City of Fernie

Flowing toward sustainability

Liquid Waste Management Plan Update

Photo: Courtesy of Tourism Fernie

City of Fernie
May 2012

Next Step in Liquid Waste Management Plan: Evaluating Our Options

In December, we brought you the first of a three-part series of newsletters about the City of Fernie's Liquid Waste Management Plan (LWMP). In it, we discussed the significant challenges the City faces regarding our overloaded liquid waste (sewage) management system. We discussed what a LWMP is and how the process will help us to identify, evaluate and implement a sustainable solution to overcome these challenges.

In this second newsletter, we discuss the options that have been evaluated for managing Fernie's liquid waste and we highlight the recommendations the City is considering implementing. Before finalizing the plan though, **we want to hear from you**. Public consultation is an important component of any LWMP. Because the LWMP will be a legal document to be in effect for the next 20 years, it is critical that Fernie residents have a say in what actions will be taken and that you fully understand what it will cost.

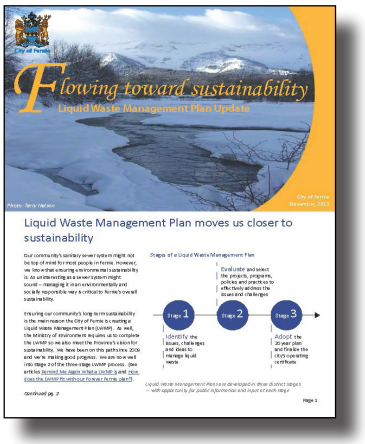
Please review the information in this newsletter and then provide your feedback on the recommendations. You can provide your input in a couple of ways, by:

- **Filling out the online survey at: www.fernie.ca**
- **Attending the LWMP Open House scheduled for:**

  May 1, 2012
  Fernie Aquatic Centre
  4:00 p.m. - 8:00 p.m.

  Refreshments provided. First 25 Participants to attend the Open House will receive 1 free family admission to the pool for use on May 1, 2012.

You can access the first LWMP Newsletter on the City's website at www.fernie.ca. Technical studies referred to in this newsletter are also available on our website.



Inflow, Infiltration and Dealing With All That Water

High levels of inflow and infiltration (I & I) is a significant problem for Fernie's sewage treatment process. Reducing I & I, or more effectively managing it, were possibilities the City wanted to consider through the LWMP process.

The City asked Urban Systems, consulting engineers, to complete an I & I Study to identify and evaluate possible solutions. The study evaluated a number of issues and identified three possible options:

Option1 Stop rainwater from entering the system by replacing the old and leaky pipes.

One of the ways to reduce I & I is to replace the City's old sewer pipes and their relevant service connections. It would help to prevent rainwater from entering the system. The cost would be approximately $16.5 million. However, because some of the leakage is also coming through residents' personal connections and not only through City pipes, the investigation found that it would be too difficult to accurately predict how effective replacing the City's pipes would be in reducing I&I.

Option 2 Let the rainwater continue to enter the system but design the sewage treatment plant to better treat it.

This option would not reduce the I & I but would allow the City to adequately deal with excess flows during peak wet weather times. It would mean continuing to collect and convey the current I & I flows to the sewage treatment plant. However, this option would require upgrading the treatment process to ensure the effluent is of high enough quality to give the City other options for dealing with it (see articles in this issue for more detail: Evaluating our liquid waste options on pg.3 and Proposed Solution on pg. 7). Upgrading the sewage treatment plant to deal with the high flows would handle the immediate problems.

What should be flowing into this sanitary manhole on Railway Ave is sewage. But this photo shows that during periods of high inflow and infiltration (when this picture was taken) what is actually flowing into the system is a lot of relatively clean water from run off and sump pumps.

What is I & I?

