Technical Memorandum No. 2

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

South East Kelowna Irrigation District

Water Supply and Treatment Cost/Benefit Review

System Options Development

November 2007

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TECHNICAL MEMORANDUM NO. 2

Water Supply and Treatment
Cost/Benefit Review
System Options Development

Issued: November 9, 2007
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1 Objective

The objective of this Technical Memorandum is to identify and develop water supply options for the South East Kelowna Irrigation District (SEKID) water system.

2 Previous

In preparing this Technical Memorandum, Associated Engineering reviewed the following reports available on SEKID's website:

1. South East Kelowna Irrigation District, Water Quality Improvement Study, updated May 2006, Mould Engineering.

2. South East Kelowna Irrigation District, Capital Works Program 2006-2016, Mould Engineering.

Some of the information contained in the above reports has been re-used in the preparation of this Technical Memorandum.

3 Existing System

SEKID is the second largest irrigation district in British Columbia. It is located on Kelowna's east bench and is bordered on the north and east by Mission Creek. The system includes the following existing components:

Hydraulic Creek Intake
The existing Hydraulic Creek intake consists of an impoundment on Hydraulic Creek from which water is drawn through a mechanical screening system at an elevation of 655 metres. A bypass weir ensures that this is maintained at a constant level of 655 metres and that a bypass flow is maintained year round through the downstream portion of Hydraulic Creek which discharges into Mission Creek.

Hydraulic Creek Chlorination Facility
The existing chlorination facility consists of a gas system fed by liquid tonners. The feed system is paced based on flow measured through one of two flow elements on the supply line in the basement of the structure. The smaller of the two flow elements on a small diameter bypass line is

used to pace the system during the low demand winter months. The large element on the main supply line is used to pace the system during the high demand summer months. During spring freshet it is not unusual to feed chlorine into the supply line at a dosage of 8 mg/l in order to meet CT requirements.

Hydraulic Creek Supply Line

The supply line is a lined and coated 1050 mm dia. steel pipe which delivers chlorinated water to the Pressure Recorder Station at the intersection of McCullough Road and McClain Road. A 300 mm dia. PVC branch main delivers water from the supply line at Field Road to the Field Road Reservoir. The supply line delivers water to three distinct distribution systems which distribute domestic and agricultural irrigation water to the end users.

Gallaghers Canyon/McCulloch Road Distribution System

The Gallaghers Canyon development is fed directly from the 2.5 ML Field Road Reservoir (HGL 620 m) and the adjacent McCulloch Road corridor is directly fed from connections to the supply line and the 750 mm dia. KLO trunk main. Together these developments encompass approximately 1200 connections which consist primarily of single family residential properties as well as the Gallaghers Canyon Golf Course. The City of Kelowna OCP estimates that 704 residential units will be developed in SEKID over a period of 20 years with the majority within the McCulloch Road corridor.

SKL System

The SKL systems consist predominantly of agricultural properties bounded to the north approximately along Spiers Road and to the west by Swamp Road. This service envelope includes South Kelowna Elementary School as well as several rural residential estate type developments.

KLO System

The KLO system consists predominantly of agricultural properties bounded to the north and east by Mission Creek. It includes the Harvest Golf Course, some commercial development in the vicinity of the KLO Road east of Kelowna Road intersection, and the Okanagan Montessori School on East Kelowna Road.

O'Reilly Road System

A well on O'Reilly Road supplies water to a distribution system serving 172 connections in the Hall Road area. This well currently has a capacity of 38 Lps (3.3 ML/d) and draws water from the Rutland Aquifer.

East Kelowna Road Wells

Two wells located on East Kelowna Road are utilized to supplement the Hydraulic Creek supply through drought years as well as improving water quality to approximately 110 domestic connections in the pressure zone that they serve in the East Kelowna Road area. These two wells each have a current pumping capacity of 60 Lps (5.2 ML/d) and draw water from the Rutland Aquifer.

4 Water Demand Design Criteria

Previous studies have been undertaken by others which have included reviews of water demands. The most recent projection of water demands was included in the Capital Works Program 2006-2016 by Mould Engineering. The projections included in that report have been used as the basis for developing the options included herein.

4.1 Peak Demand Design Basis

Typically water supply and treatment components are designed to meet maximum day demands. Using this approach, treated water storage is used to meet peak hourly demands and fire demands. This usually provides the most economical combination of water supply, water treatment, and treated water storage to meet all demand conditions.

Because the SEKID system is gravity fed, it appears that all components of the system have been sized on the basis of providing peak hour demands. For the purpose of this study, we have used the peak hour design basis used for previous planning purposes. This design basis should be reviewed, however, during the preliminary design of the selected option as it may be more economical to design the domestic components of the system on the basis of maximum day demands.

4.2 Domestic Demand Design Basis

The SEKID service area consists of 1,973 domestic service connections as of the end of 2005. For the purposes of this report, domestic demand is defined as the combined indoor and yard water demand for a typical connection in SEKID. Yard water use would include such things as yard irrigation, car washing and other outdoor water use, swimming pools, hot tubs, etc. SEKID's current design criteria are stated as follows:

Connection Type	Peak Demand
Fee Simple Lots	0.12 Lps/connection
Bare Land Strata	0.06 Lps/connection
Multi-Family Units	0.06 Lps/unit

The SEKID service envelope consists of basically two diverse domestic connection groups. One of these groups is made up of the residential service areas including the Gallaghers Canyon – McCulloch Road corridor area consisting of approximately 1200 connections, and the Hall Road area consisting of 173 connections. The other group is made up of the rural connections which consist primarily of agricultural land as well as some small country residential developments. For

the residential service areas the domestic demand refers to both indoor and outdoor water use as these are both supplied off a common service connection. For the rural service areas the domestic demand refers to only the indoor water demand, due to the fact that outdoor demands can be provided via the irrigation system. Commercial and institutional customers make up a very small component of the domestic demands and therefore, for the purpose of this assessment, have not been analyzed separately.

Associated Engineering consulted with Mould Engineering regarding the design basis for demands to be used for this study. It was noted that properties in the Gallaghers Canyon/McCulloch corridor often exceed the above noted design basis. It was also noted that agricultural properties domestic demand is close to the above noted Bare Land Strata design basis due to the fact components of yard use can be met from the irrigation systems. Commercial and institutional properties are not specifically identified relative to their water demands.

Based on the foregoing, we recommend that a peak domestic demand of 0.10 Lps/connection provides a reasonably conservative basis for projecting the total domestic demand for the SEKID service area and thus for comparing design options. This assumption should be further reviewed during the preliminary design of the selected option. Using the above noted design basis, the domestic demand is projected as follows:

Existing Domestic = 2053 conn. @ .10 Lps = 206 Lps (18.8 ML/d)
New Connections = 400 conn. @ .10 Lps = 40 Lps (3.5 ML/d)
Total Domestic Demand = 246 Lps (21.3 ML/d)

The above design criteria are considered to be conservative and thus suitable as a basis for comparing options. These criteria should be further reviewed and refined during the preliminary design stage of the project. When the project moves into predesign a more thorough breakdown of the connection types and the amount of commercial and institutional demands should be made.

Of the existing 1973 domestic connections, 172 are served via the O'Reilly Road well. Based on the above criteria, this would equate to 1.8 ML/d.

4.3 Agricultural Demand Design Basis

The SEKID service area includes 2,349 Ha of Grade 'A' serviced land. It is our understanding that this land area includes the golf courses. SEKID's current design criteria are stated as follows:

Irrigation from 0.78 to 1.01 Lps/Ha

According to information included in the Capital Works Program 2006-2016, using the above design criteria creates an unrealistically high demand when compared to actual flow records. The existing SEKID hydraulic model therefore is based on 85% of the peak demand resulting from the above noted criteria. The above criteria are based on irrigation application rates recommended by the

Ministry of Agriculture. These are apparently based on irrigation technology used in the 1960's. One reason is that more modern irrigation equipment and agricultural metering has improved irrigation efficiency and lowered peak demand values. More significantly, however, SEKID has been very proactive in implementing strategies to reduce its agricultural water demands. A significant component in these strategies involved the installation of flow meters on all agricultural services during the mid 1990's. By 2000, this program had resulted in an overall demand reduction of 10%. The second phase of the program, initiated in 2001, involved implementation of pricing strategies based on a water allotment system and inclined block rate. This program has resulted in further water demand reductions of as much as 30%. Clearly, the implementation of metering and consumption based pricing strategies for the irrigation system has been very successful.

Historical total peak demand for SEKID was apparently 1649 Lps occurring in 2003. Based on the 2,278 ha of Grade A serviced land recorded in 2003, this would equate to a net agricultural usage (after deduction of the existing domestic demand) of 0.623 Lps/ha. Using this as the design basis, the agricultural demand is projected as follows:

Existing – 2,349 ha x 0.623 Lps/ha = 1463 Lps (126.4 ML/d)
Projected – 100 ha x 0.623 Lps/ha = 62 Lps (5.4 ML/d)
Total Agricultural Demand = 1525 Lps (131.8 ML/d)

4.4 Impacts of Flow Metering

As noted above, SEKID has been very proactive in implementing strategies to reduce its agricultural water demands.

Of the existing 2000 domestic connections, approximately 660 have been fitted with meters, leaving approximately 1340 unmetered domestic connections. Domestic tolls are charged on a flat rate basis. A key component of SEKID's strategy should involve implementation of full metering coupled with consumption-based pricing. Based on the experience of the irrigation system and of other municipalities, we believe that this will result in significant reductions in domestic water consumption. The estimated cost of metering all remaining unmetered domestic service connections is $1,100,000. As noted in 4.1 above, the domestic demand criteria should be further reviewed and refined during the preliminary design stage of the project.

4.5 Total Combined Demand

Based on the above, the total projected combined demand is as follows:

Domestic	246 Lps (21.3 ML/d)
Agricultural	1525 Lps (131.9 ML/d)
Total	1771 Lps (153.1 ML/d)

As previously noted, the above demands include commercial/institutional water use although this demand component is not explicitly defined. The above noted figures will be used as the basis for comparing options.

As part of this study, we reviewed SEKID's SCADA HMI Hydraulic Creek intake flow data. This review indicated that from mid-October to mid-April demands remained consistently below 14.7 ML/d. During the shoulder seasons demands fluctuate significantly above this flow rate. Peaking during the summer peak demand period can vary significantly (as much as 90% of peak demand) depending on weather conditions. These demand variations need to be considered when developing system upgrading options.

4.6 Fire Protection

Fire protection requirements have more significant impacts on the local distribution system network capacity than on the overall system demands. Fire demands do need to be considered for the purposes of future system planning. SEKID's current design criteria are stated as follows:

Rural Residential	30 Lps
Urban Residential	60 Lps

The provision of fire protection needs to be considered when developing system upgrading options.

5 Water Treatment Impact on System Hydraulics and Operation

Water quality and potential water treatment solutions are addressed in Technical Memorandum No. 1. For the purposes of this Technical Memorandum, an important design consideration is the impact that a water treatment facility can have on system hydraulics particularly a gravity fed system. Disinfection processes such as chlorination or UV treatment have minimal impact on system hydraulics due to the fact that they are in-line processes which don't require the hydraulic head to be broken. Processes involving solids removal such as clarification and filtration, however, have a significant impact on system hydraulics and operation. These processes result in headlosses that are typically in the order of 5 or more metres through the treatment processes. More importantly, however, they necessitate a break in the hydraulic gradient unless they can be contained within pressure vessels. The other notable consideration with these processes is their impact on system operation. With SEKID's existing chlorination treatment process, it is relatively easy to rapidly increase or decrease flow rates in response to system demands. This is not the case, however, for plants involving many of the clarification and/or filtration processes. These plants typically take longer, sometimes hours, to respond to demand changes, depending on how the plant is designed and operated. Usually water treatment plants include treated water storage clearwells to provide a buffer between plant production and distribution system demands. These are important considerations in developing system option concepts.

6 Distribution System Upgrades

Previous studies have identified the need for various distribution system upgrades. It is assumed that these distribution upgrades will proceed on an as required basis and these improvements are beyond the scope of the water supply and treatment options outlined herein.

