Smart Growth on the Ground

FOUNDATION RESEARCH BULLETIN: Greater Oliver

Research compiled by:

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RAINWATER MANAGEMENT

1.0 Introduction

With 2000 hours of sunshine and only 250mm of precipitation per year, rain in Greater Oliver is an infrequent and welcome event. These refreshing moments for residents and tourists can also be a recurrent ecological disaster for the area: rainwater can erode soils and carry pollutants into sensitive waterways, ruining aquatic habitat and killing fish and other aquatic life. Rainwater management is a critical factor in the sustainable future of any community, including the arid and semi-arid communities of the Southern Okanagan.

Table 1: Precipitation in Oliver[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average (mm)	26	24.8	22.2	24.5	**37.2**	**37.2**	30.4	27.2	19.3	17.3	28	33.5	327.5
Extreme One-Day Rainfall (mm)	21	27.6	15.2	40	50.8	33.6	50	**61**	29.2	16.3	19.6	19.6	
year	1983	1994	1984	1992	1977	1982	1989	1989	1997	1956	1958	1973	

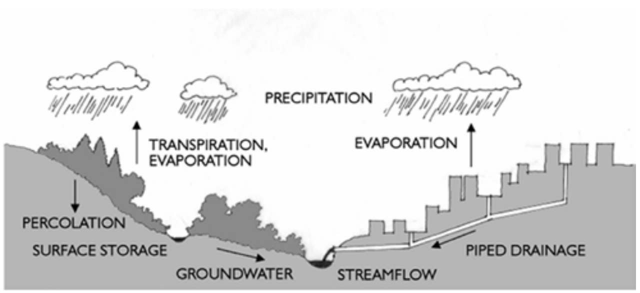

Figure 1: Rainfall before and after urbanziation.
(image by Kerry KenCairn)[5]

In a typical summer month, rainfall volume in the Greater Oliver area can easily exceed 100 million litres (26 million gallons). When this water falls on natural landscapes or well-managed agricultural lands, it recharges the groundwater or provides free irrigation for crops. When it falls on golf courses and backyards, gardens and lawns are watered. Rain that falls in the residential and commercial parts of Oliver, however, can collect pollutants from roofs and roads and quickly carry them to the nearest lake or waterway.

Unmanaged rainwater runoff disrupts the natural hydrology and dumps sediments, hydrocarbons, heavy metals, automotive fluids, nutrients, pesticides, pathogens, and unnaturally warm water into rivers, streams, and lakes.[2] The damage to receiving waters can be particularly acute in arid climates, where pollutants accumulate over a longer period of time and are then washed away by sudden and intense rain events.[3] Pollution in the Okanagan River is particularly associated with high flow volumes, which carry suspended sediments and cause higher levels of "turbidity, colour, non-filterable residue, total phosphorus and most metals".[4]

Figure 2: Permeable paving is an infiltration BMP. It is installed here in the parking lanes on a street.

Figure 3: The property and adjacent street are graded towards a rain garden.

Phosphorous is of particular concern in the Okanagan valley, where non-point source pollution such as rainwater runoff is the primary contributor.[6] Though phosphorous occurs naturally in the air and in soils, it is also found in fertilizers, manure and organic wastes, most household detergents, automotive products, and industrial products. Urban runoff tends to carry ten to fifteen times more phosphorous than undeveloped lands.[7]

2.0 Rainwater Management

The objective of stormwater management is to convey the largest anticipated volume of water away from a site as quickly as possible. By contrast, the objective of rainwater management is to preserve the pre-development quality, quantity, and flow of water leaving the development site. This can be achieved by minimizing disturbance to native soils, waterways, and vegetation, and by controlling the quality and quantity of runoff through rainwater Best Management Practices (BMPs). BMPs generally include infiltration, detention, and filtration strategies. Where the site conditions are appropriate, infiltration BMPs are considered to be the most effective for controlling flow and filtering pollutants.[8] The following table indicates preferred treatment BMPs for Oliver's arid climate.