In our first newsletter, we talked about Fernie's main liquid waste challenge being – inflow and infiltration or I&I. Inflow refers to water getting into the sewer system through above ground means, including runoff from roof leaders or through manholes after rain or snow melt. Infiltration refers to water that seeps into the system through cracked or leaky pipes, poor fitting joints or sump pumps that are connected to the system.

Because of Fernie's high levels of precipitation, our proximity to the Elk River and snowmelt from the mountains in the spring, I & I is a serious problem affecting our sewage treatment process. At peak wet weather times, Fernie's sewage treatment plant receives flows of up to four times what they are during normal days. During these peak times, the system becomes overloaded and can't properly manage the high flows.

"The situation leaves the City vulnerable to not being able to adequately control or guarantee the effluent quality generated," explains Dave Cockwell, Fernie Director of Operations. "That could result in not meeting our permit requirements and/or a negative impact on river quality."

Option 3 Apply a combination of Option 1 and Option 2

This option recognizes that removing inflow and infiltration at the source is the preferred solution, but only if done in a cost effective manner. Applying this option, the City would replace old and leaky pipes over the long-term. The cost of replacing the pipes could then be spread over approximately 20 to 30 years – lessening the financial burden for the community. However, in the short-term, we would improve the sewage treatment plant process to ensure the current flows during the highest peak wet weather times can be treated properly.

The recommendations also highlight the City's need to improve our ground water monitoring systems to better understand from which areas the highest I & I numbers are coming.

Option 3 (combining Options 1 & 2) is the direction the City is considering implementing as it would adequately meet our needs for dealing with the problem of high I & I, but also be affordable.

What Can You Do About I & I?

One of the ways we can all immediately contribute to reducing our inflow and infiltration problem is to ensure that our private roof leaders or building foundation drains are not connected to the City's sewer system. We can also repair any damaged piping on our sanitary service connections.

"One of the reasons we can't predict with great accuracy how effective replacing our older pipes will be in reducing I & I is because we don't know how much water is leaking in and how much is being intentionally diverted into the system from roof run-off or sump pumps," says Dave Cockwell, Fernie Director of Operations. "We suspect that roof run off and sump pumps contribute a significant amount of extra water to the system but, right now, we don't have the monitoring capability in place to measure it."

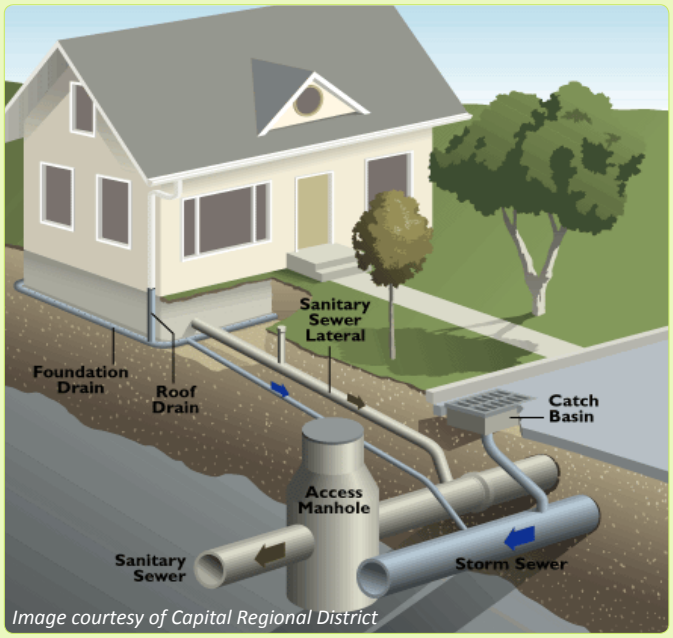


Image courtesy of Capital Regional District

This image demonstrates how having proper storm and sanitary connections can keep the two systems separate. Not everyone in Fernie has storm connections, but over time, this is something the City would like to work toward.

