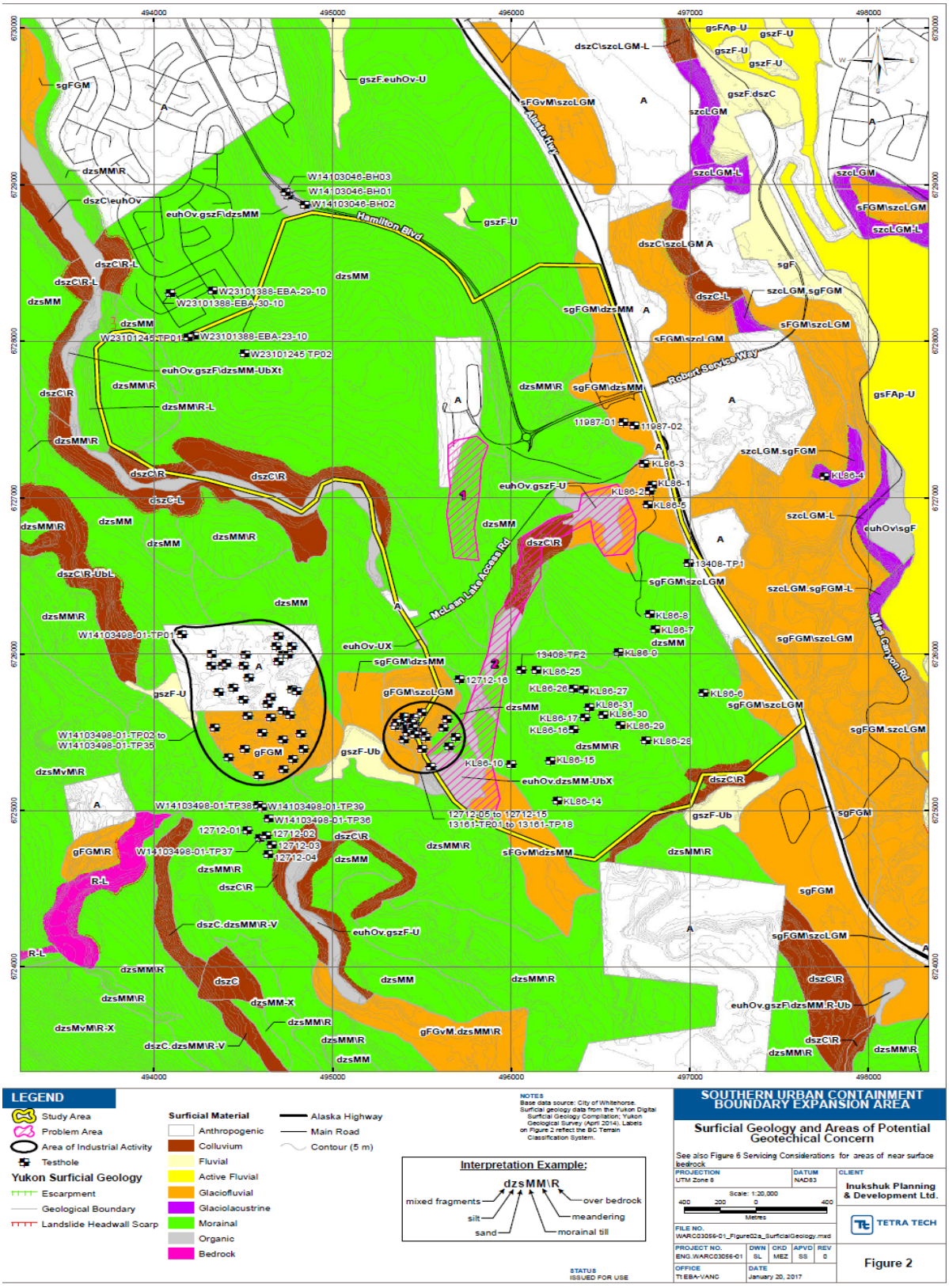

Figure 2: SUCB Areas of Potential Geotechnical Concern

Shallow bedrock and surface exposures are found throughout the area, and both the granodiorite and granite are exposed along the Hamilton Boulevard extension and McLean Lake Road. The granodiorite is a strong, massive rock that is typically grey in colour while the granite exposures are usually soft, weathered and orangey brown.

The terrain throughout the study area is variable. Significant terrain expressions include:

- Gently to strongly irregular topography influenced by the underlying bedrock (with gentle slopes/benches likely to have a thicker blanket of morainal sediments and very little soil cover or bedrock exposures in areas with steeper slopes);
- Several steep-sided meltwater channels formed during deglaciation along the northwestern edge of the study area; and,
- Steep-sided glaciofluvial complexes, specifically the existing McLean Lake Quarry and the Sleeping Giant ice contact formations in the southern portion.

Highlights

- The full spatial extent of shallow bedrock has yet to be determined. Preliminary GPR work suggests 25% of the McLean Lake area and 31% of the area beyond Copper Ridge likely have bedrock 2m or less; and,
- Some localized pre-grading may be required.

A limited geophysical investigation of the SUCB area using ground penetrating radar (GPR) was carried out to help delineate bedrock depth in the two main portions of the SUCB study area: specifically south of Copper Ridge and in the Squatter's Road/McLean Lake area. The results suggest that about 69% of the Copper Ridge area may have bedrock at minimum 2.0m depth, with the remainder likely having bedrock at 2.0m or less below grade. About 75% of the expansion area around McLean Lake is predicted to have bedrock at a minimum 2.0m depth, with the remainder likely having bedrock at 2.0m or less.

Along with the steep slopes defining the edges of the meltwater channels, there are other areas south of Drift Drive in Copper Ridge that may require pre-grading to facilitate subdivision development.

2.3 Drainage and Hydrogeology

Based on existing data and general hydrogeological principles, regional groundwater flow direction is expected to mimic topography and flow toward the Yukon River, the major regional discharge location.

Regional static groundwater levels encountered in bedrock aquifers may be relatively shallow at depths between 1.7 and 6.1 metres, although depth may be greater below topographically high points. Shallow groundwater is expected to occur where topographic troughs and subsurface conditions (such as low hydraulic conductivity bedrock or silt) are present. Shallow groundwater flow direction will be controlled by localized topography and surface dip of bedrock or silt layers and may be extremely variable throughout the study area.

Within the SUCB area, groundwater may discharge in low-lying areas with existing waterbodies (wetlands, ponds, or creeks) located within or close to the study area. Within the vicinity of groundwater discharge areas, groundwater would be expected to be at or close to the ground surface.

While the overall regional groundwater flow direction and discharge is likely east toward the Yukon River, complex topography in the SUCB means there are multiple local groundwater discharge areas within and immediately adjacent to the study area, including Ice Lake, multiple waterbodies/ponds extending along an area approximately 200 to 600m south of Lobird mobile home park, McLean Creek, and Canyon Creek.

More detailed mapping of these localized discharge areas may result in less developable land and will certainly impact potential for on-site sewage disposal system construction, if that option is pursued in the McLean Creek area. It is also worth noting that under a partial servicing option, the minimum lot size must be larger with a consequential negative impact on density.

Highlights

- Shallow groundwater flow direction is controlled by localized topography and surface dip of bedrock or silt layers will be variable throughout the area;
- Multiple local groundwater discharge areas expected which may reduce amount of developable land; and,
- Changes in the surface drainage, infiltration characteristics and water balance have contributed to higher groundwater elevation in areas not previously identified to have shallow groundwater creating post development problems with lot grading a contributing factor.

Potential problems may occur in areas where groundwater is close to surface (i.e., groundwater discharge zones or localized shallow groundwater tables) or where groundwater has the potential to be impacted by changes in surface land uses that encourage run-off rather than infiltration and groundwater recharge. Due to the variable thickness and soil types encountered, variable groundwater flow conditions are expected to occur throughout the study area. The presence of very shallow bedrock either exposed or covered by only a thin veneer/blanket of morainal sediments in localized areas, as well as the presence of low permeability silty soils, can restrict groundwater infiltration.

Existing groundwater measurements show that groundwater levels of two metres and less are possible in areas with near surface bedrock. Groundwater at these shallow depths may constrain basement construction throughout the study area.

There are several examples where shallow groundwater issues have occurred in the Whitehorse region with substantial associated costs.

Hydrogeological studies of the problem areas have suggested that increased groundwater infiltration due to changes in the surface characteristics and water balance have contributed to higher groundwater elevation in areas that were not previously identified to have shallow groundwater. Shallow aquifers that are not identified during conceptual and detailed design may become problematic after development if increased groundwater recharge and altered groundwater flow paths result and the water balance is changed. Lot grading and surface drainage management can also be contributing factors.

Aside from shallow groundwater concerns, two high potential problem areas have been identified based on the variable soil conditions and review of aerial imagery and topographic mapping.

Figure 3: Small pond below third cell of Lobird sewage lagoons

The first area is characterized by a topographic low with standing surface water and wetland conditions in the vicinity of the Lobird sewage lagoons. This area is likely to have a combination of issues related to shallow groundwater and possible contaminant migration from the lagoons, particularly if water supply wells were envisioned for the area. The McLean Lake/McLean Creek watercourse - a groundwater discharge area characterized by standing surface water and wetland conditions - is the second area of concern.

Two areas have also been identified where anthropogenic activities could have an impact on groundwater quality in downgradient areas. These include the land treatment facility located in the McLean Lake gravel quarry and the Lobird sewage lagoons.

Area water supply wells have likely been completed in igneous bedrock of the Whitehorse Batholith consisting of either granite from the Mt. McIntyre Plutonic Suite or granodiorite from the Whitehorse Plutonic Suite judging by the geological mapping and observations of shallow bedrock present. Plutonic igneous rocks typically have very low permeability in the rock matrix, and the majority of groundwater occurring in these rock types is held in fractures associated with faults and open joints. Productivity of wells installed in bedrock will depend on whether wells intersect productive fractures within the rock mass.

2.4 Ecology

Ecosystem mapping conducted in 2000 identified 12 resident ecosystem types in the SUCB with the Pine-Bearberry ecosystem covering the largest percentage of the area (approximately 68%) and White-Spruce – Feathermoss covering 11% of the area. Other mapped ecosystem units each cover around 5% or less of the area (including urban areas and open water). Land cover changes since the initial 2000 mapping work are apparent, specifically the construction of the Hamilton Boulevard extension in 2009.

Figure 4: New wetland forming in the southwest corner of the SUCB (ELR)

McLean Creek, McLean Lake and the wetland and drainages associated with them in the southwest portion of the SUCB form the largest areas considered to have significant potential wildlife value.

A series of wetlands and drainages associated with the Logan-Arkell wetland system and McIntyre Creek watershed roughly follow the western boundary. The spruce bog found in the northwest corner of the SUCB adjacent to the Copper Ridge subdivision is also deemed to be of value to wildlife. Canyon Creek and the associated wetlands abutting the former Whitehorse Copper Mine roughly mark the southern boundary of the SUCB. A new wetland area was observed to be forming close to the southern boundary of the SUCB. It is also not clear what the source of the small pond below the Lobird sewage lagoons is.

The largest portions of environmentally sensitive area in the SUCB are the steep and often unstable slopes, cliffs and bluffs associated with and/or adjacent to the areas of significant wildlife value. These typically are associated with 'lookout' points across the wider landscape. The "Rock Gardens" area (a narrow granite canyon with vertical rock outcrops) is an exception.

More than 20 mammal species potentially occur in the general region, including species of conservation concern (e.g., Little Brown Bat), managed species (e.g., Grizzly Bear, Black Bear, Wolverine, Moose and Woodland Caribou) and an estimated 78 species of birds. The Yukon Conservation Data Centre has no record of species of conservation concern for the SUCB area and no eBird or North American Breeding Bird Survey data were available for the area.

No Wildlife Key Areas, as designated by the Government of Yukon, overlap with the SUCB. Previous remote camera investigations of the area detected mostly small and medium sized mammals (American Marten, Red Fox, Red Squirrel), although larger mammals (Moose and Mule Deer) were detected a few times (EDI, 2014).

Bears were not detected by the remote cameras, although bear scat was observed close to Squatters Road during the May 2016 field reconnaissance. Black Bear-human encounters have been reported in the Squatters Road and Lobird subdivision residential areas.

Two federally recognized bird species at risk are known to occur within the SUCB; Bank Swallow and Rusty Blackbird. Both inhabit areas that are not likely to be directly impacted by development.

The only fish species documented for McLean Creek drainage is Rainbow Trout (EDI, 2014; ELR 2015) that likely overwinter in the deeper pools along McLean Creek and in McLean Lake. McLean Creek is not directly connected to the Yukon River by surface flow (AEM, 2003; EDI, 2014) and the Rainbow Trout are considered to be an isolated, introduced and naturally reproducing population (Yukon Environment, 2010). McLean Creek does not support any salmonid species.

Wildlife movement corridors are limited within the area. The McLean Creek corridor and its associated wetlands support a greater diversity of wildlife species and habitats than most other areas within the SUCB. The corridor does not connect to quality wildlife habitat at the eastern boundary, however, primarily due to industrial and commercial activity and road/trail development. Bird species, including the Rusty Blackbird, the localized population of Rainbow Trout and small and medium-sized furbearers likely benefit the most from McLean Creek habitat.

Although larger animals such as Moose, Black Bear, and deer species likely use the McLean Creek corridor from time to time, the creek is not believed to function as a good movement corridor for these species because of the poor habitat connectivity at the eastern, downstream end of the creek at the Alaska Highway. The existing residential, commercial and recreational activities in and around McLean Lake and McLean Creek may also act as a deterrent to larger mammal species use.

The wetland complex that exists along the western boundary of the SUCB provides a north-south wildlife movement corridor with potential 'escape' routes to the west (e.g., to the McIntyre Creek wildlife movement corridor) although some development in the wider regional area exists (e.g., Copper Haul Road, quarries, Fish Lake Road, Icy Waters Arctic Charr fish farm). Overall, opportunities for wildlife habitat connectivity are good along the western boundary of the SUCB.

The types of terrain and presence of residential dwellings in the southern area of the SUCB and the extensive recreational use in the northern area of the SUCB indicate that further development within the SUCB is feasible in those areas away from McLean Creek and the environmentally sensitive steep slopes that form the western and southern boundaries of the study area. A large proportion (>75%) of the SUCB contains habitat that is commonly found in the region, and the SUCB is not believed to contain major wildlife corridors nor connect isolated populations of wildlife species.

The relevant wildlife and habitat considerations are shown in **Figure 5** on the following page.

Highlights

- Pine-Bearberry ecosystem covers 68% of area;
- The McLean Creek/McLean Lake drainage and associated wetlands form the largest areas considered to have significant potential wildlife value;
- The steep and often unstable slopes, cliffs and bluffs associated with and/or adjacent to the areas of significant wildlife value are areas of environmental concern. Setbacks and buffers required; and,
- Two federally recognized bird species at risk (Swallow and Rusty Blackbird) are present but both inhabit areas not likely to be directly impacted by development.

