THE DISTRICT OF OAK BAY COMMITTEE OF THE WHOLE

Uplands Combined Sewer Separation Project

Predesign Report

October 5, 2016

Project Overview

Why are we doing this?

- No combined sewer overflows unless measures to eliminate overflows are developed as part of a liquid waste management plan (MWR Section 42)
- Only plan acceptable to MOE is the separation of combined sewers

Uplands Sewer Servicing Challenges

- Topography – Slopes from +50 metres to sea level
- Uplands road design unique in Oak Bay
- Easements dedicated at the side, rear and across lots to provide gravity service
- Archaeology potential (public and private lands)

Assumptions at the outset of the Pre-design

1. The goal of the project is to eliminate the combined sewers in Oak Bay (the Minister of Environment's condition for approval of the CALWMP) to eliminate CSO in compliance with of the MWR (Section 42).
2. A second pipe would not be installed in the existing easements;
3. The lining of the existing pipe was not part of this project (from the grant funding perspective);

Assumptions cont'd

4. The existing pipe would continue to be utilized for either sanitary sewer or stormwater conveyance.
5. A maximum practical trench depth was considered to be five metres;
6. Trenchless technology, specifically directional drilling, is not viable for the installation of the new pipe;

Assumptions cont'd

7. The District would be responsible for compliance with the Heritage Conservation Act on District property;
8. Property owners would be responsible for compliance with the Heritage Conservation Act on private property;
9. Given the limitation on trench depth, sanitary and/or stormwater pumps would factor in all options;

Assumptions cont'd

10. Stormwater would not be treated (decontaminated) prior to discharge to the sea;
11. Based on the statistics on the duration of power outages, the use of pumps on private property is viable.
12. On-site stormwater management would not be an alternative to a storm sewer connection;

Assumptions cont'd

13. In the absence of detailed geotechnical information, assumptions would be made on the occurrence of rock in generating cost estimates;
14. The cost estimates developed for private property are the average of the total cost to all property owners, that is, cost estimates were not developed on a site specific basis; and,
15. At this stage, pre-design, operation and maintenance costs estimates are based on a percentage of the capital costs.

The Options

1. New deep gravity sanitary sewer, with private sanitary sewage pumps, existing pipe for stormwater;
2. New deep gravity stormwater sewer, with private stormwater pumps and existing pipe for sanitary sewage;
3. Low pressure sanitary sewer, private sanitary sewage pumps, existing pipe for stormwater;

The Options

4. Shallow gravity stormwater pipe, with private stormwater pumps and new municipal stormwater pump stations, existing pipe for sanitary sewage;
5. Shallow gravity sanitary sewer, with private sanitary sewage pumps, existing pipe for stormwater;
6. Shallow gravity sanitary sewer, with private sanitary sewage pumps and new municipal sanitary sewage pump stations, existing pipe for stormwater.

Sewer Separation and Connection Criteria

- Mandate sewer separation for new homes;
- Mandate sewer separation for homes undergoing major renovations, based on a value of $100,000 or greater.
- The cost of connecting properties with sewers separated prior to the municipality separating the combined sewers to be included in the cost of the sewer separation construction contracts.
- Currently separation required when perimeter drains are being replaced

Use of the Existing Pipe

The Existing Pipe

- Constructed early 1900's
- Clay pipe, generally structurally sound
- Leaky joints (I&I)
- Root intrusions, particularly in easements
- Needs to be rehabilitated regardless of future use

Archaeological Overview Assessment

- Identified areas of importance to First Nations
- Oak Bay to obtain Blanket Heritage Inspection Permits covering the municipal rights of way and adjacent property owners, as the project proceeds to construction.
- District and Homeowners responsible for compliance with Heritage Conservation Act on their respective properties

Outreach and Engagement Oct. 30 - Dec. 11

District website: www.oakbay.ca

Open Houses:

- 2 North Oak Bay – 2 South Oak Bay, 1 in the Uplands neighbourhood
- Oak Bay News – Articles, editorials and advertisements