7 Servicing Options

7.1 Overview

Eight options have been developed for comparison purposes. Each option has been developed at a conceptual design level including capital and operating costs. For details regarding water treatment process technology refer to Technical Memorandum No. 1. The following is a summary of the options:

- Option 1 - Hydraulic Creek
- Option 2 - Hydraulic Creek Blended Concept
- Option 3 - Hydraulic Creek with Point of Entry Rural Treatment
- Option 4 - Hydraulic Creek Full Depth Separated System
- Option 5 - Hydraulic Creek Shallow Depth Separated System
- Option 6 - Groundwater Domestic Supply and Full Depth Separated System
- Option 7 - Groundwater Domestic Supply and Shallow Bury Separated System
- Option 8 - Dual Source System

7.2 Separation of Domestic Distribution from Agricultural Irrigation System

Options 4 to 8 involve separation of the domestic and agricultural irrigation systems in the rural areas. The separation concept incorporated into these options involves installation of small diameter rural distribution mains sized to convey the indoor domestic demand component to all rural residences and institutional and commercial properties as described herein.

- **Domestic System Water Supply:** Water supply for the domestic water system would be treated potable water.

- **Domestic Distribution System**: The distribution laterals typically range from 50mm to 75mm in diameter and the feeder trunks being larger as required to convey the treated domestic water supply from the source treatment facilities to the laterals. The new domestic distribution pipes would parallel the existing distribution mains and would incorporate pressure reducing stations at the same locations as existing pressure reducing stations and thereby operate at the same hydraulic gradient. The new rural domestic distribution system would be directly connected to the existing distribution systems serving the Gallagher's Canyon / McCulloch Road corridor and the Hall Road specified area. There would be no

direct connections allowed between the new rural domestic distribution system and the irrigation distribution system.

- **Service Connections**: New domestic service connection pipes would be installed to the property line where they would be connected to an existing or new indoor service connection pipe (owner installed) terminating at a connection to the building plumbing system. All connections between the private domestic and irrigation piping systems would be eliminated prior to connection to the new domestic system.

- **Irrigation Distribution System**: The existing distribution system would become an agricultural irrigation and fire protection distribution system and ultimately would provide all irrigation and yard water demands and fire demands to the rural areas. There would be no regulatory requirement to treat water distributed through the irrigation distribution system. The chlorination system could therefore be decommissioned although it could be left operational to minimize bacterial regrowth in the distribution system or if there were another perceived benefit for chlorinating irrigation water.

- **Fire Protection**: Fire demands in the rural areas would be provided from the irrigation distribution system. Fire demands to the Gallagher's Canyon / McCulloch Road corridor would be provided from the domestic distribution system utilizing treated water storage in the Field Road Reservoir.

8 Servicing Option Concept Descriptions

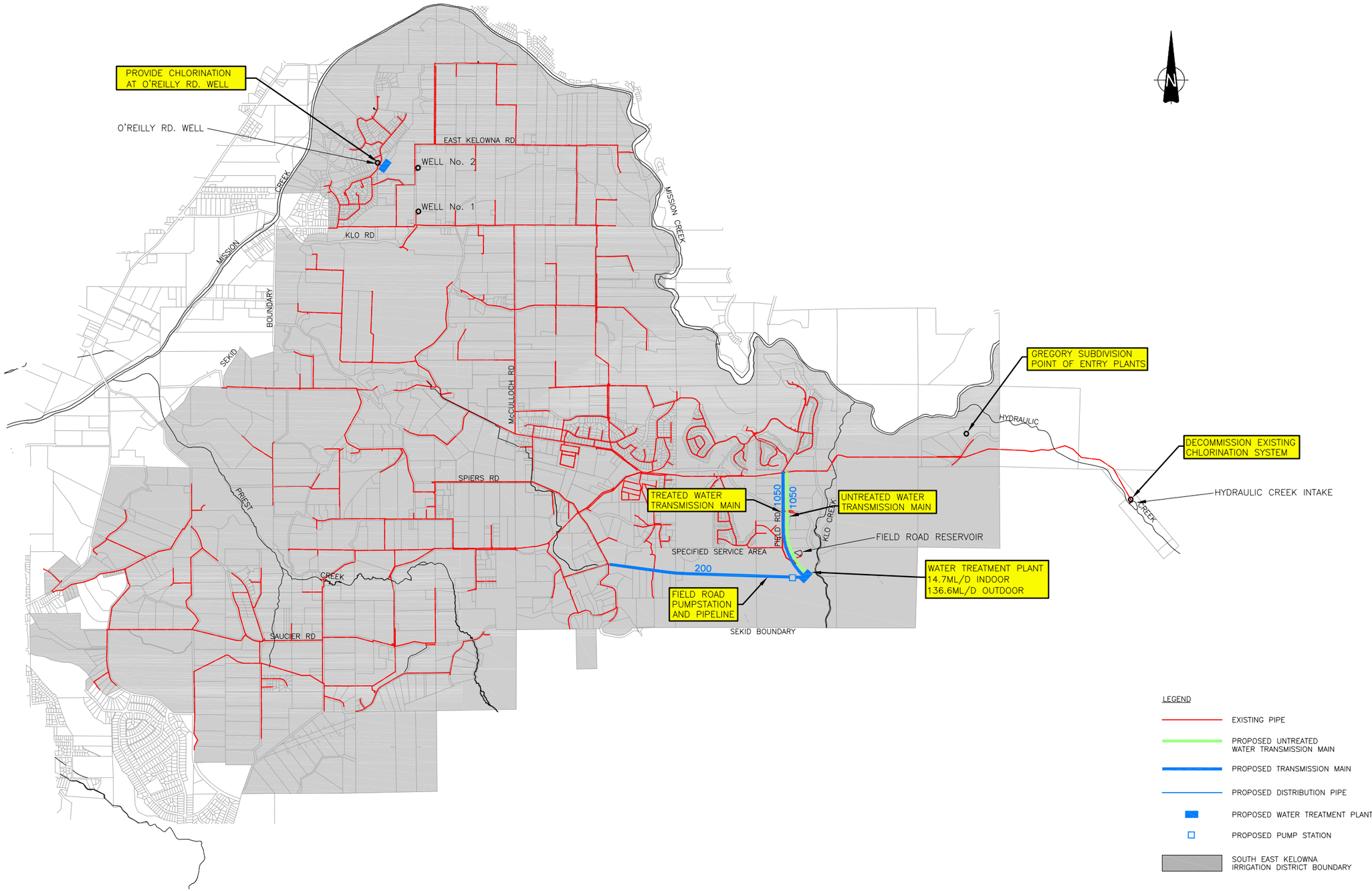
8.1 Option 1 – Hydraulic Creek

Concept

Option 1 involves continuing to utilize the existing Hydraulic Creek intake to supply the majority of the SEKID service area and treating all water delivered into the system to meet IHA's water quality requirements. The existing chlorination system would be removed from service. Because of the required capacity of the treatment plant and the types of processes required, there is inadequate space at the intake site, so the new treatment plant would have to be located elsewhere. For the purpose of this study we have assumed that it would be located at the Field Reservoir site. A pump station required to lift the HGL for zones with higher HGL than the Field Reservoir. Refer to **Plan 1-1.**

Raw Water Supply

The raw water supply would consist of Hydraulic Creek and the existing groundwater wells on O'Reilly road and East Kelowna Road. No significant improvements are envisioned on these supply sources as part of this project.



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 1: HYDRAULIC CREEK

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-1		

Water Treatment

A new water treatment plant would be required to treat the water sourced from Hydraulic Creek. Water from the groundwater wells would be chlorinated to meet IHA's requirements. For the purpose of preparing costs estimates we have assumed that the surface water treatment plant would involve Actiflo high rate clarification and filtration sized for a total production capacity of 151.3 ML/d. The remaining 1.8 ML/d of the treated water demand would be supplied from the existing O'Reilly Road groundwater wells. We have assumed that the plant would be located at the Field Road Reservoir site and the existing chlorination facility at the intake site taken out of service. The plant would include an indoor facility with a capacity of 14.7 ML/d to treat winter demands and 136.6 ML/d outdoor facility to treat spring and summer demand peaks. The indoor plant capacity was selected to treat the maximum demands observed during the seven month period between mid-October and mid-April. The plant would include a covered clearwell to provide a buffer between instantaneous demand fluctuations and WTP operability. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory subdivision on McCulloch Road.

Water Supply System

The upgrading of the water supply system would include the following components:

- Field Road Supply and Return Pipelines: New 1050 mm dia. pipelines would be required to supply raw water from the 1050 mm dia. main line on McCulloch Road to the Field Road site and to deliver treated water from Field Road site back to the McCulloch Road mainline. These mains would each be approximately 1 km in length.

- Field Road Treated Water Pump Station and Pipeline: A treated water pump station would be required to serve the high elevation pressure zones in the June Springs Road and Luxmore Road area. A 1.8 m. long 200 mm diameter treated water distribution main would be required to deliver water to the upper pressure zones.

Potential Issues

- The capital cost of the water treatment plant would have a significant impact on future taxes assuming that no financial assistance is available from senior government.

- The ongoing operation and maintenance costs for the water treatment plant would have a significant impact on future taxes.

- A treatment plant of this size would necessitate hiring considerable additional O&M staff in order to operate and maintain it.

- Delivery of treated water to high elevation areas is somewhat of a challenge and adds complexity to overall system operation.

8.2 Option 2 – Hydraulic Creek Blended Concept

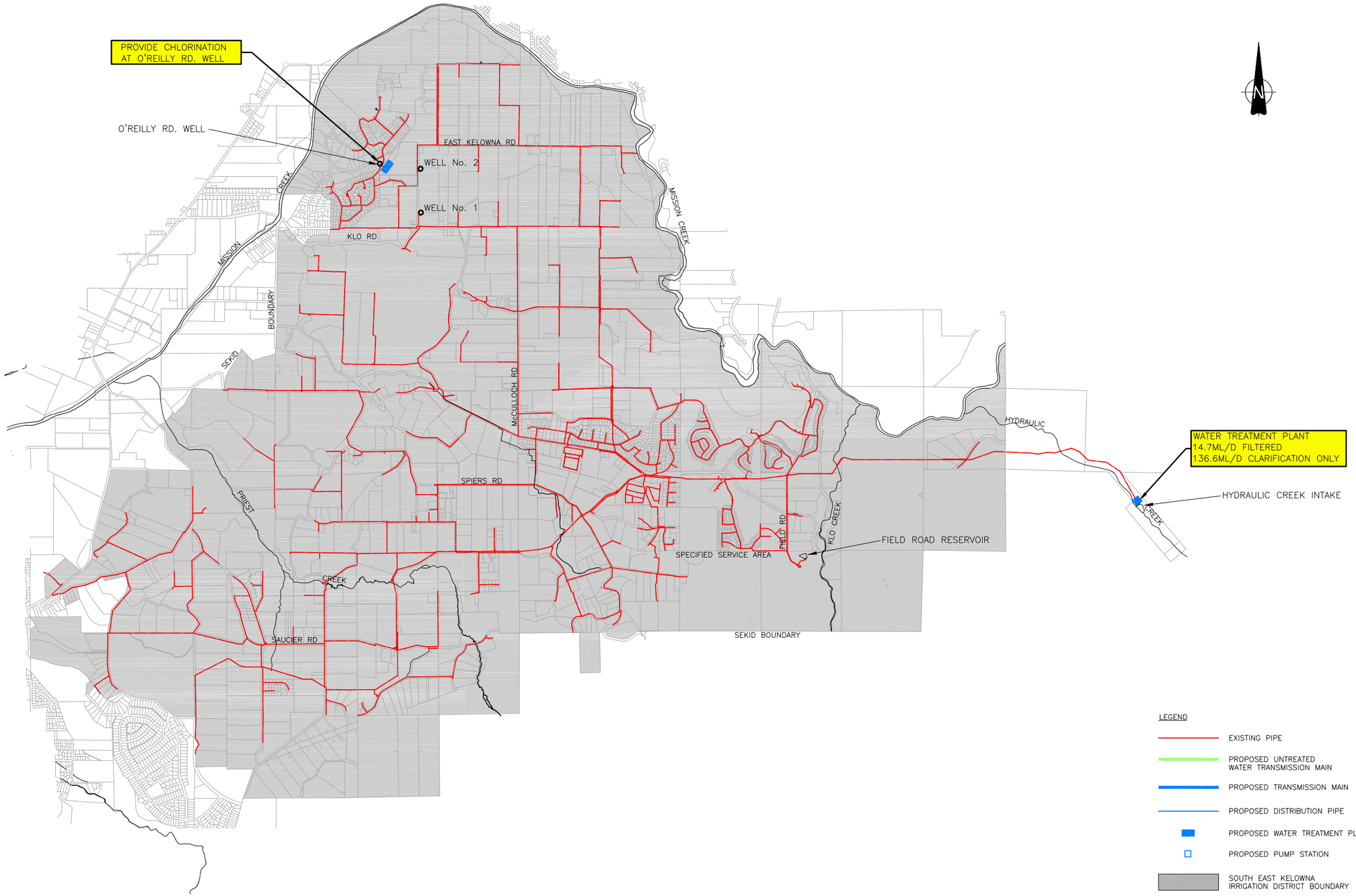
Option 2 involves continuing to utilize the existing Hydraulic Creek intake to supply the majority of the SEKID service area and filtering enough of the water delivered into the system to treat the domestic component of SEKID's demands and providing a less robust form of treatment to the remainder of water from the intake. Consideration was given to filtering a portion of the supply and no treatment to the remainder of the supply, however, it was concluded that this would require a filtration plant with a capacity exceeding 100 ML/d. It was decided that a more cost effective option would be to filter all winter period demands and to provide less robust clarification without filtration treatment to the remainder of the water. This would mean that filtered water could be delivered to all customers 7 months of the year, to customers in the urban development areas year round, and blended water to rural customers the remaining 5 months of the year. For the purpose of this assessment, we have assumed that the plant could be fit in at the existing intake site, although further investigation would be required to confirm this. This would allow the existing chlorination system to be left in place. Refer to **Plan 1-2**.

