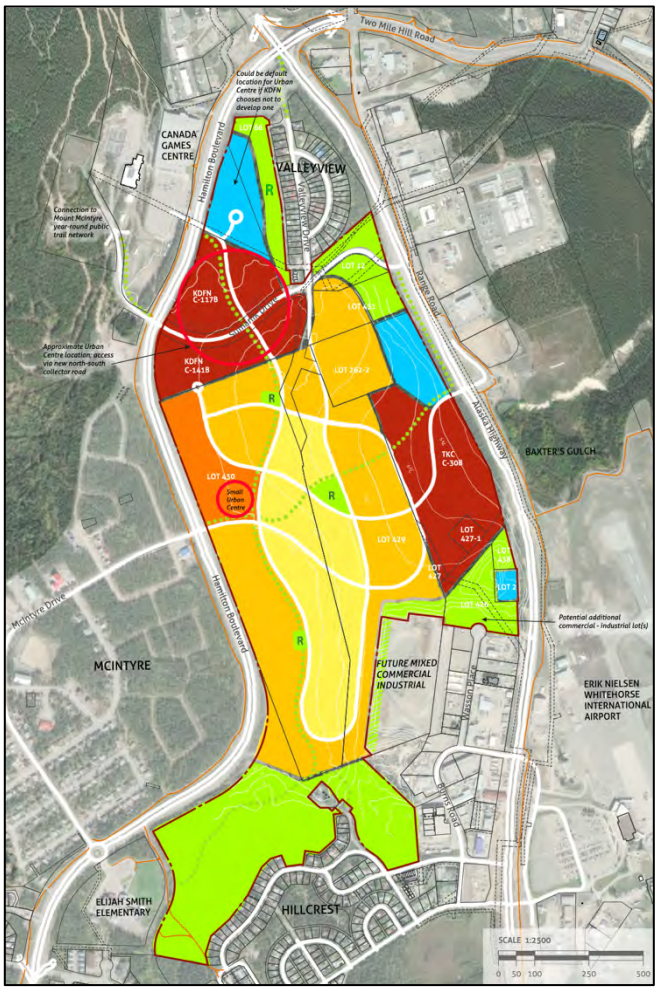
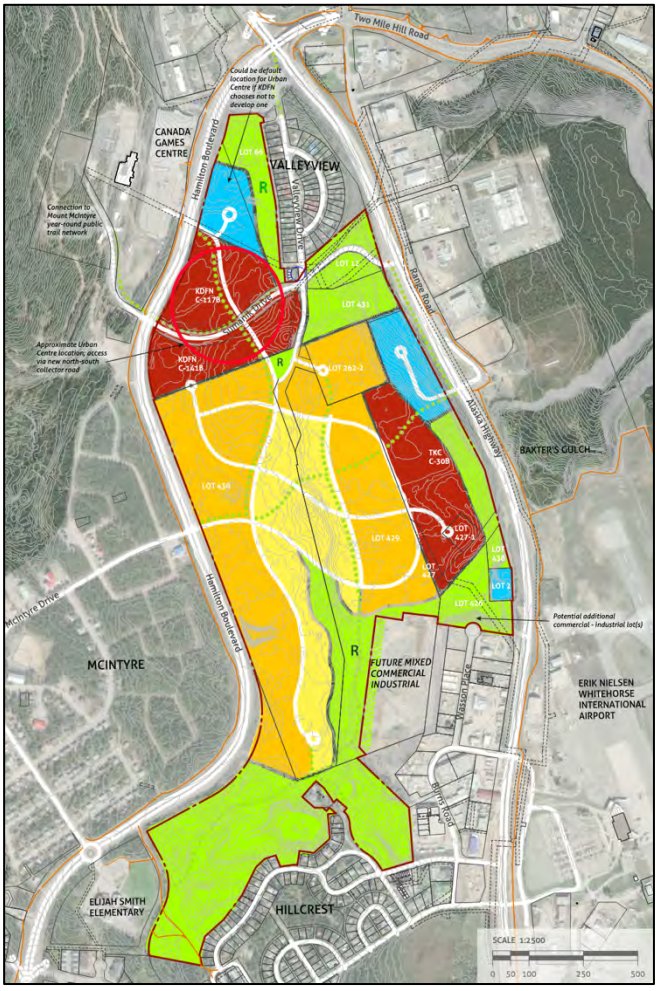
Valleyview South Master Plan

Development Scenario Brief





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JUNE 2023

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1.0 Introduction

The City of Whitehorse (hereinafter referred to as "the City") Planning and Sustainability Services Department is leading the development of a master plan for the area located between the Valleyview and Hillcrest neighbourhoods, referred to as "Valleyview South". The Valleyview South area is located near the geographic centre of Whitehorse and contains a mix of private, government, and First Nation land parcels. It has long been envisioned by the City for residential development. Refer to Figure 1.

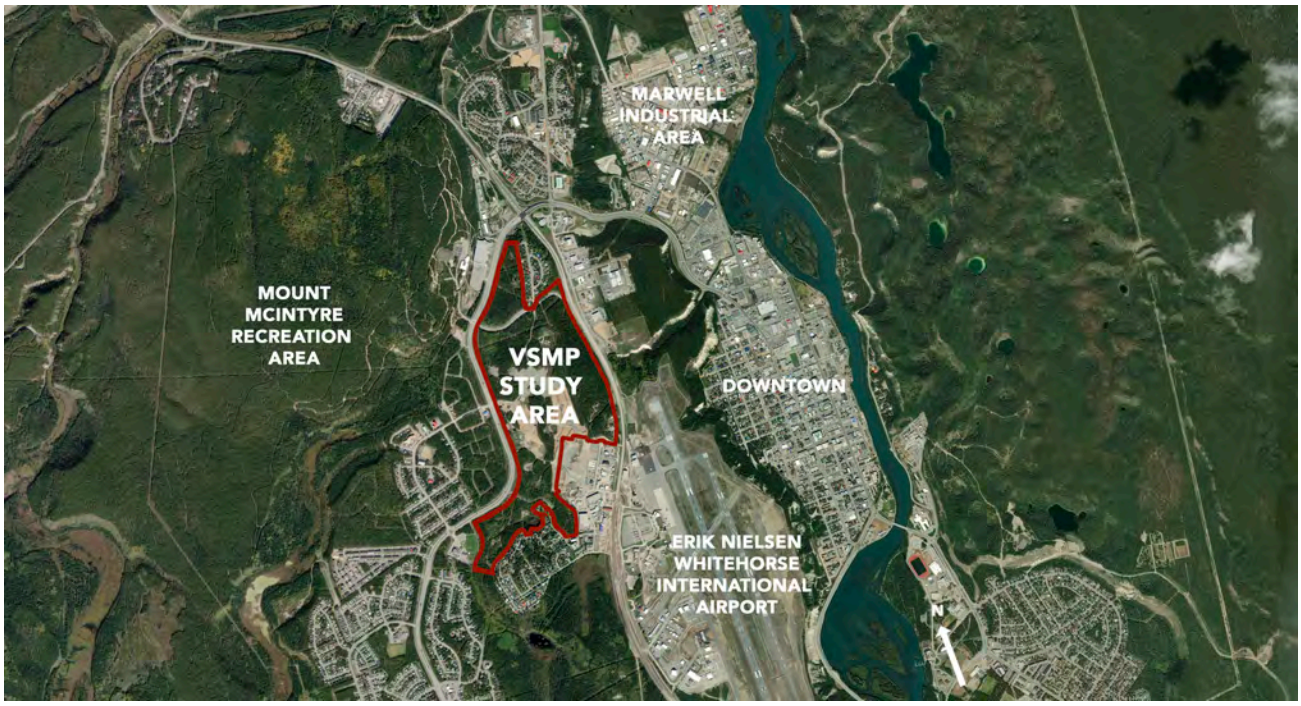

Figure 1. Geographic context of Valleyview South planning area

The Valleyview South Master Plan (VSMP) is intended to:

- Help accommodate the growth of Whitehorse's population and needs of future residents;
- Ensure the new development will fit in with existing neighbourhoods;
- Integrate the area with existing infrastructure, such as roads, trails, and water/sanitary systems;
- Identify and protect key environmental features;
- Provide direction on what types of land uses will occur, and where;
- Identify major future roads and active transportation corridors;
- Identify open space, parks, and trail connections; and
- Provide recommendations on all other relevant aspects of future development.

A multi-disciplinary team led by Groundswell Planning was retained by the City in September 2022 to undertake the Master Plan. The planning process is anticipated to take 12 months and is organized into 13 tasks under four phases, as shown in Figure 2 below.

Figure 2. Valleyview South Master Plan process

The City and other VSMP development partners (i.e., landowners with plans to develop) began Phase 4 work in January. A late January design charrette (Task 10) resulted in the preliminary outline of two concepts; since that time, partners have been working collaboratively to advance these concepts to a sufficient level of detail to facilitate high-level analysis.

This Scenario Brief represents the completion of Task 11 and provides an assessment, comparison, and differentiation of the two development scenarios, with a focus on:

- Proposed land uses, included anticipated population and density;
- Engineering aspects, including infrastructure and servicing needs and associated grading;
- Implications for known and/or potential contamination issues;
- Transportation network, including active transportation and transit;
- Financial implications, such as high-level capital and operating costs and tax revenues; and
- Potential evaluation criteria for the two concepts.

Each development scenario is visually depicted in the Land Use, Transportation, and Servicing Concepts found in Appendices A, B and C. More detailed baseline information about the planning area, including detailed maps, can be found in the Background Report.

2.0 Land Use Assessment

Planning Context

- 2040 Official Community Plan (OCP) requires 20 units/gross hectare for residential development and mandates an Urban Centre for neighbourhood commercial needs
- Kwanlin Dün First Nation (KDFN) and Ta'an Kwäch'än Council (TKC) will confirm their intended land uses after the master planning process
- North and south ends of planning area include greenspace utilized by existing neighbourhoods (Valleyview and Hillcrest, respectively)
- Development north of Sumanik Drive is likely a long-term prospect

Concept Similarities

- Concepts share a similar mix of eight land uses totalling around 115 hectares
- Parks and neighbourhood utilities are incorporated
- Both concepts assume that the satellite dish on Lot 427-1 is relocated
- Both concepts assume that KDFN will amend its Self Government Agreement to gain more development flexibility
- Both concepts do not meet the OCP target for minimum residential density
- Both concepts include an Urban Centre

Concept Differences

- High density residential development is included in Concept 1 but not Concept 2, making for a less diverse housing offer
- There is a small Urban Centre (i.e., commercial node) at McIntyre Drive in Concept 1 but not in Concept 2
- Concept 2 has more greenspace overall and retains an existing forested gulley as an anchor feature of its parks and greenspace program
- TKC C-30B has more mixed use and development yield in Concept 1 than Concept 2
- Concept 1's projected population is 3381 people and Concept 2's is 2809 people
- Concept 1 achieves a higher residential density of 17 units/hectare compared to 16 units/hectare in Concept 2

Table 1. Land use mix

LAND USE	CONCEPT 1		CONCEPT 2	
	Area (ha)	% of Total	Area (ha)	% of Total
Low density residential (e.g., single detached)	17	15%	14	12%
Medium density residential (e.g., townhomes)	33	29%	36	31%
High density (e.g., condos, apartments)	5	4%	0	0
Mixed use – residential/commercial	22	19%	18	16%
Commercial	1	1%	n/a	n/a
Public/institutional	7	6%	8	7%
Greenspace	30	26%	39	34%
TOTALS	**115**	**100%**	**115**	**100%**

Table 2. Land use allocation by landowner

PROPERTY	OWNER	PROPOSED LAND USES BY CONCEPT						
		Low density residential	Medium density residential	High density residential	Mixed use – residential/ commercial	Commercial	Public/ institutional	Greenspace
Lot 66	City of Whitehorse						1, 2	1, 2
YG parcel (north)	Government of Yukon						1, 2	1, 2
C-117B	Kwanlin Dün First Nation				1, 2			
Lot 12	City of Whitehorse		1					1, 2
Lot 431	Government of Yukon		1					1, 2
C-141B	Kwanlin Dün First Nation				1, 2			
Lot 262-2	Alacrity Enterprises		1, 2					
C-30B	Ta'an Kwäch'än Council				1, 2		1, 2	2
Lot 429/430	P.S. Sidhu Trucking	1, 2	1, 2	1		1		1, 2
Lot 427-1	Shaw Communications		2					
Lot 438	Government of Yukon							1, 2
Lot 426	Government of Yukon							1, 2
Lot 2	Guru Nanak Sikh Org.						1, 2	
YG parcel (southwest)	Government of Yukon		1, 2					1, 2

Key: 1 – land use is included in Concept 1; 2 - land use is included in Concept 2; 1, 2 – land use is reflected in both concepts

Table 3. Estimated units and population

RESIDENTIAL LAND USE	CONCEPT 1				CONCEPT 2			
	Area (ha)	Units per ha	Total Units	Population*	Area (ha)	Units per ha	Total Units	Population*
Low density residential (e.g., single detached)	17	10	170	391	14	10	142	325
Medium density residential (e.g., townhomes)	33	20	660	1518	43	30	720	1656
High density (e.g., condos, apartments)	5	40	200	460	0	0	0	0
Mixed use – residential/commercial	22	20	440	1012	10	30	360	828
TOTALS	**77**	-	**1470**	**3381**	**68**	-	**1222**	**2809**

*Population estimates are based on the average Yukon household size of 2.3 (2021 Census)

Table 4. Projected residential density

DENSITY SCENARIO	CONCEPT 1			CONCEPT 2		
	Total Units	Total Area	Units per ha	Total Units	Total Area	Units per ha
Entire study area	1470	115	13	1222	115	11
Entire study area less greenspace	1470	85	17	1222	76	16

3.0 Engineering Assessment

Planning Context

- Study area subsurface consists of mainly gravels
- Moderate to steep slopes are present along the eastern portion of the study area on TKC C-30B, making much of this area undevelopable without extensive grading
- Hamilton Boulevard sanitary trunkmain, which flows to the Marwell Lift Station, has excess capacity but the lower elevations in the central and eastern areas means that lift station(s) would be needed to pump flows upgradient
- The Airport sanitary trunkmain is a potential connection point but downstream Lift Station #1 (LS1) (which pumps flows to the Marwell Lift Station) needs replacement, as well as additional capacity to accommodate new development
- The City has stated that it wishes to reserve some capacity in the Airport trunkmain system for future Alaska Highway development but further direction is pending from the City's Water and Sewer Master Plan underway
- The Valleyview sewermain has additional capacity for about 1000 people
- Water supply is abundant given the proximity of the development to the Valleyview Reservoir but the higher fire flows required for high density residential development will need to be considered in the water supply design
- The soils onsite currently enables stormwater to infiltrate into the ground and then daylight in Baxter's Gulch
- The City is requiring stormwater to be managed onsite, as per best practice
- There are power distribution lines running through the northern portion of the study area but only a few properties in the southeast corner are connected to the grid via supply lines

Concept Similarities

- Sanitary servicing for the area north of Sumanik Drive will consist of gravity sanitary main connection to the Hamilton Boulevard trunkmain near Alaska Highway
- Both concepts assume that the water transmission main that runs parallel to Sumanik Drive is a tie-in point
- Both concepts will likely require a series of small and medium stormwater ponds
- Upgrades to the power substations at Logan and/or Arkell will be required to meet the power needs for Valleyview South

Concept Differences

- Concept 1 proposes major grading and offsite gravel hauling to maximize developable area and facilitate connection to existing City sanitary infrastructure, whereas Concept 2 involves internal grading and minimal gravel hauling

- Concept 1 includes a higher density development which will require higher fire flows (via larger watermain or a connection to the watermain that runs along the Alaska Highway)
- Concept 1 utilizes existing City sanitary infrastructure and creates an opportunity for new development to contribute to the costs for needed replacement of LS1 and potentially a section of airport sewermain that drops down the embankment next to the Black Street Stairs
- Concept 2 represents a "go it alone" sanitary servicing approach that would result in up to three new lift stations for the City to maintain in perpetuity

Refer to the Concept 1 and 2 servicing maps for further explanation. Background information is contained in Appendix A.

Note: **The following summary is based on a limited desktop review of available information. Further engineering investigation and design work will need to be conducted to confirm and/or elaborate on these initial findings and assumptions after the final preferred concept is developed.**

Table 5. Site grading

PARAMETER	CONCEPT 1	CONCEPT 2
Overall Approach		
North of Sumanik	Minimal site grading required to facilitate installation of gravity sewermains and stormwater system	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Major site grading will reshape the moderate to steep (20-40%) eastern slopes and flat upland area to a 2-3% average slope. The northwest corner will be graded to slope towards Hamilton Boulevard for sanitary servicing.	Site grading will be minimal and focused on "cut to fill" – excavating gravels from high spots to fill low spots and generally moving material to facilitate installation of roads, gravity sewermains and stormwater systems
Gravel Haulage		
North of Sumanik	Expected to be minimal	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Estimated 4.5 million m^3 of gravel would be removed via C-30B and Alaska Highway. Operation could theoretically take 5 years based on the following: • 15 trucks with 12m^3 capacity hauling two loads per hour for a total of 3600 m^3 per day • 275 hauling days per year at 5 days per week for an annual total of 985,500 m^3 • Average 10 hour workday (with longer hours in summer and shutdowns during extreme cold temperatures) More time would probably be required.	Lots 429/430, C-141B and C-30B have low spots that will need to be filled or regraded to facilitate gravity sanitary servicing. Gravel haulage can likely be avoided if there is coordination between landowners.