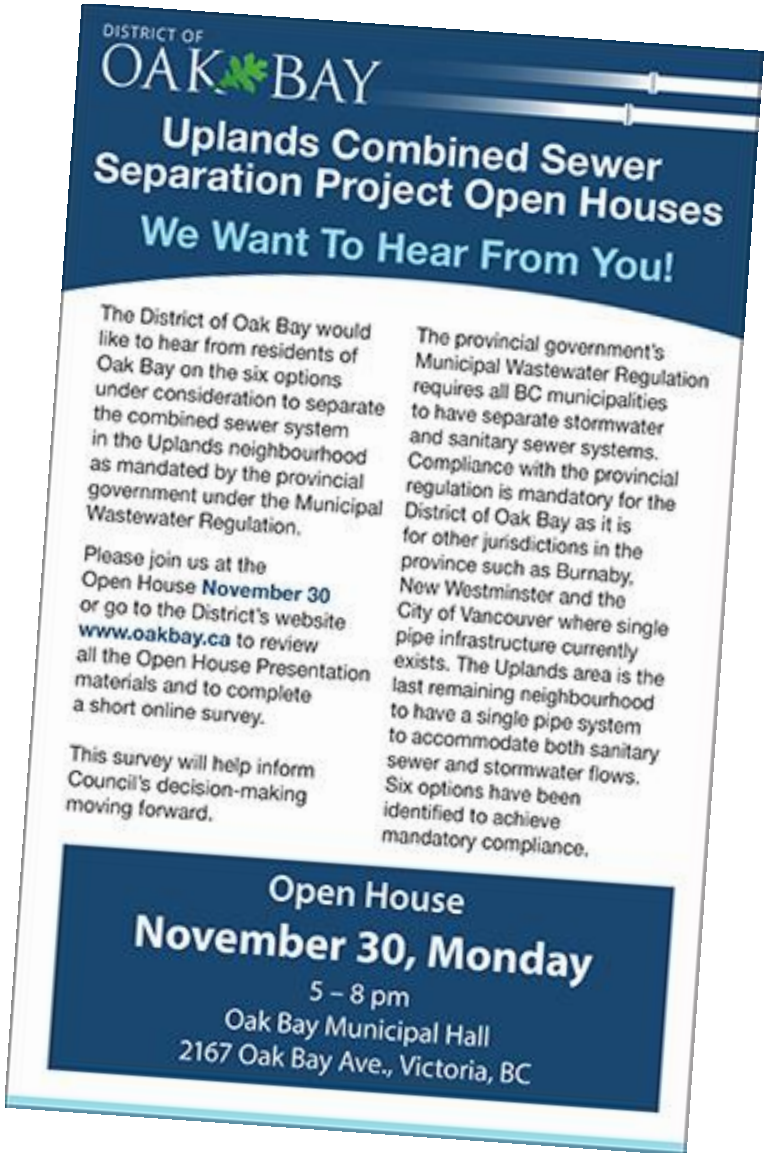
Public Opinion Survey:

- was available online, PDF for printing and in hard copy

Municipal Hall:

- all presentation materials were available to view in hard copy

- Open Houses: 247 registered
- 75% residents living in the Uplands
- Additional meeting – Nov. 30



Ranking of Six Technical Options by Public

- Uplands homeowners ranked Option 1 and Option 2 (deep gravity) as their most preferred options
- Homeowners living outside of the project area ranked Option 3 (100% pumps) as their most preferred option