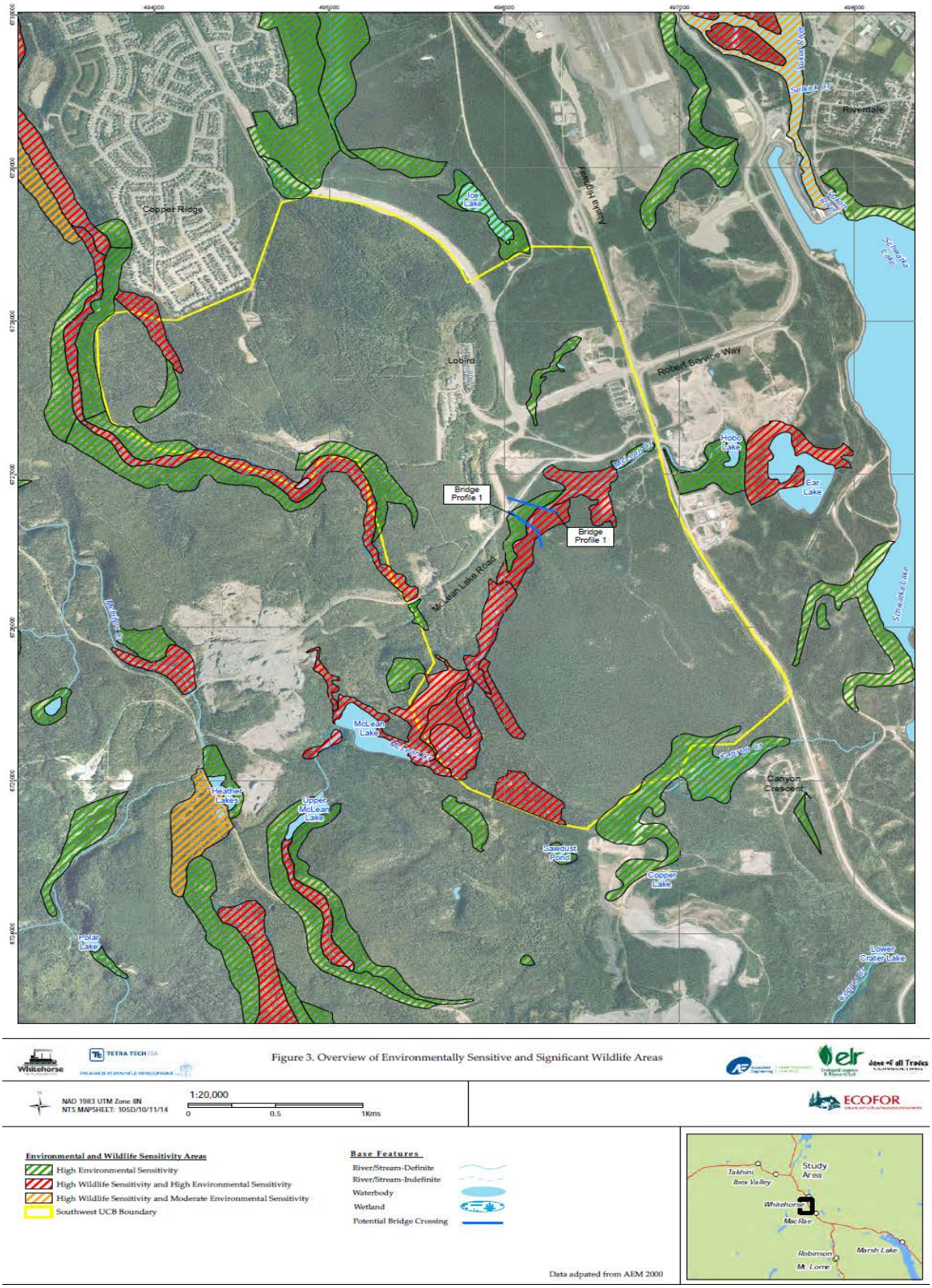

Figure 5: Overview of Environmentally Sensitive and Significant Wildlife Areas

2.5 Culture and Heritage

Heritage resources are managed under the provisions of the Yukon First Nations Umbrella Final Agreement (UFA) Chapter 13, *Yukon Historic Resources Act* and the *Archaeological Sites Regulations*. The Government of Yukon is responsible for heritage resource management on non-settlement lands. Archaeological resources are protected under the Heritage Resources Act, whether located on public or private land. Protected sites may not be altered without a permit issued by the Minister or designate.

A search of the Yukon heritage resource inventory of archaeological sites with Borden numbers identified 14 previously recorded sites within the study area and nine located just outside of it. In addition, seven Historic Period sites have been recorded in the Yukon Historic Sites Inventory (YHSI) within the study area (two are associated with Borden sites) and three more YHSI sites have been recorded immediately adjacent to the SUCB study area (one of which is associated with a Borden site).

No CMTs are known in or immediately adjacent to the study area; however, the known presence of CMTs in the NUCB and documented use of the greater Whitehorse area as a travel corridor during Precontact and Historic times suggests that unrecorded CMTs are likely present within this area too.

The GIS analysis identified more than 100 discrete areas of high heritage resource potential within the study area, totaling 70.82 ha (or 8.19% of the area). Moreover, multiple areas of old growth forest (>70 years old) with potential for CMTs were identified (343.31 ha; 39.69% of the total study area). The remaining lands are considered to possess low potential for significant heritage resource sites, although the possibility of chance finds of heritage materials is always present.

It is also considered likely that Precontact and Historic Period trails also exist on the west side of the Yukon River where they may potentially cross portions of the SUCB study area, perhaps paralleling the modern trails. Sections of Whitehorse's early wagon road network connecting the White Pass and Yukon Route railway and Whitehorse Copper Belt are also likely intact in the area, although most of the network has likely been subsumed by modern roads.

Known archaeological site locations are obscured in the mapping and should be avoided where possible. Archaeological and CMT areas are not "*no go*" zones but require pre-development field survey. Sites are managed on a site-by-site basis using avoidance minimization and/or impact mitigation measures. Old pine forests have greater CMT potential but are not necessarily a greater fire risk. Heritage survey and management work required depends on the nature and degree of ground disturbance, location of sites found, and additional chance finds discovered during fieldwork.

The archaeological potential and general areas of concern are identified in **Figure 6**.

Eleven broad site types were considered in the Heritage Resources Overview Assessment (HROA) for their likelihood to be present within the study area based on extrapolation from previous archaeological studies and known sites in the larger area. These are shown in **Table 1** on page15.

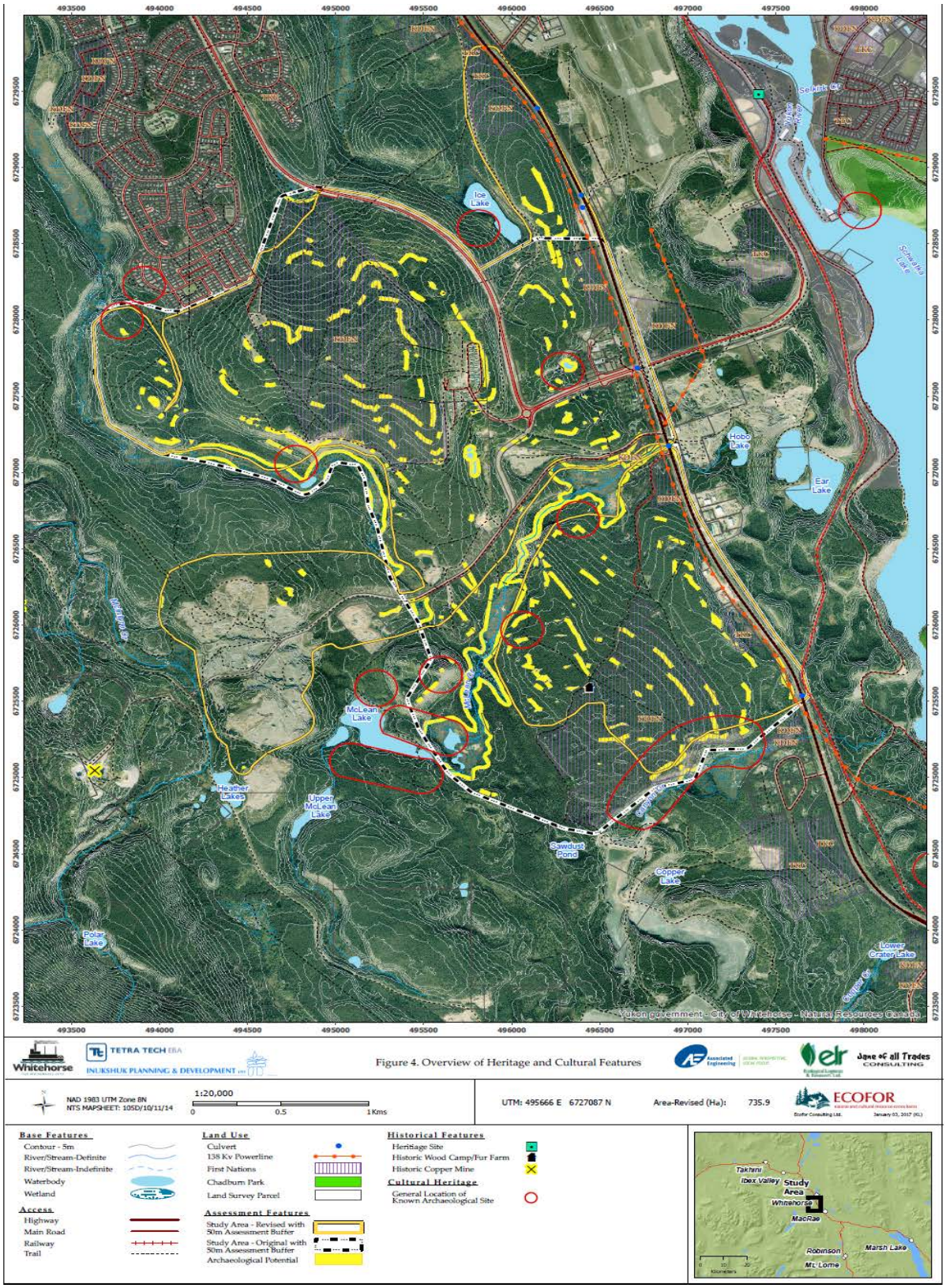

Figure 6: Overview of Heritage and Cultural Features

Table 1: Heritage Resource Site Types and Potential

Site Type	Potential	Comments
Permanent/ Long-Term Habitation	Moderate-High	Permanent/long-term habitation tends to be located near significant landscape features that provide optimal places for campsites. Several such landscape features/camping places are present within, primarily along the well-defined terraces above McLean Creek, Canyon Creek (located outside of the SUCB, but the north terrace falls within), the unnamed wetland in the SE part of the study area, and terraces near McLean Lake.
Fishing Sites	Low-Moderate	The potential for finding fishing sites is evaluated as low-moderate for McLean Creek. This site type may also overlap with temporary and long-term habitation sites.
Rock Art	Low	The rock art potential is considered to be low throughout the area.
Temporary Habitation	High	The probability of finding temporary habitation sites is bolstered by the same factors that create moderate-high potential for longer-term sites, as well as the likelihood of travel corridors passing through the study area.
Quarry Sites	Low-Moderate	Although basalt is present within the study area, it is typically not of knappable quality. There is limited potential for small outcrops of higher quality basalt or other knappable volcanic rocks. Some potential exists for knappable rocks in river and streambeds.
Human Remains	Low	Organic preservation conditions in the area are not considered to be favorable for the preservation of human remains; however there is a small chance of encountering isolated Historic Period graves.
Culturally Modified Trees	Low-Moderate	Although CMTs have been previously recorded in lands adjacent to the study area, most are quite recent and speak more to current traditional land use patterns than heritage resources.
Historic	High	Intensive use of portions of the study area from the early-19th century onward is well-documented. Historic Period sites may include settlements, trails and tramways, mining related sites, trapping related sites, wood-cutting area for personal/sternwheeler use etc.
Trails	Moderate-High	No Precontact or Historic Period trails are documented within the SUCB. However, the greater Whitehorse area has a long history of human use and documented travel corridors utilized by both First Nations and European populations. It is likely that Precontact and Historic trails also exist on the west side of the Yukon River and potentially cross portions of the SUCB.
Isolated Finds	High	Several isolated finds have been made within and immediately adjacent to the study area in areas that have been subject to intensive heritage resource survey. As such, it is considered likely that similar sites exist in areas that have not yet been surveyed.
Palaeontological	Low	The potential for encountering palaeontological materials is considered to be low. However, there is some chance of Pleistocene fossils in gravels associated with McLean Creek and the wetland in the SW portion of the study area (appears to be a relict drainage corridor).

2.6 Recreational Use

The City of Whitehorse's Department of Parks and Community Development bears primary responsibility for neighbourhood-level recreation amenities such as playgrounds, parks, and trails. Pursuant to its 2007 Trail Plan, the City of Whitehorse actively manages trails located within municipal boundaries. Neighbourhood-level trail planning identifies highly valued and/or significant trails for formal City adoption and adopted trails are incorporated into the City's Trails Maintenance Policy and maintained by the City and/or its partners on an ongoing basis. A Memorandum of Understanding was signed between the City and KDFN in spring 2015 to allow the City to adopt and manage significant trails located on KDFN lands until future development occurs.

The predominant recreational resource in the SUCB area is trails (see Figure 7). The greenspace south of Copper Ridge contains a well-used network of singletrack[3] trails primarily built by local mountain bikers in the early 2000s, including R&D, Sparky, Magic Carpet Ride, Midnight Run, Quickie, and Blair Witch, all of which have been adopted and designated non-motorized by the City. The Quickie loop is the central "hub" of the network and the most popular trail in the area. Many of these trails have incorporated the native rock outcrops as features; in some cases (particularly Quickie and Blair Witch) merging these with constructed technical trail features (TTFs) that are optional for more advanced mountain bikers. These singletrack trails are heavily used by local residents for walking, running, hiking, snowshoeing and biking. Quickie, Blair Witch, Sparky, and Midnight Run are frequently used by non-resident mountain bikers and are incorporated regularly into mountain bike races and programming.

One of many technical trail features on "Quickie" (JOAT)

The trails in the McLean Lake area are predominantly doubletrack[4], with sections of singletrack paralleling the McLean Creek drainage and along the north bank of Canyon Creek. There are also sections of what appear to be the original woodcutters trail between Squatter's Road and the Alaska Highway that became the main access to squatter sites that were subsequently legalized. The road is not maintained.

[3] A singletrack trail is so narrow that users must generally travel in single file. A single-use trail is one that is open to only one type of user and may be unidirectional depending on its purpose.

[4] A double-track trail by definition is wide enough to allow two (or more) users to travel side by side, or pass without one user having to yield the trail to another. Double-track trails generally include tote roads, ATV-width trails, etc.

Some of the trails in the Squatter's Road area, particularly singletrack along the creek, traverse private property. With the exception of a small network of potentially purpose-built trails in the Canyon Creek area, trails in the Squatter's Road and McLean Lake area appear to have developed in an ad hoc manner.

The doubletrack trail extending from Squatter's Road and connecting to McLean Lake and/or Heather Lake are key "out and away" routes. No trails in the McLean Lake area have been designated by the City and use is almost exclusively by local residents. These local trails support the typical range of motorized and non-motorized trail recreation found elsewhere in the City and have accommodated several resident recreational mushers over the past five or so years.

Another trail of note is the TransCanada Trail (TCT) urban connector – essentially a gravel road – that takes motorized users from the south end of Copper Ridge out past McLean Lake to the Copper Haul Road, the major motorized recreational artery within City limits. This route, along with the Lobird cutline and other unnamed roads connecting to the TCT urban connector, has been adopted and designated a motorized multi-use (MMU) trail by the City. The TCT and its urban connectors are signed and maintained in winter by the Klondike Snowmobile Association (KSA). The TCT and its urban connectors are of city-wide significance for motorized users but are less valued and frequented by non-motorized users.

McLean Lake was stocked with fish via various federal and local initiatives in the 1950s and 1960s resulting in a naturally reproducing population of rainbow trout. The lake was reportedly one of the most frequented fishing spots in Whitehorse during that timeframe; current use is low to moderate (including City programmed fishing instruction) and some have observed a significant decrease in visitation since the TCT connector was rerouted several years ago.

