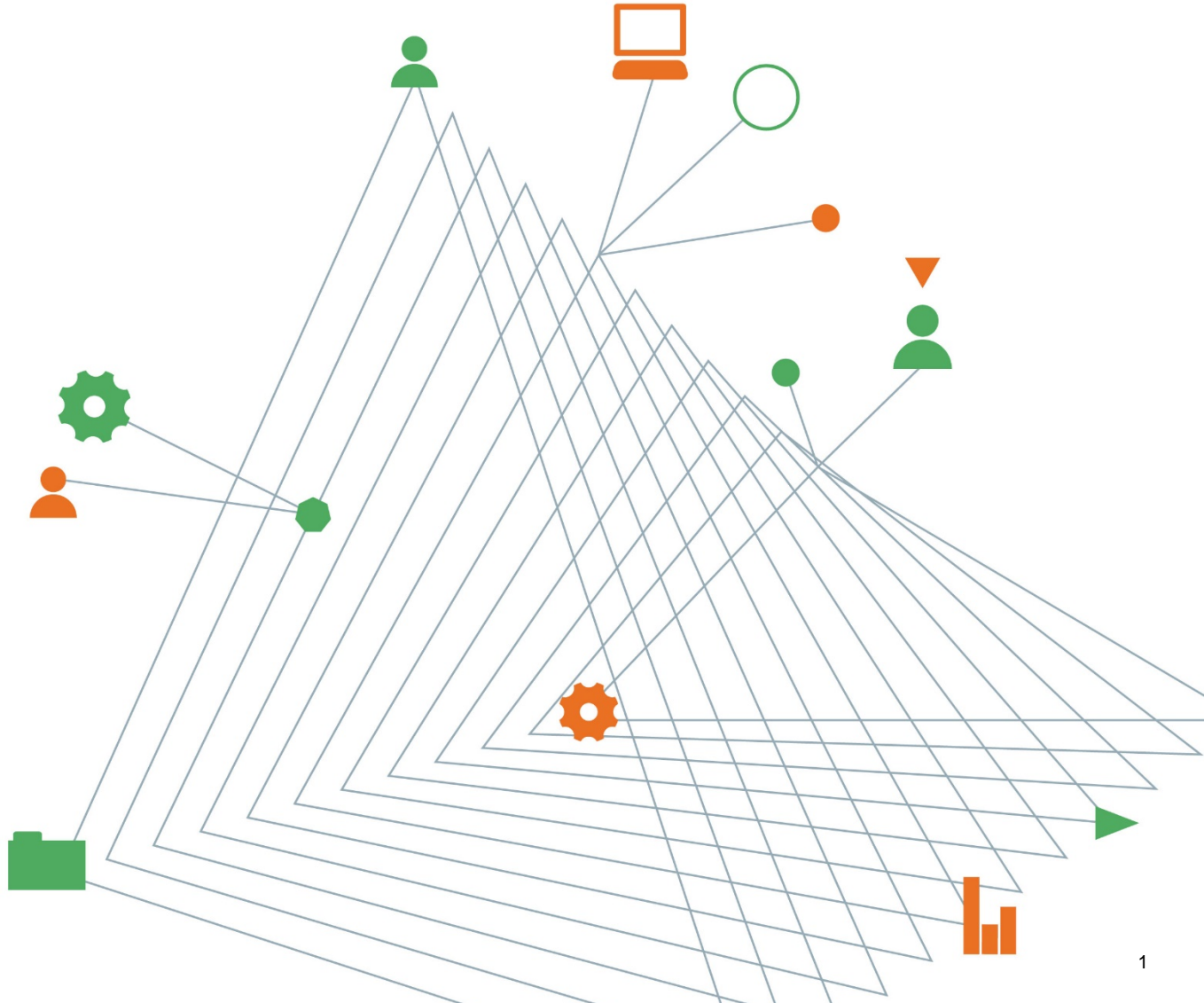


Experience  
comes to life  
when it is  
powered by  
expertise

**Karen Teague**

Fingerboards Mineral Sands Project, IAC hearings 2021



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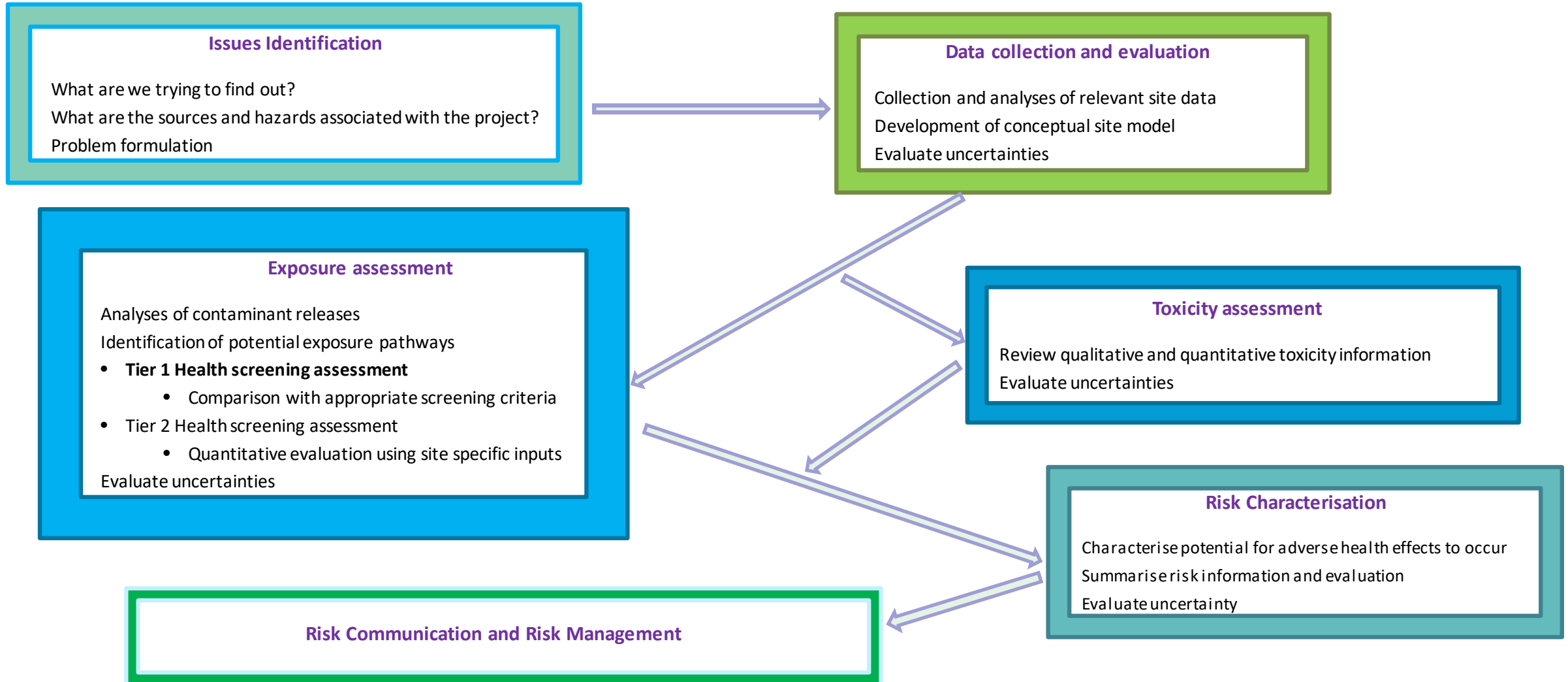
Scope of work and methodology	1
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01

# HHRA purpose, scope and methodology

- **Outline of scope**

- The scope of the HHRA includes a desktop review of relevant project reports, specialist reports and investigations conducted to date to inform the EES.
  - Compilation of the data and information collected for other EES technical studies to develop a conceptual site model.
  - Undertake a baseline evaluation of existing conditions to off-site populations associated with identified chemical and radionuclide hazards in environmental media.
  - Conduct an evaluation of potential health risks associated with predicted off-site conditions to identified off-site populations as a result of Project activities.