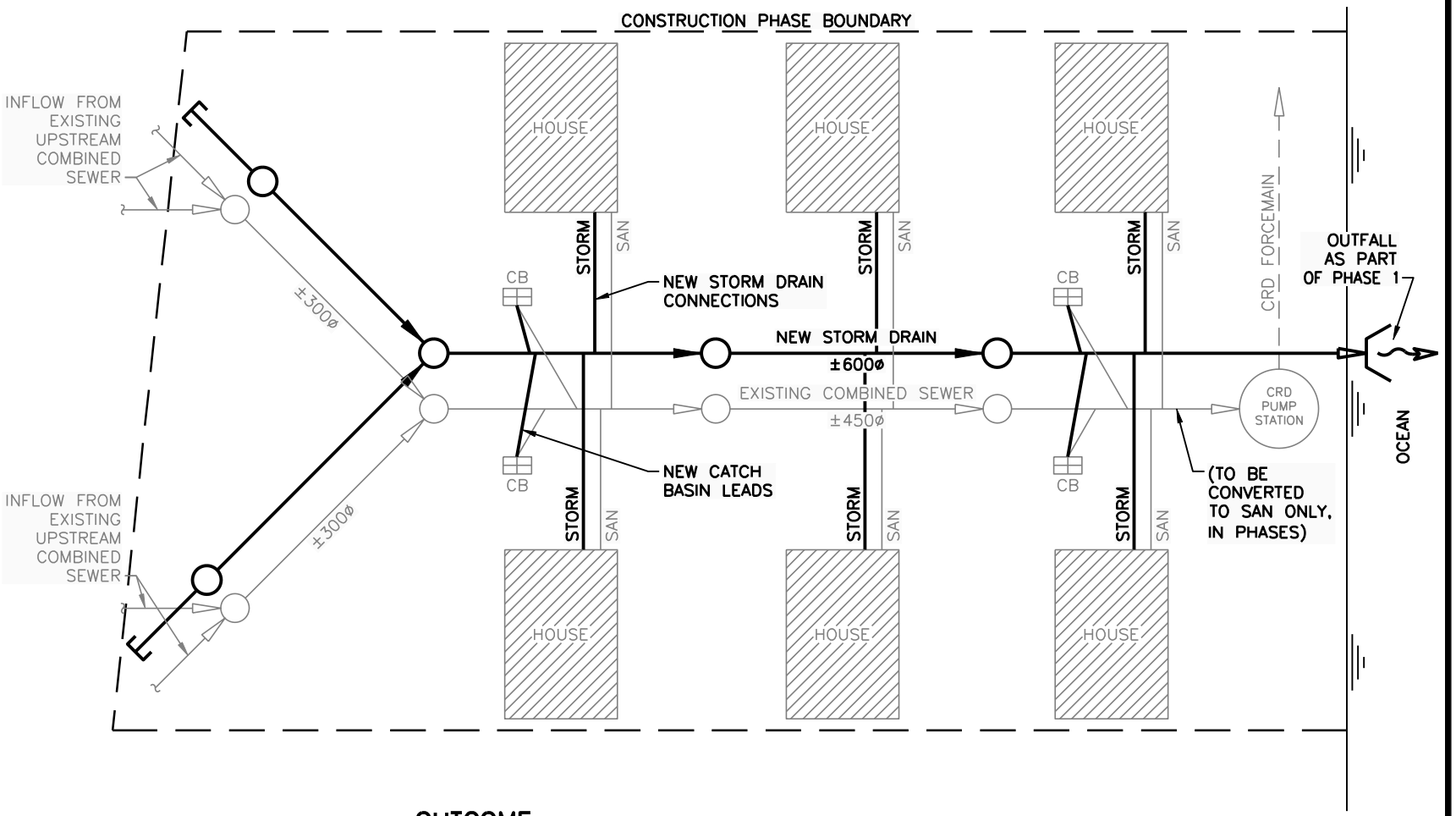
Key Themes from Public Engagement

Key Themes:

- Affordability
- Pumps
- Storm water management – on private property and on the roadways
- Easements should be part of the solution
- Most appropriate use of existing pipe
- Options in relation to timely environmental impact
- Costs estimates unrealistic for some property owners

Options for Use of Existing Pipe

1. As sanitary sewer – Options 2 and 4
   - Leaky joints (I&I)
   - Oversized as sanitary sewer
   - Additional maintenance
   - Needs rehabilitation
   - Progressive reduction in CSO (new storm sewer)



OUTCOME:

1. FOR THIS SUB-CATCHMENT, THE VOLUME OF STORMWATER ENTERING THE CRD PUP STATION WILL BE REDUCED AT TIME OF PHASE 1 CONSTRUCTION.
2. GROUNDWATER FLOW FROM PHASE 1 SUBCATCHMENT WILL CONTINUE TO REACH CRD PUMP STATION UNTIL LINING/REHAB OF EXISTING PIPES IS COMPLETE.
3. SURFACE RUNOFF WILL BE DIVERTED AWAY FROM CRD PUMP STATION, FROM THIS SUBCATCHMENT.
4. SHORT TERM - GREATER IMPACT ON C.S.O. REDUCTION. LONG TERM - LESS IMPACT.