Another significant recreational feature in the study area is the Rock Gardens, a predominantly granite canyon feature approximately 175 metres in length and varying in depth from about 5-35 metres. The Rock Gardens is accessed from a pullout located about 750 metres north of the Hamilton Boulevard/Lobird Road roundabout. Divided into the Upper Canyon, Great Unknown, and Grand Central Station climbing areas, the Gardens offers 18 climbing routes in total ranging from beginner (5.6 rating) to advanced/expert (5.12c rating). This is the most frequently visited climbing crag in the Whitehorse area and is used for both recreational programming as well as some commercial climbing instruction.

The trail network also facilitates other recreation uses such as bird watching where the trails either overlook or pass by ponds, wetlands and forest edges. While McIntyre Creek is a well-established birding area, the use of Logan-Arkell wetlands is largely unknown. There have been organized birding excursions to the spruce bog south of Copper Ridge in the past.

The relevant recreational value considerations are shown in **Figure 7**.

Highlights

- The study area if developed will be accessible to 3 regional parks and an extensive network of trails (hiking, skiing, bird watching, mountain biking) and recreational features including McLean Lake (fishing), Rock Garden (climbing).

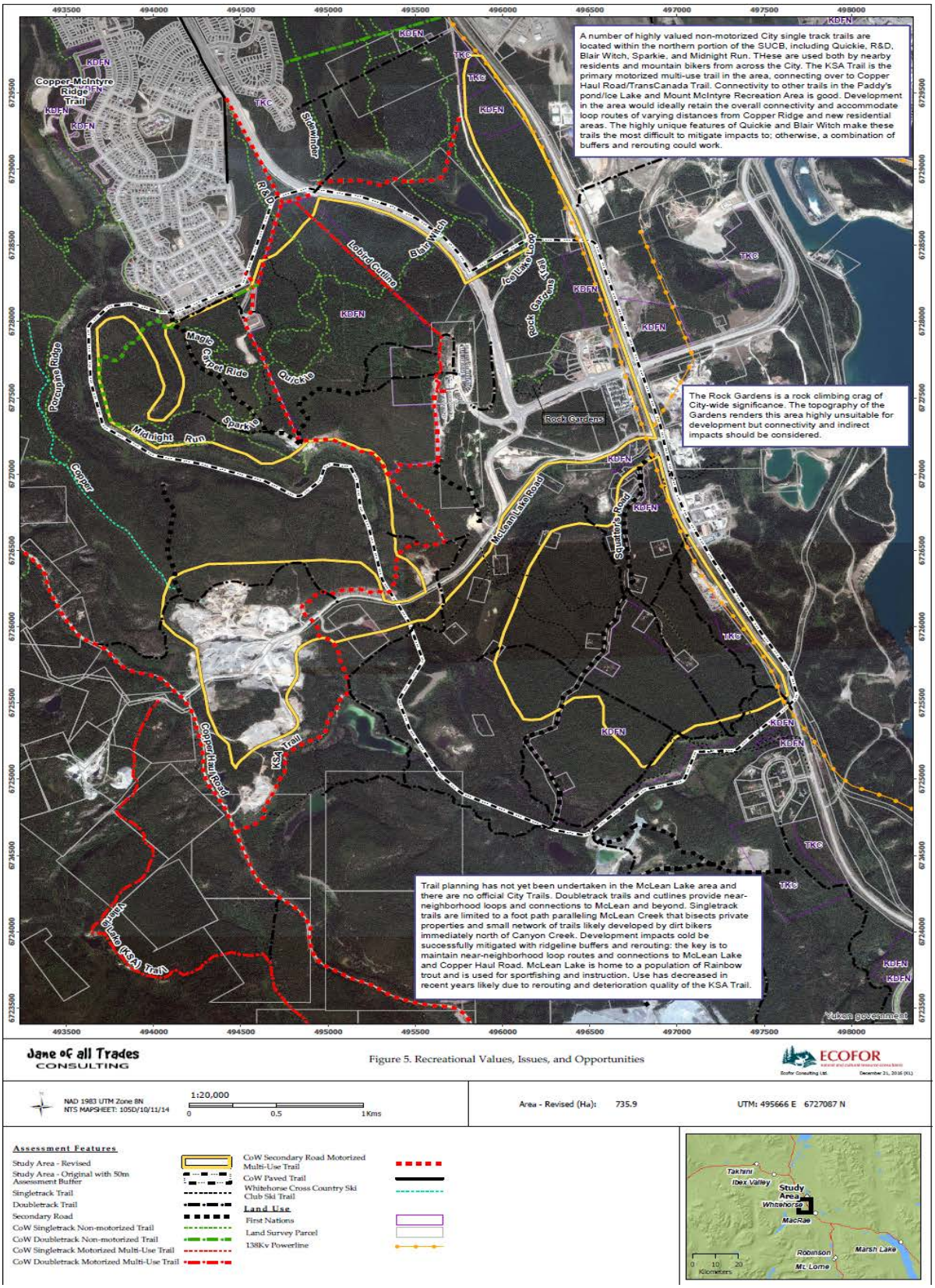

Figure 7: Recreational Values, Issues and Opportunities

2.7 Mitigation of Negative Impacts to Land Values

Some impacts are inevitable and irreversible, a consequence of urbanization and the inherent difficult decisions that go along with it. This includes the necessity for value trade-offs. The project team has identified a variety of measures to mitigate the impact of concentrating future urban growth within the proposed SUCB study area.

2.7.1 Ecology

Any residential development and corresponding increase in human population in the area will inevitably remove habitat for year-round resident species and transitory and seasonal species and place additional pressure on the remaining habitats or individual animals in the area. Displacement of animals, disturbance to fragile and sensitive habitats, increased fishing in McLean Creek, creation of new trails through sensitive habitats, an increase in wildlife-vehicle collisions, and increase in human-bear encounters are all possible negative outcomes of potential residential development.

The following mitigation measures are recommended to minimize negative impacts to significant ecological values in the study area in the event that development proceeds:

- The establishment of a minimum 30-metre setback from environmentally sensitive areas, open water and wetland areas as defined in the 2010 City of Whitehorse Official Community Plan (revised 2013), with a greater setback warranted in some locations following more detailed ecosystem mapping.
- Avoid a road crossing of McLean Creek. Assuming the Squatter's Road/Alaska Highway intersection is closed, consider a service road connection within the existing highway right-of-way linking Squatter's Road to the McLean Lake Road.

Figure 8: McLean Creek about 800m West of Alaska Highway (ELR)

2.7.2 Heritage

The following mitigation measures are recommended to minimize negative impacts to heritage values in the study area in the event that development proceeds:

- Completion of Heritage Resource Impact Assessments (HRIAs) for areas with high heritage resource potential prior to any development proceeding within them, with the possibility of additional areas of high potential being identified within a proposed development area during HRIA work and also being assessed.
- A pedestrian survey through areas with potential for CMTs dating to more than 70 years ago prior to any development proceeding within them, with any finds documented and reported to the local First Nations.
- If any additional heritage resources are observed in association with CMTs, or if any landforms with heritage resource potential (as identified in this report) are identified within them, full HRIA work is recommended due to the tendency of CMTs to be correlated with other site types such as trails.
- Requiring that development in low potential areas be allowed to proceed on the condition that all chance finds of heritage resource materials be reported immediately to the Heritage Resources Unit of Yukon Tourism and Culture, and that all work at the location of a chance find cease until the Heritage Resources Unit is able to assess the finds and issue a response.

Moreover, if any development is planned within 30m of a previously recorded heritage resource site, the potential impact to the site should be reviewed on a case-by-case basis and addressed via a more detailed HRIA. All chance finds of heritage resources should also be reviewed on a case-by-case basis to allow for a determination of whether HRIA work should be required prior to any development. If chance finds include human remains, *Guidelines Respecting the Discovery of Human Remains and First Nation Burial Sites in the Yukon* should be followed.

2.7.3 Recreation

Since the adoption of the Trail Plan in 2007, the City has made a concerted effort to rationalize the city-wide trail network to accommodate user needs, minimize conflicts between users and reduce impacts on other environmental values present. Many trails used today evolved out of bush roads, mining exploration and survey cut lines or followed game trails and natural landscape features such as watercourses and escarpments. Many were rerouted or displaced by urbanization rather than effectively incorporated into subdivision plans right at the beginning.

Trails are now an integral part of the City's open space and alternative transportation system. This means their location, routing and purpose needs to be better articulated in subdivision design. Similarly, with ever increasing use and public support, relocation and displacement are not the only mitigation measures that need to be considered to prevent overcrowding and a reduction in the quality of the user experience as the UCB area is built out.

Connectivity may require new trails allowing for seasonal and year-round use. Determining appropriate setbacks, buffers and even setting aside other areas to compensate for displacement need to be considered at the detailed design stage.

This includes recognizing that crossings of major arterial roads such as Hamilton Boulevard or the Alaska Highway, and watercourses such as McLean Creek require the same careful attention as planning the road network. The UCB boundary itself should not be considered a fixed boundary particularly from a trail development perspective. Accessibility, convenience and mobility are also interconnected considerations.

The large undeveloped green space outside the UCB boundary bordered by McLean Lake on the west, the Copper Haul Road on the north, the former Whitehorse Copper mine to the south and Copper Lake to the east could be instrumental in this regard. This area is characterized by varied micro-terrain features, rock outcrops, and open pine forest: key pre-requisites to develop a network of future high-quality trails as the UCB is built out.

The following mitigation measures are recommended to minimize the potential for negative impacts to recreational values in the study area in the event that development proceeds:

- Establish a minimum of 40-metre setbacks from ridges to provide for trail corridors, maintenance of viewscapes and further adjustments where bank stability may be an issue;
- Encourage a minimum 40-metre development buffer from Quickie, R&D, Midnight Run, Blair Witch, Midnight Run, Sparky and unnamed Canyon Creek single-track trails, with partial reroutes potentially acceptable on the southern leg of Quickie, R&D, Midnight Run and Sparky if necessary;
- Plan and construct motorized access corridors to connect to regional motorized trails to prevent incursion into valued single-track trails;
- Retain the Rock Gardens as a unique climbing area and maintain access corridors from Hillcrest, Lobird and Hamilton Boulevard;
- Maintain a development buffer around the quarry leases and McLean Lake and provide rustic facilities to minimize impacts from visitation by a larger nearby residential population;
- Maintain the loop route options from the Lobird and Squatter's Road areas;

Rock Gardens climbing area (JOAT)

- Maintain both designated and informal motorized "out and away" routes from Copper Ridge, Lobird, and Squatter's Road connecting to McLean Lake and the Copper Haul Road; and,
- Define and develop strategic trailhead locations with appropriate signage, parking and information on trail use behaviour to prevent user conflicts.

3.0 SERVICING CONSIDERATIONS

The water and sanitary sewer servicing considerations for the SUCB area have been based on a desktop review of the existing 2003 City of Whitehorse Water & Sewer Study. In general, this study provided good information on the City's entire water distribution and sewage collection networks. However, this aging report requires updating which would provide opportunity to further investigation into servicing options for the SUCB. Additional modelling has not been completed for the proposed options discussed within this report. It is further noted that since the publication of the 2003 report, the City's water source has migrated from a combined surface and groundwater source to a complete groundwater source. The population values presented within this section are specific to the City's current groundwater supply.

3.1 Water Supply and Distribution

Currently Whitehorse's water supply is drawn from multiple wells in the Riverdale aquifer located in the Riverdale subdivision. The existing supply and distribution network for the City's water is estimated to support approximately 32,000 people based on the current well supply infrastructure. According to the 2003 City of Whitehorse Sewer and Water Study (Stantec), water supply alternatives for the SUCB area would include the following:

1) A new twinned transmission main following Hamilton Boulevard;
2) An independent supply line and water treatment/pump station from Schwatka Lake;
3) Independent ground water wells; and,
4) A new transmission main along the Alaska Highway from Two Mile Hill to Robert Service Way and associated new pump house.

The 2003 study indicates that the Hillcrest and the Copper Ridge reservoirs combined can service an additional 2,027 new residential units and the accompanying commercial, institutional and recreational facilities. Further modelling is required to confirm the operational and ultimate capacities of the existing reservoir system and relate these to the proposed population densities for the SUCB as predicted growth for the reservoir service area will have changed since the 2003 study.

To achieve a robust urban level of service for the SUCB the team would recommend water distribution options that provide the SUCB area with two distinct connection points to provide adequate domestic, fire and pressure water supply. Please refer to **Figure 9** for conceptual layouts and connection points.

Generally, we would recommend an extension of the existing Alaska Highway transmission main and a secondary connection from the Copper Ridge distribution system. It is envisioned that the main supply line from the Alaska Highway transmission main would provide the primary water supply to the SUCB area with an expanded Copper Ridge reservoir providing the main pressure zone along with a secondary connection to the City's distribution system.

An expanded Alaska Highway transmission main would require a pump station to be located along the Alaska Highway with a new transmission main connection extending west up to a new reservoir located adjacent to the existing Copper Ridge reservoir.

This would allow water to be distributed throughout the SUCB from that location.

Although the SUCB area does contain a significant amount of relief, we do not see the need for a second reservoir in the area. Individual pressure zones in the lower portions of the SUCB area would be regulated with localized or individual pressure reducing valves. Detailed water modelling would be required to confirm the operational requirements of new infrastructure in the SUCB area.

The existing Copper Ridge reservoir would continue to act independently serving Copper Ridge while a new reservoir would be constructed adjacent to it to service the SUCB. Although separate systems, we envision the ability to draw on the existing reservoir and distribution system in Copper Ridge to provide additional supply or backup water to the new SUCB system depending on the ultimate selected development option.

There is good potential for a distinct looped water system within the SUCB. Depending on the development phasing and operational considerations, circulation and re-chlorination points may be required within any new water distribution system.

Highlights

- Water supply distribution is feasible to the SUCB based on desktop review;
- Updates to the 2003 Water & Sewer Study and additional water modelling are required to further water servicing discussion for the SUCB;
- Water supply would come from extension of the Alaska Highway trunk main; and,
- Copper Ridge Reservoir would need to be twinned.

Lobird has its own water distribution system operated by the property owner. However, it would be prudent to integrate these two systems as a new piped distribution system is expanded into this area to provide a consistent level of service, enhance water quality, and improve water security in this subdivision.

The ad hoc layout of the Squatter's Road/McLean Lake area lots pose challenges (and additional costs) to supply piped water via a standard looped system. A secondary backup connection to the main transmission line into this portion of the SUCB will be required. This secondary connection downstream of the proposed pump station would likely require active pumping to ensure adequate pressure. It would be used only for emergencies or short durations (i.e., during routine maintenance).

To implement a new water distribution system for the SUCB it is recommended first looking at the existing and expected future capacity of the supply infrastructure in Riverdale. Depending on the results, the capacity along the proposed distribution route through Downtown, the Two Mile Hill Booster Station and along the Alaska Highway trunk main would be evaluated further. Initial steps required to facilitate SUCB development would include expanding the Alaska Highway trunk main to the south, confirming the appropriate location for the new pumping station and the most practical routing of the new main up to the proposed new reservoir adjacent to the existing Copper Ridge facility. The assessment would also confirm the new reservoir expansion requirements.

At the detailed design stage, engineers may also wish to look at the possibility of creating a new water transmission route along Robert Service Way to provide an alternative supply for the SUCB.

Although we do not believe this is cost effective at this time, costs and feasibility may become more attractive, depending on the timing, servicing needs and nature of future development planned along Robert Service Way[5].