Table 6. Sanitary servicing

PARAMETER	CONCEPT 1	CONCEPT 2
Overall Approach		
North of Sumanik	Serviced by new gravity main that will connect to Hamilton Boulevard trunkmain near Alaska Highway intersection	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Gravity mains will convey flows to the east/southeast boundary of C-30B, where a larger sewermain will connect to the Airport sewer trunkmain. To reduce pumping requirements at LS1, gravity mains would convey flows from the northwest corner of medium and higher density housing to the Hamilton Boulevard trunkmain north of McIntyre neighbourhood.	Three lift stations/forcemains as follows: 1. Small lift station/forcemain to connect C-30B to Valleyview sewermain (or Hamilton Blvd trunkmain) 2. Medium lift station/forcemain to connect Lot 262-2 to Valleyview sewermain (or Hamilton Blvd trunkmain) 3. Large lift station/forcemain to connect Lots 429/430 and KDFN C-141B to Hamilton Boulevard trunkmain Lot 262-2 could also connect by gravity to C-30B or Lot 429/430 lift stations.
Offsite Infrastructure Implications		
North of Sumanik	None	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Airport trunkmain flows to LS1 at Shipyards Park, which requires replacement. LS1 would need additional capacity to handle new Valleyview South flows. The connecting sewermain capacity is believed to be sufficient but the section that drops down the embankment next to Black Street stairs may need to be upsized.	No offsite upgrades would be required but the City would inherit three new lift stations to maintain

Table 7. Water servicing

SERVICING PARAMETER	CONCEPT 1	CONCEPT 2
Overall Approach		
North of Sumanik	Connect to Valleyview watermain	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Connect to Sumanik and Hamilton Boulevard trunkmains to facilitate looping and potential connection to Airport main to meet fireflow requirements for high density residential development	Sumanik and Hamilton Boulevard trunkmains to facilitate watermain looping with an additional connection to Hillcrest main for the southerly road/cul-de-sac
Offsite Infrastructure Implications		
North of Sumanik	None	Same as Concept 1
Central Area	None	Same as Concept 1

Table 8. Stormwater management

SERVICING PARAMETER	CONCEPT 1	CONCEPT 2
Overall Approach		
North of Sumanik	Stormwater mains will generally follow gravity sewer network and discharge into a stormwater pond for onsite management	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Stormwater mains will generally follow gravity sewer network and discharge into a series of small to medium stormwater ponds/features for onsite management. Features would logically be situated at depressions/low spots within the development and will be designed to avoid conflicts with adjacent land uses.	Same as Concept 1
Offsite Infrastructure Implications		
North of Sumanik	None	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	An emergency overflow that tie into the existing stormwater infrastructure that discharges into Baxter's Gulch (ex. culvert across the highway or connection to stormwater system on Burns Road). An integrated stormwater management system to address the existing issues at Baxter's Gulch should be completed which should consider potential emergency flows from the Valleyview south development area, however, the stormwater management plan for Valleyview south should be designed to manage all flows onsite.	Same as Concept 1

Table 9. Power

SERVICING PARAMETER	CONCEPT 1	CONCEPT 2
Impacts to Existing Infrastructure		
North of Sumanik	No existing infrastructure in this portion of the study area	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)	Major grading will impact the ATCO Electric Yukon distribution lines running through Lots 12, 431 and C-141B. Poles would need to be raised/reinstalled.	Infilling the major depression on C-141B will require ATCO Electric Yukon distribution line poles to be raised.
Offsite Infrastructure Implications		
North of Sumanik	The Arkell substation (that feeds the Hamilton Boulevard neighbourhoods) can accommodate an additional population load of about 1200 people. New development could potentially be serviced from the Valleyview/Sumanik Drive intersection (for the main feed) and Alaska Highway (for the secondary feed), with supplementary service potentially provided from Hamilton Boulevard. ATCO staff are reviewing the concepts.	Same as Concept 1
Central Area (south of Sumanik and north of Hillcrest greenspace)		

4.0 Contamination Assessment

Planning Context

- Lots 429 and 430 are the site of the former Whitehorse Upper Tank Farm (WUTF), which was designated a contaminated site by Government of Yukon (YG) under the *Contaminated Sites Regulation* in 2011
- Most of the former WUTF has been remediated and received a Certificate of Compliance; however, there are still Areas of Environmental Concern (AEC) where known petroleum hydrocarbon soaked gravels at depth could render the site contaminated again if site grading brings the new ground surface to within 3 metres of a residential dwelling.
- TKC C-30B is located downgradient of the WUTF and has potential contamination issues, with groundwater being most likely given the vertical (versus horizontal) migration of hydrocarbons through the soils at the WUTF
- Other properties within the planning area have known (Lot 426) or potential (Lot 262-2, City road right-of-ways) contamination due to historic and/or current land use
- Under the *Environment Act*, parties responsible for contamination have a duty to clean it up. Landowners could still be considered liable for contamination that they did not create. Conducting an Environmental Site Assessment (ESA) to confirm and/or rule out the presence of contamination is a best practice before land with potential for contamination issues is transferred or sold. Individual landowners need to determine the own risk tolerance and the accompanying level of due diligence they wish to achieve.

Concept Similarities

- Both concepts propose residential land use on the currently designated portion of Lot 429 where there is known groundwater contamination
- Both concepts propose residential and/or commercial land uses on other parcels where there is a higher potential for contamination due to historic and/or current land use
- Both concepts will require additional investigations and/or risk assessment work to meet the standard of either regulatory obligations under the Environment Act or best practice

Concept Differences

- Concept 1 involves major grading that has a higher potential to bring AECs to the (post-grading) ground surface, which will need to be remediated prior to development

Note: **The following information is based on a limited desktop review of available information. Each VSMP landowner is responsible for further investigating and/or verifying the status of contamination and/or level of risk and liability posed by their respective parcels and the land uses proposed for them. Parcels that are not listed in the tables following could have contamination issues.**

Table 10. Implications for areas of known contamination

PARAMETER	CONCEPT 1	CONCEPT 2
Lots 429/430 – Certificate of Compliance	Proposed for residential use. Major grading has a high likelihood of bringing post-grading elevations to within 3m of known depth of contamination for numerous AECs. A preliminary grading plan would confirm which AECs are impacted. A comprehensive sampling plan should be organized with AECs staked out prior to onset of earthmoving. Depressions could be backfilled with clean material or soils could remain in place if not contaminated. Either scenario would require confirmatory sampling and close liaison with YG Department of Environment.	Lower likelihood of post-grading elevations to be within 3m of AEC contamination depths. Same approach as Concept 1 would be advised.
Lots 429/430 – Ministerial Designation portion	Proposed for residential use. Designated status means any earth-moving activities are subject to oversight by YG Department of Environment. Contamination is groundwater related and grading would not be expected to impact it. Regardless of grading approach, the Certificate of Compliance would be issued only if YG is satisfied that the area poses little to no risk. This could occur in two ways: 1. Sampling could confirm that contamination has naturally attenuated to below numerical standards (which may be possible depending on the development timeline); or 2. A risk assessment confirms that there is no risk to human health. The Certificate would likely detail the conditions within which human health risks are deemed non-existent and/or minimal. The administrative mechanism for transferring the Certificate (and accompanying conditions) to subsequent subdivided and privately owned parcels will need to be determined.	Same as Concept 1
Lot 426	There could be potential for an additional lot of mixed industrial-commercial use north of Wasson Place. Contamination was encountered during construction activity in 2022. A Phase 2 ESA is recommended.	Same as Concept 1

Table 11. Implications for areas with higher potential for contamination

PARAMETER	CONCEPT 1	CONCEPT 2
Lot 262-2	Proposed for residential use. ESA is out of date and doesn't reflect past decade or so of winter snow storage use. Updated Phase 1 ESA is recommended.	Same as Concept 1
TKC C-30B	Proposed for residential, institutional and commercial usea. No ESA has been completed to date. Groundwater contamination is possible due to downgradient location from WUTF. A Phase 1 ESA is recommended. If groundwater contamination is confirmed but soil contamination is considered unlikely, a risk assessment could be undertaken to confirm that there are minimal risks to human health from the proposed development.	Proposed for residential and institutional land uses. Same process and recommendations as for Concept 1.
Lot 427-1	Currently houses two satellite receivers but proposed for decommissioning, sale and future mixed use commercial with some residential. A Phase 1 ESA is recommended prior to sale and/or transfer of parcel for development.	Same as Concept 1 but proposed end use is residential.
City road right-of-ways	Two City road right-of-ways intersect with and/or border former pipeline infrastructure. Concept 1 proposes integration of #8006308 into mixed use commercial-residential and #8034222 into residential. A Phase 2 ESA is recommended prior to transfer.	Proposed end use for #8006308 is residential. #8034222 would remain a road. A Phase 2 ESA is recommended prior to transfer or sale for residential development.
Pipeline easements	Situated within proposed mixed use residential with some commercial (C-141B) and mixed use commercial with some residential (C-30B). A Phase 2 ESA is recommended.	Situated within proposed mixed use residential with some commercial (C-141B) and residential (C-30B). A Phase 2 ESA is recommended.
KDFN C-141B	Proposed for mixed residential with some commercial. The eastern portion intersects with the (assumed) former pipeline right-of-way. A Phase 2 ESA is recommended.	Same as Concept 1

5.0 Transportation Assessment

Planning Context

- Study area is bounded by Alaska Highway and Hamilton Boulevard, both of which have adjacent multi-use pathways (Hamilton Boulevard and Airport Trail) to/from downtown
- Sumanik Drive bisects the northern portion of planning area but has no sidewalk and is limited to a right-in, right-out intersection with Alaska Highway
- City of Whitehorse Official Community Plan prioritizes good active transportation and transit and the Bicycle Network Plan identifies east-west connection through planning area

Concept Similarities

- Both feature extensive active transportation network that connects the new neighbourhood to key community destinations and improves connections for existing neighbourhoods
- Both have a quasi-loop collector road and intersecting north-south collector road that connects central area to Hamilton Boulevard at the Canada Games Centre
- Similar intersection treatments and transit are proposed for both concepts

Concept Differences

- Concept 1 includes an Alaska Highway connection to/from the central area
- Concept 1 has a greater impact on the Alaska Highway whereas Concept 2 has a greater impact on Hamilton Boulevard
- Concept 1 has greater overall traffic impact due to the higher population

Table 12. Road network

DESIGN PARAMETER	CONCEPT 1	CONCEPT 2
Description	• Central quasi "loop" through central area • North-south connection between central area and portions north of Sumanik Drive • Connection to/from Alaska Highway	Same as Concept 1 except the Alaska Highway connection only serves a local road on C-30B and not the entire VSMP area
Road Hierarchy	• 2.2km of Minor Urban Collector road (22.5m ROW) • 2.8km of local roads (20m ROW) shown (total length of local roads will be higher)	• 2.2km of Minor Urban Collector road (22.5m ROW) • 3.0km of local roads (20m ROW) shown
Intersection Treatments	• Traffic light upgrades (3 to 4 way) at Canada Games Centre & Hamilton Blvd and Alaska Highway & Range Road • New roundabout at McIntyre Drive & Hamilton Boulevard • Two new 4-way stops on Sumanik Drive and several internal 4-way stops	Same as Concept 1

Table 13. Projected traffic impacts

TRAFFIC PARAMETER	CONCEPT 1	CONCEPT 2
Total Number of Vehicle Trips Generated at Full Build-out		
Weekday AM peak hours	1300	1105
Weekday PM peak hours	1660	1427
Potential Percentage Increase in Vehicular Demand on Surrounding Road Network – AM (PM)		
Hamilton Boulevard (between McIntyre Drive and Alaska Highway & Hamilton Blvd/Two Mile Hill Rd intersection)	20% (25%)	35% (40%)
Two Mile Hill Road (east of Range Road intersection)	15% (20%)	15% (20%)
Alaska Highway (between Range Road and Hamilton Boulevard/Two Mile Hill Road intersections)	40% (60%)	5% (10%)
Range Road (between Two Mile Hill and Alaska Highway intersection)	10% (15%)	5% (10%)

Table 14. Active, shared and other transportation

DESIGN PARAMETER	CONCEPT 1	CONCEPT 2
Multi-Use Pathways		
Total Distance	4.1 km	4.4 km
Connections to Recreation and Greenspace Destinations	• Canada Games Centre (CGC) • Mount McIntyre public trail network	Same as Concept 1
Connections to Downtown	• Airport Trail at Range Road & Alaska Highway	Same as Concept 1
Connections to/from Existing Neighbourhood	• Valleyview to Airport Trail, Mount McIntyre public trail network, CGC • Hillcrest and Granger to CGC/Mount Mac and Airport Trail at Range Road & Alaska Hwy	Same as Concept 1
Transit		
New stops	• 3 new stops within central area • 1 new stop on Hamilton Boulevard • 1 new stop on Alaska Highway	Same as Concept 1
Integration with Existing Transit	Integrates well with Route #3 already servicing Hillcrest, McIntyre and Valleyview	Same as Concept 1
Other		
Motorized recreational vehicles	Hamilton Boulevard will remain the only designated Motorized Multi-Use trail and motorized users can access it via local roads with license and registration and in accordance with City bylaws	Same as Concept 1

6.0 Concept Evaluation

Planning Context

- The development of the preferred concept (and subsequent refinement to the final version) will be informed by how well the concepts perform against multiple success criteria
- The preferences expressed by the public, citizens and adjacent neighbourhood associations in November 2022 will be tested again in the upcoming June engagement around the two draft land use concepts
- The overall objective is for VSMP partners to develop a concept that minimizes their development risks and maximizes rewards for both themselves and the broader community
- Development partners will decide upon the final preferred concept and are seeking a consensus decision, with City Council having final approval

A key consideration for VSMP partners is how well the two concepts fulfill the direction provided by the public and TKC/KDFN citizens during the November/December 2022 engagement. A preliminary assessment is provided in Table 15; this will be further explored and confirmed during the June engagement. (Note that ratings of low, moderate, and high correspond with the perceived degree to which each concept satisfies the direction).

Table 15. Public, citizen and neighbourhood preferences

NOVEMBER 2022 ENGAGEMENT INPUT	CONCEPT 1	CONCEPT 2
Public and Citizens		
Connect the neighbourhood with quality active transportation and transit options	High	High
Retain existing greenspaces	Low	Low to moderate
Create small and medium-sized parks and connect them to trails	High	High
Minimize negative impacts to traffic, especially for "above the airport" residents	Moderate	Moderate
Provide a range and mix of housing forms and densities	High	Moderate
Avoid too much density	Moderate	Moderate
Provide commercial amenities for nearby residents	High	High
Adjacent Neighbourhoods (Granger, Hillcrest, Valleyview)		
Avoid new roads into Hillcrest	High	High
Re-establish full Alaska Highway connection to Valleyview	High	Low
Retain Hillcrest greenspace	High	High
Retain Valleyview greenspace	Low	Low to moderate
Provide new commercial spaces nearby	High	Moderate
Minimize construction and quarrying-related disturbance	Low to moderate	Moderate to high
Improve active transportation routes for existing residents	High	High

Numerous other criteria will factor into the concept evaluation and decision-making of VSMP partners and will be confirmed and applied as deemed appropriate by them.

Conformance with Official Community Plan

- Residential density requirements
- Requirement for Urban Centre to service the new population
- High-quality active transportation network
- Diverse neighbourhood with quality public spaces

Landowner Risks and Rewards

- Operations and maintenance burden for the City
- Individual landowner autonomy over their development timeframes
- Degree of coordination and cooperation required among landowners
- City Council support and regulatory certainty
- Public, citizen and/or neighbourhood support
- Cost recovery and/or return on investment
- Impacts to neighbouring private properties
- First Nation economic development opportunities
- Development flexibility for First Nation governments
- Integration of McIntyre with rest of Whitehorse
- Fostering of partnerships and relationships between landowners

Other Rewards

- Landowner motivation to proceed and deliver new housing options for Whitehorse in this central area
- Impact on need to develop Whitehorse area greenspace for new neighbourhoods
- Impact on need to develop Whitehorse area greenspace for gravel reserves (and reduce carbon footprint of gravel through shortened hauling distance)

APPENDIX A

Land Use Concept Maps

APPENDIX B

Servicing Concept Drawings

APPENDIX C

Engineering Background Information

MEMORANDUM

TO	Jane Koepke, Groundswell Planning Taylor Eshpeter, P.Eng., Engineering, City of Whitehorse		
FROM	Mark Verhalle , EIT and Adam Greenwood, P.Eng.	**DATE**	February 9, 2023
RE	Valleyview South Masterplan - **DRAFT** Airport Sanitary Trunkmain Connection Assessment	**PROJECT No.**	14-08

Following the stakeholder consultations and workshops completed as part of the Valleyview South Master Plan project, the feasibility of a gravity connection to the sanitary sewer system at the airport has been identified as an item that the stakeholders would like to better understand. The intent of the memorandum is to review the catchment area of the sanitary sewermain, refer to as the Airport Trunkmain in this memo, that flows from the airport to Lift Station 1 (LS1) to determined if there is additional capacity to receive sanitary flows from the Valleyview South development area.

1 Existing Airport Trunkmain Capacity Review

The Airport Trunkmain is a gravity sewermain that runs from the airport to LS1 and is relied upon to convey flows from the Hillcrest, airport, downtown and Riverdale areas as outlined in the Figure 1 to 4 in Appendix A. LS1 then pumps the sanitary flows to the Marwell Lift Station which ultimately pumps the sanitary flows to the Livingstone Trail Environmental Control Facility (LTECF) for treatment. In 2007, sections of the Airport Trunkmain in the downtown were upgraded to address capacity issues identified in the 2003 Water and Sewer Master plan. In addition, the trunkmain is scheduled to be realigned around the airport runway this upcoming summer (construction 2023/2024). Currently the Airport Trunkmain has a catchment area of approximately 406 hectares as shown in Figure 1. Expansion to the Riverdale, Hillcrest and the Airport catchment areas may increase the future catchment area to approximately 500 hectares. This future catchment area does not include the proposed Valleyview South development as it was anticipated that the development area would connect to the sewer trunkmain on Hamilton Boulevard which flows by gravity to the Marwell Lift Station.