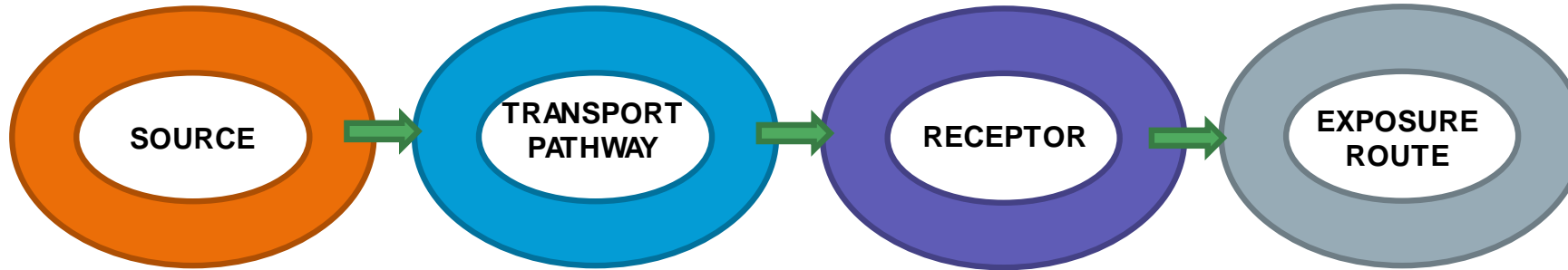


## Key studies reviewed

Related studies and data sources	Prepared by
Radiation Assessment Report	SGS Radiation Services, April 2020
Groundwater and Surface Water Impact Assessment	Coffey Services, June 2020
Stage Two Air Quality and Greenhouse Gas Assessment	Katestone Environmental. April 2020
Landform, Geology, and Soil Investigation	Landloch, April 2020
Horticultural Impact Assessment	RMCG, April 2020
Landscape Stability and Sediment Transport Regime Assessment	Water , April 2020
Land Use and Planning Impact Assessment	Matrix Planning, April 2020
Socioeconomic Impact Assessment	Coffey Services, May 2020
Geochem Testing of Fingerboard Tailings and Overburden - Preliminary Report	Environmental Geochemistry International, April 2020
Rainwater Tank Report	Ventia, October 2019

# 02

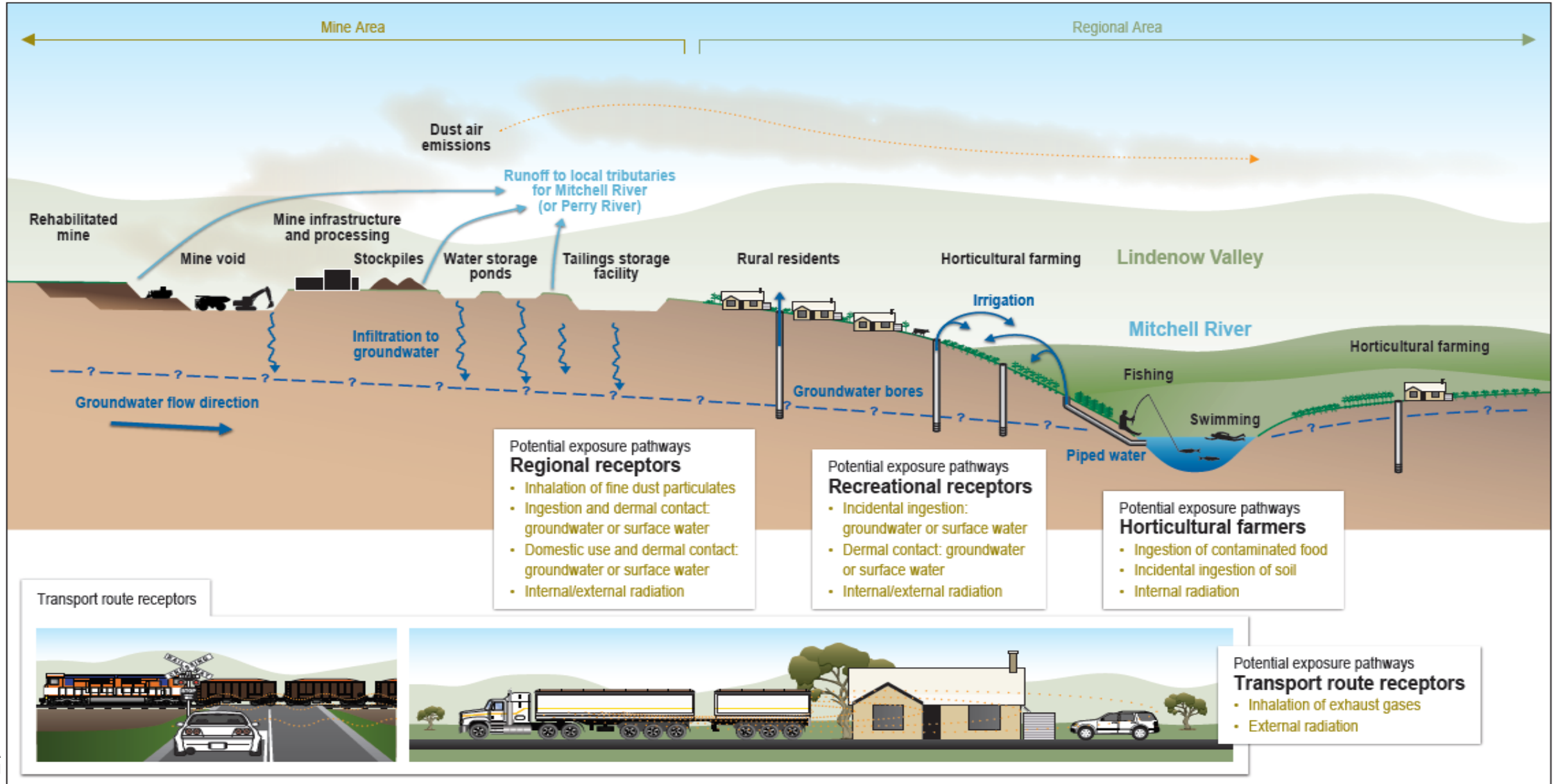
## Development of the conceptual site model