Domestic water wells in the SUCB are expected to be highly variable and there is a risk of low groundwater yields and potential for water quality and well maintenance concerns. Drilling of wells will likely be "hit-or-miss", with the high costs of well drilling potentially constraining residents' ability to drill additional wells should initial wells not provide adequate yield. Even if multiple wells are drilled on a lot, it may not guarantee that required yields are met.

Costs to install water wells typically depend on a variety of factors including depth, type of installation, size of well, location and problems encountered during drilling. It is anticipated that the water wells will typically be sized for domestic supply (approximately 150mm diameter), and installed according to typical domestic well design by a local contractor. The single greatest factor influencing well installation costs is typically well depth. Bedrock wells are often deeper due to the need to encounter bedrock fractures to obtain sufficient flow for water supply. Water wells in the Lobird area are up to 200m deep. Similar conditions and depths may be encountered throughout the area.

In general, expanding the City's current water distribution network to service future development within the SUCB area is feasible. However, to determine optimal service approach, system upgrade requirements and associated costs, further engineering assessment is required to refine the proposed servicing solutions presented once a confirmed development area and approach has been finalized.

It should be noted that some wells in areas adjacent to the SUCB show high uranium concentrations. This means that systems may require point of entry uranium removal using either an ion exchange or reverse osmosis. The cost to install, operate and maintain this type of system should be considered in cost estimates. Recent expansion of the Yukon Government Domestic Water Well Program may provide access to financing for rural lot owners to develop wells in any new country residential zoned lots should they be considered in the SUCB area.

In summary, we recommend looking at the existing and expected future capacity of the water well supply infrastructure in Riverdale first as this is likely to be the most straightforward supply management solution if sufficient capacity exists (or can be reasonably expanded to increase production capacity).

An overview of servicing considerations is shown in **Figure 9**.

Highlights

- The private Lobird water system should be integrated into the public system when feasible.
- Drilling private wells will be "hit or miss" and high uranium concentrations may be encountered requiring special treatment
- The existing and expected future capacity of the Selkirk aquifer in Riverdale as a potential water supply option should be explored.

[5] A land use plan for the Robert Service Way area will get underway in early 2017.

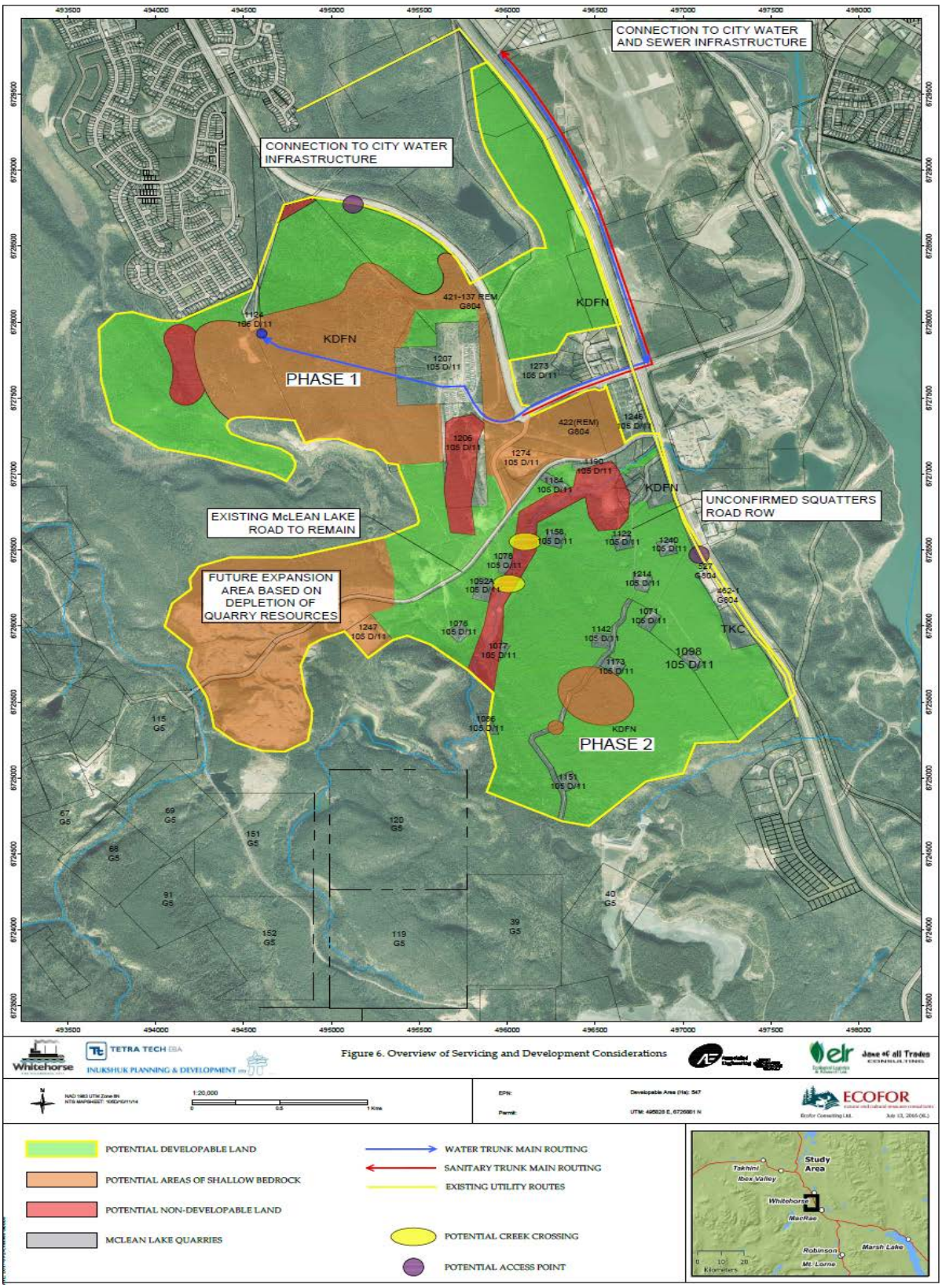

Figure 9: Overview of Servicing and Development Considerations

3.2 Sewage Collection and Transmission

In general, the City's sanitary sewage is collected and discharged for treatment in the Livingston Trail Environmental Control Facility (LTECF). This facility has an estimated service population of approximately 36,000 to allow for future growth. As such, the estimated expansion within the SUCB area would exceed the current design level for the City's existing sanity sewage treatment infrastructure.

The current sewer system servicing Copper Ridge does not have the capacity to service a residential development in the SUCB to an urban standard. Substantial upgrades to the existing pump stations and trunk main infrastructure in the Copper Ridge/Granger area would be required to connect the SUCB to the existing service collection system. The 2003 City of Whitehorse Water and Sewer Report suggests that a new lagoon system be investigated for the SUCB area; however, based on our assessment of available land, environmental sensitivities, and the prevailing southerly winds, the team does not view this option as viable to support development within the SUCB.

Onsite mechanical treatment of collected sewage could be a viable solution but is not considered practicable at this time. Currently, there is not enough information on the capacity of possible watercourse drainages near the SUCB (i.e. Logan/Arkell wetlands and McLean Creek) to assess the practicality of discharging the treated effluent into them. With the proposed population of approximately 16,000 people the estimated volume of wastewater produced would be approximately 6900 m^3 per day (based on 500L/day/person with 80% retained as sewage). This amount of discharge may be problematic to dispose of in either the Mclean or McIntyre creek drainage systems without a very detailed study of hydrological capacity and a careful assessment of the effects of the additional flow volumes on watercourse environmental integrity.

McLean Creek is unlikely to be suitable because it enters a subsurface regime prior to reaching the Yukon River. McIntyre Creek may be a possibility because it flows through the Logan-Arkell wetlands system which can act as a filter but again would require detailed study and comparison with a piped sewage discharge option.

Upper cell of Lobird Sewage lagoon system (ELR)

The SUCB could be serviced via the construction of a sanitary sewer main that ties into the Downtown trunk system (Trunk 1) and ultimately Lift Station #1 and eventually the Marwell Lift Station. A connection point to the existing City sanitary system is shown in **Figure 9** on page 25. Major upgrades would be required to accommodate the additional flows in the trunk mains and associated lift stations of this catchment area.

Since the present system is already at capacity, upgrades will be required regardless. As such, any transmission main upgrades along this general route could be planned and coordinated to account for future SUCB development needs. This planning work is recommended to be incorporated into an overall update of the 2003 Water & Sewer Study.

Highlights

- Lagoon system is not feasible;
- Onsite mechanical treatment not feasible as this time;
- Connection to City Sanitary Trunk 1 system is feasible but it would require major upgrades;
- Updates to the 2003 Water Sewer Study are required to address specific upgrades required within the Trunk 1 system; and,
- Connecting the existing adhoc McLean Lake country residential lots into a piped collection system would be technically challenging and expensive.

In general, the relief provided within the SUCB enables a gravity collection system servicing lift stations to transmit the collection toward the existing sanitary collection infrastructure near the Erik Nielsen Whitehorse International Airport. We envision the existing Lobird lagoon treatment system being decommissioned and eventually remediated to parkland status. Under such a scenario, any proposed gravity system to service the SUCB area would need to involve tying the existing Lobird system load in for ultimate conveyance to the LTECF.

There are several reasons for incorporating Lobird sewage collection into a future SUCB system. First, as with water supply, the sewage system is privately owned and operated by the Lobird Trailer Park owners. Knowing the infrastructure condition and remaining service life of these systems is critical to integration planning.

Second, it is difficult to project future capacity needs especially if the owner decides to redevelop the property to a higher density at some time in the future. Third, the presence of the existing sewage lagoons imposes restrictions on the type of development that can be undertaken within a specified distance of the operating area, indirectly restricting future residential possibilities on lands beyond the current property owner's boundaries.

Existing individual residences in the McLean Lake portion of the SUCB could be connected to a proposed sanitary collection system; however, this would pose increased technical challenges and costs. The 1ha minimum lot size of these former squatter residences was intended to allow for onsite septic systems and drilling of private water wells. Again, the ad hoc layout of these lots complicates their integration into a functional urban style collection system for the purposes of increased development density. As each individual system has been installed without planning for future development, the invert grades would likely restrict any central sanitary collection system. Overcoming this challenge may involve each residence having a pump to lift the sewage to a level where it can be discharged into an overall gravity system, regardless of existing invert elevations.

The potential for on-site sewage disposal within the SUCB will be somewhat variable. Soil absorption systems require a minimum of 1.2 metres of separation between the absorption field piping and the top of a bedrock surface, seasonal high groundwater, or any other impervious surface.

The shallow depth to bedrock and high groundwater table likely to be encountered throughout the study area may make installation complicated and expensive for property owners. In areas where near surface or exposed bedrock is encountered, absorption field preparation will require importing significant volumes of accepting soil to facilitate treatment and disposal.

Previous percolation test results from this area suggest that the near-surface ablation tills and sandier soils had acceptable percolation rates for on-site sewage disposal system installation. In light of anticipated variation in the proportions of silt, sand and gravel, feasibility of septic field construction should be evaluated on a lot-by-lot basis and alternate sewage disposal systems may warrant consideration on lots where the topography does not support conventional on-site sewage disposal system construction.

The potential for impacts to groundwater quality from on-site sewage disposal will depend on lot size and connectivity between the shallow overburden aquifer (if present) and the deep bedrock aquifer where residential water wells will likely be constructed. Bedrock aquifer hydraulic conductivity is dependent on the presence of fractures. This connectivity can be highly variable depending on the fracture geometry and the thickness of the overburden.

Nitrate ($N0_3$) sourced from on-site sewage disposal systems has been identified as a chemical of concern that could impact groundwater, particularly in areas where the water supply comes from private water supply wells. Impacts include adverse health effects (Hagerty et. al. N.D.) and if discharged into surface water, excessive plant and algae growth can deplete oxygen levels that can affect aquatic life in general and harm early life stages in aquatic organisms (CCME 2009).

Consideration should be given to lot sizing based on the potential for nitrate impact. A mass balance analytical model can be used to predict contaminant concentrations based on actual (or assumed if sufficient data is not available) hydraulic conductivity, hydraulic gradient and groundwater flow directions. Through the use of an analytical model such as this and an appropriate factor of safety, lot sizes can be adjusted to minimize risk of impact to nearby groundwater users. In typical situations where residents are relying on groundwater supply and on-site sewage disposal, a minimum lot size of 1ha should be assumed, at least until further assessment is conducted to refine the sizing based on actual subsurface conditions.

Nitrate concentrations can also be reduced through the use of mechanical treatment systems, allowing for an accompanying reduction in lot size – a technique applied to Phase 2 of the Ravens Ridge subdivision. Potential impacts from nitrate loading can also be mitigated through the use of a filtration system if concentrations exceed drinking water guidelines (regular testing of the water by the individual home owners will be necessary). Since groundwater quality will depend on the level of loading, larger lot sizes will reduce the potential for on-site sewage disposal to have negative impacts on the groundwater quality.

Phasing of the sanitary infrastructure would assess existing and future capacity of the lagoons and trunk lines and lift stations along the proposed flow route to determine the required off-site upgrades, working back towards the SUCB area. The trunk system within the airside boundaries of the Erik Nielsen Whitehorse International Airport would require additional detailed planning to facilitate extension.

For ongoing operation and maintenance consideration the City may wish to investigate the possibility of relocating this portion of the trunk system outside the airside boundary for future ease of maintenance and operations.

At this point, we can conclude that the LTECF capacity will be exceeded before build-out. While lagoon cell capacity can be readily increased, future development should examine measures to reduce per capita water consumption to reduce accompanying wastewater production volumes. Limiting clean water flows will help to increase the effluent concentration for successful treatment processes within the existing lagoons, as well as lengthen lagoon lifespan.

3.3 Transportation

The 2002 City-Wide Transportation Study (UMA) concluded that a two-lane extension of Hamilton Boulevard to connect to Robert Service Way would have sufficient capacity for an additional development such as the SUCB. With this road now constructed and providing a critical transportation link for a potential SUCB, further investigation would be required to determine to what extent, if any, Robert Service Way and/or Hamilton Boulevard would require additional lanes to accommodate increased traffic volumes.

The City recently completed and opened a McLean Lake Road spur off of the Hamilton Boulevard roundabout with the expectation that quarry-related traffic will be redirected away from the present McLean Lake Road/Alaska Highway intersection. The existing Mclean Lake quarry operations are expected to continue for the foreseeable future, with a possible expected lifespan into 2041. The industrial traffic is almost certain to remain on McLean Lake Road, which may require further upgrades and hard surfacing given the revised estimate of remaining quarry life.

The Government of Yukon commissioned a functional plan for the Alaska Highway corridor in 2015. Segment 3 of the plan envisions the removal of the McLean Lake Road and Squatter's Road intersections at the Alaska Highway. The eastern-most segment of the Mclean Lake Road was recently closed to industrial traffic and industrial users rerouted to the Hamilton Boulevard roundabout. One option would be to tie Squatters Road back into the eastern-most portion of McLean Lake Road via a service road in the highway right-of-way. The McLean Creek culvert would need to be extended.

In general, the 2015 Alaska Highway functional plan does not appear to address the possibility of a major subdivision development within the McLean Creek area or broader SUCB study area. Such a development will have major impacts on the local transportation network, including the Alaska Highway, with increased traffic volumes and the potential need for additional intersections.

We understand the City hopes to work closely with the Government of Yukon with the aim of creating a functional plan that meets the needs of all parties. Upon completion of these discussions, the routing of the McLean Lake and Squatter's Road may be revised further and connections to the Alaska Highway potentially retained. A joint planning effort is needed to ensure that the highway functional plan better integrates the active transportation and transit requirements of the SUCB area with the needs of a major highway.