Raw Water Supply

The raw water supply would consist of Hydraulic Creek and the existing groundwater wells on O'Reilly Road and East Kelowna Road. No significant improvements are envisioned on these supply sources as part of this project.

Water Treatment

A new water treatment plant would be required to treat water sourced from Hydraulic Creek to service a total treated water capacity of 151.3 ML/d. Water from the groundwater wells would be chlorinated to meet IHA's requirements. For the purpose of preparing cost estimates, we have assumed that the surface water treatment plant would involve Actiflo high rate clarification and filtration treatment process sized for a capacity of 14.7 ML/d and Actiflo high rate clarification only for the remaining 136.6 ML/d. The remainder of the treated water demand would be supplied from the existing groundwater wells. The new plant would be treated in the vicinity of the existing Hydraulic Creek intake site. The plant would include a clearwell to provide a buffer between instantaneous demand fluctuations and WTP operability. During spring and summer months the filtration plant and groundwater wells would be operated at their full production capacity on a continuous basis. All excess and peaking demands during the high demand period would be supplied from the clarification facility. The blended water stream would have turbidities and colour meeting the Canadian Guidelines for Drinking Quality. Piloting would be required to predict the impact of the blending strategy on these parameters.



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 2: HYDRAULIC CREEK BLENDED CONCEPT

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-2		

Water Supply System
The only required improvement of the water supply system would be as follows:

- Hydraulic Creek Supply and Return Pipelines: A new 1050 mm diameter pipeline would be required to divert raw water upstream of the existing chlorination facility to the new water treatment plant and to deliver treated water from the plant back to the mainline downstream of the chlorination facility.

Potential Issues
- Rural customers would receive a somewhat lower water quality than urban customers during the high demand periods, although the water would comply with IHA's requirements with respect to turbidity and protozoa.

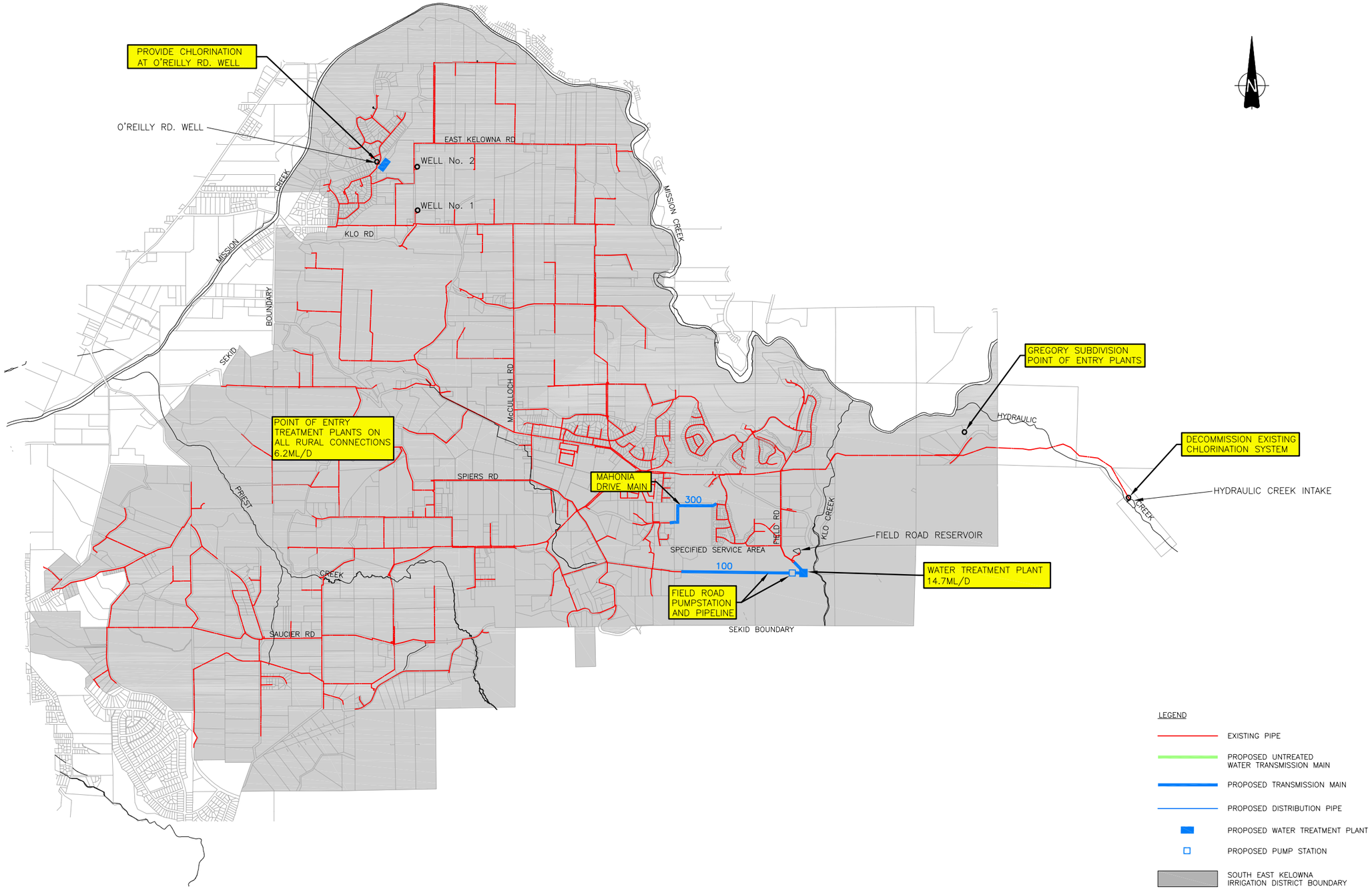
- Further investigation would be required to confirm that the plant could be built at the existing intake site.

8.3 Option 3 – Hydraulic Creek with Point of Entry Rural Treatment

Concept
Option 3 involves continuing to utilize the existing Hydraulic Creek intake to supply the majority of the SEKID service area and treating enough of the water delivered into the system to treat the Gallagher's Canyon/McCulloch Creek corridor component of SEKID's demands on a year round basis. Point of entry (POE) treatment systems would be used to treat water delivered to all rural customers during the high demand summer months. For the purpose of this assessment we have assumed that the new plant would be built at the Field Reservoir site. The existing chlorination system would be decommissioned. Refer to **Plan 1-3**.

Raw Water Supply
The raw water supply would consist of Hydraulic Creek and the existing groundwater wells on O'Reilly Road and East Kelowna Road. No significant improvements are envisioned on these supply sources as part of this project.

Water Treatment
A new water treatment plant would be required to treat the water sourced from Hydraulic Creek to treat the demands of the McCulloch Road/Gallaghers Canyon corridor. Water from the groundwater wells would be chlorinated to meet IHA's requirements. For the purpose of preparing cost estimates, we have assumed that the surface water treatment plant would involve Actiflo high rate clarification and filtration sized for a capacity of 14.7 ML/d. The treated water demands to the O'Reilly Road area would continue to be supplied from the existing groundwater wells. The new plant would be located at the Field Road Reservoir site. During low demand seasons the treated water would be delivered to all rural customers. During the high demand spring and summer months, water delivered to rural residences would be treated using POE water treatment facilities. These POE systems would involve ultra-filtration membrane and UV treatment. Local septic



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 3: HYDRAULIC CREEK WITH POINT OF ENTRY RURAL TREATMENT

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-3		

systems would be required to dispose of plant residuals from the POE systems. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory Subdivision on McCulloch Road on a year round basis.

Water Supply System

The upgrading of the water supply system would include the following components:

- Mahonia Drive Pipeline: A 300 mm dia. main from the Gallagher's Canyon development to Mahonia Drive will improve the distribution of water from the treatment plant at Field Road Reservoir to this area.

- Field Road Treated Water Pump Station and Pipeline:
  A treated water pump station would be required to serve the high elevation pressure zones in the June Springs Road and Luxmore Road area. A 1 km long 100 mm diameter treated water distribution main would be required to deliver water to this area.

Potential Issues

- Water used for irrigation purposes would be untreated creating the potential for ingestion of non-potable water.

- If SEKID is responsible for the operation and maintenance of the POE systems the operating and maintenance costs during the periods of operation could be considerable.

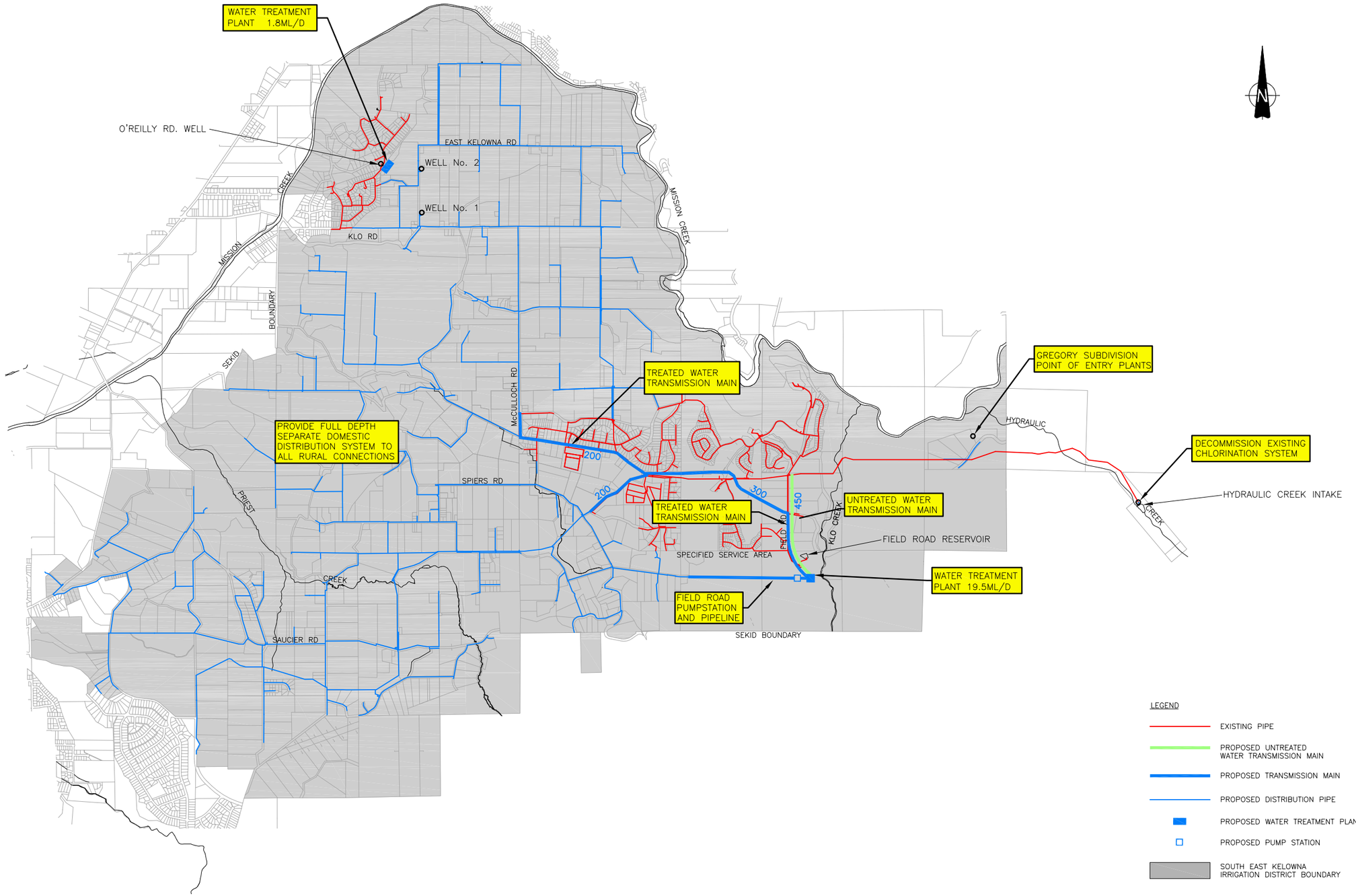
8.4 Option 4 – Hydraulic Creek Full Depth Separated System

Concept

Option 4 involves continuing to utilize the existing Hydraulic Creek intake to supply the majority of the SEKID service area and treating enough of the water delivered into the system to treat the domestic component of SEKID's demands. This would be accompanied by the construction of a separate deep bury domestic distribution system throughout the rural service area to enable the supply of filtered water to all domestic customers on a year-round basis. For the purpose of this assessment we have assumed that the new treatment plant would be located at the Field Reservoir site. The existing chlorination system would be decommissioned although it could be retained to use on an occasional basis to control re-growth in the agricultural distribution system. Refer to **Plan 1-4**.