Table 2: Recommended BMPs for Arid Climates (adapted from EWSMM [9])

Stormwater Practice	Arid Climates (<400mm)
Sand Filters	preferred
Bio-infiltration Swales	acceptable
Extended Detention Dry Ponds	preferred
Infiltration	acceptable
Wet Ponds	not recommended
Stormwater Wetlands	not recommended
Biofiltration Swales	not recommended

The Regional District's plan for the Oliver rural area includes a goal to "protect the quantity and quality of ground and surface water resources" [10], and encourages subdivision approvals to address stormwater runoff on a parcel by parcel basis.[11] The Town of Oliver OCP adds to this the specific instruction to "direct drainage discharge away from Tucelnuit lake, the Okanagan river, and oxbows, wherever possible. Storm water runoff is to be directed to containment areas or to properly designed drywell catchment facilities."[12]

In Oliver, the drywell catchment strategy (which is an infiltration BMP) is already the status quo for rainwater management.[13] Where considered necessary due to physical constraints, however, rainwater is collected to pipes and discharged to oxbows and the Okanagan River.

Figure 4: Roadside swales are BMPs commonly found in suburban and rural areas.

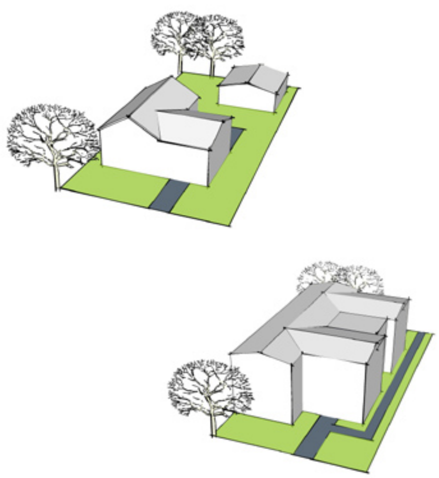

Figure 5: Residential lot coverage changes significantly at higher densities.

3.0 Oliver's Challenge

Greater Oliver is primarily developed along the Okanagan River valley, either within the historic floodplain or on the benches and gentler slopes above. The sandy loam soils in most of the valley are well-suited to infiltration strategies. Just over ten percent of the developed area (not including farmlands) is actually collected into pipes and discharged to surface waters. These areas include the downtown section of Highway 97, developments in the floodplain, and a small area below the bluffs to the northwest of downtown.

In the next thirty-five years, Oliver will intensify and possibly expand its development footprint. As roofed and paved areas increase to accommodate jobs and housing, rainwater runoff volumes will increase, and Oliver will be challenged to maintain, if not improve , its rainwater management strategy. Specifically, this challenge can be reviewed under two themes:

1. Maintain the current trend in using infiltration strategies as the primary means for rainwater management. (section 4.0)
2. Determine the need and subsequent mitigation strategies for existing and future surface water discharges. (section 5.0)

4.0 Maintaining Infiltration Strategies

4.1 The Catch Basin System

In some cases it may be necessary to retrofit the catch basin system with a quality control BMP. Pretreatment systems such as oil/water separators, sand filters, and surface infiltration facilities could reduce groundwater contamination risk where the pollutant loading is high or where the treatment capacity of subsurface soils is low. These areas would include commercial, industrial, and heavy traffic areas that are built over coarse textured soils such as gravelly sand or gravel. Catch basins are not suitable for heavily managed landscape areas such as farms and golf courses, where pesticide and fertilizer use is high. For such areas, surface infiltration strategies are recommended.[14]

4.2 Residential lots and Infill Development

Oliver's system of catch basins and its relatively large areas of permeable site coverage on residential lots help to manage the area's rainwater primarily through infiltration stategies. Except where physical constraints make it impossible, new developments are now required to infiltrate rainwater on site. This minimizes the need for more expensive drainage infrastructure and end-of-pipe structural BMPs. For most areas in the Town of Oliver, on-site infiltration can be easily achieved using simple BMPs such as rain gardens and infiltration basins.