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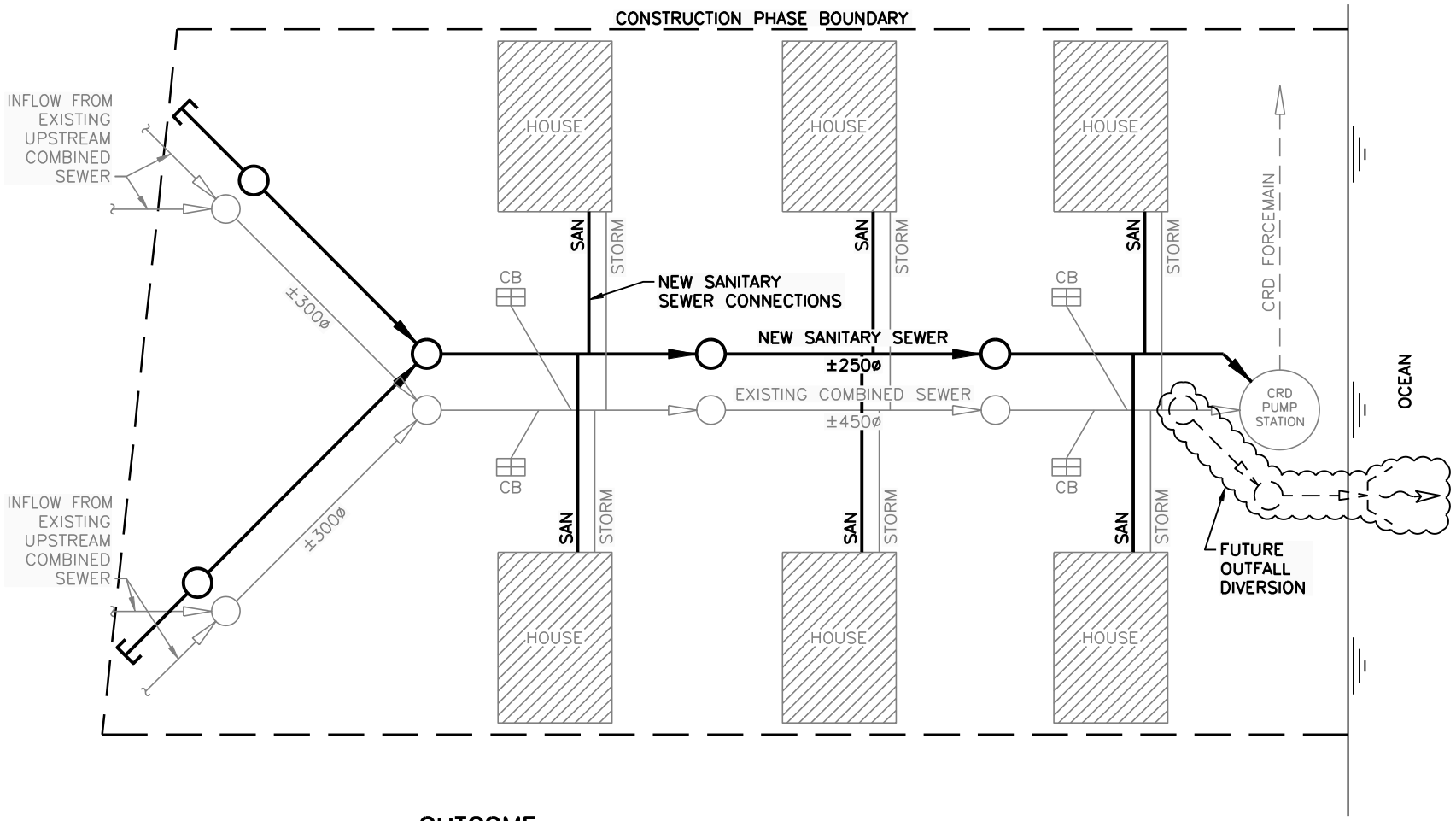
SCHEMATIC "PHASE #1" SCOPE
OPTION 2 - NEW STORM DRAIN

SCALE:	N.T.S.
DRAWN BY:	MTK
DATE:	NOVEMBER 2015
DRAWING No:	15-326-SK.2

Options for Use of Existing Pipe

2. As storm drain – Options 1, 3, 5 and 6
   - Undersized – replace undersized sections
   - Needs rehabilitation
   - Defers CSO elimination



OUTCOME:

1. EXISTING COMBINED 450ø TO REMAIN IN SERVICE (NEW 250ø IS TOO SMALL).
2. NO REDUCTION IN FLOW TO CRD PUMP STATION UNTIL EXISTING CAN BE DIVERTED TO OCEAN OUTFALL. AT THAT TIME = FULL STORMWATER REDUCTION FROM CRD PUMP STATION.
3. FUTURE DIVERSION OUTFALL CANNOT OCCUR UNTIL ALL SANITARY SEWER (FROM SUBSEQUENT PHASES), IN THIS SUBCATCHMENT IS EXTRACTED FROM THE EXISTING SYSTEM.
4. SHORT TERM – LESS IMPACT ON C.S.O. REDUCTION. LONG TERM – GREATER IMPACT.