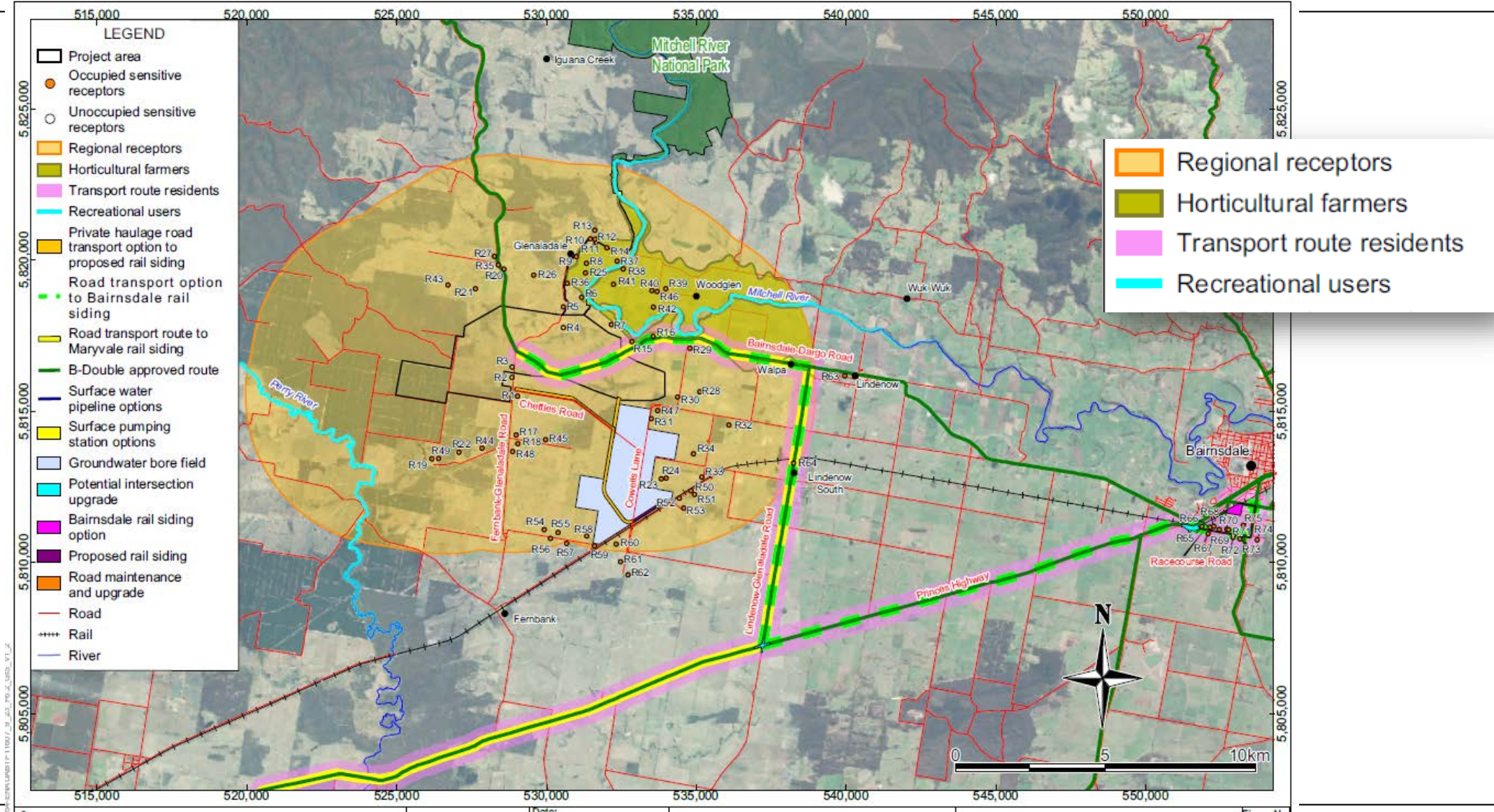
- **Source:** Project area construction, operations, processes and related activities. Identification of chemicals of potential concern (COPC)
- **Transport pathways:** The fate and transport of contaminants once released from the source. This is usually via wind, water, sediments, soil, food etc.
- **Receptors:** The point of exposure will depend on where the receptor is located.
- **Exposure route:** Once the source-pathway-receptor linkages have been identified, the potential direct and indirect routes of exposures can be determined. The route of exposure describes how a contaminant enters the body either via ingestion, inhalation or dermal contact.