Were the southern/McLean Lake area portion of the SUCB to be developed to an urban density standard, a crossing of McLean Creek may be required in the vicinity of the spur road connector. A looped internal major collector configuration is preferred to balance traffic loads, facilitate bus service and provide a secondary access for emergency/evacuation purposes. A crossing would allow for traffic and pedestrian travel between the northern and southern portions of the area, as well as provide more direct access to Hamilton Boulevard and the Alaska Highway via the intersection with Robert Service Way. Current residences along the McLean Creek corridor, terrain risk concerns and other environmental values present will limit the potential for crossing locations. From an environmental perspective it would be preferable not to establish such a crossing but in this case a compromise may be necessary for efficient circulation and access as well as the extension of utility infrastructure.

Although not considered in the functional plan, at least one new access point on to the Alaska Highway south of Squatter's Road may be required if the McLean Lake area is developed to a higher density. Possible location options are shown in **Figure 9** back on page 25.

Option #1 has not been allowed for within the functional plan while a formal intersection is allowed for in Option #2. The second option poses terrain challenges because of the steep grades off the highway, and further study is required. Any proposed access points would be part of an overall transportation study of this area. It will also need to consider the outcome of the Robert Service Way Planning Study currently underway.

While the Alaska Highway upgrade includes a provision for a multi-use trail within the highway right-of-way, the selection of crossings should consider integration with the trail network used by walkers, cyclists, etc. For example, there is a trail that connects to the Weigh Scales along a powerline right-of-way and connects across the Alaska Highway to the airport perimeter trail and eventually to Robert Service Way near the Yukon Energy Corporation building.

The majority of the roadways constructed throughout the SUCB area will be built on a subgrade comprised of a morainal till veneer or mantle overlying bedrock. Some glaciofluvial gravel exists in pockets near the McLean Creek corridor and isolated areas with organics and/or wet silty soils (including pockets of discontinuous permafrost) may be encountered. It should be noted that streets and access road structure will vary based on whether an urban or rural standard is required for specific portions of the study area.

The till subgrade soils are acceptable for roadway construction; however, the silt content will make the subgrade soils frost susceptible. Subgrade preparation is critical since in a dry state, it will result in a very strong subgrade surface with decreased potential for frost heave. If allowed to become wet or saturated, the subgrade strength decreases dramatically and the potential for frost heave damage increases, as evidenced by a short section of the Hamilton Boulevard extension that poses ongoing maintenance problems.

3.3.1 Transit and Active Transportation

City of Whitehorse Transit Route 5 provides service to the existing Lobird neighbourhood. In a general sense, further transit expansion into the SUCB is feasible as the area develops.

Density, subdivision layout (five minute walking distance), trip origin/destination pairing and frequency are principal level of service standard considerations in operating a viable and efficient transit system. This is also why a looped road network is an important design consideration as increased transit usage is one of the City's important sustainability objectives.

Active transportation connections to the Downtown core are possible and should be incorporated into any future planning and design. However, the combination of distance between the SUCB and Downtown core and the elevation gain/loss between the two areas will pose a serious disincentive. To mitigate these issues, we suggest the following options:

- Shorten the length of the active transportation routes with trail improvements around the airport;
- Improve access between the airport bench and river valley to connect with the paved Millennium and Waterfront trails and the paved trail running parallel to the toe of the Downtown escarpment;
- Coordinate the active transportation routes with the Alaska Highway Functional Plan to improve highway crossing points;
- Focus on increasing commercial and public sector development within the SUCB to create a business hub to reduce overall commuter demands;
- Implement improved transit service to the SUCB area from the existing central business district; and,
- Investigate the feasibility of a grade separated crossing of the Alaska Highway to improve active commuter safety.

3.4 Power and Communications

Primary power and communication infrastructure already exists along the Alaska Highway corridor on the eastern boundary of the SUCB. This provides for a relatively simple and straightforward extension of these services into the SUCB. Secondary feeds would be possible via upgrades to existing networks in Copper Ridge.

ATCO is able to provide two primary points of connection to their existing distribution network. One is off the Alaska Highway at Lodestar Lane while the other is through their Copper Ridge sub-station. Additional sub-station infrastructure would be required in both primary connection locations to service the SUCB. It should also be noted that power from the dam goes to the McRae Substation first and returns along the Alaska Highway to Robert Service Way. It is not connected to the Lodestar substation.

Northwestel infrastructure would involve tying into the main fibre connection along the Alaska Highway. It would generally follow and be installed within the proposed internal UCB road rights-of-way as needed. Expansion of the cellular network would be required to provide additional bandwidth coverage for the expanded population within the SUCB.

The highest point of land for installation of a cell tower is in the vicinity of the upper Copper Ridge reservoir. It can easily be achieved with a facility expansion and would not require additional land.

3.5 Municipal Landfill

The SUCB area is expected to utilize the services of the existing City of Whitehorse Landfill located near the Porter Creek Subdivision. Based on the 2013 City of Whitehorse Landfill Cost Assessment Report (Morrison Hershfield) and discussions with the City of Whitehorse, the current landfill has adequate capacity. The landfill has capacity for additional development and population growth until approximately 2046 based on current waste diversion rate of 20%, which equates to a service population of approximately 43,000 people. However, the City of Whitehorse is undertaking steps to increase the diversion rates upwards of 50%, which would further extend the life of the landfill until 2057 and generate a service capacity of up to 51,000 people.

3.6 Underground Utilities Construction

The costs associated with deep and shallow utilities installation in bedrock is an important factor in determining the level of service standard used and density of development needed to recover higher installation costs. There is a direct relationship between the nature and cost of services provided at an urban versus country-residential standard. The principal difference is that some costs (e.g., drilling a water well, installing a septic system) are transferred directly to the property owner in a country residential development, whereas underground services are incorporated into the price of an urban lot. The assumption of responsibility for service costs also applies to the subsequent operating costs for either level of service.

While the City's overall objective may be to minimize the footprint of new development to reduce sprawl, applying a lower density of development in one area to compensate for local ground conditions may be justifiable and offset by applying a higher standard in another, when full life cycle costs and other values present are factored in.

Another option is to intentionally focus higher density housing in these areas using the same principle that higher density offsets the extra servicing costs by distributing those higher costs over more units.

The potential to encounter shallow bedrock in significant portions of the SUCB has been identified as a key issue.

Consistent cutline stand height within Lodgepole pine – bearberry – lichen forest west of Lobird often indicative of near surface bedrock (ELR)

Based on the results of the preliminary ground penetrating radar (GPR) investigation, it is estimated that 23% of the study area may be underlain by near surface bedrock. Further work will be required to delineate the spatial dimensions and implications for subdivision planning.

The work should focus initially along possible roadway corridors using a combination of geophysical methods such as ground penetrating radar accompanied by test-pitting.

Perched and shallow groundwater should be anticipated during deep utility construction. Contractors should be prepared to pump water and install bedding stone where seepage zones are encountered. Developers must be cognisant of the potential to form “hydraulic short-cuts” when utility trenches are blasted into bedrock and incorporate properly spaced ditch plugs in the deep utilities design.

The majority of the utility trenches would be excavated in morainal till soils (defined as a homogeneous blend of silt, sand, gravel and cobble or boulder sized pieces), which are considered to be good foundation soils as long as they are not saturated.

3.7 Sand & Gravel Materials Source

With the existing McLean Lake quarries located adjacent to the SUCB, it is assumed they will serve as the principal aggregate source for a future residential development. However, forecasting pit life is not an exact science. Pit life depends on the quantity and quality of aggregate material present, yearly demand, the rate of production and depletion, and the number of alternative sources available. In 2015, Inukshuk, in association with Tetra Tech EBA and Underhill Geomatics, published an updated, qualified assessment of quarry reserves and estimated pit life. The study estimated that approximately half of the city’s annual demand would be sourced from these existing quarry leases (100,000-125,000m³/yr.).

Substantive reserves remain in the McLean Lake area, not including the nearby Sleeping Giant deposit, which alone is estimated to hold 2.5M m³ of reserves. The remaining pit life for the McLean Lake quarry area is likely to be 35-40 years based on Tetra Tech EBA test-hole results and forecasted demand. The McLean Lake Quarry may still contain up to 4.542M m³ of extractable aggregate material comprised of 1.8M m³ of proven reserves and 2.635M m³ of probable reserves spread over the seven existing leases. This estimate will change over subsequent years with further exploitation and additional testing.

The timing and material volume requirements for residential development in the SUCB area are currently unknown. Using Whistle Bend as a proxy, we can assume development will be phased. This will affect the timing and volume of aggregate demand. It is also assumed that development of any UCB infill or expansion area will be timed to commence just prior to Whistle Bend build-out. It would be premature at this time to assume which UCB area might be developed first or furthermore - that all future development would only occur in these two areas.

Proximity to the existing quarries is a factor in development cost and given the uncertainty around timing, the team recommends that the 2015 assessment of McLean Lake Quarry life be reviewed every 10 years in conjunction with an update to the Management Plan. This will ensure the available aggregate potential is optimized.

For the foreseeable future aggregate mining will continue and an appropriate buffer for noise and dust control will need to be maintained. To date it has been assumed the eventual end use after extraction is complete would be industrial but given its location, it would be just as easy to reclaim this land for residential rather than industrial use. This option should be kept in mind during future OCP reviews to decades from now.

3.8 Level of Service Standards

Two levels of service standard options were considered. The first, full service option assumes paved roads, curbs, gutters and sidewalks with underground utilities consistent with urban City servicing standards applied across the entire developed area. It also assumes that areas such as Lobird (which has its own water supply and wastewater system) are absorbed into the city-wide system and, to the degree possible, brought up to modern standards.

The second, partial service option would be a modified country residential standard, which by necessity involves larger lots and lower density. In general, roads would be BST surfaced with ditches rather than curbs, and no gutters or sidewalks. Property owners would be responsible for provision of their own water supply and sewage disposal systems and power and telephone service would be provided through overhead lines to the property line. Garbage pick-up and disposal would be provided by the City.

It is important to remember that the intent of establishing an urban containment boundary is to reduce the urban footprint and increase density. It is not only a trade-off between initial capital cost (increased density distributes costs over more users) but also factors in the downstream operating and subsequent future replacement costs that need to be accounted for in life cycle costing. The other key considerations relate to housing choice and affordability.

Cost estimates are based on historical Whistle Bend development costs and are considered Class D (+/- 30%) estimates. Not included are owner costs, future study costs, GST, cost escalation beyond 2016, land costs, and legal survey costs. Offsite costs have not been included in the above estimates to allow simple comparison with other possible development areas. Offsite costs will be substantial and are discussed in **Section 5.0.** Cost recovery is largely dependent on the method of financing and typically, in the Yukon, on the degree of senior government support.

The preliminary estimate of development servicing cost has been prepared using Whistle Bend data as the base case for discussion purposes. The information should be used with caution. Upon further refinement of the developable areas and investigation of site-specific conditions, the initial per hectare costs may change.

On paper, the rural residential development option appears less expensive because the site servicing costs are transferred to the lot purchaser. Second, the lack of underground infrastructure eliminates the cost implications associated with potential pockets of shallow bedrock. Once the overall capital and on-going costs of drilling a well and installing a septic system are added in however, along with the lower net density, the rural residential option may not ultimately be less expensive, or for that matter - in the best long-term interests of the city as a whole.

Highlights

- Full and partial service level options are feasible but only the full service option is consistent with the UCB objective of a reduced footprint through increased density;
- Full cost recovery is assumed to be the minimum pricing standard; and,
- Added density and a compact urban form generate more taxpayers to cover downstream operating and eventual infrastructure replacement costs as well as improving affordability.

4.0 PLANNING AND DEVELOPMENT CONSIDERATIONS

While this is a pre-feasibility study, it is important that the larger city-wide growth management goals, objectives and policy context be considered. Many factors will affect the timing, pace, scale and nature of development that occurs. Perspectives may change as new information becomes available from the follow-up investigations recommended as part of this study and as the planning work itself is refined over time. It is likely, for example, that at least one more review of the City's Official Community Plan (OCP) will occur after 2017 and before a decision needs to be made on which Urban Containment Boundary (UCB) area will be developed next.

4.1 Guiding Legislation and Policy

The *Yukon Municipal Act* requires incorporated municipalities to prepare an OCP and Zoning Bylaw (ZB) with periodic updates to ensure currency and relevance to changing circumstances. Municipalities have the authority to determine how plans will be implemented through policy and bylaw. The Zoning Bylaw must be consistent with the direction set out in the OCP.

The concept of an UCB was introduced in the 2010 OCP as a growth management tool and a means to promote a compact, more efficient urban form. More recent master plans completed by the City, including the 2015 Strategic Sustainability Plan and 2014 Transportation Demand Management Plan reinforce the broad direction given by the OCP, focusing on efficient, low-impact transportation, dense and livable urban forms, and wilderness preservation.

The *Umbrella Final Agreement* (UFA) lays out the broad framework for the land management and land use planning inter-governmental relationship for the two First Nations with Settlement lands located within the NUCB, Kwanlin Dün First Nation (KDFN) and Ta'an Kwäch'än Council (TKC). The essence of the UFA is the encouragement of land management coordination and promotion of land use compatibility through joint planning initiatives. The KDFN and TKC Final and Self-Government Agreements also address land use compatibility and planning coordination. They acknowledge that both First Nations can enact legislation applicable to their own Settlement lands and enter into local service agreements for the provision and operation of infrastructure. Both agreements also provide for collaborative planning mechanisms.

Settlement Lands are classified as site specific, rural or community lands, and further defined as Category A, B and C. On Category A lands, a First Nation has surface and subsurface rights. On Category B lands they only have surface rights. Within the City of Whitehorse KDFN lands are also classified as Type 1, 2 or 3 in accordance with the degree to which self-government powers apply. On Type 1 lands, the First Nation has full self-government powers, whereas Type 2 and 3 lands confer progressively less powers. All KDFN settlement lands located within the SUCB are classified as Type 2. TKC lands are classified as B and C.

Over the past year KDFN has prepared and approved a *Traditional Territory Land Vision,* which sets out a broad framework for planning and land management within the traditional territory.

It is analogous to the City's OCP, with the intent to "ensure a consistent approach to the planning, management and use of settlement land based on the values of the Kwanlin Dün community"[6].

The vision articulates four main land-supported goals:

- *Conserve areas of high ecological value and maintain and improve the health of wildlife populations;*
- *Conserve areas of high heritage value, while maintaining and creating opportunities for Kwanlin Dün citizens' traditional use of the land;*
- *Develop opportunities to support the provision of land for individual citizens and for government needs to provide services to citizens; and*
- *Make lands available to generate revenue for the benefit of the KDFN community*[7]*.*

Within the SUCB, the primary purpose of the selected KDFN C-parcels is revenue generation and lands are identified primarily for residential and commercial uses. While revenue generation is a consideration, conservation of lands of high ecological value and ensuring land is available for traditional uses and governance needs are also land management objectives. TKC does not currently have an overarching land visioning document.

Development within the SUCB will trigger an assessment under the *Yukon Environmental and Socioeconomic Assessment Act* (YESAA). The Yukon Environmental and Socioeconomic Assessment Board may make recommendations to the authorities having jurisdiction whether a project should proceed, with or without conditions, or not proceed. Every land development project creates impacts, both positive and negative. The identification of potential impacts and mitigation measures at the pre-feasibility stage allows for project adjustments to be made to minimize potentially negative consequences.

4.2 Planning & Design Principles

The 2010 OCP sets out broad goals, objectives, principles and land management policies, connecting them back to the values Whitehorse residents feel are important. Several key OCP themes are particularly relevant to planning for the SUCB area. These include:

- Linking stewardship, environmental protection, sustainability and efficiency;
- Supporting inclusiveness, equity, culture, partnership, integration and accountability; and
- Demonstrating leadership and investment in energy conservation and participatory decision-making while preserving choice for future generations.