Raw Water Supply

The raw water supply would consist of Hydraulic Creek and the existing groundwater wells on O'Reilly Road and East Kelowna Road. No significant improvements are envisioned on these supply sources a part of this project.



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 4: HYDRAULIC CREEK FULL DEPTH SEPARATED SYSTEM

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-4		

Water Treatment

A new water treatment plant would be required to treat the water sourced from Hydraulic Creek to treat the domestic demands for all areas except the O'Reilly Road area. Groundwater supplied to the O'Reilly Road area would be chlorinated to meet IHA's requirements. For the purpose of this study we have assumed that the surface water treatment plant would consist of Actiflo high rate clarification and filtration sized for a capacity of 19.5 ML/d. The new treatment plant would be located at the Field Road Reservoir site and would deliver the full domestic demands for the entire service area, except O'Reilly Road area, on a year-round basis. The O'Reilly Road area would continue to be supplied from the O'Reilly Road well. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory Subdivision on McCulloch Road on a year round basis.

Water Supply System

The upgrading of the water supply system would include the following components:

- Field Road Raw Water Supply Pipeline: A new 1 km long 450 mm dia. raw water supply pipeline would be required to deliver the domestic supply along Field Road from the 1050 supply line to the new treatment plant.

- Domestic Supply and Distribution System: New mains would be installed to convey water from the new water treatment plant to the distribution system. The existing 300 mm dia. Field Reservoir supply main would be converted to a distribution main to deliver water to the separated domestic distribution system. The separated system would involve the installation of 83.3 km of small diameter distribution mains paralleling the existing distribution mains throughout the entire rural area served by the existing system. These distribution mains would vary in diameter from 50 mm up to 200 mm. The main supply from the Field Road Reservoir would be a 2.7 km long 300 mm dia. main aligned along McCulloch Road to each of the distribution trunks. These mains would operate at essentially the same HGL as the existing distribution system, thereby necessitating the installation of small diameter PRV's adjacent to the existing system PRV's.

- Field Road Treated Water Pump Station and Pipeline: A treated water pump station would be required to serve domestic demands in the high elevation pressure zones in the June Springs Road and Luxmore Road area. A 1 km long 100 mm treated water distribution main would be required to deliver water to this area.

Potential Issues

- Untreated water will be delivered through the irrigation distribution system. Although the irrigation system would be clearly no longer considered a source of potable water, the potential exists for human ingestion of non-potable water.

- There is a significant capital cost involved in constructing the domestic distribution system assuming that no financial assistance is available from senior government.

- Because of the small diameter of the domestic distribution system, it would have very limited capacity expandability in the event of a significant residential development requiring large quantities of domestic water supply. This needs to be considered during system planning.

8.5 Option 5 – Hydraulic Creek Shallow Depth Separated System

Concept

Option 5 involves continuing to utilize the Hydraulic Creek intake to supply the majority of the SEKID service area and treating enough of the water delivered into the system to treat the domestic component of SEKID's water demands. This would be accompanied by the construction of a separate shallow bury domestic distribution system throughout the rural service area to enable the supply of filtered water to all domestic customers on a year-round basis. The primary difference between this option and Option 4 is that, because the pipe is shallow bury and could therefore freeze in the winter months, the separate distribution mains would only be operated approximately 7 months per year and would be drained during the winter months. During the winter months, the water supply from the domestic treatment plant would be redirected through the existing distribution mains.

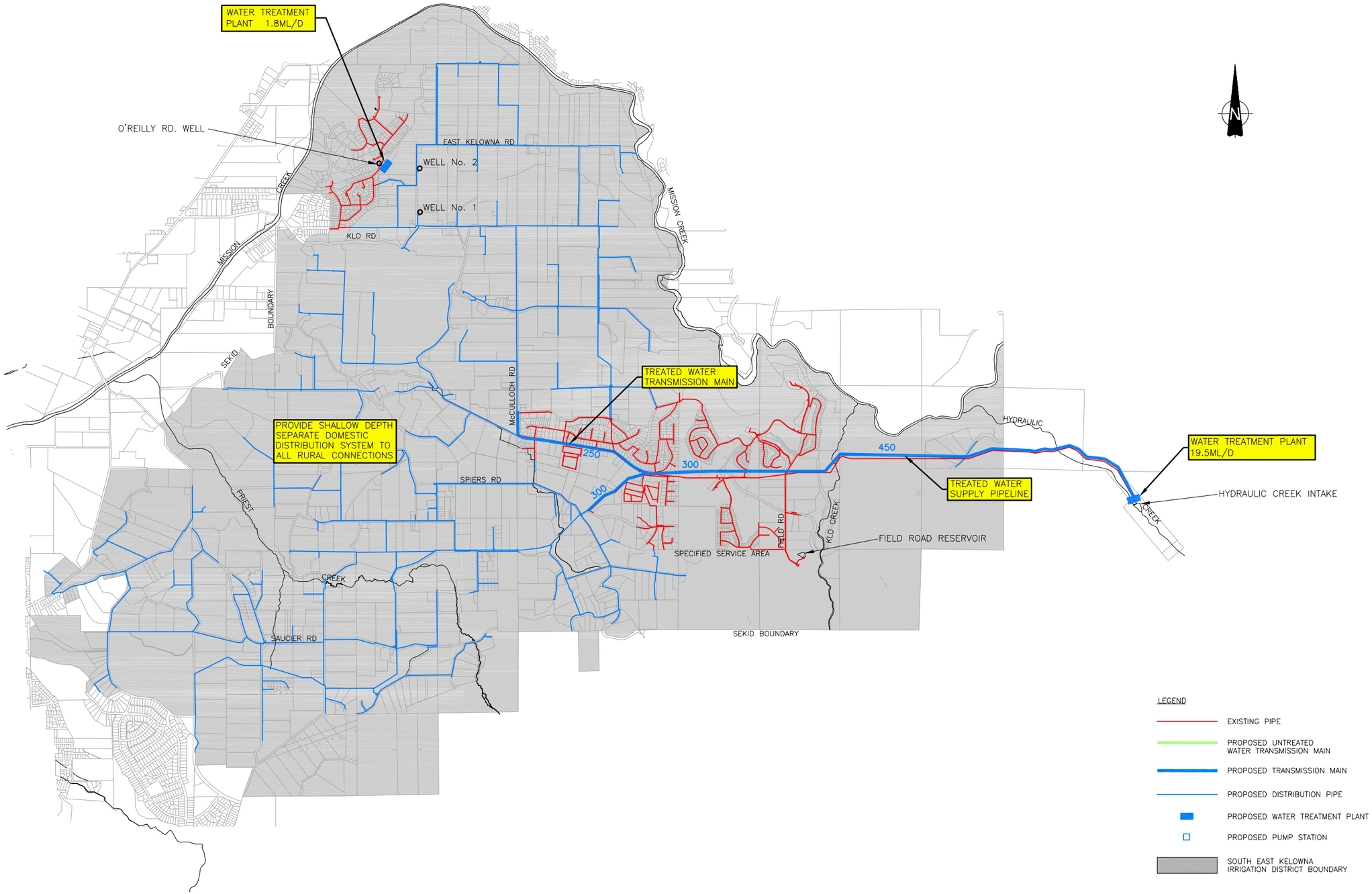
Because the existing distribution system would be used on a seasonal basis for domestic distribution, the existing chlorination system would be left operational to prevent the possibility of bacterial re-growth in the distribution system (it might be possible to only run the chlorination system occasionally to keep the existing mains clean). For the purpose of this assessment, we have assumed that the new treatment plant would be located at the Hydraulic Creek Intake site in order that it treat unchlorinated water (the alternative would be to install a second raw water supply line from Hydraulic Creek to the Field Reservoir site). Refer to **Plan 1-5**.

Raw Water Supply

The raw water supply would consist of Hydraulic Creek and the existing groundwater wells on O'Reilly Road and East Kelowna Road. No significant improvements are envisioned on these supply sources as part of this option.

Water Treatment

A new water treatment plant would be required to treat the water sourced from Hydraulic Creek to treat the domestic demands for all areas except the Hall Road area. Groundwater supplied to the Hall Road area would be chlorinated to meet IHA's requirements. For the purpose of this study we have assumed that the surface water treatment plant would consist of Actiflo high rate clarification and filtration sized for a capacity of 19.5 ML/d. The new treatment plant would be located at the Hydraulic Creek intake site and would deliver the full domestic demands for the entire service area on a year-round basis, albeit through different distribution systems on a seasonal basis.



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 5: HYDRAULIC CREEK SHALLOW DEPTH SEPARATED SYSTEM

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-5		

Water Supply System

The upgrading of the water supply system would include the following components:

- McCulloch Road Domestic Supply Pipeline: A new 4.5 km long 450 mm dia. supply pipeline would be required to deliver the domestic supply from the new water treatment plant at Hydraulic Creek Intake site along McCulloch Road to the intersection with Field Road where it would be connected to the existing 300 mm dia. Field Road Reservoir supply line and the new separate domestic distribution system.

- Domestic Distribution System: A new full depth 2.7 km long 300 mm dia. supply main would be extended from Field Road along McCulloch road to the Pressure Recorder Station on McLain Road where it would connect to the various legs feeding the new separated domestic distribution system. The separate domestic distribution system would involve the installation of 83.3 km of small diameter (50 mm to 200 mm) shallow bury distribution mains paralleling the existing distribution mains throughout the entire rural area served by the existing system. These distribution mains would operate at essentially the same HGL as the existing distribution system thereby necessitating the installation of small diameter PRV's adjacent to the existing system PRV's.

Potential Issues

- With partially treated water being delivered through the irrigation distribution system, and this system being used a portion of the time for delivery of potable water, the potential exists for human ingestion of non-potable water at other times. It should be noted, however, that for this option the irrigation system would be distributing chlorinated water.

- The capital cost saving of the shallow bury pipe installation will be offset by increased operational effort and costs to drain the distribution mains in order to changeover the distribution of treated water twice per year. This process would have to be very carefully managed to eliminate the potential of non-potable water entering treated water plumbing systems. IHA has expressed concern about this issue.

- Because of the small diameter of the domestic distribution system, it would have very limited capacity expandability in the event of a significant residential development requiring large quantities of domestic water supply. This needs to be considered during system planning.

8.6 Option 6 – Groundwater Domestic Supply and Full Depth Separated System

Concept

Option 6 involves expanding the existing Rutland Aquifer wellfield in order to supply the entire SEKID service area domestic demands utilizing groundwater. The existing Hydraulic Creek intake would be converted to supply the agricultural demands. The expanded wellfield would be accompanied by the construction of a separate deep bury domestic distribution system throughout

the rural service area to enable the supply of groundwater to all domestic customers on a year-round basis. For the purpose of this assessment we have assumed that the additional wells would be installed on Dunster Road. The existing chlorination system at Hydraulic Creek Lake intake would be decommissioned, although it could be retained to be used on an occasional basis to control bacterial re-growth in the agricultural distribution system. Refer to **Plan 1-6**.