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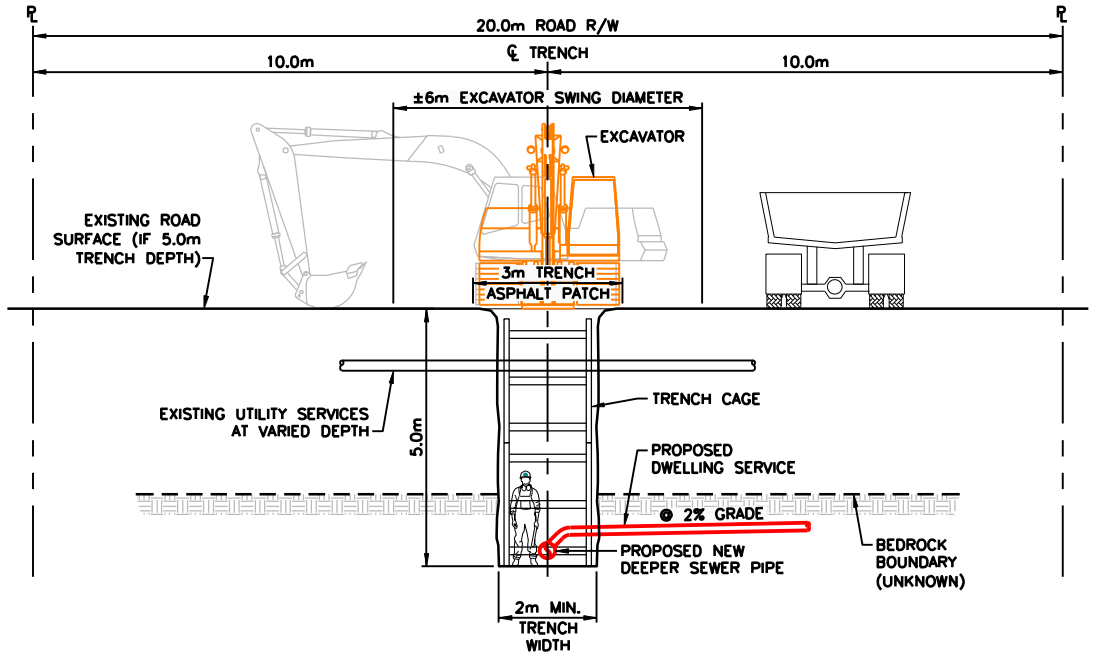
SCHEMATIC "PHASE #1" SCOPE
OPTION 1 – NEW SANITARY SEWER

SCALE:	N.T.S.
DRAWN BY:	MTK
DATE:	NOVEMBER 2015
DRAWING No:	15-326-SK.1

Additional Studies Directed by Council

Deep Sewer Option



NOTES:

1. TRENCH CAGE(S) ASSUMED.
2. 5.0m MAXIMUM DEPTH BY MODERATELY SIZED EXCAVATION EQUIPMENT.
3. UTILITY CONFLICTS WILL OCCUR. SOME RECONSTRUCTION/REPAIR OF OTHER UTILITIES WILL BE REQUIRED.
4. ONE FULL LANE WILL BE RECONSTRUCTED/REPAIRED (½ OF THE ROAD).
5. BOULEVARDS WILL REMAIN INTACT, FOR THE MOST PART.

1:100 0 2 6m

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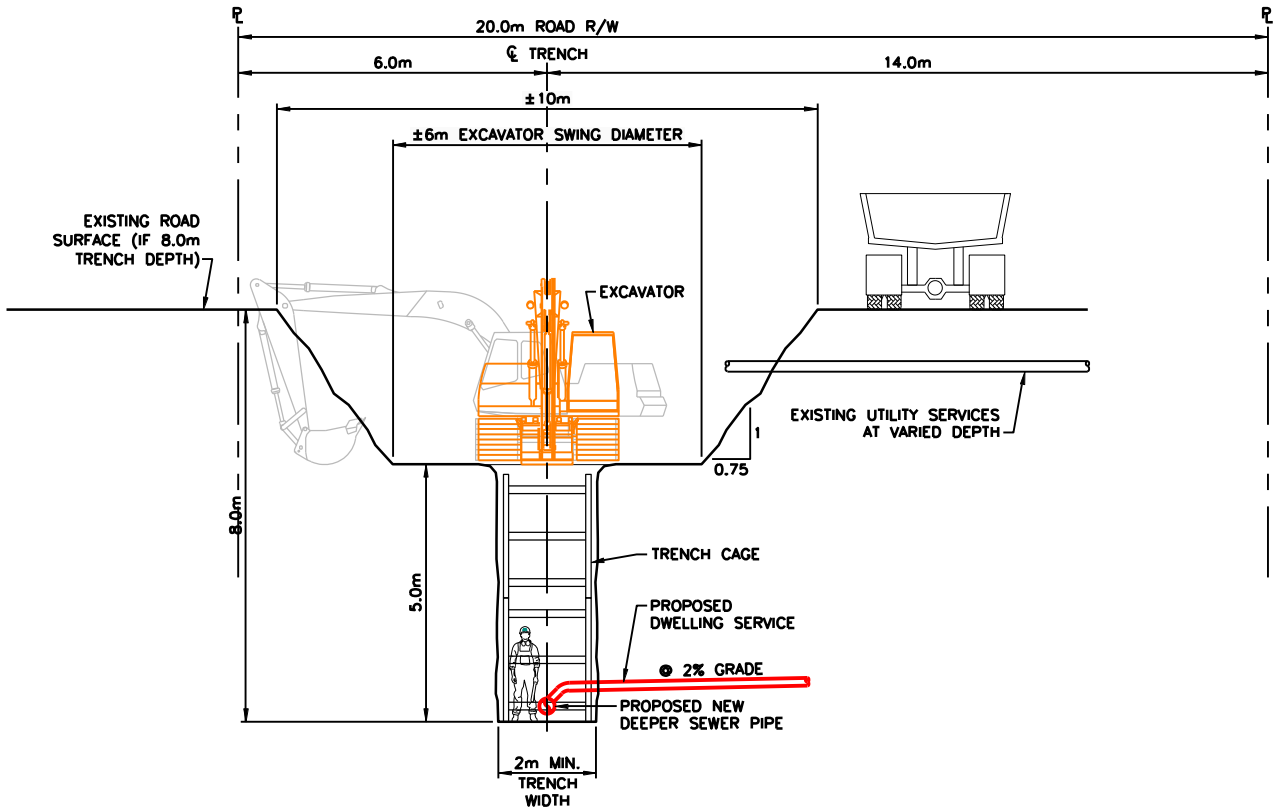
TYPICAL 5m DEEP GRAVITY SEWER TRENCH DETAIL