1.1 Trunkmain Capacity and Design Flows

The capacity of the Airport Trunkmain was calculated using the record drawings of the existing sewermains and the design drawings for the proposed realignment of airport sewermain. The capacity of each section of the trunkmain is included in Appendix B. The residential design flows for the catchment areas were calculated using the average day water use of 500 L/person/day, a peaking factor of 4 and assuming the sanitary flows are 90% of the water demands defined in the City of Whitehorse Servicing Standards Manual (SSM). An average day sanitary flow of 18 m^3/Ha/Day and a peak sewer flow of 72 m^3/Ha/day was calculated to determine the design flows for residential land. The

commercial water demands are not listed in the SSM, which makes sense as it is dependent on the type of commercial activity, therefore the downtown commercial water use of 32 m^3/Ha/day and a commercial water use of 10 m^3/Ha/day for areas outside of the downtown (airport, Riverdale, Hillcrest) as outlined in the 2003 Water and Sewer Master Plan was used. Using the peaking factor of 3 for commercial water use and assuming the sanitary flows are 90% of the water use as per the SSM, the average day sanitary flow of 28.8 m^3/Ha/Day and a peak sewer flow of 86 m^3/Ha/day was calculated for downtown commercial land and the average day sanitary flow of 9.0 m^3/Ha/Day and a peak sewer flow of 27 m^3/Ha/day was calculated for commercial land outside of the downtown. As outlined in the SSM, a multiple of 1.1 was applied to the design flows to account for potential future chances in zoning. A summary of the calculated design flows for each segment of the airport trunkmain is shown in Appendix B.

Based on our calculations, the Airport trunkmain is able to accommodate the design flow of the existing catchment area with all sewermains less than 34% full (based on depth). Based on our calculations, the pipe section that is the fullest (34%) is Pipe 10 which is a 200mm sewermain that drops down the escarpment at the end of Black Street. When we look at the future catchment area, the additional flows coming from development areas L and M south of Hillcrest, as shown on Figure 1, all pipes will operate at less than 40% full with Pipe 10 continuing to operate the fullest (40%).

1.2 Airport Trunkmain Available Capacity

Given design flows for sewer systems are based on the peak flow events, some utilities size their systems to manage peaks flows when the pipes are full (start to surcharge) while others size their systems with the pipes operating less than full. Ultimately the decision regarding systems sizing requirements is based on the risk of sanitary services backing up and causing property damage. For this reason, in areas where there are no sanitary service connections, such as down the embankment, it is reasonable for a utility to be comfortable with the sewermain operating full (surcharging slightly) during peak event. Alternatively, in other areas with sewermain that are shallow and present a risk of a backup into a sewer connection (sewermain depth and sanitary service depth are similar), these lines should be sized to manage peak events with the sewermain less than full. Further review of the sewermain can be completed to confirm what is acceptable. However, for the purposes of this Airport Trunkmain capacity assessment, we assumed that the sewermain can operate up to 90% full. Based on the design flow calculations in section 1.2, the available capacity for the existing and future catchment scenarios are summarized in Table 2.

Table 1 – Airport Trunkmain Available Capacity

Design Catchment Scenario	Existing	Future	Units
Limiting Trunkmain Section	Pipe 10	Pipe 10	-
Available Capacity	95	88	L/s
	8,213	7,572	m^3/Day
Peak Res. Sewage Flow	72	72	m^3/Ha/Day
Infiltration Rate	6,000	6,000	L/Ha/Day
Additional Residential Area	105	97	Ha
Population Density	40	40	People/Ha
Additional Service Population	4,212	3,883	Persons

The calculations to determine the available capacity and estimate the additional service population that may be connected to the Airport Trunkmain is based on City's SSM design criteria and the commercial water use listed in the 2003 Water and Sewer Master Plan. Recent water use data suggests the actual water use in Whitehorse is lower than the SSM design, however, recent developments of the ongoing project to update the water and sewer master plan suggests that groundwater and surface water flows entering the sewer system, also known as inflow and infiltration (I&I), may be very substantial, particularly in areas close to the river. The only way to confirm the available capacity is to review the sanitary flow data, discussed further in section 1.3.

1.3 Historical Sanitary Flow Data

The most recent assessment of the Airport Trunkmain capacity was based on information provided in the 1990 and 2003 Water Sewer Masterplan. In the late 90s and early 2000s, the City put a lot of effort into reducing water usage to extend the useful life of the City's water source wells and delay the need for an additional well(s). Through these efforts, which included the elimination of bleeders and other water reduction strategies, recent per capita water usage rates have decreased substantially and are currently suspected to be somewhere between 300 to 350 L/person/day. Recent flow monitoring completed in 2022 along with the City's lift station flow data are being analysed as part of the ongoing water and sewer master plan update project to develop a current model of the City's sewer infrastructure. Two of the 2022 sanitary flow monitoring locations were on the Airport Trunkmain as follows:

- Manhole 1156 (February 8 to July 14, 2022) – Unfortunately, due to turbulent flow conditions at this manhole, the accuracy of this data cannot be relied upon.
- Manhole 7078 (October 21 to November 20, 2022) - a summary of the flow data is shown below in Figure 5 and Table 2.

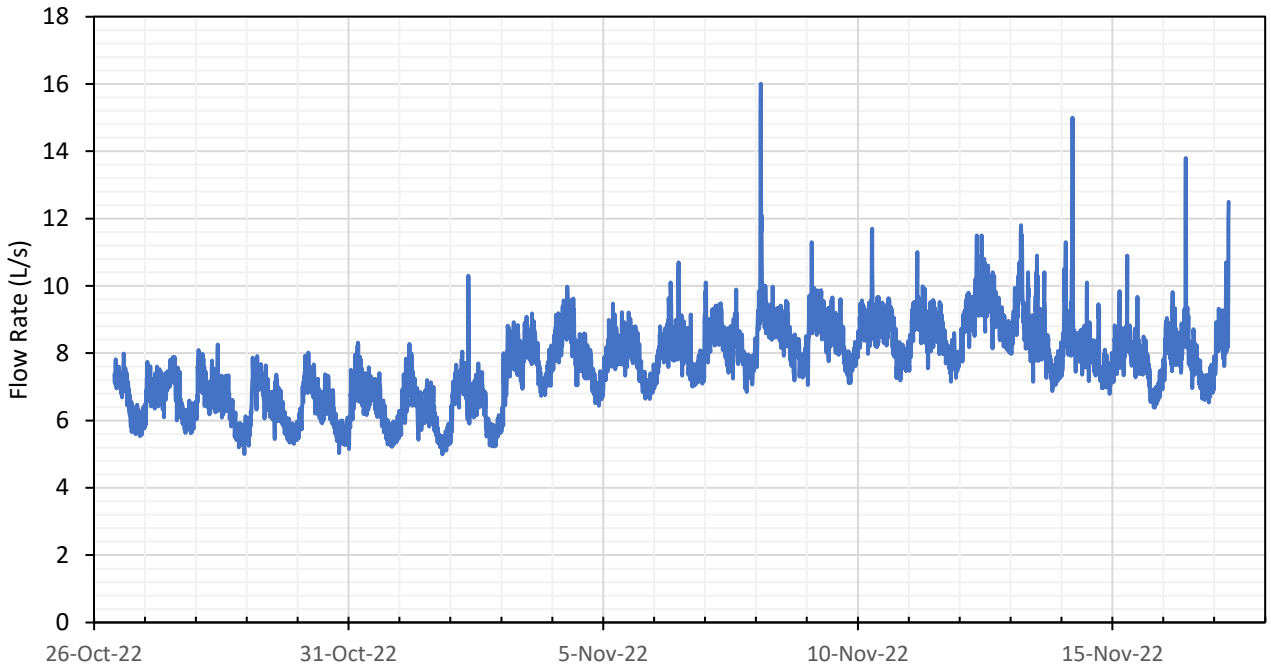

Figure 5 – Airport Trunkmain Sanitary Flow Monitoring Data (MH 7078)

Table 2 – Airport Trunkmain Sanitary Flow Monitoring (MH 7078)

Month	Min	Average	Max	Units
October, 2022	5.0	6.5	8.3	L/s
November, 2022	5.0	8.1	16.0	L/s

The flows listed in Table 2 provide an indication of the winter dry weather flows for the Hillcrest and airport areas. There is a noticeable increase (approximately 20%) in the flows from October to November which is likely attributed to the bleeders being turned on. Dry weather flows are typically associated with reduced I&I as surface runoff is not occurring with everything being frozen and groundwater levels are typically at their lowest levels at the end of the summer season. For this reason, it is expected that the spring and summer sanitary flows will see an increase in flows. That said, the design flow for the existing Hillcrest and Airport catchment area at MH 7078, included in Appendix B, was calculated to be 39.1 L/s. Given the maximum flow recorded during the monitoring period was 16.0 L/s, the design criteria for water use and I/I are higher than what was monitoring. Additional analysis of the design flows for the existing catchment area can be undertaken, however, the flow monitoring data suggests the actual sanitary peak flows are less than the design flows and supports the notion that the Airport Tunkmain can manage a larger catchment area.

2 Lift Station 1 and 3 Capacity Review

The existing lift stations are relied upon to manage the sanitary flows and ultimately convey them to the LTECF for treatment. Lift Station 3 (LS3) pumps all sanitary flows from Riverdale and the hospital across the river where they are conveyed by gravity to LS1. LS1, located adjacent to Shipyard's Park, is responsible for pumping all sanitary flows from the Airport Trunkmain, as well as Riverdale and the downtown sanitary flows, to the Marwell Lift Station. Connecting the Valleyview South development to the Airport Trunkmain needs to consider the implication of the both the LS1 and LS3 conditions. A review of the design flows is presented below. The capacity of Marwell Lift Station is not included as part of this current assessment.

2.1 LS1 and LS3 Capacities and Design Flows

The design flows for both lift stations along with their pumping capacities (listed in the 2003 Water and Sewer Study - actual pumping capacity should be confirmed) are presented in Table 3. Note that the future flows in Table 3 do not consider the 'Beyond Copper Ridge" flows that may potentially contribute to LS1 as outlined in the 2003 Water and Sewer Master Plan.

Table 3 – Peak Hour Flow

Station	Lift Station Capacity (L/s)			Design Flow	
	One Pump	Two Pumps	Three Pumps	Existing Peak Flow (L/s)	Future Peak Flow (L/s)
Lift Station 3	100	185	245	131.8	174.9
Lift Station 1	-	280	315	229.8	275.2

With reference to Table 3, it appears the lift stations have sufficient capacity to manage both the existing and future design flows and accommodate additional sanitary flows. That said, it is suspected that there is a significant source of I&I entering the sanitary collection system which contributes to the sanitary flows at both LS1 and LS3, discussed further below.

2.2 Historical Sanitary Flow Data

Attempts were made to monitor the flows entering each lift station to confirm the flow data collected from the lift station flow meters as part of the ongoing water sewer master plan update project, however, the sewermains are surcharging upstream of both lift stations which is not a good condition for monitoring flows. Through discussions with operations staff, it is understood that the lift station water levels are set to maintain a highwater level in the lift station wet well so that the bar screens at the inlet of the lift stations are submerged. This operating condition

ensures that all trash and debris that is flowing down the sewermain remains in suspension which is easier to remove compared to the debris getting caked onto the bar screen. To address these operating conditions, it is possible to install a macerator such as a Muffin Monster® or replace the pumps with solid handling pumps, however, reviewing possible options to address this operational issue is not part of this current assignment. Given that the lift station(s) will be replaced in the future, these potential improvement(s) should be considered as part of the replacement design.

To review the existing flows, the lift station flow data for both lift stations was reviewed and is presented in Table 4. Note that the data ranges for the data that was reviewed are for different time periods.

Station	Average Peak Hour Flow (L/s)	Existing Peak Design Flow (L/s)	Future Peak Design Flow (L/s)	Comments
Lift Station 3	193.5[1]	131.8	174.9	2022 Flow monitoring analysis suggests a significant source of I/I into LS3 (potentially up to ~90L/s)
Lift Station 1	170.4[2]	229.8	275.2	Future peak design flow is larger than the recorded peak average flow, suggesting that LS1 will need to be upgraded

Notes: 1) based on peak average hour LS1 flow meter data between July 1, 2020 and December 31, 2020.
2) based on peak average hour LS3 flow meter data between March 30, 2021 and Sept. 30, 2021.

As outlined in Table 4, the flows at LS3 are greater than the design flow. Recent analysis of the sanitary flows suspects that there may be a significant source of I&I upstream of LS3. This may be the reason why the existing design flow is less than the average peak hour flow recorded at the LS3. It should also be noted that the average peak hour flow at LS1 should be greater than the LS3 flow since LS1 receives all of the flows from LS3. Further review of the flow data and analysis of potentially sources of I/I are recommended given the flow data presented in Table 4 raises some questions about the accuracy of the data.

2.3 Available Capacity

Based on the design flows and pumping capacity listed in Table 3, there is additional capacity for LS1 to accept additional flows, however, it is recommended that the additional analysis be undertaken to confirm the operating conditions of the two lift stations to confirm the accuracy of the flow data and potential sources of I/I. Further information will be presented as part of the ongoing water and sewer master plan update, however, the recommendation of that study will likely recommend similar investigative work to confirm the I&I and operating conditions of LS1 and LS3.

2.4 Additional Considerations

Based on discussions with City staff, LS1 is nearing the end of its useful life and is scheduled to be replaced in the near future. For this reason, the City has justified reservations about adding additional sanitary flows to LS1. As part of the considerations to connect the proposed Valleyview South development to the Airport Trunkmain, the timing of the LS1 should be discussed to see if it's possible to mitigate the City's concerns by timing the tie-in to the Airport Trunkmain to coincide with the LS1 replacement lift station being brought online.

3 Closing

Based on data available, it appears that the Airport Trunkmain and LS1 can accommodate additional sanitary flows up to around 4,000 people. However, it is important that additional analysis and investigative work be undertaken to confirm the findings of this assessment. Furthermore, it is recommended that additional thought be put towards ensuring that the timing of LS1 replacement lift station addresses the ongoing operational challenges and minimizes the risk of expanding the catchment area of LS1.

Please let us know if you would like to discuss the findings of this assessment or subsequent steps that may be taken to ensure any capacity concerns are addressed properly.

Sincerely,

Mark Verhalle, EIT
Project Engineer

Adam Greenwood P.Eng
Project Manager

APPENDIX A

LEGEND

- ZONE A
  3.1Ha Residential
  10.1Ha Commercial
  2.2 Public Service
- ZONE B
  11.3Ha Residential
  2.2 Ha Commercial
- ZONE C
  4.4Ha Residential
- ZONE D
  Commercial 35.0Ha
- ZONE E
  36.1Ha Commercial
- ZONE F
  3.9Ha Commercial
- ZONE G
  3.71Ha Residential
  19.8Ha Commercial
- ZONE H
  0.8Ha Commercial
  2.8Ha Public Water Front
- ZONE I
  23.7Ha Residential
  0.9Ha Commercial
- ZONE J
  13.2Ha Commercial
- ZONE K
  29.5Ha Commercial
- ZONE L
  21.3Ha Future Commercial
- ZONE M
  16.4Ha Future Commercial
- ZONE W
  33.5Ha Commercial

PROPOSED VALLEY VIEW SOUTH

AREA I

AREA J

AREA K

AREA L

AREA M

ALASKA HIGHWAY

WHITEHORSE AIRPORT TRUNKMAIN

63,029.64 mm

AREA A

AREA B

AREA C

AREA D

AREA E

AREA F

AREA G

AREA H

AREA W

LIFT STATION #1

YUKON RIVER

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 17 19 20 22 23 24 25

GREENWOOD ENGINEERING SOLUTIONS

1:2500 0 25 75 125m

Valley View South Masterplan
Figure 1 - Airport Sanitary Trunkmain Overview

Feb 06, 2023

Plotted by Mark Verhalle

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LEGEND

- ZONE D
  35.0Ha Commercial
- ZONE E
  36.1Ha Commercial
- ZONE N
  116.5Ha Residential
- ZONE O
  9.2Ha Commercial
- ZONE P
  1.4Ha Commercial
- ZONE Q
  7.1Ha Commercial
- ZONE R
  1.3Ha Commercial
- ZONE S
  2.7Ha Commercial
- ZONE T
  8.1Ha Commercial
- ZONE U
  2.4Ha Commercial
- ZONE V
  8.9Ha Commercial