Raw Water Supply

The existing Rutland Aquifer sourced groundwater system would be significantly expanded to increase its capacity to provide a capacity of 21.3 ML/d. The writer consulted with SEKID's groundwater consultant, Remi Allard, of Golder Associates to confirm that expansion of the wellfield to deliver this demand is reasonably possible. Golder Associates report entitled "Report on Hydro-geological Evaluation Well Field Capacity – South East Kelowna Irrigation District" confirms the capabilities of the expanded well-field. For the purpose of estimating costs, we have assumed that two new wells, each with a capacity of 5.3 ML/d would be developed in order to provide redundancy in the supply system. The existing Hydraulic Creek intake would be dedicated to supplying all agricultural demands and therefore no significant improvements are envisioned on the Hydraulic Creek supply system as part of this option.

Water Treatment

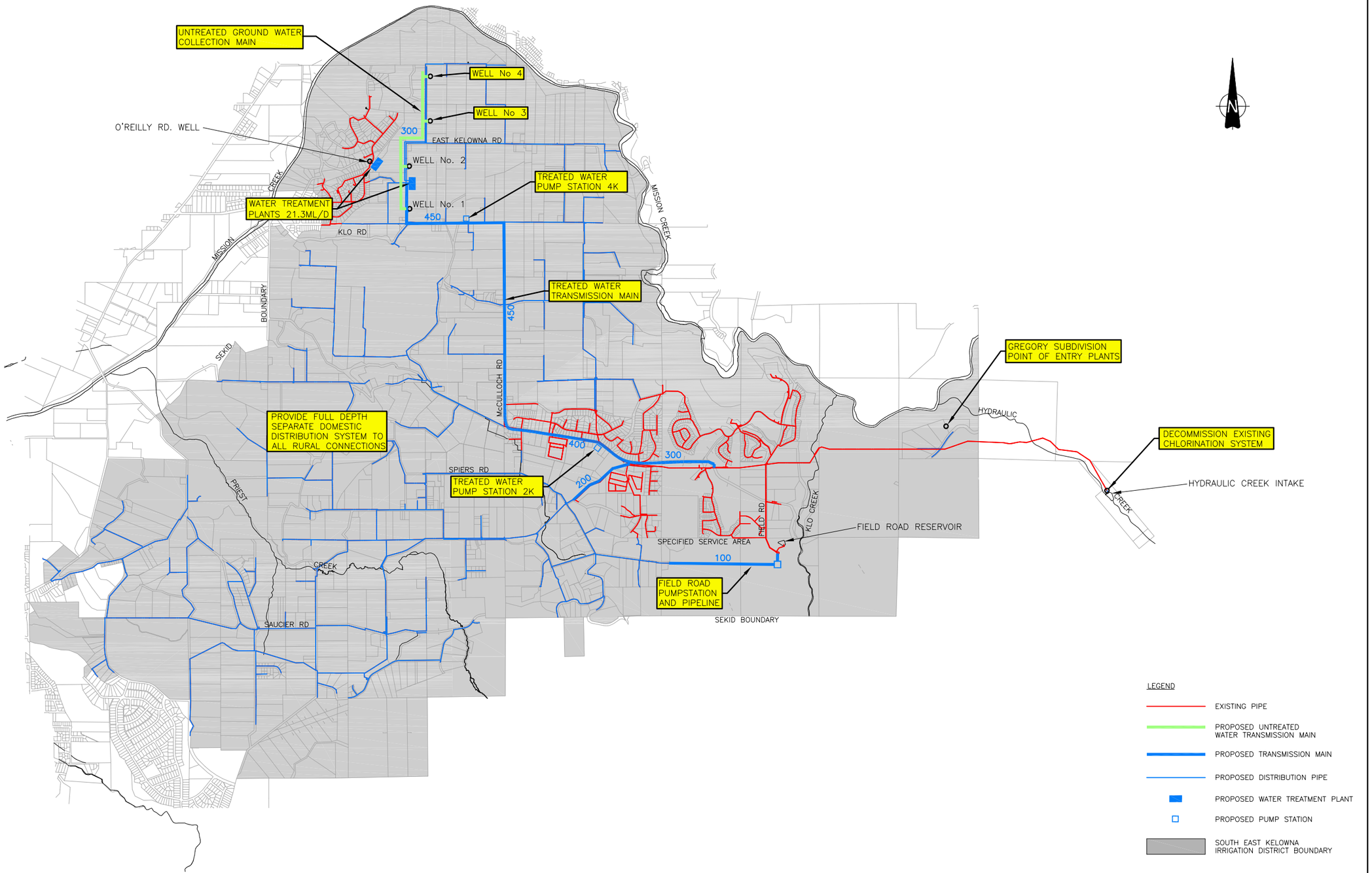
New water treatment plants consisting of chlorination would be required to treat all water sourced from the expanded well-field. By providing a single centralized treatment plant on East Kelowna Road to treat water from existing Wells 1 & 2 and new Wells 3 & 4, the long-term operation and maintenance costs would be reduced and consistency of treated water quality ensured. A separate small plant would be installed at the O'Reilly Road well to serve the Hall Road area. Optionally softening plants could also be provided although there is no regulatory requirement for softening the groundwater. For the purposes of preparing cost estimates, we have assumed that membrane technology would be utilized for this optional softening plant. The new treatment plants would deliver the full domestic demands for the entire service area on a year-round basis. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory Subdivision on McCulloch Road on a year round basis.

Water Supply System

The upgrading of the water supply system would include the following components:

- Untreated Groundwater Collection Mains: New 250 mm diameter groundwater collection mains would be required to deliver water from the expanded wellfield to the water treatment plant on East Kelowna Road.

- Domestic Treated Water Pump Stations: New treated water pumping stations would be constructed adjacent to PRV 4K and PRV 2K to raise the HGL to be capable of delivering water to the Field Road Reservoir. Pump Station 4K would have a capacity of 19.1 ML/d and Pump Station 2K would have a capacity of 16.3 ML/d. The pump station would have a



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 6: GROUNDWATER DOMESTIC SUPPLY FULL DEPTH SEPARATED SYSTEM

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-6		

capacity of 19.1 ML/d and would include two duty pumps and one spare pump of equal 9.6 ML/d capacity.

- Domestic Treated Water Supply Pipeline: A new 450 mm dia. treated water supply pipeline would be constructed from the water treatment plant to a tie-in with the domestic feeder at Gulley Road. From Gulley Road to the SKL domestic feeder at McClain Road the pipeline diameter would be 400 mm. From McClain Road a 300 mm dia. main would be constructed to a connection to the existing 300 mm dia. main at Gallagher's Blvd.

- Domestic Distribution System: A new full depth separate domestic distribution system would involve the installation of 78.8 km of small diameter (50 mm to 200 mm) shallow bury distribution mains paralleling the existing distribution mains throughout the entire rural area served by the existing system. These distribution mains would operate at essentially the same HGL as the existing distribution system thereby necessitating the installation of small PRV's at the same locations as the existing system PRV's.

- Field Road Treated Water Pump Station and Pipeline: A treated water pump station would be required to serve domestic demands in the high elevation pressure zones in the June Springs Road and Luxmore Road area. A 1 km long 100 mm treated water distribution main would be required to deliver water to this area.

Potential Issues

- Untreated water will be delivered through the irrigation distribution system. Although the irrigation system would be clearly no longer considered a source of potable water, the potential exists for human ingestion of non-potable water.

- There is a significant capital cost involved in constructing the domestic distribution system assuming that no financial assistance is available from senior government.

- Because of the small diameter of the domestic distribution system, it would have limited capacity expandability in the event of a significant residential development requiring large quantities of domestic water supply. This needs to be considered during system planning.

- The softening plant is identified as an optional provision. The groundwater supply has significantly higher hardness than the Hydraulic Creek supply. While this is not a health issue, it could create some aesthetic issues for the ratepayers if softening is not implemented at the treatment plant site. If softening is implemented, residuals management would have to be addressed. For the purpose of this assessment we have assumed that it would be conveyed into the sanitary system, however, this has not been reviewed with the City.

8.7 Option 7 – Groundwater Domestic Supply and Shallow Bury Separated System

Concept

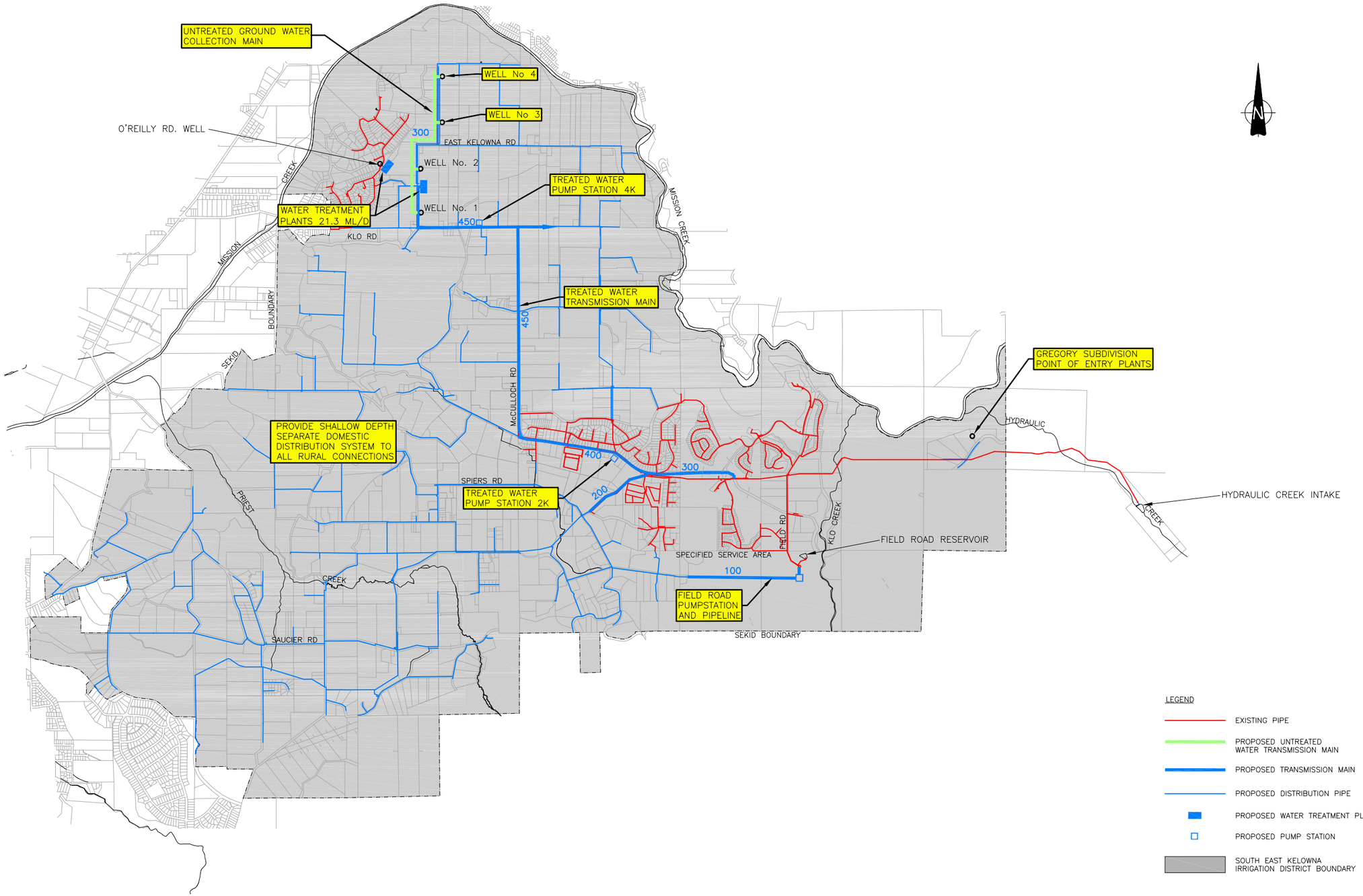
Option 7 involves expanding the existing Rutland Aquifer well-field in order to supply the entire SEKID service area domestic demands utilizing groundwater. The existing Hydraulic Creek intake would be converted to supply the agricultural demands. The expanded well-field would be accompanied by the construction of a separated shallow bury domestic distribution system throughout the rural service area to enable the supply of groundwater to all domestic customers on a year-round basis. For the purpose of this assessment we have assumed that the additional wells would be installed on Dunster Road. The primary difference between this option and Option 6 is that, the pipe is shallow bury. Preliminary analysis suggests that there may be adequate heat in the groundwater supply during the winter months to prevent freezing within the distribution system. This will be dependent on a more detailed review of heat loss from the relatively warm groundwater through the distribution system during winter months. Other freezing management strategies can be explored such as providing a continuous bleed system to ensure sufficient heat or to deepen the pipeline bury in areas where low flows could result in freezing. Because the existing distribution system may be used seasonally, the existing chlorination system at Hydraulic Creek Lake intake should be left in place to prevent the possibility of re-growth in the distribution system. It might be possible to only use the chlorination system on an occasional basis to control bacterial re-growth in the agricultural distribution system and keep the system clean. Refer to **Plan 1-7**.