A typical single-family residential lot and the area of adjacent street have about 40% impermeable surfaces (roofs and pavement) and 60% permeable surfaces (front and back yards). On this type of site, two-thirds of the rainfall will become runoff. On the very permeable soils that underlie most of the town, simply directing the roof leaders and driveway grading towards the yard will effectively capture this water.

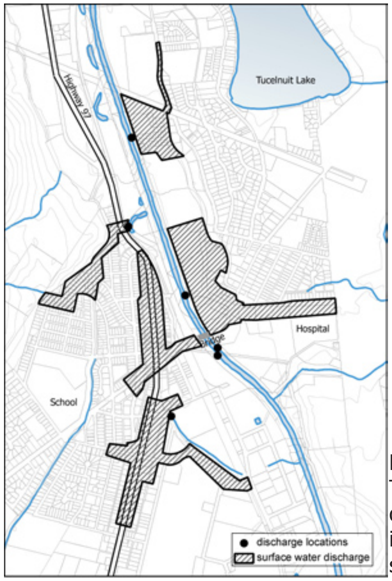

Figure 6:
Ten percent of the developed area in Oliver drains to surface waters.

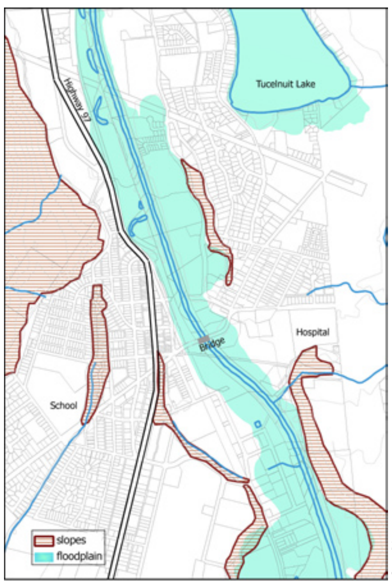

Figure 7:
Floodplains and steeply sloping areas in Oliver.

In a typical infill development scenario, this single family dwelling may be expanded into a duplex or multifamily building. In this case the roofed and paved areas would likely increase while the yard areas decrease (to approximately 70% and 30% respectively). Again, a landscaped yard could capture much of the site runoff, and a small 20 square-metre infiltration trench or 5 square-metre rain garden could easily manage all of the rainwater falling on site.[15]

4.3 Development Near Slopes and Floodplains

The floodplain and hillsides of Oliver are areas that have been considered for new and higher density development. In both cases there are specific limitations to consider for developing a rainwater management strategy.

The floodplain area naturally tends to have ground water that is closer to the soil surface: from 0.2 to 1.5 meters depth to water table seasonally. Few infiltration BMPs are considered effective where the seasonal high water table is less than 1.5 metres (5 feet) below the bottom of a constructed BMP system.[16]

On hilltops and slopes, hazardous conditions can exist where groundwater seeps down slope or where surface waters collect and run quickly downhill. Infiltration BMPs are recommended only if they can be set back 15m (50 ft) from the top of steep slopes (>15%) or at least as far back as the slope is high, and then not without a site specific assessment of the soil and slope conditions.

In both cases the conventional response would be to collect rainwater to an underground pipe system and convey it directly to the most convenient discharge opportunity, which in Oliver is typically an oxbow or the river. In a future where these oxbows and the river are still environmentally sensitive areas, or have been restored to such a condition, the runoff would require some detainment and filtering before being released. A "treatment train" composed of a conventional pipe system and rainwater BMPs such as vegetated swales, sand filters, subsurface storage, and detention ponds could provide such controls. This strategy will be described in section 5.0.