AREA D
AREA E
AREA N
AREA R
AREA S
LIFT STATION #3
AREA T
AREA U
AREA V
AREA O
AREA N
AREA Q
AREA N
AREA P
AREA N

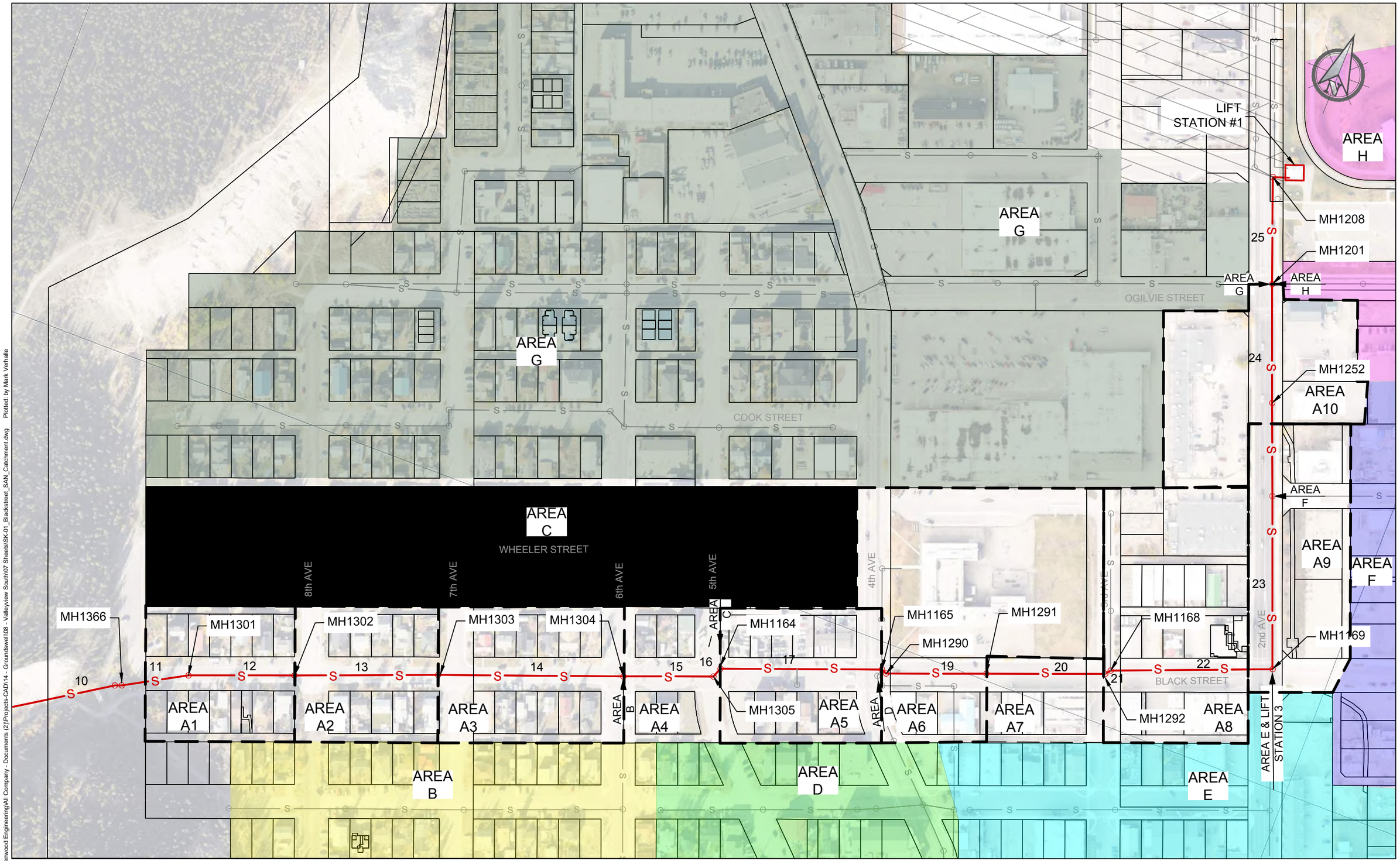
GREENWOOD ENGINEERING SOLUTIONS

1:8000 0 80 240 400m

Valley View South Masterplan
Figure 2 - Riverdale Sanitary Overview

Feb 06, 2023

C:\Users\green\Greenwood Engineering\All Company - Documents (2)\Projects-CAD\14 - Groundswell\08 - Valleyview South\07 Sheets\SK-02_Riverdale_SAN_Catchment.dwg Plotted: by Mark Verhalle



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GREENWOOD ENGINEERING SOLUTIONS

1:2500 0 25 75 125m

Valley View South Masterplan
Figure 3 - Black Street Sanitary Trunkmain

Feb 06, 2023

AREA I

AREA J

AREA K

AREA L

AREA M

MH7007
MH7006
MH7005
MH7004
MH7003
MH7002
MH7001
MH7071
MH7072
MH7110
MH7111
MH7112
MH7073
MH7078
MH7079
MH7080
MH7081
MH7082
MH7085
MH7086

S
S
S
S
1
2

ALASKA HIGHWAY

GREENWOOD ENGINEERING SOLUTIONS

1:6000 0 60 180 300m

Valley View South Masterplan
Figure 4 - Hillcrest & Airport Sewer Main

Feb 06, 2023

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APPENDIX B

Project Valleyview South Master Plan **Date** 07-Feb-23
Prepared by MV/AG

Airport Trunkmain Capacitiy Review

Pipe ID	Existing										Future									
	Contributing Areas	Service Population	Residential		Commercial			Infiltration		Total Design Flow	Contributing Areas	Service Population	Residential		Commercial			Infiltration		Total Design Flow
			Area	Design Flow	Downtown Area	Outside DT Area	Design Flow	Area	Design Flow				Area	Design Flow	Downtown Area	Outside DT Area	Design Flow	Area	Design Flow	
Pipe 1	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 2	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 3	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 4	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 5	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 6	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 7	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 8	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 9	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 10	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 11	I,J,K	1,820	23.7	21.7	0.0	43.6	5.6	67.3	4.7	31.9	Existing + L,M	2,574	23.7	21.7	0.0	81.3	10.4	105.0	7.3	39.4
Pipe 12	I,J,K,A1	1,861	24.7	22.7	0.0	43.6	5.6	68.3	4.7	33.0	Existing + L,M	2,615	24.7	22.7	0.0	81.3	10.4	106.0	7.4	40.4
Pipe 13	I,J,K,A1,A2	1,901	25.7	23.6	0.0	43.6	5.6	69.3	4.8	34.0	Existing + L,M	2,655	25.7	23.6	0.0	81.3	10.4	107.0	7.4	41.4
Pipe 14a	I,J,K,A1,A2,A3	1,949	26.9	24.7	0.0	43.6	5.6	70.5	4.9	35.1	Existing + L,M	2,703	26.9	24.7	0.0	81.3	10.4	108.2	7.5	42.6
Pipe 14b	I,J,K,A1,A2,A3	1,949	26.9	24.7	0.0	43.6	5.6	70.5	4.9	35.1	Existing + L,M	2,703	26.9	24.7	0.0	81.3	10.4	108.2	7.5	42.6
Pipe 15	I,J,K,A1,A2,A3,A4,B	2,525	36.7	33.7	2.9	43.6	6.7	39.6	2.8	43.1	Existing + L,M	3,279	36.7	33.7	2.9	81.3	11.5	39.6	2.8	47.9
Pipe 16	I,J,K,A1,A2,A3,A4,B	2,525	36.7	33.7	2.9	43.6	6.7	39.6	2.8	43.1	Existing + L,M	3,279	36.7	33.7	2.9	81.3	11.5	39.6	2.8	47.9
Pipe 17	I,J,K,A1,A2,A3,A4,B,C,A5	2,771	41.1	37.7	4.0	43.6	7.2	45.1	3.1	48.0	Existing + L,M	3,525	41.1	37.7	4.0	81.3	12.0	45.1	3.1	52.8
Pipe 18	I,J,K,L,M,A1,A2,A3,A4,B,C,A5,D,	5,011	41.1	37.7	39.0	43.6	21.4	80.1	5.6	64.7	Existing + L,M	5,765	41.1	37.7	39.0	81.3	26.2	80.1	5.6	69.5
Pipe 19	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6	5,182	41.1	37.7	41.6	43.6	22.5	82.8	5.7	66.0	Existing + L,M	5,936	41.1	37.7	41.6	81.3	27.3	82.8	5.7	70.8
Pipe 20	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7	5,216	41.1	37.7	42.2	43.6	22.7	83.3	5.8	66.2	Existing + L,M	5,970	41.1	37.7	42.2	81.3	27.5	83.3	5.8	71.0
Pipe 21	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7	5,216	41.1	37.7	42.2	43.6	22.7	83.3	5.8	66.2	Existing + L,M	5,970	41.1	37.7	42.2	81.3	27.5	83.3	5.8	71.0
Pipe 22	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7,A8	5,331	41.1	37.7	44.0	43.6	23.5	85.1	5.9	67.1	Existing + L,M	6,085	41.1	37.7	44.0	81.3	28.3	85.1	5.9	71.9
Pipe 23	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7,A8,E,F,LS3,A9	14,253	157.6	144.5	97.8	84.5	50.6	255.4	17.7	212.8	Existing + L,M, Riverdale Expansion	16,785	197.6	181.2	97.8	131.1	56.5	295.4	20.5	258.2
Pipe 24	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7,A8,E,F,LS3,A9, A10	14,349	157.6	144.5	99.3	84.5	51.2	256.9	17.8	213.6	Existing + L,M, Riverdale Expansion	16,881	197.6	181.2	99.3	131.1	57.1	296.9	20.6	258.9
Pipe 25	I,J,K,A1,A2,A3,A4,B,C,A5,A6,D,A6,A7,A8,E,F,LS3,A9,A10,G,H	15,928	164.2	150.5	119.9	84.5	59.6	284.0	19.7	229.8	Existing + L,M, Riverdale Expansion	18,459	204.2	187.1	119.9	131.1	65.5	324.0	22.5	275.2

Project Valleyview South Master Plan
Prepared by MV/AG **Date** 07-Feb-23

Airport Trunkmain Capacitiy Review

Pipe ID	Upstrem Manhole	Downstream Manhole	Pipe Dia (mm)	Grade (%)	Capacity at 90% (L/s)	Existing Design Flow (L/s)	Available Capacity (L/s)	Future Design Flow (L/s)	Available Capacity (L/s)
Pipe 1	7085	7086	450	0.6%	239.3	31.9	207.3	39.4	199.9
Pipe 2	7086	-	450	0.8%	273.5	31.9	241.5	39.4	234.1
Pipe 3	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 4	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 5	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 6	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 7	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 8	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 9	-	-	450	0.4%	192.2	31.9	160.2	39.4	152.8
Pipe 10	-	1366	200	13.2%	127.0	31.9	95.1	39.4	87.6
Pipe 11	1366	1301	375	13.2%	678.9	31.9	647.0	39.4	639.6
Pipe 12	1301	1302	375	4.7%	406.8	33.0	373.9	40.4	366.5
Pipe 13	1302	1303	450	1.2%	332.9	34.0	298.9	41.4	291.5
Pipe 14a	1303	1304	450	0.6%	225.4	35.1	190.2	42.6	182.8
Pipe 14b	1303	1304	450	0.5%	221.2	35.1	186.1	42.6	178.7
Pipe 15	1304	1305	525	0.3%	246.8	43.1	203.7	47.9	198.9
Pipe 16	1305	1164	525	3.9%	899.4	43.1	856.2	47.9	851.4
Pipe 17	1164	1165	500	0.3%	224.1	48.0	176.1	52.8	171.3
Pipe 18	1165	1290	600	0.3%	364.4	64.7	299.7	69.5	294.9
Pipe 19	1290	1291	600	0.2%	277.6	66.0	211.7	70.8	206.9
Pipe 20	1291	1292	600	0.2%	261.8	66.2	195.5	71.0	190.7
Pipe 21	1292	1168	600	0.2%	261.8	66.2	195.5	71.0	190.7
Pipe 22	1168	1169	500	0.4%	246.4	67.1	179.4	71.9	174.6
Pipe 23	1169	1252	760	0.3%	650.4	212.8	437.6	258.2	392.2
Pipe 24	1252	1201	760	0.3%	650.4	213.6	436.9	258.9	391.5
Pipe 25	1201	1208	760	0.3%	650.4	229.8	420.6	275.2	375.3
						Min Available Capacity	**95.05**	**Min**	**87.64**

Project	**Valley View South Masterplan**
Description	**Riverdale to Lift Station 3 Sanitary Flows**
By	**MV**
Date	**2022-01-30**

Design Criterial

Residential

Water - Section 2.3 - 2022 City of Whitehorse Servicing Standards Manual

ADD	500	(L/person/day)
MDD	2	x ADD
PHD	3	x ADD

Sanitary - Section 2.3 - 2022 City of Whitehorse Servicing Standards Manual

Min Density	40	(Persons/Ha)
Sanitary Flows	90%	
Peak San Flow	4	x ADD
Avg Day San Flow	18	m^3/Ha/Day
Peak Sewage Flow	72	m^3/Ha/Day
Infiltration	6000	(L/Ha/Day)
Multiplier for flows for areas larger than 10 Ha to account for future changes in zoning	1.1	SSM section 2.4

Commercial

Average Commercial Water Daily Demand (ACDD)	10	m^3/Ha/Day	Table 2.11, 2003 Whitehorse Water Sewer Masterplan
Sanitary Flows	90%	of Water Demands	
Avg Day San Flow	9	m^3/Ha/Day	
Peak Sewage Flow	3	x ADD	Section 2.3 - 2022 City of Whitehorse Servicing Standards Manual
Peak Sewage Flow	27	m^3/Ha/Day	
Equivalent Population	20	Persons / Ha	ACDD/ADD
Multiplier for flows for areas larger than 10 Ha to account for future changes in zoning	1.1		SSM section 2.4

Area	Service Population	Residential		Commercial		Infiltration (L/s)	Design Flow (L/s)
		Area (Ha)	Design Flow (L/s)	Area (Ha)	Design Flow (L/s)		
N	4,661	116.5	106.8	0.0	0.0	8.1	114.9
O	183	0.0	0.0	9.2	3.2	0.6	3.8
P	29	0.0	0.0	1.4	0.5	0.1	0.6
Q	141	0.0	0.0	7.1	2.4	0.5	2.9
R	25	0.0	0.0	1.3	0.4	0.1	0.5
S	53	0.0	0.0	2.7	0.9	0.2	1.1
T	161	0.0	0.0	8.1	2.8	0.6	3.3
U	47	0.0	0.0	2.4	0.8	0.2	1.0
V	177	0.0	0.0	8.9	3.0	0.6	3.7
Existing LS 3 Population	**5,477**				**Existing LS 3 Peak Flow (L/s)**		**131.8**
Future Riverdale Build Out	1,777	40	36.7	8.865195	3.0	3.4	43.1
Future LS 3 Population	**7,254**				**Future LS 3 Peak Flow (L/s)**		**174.9**

Project	**Valleyview South Master Plan**						
Description	**Pipe Capacity Review**						
Prepared by	**MV/AG**						
Date	**25-Jan-23**						
Pipe ID	**Pipe 1**	**Pipe 2**	**Pipe 3**	**Pipe 4**	**Pipe 5**	**Pipe 6**	**Pipe 7**
Pipe Diameter (mm)	450	450	450	450	450	450	450
Length (m)		110	110	80.09	109.91	110	80.02
Grade (%)	0.62%	0.81%	0.40%	0.40%	0.40%	0.40%	0.40%
MH U/S	7085	7086	-	-	-	-	-
MH D/S	7086	-	-	-	-	-	-
Pipe Material	PVC	PVC	PVC	PVC	PVC	PVC	PVC
n	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Diameter (m)	0.450	0.45	0.45	0.45	0.45	0.45	0.45
Pipe Radius (m)	0.225	0.225	0.225	0.225	0.225	0.225	0.225
Perimeter (m)	1.414	1.4137167	1.4137167	1.4137167	1.4137167	1.4137167	1.4137167
Cross Section Area, A (m^2)	0.159	0.1590431	0.1590431	0.1590431	0.1590431	0.1590431	0.1590431
Conditions at Existing Design Flow (pipe flowing less than 50% Full)							
Pipe % Full	35%						
Flow depth (m)	0.159	0.159	0.159	0.159	0.159	0.159	0.159
circular segment height, h (m)	0.159	0.159	0.159	0.159	0.159	0.159	0.159
center angle,θ	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463
Circular segment area, K (m2)	0.0503	0.0503	0.0503	0.0503	0.0503	0.0503	0.0503
Arc Length, s (m)	0.5729	0.5729	0.5729	0.5729	0.5729	0.5729	0.5729
Flow Area, A (m2)	0.0503	0.0503	0.0503	0.0503	0.0503	0.0503	0.0503
Wetted Perimeter, P_w (m)	0.5729	0.5729	0.5729	0.5729	0.5729	0.5729	0.5729
Hydraulic Radius, R_h (m)	0.0877	0.0877	0.0877	0.0877	0.0877	0.0877	0.0877
Velocity (m/s)	1.1958088	1.3668109	0.9604968	0.9604968	0.9604968	0.9604968	0.9604968
Flow (L/s)	60.098	68.692	48.272	48.272	48.272	48.272	48.272
Conditions at Future Design Flow (Pipe flowing less than 50% Full)							
Pipe % Full	40%						
Flow depth (m)	0.159	0.1781409	0.1781409	0.1781409	0.1781409	0.1781409	0.1781409
circular segment height, h (m)	0.159	0.272	0.272	0.272	0.272	0.272	0.272
center angle,θ	2.5463	3.5612	3.5612	3.5612	3.5612	3.5612	3.5612
Circular segment area, K (m2)	0.0503	0.1005	0.1005	0.1005	0.1005	0.1005	0.1005
Arc Length, s (m)	0.5729	0.8013	0.8013	0.8013	0.8013	0.8013	0.8013
Flow Area, A (m2)	0.0503	0.0586	0.0586	0.0586	0.0586	0.0586	0.0586
Wetted Perimeter, P_w (m)	0.5729	0.6124	0.6124	0.6124	0.6124	0.6124	0.6124
Hydraulic Radius, R_h (m)	0.0877	0.0957	0.0957	0.0957	0.0957	0.0957	0.0957
Velocity (m/s)	1.2	1.4	1.0	1.0	1.0	1.0	1.0
Flow (L/s)	60.1	84.8	59.6	59.6	59.6	59.6	59.6
Conditions with Pipe at 90% Full							
Pipe % Full	90%						
Flow depth (m)	0.405	0.405	0.405	0.405	0.405	0.405	0.405
circular segment height, h (m)	0.045	0.045	0.045	0.045	0.045	0.045	0.045
center angle,θ	1.287	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022
Circular segment area, K (m2)	0.008	0.0082772	0.0082772	0.0082772	0.0082772	0.0082772	0.0082772
Arc Length, s (m)	0.290	0.2895755	0.2895755	0.2895755	0.2895755	0.2895755	0.2895755
Flow Area, A (m2)	0.151	0.1507659	0.1507659	0.1507659	0.1507659	0.1507659	0.1507659
Wetted Perimeter, P_w (m)	1.124	1.1241412	1.1241412	1.1241412	1.1241412	1.1241412	1.1241412
Hydraulic Radius, R_h (m)	0.134	0.1341165	0.1341165	0.1341165	0.1341165	0.1341165	0.1341165
Velocity (m/s)	1.6	1.8	1.3	1.3	1.3	1.3	1.3
Flow (L/s)	239.3	273.5	192.2	192.2	192.2	192.2	192.2