# Conceptual site model: Potential receptors and exposure pathways



# Receptor populations of concern



03

# Outcomes of the baseline HHRA



Media	Contaminant	Relevant receptors in Off-site Areas	Average concentration	Maximum concentration	Relevant report
Fine particulate matter	PM <sub>10</sub>	Regional residents	Below criteria	Below criteria	Air quality assessment: Katestone 2020
	PM <sub>2.5</sub>		Below criteria	Below criteria	
	Respirable crystalline silica <sup>(1)</sup>		Below criteria	Below criteria	
	Metals		Below criteria	Below criteria	
	Radionuclides		No exceedances		
Dust	Deposition	Below criteria	NA		
Exhaust gases	NO <sub>2</sub> , SO <sub>2</sub>	Transport route residents	Below criteria		
		Regional residents	Below criteria		
Ambient air	Radiation	Transport route residents	Within background levels		Radiation assessment: SGS, 2020
		Regional residents			

1. Measured as PM<sub>2.5</sub>.

Media	Contaminant	Relevant receptors in Off-site Areas	Average concentration	Maximum concentration	Relevant report
Topsoil – regional area	Metals	Regional residents	Below criteria		Soil assessment: Landloch, 2020
	Radionuclides		Within average global range		Radiation assessment: SGS, 2020
Crops	Radionuclides <sup>(1)</sup>	Horticultural farmers	Within global average intake range		Radiation assessment: SGS, 2020
Sediment	Metals	Recreational users	Below criteria		Sediment assessment: Water Technology, 2020

1. Based on a quantitative assessment undertaken by SGS (2020)

# Health baseline assessment – Surface water, groundwater and tank water

Media	Contaminant	Relevant receptors in Off-site Areas	Average concentration	Maximum concentration	Relevant report
Surface water	Metals	Regional residents	Below criteria	4 exceedances <sup>(1)</sup>	Surface water assessment: Coffey, 2020
		Recreational users	Below criteria		
	Radionuclides	Regional residents	Below criteria		Radiation assessment: SGS, 2020
		Recreational users	Below criteria		
Harvested rainwater	Metals	Regional residents	Below criteria		Ventia, 2019
	Radionuclides		Below criteria		
Groundwater	Metals	Regional residents	2 exceedance <sup>(2)</sup>	4 exceedances <sup>(3)</sup>	Groundwater assessment: Coffey, 2020
		Recreational users	Below criteria	1 exceedance <sup>(4)</sup>	
	Radionuclides	Regional residents	Below criteria		Radiation assessment: SGS, 2020
		Recreational users	Below criteria		