These themes and intentions for city growth management can be reflected in the following core principles intended to guide the SUCB residential development planning process. They are:

The neighbourhood as the fundamental building block

[6] Kwanlin Dün First Nation Traditional Territory Land Vision 2016

[7] IBID

Sustainable neighbourhoods require diversity and system integration so they can adapt to change over time without compromising foundational values such as walkability, access to transit, open space and efficient service delivery.

- ***The "do no harm" precautionary principle***

The intent of this principle is to address the risk of unintended consequences arising from a lack of sufficient information, knowledge and foresight, or holistic thinking about long-term consequences.

- ***Diversity helps maintain environmental integrity and resilience.***

Balancing environment, economy and community needs and values is the challenge. Diversity in urban form and housing type provides lifestyle choice while supporting broad community goals such as inter-generational living, aging in place, inclusiveness, affordability, etc. Ecological diversity respects the functions and roles of natural systems while economic diversity supports sustainable prosperity.

- ***System connectivity has consequential threshold effects on the provision and reliability of hard and soft services.***

The inter-connectivity and inter-dependency systems relationship applies not only from a service delivery standard perspective but is also a consideration in risk management. Without back-up systems there can be serious cumulative consequences. Connectivity is equally important to planning for parks, trails and protected area functionality.

- ***The planning process itself should be holistic, open, transparent, inclusive and participatory***.

This principle cannot be taken for granted though it would appear to be self-evident. Without a balanced presentation of facts, discussion of alternative scenarios and effective debate of values, trade-offs, and the cost/benefits of the choices available (including their consequential impacts for future generations) good decisions are difficult to make.

- ***Life cycle costing and asset management consequences are an integral part of land development planning.***

Full cost accounting considers the initial capital investment, the life cycle operating cost and the eventual replacement cost. It includes consideration of options and mitigation measures proposed in suggested trade-offs should be spelled out to assist informed decision-making.

- ***A commitment to best practices and leadership acknowledges that circumstances and needs change over time.***

This acknowledges that change is a constant and there are always unforeseen variables that come into play. Technology improves, and new creative solutions can be found by thinking out of the box.

- ***Demand side management acknowledges there are limits to growth and service threshold capacity points that need to be considered in promoting sustainability in practical asset management terms.***

Managing power demand through energy efficient construction, reducing per capita water consumption rates, increasing waste diversion, and promoting public transit to reduce traffic congestion are all tried-and-true practices that enhance liveability while reducing capital and operating system costs.

- ***The crime protection through environmental design (CPED) principle is becoming increasingly popular and is being expanded to address all forms of safety and risk management.***

Traditionally CPED was applied at a detailed site planning level but it can also be used in subdivision planning in several ways. Specific safety concerns such as wildfire risk and minimizing negative human/wildlife interactions are examples relevant to SUCB planning.

An example of achieving both equity and safety objectives would be the construction of a single sided street along an escarpment with a public trail along the top of the bank. The houses are more valuable because of the view, the public retains access to the trail, and the residences provide informal supervision of the public space.

- ***Walkability and liveability involves incorporating human scale design elements in building form and amenity space provision, streetscape and public facility location, layout and purpose, and differentiating between private, semi-public and public spaces. It also implies attention to providing affordable housing choices to accommodate a range of ages, income levels and lifestyles that will change over time as each neighbourhood develops its own character.***

This is consistent with the concept of "complete streets and neighbourhoods" and the ecological principle that diversity is the key to system health and stability, as well as inherent resilience and adaptability.

4.3 Big Picture Planning Context Considerations

The following is a brief discussion of some of the other relevant "big picture" considerations that need to be kept in mind as planning for the SUCB progresses.

4.3.1 McLean Lake Quarry Future

The fact that the McLean Lake Quarry has an anticipated 30+-year life remaining has two long-term implications for UCB planning. First, it has generally been assumed and reflected in the OCP that the end use for this area would be industrial. Second, the quarries are likely to still be in use when development of the SUCB is initiated. The associated noise, dust and seasonal truck traffic on the McLean Lake Road will need to be factored into how the development is phased.

The assumption of a final industrial land use in the McLean Lake Quarry area should be questioned in the 2017 OCP review. There is little difference between re-grading this disturbed area for industrial or residential use. Second, while this area would not be needed in the near term, it does include areas that are suitable for development and expansion of the SUCB in the future. Industrial use may not be the highest and best end use after extraction is complete. The City's pending 2017 industrial land supply and demand study may shed additional light on those needs.

4.3.2 McLean Lake, Paddy's Pond/Ice Lake and McIntyre Creek Regional Parks

The SUCB is located adjacent to or in close proximity to three of the five Regional Parks created by the 2010 OCP: McLean Lake, Paddy's Pond/Ice Lake, and McIntyre Creek. To some degree, these parks perform a large-scale mitigating function to future development in the SUCB because they encompass many of the significant ecological values in the area, and to a lesser extent, heritage and recreational values.

The riparian emphasis for McLean Lake Regional Park, coupled with its generally poor suitability for trail development, will constrain the potential for this protected area to compensate for lost recreational values in the SUCB area. Recreational use (i.e., particularly trail use and density is already relatively high in the Paddy's Pond/Ice Lake area, and much of the undeveloped area is similarly unsuitable for compensatory development. McIntyre Creek Park may be able to accommodate these needs better, but its distance from the SUCB is a limiting factor.

4.3.3 First Nation & Other Private Landowners

While both First Nations have private land interests in the SUCB, KDFN is by far the largest private landowner with two large land selections: C-57B close to Copper Ridge and C-24B in the heart of the McLean Lake area. Both were selected and identified for residential/commercial use. Perhaps the most relevant finding of this feasibility study to KDFN is that both areas are likely to have near surface bedrock, which will raise the cost of servicing.

A critical consideration to the First Nation is land tax exemptions, which expire 15 and 20 years following the signing of the Final and Self-Government Agreements in 2005. In the case of C-57B, that is 2025 while C-24B is earlier in 2020.

KDFN is now the largest private landowner within municipal boundaries. The First Nation has a vested interest in when and how development proceeds in the SUCB. It also has other smaller parcels within or adjacent to the study area along the Alaska Highway designated for commercial and industrial use. TKC has one selection in the south end of the SUCB adjacent to the Alaska Highway near Canyon Creek.

The Lobird Mobile Home Park is the next largest private land holding. Its significance to this study is threefold. First, it operates its own water supply and sewage disposal system, the implications of which are discussed in the servicing section. Second, the long, linear and narrow parcel configuration is centrally located in the SUCB, abutting KDFN lands to the west and Commissioner's land on the other three sides. Extending the Lobird access road through the property will be necessary to create an efficient circulation pattern and develop the adjacent KDFN lands.

Similarly, some form of public/private land swap as well as closure of the sewage lagoons will likely be necessary to effectively integrate the Lobird neighbourhood into the rest of the SUCB.

There are also approximately 19 scattered one hectare size country residential land parcels in the McLean Lake area. They were created during the squatter legitimization process in the 1990s. The 2000 McLean Lake Planning Area Study (Inukshuk) made an effort to integrate the scattered existing residential parcels into an overall development plan for that area.

The study concluded that a country residential development density model would be most suitable given the likely presence of near surface bedrock and the nature of land use to date. The study included a conceptual layout, portions of which remain relevant to this current SUCB study. The 2000 Plan did not include a McLean Creek crossing but moved the Squatter's Road intersection further south, adding another access off the Alaska Highway just north of Canyon Creek.

It should be noted that the planning study pre-dated First Nation land selections in this area as well as final routing plans for the Hamilton Boulevard extension and the McLean Lake Road rerouting to the traffic circle at Hamilton Boulevard connecting into Robert Service Way.

4.4 Population Growth

In 2016 the Yukon Bureau of Statistics introduced a new population projection methodology. In addition to high, medium and low projections based on standard demographic data sets, the YBS has added a "preferred" projection that adds the outputs of an economic factors model that looks at in-migration as a function of the economic performance of the Yukon.

The following chart presents the number of housing units required to house the projected growth in population over different time periods based on an assumed average of 2.2 people per unit. By 2030, more than 2,100 new housing units will be required at a minimum, with over 3,600 units required under a high growth projection. Note housing units do not equate to number of lots required because that is determined by density (e.g. Number of units/hectare).

Table 2: Population projection 2017 - 2030

Scenario	2017 to 2020	2021 to 2025	2026 to 2030	Total by 2030
Low growth	533	793	795	2,121
Medium growth	812	984	984	2,780
High growth	1,192	1,236	1,234	3,662
Preferred projection	762	1,236	836	2,835

Source: Yukon Bureau of Statistics special data request.

4.5 Forest Fire Risk

While proximity to wilderness has its benefits it also carries with it certain risks – chief among them are wildfires. The prevailing winds in the Yukon River valley in Whitehorse are south to north. There is an emerging consensus among forest fire fighting agencies and wildland managers that wildfire risk is steadily increasing for a variety of reasons including climate change. What the wildfire experiences of Kelowna, Slave Lake, and most recently Fort McMurray show, is that the intensity, speed, behaviour and severity of damage associated with wildfires is becoming more unpredictable and extreme.

Whitehorse has had several close calls over the years. It is no longer a question of "if", but rather "when". The literature suggests that while traditional fire smart activities help, they are not enough and are often carried out in an ad hoc manner after a significant event has occurred.

5.0 SUCB DEVELOPMENT FEASIBILITY

Feasibility is a highly subjective term. The context is important because it shaped the project approach and focus. In this study the priority was to accommodate future urban growth in a compact form. Thus development suitability looked at access, terrain conditions, proximity to existing services and the expected general planning and engineering requirements to achieve that aim. Weighing the costs and benefits of various trade-offs is a Council responsibility. This study identifies those trade-offs at a broad scale.

In a 21st century context, technical, environmental and engineering feasibility is only one part of the development equation: legal, social, financial and political considerations also figure prominently in determining highest and best land use. Feasibility can also be influenced by factors that can't necessarily be foreseen. The challenge is finding the right balance and flexibility to accommodate today's needs and preferences without unduly compromising future choices.

Geotechnical, hydrogeological, and terrain characteristics can be considered the core constituents of technical feasibility. Social feasibility speaks to the human-ascribed values present in the landscape, such as heritage and recreation. Environmental feasibility occupies a spectrum between the technical and social realms: countless urban developments of the past have proven the technical ease with which wildlife and habitat can be displaced, but modern-day social values around ecological preservation pose barriers to the continuance of such practices.

Legal and political feasibility are closely intertwined and provide a bridge between public institutions and social feasibility. Engineering and financial feasibility tend to exhibit an inverse relationship: theoretically speaking, engineering constraints can be overcome with infinite financial resources. The reality is virtually always different.

The key conclusion is this: the technical, engineering, and financial parameters of feasibility can be evaluated in a relatively neutral, objective way. The evaluation of feasibility according to virtually all other parameters relies on the careful weighing and negotiation of comparatively more value-laden, subjective considerations. It is not the role of the team to make those determinations, but rather to provide a solid baseline of information from which the potential value conflicts and trade-offs posed by development can be understood by decision makers.

With those roles in mind a preliminary determination of development feasibility was nonetheless explored. The team developed a revised study area as a means of revealing trade-offs and facilitating a quantitative assessment of engineering and financial feasibility. The general approach taken was to factor in known and strongly suspected technical constraints, incompatible land uses, and significant environmental, heritage and recreational values that do not obviously compromise the objective of optimizing the amount of potentially developable land. In this sense, the approach prioritizes the fulfillment of the primary purpose behind the Urban Containment Boundary (UCB) concept.

The following sections describe the revised study boundary and development assumptions proposed by the team and the degree to which the resulting SUCB concept is likely to satisfy some of the criteria underpinning social, legal, and political feasibility.

The resulting servicing costs and financial feasibility determinations are intended to serve as a "base case" from which the implications of adjustments to the development boundary can be understood at a broad level.

5.1 Description and Boundaries

Based on the results of the discipline-specific assessments and a balance of broader planning considerations, a revised SUCB study area was developed by the team for discussion purposes. The revised study boundary assumes the following:

- Approximately 167ha of environmentally sensitive area along the northwestern study area boundary and the portion north of C-57B are unsuitable for development;
- 110ha currently occupied by the gravel quarries could be reclaimed for residential use upon resource depletion and should be incorporated into the SUCB; and,
- The proposed McLean Lake and McIntyre Creek regional parks should be expanded to provide a greater buffer for the McLean Lake/Creek wetland area.

Within the remaining 792ha SUCB study area, additional assumptions are made regarding development feasibility. These are:

- Approximately 446ha (or 56%) of the revised gross area is developable;
- Approximately 170ha (or 23%) of the revised area could have potential near-surface bedrock, which could pose additional costs and complexity; and,
- An 11ha parcel will become developable after the Lobird sewage lagoon is remediated.

Figure 10 illustrates the revised boundary and land allocation considerations.

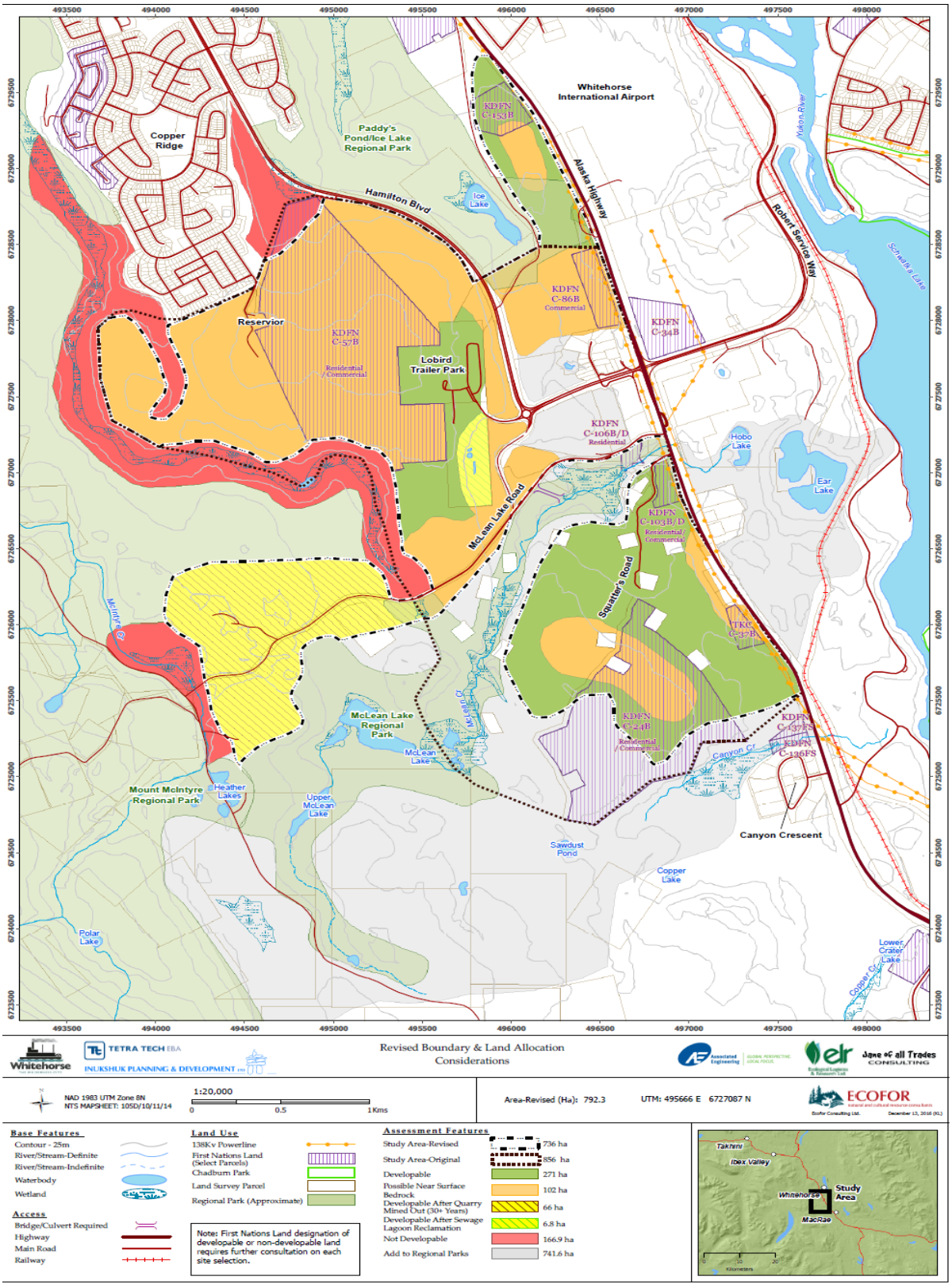

Figure 10: Revised Boundary and Land Allocation Considerations

5.2 Stakeholder/Partner Input

Development feasibility is typically evaluated against its ability to satisfy a pre-determined set of criteria. Not all criteria are created equal: some may be considered "musts" whereas others are "nice to haves". A variety of approaches, including criteria weighting, can be applied to ensure those nuances are captured at the evaluation stage. As a starting point, City staff and their Kwanlin Dün First Nation (KDFN), Ta'an Kwäch'än Council (TKC) and Government of Yukon (YG) counterparts were tasked with a criteria-based exercise at a daylong workshop in September 2016. It included the following steps:

1. Reviewing and revising a draft set of development suitability criteria;
2. Ranking the final set of criteria in accordance with priority to decision makers; and,
3. Evaluating the ability of the revised SUCB study area and development assumptions to satisfy each criterion on a 5-point scale (with 1 signifying strong disagreement that the criteria were satisfied and 5 signifying strong agreement).