SCALE:	1:100
DRAWN BY:	PL/MTK
DATE:	2016-02-01
DRAWING No:	15-326-SK.5



NOTES:

1. AT 8m DEPTH, EXCAVATOR MAY NOT BE ABLE TO REACH DUMP TRUCK FOR SPOIL DISPOSAL.
2. PROBABILITY OF TREES & MATURE BOULEVARD VEGETATION DISRUPTION IS HIGH.
3. ENTIRE ROAD RECONSTRUCTION IS LIKELY FOR VERY DEEP SEWERS (>5M DEPTH).
4. WOULD NEED TO SUPPORT OR TEMPORARILY RE-ROUTE/RECONSTRUCT EXISTING UTILITIES & SERVICE CONNECTIONS.
5. TRENCH WILL NEED TO BE OFFSET ±6m FROM ROAD ℄, IN ORDER TO ALLOW ROOM FOR TRUCKS, ETC. WITHIN 20m ROAD R/W.

1:100 0 2 6m

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TYPICAL 8m DEEP GRAVITY SEWER TRENCH DETAIL

SCALE:	1:100
DRAWN BY:	PL/MTK
DATE:	2016-02-01
DRAWING No:	15-326-SK.6

On-site Stormwater Management

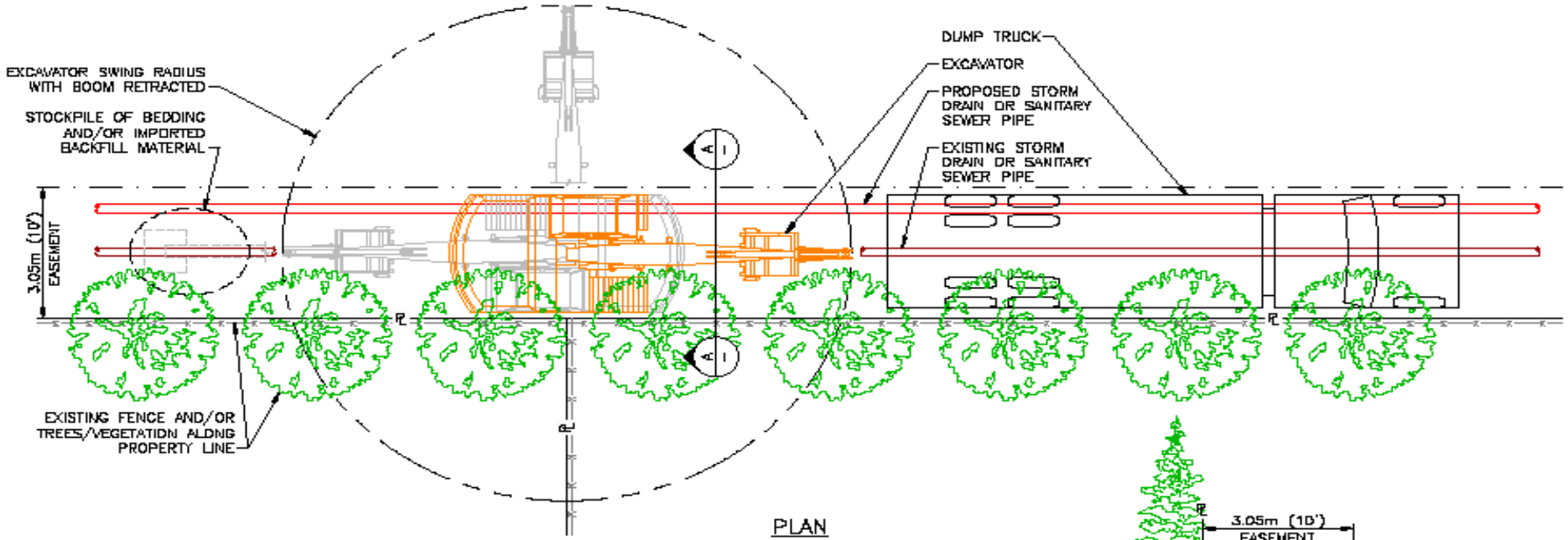
- Lot size
- Geotechnical conditions – sands and gravel, clay or rock
- Climate change – more intense rainstorms
- Potential for runoff to neighbouring properties
- On-site storage
- Archaeological
- Hook-up to sewer mandatory (Bylaw No. 3891)