Project	**Valleyview South Master Plan**						
Description	**Pipe Capacity Review**						
Prepared by	**MV/AG**						
Date	**25-Jan-23**						
Pipe ID	**Pipe 8**	**Pipe 9**	**Pipe 10**	**Pipe 11**	**Pipe 12**	**Pipe 13**	**Pipe 14a**
Pipe Diameter (mm)	450	450	200	375	375	450	450
Length (m)	109.98	122.52	200	49.22	74.45	102.27	109.66
Grade (%)	0.40%	0.40%	13.2%	13.2%	4.74%	1.20%	0.55%
MH U/S	-	-	-	1366	1301	1302	1303
MH D/S	-	-	1366	1301	1302	1303	1304
Pipe Material	PVC	PVC	AC	PVC	PVC	PVC	PVC
n	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Diameter (m)	0.45	0.45	0.2	0.375	0.375	0.45	0.45
Pipe Radius (m)	0.225	0.225	0.1	0.1875	0.1875	0.225	0.225
Perimeter (m)	1.4137167	1.4137167	0.6283185	1.1780972	1.1780972	1.4137167	1.4137167
Cross Section Area, A (m^2)	0.1590431	0.1590431	0.0314159	0.1104466	0.1104466	0.1590431	0.1590431
Conditions at Existing Design Flow (pipe flo							
Pipe % Full							
Flow depth (m)	0.159	0.159	0.071	0.133	0.133	0.159	0.159
circular segment height, h (m)	0.159	0.159	0.071	0.133	0.133	0.159	0.159
center angle,θ	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463
Circular segment area, K (m2)	0.0503	0.0503	0.0099	0.0349	0.0349	0.0503	0.0503
Arc Length, s (m)	0.5729	0.5729	0.2546	0.4774	0.4774	0.5729	0.5729
Flow Area, A (m2)	0.0503	0.0503	0.0099	0.0349	0.0349	0.0503	0.0503
Wetted Perimeter, P_w (m)	0.5729	0.5729	0.2546	0.4774	0.4774	0.5729	0.5729
Hydraulic Radius, R_h (m)	0.0877	0.0877	0.0390	0.0731	0.0731	0.0877	0.0877
Velocity (m/s)	0.9604968	0.9604968	3.2133981	4.8861341	2.9279765	1.6636292	1.1262823
Flow (L/s)	48.272	48.272	31.901	170.530	102.189	83.609	56.604
Conditions at Future Design Flow (Pipe flow							
Pipe % Full							
Flow depth (m)	0.1781409	0.1781409	0.0791737	0.1484508	0.1484508	0.1781409	0.1781409
circular segment height, h (m)	0.272	0.272	0.121	0.227	0.227	0.272	0.272
center angle,θ	3.5612	3.5612	3.5612	3.5612	3.5612	3.5612	3.5612
Circular segment area, K (m2)	0.1005	0.1005	0.0198	0.0698	0.0698	0.1005	0.1005
Arc Length, s (m)	0.8013	0.8013	0.3561	0.6677	0.6677	0.8013	0.8013
Flow Area, A (m2)	0.0586	0.0586	0.0116	0.0407	0.0407	0.0586	0.0586
Wetted Perimeter, P_w (m)	0.6124	0.6124	0.2722	0.5104	0.5104	0.6124	0.6124
Hydraulic Radius, R_h (m)	0.0957	0.0957	0.0425	0.0797	0.0797	0.0957	0.0957
Velocity (m/s)	1.0	1.0	3.4	5.2	3.1	1.8	1.2
Flow (L/s)	59.6	59.6	39.4	210.6	126.2	103.3	69.9
Conditions with Pipe at 90% Full							
Pipe % Full							
Flow depth (m)	0.405	0.405	0.18	0.3375	0.3375	0.405	0.405
circular segment height, h (m)	0.045	0.045	0.02	0.0375	0.0375	0.045	0.045
center angle,θ	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022
Circular segment area, K (m2)	0.0082772	0.0082772	0.001635	0.0057481	0.0057481	0.0082772	0.0082772
Arc Length, s (m)	0.2895755	0.2895755	0.1287002	0.2413129	0.2413129	0.2895755	0.2895755
Flow Area, A (m2)	0.1507659	0.1507659	0.0297809	0.1046985	0.1046985	0.1507659	0.1507659
Wetted Perimeter, P_w (m)	1.1241412	1.1241412	0.4996183	0.9367843	0.9367843	1.1241412	1.1241412
Hydraulic Radius, R_h (m)	0.1341165	0.1341165	0.0596073	0.1117638	0.1117638	0.1341165	0.1341165
Velocity (m/s)	1.3	1.3	4.3	6.5	3.9	2.2	1.5
Flow (L/s)	192.2	192.2	127.0	678.9	406.8	332.9	225.4

Project	**Valleyview South Master Plan**					
Description	**Pipe Capacity Review**					
Prepared by	**MV/AG**					
Date	**25-Jan-23**					
Pipe ID	**Pipe 14b**	**Pipe 15**	**Pipe 16**	**Pipe 17**	**Pipe 18**	**Pipe 19**
Pipe Diameter (mm)	450	525	525	500	600	600
Length (m)	21.6	63.79	6.28	114.2	5	71
Grade (%)	0.53%	0.29%	3.85%	0.31%	0.31%	0.18%
MH U/S	1303	1304	1305	1164	1165	1290
MH D/S	1304	1305	1164	1165	1290	1291
Pipe Material	PVC	PVC	PVC	Conc.	DI	DI
n	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Diameter (m)	0.45	0.525	0.525	0.5	0.6	0.6
Pipe Radius (m)	0.225	0.2625	0.2625	0.25	0.3	0.3
Perimeter (m)	1.4137167	1.6493361	1.6493361	1.5707963	1.8849556	1.8849556
Cross Section Area, A (m^2)	0.1590431	0.2164754	0.2164754	0.1963495	0.2827433	0.2827433
Conditions at Existing Design Flow (pipe flo						
Pipe % Full						
Flow depth (m)	0.159	0.186	0.186	0.177	0.212	0.212
circular segment height, h (m)	0.159	0.186	0.186	0.177	0.212	0.212
center angle,θ	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463
Circular segment area, K (m2)	0.0503	0.0684	0.0684	0.0620	0.0893	0.0893
Arc Length, s (m)	0.5729	0.6684	0.6684	0.6366	0.7639	0.7639
Flow Area, A (m2)	0.0503	0.0684	0.0684	0.0620	0.0893	0.0893
Wetted Perimeter, P_w (m)	0.5729	0.6684	0.6684	0.6366	0.7639	0.7639
Hydraulic Radius, R_h (m)	0.0877	0.1023	0.1023	0.0975	0.1170	0.1170
Velocity (m/s)	1.1056148	0.9063504	3.3023833	0.9070929	1.0243285	0.7805391
Flow (L/s)	55.565	62.000	225.902	56.281	91.520	69.738
Conditions at Future Design Flow (Pipe flow						
Pipe % Full						
Flow depth (m)	0.1781409	0.2078311	0.2078311	0.1979344	0.2375212	0.2375212
circular segment height, h (m)	0.272	0.317	0.317	0.302	0.362	0.362
center angle,θ	3.5612	3.5612	3.5612	3.5612	3.5612	3.5612
Circular segment area, K (m2)	0.1005	0.1367	0.1367	0.1240	0.1786	0.1786
Arc Length, s (m)	0.8013	0.9348	0.9348	0.8903	1.0684	1.0684
Flow Area, A (m2)	0.0586	0.0797	0.0797	0.0723	0.1042	0.1042
Wetted Perimeter, P_w (m)	0.6124	0.7145	0.7145	0.6805	0.8166	0.8166
Hydraulic Radius, R_h (m)	0.0957	0.1116	0.1116	0.1063	0.1276	0.1276
Velocity (m/s)	1.2	1.0	3.5	1.0	1.1	0.8
Flow (L/s)	68.6	76.6	279.0	69.5	113.0	86.1
Conditions with Pipe at 90% Full						
Pipe % Full						
Flow depth (m)	0.405	0.4725	0.4725	0.45	0.54	0.54
circular segment height, h (m)	0.045	0.0525	0.0525	0.05	0.06	0.06
center angle,θ	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022
Circular segment area, K (m2)	0.0082772	0.0112662	0.0112662	0.0102188	0.0147151	0.0147151
Arc Length, s (m)	0.2895755	0.3378381	0.3378381	0.3217506	0.3861007	0.3861007
Flow Area, A (m2)	0.1507659	0.2052091	0.2052091	0.1861307	0.2680282	0.2680282
Wetted Perimeter, P_w (m)	1.1241412	1.3114981	1.3114981	1.2490458	1.4988549	1.4988549
Hydraulic Radius, R_h (m)	0.1341165	0.1564693	0.1564693	0.1490183	0.178822	0.178822
Velocity (m/s)	1.5	1.2	4.4	1.2	1.4	1.0
Flow (L/s)	221.2	246.8	899.4	224.1	364.4	277.6

Project	**Valleyview South Master Plan**					
Description	**Pipe Capacity Review**					
Prepared by	**MV/AG**					
Date	**25-Jan-23**					
Pipe ID	**Pipe 20**	**Pipe 21**	**Pipe 22**	**Pipe 23**	**Pipe 24**	**Pipe 25**
Pipe Diameter (mm)	600	600	500	760	760	760
Length (m)	85	3.5	116	190.87	85.75	76.5
Grade (%)	0.16%	0.16%	0.375%	0.28%	0.28%	0.28%
MH U/S	1291	1292	1168	1169	1252	1201
MH D/S	1292	1168	1169	1252	1201	1208
Pipe Material	DI	DI	AC	AC	AC	AC
n	0.013	0.013	0.013	0.013	0.013	0.013
Pipe Diameter (m)	0.6	0.6	0.5	0.76	0.76	0.76
Pipe Radius (m)	0.3	0.3	0.25	0.38	0.38	0.38
Perimeter (m)	1.8849556	1.8849556	1.5707963	2.3876104	2.3876104	2.3876104
Cross Section Area, A (m^2)	0.2827433	0.2827433	0.1963495	0.453646	0.453646	0.453646
Conditions at Existing Design Flow (pipe flo						
Pipe % Full						
Flow depth (m)	0.212	0.212	0.177	0.269	0.269	0.269
circular segment height, h (m)	0.212	0.212	0.177	0.269	0.269	0.269
center angle,θ	2.5463	2.5463	2.5463	2.5463	2.5463	2.5463
Circular segment area, K (m2)	0.0893	0.0893	0.0620	0.1434	0.1434	0.1434
Arc Length, s (m)	0.7639	0.7639	0.6366	0.9676	0.9676	0.9676
Flow Area, A (m2)	0.0893	0.0893	0.0620	0.1434	0.1434	0.1434
Wetted Perimeter, P_w (m)	0.7639	0.7639	0.6366	0.9676	0.9676	0.9676
Hydraulic Radius, R_h (m)	0.1170	0.1170	0.0975	0.1482	0.1482	0.1482
Velocity (m/s)	0.7358993	0.7358993	0.9976692	1.1396697	1.1396697	1.1396697
Flow (L/s)	65.750	65.750	61.901	163.373	163.373	163.373
Conditions at Future Design Flow (Pipe flow						
Pipe % Full						
Flow depth (m)	0.2375212	0.2375212	0.1979344	0.3008602	0.3008602	0.3008602
circular segment height, h (m)	0.362	0.362	0.302	0.459	0.459	0.459
center angle,θ	3.5612	3.5612	3.5612	3.5612	3.5612	3.5612
Circular segment area, K (m2)	0.1786	0.1786	0.1240	0.2865	0.2865	0.2865
Arc Length, s (m)	1.0684	1.0684	0.8903	1.3533	1.3533	1.3533
Flow Area, A (m2)	0.1042	0.1042	0.0723	0.1671	0.1671	0.1671
Wetted Perimeter, P_w (m)	0.8166	0.8166	0.6805	1.0344	1.0344	1.0344
Hydraulic Radius, R_h (m)	0.1276	0.1276	0.1063	0.1616	0.1616	0.1616
Velocity (m/s)	0.8	0.8	1.1	1.2	1.2	1.2
Flow (L/s)	81.2	81.2	76.5	201.8	201.8	201.8
Conditions with Pipe at 90% Full						
Pipe % Full						
Flow depth (m)	0.54	0.54	0.45	0.684	0.684	0.684
circular segment height, h (m)	0.06	0.06	0.05	0.076	0.076	0.076
center angle,θ	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022	1.2870022
Circular segment area, K (m2)	0.0147151	0.0147151	0.0102188	0.0236096	0.0236096	0.0236096
Arc Length, s (m)	0.3861007	0.3861007	0.3217506	0.4890608	0.4890608	0.4890608
Flow Area, A (m2)	0.2680282	0.2680282	0.1861307	0.4300364	0.4300364	0.4300364
Wetted Perimeter, P_w (m)	1.4988549	1.4988549	1.2490458	1.8985496	1.8985496	1.8985496
Hydraulic Radius, R_h (m)	0.178822	0.178822	0.1490183	0.2265079	0.2265079	0.2265079
Velocity (m/s)	1.0	1.0	1.3	1.5	1.5	1.5
Flow (L/s)	261.8	261.8	246.4	650.4	650.4	650.4

Preliminary Review of the Integrated Wastewater Servicing Options for the Valleyview South Development Area

Intended for further discussion with the City

Wastewater Servicing Option		Description	Advantages	Challenges/Disadvantages	Upgrade Requirements	Preliminary Order of Magnitude Cost Estimates
1	Hamilton Boulevard	Connects to the santiary trunkmain that runs along Hamilton Boulevard. Some portions of the development may connect to this trunkmain by gravity but a lift station would be required to service this entire area. Offsite upgrades are not anticipated at this time, however, this will be confirmed in the water and sewer master plan.	- The Hamilton Boulevard trunkmain flows to the Marwell Lift Station, avoiding contributing flow to LS-1. - Limited offsite upgrades and disturbance to public. - Can proceed completely independently without affecting other infrastructure	- Higher capital cost. - A new lift station is required and the City will be responsible for the future O&M and asset management costs. - Requires crossing Hamilton Boulevard and will likely results in traffic/public disturbances. - Doesn't benefit existing City infrastructure; simply adds to it	New lift station and forcemain that crosses Hamilton Boulevard.	$6,900,000
2	Valleyview Drive	Connects to the sanitary sewermain on Valleyview Drive. A new lift station would be required and the existing sewermain would need to be replaced, including replacing the crossing of Hamilton Boulevard. Offsite upgrades are not anticipated at this time, however, this will be confirmed in the water and sewer master plan.	- The Hamilton Boulevard trunkmain flows to the Marwell Lift Station, avoiding contributing flow to LS-1. - Replace an aging sewermain as part of the work. Could potentially include the watermain replacement along along the alignment as part of the work if it is scheduled for replacement.	- Higher capital cost. - A new lift station is required and the City will be responsible for the future O&M and asset management costs. - Disturbance to the residents of Valleyview Drive. - Requires crossing Hamilton Boulevard and will likely results in traffic/public disturbances.	New lift station and forcemain and the replacement of the sewermain along Valleyview Drive including the sewermain crossing of Hamilton Blvd.	$7,100,000
3	Range Road	Connects to the sanitary sewermain on Range Road which flows to the Range Road lift statoin where it is pumped into the Hamilton Blvd trunkmain. The existing lift station would need to be upgraded and the sewermain along range road would need to be upsized. A highway crossing of the sewermain would be required. Offsite upgrades are not anticipated at this time, however, this will be confirmed in the water and sewer master plan.	- Lower capital cost. - Avoids the construction of an additional lift station reducing the O&M and assessment management costs associated with a new lift station. - The Hamilton Boulevard trunkmain flows to the Marwell Lift Station, avoiding contributing flow to LS-1. - Replace an aging sewermain as part of the work. Could potentially include the watermain replacement along along the alignment as part of the work if it is scheduled for replacement.	- Upgrade to the Range Road lift station is required and the City will be responsible for the future O&M and asset management costs. - Disturbance to the business owners along Range Road. - Requires crossing Highway which will require an approval and will likely results in traffic/public disturbances. - Public perception of disturbing/replacing recently installed infrastructure may be negative	Upgrade of range road lift statoin and the replacement of the sewermain along Range Road including the sewermain crossing of the highway. May require upgrades to the forcemain.	$3,900,000
4	Airport Sewermain	Connects to the airport sewermain scheduled to be installed in 2023 which flows to the lift station #1 (LS-1) at shipyards park. LS-1 pumps to the Marwell lift station. The sewermain that flow down the embankment may need to be upsized to accommodate the flow, however, this should be confirmed as part of subsequent analysis.	- Lower capital cost. - Avoids the construction of an additional lift station reducing the O&M and assessment management costs associated with a new lift station. - Contributes to the cost of replacing LS-1 which is slotted for replacement. Completing the lift station replacement benefits the City and will contribute to lower O&M costs compared to operating the existing lift station. - Creates a "win-win" for both private development and City	-Contributes flow to LS-1 which is nearing the end of its useful life and this connection cannot proceed until the lift station is replaced. - Requires crossing Highway which will require an approval and will likely results in traffic/public disturbances.	Sewermain crossing the highway that ties into the proposed airport sewermain. A portion of the LS-1 replacement costs will be required (likely somewhere between 5-10% of the lift station costs).	$3,800,000