Evaluating our Liquid Waste Options

As the Inflow and Infiltration study indicated, significantly reducing the excess effluent (treated wastewater) generated by high inflow and infiltration will be difficult to achieve in the short-term. Therefore, we need to look at other possible solutions for managing the excess effluent during peak wet weather periods.

The City evaluated three options for better managing the effluent volumes:

1. **Release all effluent to the ground (rapid infiltration basins)**
2. **Improve effluent quality to a level acceptable for effluent reuse**
3. **Improve effluent quality to a level acceptable for release to the Elk River**

The next three articles describe in more detail the results of these evaluations.

1 Release all effluent to the ground (rapid infiltration basins)

The City currently uses rapid infiltration basins (RI basins) to dissipate the effluent generated by the sewage treatment plant. These pond-like structures hold the treated effluent until it is able to infiltrate through the ground underneath. The current RI basins handle the effluent volumes most of the time. However, during times of high rain fall or snow melt, when the flow into the sewage treatment system can reach four times normal levels, the RI basins can't handle the volumes.

The Liquid Waste Management Plan process needs to address two fundamental questions:

- Why are the RI basins not able to handle all the effluent?
- Can the RI basins' performance be improved somehow?

The City engaged Thurber Engineering, geotechnical and hydrogeological specialists, to study existing data and conduct tests to provide more information. The RI Basin Study shows that the performance of the RI basins can be restricted for a couple of reasons.

Treated effluent is pumped into the rapid infiltration (RI) basins, two of which are seen in this photo. The effluent infiltrates into the ground below. The City will continue to use the RI basins to their maximum capacity. However, during peak wet weather times, the basins can't accommodate all the treated effluent that is generated and another option is required.

Firstly, the area naturally has high groundwater levels. In order for the RI basins to work properly, the water that goes into them needs to have somewhere in which to dissipate.

However, when the ground below the basins is already saturated, it creates a barrier to additional water moving through it.

A second issue is the low permeability of the soils. According to the Thurber study, the soils in the area are not porous enough for water to flow easily through them. That creates another barrier to dissipation.

These issues don't just apply to the area immediately adjacent to the sewage treatment plant. High ground water and low soil permeability are realities throughout the Fernie area.

The study concluded that, because of the natural environment (groundwater and soils), the RI basins are limited in their capacity to provide the necessary rapid infiltration of effluent. There is little to no opportunity to improve the existing basins' performance because of the natural environment. Also, investing in studies to look for another location for the RI basins would be costly and would not likely identify a piece of ground that would produce significantly better results. **For that reason, releasing all effluent to the ground is not a viable option for Fernie.**

2 Reuse the treated effluent

Reusing treated effluent is an option that a number of communities have been able to implement as an alternative to discharging. It was an option that the City of Fernie explored as well.

There are a number of ways that communities are reusing their treated effluent. In British Columbia, the most common use is irrigation (for example crops and golf courses). Other possible uses in urban areas include toilet flushing, street cleaning, fire control and landscape waterfalls. Reuse regulations also allow industries, like mining, to use treated effluent in their technical processes. The construction industry is also able to use effluent for activities like soil compaction, dust control and making concrete. Treated effluent can even be used for recreational uses, such as making snow.

The City investigated whether its effluent could be used for irrigating Fernie's golf courses. While it's not a viable option now, the City would like the LWMP to reflect effluent reuse as a possibility for the future.

Depending on how it is to be reused, the effluent must meet quality standards set out by the BC Government. Uses are categorized as either restricted public access or unrestricted public access. Each has specific treatment standards based on mitigating risks to public health and the environment.

Urban Systems completed a study to assess whether effluent reuse would be a viable option for the City of Fernie. "We initially considered a number of effluent uses that might fit for Fernie, including wetlands, mining uses, and irrigating golf courses," explains Dr. Joanne Harkness, Urban Systems water and wastewater specialist. "Only irrigation of the golf course showed any potential, so we looked more closely at that option."