5.0 Mitigating Existing and Future Surface Water Discharges

Approximately 10% of the developed part of the town discharges rain runoff to surface waters. As noted above, it is possible that some future developments may also need to consider this option. While such a small proportion of land may seem of development. [17]

In these situations, BMPs can still be used to treat rainwater and control its flow by linking surface BMPs with subsurface piping. This treatment train can function with the net effect of discharging rainwater in a safe, clean, and environmentally sensitive way. Combinations of energy dissipaters, swales with impermeable liners, detention and settling ponds, and filtering mechanisms such as sand filters can all be built in series or parallel to piped drainage systems. In more urban areas, permeable paving can be installed over subsurface storage systems. There are also manufactured

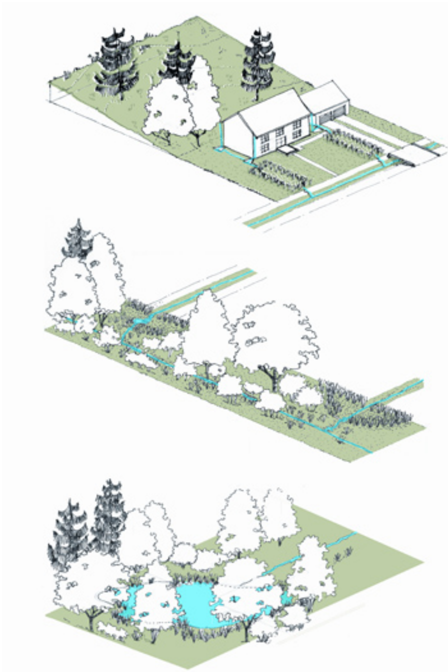

Figure 8: A treatment train includes multiple BMPs that convey, treat, and discharge rainwater.

Figure 9: This park design illustrates the integration of a detention pond (left) with other uses.

units which are designed to detain and filter runoff for small areas. Such hybrid systems require a very site specific understanding of the soil characteristics and treatment objectives.

5.1 Main Street Scenario

The downtown section of Highway 97 drains directly to two outfalls; one on the river just south of the 350th Street bridge, and the other on a small spring-fed creek adjacent to the industrial district and fruit packing plant. Runoff from a commercial area with medium traffic volumes[18] has a medium to high level of pollutant loading[19] and would require both flow control and pollutant filtering. A treatment train in this case could include BMPs at either end of a piped system.

Pre-pipe BMPs would generally be implemented on individual sites or in the street right-of-way during redevelopments. Commercial sites are mostly either roofed or paved, but if 15% of any typical site were paved with porous concrete, then most of the rainwater could be infiltrated. Larger parking areas, such as those at a grocery store, can use linear rain gardens between parking rows to capture runoff.

Post-pipe BMPs would require a series of more structural strategies, including a dry detention pond and a filtering device such as a sand filter. Play fields can often be designed to serve as an occasional detention pond. The park near the 350th Street bridge, for example, could include a 2,000 square metre (½-acre) play field/detention pond which would be a part of the treatment train. The treatment train would also include erosion control devices, a settling pond, and a sand filter.

6.0 Summary

The Town of Oliver has set a successful standard for using infiltration strategies to manage rainwater and stormwater runoff. As Oliver changes to accommodate population growth, a few variations on the existing strategy will help the town reduce its impact on the quality of its local waters and aquatic habitats. These variations include minimizing groundwater hazards with pre-infiltration treatment devices, and minimizing habitat degradation by controlling any new or existing surface discharges. The table below summarizes these strategies and provides some additional considerations.