1. Arsenic, chromium, lead and manganese.
2. Manganese and nickel.
3. Arsenic, cadmium, manganese and nickel.
4. Nickel.

# 04

## Outcomes of the predicted HHRA

# Predicted health assessment - Air

Media	Contaminant	Relevant receptors in Off-site Areas	Construction	Operations / Rehabilitation	Relevant report
Fine particulate matter	PM <sub>10</sub>	Regional residents	Additional management measures may be required on days where meteorological conditions indicate a greater potential for dust migration.		Air quality assessment: Katestone 2020 Additional air quality modelling: Katestone Feb 2021
	PM <sub>2.5</sub>		Below criteria	Below criteria	
	Respirable crystalline silica <sup>(1)</sup>		Below criteria	Below criteria	
	Metals		Below criteria	Below criteria	
	Radionuclides		Low and acceptable		
Dust	Deposition		Low and acceptable		
Exhaust gases	NO <sub>2</sub> , SO <sub>2</sub>	Transport route residents	Negligible		
		Regional residents	Negligible		
Ambient air	Radiation	Transport route residents	Negligible		Radiation assessment: SGS 2020
		Regional residents	Negligible		

1. Measured as PM<sub>2.5</sub>.



# Predicted health assessment – Soil, crops and sediment

Media	Contaminant	Relevant receptors in Off-site Areas	Construction	Operations / Rehabilitation	Relevant report
Topsoil – regional area	Metals	Regional residents	Not evaluated	Not evaluated	Not applicable
	Radionuclides		Not assessed	Low and acceptable post rehabilitation	Radiation assessment: SGS 2020
Crops	Radionuclides <sup>(1)</sup>	Horticultural farmers	Low and acceptable		Radiation assessment: SGS 2020

1. Based on a quantitative assessment undertaken by SGS (2020)

# Predicted health assessment – Surface water, groundwater and tank water

Media	Contaminant	Relevant receptors in Off-site Areas	Construction phase	Operations / Rehabilitation	Relevant report
Surface water	Metals	Regional residents	Low and acceptable		Surface water assessment: Coffey 2020
		Recreational users	Low and acceptable		
	Radionuclides	Regional residents	Low and acceptable		Radiation assessment: SGS 2020
		Recreational users	Low and acceptable		
Tank water	Metals	Regional residents	Negligible		HHRA report: Coffey 2020
	Radionuclides		Negligible		
Groundwater	Metals	Regional residents	Low and acceptable		Groundwater assessment: Coffey 2020
		Recreational users	Low and acceptable		
	Radionuclides	Regional residents	Low and acceptable		Radiation assessment: SGS 2020
		Recreational users	Low and acceptable		