Preliminary Order of Magnitude Cost Estimates

1	Hamilton Boulevard Connection	Unit	Quantity	Unit Rate	Total Estimate	
1.1	New Lift Station	LS	1	$4,000,000	$4,000,000	
1.2	Forcemain	lm	1,000	$500	$500,000	
1.3	Hamilton Blvd Crossing	lm	50	$1,500	$75,000	
				Subtotal	$4,575,000	
				Contingency and Engineering (50%)	$2,287,500	
				Total	$6,862,500	
2	**Valleyview Drive Connection**	Unit	Quantity	Unit Rate	Total Estimate	
2.1	New Lift Station	LS	1	$4,000,000	$4,000,000	
2.2	Forcemain	lm	600	$500	$300,000	
2.3	Gravity Sewer Upgrade	lm	500	$650	$325,000	
2.4	Hamilton Blvd Crossing	lm	50	$1,500	$75,000	
				Subtotal	$4,700,000	
				Contingency and Engineering (50%)	$2,350,000	
				Total	$7,050,000	
3	**Range Road Connection**	Unit	Quantity	Unit Rate		
3.1	Gravity Sewer Connection to Range Road	lm	350	$750	$262,500	
3.2	Highway Crossing	lm	50	$1,500	$75,000	
3.3	Gravity Sewer Upgrade (Pipe 10 down Embankment)	lm	65	$750	$48,750	
3.4	Lift Station Upgrade	LS	1	$2,000,000	$2,000,000	
3.5	Potential Forcemain Upgrades	LS	1	$200,000	$200,000	
				Subtotal	$2,586,250	
				Contingency and Engineering (50%)	$1,293,125	
				Total	$3,879,375	
4	**Airport Connection**					
4.1	Gravity Sewer to Airport Sewermain	lm	500	$750	$375,000	
4.2	Highway Crossing	lm	50	$1,500	$75,000	
4.3	Gravity Sewer Upgrade	lm	550	$650	$357,500	
4.4	Portion of Lift Station #1 Upgrade	LS	1	$1,500,000	$1,500,000	Assumes ~5-10% of lift station upgrade costs
3.5	Potential Forcemain Upgrades	LS	1	$200,000	$200,000	
				Subtotal	$2,507,500	
				Contingency and Engineering (50%)	$1,253,750	
				Total	$3,761,250	

MEMORANDUM

TO	Jane Koepke, Groundswell Planning Taylor Eshpeter, P.Eng., City of Whitehorse		
FROM	Mauro Trevisan, E.I.T. and Adam Greenwood, P.Eng.	**DATE**	May 17, 2023
RE	Valleyview South Master Plan Stormwater Management Considerations	**PROJECT No.**	14-08

1 Introduction

Greenwood Engineering Services (GES) has been retained by Groundswell Industries to provide engineering servicing input for the proposed Valleyview South Master Plan development area. Recent discussions with the City highlighted their concerns related to stormwater management for the development, including the expectation that all stormwater will be managed onsite and not enter Baxter's Gulch, located directly downstream of the proposed development area. Those discussions also highlighted a desire for the Valleyview South Maser Plan (VSMP) to consider "lessons learned" from the Whistle Bend development. The intent of this memo is to provide an overview of the operational issues currently being experienced in the Whistle Bend development and broader context for the City's expectations around Baxter's Gulch and the VSMP area.

2 Lessons Learned from Whistle Bend

On April 27, 2023, GES was toured through the Whistle Bend development by Dale Cebuliak, Engineering Department and Byron Wagner, Utilities Systems Supervisor to review the stormwater system. Meeting minutes from the site meeting are attached. A brief overview of the items discussed are summarized below.

The Whistle Bend development includes a wet pond to manage the stormwater for the development. The wet pond was originally designed to be a dry retention pond; however, we understand that the main issue was that the design of the pond did not consider the soil conditions as a geotechnical engineer did not provide the necessary input prior to the construction of the stormwater pond. As a result, the pond does not effectively infiltrate or evaporate water, and without an outlet, the pond holds water and rises uncontrollably during freshet. A pump station to drain the pond has since been constructed to control the water level of the pond. Since the pond was designed to infiltrate the stored water, it is very shallow and experiences issues with algae blooms which create odour issues and require ongoing maintenance to remove the algae. The City is exploring ways to reduce the algae issues, such as looking at ways to increase the turnover of the pond and eliminating the use of fertilizers in the surrounding greenspace, however, the City will need to continue to manage the pump station and algae blooms in the pond.

During the site visit, we also toured the dry pond that was recently constructed to manage stormwater for the phases of Whistle Bend currently under construction. The City indicated that they were happy to see that it was going to be a

dry pond. It was noted during the site visit that the pond is a significant engineered structure that does not fit into the natural landscape and there is currently limited recreational or environmental value with the structure. The design of a stormwater pond should consider both the stormwater design requirements as well as the landscape and setting of the facility so that it is simply not an engineered structure that detracts from the site or creates safety issues with the neighbouring land uses. That said, we have not been provided the design drawings of the pond and therefore do not know what the ultimate site design will yield.

3 Existing Issues in Baxter's Gulch

Given the Valleyview South's current drainage to Baxter's Gulch and the City's request (during a meeting on April 27, 2023) to avoid contributing any post-development stormwater flows to it, we felt the situation at Baxter's Gulch warranted a closer look.

City staff explained that the effects of unmanaged stormwater runoff from the drainage areas flowing through Baxter's Gulch contribute to the downcutting and eroding of the creek channel, and oversteepening the valley walls. The subsequent sloughing of the valley causes sediment dams and outburst flows, periodically transporting high sediment loads to the outlet of the Gulch to accumulate in the culvert that crosses Two Mile Hill Road. This creates significant operational issues for the City as they are required to frequently clear out the culvert and maintain the drainage path. This issue also poses a safety risk to pedestrians, vehicles and potential damage to public property if the culvert backs up and the stormwater flows overland across Two Mile Hill Road. Although we have no previous professional experience working on the issues with this Gulch, being residents of Whitehorse, we have observed the silts that are washed onto Two Mile Hill Road and these operational issues come as no surprise.

In 2021, Morrison Hershfield (MH) performed a drainage study of the creek from Baxter's Gulch which crosses Two Mile Hill Road and Quartz Road and discharges into the Yukon River. The study identifies Baxter's Gulch as the drainage path where groundwater flows daylights to the surface, and where runoff from the Whitehorse airport, parts of the Alaska highway, and Hillcrest neighborhood areas are directed. The study identified high stream flows during spring freshet as a significant factor to flooding conditions and recognizes that the airport, using the northwest corner of the airport as a snow dump, was a substantial contributor to these flows. The MH study ultimately recommends installing sediment basins upstream of the Two Mile Hill culvert as well as ditch improvements between the Two Mile Hill Road culvert and the culvert that crosses Quartz Road. The sediment basins would operate in a similar manner to the existing sediment basins at the south end of 8th Avenue at the west end of Main Street. The City indicated that these existing sediment basins require regular maintenance to remove the sediment, but that they have found they are effective in managing the sediment and reducing the amount of sediment that enters the storm system; thereby reducing flushing and sedimental removal tasks in the storm system. Photos 1 and 2 of the existing sediment basins highlight how much sediment is managed in these basins from stormwater runoff.

Photos 1 and 2: Existing Sediment Basin Looking North and South, Respectively

After flowing through the Two Mile Hill culvert, the stormwater drainage path flows through an open channel that borders the commercial properties and then crosses Quartz Road where the water is discharged into the Yukon River. Further consideration should also be taken to address pollutant loading of stormwater runoff from the Hillcrest industrial and commercial developments, the airport runway and taxiway (e.g. de-icing agents, fuel, etc.), the Alaska Highway and the contamination of the former tank farm located within the Valleyview South development area. Since there is no proper detention or treatment systems in place to remove contaminants from the stormwater stream, there is a high potential for the transportation of sediments and pollutants to the Yukon River. It would be prudent for the City to address these issues as it relates to the City meeting acceptable water quality targets in the City's operational water license, as well as impacts to the environment.

In addition to the environmental impacts within the Gulch, continued erosion of the gulch has the potential to impact the highway right-of-way, City paved trails and the airport property adjacent to the Gulch. It would be wise to better understand this risk and work with the airport to develop an approach that manages potential risks to City infrastructure, property, and natural systems.

4 Catchment Area for Baxter's Gulch

Further to the issues with Baxter's Gulch discussed in Section 3, an overview of the catchment area to Baxter's Gulch is outlined in Figures 1 and 2. The volumes listed in Figure 2 list the stormwater flows generated from each catchment area for a 15 minute storm event with a 5 year return period using the Rational Method. This approach

was used to provide a general overview of stormwater conditions within the area and to provide some perspective on the stormwater runoff flows expected from the various catchment areas. Ultimately, forecasting stormwater runoff flows for areas larger than 10 hectares requires further analysis and will require the use of computer simulations which should be completed as part of subsequent stormwater management design. With reference to figure 2, it is clear that the airport contributes more than 65% of the stormwater flows to Gulch.

In reviewing the proposed stormwater improvements to the Airport, a stormwater sewer will be installed to collect the runoff generated from the entire airport and direct it to Baxter's Gulch with the storm pipes discharging directly into the gulch without any stormwater ponds or energy dissipating structures. We are unsure of the rationale behind this design as it does not follow typical best management design practices for stormwater management and will most likely further destabilize Baxter's Gulch and worsen issues downstream at the Two Mile Hill Road culvert. An excerpt from the proposed stormwater infrastructure discharging to Baxter's Gulch is shown in Image 1. It should be noted that the design drawings do state "the drainage design may be adjusted following an airport drainage attenuation / diversion study". It is our understanding that a contract has been awarded to a contractor and the work is scheduled to be installed over the next few construction seasons. We are not aware of any changes to the design and we recommend the City ensure the appropriate stormwater management infrastructure be included as part of the work to support the City's efforts to manage the issues in Baxter's Gulch discussed further in Section 5.

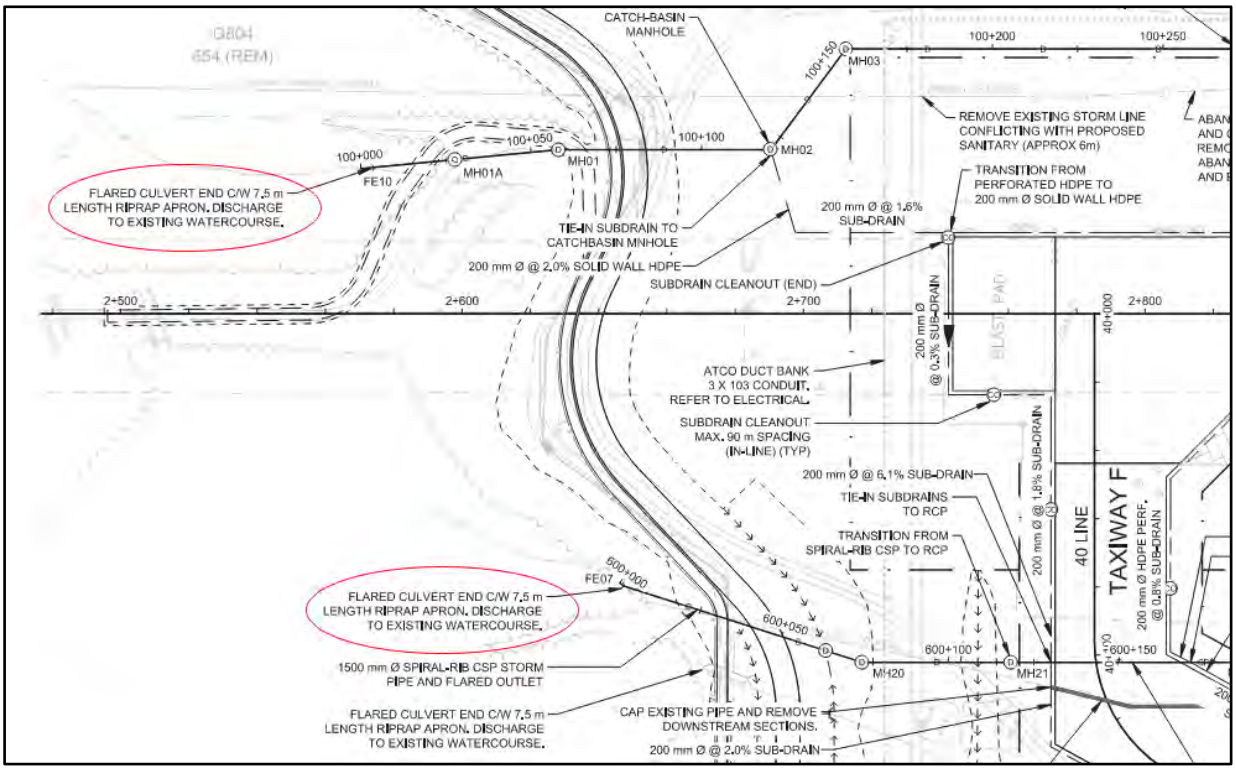

Image 1: Proposed Stormwater Outfalls into Baxter's Gulch

Source: Erik Nielsen Whitehorse International Airport Airfield Upgrades, Drainage Plan – Runway 14R-32L, Associated Engineering, Issued for RFP, Sept 23, 2022

5 Recommended Stormwater Improvements to Address Issues to Gulch

Based on the available information, it is recommended that the entire catchment area of the Baxter's Gulch be reviewed, and an integrated approach be developed. The development of an integrated stormwater management plan is not within the scope of this assignment, and we recommend that the City work with the airport and highways to develop an integrated stormwater management plan that manages the stormwater from the airport, highway and hillcrest and industrial subdivisions that contribute to the stormwater flows to Baxter's Gulch. The stormwater management plan should also account for future development plans for the Valleyview South development area.

A couple of options, discussed briefly with the City during the site visit, included the installation of an overland drainage pipes that directs the stormwater runoff through Baxter's Gulch to reduce erosion issues, and the development of a stormwater management facility to treat the stormwater and buffer the runoff peak flow events. This approach of developing proper stormwater management infrastructure is suggested in the proposed airport stormwater improvement discussed in Section 4, however, the design currently does not include any of this infrastructure.

6 Proposed Stormwater Management for Valleyview South Development Area

Currently there is no channelized flow from the site and given the granular and free draining nature of the soils defined in the January 31, 2013 Impact, Mitigation and Compensation Report for Remediation Work at the Former Whitehorse Upper Tank Farm report by Golder Associates, all the stormwater is currently managed through infiltration into the soils. A common topic related to the impact of development in urban areas is the correlation between increased impervious, or hard surfaces, and surface runoff. As seen in Image 2, the development of natural areas creates an imbalance in runoff and infiltration.

As outlined in the MH report, groundwater is daylighting in Baxter's Gulch throughout the year at an estimated rate of 5 L/s. Since the seepage occurs year-round, the catchment area contributing to the seepage flows entering the Gulch area is much larger than just the Valleyview South development area. Therefore, any changes to the amount of stormwater infiltration within the development will likely have little impact to groundwater inputs to Baxter's Gulch. We therefore recommend the focus of stormwater management within the development is towards controlling surface runoff.

Implementing best management practices within the development would be to continue to send the stormwater from the Valleyview South development area subsurface through appropriately sized and designed stormwater management facilities that will consist of a stormwater management pond(s) as well as smaller low impact source controls, such as bioswale, rock pits and rain gardens, should be considered to manage high flow conditions and reduce peak volumes. All these facilities will be much smaller than the stormwater facilities in Whistle Bend, and will be located in low lying areas and should be integrated into the landscape design for the greenspaces. Obviously,

some of the design features that are typically used in warmer climates will not be appropriate for the site and additional thought needs to be put into how best to manage the peak stormwater runoff event that will occur during spring freshet when the ground may still be frozen. For example, a wet pond could be considered to capture sediments, control runoff volumes and maintain an unfrozen pathway for infiltration during the spring freshet. The design should consider the current issues experienced in Whistle Bend to avoid ongoing operational issues associated with the improper design (ex. ensure proper turnover, an overflow outlet, and consider the soils in the design).

Given the topography of the existing site, and the fact that two concepts are currently being explored with very different grading designs, the layout and design of the stormwater system cannot be completed at this time, however, it is likely that a stormwater storage control facility will be located downstream of the development area, either within the Valley South development area along the highway, or as part of an integrated stormwater management system with the other catchment areas. The design of the stormwater system shall manage peak events and seek to minimize any surface runoff directly into Baxter's Gulch, however, a properly designed overflow structure should be included in the design to ensure the stormwater system can manage a peak event while also limiting negative effects to Baxter's Gulch.