Raw Water Supply

The existing Rutland Aquifer sourced groundwater system would be significantly expanded to increase its capacity to provide a capacity of 21.3 ML/d. The writer consulted with SEKID's groundwater consultant, Remi Allard of Golder Associates, to confirm that expansion of the wellfield to deliver this demand is reasonably possible. Golder Associates report entitled "Report on Hydro-geological Evaluation Well Field Capacity – South East Kelowna Irrigation District" confirms the capabilities of the expanded well-field. The existing Hydraulic Creek intake would be dedicated to supplying all agricultural demands and therefore no significant improvements are envisioned on the Hydraulic Creek supply system as part of this option. A significant advantage with groundwater is that its temperature remains above 9 ºC during the winter months. This additional heat may allow the shallow bury distribution system to be operated year round, although further investigation and analysis would be required to determine the feasibility of this.

Water Treatment

New water treatment plants consisting of chlorination would be required to treat all water sourced from the expanded well-field. By providing a single centralized treatment plant on East Kelowna Road to treat water from existing Wells 1 & 2 and new Wells 3 & 4, the long-term operation and maintenance costs would be reduced and consistency of treated water quality ensured. A separate small plant would be installed at the O'Reilly Road well to serve the Hall Road area. Optionally softening plants could also be provided although there is no regulatory requirement for softening the groundwater. For the purposes of preparing cost estimates, we have assumed that membrane technology would be utilized for this optional softening plant. The new treatment plants would



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 7: GROUNDWATER DOMESTIC SUPPLY SHALLOW DEPTH SEPARATED SYSTEM

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-7		

deliver the full domestic demands for the entire service area on a year-round basis. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory Subdivision on McCulloch Road on a year round basis.

Water Supply System

The upgrading of the water supply system would include the following components:

- Untreated Groundwater Collection Mains: New 250 mm diameter groundwater collection mains would be required to deliver water from the expanded wellfield to the water treatment plant on East Kelowna Road.

- Domestic Treated Water Pump Station: A new treated water pumping station would be constructed either at the water treatment plant site or adjacent to PRV 4K to raise the HGL to be capable of delivering water to the Field Road Reservoir. The pump station would have a capacity of 19.1 ML/d and would include two duty pumps and one spare pump of equal 9.6 ML/d capacity.

- Domestic Treated Water Supply Pipeline: A new 450 mm dia. treated deep bury water supply pipeline would be constructed from the water treatment plant to a tie-in with the domestic feeder at Gulley Road. From Gulley Road to the SKL domestic feeder at McClain Road the pipeline diameter would be 400 mm. From McClain Road a 300 mm dia. main would be constructed to a connection to the existing 300 mm dia. main at Gallagher's Blvd.

- Domestic Distribution System: A new shallow bury separate domestic distribution system would involve the installation of 78.8 km of small diameter (50 mm to 200 mm) shallow bury distribution mains paralleling the existing distribution mains throughout the entire rural area served by the existing system. These distribution mains would operate at essentially the same HGL as the existing distribution system thereby necessitating the installation of small PRV's at the same locations as the existing system PRV's.

- Field Road Treated Water Pump Station and Pipeline: A treated water pump station would be required to serve domestic demands in the high elevation pressure zones in the June Springs and Luxmore Road area. A 1 km long 100 mm treated water distribution main would be required to deliver water to this area.

Potential Issues

- With untreated water being delivered through the irrigation distribution system, and this system being used a portion of the time for delivery of potable water, the potential exists for human ingestion of non-potable water.

- The capital cost saving of the shallow bury pipe installation will be offset by increased operational effort and costs to drain the distribution mains in order to change over the distribution of treated water twice per year. This process would have to be very carefully

managed to eliminate the potential of non-potable water entering treated water plumbing systems. IHA has expressed concern about this issue.

- Because of the small diameter of the domestic distribution system, it would have limited capacity expandability in the event of a significant residential development requiring large quantities of domestic water supply. This needs to be considered during system planning.

- The groundwater softening plant is identified as an optional provision. The groundwater supply has significantly higher hardness than the Hydraulic Creek supply. While this is not a health issue, it could create some aesthetic issues for the ratepayers if softening is not implemented at the treatment plant site. If softening is implemented, residuals management would have to be addressed and for the purpose of this assessment we have assumed that the residuals would be conveyed into the City sanitary sewer system, however, this has not been reviewed with the City.

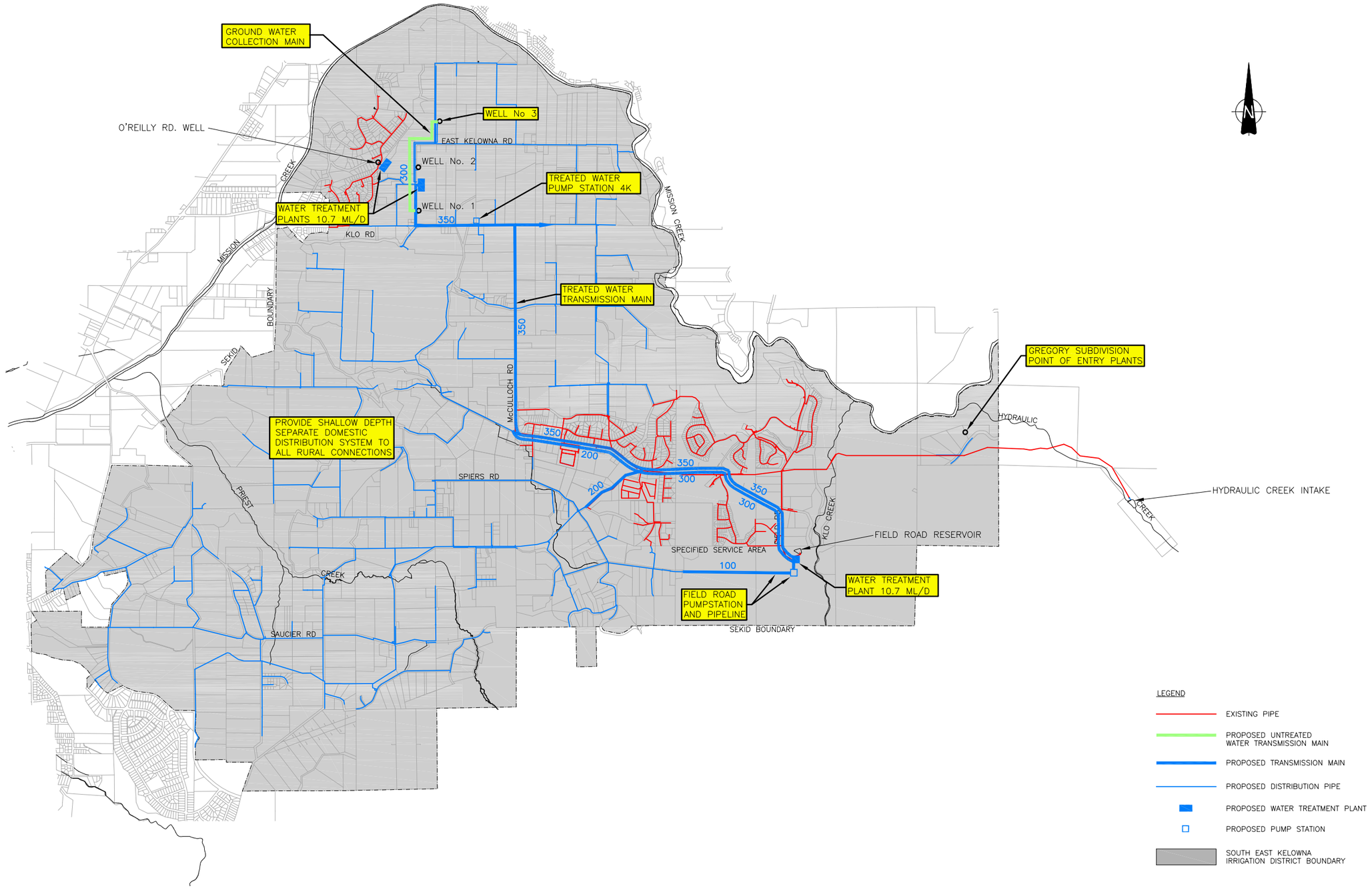
8.8 Option 8 – Dual Source Domestic Supply and Full Depth Separated System

Concept

Option 8 involves expanding the existing Rutland Aquifer wellfield in order to supply approximately half of the SEKID service area domestic demands utilizing groundwater. The existing Hydraulic Creek intake would be converted to supply the agricultural demands, however, a domestic supply water treatment plant capable of supplying the other half of the total domestic demand (10.7 Ml/d) would be constructed at the Field Road Reservoir site. The domestic supply and treatment facilities would be accompanied by the construction of a separate deep bury domestic distribution system throughout the rural service area to enable the supply of domestic water to all domestic customers on a year-round basis. For the purpose of this assessment we have assumed that one additional well would be installed on Dunster Road. The existing chlorination system at Hydraulic Creek Lake intake would be decommissioned, although it could be retained to use on an occasional basis to control bacterial re-growth in the agricultural distribution system. Refer to **Plan 1-8**.

Raw Water Supply

The existing Rutland Aquifer sourced groundwater system would be expanded to increase its capacity to provide a capacity of 10.6 ML/d. For the purpose of estimating costs, we have assumed that one new well with a capacity of 5.3 ML/d would be developed in order to provide redundancy in the supply system. The other 10.7 ML/d of domestic demand would be drawn from the existing Hydraulic Creek supply system into Field Road Reservoir site. The Hydraulic Creek intake would therefore supply all agricultural demands and half of the domestic demands and therefore no significant improvements are envisioned on the Hydraulic Creek supply system as part of this option.



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SOUTH EAST KELOWNA IRRIGATION DISTRICT

WATER SUPPLY & TREATMENT COST BENEFIT REVIEW

OPTION 8: DUAL SOURCE DOMESTIC SUPPLY AND SEPARATE RURAL DOMESTIC DISTRIBUTION SYSTEM

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-8		

Water Treatment

New water treatment plants consisting of chlorination would be required to treat all water sourced from the expanded well-field. A new centralized treatment plant would be located on East Kelowna road adjacent to Well No. 1 and would deliver half of the domestic demands for the service area on a year-round basis. A separate small plant would be installed at the O'Reilly Road well to serve the Hall Road area. Concurrently a surface water treatment plant consisting of Actiflo high rate clarification and filtration sized for a demand of 10.7 ML/d would be constructed at the Field Road Reservoir site. All domestic water supply from both the groundwater and surface water supply and treatment facilities would be directed into the Field Road Reservoir where it would be blended. Blending would potentially eliminate the need for optional softening of the groundwater. A point of entry water treatment plant (or individual point of entry plants) would be required to serve the five properties in the Gregory Subdivision on McCulloch Road on a year round basis.

Water Supply System

The upgrading of the water supply system would include the following components:

- Untreated Groundwater Collection Mains: New 250 mm diameter groundwater collection mains would be required to deliver water from the expanded well-field to the water treatment plant on East Kelowna Road.

- Domestic Treated Water Pump Stations: New treated water pumping stations would be constructed adjacent to PRV 4K to raise the HGL to be capable of delivering the groundwater to the Field Road Reservoir. Pump Station 4K would have a capacity of 10.6 ML/d. The pump station would include two duty pumps and one spare pump of equal 5.3 ML/d capacity.

- Domestic Treated Water Supply Pipeline: A new 350 mm dia. treated water supply pipeline would be constructed from the groundwater treatment plant to the Field Road Reservoir. A new treated water supply main would deliver water from the Field Road Reservoir to connections to the new rural domestic distribution system along McCulloch Road and KLO Road.

- Domestic Distribution System: A new full depth separate domestic distribution system would involve the installation of 78.8 km of small diameter (50 mm to 200 mm) shallow bury distribution mains paralleling the existing distribution mains throughout the entire rural area served by the existing system. These distribution mains would operate at essentially the same HGL as the existing distribution system thereby necessitating the installation of small PRV's at the same locations as the existing system PRV's.

- Field Road Treated Water Pump Station and Pipeline: A treated water pump station would be required to serve domestic demands in the high elevation pressure zones in the June Springs Road and Luxmore Road area. A 1 km long 100 mm treated water distribution main would be required to deliver water to this area.

