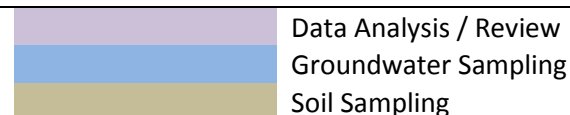




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### Chart and Summary of Environmental Studies Occurring in Hullcar Valley

Task name	Resource	Start	Finish	2016						2017		
				July	August	September	October	November	December	January	February	March
1 Integrated Monitoring Study	Inter-Min WG	28-07-2016	31-03-2017									
	Phase I - Desktop Assessment Golder	28-07-2016	30-09-2016	[Purple bar]								
	Phase II - Field Assessment Golder	30-09-2016	28-02-2017				Deep Soil	[Purple bar]		[Purple bar]		
2 Ambient Hydrogeological Network Sampling	FLNRO Dave Thomson	15-08-2016	15-10-2016		[Blue bar]	[Purple bar]						
3 Post-Harvest Nitrate Study	AGRI Dave Poon	15-09-2016	07-31-2017		[Purple bar]	Surface Soil		[Olive bar]		To May 2017 →		
4 Steele Springs Drinking Water Overflow	ENV Devan Oldfield	04-07-2014	tbd	[Blue bar]								
5 Deep Creek Monitoring	ENV Dennis Einarson	15-08-2016	30-09-2016		[Blue bar]	[Purple bar]						
6 Environmental Impact Assessments	Associated Environmental											
	Grace-Mar Farm Kampman	5-08-2016	17-11-2016				Deep Soil	Surface Soil	[Purple bar]			
	H.S. Jansen & Sons Farm Ltd. Jansen	5-08-2016	17-11-2016				Deep Soil	Surface Soil	[Purple bar]			
	Ken Regehr Farm Curtis Farm Regehr Curtis						[Blue bar]					



## Summary of Environmental Studies Occurring in Hullcar Valley

### 1. The Integrated Monitoring Study is being undertaken by the Inter-Ministry Working Group. Golder & Associates is the contractor.

The primary purpose of the proposed study is to synthesize available information to characterize and map the hydrogeology of the unconsolidated Hullcar Aquifers and further understand the water quality of these aquifers. The main study objectives are to:

- Provide a robust understanding of the hydrogeologic regime in the Hullcar area, including sources of recharge, horizontal and vertical flow directions within the aquifers, and interaction with surface water.
- Determine sources and sinks of nitrogen relevant to the study area, and the fate and transport processes such as biogeochemical transformation/attenuation that occur within the study area.
- Identify data gaps in monitoring activities for improved estimates related to the above two objectives.

The study will be conducted in two phases:

Phase I – A desktop assessment to be completed by September 30. The assessment will:

- Compile publicly available literature
- Develop a conceptual model of groundwater movement in the study area
- Compile and review available data and reports relevant to understanding the water chemistry of the aquifers and surface water
- Define extraction rates and well capture zones for community water supply wells, springs and irrigation supply wells
- Develop a water budget to understand the main factors controlling water availability to wells and springs used for water supply
- Assess and describe the nature of groundwater connectivity to surface waters
- Provide an assessment on the degree of hydraulic communication between adjacent aquifers and
- Develop a conceptual contaminant flow model

Phase II – Field assessment to be completed by February 28, 2017. The assessment will consist of:

- Field reconnaissance of potential organic and inorganic nitrate sources informed by Phase I
- Field reconnaissance, surveying and possible sampling of spring discharge locations and other areas of groundwater/surface water interactions
- Conduct additional fieldwork to characterize groundwater quality, geology, hydraulic conductivities and water level elevations



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- Confirm and further describe the nature of groundwater connectivity to surface waters through field assessment, and document the rationale supporting the characterization of connectivity between surface and groundwater
- To further characterize the relationship between depth and nitrogen concentrations, perform up to five deep soil samples (up to 3 m depth) at locations identified by Ministry staff
- Determine a mass balance of nitrate as nitrogen loading onto the aquifer
- Identify data gaps for monitoring and future contaminant flow modelling and
- Provide recommendations for options for managing groundwater quality issues of concern to help inform a management plan;