The evaluation concluded that the golf courses (one existing and one to be developed) would require only about 20 percent of the City's effluent and only during irrigation season. That means the City would still be in a position of finding an alternative solution for the remaining 80 percent of the effluent. The study also estimated the cost of building a pipeline to transport the effluent the eight kilometres from the sewage treatment plant to the golf courses would be approximately $3.5 million.

The study concluded that the low volumes and high costs made effluent reuse not a viable option and that it would not be worthwhile to undertake any further studies at this time.

"That is not to say that effluent reuse would never be an option for the City," explains Joanne. "In fact, it would be worthwhile to ensure that the LWMP provides for this future possibility. The LWMP is a 20-year plan, so circumstances may change making effluent reuse a viable option someday."

3 Improve effluent quality and release some of the effluent to the Elk River

The third option the City considered was the release of excess treated effluent to the Elk River during times when the RI basins cannot handle all the volume (primarily during peak wet weather times).

Effluent released to a fish bearing surface water on a regular basis must be treated to a high quality – higher than what is required to discharge to the ground. Conducting an Environmental Impact Study (EIS) was the first step in finding out if this option might be viable.

"The goal with the EIS was to identify what needs to be achieved with the treated effluent to ensure that any release to the river would not have a negative impact on public health or the environment," says Dave Cockwell, Fernie's Director of Operational Services.

The EIS was conducted by Dr. Joanne Harkness, registered professional biologist and wastewater specialist with Urban Systems. It considered the provincial and federal requirements for treated wastewater, as well as the unique conditions of the Elk River itself.

While the release to the river would only happen when the RI basins can't handle the volume, the study modelled the worst case scenario, to identify the requirements that would be necessary if all the City's treated effluent was to be released to the river.

Effluent released to a fish bearing surface water on a regular basis must be treated to a higher quality than effluent being released to the ground.

"We knew that if the effluent could meet the criteria for daily release, the impact on the river for occasional release would likely be less than what the study estimated," says Joanne.

So what did the study look at?

There are several substances of concern that are commonly found in sewage. These are treated for at the sewage treatment plant. They include:

- Carbonaceous BOD_5 and total suspended solids (organic matters)
- Ammonia
- Nitrate
- Phosphorus
- Faecal coliforms

You can read about each of these substances and the concerns they pose in the EIS study on the City's website. The Environmental Impact Study needed to answer a couple of questions, including:

- Which of these substances already exist in the river (naturally or from other sources)?
- What concentrations of these substances would the treated effluent need to achieve to meet provincial and federal requirements and mitigate any negative impact on public health or the environment?

"Through this study we found that, if the substance concentrations are maintained at the levels indicated in the EIS, we have a high degree of confidence there would be little risk of impact on the Elk River, either from an environmental or public health perspective," says Joanne. "Also, the quantity of release to the river would generally be less than the daily flow because of continued use of the RI basins. For that reason, we expect the actual situation will be even more favourable than what the study predicted, modelling a full daily release."

The EIS also recommended that the City adopt a tailor made monitoring program. The improved monitoring will identify if further upgrades are needed and a higher effluent quality maintained.

The studies indicate that improving effluent quality and releasing some of the effluent to the Elk River is the only viable option for managing the City's effluent volumes at this time.

We encourage you to review the full Environmental Impact Study on the City's website if you are interested in the details.

How Do We Deal With High I & I Now?

When I & I flows are high and the sewage treatment system is producing more treated effluent than the rapid infiltration basins can handle, the City releases some of the effluent to the Elk River.