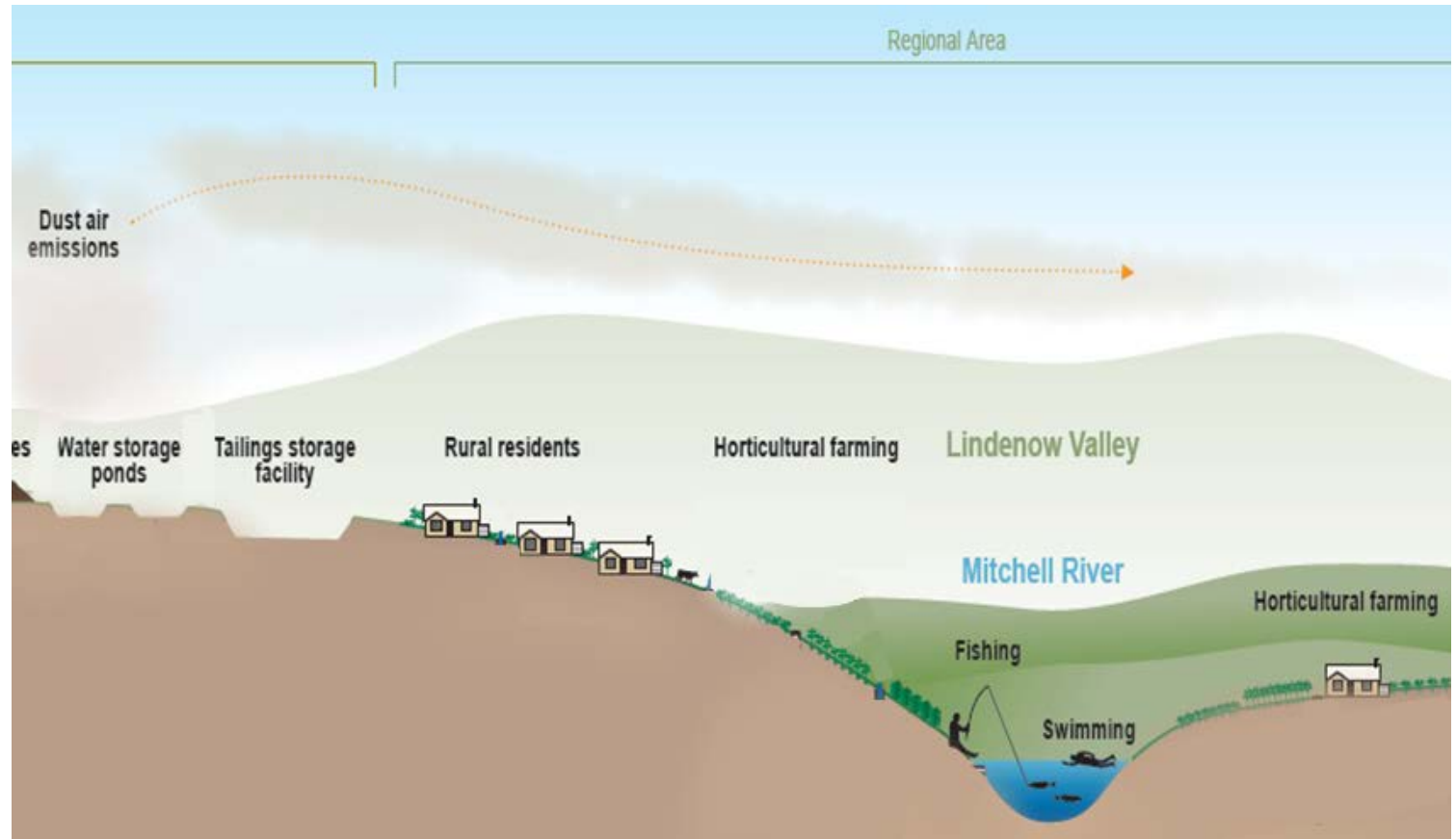
# 05

## Key issues

Receptors were identified based on:

- The CSM and the potential transport pathways of contaminants released by the project activities
- Sensitive receptor settings were identified based on location.
  - Airborne contaminants assumed to be in higher concentrations closer to the source due to dispersion and fallout processes with distance.
- Sensitive receptors may include young children, older people and people with chronic health conditions.
- Young children considered to be the more sensitive given:
  - Potential for greater intakes per body weight
  - Potential for developmental health effects
  - Present in rural residential, recreational and horticultural settings
  - Exposure periods greater in a residential setting than in school, kindergarten or child care settings.

- Selected sensitive receptors:
  - Young children in a residential
  - Adult worker in an agricultural setting
- Quantitative assessment of potential exposures associated with dust deposition on:
  - Crops
  - Livestock (beef and dairy cattle) pastures.
  - Soil
- Quantitative assessment of potential exposures associated with airborne dust



## Metals and metalloids in dust fallout:

- Rainwater tanks and dams
  - Quantitatively assessed based on conservative assumptions likely to overestimate concentrations in tank/dam water.
- Woodglen water storage dam
  - Treated via dissolved air floatation and filtration (DAFF) water treatment process before water is released to customers
- Crops and pasture
  - Radionuclides in soil and crops quantitatively addressed in the Radiation Assessment report.