For the most part, the SUCB area received average scores in the 2.5-3.5 range against the various criteria and a total aggregate average score of 50.23 out of a possible 85 points. The development suitability criteria and results of workshop participant scoring of the SUCB against those criteria are shown in **Table 3.**

Table 3: Performance of SUCB Revised Boundary against Development Suitability Criteria

Rank	Primary Criteria	Average Score
1	Respect/protect environmentally sensitive areas	3.45
2	Take wildfire risk management into account	2.73
3	Reflect highest and best use of UCB lands	3.36
4	Minimize overall urban development footprint	2.45
5	Integrate private/public lands	2.91
6	Avoid or protect known heritage values present	3.73
7	Encourage densification and servicing efficiency	3.18
8	Minimize significant landscape alteration to build	2.45
9	Acknowledge need for a range of affordable housing choices	2.8
10	Anticipate and promote multi-modal active transportation choices	3.09
	Secondary Criteria	
11	Need for best practices in infrastructure delivery and asset management	3.36
12	Integrate well with existing neighbourhoods	3.18
13	Overcome identified physical constraints	2.45
14	Maintain existing recreation assets	3.09
15	Address existing level of service standards and infrastructure deficiency threshold limits	2.82
16	Address spill-over effects beyond UCB into adjacent undeveloped areas	2.45
17	Incorporate and reflect direction in City plans and policies	2.73
TOTAL AGGREGATE AVERAGE SCORE		**50.23**
OUT OF TOTAL POSSIBLE SCORE		**85**

Workshop participant scoring reflected the general consensus that perhaps the greatest advantage of the SUCB is its proximity to existing urban development and the relative ease with which ecological values can be protected. The suspected extent of near surface bedrock and the associated costs were seen as the greatest disadvantages.

5.3 Capacity and Density

Using an industry standard ratio of 60% of gross area for lots, the revised study boundary area has the potential to provide a net developable area of 446ha. Based on a unit density of 16 units/ha and a unit population density of 2.2 persons/unit (both parameters provided by the City of Whitehorse as a guideline), the SUCB area could accommodate a minimum estimated population of 16,000 people.

Sixteen units/ha is a very low overall density for a large development. It is more consistent with a conventional Whitehorse subdivision like Copper Ridge and does not meet the UCB densification objective. The implications of increasing the overall SUCB density to match the actual housing mix of Whistle Bend Phases 1 & 2 are illustrated in **Table 4** and**Table** 5.

Table 4: Whistle Bend Phases 1 & 2 Actual Density and Number of Units

Lot Type	Area (ha)	% of total area	# of units	% of units	Density (units/ha)	Notes
Single family	12.5	44%	185	22%	14.9	Area taken from plan Number of units counted from plan Number of units from City's density estimate of 50 units/ha
Duplex	3.1	11%	68	8%	22.2	
Townhouse	2.4	9%	50	6%	20.5	
Multi-family	10.6	37%	528	64%	50	
Total	**28.5**	**100%**	**831**	**100%**		

Table 5: Density Implications of Incorporating Multi-Family Residential Housing into SUCB

Lot Type	% of total area	Area (ha)	Density (units/ha)	Number of units	Population per unit	Population
Single family	44%	194.7	14.9	2,892	2.2	6,363
Duplex	11%	47.9	22.2	1,063	2.2	2,339
Townhouse	9%	38.2	20.5	782	2.2	1,720
Multi-family	37%	165.2	50	8,260	2.2	18,173
Total	**100%**	**446**		**12,997**		**28,594**

Once built out, multi-family units will make up the majority of residences in Whistle Bend Phases 1 & 2 and, by implication, will house the majority of residents.

If the same ratio of multi-family residential development is applied to the SUCB there will be a significant increase in the number of residential units, with the accompanying population increasing to 28,594 people.

The increase in density may have significant effects on off-site costs if the increase in population hits threshold points that trigger the need for significant new investment in infrastructure upgrades (e.g., water, sewer, transportation, solid waste and power). These infrastructure systems do not necessarily all share the same threshold points. Knowing the infrastructure capacity thresholds influences development phasing, strategic infrastructure planning and timing of investment decisions from an asset management perspective.

Assuming that trench excavation and/or drill and blast techniques are employed, the SUCB area can be developed to an urban service standard. All servicing cost estimates have been developed with the assumption that an urban service standard will be desired by the City and its prospective development partners.

5.4 Development Phasing

Traditionally, phased subdivision development has provided a 150 – 200 lot supply to allow development to proceed under market-supported conditions. As such, the proposed developable SUCB area could produce a subdivision development comprising between 80 and 107 phases at 150 – 200 lots per phase. Other threshold considerations however, may affect both timing and size of each phase. For example, the ability of the water and sewage systems or roadways to accommodate the demands of new development will likely be exceeded unless their design capacities are increased in concert with the new development. The main considerations for phasing are:

- Market demand and keeping the 150 – 200 lot portions as consistent as is practicable;
- Providing looped water distribution to the development area as part of staged phasing via a master plan for the SUCB area. It may be necessary to construct some portions of water infrastructure in advance to allow for earlier phases to operate efficiently;
- Advanced construction of development wide supporting infrastructure is always a challenge in preparing the infrastructure phasing plan because of the implications associated with lower operational utilization levels during the early subdivision build-out period;
- Providing an efficient transportation network within the SUCB with convenient access to the Hamilton Boulevard roundabout. We also envision the eventual creation of a McLean Creek crossing to connect to the newly opened Hamilton Boulevard roundabout access from the McLean Lake Road if the extension into the McLean Lake area proceeds. This will balance traffic loads and facilitate future extension of transit service when warranted.
- The installation of associated infrastructure (e.g. water, sanitary and storm sewer) may require additional road construction prior to adjacent lot development Costs related to staged or early construction of development wide support infrastructure will need to be amortized over the life of the development;
- Planning underground infrastructure to efficiently service the phased approach to the entire development while minimizing the amount of infrastructure required beyond the immediate phases;

- Considering major onsite sanitary infrastructure development such as pump stations and force mains early in the planning stages through a master planning exercise to allow for efficient usage through a long-term development horizon; and,

- Undertaking storm water management planning, including sustainable options for climate change, early in the project feasibility stage upon acceptance within the OCP. It will be necessary to plan future storm water features in the SUCB and set aside the land required to accommodate such infrastructure in all phases. The construction of storm water management facilities for the entire development area may be required in initial development phases.

Overall, the SUCB is expected to require a number of significant infrastructure upgrades and capital investments to achieve the access and levels of service required to allow development in the area to proceed efficiently.

5.5 Development Costs

Cost estimates for the SUCB are generally based on information provided to the team for the recent Whistle Bend Subdivision on a per hectare basis. Quantity measurements for roads, grading, or linear infrastructure have not been undertaken. The cost estimates are considered to be Class D estimates appropriate for a pre-feasibility level of detail. Both onsite and offsite infrastructure costs have been estimated and will need to be updated as additional consultation and design are carried out in the future. Costs are presented are in 2016 dollars and additional considerations are highlighted.

5.5.1 Off-Site Costs

Cost estimates for offsite infrastructure are based on the proposed infrastructure requirements described within this document. As planning for the proposed development proceeds, boundaries will be further refined, and the housing mix and density determined by updating the project proforma. Similarly, completion of necessary updates to the City's infrastructure master plans will also inform the specific requirements for offsite infrastructure upgrades to support SUCB development. The associated costs can then be refined as well and adjusted.

Offsite costs have been based on average unit rates for similar infrastructure from past projects and are summarized in **Table 6**. An estimated $113 million in offsite development costs are required to support an urban service standard within the SUCB. Cost estimates for offsite infrastructure are based on the proposed infrastructure requirements described within this document.

As planning for the proposed development proceeds, boundaries will be further refined, and the housing mix and density determined by updating the project proforma. Similarly, completion of necessary updates to the City's infrastructure master plans will also inform the specific requirements for offsite infrastructure upgrades to support SUCB development. The associated costs can then be refined as well and adjusted.

Table 6: Estimated Off-Site Costs Associated with SUCB Development

Infrastructure	Cost Estimate	Notes
Reservoir	$8,500,000	Based on Valleyview engineering estimate
Extended Alaska Highway Water Main	$2,750,000	Water main to connect Airport South development area to SUCB boundary
Copper Ridge Water Main Connection	$500,000	Based on new water main connection and pressure reducing valve (PRV) station
Alaska Highway Water Pump Station	$3,500,000	Based on Whistle Bend water pump station and allowing for larger population
2 Mile Hill Booster Upgrades	$750,000	Estimate for new pumps and supervisory control and data acquisition (SCADA)
Riverdale Wells	$12,000,000	New pump house and two wells
Primary Sanitary Collection Pump House	$6,500,000	Based on Whistle Bend sanitary pump house and larger service areas
Sanitary Force Main to City Collection System	$2,500,000	Hamilton Boulevard to Lodestar Lane
Upgrades to Existing City Gravity System	$3,200,000	Lodestar to Lift #1
Upgrades to Existing City Lift Stations	$8,000,000	New Lift #1 and Marwell Lift upgrades
Upgrades to Existing City Force Mains	$2,420,000	Lift #1 to Marwell
Upgrades to Lagoons	$9,000,000	Assumes two new cells added to existing system
Alaska Highway Intersection (South End)	$950,000	Estimate only, will depend on Alaska Highway corridor improvements
Hamilton Boulevard Intersection	$750,000	Estimate only, will depend on final layout and traffic model
City Network Upgrades	$3,500,000	Allowance for various upgrades
Hamilton Boulevard Improvements	$3,250,000	Allowance for various upgrades
McLean Creek Crossing	$500,000	Multi-plate culvert structure similar to McIntyre Creek Alaska Highway crossing
Engineering Master Plans	$1,040,000	
SUCB Off-Site Sub-total	**$69,610,000**	
Contingency (30%)	$20,883,000	Includes allowance for all recommended studies
Engineering (15%)	$10,441,500	
Developer Costs (10%)	$6,961,000	
Permitting (5%)	$3,480,500	
SUCB Off-Site Total	**$111,376,000**	

5.5.2 Onsite Costs

A full service urban development standard consisting of full utility (water, storm, sanitary), shallow utilities (ATCO, Northwestel) and full surface works (full curb/gutter/asphalt surfacing) is assumed. In addition landscaping, developer and permitting costs has been added in.

The key cost drivers include:

- Whistle Bend Phases 1 & 2 onsite development costs - $650,000/ha (Yukon Government);
- Estimated Whistle Bend Phase 3 – 7 onsite development costs - $650,832/ha (City, Whistle Bend Phase 3 – 7 Report), with the following adjustments:
  - *In areas expected to have shallow bedrock, modified construction techniques may be required. Costs have been increased by 30% over the standard Whistle Bend costs to cover this[8];*
  - *The current area shown within **Figure 8** outlining possible near surface bedrock has been based on a desktop study and refined with limited ground penetrating radar. Further exploration of bedrock should be undertaken as it is a significant capital cost driver; and.*
  - *The costs of remediating the Lobird lagoon area have been incorporated into the per hectare development costs;*
- Remediation costs for Lobird lagoon area are based on a per hectare estimate;
- Municipal landfill costs for additional cells are not incorporated as they are considered an optional rather than capital cost;
- Landscaping costs estimate - $85,000/ha (Whistle Bend Phase 3 – 7 Report);
- Shallow utility costs - $75,000/ha (ATCO, NWTel);
- Developer costs – Assumed at 10% of net development costs; and
- Permitting – Assumed at 5% of net development costs.

Based on the key cost drivers outlined above and the calculated net development area, on-site development costs are estimated to be $439.3 million or $985,000/ha.

A breakdown of the on-site costs is shown on the following page in **Table 7**.

[8] This allowance has been based on a high-level comparison of costs within Yellowknife for developments with a low probability of bedrock and those known to be fully situated in bedrock.

Table 7: Estimated On-Site Costs Associated with SUCB Development

	Developable	Possible Near Surface Bedrock	Post Quarry Reclamation	Post Lagoon Reclamation	Non-Developable	Total
Gross area (ha)	452	170	110	11.3	49	792.3
Net area (ha)	271.2	102	66	6.8	-	446
Development costs ($/ha)	$650,000	$850,000	$650,000	$700,000		
Landscaping ($/ha)	$85,000	$85,000	$85,000	$85,000		
Shallow utilities ($/ha)	$75,000	$75,000	$75,000	$75,000		
Subtotal Costs ($)	**$219,672,000**	**$103,020,000**	**$53,460,000**	**$5,830,800**		**$381,982,800**
Developer Costs (10%)						$38,198,280
Permitting (5%)						$19,099,140
Total Cost						**$439,280,220**
Total Cost ($ per ha)						**$984,977**

Notes on **Table 7**:

- Costs are in 2016 dollars.
- Net development ratio of 60% of gross based on Whistle Bend Phases 1 & 2
- Per hectare development costs based on Whistle Bend Phases 1 & 2 provided by Government of Yukon.
- Contingency and engineering costs are included in the per hectare estimates.
- Accounts for remediation of lagoon area.
- Assumes quarry reclamation is carried out at the expense of the lease holder.
- Unit and population density provided by the City of Whitehorse.
- Assumption of average unit density of 16 per ha (a low density) gives 7,136 total units.
- Average of 2.2 people per unit gives a total service population of 15,698.
- Total population would exceed current well and lagoon design population of approximately 32,000 and 36,000 respectively (therefore the need for new wells and lagoons).