**2. Ambient Hydrogeological Network Sampling – undertaken by Ministry of Forests, Lands and Natural Resource Operations. Contact is Dave Thomson, Hydrogeologist.**

The Ambient Groundwater Quality Monitoring and Assessment Program (AGQMAP) has been carried out by the Government of British Columbia since 1985. Ambient groundwater quality monitoring is useful for establishing baseline groundwater characteristics and for investigating long-term trends or impacts to groundwater quality from human activities. This program has been sampling private wells in the Hullcar Valley since 2009. Traditionally, local wells were sampled in September of each year; however for the 2016 sampling, the time period has been shifted to mid-August. As well, the samples will be analysed for additional parameters. The results will be incorporated into the integrated monitoring study.

**3. Tracking Post-Harvest Soil Nitrate in Agricultural Fields over the Hullcar Aquifer.**

**Short title: Post-Harvest Nitrate Study – being undertaken by the Ministry of Agriculture. Contact is Dave Poon. Work to be completed by a contractor tbd.**

The purpose of the study is to better understand the distribution of fields with high levels of residual nitrate, and whether the residual nitrate is expected to be lost from agricultural fields over the winter. Secondary objectives are to provide soil test results that would be suitable to be used for nutrient management planning. This study will be completed in three phases:

Part 1: Preparation – August 2 to September 7, 2016

Part 2: Soil sampling and testing, collection of application records – September 2016 to May 2017 (contractor)

Part 3: Data analyses and report writing – December 2016 to July 2017

*Out of scope*

- Describing the nitrate leaching from non-cropped areas such as outdoor confinement areas, manure storages, and grazing or riparian areas that are not cropped



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- Describing nitrate leaching (due to over-irrigation) during the growing season
- Describing nitrogen transformations (e.g., mineralization and denitrification) that influence soil nitrate concentrations

#### **4. Steele Springs Drinking Water Overflow**

The Ministry of Environment began regular monthly sampling of the Steele Springs Drinking Water Overflow in July 2014 with the purpose of monitoring the trend of nitrates in the aquifer. All monthly sampling results are shared with Steele Springs Water Board, Inter-Ministry Working Group and, starting February 2016, incorporated in a quarterly Ministry of Environment Biologist Memo.

Starting with the June 22 sample, the Ministry of Environment increased the number of sampling parameters for the Steele Springs drinking water overflow. The additional 19 parameters will provide beneficial information to the integrated monitoring study.

#### **5. Deep Creek Monitoring**

The Ministry of Environment conducted surface water sampling of Deep Creek including a 'spring' near Deep Creek. Parameters include the 19 currently being sampled for in Steele Springs Drinking Water overflow as well as stable isotopes of oxygen, hydrogen and some for nitrogen-15. The results will be incorporated into the integrated monitoring study and uploaded to the Environmental Monitoring System.

#### **6. Environmental Impact Assessments - undertaken by the agricultural operators as required in the Pollution Abatement/Prevention Orders. Work is being completed by qualified professionals (contractors).**

Environmental impact assessments (EIA) are to be undertaken as part of the Pollution Abatement/Prevention Orders issued to Curtis Farm, Grace-Mar Farm, H.S. Janson & Sons Farm Ltd., and Ken Regehr Feedlot. The EIA must, at a minimum, assess the impact or potential impact the following operations have/may have on nitrates and other nitrogen compounds entering surface or groundwater. The EIA for the Grace-Mar Farms and H.S. Janson & Sons Farm Ltd. is currently underway and includes drilling and installing monitoring wells; conducting groundwater sampling and aquifer parameter tests; analysis of hydrogeological and groundwater data; and soil sampling. Deep soil samples will be collected in the unsaturated zone from the boreholes dug for several monitoring wells.