7 Closing

Given the free draining nature of the sand and gravel within the site, the stormwater management of the Valleyview South development area can be designed to minimize the stormwater runoff from the development area using appropriately sized and designed storage and infiltration facilities. Ultimately, stormwater management for the Valley South development area should be considered as part of the City's stormwater management of Baxter's Gulch and requires collaboration and coordination between multiple parties, most notably the airport. It is recommended that the City work with the airport and highway to develop an integrated stormwater management plan to manage the stormwater from the airport, highway and Hillcrest and Burns Road/Wasson Place subdivisions to address impacts to Baxter's Gulch and downstream systems.

LEGEND

- Valleyview South Study Area
  113.6Ha Mixed Residential
- Hillcrest Residential
  23.7Ha Residential
  0.9Ha Commercial
- Burns Road Industrial
  26Ha Industrial
- Whitehorse
  International Airport
  289 Ha Commercial
- Baxters Gulch
  16.9 Ha Greenspace
- Alaska Highway
  17.7Ha Pavement

HILLCREST RESIDENTIAL

HAMILTON BLVD

BURNS ROAD INDUSTRIAL

PROPOSED VALLEYVIEW SOUTH

ALASKA HIGHWAY

WHITEHORSE INTERNATIONAL AIRPORT

PEDESTRIAN TRAIL

CREEK

BAXTERS GULCH

TWO MILE HILL ROAD CULVERT

2-MILE HILL ROAD

YUKON RIVER

YUKON RIVER OUTFALL

DRAINAGE DITCH

QUARTZ ROAD CULVERT

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GREENWOOD ENGINEERING SOLUTIONS

1:15,000 0 150 450 750m

Valleyview South Masterplan
Figure 1 - Drainage Catchment Areas

May 16, 2023

PROPOSED VALLEYVIEW SOUTH CATCHMENT AREA

PRE DEVELOPMENT RUNOFF VOLUME = 818CM
POST DEVELOPMENT RUNOFF VOLUME = 2,993CM

20.4%

HILLCREST AND BURNS ROAD SUBDIVISIONS CATCHMENT AREA

RUNOFF VOLUME = 1,288CM

8.8%

5.2%

ALASKA HIGHWAY CATCHMENT AREA

RUNOFF VOLUME = 757CM

65.6%

AIRPORT CATCHMENT AREA

RUNOFF VOLUME = 9,609CM

Legend

% Percent Contribution of Total Flow

Existing infrastructure

Notes

Flow volumes estimated in cubic meters for each catchment for a 5-year return period with a 15 minute storm duration based on intensity duration curves provided by Environment Canada.

BAXTER'S GULCH

TWO MILE HILL CULVERT

DRAINAGE DITCHES

QUARTZ ROAD CULVERT

YUKON RIVER

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GREENWOOD ENGINEERING SOLUTIONS

Valleyview South Masterplan Draomage
Figure 2 - Drainage Process Chart

May 16, 2023

MINUTES

Date & Time | April 27, 2021, *9:00am* Location | Whistlebend Detention Ponds, Whitehorse

Project:	Valleyview South Master Plan
Project Number:	14-08
Type of Meeting:	Review Whistle Bend Detention Pond Site Meeting
Attendees:	Byron Wagner, City of Whitehorse (CoW) Dale Cebuliak, CoW Adam Greenwood, Greenwood Engineering (GES) Mauro Trevisan, GES
Distribution:	Attendees

ITEMS DISCUSSED

1. Intent

The purpose of the site meeting was to get a better understanding of the issues with the stormwater ponds so that the stormwater management system for the Valleyview South development area can consider these issues.

2. Whistle Bend Detention Pond Management

Issue: Algae blooms

- Parks were using fertilizer on surrounding lawn but are no longer using it.
- Periodic removal of algae and sediments is required. Arctic Backhoe has removed the algae two years ago.

Considerations:

- Wet pond depth is on average 1.5 m deep, typically 2-3 m depth is used
- Maintenance options include dye, algaecide, bubblers, and vegetating the shoreline to absorb nutrients.
- Typical stormwater pond design has a turns over at least twice per season. There is currently not enough flow entering the storm pond and the City is considering directing more stormwater from other development areas to increase the turn over of the pond. Currently the pump station can draw down ~7cm per day.
- Outfall structures would also provide proper turnover and should be considered in the design of a stormwater pond.

City Comments:

- A dry pond is preferred due to the operational issues experienced with the Whistle Bend wet pond.
- O&M is an issue with detention ponds when they are not designed properly; the City has limited staff that can manage the ponds and they have to contract out some of the work, such as the removal of the algae using hydrovac trucks.

Issue: Infiltration

- The pond was originally designed to absorb into the ground, however geotechnical study indicated the soils were too tight.
- With no outfall structure, pond was overflowing during spring freshet resulting in groundwater issues and needing to pump water into the forest.
- A pumphouse was installed to draw down the water level of the pond.

City Comments:

- The new dry pond works well and has an outlet.
- The Hidden Valley evaporation pond is not functioning as it should, and operations staff need to frequently pump out the pond.

3. Baxters Gulch

Issues: High surface runoff

- Runoff from the airport and Hillcrest flows into Baxter's Gulch and the airport piles snow at the North end of their property. During spring freshet, high flows erode the valley causing sediment dams and flooding at the Two Mile Road culvert.

Considerations:

- Geotech/hydrogeology study is required to determine contribution of the Valleyview South development to seepage flows into Baxter's Gulch.
- An overland pipe could be used to convey stormwater runoff volumes from Baxter's Gulch to the Two Mile culvert.
- A balance of overland flow and subsurface flow is required to manage surface flows into Baxter's Gulch and proper stormwater management will require a broader scope to include the airport, Hillcrest and industrial subdivisions, the Alaska Highway and the Valleyview South development area catchments.

City Comments:

- The natural open channel from Two Mile to Quartz Road functions well, issues occur at manmade structures.
- The Two Mile culvert is heat traced, but is full of sediment.

APPENDIX D

Transportation Concept Drawings

APPENDIX E

Transportation Review Memo

MEMORANDUM

MORRISON HERSHFIELD

TO:	Jane Koepke, Groundswell Planning	**FROM:**	Stanley Li, P.Eng., PTOE
		PROJECT No.:	2203772.00
RE:	Valleyview South Master Plan High Level Transportation Review	**DATE:**	5/18/2023

X:\PROJ\2022\220377200-VALLEYVIEW SOUTH MASTER PLAN TIA\08. WORKING\TRAFFICIMPACTASSESSMENT\REPORT\20230515MEMO\2203772_VALLEYVIEWNEIGHBOURHOODTRAFFICIMPACTSUMMARY_2023MAY15.DOCX

The purpose of this memorandum is to conduct a high-level review of the transportation implications of the two draft concepts that have been developed for the Valleyview South Master Plan (VSMP). This review includes traffic impact estimates and summarizes the potential traffic pattern changes of the internal and surrounding road networks. A full traffic impact assessment report will be conducted when a final preferred concept is chosen.

1.0 Overview of Concepts

Two land use and roadway network concepts were developed by Groundswell Planning's team and are illustrated in the Land Use Concepts and accompanying Transportation Maps. Please refer to the Scenario Brief document for a general description of the concepts.

2.0 Official Community Plan Guidance

Section 11.0 Transportation and Mobility of the City's recently adopted Official Community Plan contains numerous policies that are relevant to the transportation aspects of VSMP. The more noteworthy policies include:

11.2 Active transportation modes (i.e. pedestrians and cyclists) are prioritized over shared and personal modes.

11.7 The City will encourage a shift towards increased use of active and shared transportation modes.

11.11 A Complete Streets approach will be applied to roadway reconstruction, upgrades, and new construction.

11.12 The design of the transportation network will support surrounding land use, consider the needs of all users, incorporate multi-modal movements, and include opportunities for decorative street furniture or public art, where appropriate.

11.17 The City will ensure that new developments are designed and connected to the active transportation network in a way that supports the hierarchy of transportation modes included (in 11.2)

11.18 Initiatives that remove physical barriers, address safety concerns, close route gaps, improve winter maintenance, and improve lighting for active transportation modes throughout the community will be supported, where feasible.

11.20 The City will ensure that the active transportation network is designed with connections to support year-round multi-modal movements.

11.21 The City will work with community partners to enhance the overall active transportation network connectivity to destinations such as schools, hospital, and major workplaces.

Given the preliminary design stage the project is at, it is difficult to articulate how these policies may be reflected. The final Master Plan will provide additional guidance.

3.0 Trip Generations

The ITE Trip Generation Manual 11th Edition is used to estimate the trips generated from the proposed development. Based on the nature of the developments, a list of ITE Land Use codes was considered for this study.

The following tables (**Table 1** and **Table 2**) summarize the estimated trip generation resulting from the development for the full build-out year. (Note that the numbers were provided for analysis in early May and final land use assessment numbers may differ slightly). The land use types, number of units, and populations are very preliminary given the uncertainty around intended land uses on the Kwanlin Dün First Nation and Ta'an Kwäch'än Council parcels.

TABLE 1. CONCEPT 1 TRIP GENERATION - WEEKDAY AM & PM PEAK HOURS (FULL BUILD-OUT YEAR)

Land Parcels	Units	Population	Estimated Trips – AM Peak (PM Peak)*
Tank Farm (Concept 1)	1,200	2,800	860 (1,100)
Lot 262-2	220	515	140 (190)
KDFN C-117B	150	351	80 (100)
KDFN C-141B	150	351	80 (100)
Lot 431	56	132	50 (60)
TKC C-30B (Concept 1)	160	375	90 (110)
Total	1,936	4,523	1,300 (1,660)

*: Estimated trips include both inbound and outbound trips

TABLE 2. CONCEPT 2 TRIP GENERATION - WEEKDAY AM & PM PEAK HOURS (FULL BUILD-OUT YEAR)

Land Parcels	Units	Population	Estimated Trips – AM Peak (PM Peak)*
Tank Farm (Concept 2)	1,000	2,300	715 (927)
Lot 262-2	220	515	140 (190)
KDFN C-117B	150	351	80 (100)
KDFN C-141B	150	351	80 (100)
TKC C-30B (Concept 1)	163	381	90 (110)
Total	1,936	3,898	1,105 (1,427)

*: Estimated trips include both inbound and outbound trips

4.0 Trip Distributions

Trip distribution is used to determine the directional percentages for vehicles entering and leaving the proposed site. Considering the nature of the proposed development, the city's employment projections for 2040 horizon year was used to conceptually distribute future VSMP traffic to the surrounding road network. The traffic distribution patterns of the different neighbourhoods, including VSMP, are illustrated in **Table 3**.

TABLE 3.TRIP DISTRIBUTION ASSUMPTIONS

Surrounding Road Network	Neighbourhoods	2040 Employment Projections	Proposed Trip Distribution from Subject Development
Alaska Hwy North	Porter Creek, Kulan, Taylor, Crestview, Whistle Bend (half), Whistle Bend Bench (half), Hidden Valley, McPherson, Wilderness Area	2,697	9.75%
Alaska Hwy South	Riverdale, Airport, Dam, Batter Plant, Hillcrest Industrial, Hillcrest, West of Airport, South of RSW, Copper, Fox Haven, Pineridge, Spruce Hill, Wolf Creek, Mary Lake, Cowley Creek	6,125	22.13%
Two Mile Hill East	Downtown, Marwell	14,970	54.09%
Hamilton Blvd South	McIntyre, Ingram, Arkell, Logan, Granger, Copper Ridge, Hamilton SGA	1,550	5.6%
Range Rd North	Range Rd & Two Mile Hill area, Takhini, Whistle Bend (half), Whistle Bend Bench (half)	1,973	7.13%
Canada Game Centre (CGC)	CGC	180	0.65%
Internal	Valleyview, Valleyview South	180	0.65%
	Total	27,675	100%

5.0 Trip Assignment

Based on the trip generation and trip distribution assumptions, the traffic volumes are assigned to the internal road network. The average annual daily traffic (AADT) projections and accompanying delineation of the collector/minor arterial network are illustrated in **Figure 3** and **Figure 4** for Concept 1 and Concept 2, respectively. As shown in **Figure 3** and **Figure 4**, the AADT of the most internal collectors/minor arterials varies from 1,500 vehicles/day to 4,000 vehicles/day. (Note that the concepts shown reflect an earlier version but are substantively like the final versions and sufficient for our analysis).

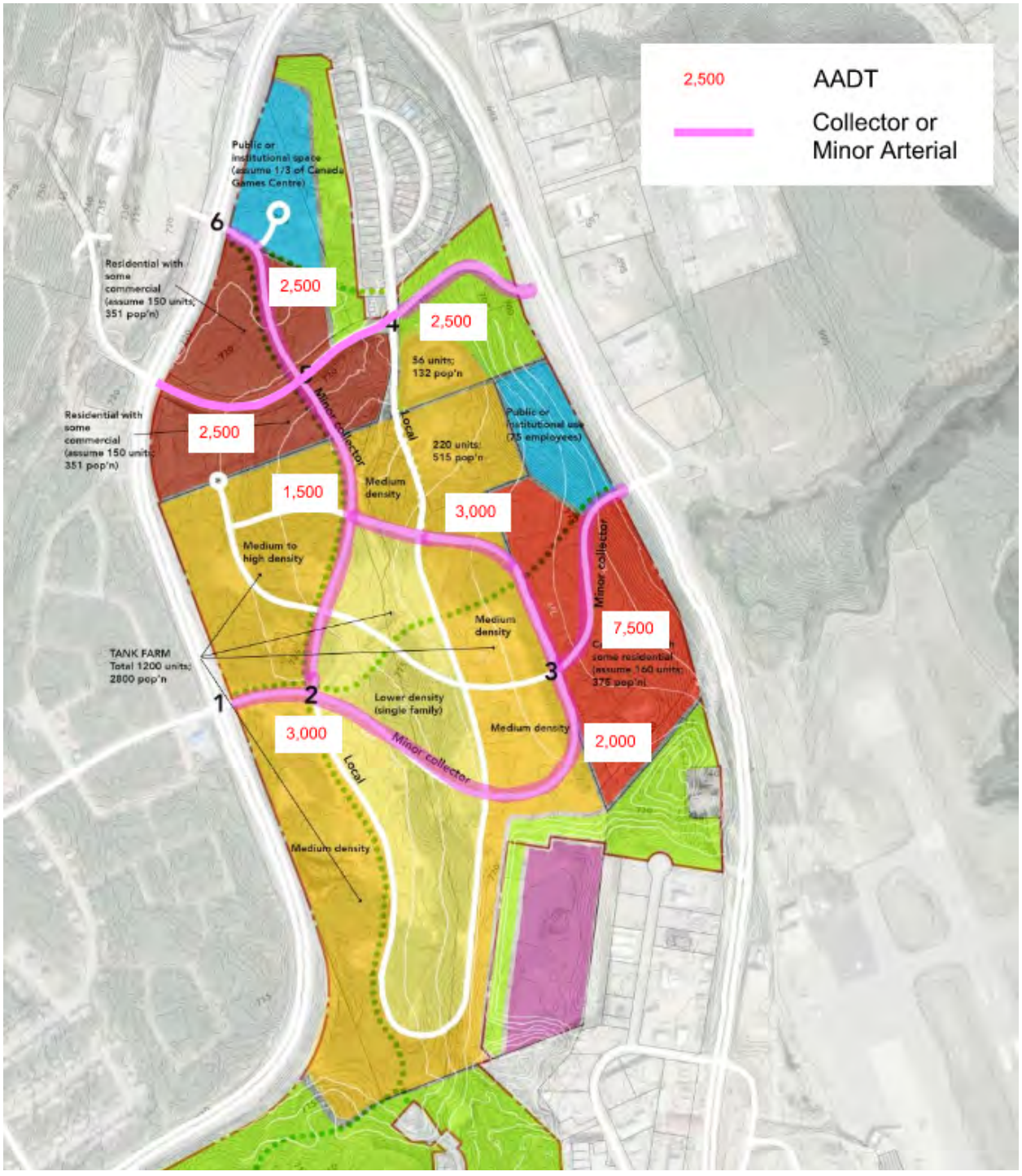

FIGURE 1. CONCEPT 1 - PROJECTED TRAFFIC VOLUMES (AADT)