Not an alternative to a storm sewer water connection

Effect of Service Installation on Tree Canopy

- Staff report – May 2016
- 91 homes with separated services
- 2 properties with tree stress or damage

Use of Existing Easements



PLAN
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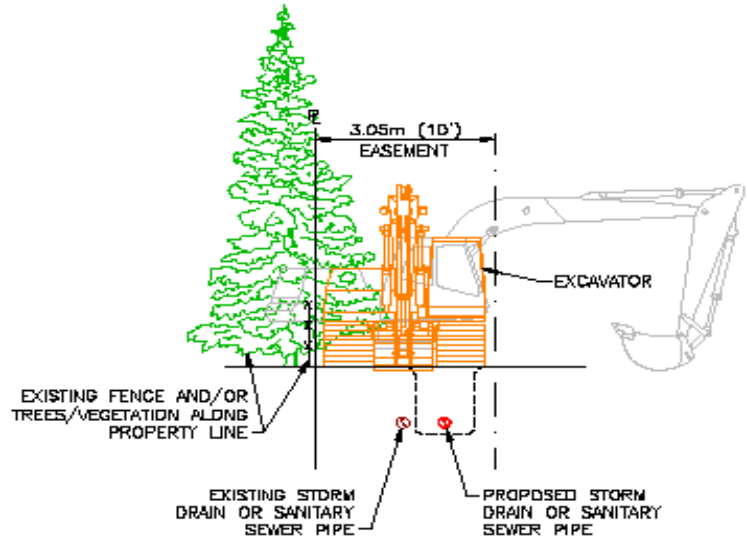

SECTION A–A
1:100

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PIPE INSTALLATION IN 3.05m (10') EASEMENT

SCALE:	1:100
DRAWN BY:	MTK
DATE:	2015-12-03
DRAWING No:	15-328-SK.4

P:\15-328 UPLANDS COMBINED SEWER SEPARATION PROJECT PRE-DESIGN\(10) DRAWINGS\SK.4.DWG 1/25/2016 1:31 PM LAYOUT1

Alternative Construction Methods

- Cured in place pipe rehabilitation
- Slip lining
- Pipe jacking
- Pipe bursting
- Horizontal directional drilling

Geotechnical Investigation

- The objectives of the geotechnical investigation were:
- to undertake a geotechnical survey, to a maximum depth of five (5) metres, to determine the location of bedrock;
- to assess the suitability of sub-surface soils as trench backfill; and
- to record any other geotechnical information that would be of relevance to the installation of a sewer pipe, for example, the presence of groundwater, potential for trench sloughing etc.

Implications of geotechnical Investigation

- Better understanding of likelihood of encountering rock
- Estimated volume of rock increased
- Confirmed unit cost of rock excavation
- Estimated volume of reusable trench material decreased

Summary of Results of Additional Studies

- Deep sewer option – not practical
- Directional drilling – not feasible for main sewer pipe
- Use of existing easements – environmental/property impacts
- On-site stormwater management – not an alternative
- Tree canopy – site specific routing of service connections/HDD
- Geotechnical investigation – cost implications

Updated Service Type

Humber And Rutland	Pumped services		Gravity services		Total number of services	
	Was	Now	Was	Now	Was	Now
Option 1	85	66	308	325	393	391
Option 3	85	61	308	330	393	391
Option 3	393	391	0	0	393	391
Option 4	179	180	214	204	393	391
Option 5	191	170	202	221	393	391
Option 6	149	152	244	239	393	391

Revised Cost Estimates

Option No.	Capital Cost $millions			Average Annual Operations and Maintenance Costs $'000			Aggregate 50-year duration net present value
	Totals	To the municipality	To the private landowners	Totals	To the municipality	To the private landowners	
1	30.9	24.3	6.6	78	65	13	35.9
2	31.9	25.1	6.7	77	64	13	36.8
3	14.2	7.2	7.0	110	9	101	21.3
4	21.5	15.1	6.4	91	46	45	27.4
5	21.4	15.0	6.4	89	48	41	27.2
6	23.4	16.9	6.5	90	54	36	29.2

Average Cost per Residential Unit

Option No.	Total Average Capital Cost per Residential unit ($'000)			
	Cost to landowners with new pumps		Costs to landowners with gravity service	
	High	Low	High (deep, long service)	Low (shallow, short service)
1	20	17	38	14
2	20	17	38	14
3	20	17	n/a	n/a
4	20	17	38	14
5	20	17	38	14
6	20	17	38	14