Potential Issues

- With untreated water being delivered through the irrigation distribution system. Although the irrigation system would be clearly no longer considered a source of potable water, the potential exists for human ingestion of non-potable water.

- There is a significant capital cost involved in constructing the domestic distribution system assuming that no financial assistance is available from senior government.

- Because of the small diameter of the domestic distribution system, it would have limited capacity expandability in the event of a significant residential development requiring large quantities of domestic water supply. This needs to be considered during system planning.

- More investigation would be necessary to establish the compatibility of the two treated water supplies for blending and optimum blending ratios.

- The SEKID O&M staff would have to operate and maintain two domestic supply systems, however, this would also give them much greater operational flexibility.

9 Cost Estimates

9.1 Cost Estimating Basis

The capital cost estimates used for the comparison of the options have been developed using unit pricing for all components. The unit pricing is based on 2007 dollars and includes 30% allowance for engineering contingencies. Unit pricing used for development the cost estimates is included in the appendices. Breakdowns for the costs are also provided in the appendices.

The operation and maintenance costs have been determined by separating out energy costs from other O&M costs and basing the other O&M costs on percentage of capital costs, depending on the type of facility or construction.

9.2 Capital Cost Summary

Table 2-1 provides a comparative summary of the capital costs for each option.

Table 2-1
System Options Capital Cost Summary

OPTION	DESCRIPTION	SUPPLY SYSTEM COSTS	REQUIRED WATER TREATMENT COSTS	OPTIONAL WATER TREATMENT COSTS	TOTAL REQUIRED	TOTAL INCLUDING OPTIONAL
1	Hydraulic Creek	$4,057,000	$50,725,000	$0	**$54,782,000**	**$54,782,000**
2	Hydraulic Creek Blended Concept	$156,000	$39,623,000	$0	**$39,779,000**	**$39,779,000**
3	Hydraulic Creek With Point of Entry Rural Treatment	$652,000	$15,438,000	$0	**$16,090,000**	**$16,090,000**
4	Hydraulic Creek Full Depth Separated System	$11,367,000	$11,980,000	$0	**$23,347,000**	**$23,347,000**
5	Hydraulic Creek Shallow Depth Separated System	$9,117,000	$11,980,000	$0	**$21,097,000**	**$21,097,000**
6	Groundwater Domestic Supply and Full Depth Separated System	$16,681,000	$883,000	$10,010,000	**$17,564,000**	**$27,574,000**
7	Groundwater Domestic Supply and Shallow Depth Separated System	$12,095,000	$883,000	$10,010,000	**$12,978,000**	**$22,988,000**
8	Dual Source Groundwater & Hydraulic Creek Supply and Full Depth Separated System	$14,680,000	$6,470,000	$0	**$21,150,000**	**$21,150,000**

9.3 Operation and Maintenance Cost Summary

Table 2-2 provides a comparative summary of the estimated annual operation and maintenance costs for each option.

Table 2-2
System Options Annual O&M Cost Summary

OPTION	DESCRIPTION	SUPPLY SYSTEM ANNUAL O&M COSTS	REQUIRED WATER TREATMENT ANNUAL O&M COSTS	OPTIONAL WATER TREATMENT ANNUAL O&M COSTS	TOTAL REQUIRED ANNUAL O&M COSTS	TOTAL ANNUAL O&M COSTS INCLUDING OPTIONAL
1	Hydraulic Creek	$32,000	$1,171,000	$0	**$1,203,000**	**$1,203,000**
2	Hydraulic Creek Blended Concept	$8,000	$914,000	$0	**$922,000**	**$922,000**
3	Hydraulic Creek With Point of Entry Rural Treatment	$6,000	$356,000	$0	**$362,000**	**$362,000**
4	Hydraulic Creek Full Depth Separated System	$59,000	$276,000	$0	**$335,000**	**$335,000**
5	Hydraulic Creek Shallow Depth Separated System	$117,000	$276,000	$0	**$393,000**	**$393,000**
6	Groundwater Domestic Supply and Full Depth Separated System	$215,000	$33,000	$369,000	**$362,000**	**$731,000**
7	Groundwater Domestic Supply and Shallow Depth Separated System	$377,000	$33,000	$369,000	**$410,000**	**$779,000**
8	Dual Source Groundwater & Hydraulic Creek Supply and Full Depth Separated System	$215,000	$149,000	$0	**$364,000**	**$364,000**

Prepared by:

W.J (Bill) Harvey, P.Eng.
Project Manager

WJH/cb

Enclosure - 3A

Reviewed by:

Ian P.D. Wright, P.Eng.
Vice President, Water Treatment

ENCLOSURE 3A – COST ESTIMATING BACKUP

South East Kelowna Irrigation District
Systems Options Costs
Table 2-1
Capital Cost Summary

OPTION	DESCRIPTION	SUPPLY SYSTEM COSTS	REQUIRED WATER TREATMENT COSTS	OPTIONAL WATER TREATMENT COSTS	TOTAL BASED ON REQUIRED WATER TREATMENT	TOTAL INCLUDING OPTIONAL WATER TREATMENT
1	Hydraulic Creek	$4,057,000	$50,725,000	$0	**$54,782,000**	**$54,782,000**
2	Hydraulic Creek Blended Concept	$156,000	$39,623,000	$0	**$39,779,000**	**$39,779,000**
3	Hydraulic Creek With Point of Entry Rural Treatment	$652,000	$15,438,000	$0	**$16,090,000**	**$16,090,000**
4	Hydraulic Creek Full Depth Separated System	$11,367,000	$11,980,000	$0	**$23,347,000**	**$23,347,000**
5	Hydraulic Creek Shallow Depth Separated System	$9,117,000	$11,980,000	$0	**$21,097,000**	**$21,097,000**
6	Dual Source Domestic Supply and Full Depth Separated System	$16,681,000	$883,000	$10,010,000	**$17,564,000**	**$27,574,000**
7	Groundwater Domestic Supply and Shallow Depth Separated System	$12,095,000	$883,000	$10,010,000	**$12,978,000**	**$22,988,000**
8	Dual Source Domestic Supply and Full Depth Separated System	$14,680,000	$6,470,000	$0	**$21,150,000**	**$21,150,000**

Souuth East Kelowna Irrigation District
System Options Costs
Table 2-2
O and M Cost Summary

OPTION	DESCRIPTION	SUPPLY SYSTEM ANNUAL O&M COSTS	REQUIRED WATER TREATMENT ANNUAL O&M COSTS	OPTIONAL WATER TREATMENT ANNUAL O&M COSTS	TOTAL REQUIRED ANNUAL O&M COSTS	TOTAL ANNUAL O&M INCLUDING OPTIONAL WATER TREATMENT
1	Hydraulic Creek	$32,000	$1,171,000	$0	**$1,203,000**	**$1,203,000**
2	Hydraulic Creek Blended Concept	$8,000	$914,000	$0	**$922,000**	**$922,000**
3	Hydraulic Creek With Point of Entry Rural Treatment	$6,000	$356,000	$0	**$362,000**	**$362,000**
4	Hydraulic Creek Full Depth Separated System	$59,000	$276,000	$0	**$335,000**	**$335,000**
5	Hydraulic Creek Shallow Depth Separated System	$117,000	$276,000	$0	**$393,000**	**$393,000**
6	Dual Source Domestic Supply and Full Depth Separated System	$215,000	$33,000	$369,000	**$362,000**	**$731,000**
7	Groundwater Domestic Supply and Shallow Depth Separated System	$377,000	$33,000	$369,000	**$410,000**	**$779,000**
8	Dual source system	$215,000	$149,000	$0	**$364,000**	**$364,000**

South East Kelowna Irrigation District
System Options Costs
Table 2-3

OPTION 1						
Hydraulic Creek						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Field Road Supply & Return Pipelines	151.3	1050	mm	2000	$3,120,000	$15,600
Field Road Pump Station	3.7	34	kw		$586,300	$14,798
June Springs Supply Main	3.7	200	mm	1800	$350,415	$1,752
					$0	$0
Subtotal					**$4,057,000**	**$32,000**
Water Treatment	**14.7**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$650,000	
Civil		1	LS		$980,000	
Architectural/ Structural		1	LS		$2,610,000	
Process Mechanical					$1,505,000	
Actiflo Supply		1	LS	650000		
Actiflo Installation		40	%	260000		
PAC		1	LS	75000		
KMnO4		1	LS	75000		
Filtration Supply		40	%	300000		
Filtration Installation		1	LS	120000		
Chlorination		1	LS	25000		
Building Mechanical		1	LS		$330,000	
Electrical/ Instrumentation		1	LS		$460,000	
Residuals Management		1	LS		$500,000	
Subtotal plus 30% eng'g & contingencies					**$9,146,000**	**$211,000**
Water Treatment	**136.6**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$2,950,000	
Civil		1	LS		$3,540,000	
Architectural/ Structural		1	LS		$11,200,000	
Process Mechanical					$7,934,000	
Actiflo Supply		1	LS	2310000		
Actiflo Installation		40	%	924000		
PAC		1	LS	150000		
KMnO4		1	LS	150000		
Filtration Supply		40	%	2000000		
Filtration Installation		1	LS	800000		
Chlorination		1	LS	100000		
Piping		1	LS	1500000		
Building Mechanical		1	LS		$1,470,000	
Electrical/ Instrumentation		1	LS		$2,650,000	
Residuals Management		1	LS		$2,200,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$41,579,000**	**$960,000**
TOTAL					**$54,782,000**	**$1,203,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-4

OPTION 2						
Hydraulic Creek Blended Concept						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Hydraulic Creek WTP Supply & Return Pipelines	151.3	1050	mm	100	$156,000	$7,800
Subtotal					**$156,000**	**$8,000**
Water Treatment	**14.7**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$650,000	
Civil		1	LS		$980,000	
Architectural/ Structural		1	LS		$2,610,000	
Process Mechanical					$1,505,000	
Actiflo Supply		1	LS	650000		
Actiflo Installation		40	%	260000		
PAC		1	LS	75000		
KMnO4		1	LS	75000		
Filtration Supply		40	%	300000		
Filtration Installation		1	LS	120000		
Chlorination		1	LS	25000		
Building Mechanical		1	LS		$330,000	
Electrical/ Instrumentation		1	LS		$460,000	
Residuals Management		1	LS		$500,000	
Subtotal plus 30% eng'g & contingencies					**$9,146,000**	**$211,000**
Water Treatment	**136.6**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$1,930,000	
Civil		1	LS		$3,280,000	
Architectural/ Structural		1	LS		$8,290,000	
Process Mechanical					$3,684,000	
Actiflo Supply		1	LS	2310000		
Actiflo Installation		40	%	924000		
PAC		1	LS	175000		
KMnO4		1	LS	175000		
Chlorination		1	LS	100000		
Building Mechanical		1	LS		$960,000	
Electrical/ Instrumentation		1	LS		$960,000	
UV Facility		1	LS		$2,100,000	
Residuals Management		1	LS		$2,200,000	
Point of Entry Systems - Gregory Subdivision		5	LS	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$30,477,000**	**$703,000**
TOTAL					**$39,779,000**	**$922,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-5

OPTION 3						
Hydraulic Creek With Point of Entry Rural Treatment						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Field Road Pump Station	0.5	5	kw		$269,750	$3,793
June Springs Supply Main	0.5	100	mm	1000	$122,525	$613
Mahonia Drive Watermain	9.8	300	mm	700	$259,578	$1,298
					$0	$0
Subtotal					**$652,000**	**$6,000**
Water Treatment	**14.7**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$650,000	
Civil		1	LS		$980,000	
Architectural/ Structural		1	LS		$2,610,000	
Process Mechanical					$1,505,000	
Actiflo Supply		1	LS	650000		
Actiflo Installation		40	%	260000		
PAC		1	LS	75000		
KMnO4		1	LS	75000		
Filtration Supply		40	%	300000		
Filtration Installation		1	LS	120000		
Chlorination		1	LS	25000		
Building Mechanical		1	LS		$330,000	
Electrical/ Instrumentation		1	LS		$460,000	
Residuals Management		1	LS		$500,000	
Point of Entry Systems - UF/ GAC/ UV		600	each	8000	$4,800,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$15,438,000**	**$356,000**
TOTAL					**$16,090,000**	**$362,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-6