The release is done on an emergency basis and is authorized under a permit granted by the Ministry of Environment. The approval for emergency release carries with it certain conditions. The City must:

- Receive written permission from the Ministry of Environment before the release
- Notify the Public Health Officer and Environment Canada
- Notify the community via radio and newspaper ads
- Conduct daily monitoring of the river at three locations: upstream of the outfall, at the outfall and downstream from the outfall
- Report the monitoring data to the MOE within 30 days of the end of the release

Wendy Murdoch, Environmental Protection Officer with the Ministry of Environment reviews the monitoring data for each permitted release. "The parameter levels that the City is achieving during the releases are not at a level that would have a negative impact on the receiving environment," she says. "When they must release to the river there is very little effluent in the water because it contains a lot of rainwater or snowmelt."

However, continuing to operate under the permit will no longer be an option for Fernie. The permit was established at a time when effluent flows were much less. If the flows exceed the permitted levels by 10 percent or more, which Fernie's does, the City cannot still operate under a permit.

For that reason, Fernie is developing a Liquid Waste Management Plan that will be a site specific approach to identify the best way to manage our high I &I as well as meet all provincial and federal regulations for sewage treatment.

Proposed Solution

As we've already seen, Fernie's effluent disposal process often becomes overloaded and can't manage the volumes of treated effluent it generates. When that happens, the City releases excess effluent to the Elk River (See article: How do we deal with high I & I now?).

"Because of our high inflow and infiltration and the limited capacity of the rapid infiltration basins, we need to release effluent to the river more frequently," explains Dave Cockwell, Fernie Director of Operations. "We can no longer consider this an emergency solution and it is not sustainable in the long-run. Since we know that we can't use ground discharge for all our effluent and there are no good options for reuse right now, the only other viable solution we have is to release to the river on a more regular basis."

If treated to the parameters identified in the Environmental Impact Study (EIS), the City's effluent will have low risk of negatively impacting the environment or human health.

However, another question the City needed to answer was: How do we ensure our effluent will consistently meet this high quality? The City looked at two options that would get us there.

Lagoon-Based Approach

Fernie's existing sewage treatment process consists of three aerated lagoons that treat the effluent before it is released to the rapid infiltration basins (ground). Currently, treatment occurs as the microorganisms (naturally present in the lagoons) consume substances like BOD5, TSS and ammonia during the 30 to 60 days the effluent is in the lagoons. However, to achieve the high quality effluent required for river release, the lagoons would need to be upgraded with specialized technology to provide phosphorus reduction and ultraviolet (UV) light disinfection.

"Phosphorus reduction and UV disinfection are widely used by other municipalities and are reliable methods," says Chris Town, Urban Systems Senior Wastewater Engineer. "This option would also maximize the use of the existing lagoons and no significant additional infrastructure would need to be built."

Phosphorus levels (which could cause algae growth in the river) would be reduced by adding alum. Alum reacts with phosphorus to make it settle to the bottom. As it does now, the lagoon process would continue to produce sludge (organic matter) that settles to the bottom. The lagoons are large enough that the sludge would need to be removed about every 10 to 15 years.

Mechanical (SBR) Option

Another solution that can achieve the high quality effluent is a mechanical process. In this scenario, the City would be able to use one of the existing three lagoons to settle out solids (as it does now). However, we would need to build four biological treatment tanks (called sequencing batch reactors or SBR) to reduce ammonia, carbonaceous BOD5, total suspended solids and phosphorus. Each of the tanks would accommodate about one quarter (1/4) of the flow. Disinfection would be achieved with UV light as in the lagoon option. However, the system would have a number of mechanical processes including decanting mechanisms, pumps to discharge sludge and a centrifuge to dewater solids.

The batch reactors are much smaller than the lagoons and the process happens much faster - over eight hours versus 30 to 60 days as with the lagoons. The sludge (organic matter) that accumulates in the mechanical process would need to be separated out on a daily basis and trucked away weekly.

Fernie's sewage treatment lagoons, shown here with newly installed blower lines, currently treat the effluent through 30 to 60 days of aeration. If adopted, the recommended option would see phosphorus reduction and UV disinfection added to the process.