5.5.3 Conceptual Costs and Lot Pricing Implications

With Class D estimates for the on and off-site costs of SUCB development set out in **Tables 6** and **7**, it is possible to provide a preliminary estimate for the average lot price per housing unit. A straightforward analysis that distributes all costs across all units indicates that the average lot price per housing unit will need to be $76,456 to recover all costs, as shown in **Table 8.** Note that this high-level analysis makes the simplifying assumption that all the lots are developed and sold in a short time frame (see assumptions on phasing and inflation below) to allow a straight-forward comparison with current land prices.

Table 8: Estimated Average Lot Price in SUCB

Total hectares to be developed	446
Total number of units (16 per ha)	7136
Total off site costs	$106,283,500
Total on site costs	$439,280,220
Total costs	$545,563,720
Total cost per hectare	$1,223,292
Average lot price per housing unit for cost recovery	**$76,456**

Key issues and assumptions underlying the estimate of the average price include:

- Most of the on-site cost calculations are based on actual costs from the first two phases of Whistle Bend as described in the preceding sections and are considered very robust;
- The off-site costs are based on average unit rates of similar recent infrastructure as described in the preceding sections and are similarly considered robust estimates;
- The numbers used are not based on an overall master plan design for the area due to the very preliminary nature of the study. The final mix of lot size and type may vary significantly around the average price and, if the density is significantly higher - will push the average lot price per housing unit down;
- No allowance is made for any costs associated with phasing the development, e.g., an allowance for the cost of money incurred by the need to build off-site infrastructure in advance of lot sales; and,
- No allowance is made for inflation - all costs are in 2016 dollars.

It is important to note that these average lot prices are based on the assumption of a single family dwelling density figure; in reality, the cost per lot could be substantially lower if a mix of housing densities is employed (for example, multi-family high density development can be in the 40 to 100 unit/ha range).

To put the estimated average SUCB lot price per housing unit into a broader context, **Table 9** presents the average lot price for Whistle Bend Phases 1 & 2 for single family, townhouse, and duplex lots only.

The average price for each type of lot is from Government of Yukon Lands Branch 2015 sales data and the overall average price is calculated by weighting the total number of each type of lot sold by its 2015 sale price.

Table 9: Weighted Average Unit Cost for Whistle Bend Phases 1 and 2

Lot Type	Number	Average 2015 selling price	Percentage of total	Weighted cost
Single family lots	185	$119,154	61.1%	$72,751
Duplex (units)	68	$77,778	22.4%	$17,455
Townhouse lots	50	$77,778	16.5%	$12,835
Total	**303**			**$103,040**

Note that there was no separate price provided for townhouse lots at Whistle Bend and we have made the assumption that the price was equal to the per-unit price of a duplex lot for the purpose of this analysis.

The estimated cost per unit in the SUCB, at $76,456, is 26% lower than the $103,040 average for the mix of single family, duplex and townhouse lots sold in Whistle Bend phases 1 & 2. However, Whistle Bend also has several multi-family developments of different sizes that, if included, would bring the weighted cost down significantly. Increasing the density in the SUCB area will also lower the average lot price per housing unit.

It should be noted that development cost charges levied by the City are not included in the residential lot costs shown for Whistle Bend. These charges were generally deferred to the building permit stage of development. If the same approach is taken for the development of the SUCB then the estimates shown here remain comparable.

16 units/ha is a conventional low density subdivision. It represents the minimum lot yield to facilitate macro-level cost comparisons assuming full land utilization. Densification changes the ratio between lower and higher density housing types. Double the above density and only half the land is required to generate the same unit yield and population growth.

We are not attempting to bring multi-family lots into the average per unit lot cost comparison. The possible variations in size of multi-family lots, the unit density and the type of residence (e.g., condo versus rental) make this type of comparison too complex for this high-level analysis. To make a meaningful comparison that includes multi-family development as part of the mix, several detailed pro-forma scenarios would be needed. A sensitivity analysis of those scenarios would then help find the “sweet spot” between demand, cost, and price for different types of lots in the development.

Public policy will also play a crucial role by integrating social considerations and priorities including affordability and housing choices.

6.0 CONCLUSION AND RECOMMENDATIONS

The study team concludes that the development in the Southern Urban Containment Boundary (SUCB) area is technically and economically feasible.

The recommendations that follow speak to bridging the discipline-specific information gaps and "next steps" from a strategic, process-oriented standpoint. It assumes the City accepts the study conclusion and wishes to reserve the option to pursue some level of development in the SUCB area. While there is no immediate urgency to move forward immediately, the following discussion provides guidance on what actions can be taken to move forward in a strategic fashion.

6.1 Bridging the Information Gaps

The following is a list of outstanding information gaps identified by the project team. The team recommends these studies be completed prior to moving into detailed conceptual subdivision design. Much of the information will assist the City (and potential development partners) in meeting the requirements of the *Yukon Environmental and Socioeconomic Assessment Act* review process.

6.1.1 Geotechnical and Hydrogeological Considerations

Further consideration of the SUCB for development should be accompanied by:

- Installation of test wells to ensure adequate groundwater supply if on-site water supply wells for country residential development are contemplated in some portion of the SUCB area;
- Acquisition (if possible) and review of any information on yield, depth, and water quality from private water wells in the Squatter's Road area;
- Individual percolation testing at each individual lot to inform septic disposal system design;
- Further investigation of potential downgradient groundwater impacts from the Lobird sewage lagoons and McLean Lake and Sleeping Giant industrial development, including (at a minimum) review of inputs to the lagoons (volumes, concentrations) and estimated infiltration rate;
- Detailed geotechnical evaluation (including drilling boreholes) at a McLean Creek crossing to inform the more detailed recommendation for an appropriate pile design/installation;
- A more detailed geophysical evaluation is needed to better define the spatial extent and boundaries of the near surface bedrock including depth to estimate in-ground utility installation costs and determine if alternative servicing options should be considered further and incorporated into detailed subdivision design; and,
- The re-establishment of McLean Lake quarry reserve volumes in ten-year intervals, starting from updated 2015 study baseline.

6.1.2 Civil Engineering & Site Servicing

Given the size and intended function of the SUCB, the following information gaps need to be filled:

- Further investigate the impacts of increased traffic volumes from SUCB development on Hamilton Boulevard and Robert Service Way;

- Update the City Wide Sewer and Water Master Plan to account for the estimated population growth and servicing requirements for SUCB development;
- Update the 2002 City-Wide Transportation Master Plan to account for the estimated SUCB population growth and their transportation requirements. Address need for secondary Alaska Highway access points based on expected densities.

From a development phasing standpoint, the following sequence of steps should be followed:

- Confirmation of the development area boundaries to inform the next feasibility stage of planning, engineering, and design; and,
- Confirmation of the level of service standard desired by the City and its development partners.

6.1.3 Ecology

If the SUCB area is considered further for development the following data collection or refinement tasks are recommended:

- Complete ecosystem mapping at a more refined scale of 1:5,000 to provide a greater level of land cover detail and update the accuracy and completeness of the existing data (e.g., areas of disturbed ground and seral stages) and help guide other targeted surveys (e.g., bat surveys, rare plant and habitat surveys);
- Consider undertaking a bat day-roost assessment with targeted surveys due to the proximity of good foraging habitat contiguous to the SUCB and potential availability of day roosting habitat in the SUCB;
- In conjunction with completion of the ecosystem mapping at a scale of 1:5000, consider the need for additional targeted rare plant and habitat surveys; and,
- Complete wildlife surveys for the KDFN McLean Lake land parcel C-24B, Lot 1218 (e.g., breeding bird surveys, remote wildlife camera study, winter tracking survey).

6.1.4 Heritage & Culture

The HROA report for this area should be submitted to the Kwanlin Dün First Nation (KDFN) and the Ta'an Kwäch'än Council (TKC) for review and consultation with regard to traditional knowledge/land use. Should future HRIA work be conducted, all heritage resource sites identified, whether new or revisited; should be recorded as per the requirements outlined in the *Yukon Archaeological Sites Regulation* (O.I.C. 2003/73). Once recorded/revisited, specific heritage resource management recommendations should be made for each site that reflects the potential impacts associated with the proposed development that spurred the HRIA.

6.1.5 Recreation

An overall trail development and management strategy should be an integral part of the next stage of subdivision planning. This will ensure the resulting trail network is consistent with city-wide Trail Plan goals and integrated into the subdivision's parks, open space and alternative transportation network. In addition to mitigation measures, future development should embrace best practices in an effort to support and enhance recreational values and create a high quality of life for area residents.

Best practices include the creation of diverse "stacked loop" trail networks with appropriate signage to avoid user conflicts, provision of urban recreation features (i.e., playgrounds, skating rinks), incorporation of "on trend" amenities such as natural playgrounds and community gardens, and conformance to best practices of sustainable and user-oriented trail design.

Lastly, the development of new recreational trails should be considered in the interests of preventing overcrowding on existing trails and negative impacts on user experience. Towards this end, it should be noted that the area southwest of McLean Lake is characterized by varied micro-terrain features, rock outcrops, and open pine forest - key prerequisites for the development of high-quality trails serving a variety of users.

6.1.6 Forest Fire Risk Assessment

There has already been one significant wildfire scare in the margins of the Copper Ridge subdivision in the past decade. The lessons from Kelowna, Slave Lake and most recently Fort McMurray suggest that wildfire risk will increase in the future in both magnitude and intensity. Approximately forty percent of the study area contains old growth coniferous forest. The heritage assessment anticipates patches of culturally modified trees will also be present. Since old growth coniferous forest is more vulnerable to wildfire than deciduous forests, it would be prudent to assess both the existing and potential future wildfire risk so the necessary risk abatement programming can be integrated into subdivision design.

Such an assessment was not within the present scope of work but should be considered in the next phase of planning.

6.2 Making Sense of it All: Process "Next Steps"

With four phases of Whistle Bend remaining to be built out, any sense of immediacy around the decision to proceed or not with urban development in the SUCB may be muted. Nonetheless, the upcoming community discussions in the coming months around the review of the City's Official Community Plan (OCP) necessitates a thoughtful consideration of how to frame and rationalize the City of Whitehorse's thinking in regards to the SUCB area and its eventual use.

The September 2016 workshop held with City staff and their KDFN, TKC and Government of Yukon counterparts failed to yield a strong consensus on whether or not residential development in the SUCB was in the best interests of residents and/or governments. Consensus did emerge, however, around a desire to see the City and its partners proactively pursue development of other vacant lands – primarily First Nation-owned lands located in closer proximity to already existing subdivisions.

Furthermore, there was strong consensus that the City should remain committed to the vision of smart growth, higher densification, and sustainability articulated in the 2010 OCP and not default to the less sustainable practices (i.e., country residential) of the past.

As stated previously, it is ultimately Mayor and Council, with the advice of City administration and public input through the upcoming OCP review, who must weigh the complex and competing values at play in regards to prospective development in the SUCB. In addition to the planning principles and considerations highlighted in **Section 4.0** of this report, the City must not lose sight of the fact that the UCB concept in and of itself is a pro-active measure intended to check urban sprawl.

The broader objective is to encourage sustainable growth, which implies that development within it should be compatible with the aim of densification.

It needs to be understood from the outset that actually developing the constituent parts of a UCB, including the SUCB specifically, involves value trade-offs that may conflict with site-specific values present and other broader cost recovery objectives. This is to be expected.

The key question moving forward is how the City (and its prospective partners) maintains a principled, coherent, and consistent approach to the question of development in Whitehorse.

6.3 Big Picture Decision-Making Considerations

To that end, the team offers the following overarching considerations to the City as it approaches the upcoming OCP review and its determination of how to designate future land use in the SUCB:

- Creation of five Regional Parks in the 2010 OCP process effectively alienated 30% of the municipal land area from future residential development. The new park boundaries prioritize the ecological, heritage, intrinsic wilderness, and recreational values in the areas where they were understood to be most prevalent on a City-wide basis;
- Public expectations around protected areas tend to be high. Reversing a decision to preserve and protect green space is likely to encounter significantly more opposition than a decision to leave future options open if deemed to be in the public interest. Likewise, a decision to preserve options does not necessarily equate to a tacit decision to pursue them to the exclusion of other options that may satisfy the public interest to an equal or greater degree;
- Several recent City of Whitehorse-issued reports have cited a shortage of affordable land as a contributing factor to the significant escalation in housing prices that Whitehorse experienced from the mid-2000s to 2011. The reports stressed the importance of the OCP policy which supports maintaining a two year supply of lots and recommended that the City exercise its jurisdiction to prevent future land and/or housing shortages by facilitating housing availability and affordability;
- With staking within municipal boundaries under moratorium, and trail planning in the area largely complete including the establishment of McIntyre, McLean Lake, and Ice Lake/Paddy's Pond regional park boundaries, it is reasonable to assume that the SUCB area will remain more or less in its present state for the foreseeable future;
- Current residents may show a general disinclination towards the question of future growth and how to accommodate it. Both planners and public governments have to balance the interests of current residents with those who lack a voice – the residents of the future;
- Accommodating inevitable population growth in the capital region isn't solely the purview of the City of Whitehorse. The continued practice of country residential lot development outside City boundaries undermines sustainability as well as impacting wildlife and habitat protection at a much larger scale;

- Sprawl still exists because the demand is still there but the cumulative effects of such continued accommodation of personal interests comes at an ever increasing cost to future generations. This is also a major concern to both First Nation governments and merits a review and discussion of the Yukon government's current policy on land availability; and,
- At this very preliminary level of investigation, there are many unknowns. The precautionary principle can be taken as a directive to further study and seek to understand complex issues rather than to abandon further exploration of them.

Highlights

- The Yukon Bureau of Statistics population growth forecast expects Whitehorse to grow by 6,237 people between 2017 and 2030 requiring 2,835 housing units; and,
- Between Whistle Bend, infill redevelopment and modest increases in densification, the need to develop a new area can quite likely be postponed by 10-15 years.

6.4 Summary of Process Steps Going Forward

To move forward the following steps are recommended:

- Engaging the Government of Yukon and First Nations in the greater Whitehorse area around the development of a regional growth strategy that aligns with sustainability objectives;
- Assessing the action recommendations and partnership opportunities arising from the SUCB study conclusions;
- Reviewing the results and recommendations of the two pre-feasibility studies for the Northeastern and Southern Urban Containment Boundary areas with the affected partner governments (City/YG/TKC/KDFN) comparing and contrasting the merits of each;
- Consider reframing public input during the next OCP review around the question of *which* currently undeveloped areas within the Urban Containment Boundary – all of which hold high ecological, recreational, or other values – may be most suitable for future development, versus whether one or both should be developed at all;
- Should the SUCB area be retained as a future residential development option by the City, work with government partners to identify the key conditions upon which a future determination to proceed would be based and address the information gaps outlined in **Section 6.1** accordingly; and,
- Continue and prioritize discussions with the Government of Yukon and First Nation governments around creating an action-oriented, collaborative approach to optimize and integrate the development of First Nation settlement lands within the City of Whitehorse in an efficient and cost effective manner.

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8.0 TECHNICAL REPORT APPENDICES

The individual working draft background technical reports are available from the City of Whitehorse Planning Department. Components of those reports may differ from this report in terms of figure numbers; area estimates etc. and content edits. The salient features of these reports dealing with geotechnical matters, ecological considerations, recreation values and heritage considerations are summarized herein.

The civil engineering considerations were not written up as a separate report for several reasons. First key city-wide infrastructure reports were out-of-date. Second, the servicing concepts depend on having conceptual plan design options to evaluate. Preparing such concepts was not within the project scope and budget. Fourth, the findings of the other studies related to other values present and geotechnical considerations were needed to provide context for both conceptual plan preparation and servicing assessment.