OPTION 4						
Hydraulic Creek Full Depth Separated System						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Field Road Raw Water Supply Pipeline	19.5	450	mm	1000	$709,800	$3,549
Field Road Pump Station	0.5	5	kw		$269,750	$4,012
June Springs Supply Pipeline	0.5	100	mm	1000	$122,525	$613
Domestic Distribution System - full depth	19.5				$10,264,540	$51,323
					$0	$0
Subtotal					**$11,367,000**	**$59,000**
Water Treatment	**19.5**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$850,000	
Civil		1	LS		$1,280,000	
Architectural/ Structural		1	LS		$3,400,000	
Process Mechanical					$1,965,000	
Actiflo Supply		1	LS	850000		
Actiflo Installation		40	%	340000		
PAC		1	LS	100000		
KMnO4		1	LS	100000		
Filtration Supply		40	%	375000		
Filtration Installation		1	LS	150000		
Chlorination		1	LS	50000		
Building Mechanical		1	LS		$430,000	
Electrical/ Instrumentation		1	LS		$600,000	
Residuals Management		1	LS		$650,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$11,980,000**	**$276,000**
TOTAL					**$23,347,000**	**$335,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-7

OPTION 5						
Hydraulic Creek Shallow Depth Separated System						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
McCulloch Road Treated Water Supply Pipeline	19.5	450	mm	4500	$3,194,100	$15,971
Domestic Distribution System - shallow depth	19.5				$5,923,230	$100,816
					$0	$0
Subtotal					**$9,117,000**	**$117,000**
Water Treatment	**19.5**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$850,000	
Civil		1	LS		$1,280,000	
Architectural/ Structural		1	LS		$3,400,000	
Process Mechanical					$1,965,000	
Actiflo Supply		1	LS	850000		
Actiflo Installation		40	%	340000		
PAC		1	LS	100000		
KMnO4		1	LS	100000		
Filtration Supply		40	%	375000		
Filtration Installation		1	LS	150000		
Chlorination		1	LS	50000		
Building Mechanical		1	LS		$430,000	
Electrical/ Instrumentation		1	LS		$600,000	
Residuals Management		1	LS		$650,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$11,980,000**	**$276,000**
TOTAL					**$21,097,000**	**$393,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-8

OPTION 6						
Groundwater Domestic Supply and Full Depth Separated System						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Groundwater Collection Mains	10.6	300	mm	1600	$593,320	$2,967
Well No's 1 & 2 Backup Genset					$325,000	$6,500
Well No. 3	5.3				$285,000	$34,386
Well No. 4	5.3				$285,000	$34,386
Well No's 3 and 4 Land Acquisition		0.1	ha		$100,000	
Groundwater Environmental Assessment					$75,000	
Domestic Treated Water Pump Station - 4K	19.1	280	kw		$1,066,000	$84,244
Domestic Treated Water Pump Station - 2K	16.3	336	kw		$1,175,200	$100,053
Domestic Distribution System - full depth	21.3				$12,384,499	$61,922
Field Road Pump Station	0.5	5	kw		$269,750	$3,793
June Springs Supply Main	0.5	100	mm	1000	$122,525	$613
					$0	$0
Subtotal					**$16,681,000**	**$329,000**
Water Treatment Plant	**21.3**	**Quantity**	**Units**	**Unit Cost**		
Chlorination - NaOCl Generation		1	LS		$639,000	
Membrane Softening - Optional		1	LS		$7,700,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal (excl Optional) plus 30% eng'g & contingencies					**$883,000**	**$33,000**
Subtotal (incl Optional) plus 30% eng'g & contingencies					**$10,893,000**	**$402,000**
TOTAL EXCLUDING OPTIONAL SOFTENING					**$17,564,000**	**$362,000**
TOTAL INCLUDING OPTIONAL SOFTENING					**$27,574,000**	**$731,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-9

OPTION 7						
Groundwater Domestic Supply and Shallow Depth Separated System						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Groundwater Collection Mains	10.6	300	mm	1600	$593,320	$2,967
Well No's 1 & 2 Backup Genset					$325,000	$6,500
Well No. 3	5.3	120	kw		$285,000	$34,386
Well No. 4	5.3	120	kw		$285,000	$34,386
Well No's 3 and 4 Land Acquisition		0.1	ha		$100,000	
Groundwater Environmental Assessment					$75,000	
Domestic Treated Water Pump Station - 4K	19.1	280	kw		$1,066,000	$84,244
Domestic Treated Water Pump Station - 2K	16.3	336	kw		$1,175,200	$100,053
Domestic Distribution System - shallow depth					$7,798,641	$110,193
Field Road Pump Station	0.5	5	kw		$269,750	$3,793
June Springs Supply Main	0.5	100	mm	1000	$122,525	$613
					$0	$0
Subtotal					**$12,095,000**	**$377,000**
Water Treatment Plant	**21.3**	**Quantity**	**Units**	**Unit Cost**		
Chlorination - NaOCl Generation		1	LS		$639,000	
Membrane Softening - Optional		1	LS		$7,700,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal (excl Optional) plus 30% eng'g & contingencies					**$883,000**	**$33,000**
Subtotal (incl Optional) plus 30% eng'g & contingencies					**$10,893,000**	**$402,000**
TOTAL EXCLUDING OPTIONAL SOFTENING					**$12,978,000**	**$410,000**
TOTAL INCLUDING OPTIONAL SOFTENING					**$22,988,000**	**$779,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
System Options Costs
Table 2-10

OPTION 8						
Dual Source Domestic Supply and Full Depth Separated System						
Component	**Capacity (ML/d)**	**Size**	**Units**	**Length (lin.m.)**	**Capital Cost**	**Initial Annual O&M Cost**
Supply System						
Groundwater Collection Mains	10.7	300	mm	600	$222,495	$1,112
Well No. 3	5.3	120	kw		$200,000	$33,536
						$0
Domestic Treated Water Pump Station - 4K	10.7	380	kw		$1,261,000	$112,474
						$0
Domestic Distribution System - full depth	21.3				$10,264,540	$51,323
Field Road Pump Station	0.5	5	kw		$269,750	$3,793
June Springs Supply Main	0.5	100	mm	1000	$122,525	$613
Transmission Main to Field Road Reservoir	10.7	350	mm	6400	$2,339,200	$11,696
Subtotal					**$14,680,000**	**$215,000**
Water Treatment Plant	**10.7**	**Quantity**	**Units**	**Unit Cost**		
General Requirements		1	LS		$460,000	
Civil		1	LS		$690,000	
Architectural/ Structural		1	LS		$1,830,000	
Process Mechanical					$1,057,000	
Actiflo Supply		1	LS	455000		
Actiflo Installation		40	%	182000		
PAC		1	LS	60000		
KMnO4		1	LS	60000		
Filtration Supply		1	LS	200000		
Filtration Installation		40	%	80000		
Chlorination		1	LS	20000		
Building Mechanical		1	LS		$230,000	
Electrical/ Instrumentation		1	LS		$320,000	
Residuals Management		1	LS		$350,000	
Point of Entry Systems - Gregory Subdivision		5	each	8000	$40,000	
Subtotal plus 30% eng'g & contingencies					**$6,470,000**	**$149,000**
TOTAL					**$21,150,000**	**$364,000**
All Subtotal and Total costs based on 2007 dollars including a 30% allowance for engineeering & contingencies						

South East Kelowna Irrigation District
Sparate Domestic Distribution Cost Estimates
Table 2-11

Domestic Distribution System - Hydraulic Creek Supply							
				1.5m Depth		**.75m Depth**	
Section	**Diameter (mm)**	**Quantity**	**Units**	**Unit Cost**	**Cost**	**Unit Cost**	**Cost**
	50	50935	lin m	$ 69	$ 3,527,249	$ 31	$ 1,599,359
	75	20195	lin m	$ 74	$ 1,499,479	$ 36	$ 735,098
	100	3985	lin m	$ 94	$ 375,586	$ 56	$ 224,754
	150	4210	lin m	$ 115	$ 482,045	$ 77	$ 322,697
	200	3340	lin m	$ 150	$ 500,165	$ 112	$ 373,746
	250	0	lin m	$ 210	$ -	$ 160	$ -
	300	3405	lin m	$ 285	$ 971,276	$ 223	$ 760,677
PRV's	50 to 100	30	each	$ 8,000	$ 240,000	$ 8,000	$ 240,000
Connect Domestic Services	25	600	each	$ 500	$ 300,000	$ 500	$ 300,000
SUBTOTAL					**$ 7,895,800**		**$ 4,556,331**
ENG'G & CONTINGENCIES				**@30%**	**$ 2,368,740**	**@30%**	**$ 1,366,899**
TOTAL					**$ 10,264,540**		**$ 5,923,230**

Domestic Distribution System - Groundwater Supply							
				1.5m Depth		**.75m Depth**	
Section	**Diameter (mm)**	**Quantity**	**Units**	**Unit Cost**	**Cost**	**Unit Cost**	**Cost**
	50	49630	lin m	$ 69	$ 3,436,878	$ 31	$ 1,558,382
	75	19150	lin m	$ 74	$ 1,421,888	$ 36	$ 697,060
	100	3985	lin m	$ 94	$ 375,586	$ 56	$ 224,754
	150	2965	lin m	$ 115	$ 339,493	$ 77	$ 227,267
	200	2355	lin m	$ 150	$ 352,661	$ 112	$ 263,525
	250	0	lin m	$ 210	$ -	$ 160	$ -
	300	1675	lin m	$ 285	$ 477,794	$ 223	$ 374,195
	400	1365	lin m	$ 456	$ 622,099	$ 370	$ 504,914
	450	3590	lin m	$ 546	$ 1,960,140	$ 448	$ 1,608,859
PRV's	50 to 100	30	each	$ 8,000	$ 240,000	$ 8,000	$ 240,000
Connect Domestic Services	25	600	each	$ 500	$ 300,000	$ 500	$ 300,000
SUBTOTAL					**$ 9,526,538**		**$ 5,998,955**
ENG'G & CONTINGENCIES				**@30%**	**$ 2,857,961**	**@30%**	**$ 1,799,686**
TOTAL					**$ 12,384,499**		**$ 7,798,641**

South East Kelowna Irrigation District
Pipe Supply Installation Unit Costs
Table 2-12

Unit Costs per Lineal metre
Buried Pipe

		Trenching, Backfilling, & Restoration - 1.5m depth					Trenching, Backfilling, & Restoration - 0.75m depth				
Diameter	Pipe Supply & Install (1)	Trenching & Backfilling (2)	Pavement Restoration	**Total Excl Pavement**	**Total Incl Pavement**	**Blended Total 5% Paved**	Trenching & Backfilling (2)	Pavement Restoration	**Total Excl Pavement**	**Total Incl Pavement**	**Blended Total 5% Paved**
50	$ 5	$ 60	$ 85	**$ 65**	**$ 150**	**$ 69**	$ 24	$ 48	**$ 29**	**$ 77**	**$ 31**
75	$ 10	$ 60	$ 85	**$ 70**	**$ 155**	**$ 74**	$ 24	$ 48	**$ 34**	**$ 82**	**$ 36**
100	$ 30	$ 60	$ 85	**$ 90**	**$ 175**	**$ 94**	$ 24	$ 48	**$ 54**	**$ 102**	**$ 56**
150	$ 50	$ 60	$ 90	**$ 110**	**$ 200**	**$ 115**	$ 24	$ 53	**$ 74**	**$ 127**	**$ 77**
200	$ 85	$ 60	$ 95	**$ 145**	**$ 240**	**$ 150**	$ 24	$ 58	**$ 109**	**$ 167**	**$ 112**
250	$ 125	$ 80	$ 100	**$ 205**	**$ 305**	**$ 210**	$ 32	$ 63	**$ 157**	**$ 220**	**$ 160**
300	$ 180	$ 100	$ 105	**$ 280**	**$ 385**	**$ 285**	$ 40	$ 68	**$ 220**	**$ 288**	**$ 223**
350	$ 240	$ 120	$ 110	**$ 360**	**$ 470**	**$ 366**	$ 48	$ 73	**$ 288**	**$ 361**	**$ 292**
400	$ 310	$ 140	$ 115	**$ 450**	**$ 565**	**$ 456**	$ 56	$ 78	**$ 366**	**$ 444**	**$ 370**
450	$ 380	$ 160	$ 120	**$ 540**	**$ 660**	**$ 546**	$ 64	$ 83	**$ 444**	**$ 527**	**$ 448**
600	$ 450	$ 200	$ 135	**$ 650**	**$ 785**	**$ 657**	$ 80	$ 98	**$ 530**	**$ 628**	**$ 535**

Notes:
(1) PVC Pipe plus 60% allowance for valves, fittings, and tie-ins plus additional allowance for bedding
(2) Compacted native backfill
(3) Costs do not include engineering and contingencies