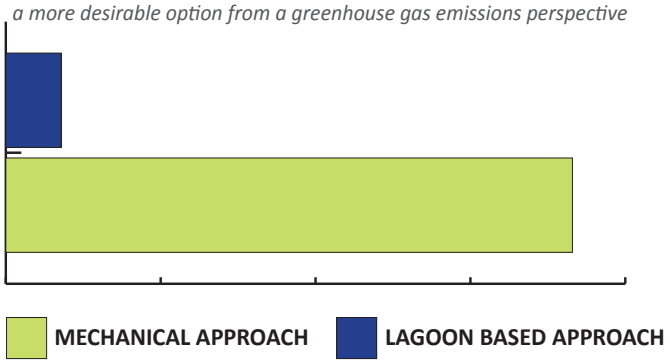
Understanding the Benefits and Costs

At the end of the day, both of the systems will produce the high quality effluent the City requires.

The mechanical process requires a smaller footprint because the tanks are much smaller than the lagoons and the effluent moves through the system much more quickly. When land availability is low, the mechanical option can be more desirable; however, because the City already has three existing lagoons operating, the smaller footprint is not a benefit in this case. Compared to the mechanical process, the lagoons are less complex, easier to operate and more robust given that they have fewer mechanical processes to maintain.

Energy Use

The lagoon option requires about nine times less electricity to operate, a more desirable option from a greenhouse gas emissions perspective



What About Meeting Future Regulations?

According to Wendy Murdoch, Environmental Protection Officer with the Ministry of Environment, both treatment options will enable the City to meet current provincial and federal standards for protecting the receiving environment.

The Environmental Impact Study (EIS) also confirmed that the lagoon option will allow the City to get in front of more stringent, emerging federal regulations.

Dr. Joanne Harkness, professional biologist and water and wastewater specialist with Urban Systems Ltd. explains: "During the EIS, we focused on the provincial regulations but also on the Federal Wastewater Systems Effluent Regulations that the government will soon be publishing. We're confident the lagoon treatment will meet the emerging requirements as well."

Adds Wendy, "The lagoon option will produce excellent quality effluent, but for about $10 million less than the mechanical process. The cost is an important factor for a small tax base like Fernie. However, they won't be compromising effluent standards for cost."

The table below shows that the capital, operating and life cycle costs of the lagoon option is approximately six times less than the mechanical option. You can see a second table that provides detail on all the evaluation factors used to assess both options on the City's website at www.fernie.ca.

Option	Capital Cost	Operating Cost	Life Cycle Cost
Lagoon Option	$ 1,253,000	$ 163,000	$ 3,678,000
SBR Option	$ 8,154,000	$ 358,000	$ 14,471,000

"We think the decision is pretty clear," says Dave. "The lagoon option gives us the same quality effluent with a much simpler process to maintain and is more cost effective for taxpayers."

Regardless of the disinfection process adopted, the City will need to also change the effluent outfall location (where the effluent meets the river water). When originally built, the outfall was located close to the river bank in a location that had much higher river flow than today. The river flow in this area has decreased significantly since then and the outfall location is no longer acceptable. To ensure the adequate mixing identified in the Environmental Impact Study is achieved, the outfall will be moved to the middle of the river. The cost of changing the outfall is approximately $200,000 and is included in the costs above.

Paying for the upgrades

In 2010, the City implemented sewer utility user fee increases for the five year period from 2010 through 2014. These increases provided allowances for the outcomes of the Liquid Waste Management Plan, including upgrades to facilities, and ongoing operation and maintenance costs. The City anticipates that the revenues from these increases will be sufficient to cover the costs of the lagoon upgrade option described above. Council is examining sewer utility funding as part of its current financial plan discussions, and will confirm this direction once they conclude these deliberations in May 2012.

Fernie's lagoon outfall will need to be moved to the middle of the river to allow proper mixing.

City of Fernie

PO Box 190
501 - 3rd Avenue
Fernie, BC, V0B 1M0

www.fernie.ca