Table 3: Design Guidelines[20]

Guideline	Example
minimize disturbance to native soils, waterways, and vegetation	follow 15-30m setback guidelines for riparian areas
use on site infiltration strategies wherever possible	direct roof leaders and pavement grading towards yards and landscaped areas
minimize contiguous impervious surfaces	use planting strips to break up large parking lots
reduce impervious surfaces where possible	minimize road and lane widths
use a treatment train where localized infiltration strategies are unsuitable	control flow and quality with on-site infiltration or at pipe-ends with sand filters and detention ponds
infiltration BMPs setbacks	30m (100 ft) :: water supply wells 30m (100 ft) :: septic systems 6m (20 ft) :: downslope from building foundations 30m (100 ft) :: upslope from building foundations 15m (50 ft) or same as slope height :: top of steep slopes 30m (100 ft) :: open water features
approximate area ratio guidelines	detention pond/drainage area: 2% porous concrete/impervious site area: 10% landscaped swale/impervious site area: minimal rain garden/impervious site area: minimal

Additional Resources

Eastern Washington Stormwater Management Manual
http://www.ecy.wa.gov/biblio/0410076.html

Water Balance Model.
www.waterbalance.ca/

Stormwater Planning, A Guidebook for British Columbia.
http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html

References

[1] Environment Canada climate data: www.climate.weatheroffice.ec.gc.ca/climate_normals
[2] from Stormwater Planning, A Guidebook for British Columbia, p1.6. BC Ministry of Land, Air, and Water Protection, May 2002. ,and, Tackling Non-Point Source Water Pollution in British Columbia: An Action PlanBC. Ministry of Water, Land and Air Protection, March 1999. website: www.env.gov.bc.ca/wat/wq/bmps/npsaction.html#2
[3] Eastern Washington Stormwater Management Manual p1.7. Washington State Department of Ecology Water Quality Program, September 2004.
[4] Wipperman, B. State of water quality of Okanagan River at Oliver, 1980-1995. Environment Canada, Ministry of Environment, Lands and Parks. 1996
from: www.env.gov.bc.ca/wat/wq/quality/okanagan/okanagan-04.htm#P191_15357
[5] image published in Girling. Where Waterworks Meet Nature. Places 10:3, 1996
[6] Tackling Non-Point Source Water Pollution in British Columbia: An Action PlanBC. Ministry of Water, Land and Air Protection, March 1999. website: www.env.gov.bc.ca/wat/wq/bmps/npsaction.html#2
[7] Ruzzo, William. Sources of Phosphorus. Cherry Creek Basin Water Authority website: www.cherrycreekbasin.org.
[8] Eastern Washington Stormwater Management Manual pp2.16 and 2.18
[9] Eastern Washington Stormwater Management Manual p5.13
[10] Oliver Rural Official Community Plan Bylaw No.2122, 2002. p12. from: www.rdos.bc.ca/index.php?id=99
[11] Oliver Rural Official Community Plan Bylaw No.2122, 2002. p41. from: www.rdos.bc.ca/index.php?id=99
[12] Town of Oliver Official Community Plan Bylaw 1070, 2003. Schedule A. p71.
from: www.oliver.ca/siteengine/ActivePage.asp?PageID=47
[13] T.R. Underwood Engineering, p2.2. Town of Oliver Developing Growth Options, November 1996.
[14] Eastern Washington Stormwater Management Manual pp5.45 to 5.50
[15] calculated using the Water Balance Model. website: www.waterbalance.ca/
[16] Eastern Washington Stormwater Management Manual p5.14
[17] Eastern Washington Stormwater Management Manual p1.4
[18] projected SADT(Summer Avg. Daily Traffic) for the year 2025 is 13,320. from: Urban Systems, pg12. South Okanagan Corridor Management Plan Draft Report. BC Ministry of Transportation, 2003.
[19] Eastern Washington Stormwater Management Manual p5.49
[20] adapted from Eastern Washington Stormwater Management Manual, pp5.14 to 5.28; and Water Balance Model

Credits

Figure 1: Kerry KenCairn
Figure 3: www.apwa.net
Figure 8: Cynthia Girling and Ron Kellett, Skinny Streets and Green Neighborhoods. Island Press, 2005.
Figure 9: www.bergerpartnership.com

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