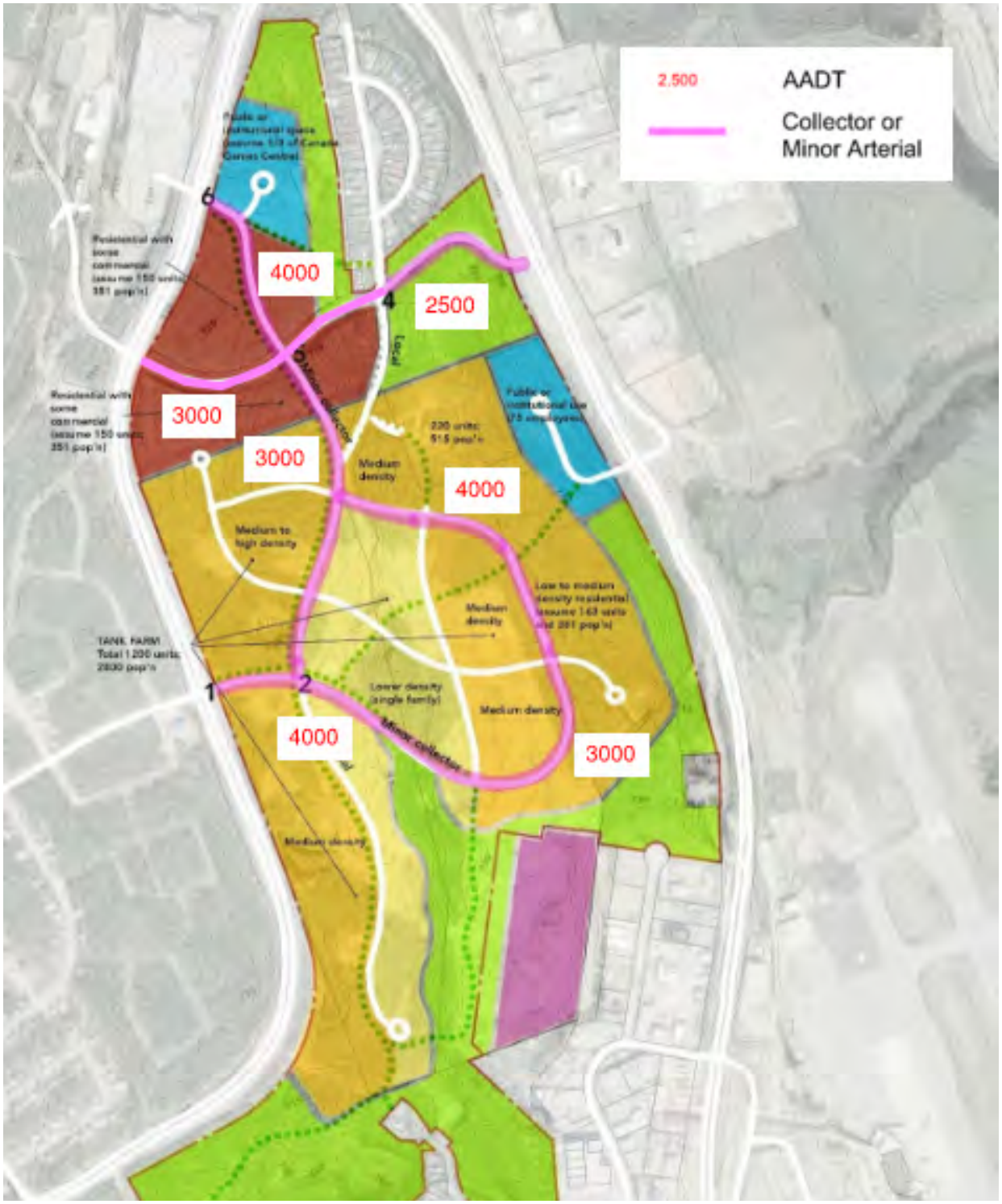

FIGURE 2. CONCEPT 2 - PROJECTED TRAFFIC VOLUMES (AADT)

6.0 Internal Intersection Control Treatments

Based on the projected AADT and traffic volumes during a.m. and p.m. peak hours for the internal roadway network, the recommended internal intersection treatments include:

- Two-way stop control when collector / minor arterial intersects with local roads; and
- All-way stop control or roundabout when collector / minor arterial intersections with collector / minor arterial (intersections 2, 3, 4, and 5).

7.0 Access Intersection Control Treatments

The signalized intersections of Hamilton Boulevard & Canada Games Centre and Alaska Highway & Range Road will need to be upgraded from 3-way to 4-way. It is also assumed that the signalized intersection of Hamilton Boulevard & Sumanik Drive will remain the same, although some intersection improvements should be explored to address the safety concerns of Valleyview residents taking westbound right turns from Sumanik Drive.

The intersection of Hamilton Boulevard & McIntyre Drive will need to be signalized or upgraded to a roundabout if all turning movements are allowed.

8.0 Classification of Roadways

Based on the AADT projections above, a minor collector designation (22.5 m ROW width under the City of Whitehorse Servicing Standards Manual) can be applied to most of the internal collector road for both concepts. Under Concept 1, the internal collector between Alaska Highway & Range Road intersection and intersection No. 3 is recommended as a minor collector (24.5 m ROW width) or major collector given the high AADT volumes.

9.0 Transit Routes

Transit routing changes frequently but our preliminary analysis suggests that the VSMP neighbourhood could be easily integrated into the current City transit system. Both concepts include a series of bus stops located along the minor collector road “loop”. New stops along Hamilton Boulevard and the Alaska Highway would be required to keep all proposed transit stops located within the recommended 400 metre walking distance from residences.

As shown in **Figure 5**, Route #3 currently services the McIntyre, Hillcrest and Valleyview neighbourhoods. The proposed Alaska Highway transit stop could be incorporated into the southbound run to Hillcrest, whereas the proposed Hamilton Boulevard and internal VSMP neighbourhood transit stops could be incorporated into the northbound return leg from McIntyre.

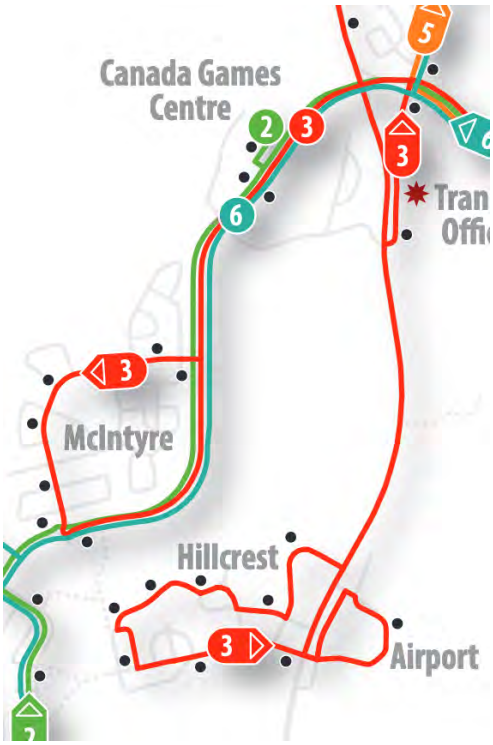

FIGURE 3. CURRENT CITY TRANSIT ROUTING AROUND THE STUDY AREA

10.0 Active Transportation Connections

To ensure integration to the existing and proposed city-wide active transportation network, both concepts include an extensive AAAAA (Always Available for All Ages and Abilities) multi-use pathway (MUP) network. **Figure 6** shows a highly conceptual analysis of key desire lines within the VSMP area, which reflect the following travel patterns:

- Anticipated major east-west movement through the VSMP area to the Alaska Highway (for VSMP residents as well as McIntyre and other “above the airport” neighbourhood residents using the Hamilton Boulevard MUP;
- Existing and anticipated north-south movement between the VSMP area, Hillcrest, Granger and Canada Games Centre/Mount McIntyre Recreation Centre area;
- Existing movement between Valleyview and the Airport Trail, Canada Games Centre/Mount McIntyre Recreation Centre, and the Mount Mac public trail network;
- Existing and anticipated north-south movement between Hillcrest and Granger neighbourhoods and the VSMP area and destinations beyond (north and east);
- Anticipated northwest movement between the VSMP neighbourhood and the Mount Mac public trail network.

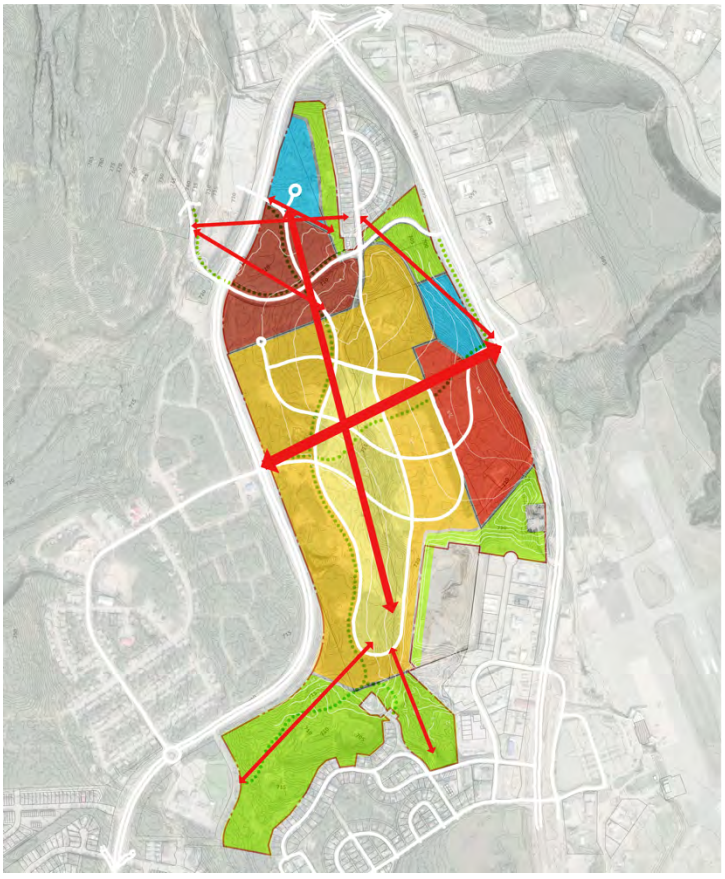

FIGURE 6. CURRENT CITY TRANSIT ROUTING AROUND THE STUDY AREA

The east-west MUP reflects the general concept proposed in the City's Bicycle Network Plan (2019), shown in **Figure 7**. The internal N-S active transportation facilities will be able to provide additional N-S active transportation connections (besides Alaska Highway and Hamilton Boulevard) within the neighbourhood, which will improve connectivity and safety for active transportation modes. These concepts also address deficiencies in the active transportation network for Valleyview and its lack of logical (and convenient) connection to the public trails at Mount McIntyre, which will become more important if and when the adjacent greenspace to the west is developed (as both concepts propose).

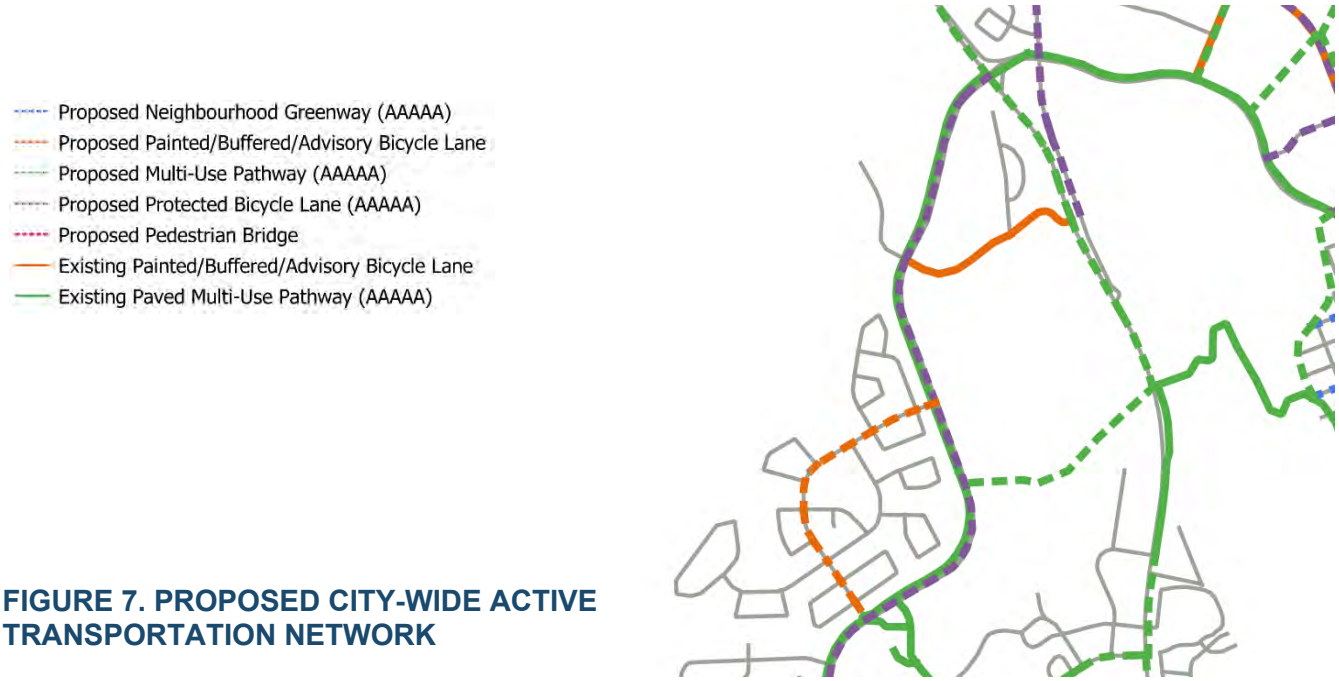

FIGURE 7. PROPOSED CITY-WIDE ACTIVE TRANSPORTATION NETWORK

The Cycling Association of Yukon, in partnership with Hillcrest Community Association, is exploring the potential for a highway underpass in the crossing location indicated on Figure 7. Should this prove viable and funding is secured to proceed, the east-west routing could be altered. For now, the team assumes that the Airport Trail connection point is at the Alaska Highway & Range Road intersection.

There is also an existing buffered bike lane along Sumanik Drive between Hamilton Boulevard and Alaska Highway; this should be maintained.

11.0 Shortcutting Concerns

Concept 1's connection to the Alaska Highway could potentially invite residents of other "above the airport" neighbourhoods to use it as a shortcut to the downtown area, avoiding the busy Alaska Highway & Hamilton Boulevard intersection. However, we do not anticipate this being an issue given that Alaska Highway & Hamilton Boulevard intersection still has sufficient residual capacity for E-W directions. We predict that the majority of the traffic will still stay on Hamilton Boulevard instead of shortcutting through the subject development.

It is also worth noting that the City is conducting a design study to upgrade the intersections of Alaska Highway & Hamilton Boulevard and Two Mile Hill Road & Range Road. Therefore, it is anticipated that additional capacity will be provided to the two intersections as the subject neighbourhood is being developed, further motivating vehicles to remain on Hamilton Boulevard. Concept 1 features

intersecting collector roads to access the Alaska Highway from the future McIntyre Drive entrance to the Valleyview South neighbourhood. This design element was intended to discourage short cutting by posing additional delay compared to a continuous collector road alignment connecting the two intersections.

12.0 Impact to Surrounding Road Network

With the above trip generation estimates and trip distribution assumptions, the following tables (**Table 4** and **Table 5**) show the projected impacts to the surrounding road network in 2040 full build-out year for both Concept 1 and Concept 2.

TABLE 4.PROJECTED IMPACT FOR THE SURROUNDING ROAD NETWORK (2040) – CONCEPT 1

Impacted Roadway	Potential Increase of Vehicular Demand – AM (PM)	Background AADT
Hamilton Blvd (W of Alaska Hwy & Hamilton Blvd intersection)	20% (25%)	20,000
Two Mile Hill Rd (E of Two Mile Hill Rd & Range Rd)	15% (20%)	40,000
Alaska Hwy (S of Alaska Hwy & Hamilton Blvd intersection)	40% (60%)	10,000
Range Rd (S of Two Mile Hill Rd & Range Rd)	10% (15%)	7,000

TABLE 5.PROJECTED IMPACT FOR THE SURROUNDING ROAD NETWORK (2040) – CONCEPT 2

Impacted Roadway	Potential Increase of Vehicular Demand – AM (PM)	Background AADT
Hamilton Blvd (W of Alaska Hwy & Hamilton Blvd intersection)	35% (40%)	20,000
Two Mile Hill Rd (E of Two Mile Hill Rd & Range Rd)	15% (20%)	40,000
Alaska Hwy (S of Alaska Hwy & Hamilton Blvd intersection)	5% (10%)	10,000
Range Rd (S of Two Mile Hill Rd & Range Rd)	5% (10%)	7,000

Table 4 shows that we anticipate only a modest increase in Range Road traffic volumes with Concept 1 and that most of the Valleyview South traffic entering/exiting via the east boundary to use the Alaska Highway. This is due to the current geometric settings of the Westbound left turn and Northbound right turn movements at Two Mile Hill Road & Range Road not being able to accommodate major volume increases; specifically, the left turn is already extending beyond its available storage length and the right turn is approaching capacity. When people see a long queue at these two movements, they will seek the alternative (i.e., Alaska Highway).

Table 6 and **Table 7** summarize the movements that will potentially experience large vehicular demand increases under both concepts.

TABLE 6. MOVEMENTS WITH POTENTIAL LARGER INCREASES IN VEHICULAR DEMAND – CONCEPT 1

Impacted Roadway	AM Peak Hour	PM Peak Hour
Alaska Highway & Hamilton Boulevard – Two Mile Hill Road	Northbound right turn Eastbound through	Westbound left turn
Two Mile Hill Road & Range Road	Eastbound through	Westbound through

TABLE 7. MOVEMENTS WITH POTENTIAL LARGER INCREASES IN VEHICULAR DEMAND – CONCEPT 2

Impacted Roadway	AM Peak Hour	PM Peak Hour
Alaska Highway & Hamilton Boulevard – Two Mile Hill Road	Eastbound through	Westbound through
Two Mile Hill Road & Range Road	Eastbound through	Westbound through

Overall, Concept 2 has a lesser impact on the surrounding network; however, this is due to the lower number of units and population. While Concept 1 has a greater impact, we note the following:

- The Northbound right turn at the Alaska Highway & Two Mile Hill Road intersection has considerable capacity to handle increases and the City is proposing to add an Eastbound accelerating lane for the right turn to make it a free flow; and

- The Westbound left turn at the Alaska Highway & Two Mile Hill Road intersection also has more capacity to handle increases because it is a protected movement.

Detailed capacity analysis results and associated mitigation measures for any failing movement will be summarized in the full traffic impact assessment report when a preferred land use concept is developed.

13.0 Closing

Should you have any questions or comments concerning the contents of this memorandum, please do not hesitate to contact the undersigned.

Sincerely,
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