Triple Bottom Line Evaluation Criteria

Environmental, Social, Financial

TBL Evaluation - Environmental

- Most environmentally appropriate use of existing pipe – 2 & 4
- Progressively reduce frequency and duration of CSO – 2 & 4
- Construction timeframe*– 3
- Preserve mature tree canopy and vegetation - 3, 4, 5 and 6
- Climate change impacts - 2 & 4

* Assumes all dwellings connected as construction proceeds

TBL Evaluation - Social

- Affordability and fairness
- Maximize potential for gravity service, minimize pumps - 1 & 2
- Minimize disruption on private property – 3, 4, 5 and 6
- Minimize neighbourhood disruption – 3, 4, 5 and 6
- Deep gravity vs pumped connections – 3, 4, 5 and 6

TBL Evaluation - Financial

- Geotechnical considerations – 3, 4, 5 and 6
- Operation, maintenance and lifecycle costs to District – 3
- Deep vs shallow pipe alignments – 3, 4, 5 and 6
- Capital cost to District – 3
- Capital cost to Uplands property owners – no difference
- Maintenance and lifecycle costs to Uplands owners – 1 & 2

Table 6: Decision Matrix / Balanced Scorecard Evaluation

	DECISION CRITERIA	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Notes / Data Source
Social & Environmental Criteria	Most environmentally appropriate use of the existing pipe, that is, should the existing pipe carry sanitary sewage or stormwater. *	○	●	○	●	○	○	A new sanitary sewer network would not be leaky. A new storm network will allow reductions in CSOs on a phased, incremental basis, which is an environmentally superior outcome.
	Progressively reduce the frequency and duration of overflows.	○	●	○	●	○	○	Conclusion that a new phased sanitary sewer system will not allow diversions of stormwater from the existing system until the new system is constructed in full and all private property reconnections are confirmed to be functional.
	Timeframe to completion of the project, based on a phased construction program.	○	○	◑	◑	◑	◑	Assuming the project is competed in phases and overall project capital cost will be a key determiner with respect to total project construction duration. Under Option #3, hookup would be mandatory at time of system construction.
	Preserve the mature tree canopy.	○	○	●	●	●	●	Assumes new shallower pipe systems will be more effectively maintained within alignments under existing pavement areas. Trees over private properties will be least impacted by shallow pressure sewer services. Easements will not be disrupted.
	Minimize disruption on private property.	○	○	◑	◑	◑	◑	Presumption is that pumping systems are disruptive, as is the need for very deep service connections over private properties, and that pumped services will be easier to install than will gravity services, generally speaking.
	Maximize opportunity for gravity service to residents and minimize the number of pumps.	●	●	○	◑	◑	◑	Deeper sewers provide the opportunity to maximize gravity service and minimize the number of pumps.
Project Cost Criteria	Capital costs to Uplands property owners.	◑	◑	◑	◑	◑	◑	Updated Cost Estimates, September, 2016.
	Capital costs to the District.	○	○	●	◑	◑	◑	Updated Cost Estimates, September, 2016.
	Maintenance and lifecycle costs to Uplands property owners.	●	●	○	◑	◑	◑	Updated Cost Estimates, September, 2016.
	Maintenance and lifecycle costs to the District.	○	○	●	◑	◑	○	Updated Cost Estimates, September, 2016.
	Reduce project cost risks.	○	○	●	◑	◑	◑	Most recent geotechnical report, July 2016, by WSP. Notes probability of rock. Risk of encountering rock will increase, generally speaking, with pipe depth.
Total scores, if preferred = 2 points, least preferred = 0 points, intermediate = 1 point		**5**	**9**	**11**	**14**	**10**	**9**	

*Presumes the existing pipe is to be rehabilitated within a reasonable time frame, moving forward.

● Most Favoured ◑ ○ Least favoured

Note: In Table 6, some criteria from the preceding discussion have been combined, reflecting similar themes.

Recommendations (Part 1)

1. Implement Option 4, a shallower gravity based storm system, including two isolated areas requiring municipal stormwater pump stations.
2. Undertake design by catchment area not by construction phase.
3. Undertake construction on a phased project basis, beginning with the Humber catchment, with contract packages at a minimum of $2 million each.
4. Develop a plan for rehabilitation of the existing pipes.

Reasons for Recommending Option 4

- Incrementally reduces CSO
- Progression towards compliance
- Total cost to property owners in Uplands is similar for all options
- Cost to District mid-way between lowest and highest cost options

CALWMP Amendment

- CALWMP amendment to incorporate District's Plan
- Submit plan to CRD
- CRD request to MOE for amendment to CALWMP

Recommendations (Part 2)

- Approve the request to the CRD and the MOE to amend the Core Area Liquid Waste Management Plan

Questions?