- **Contaminants of potential concern**

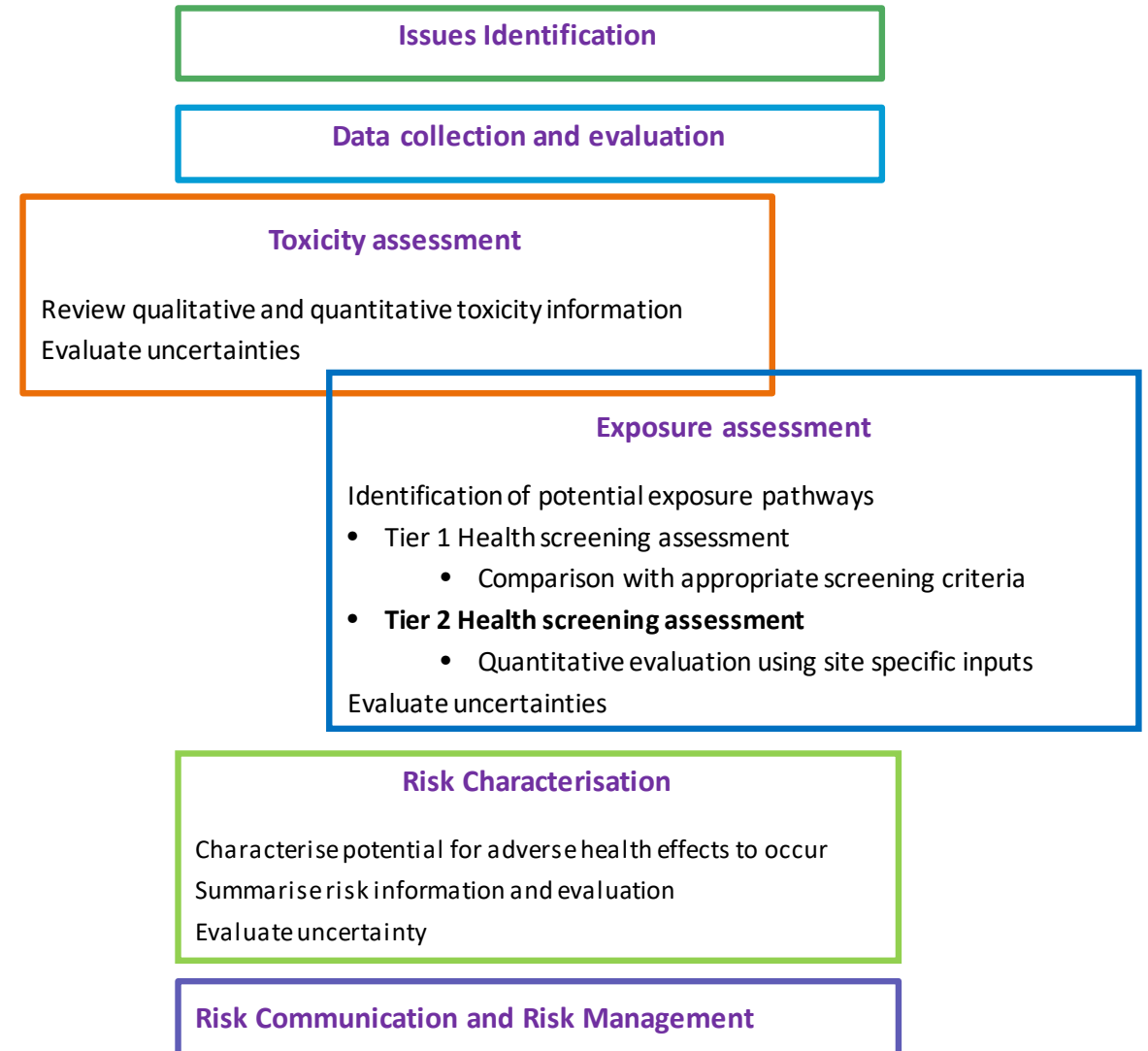
- Metals and metalloids identified in Air Quality modelling.

- **Toxicity assessment**

- Classified as to carcinogenicity according to the NEPM process.
- Toxicity reference values were selected from NEPM or USEPA sources where available or extrapolated.
- Identified bioavailability adjustments and background exposures

- **Exposure assessment**

- The exposure pathways quantitatively assessed are:
  - Consumption of beef and milk from livestock raised in the regional area, that may have ingested impacted pasture, soil or inhaled particulates associated with Project activities.
  - The deposition of dust on crops and soil associated with dust fallout, translocation via roots and the subsequent ingestion of crops by sensitive receptor populations.
  - Incidental ingestion of impacted soil as a result of dust deposition.
  - Inhalation of contaminants in airborne particulates.



- **Exposure assessment**

- Point of exposure estimates:
  - Soil concentration at the end of mine lifetime
  - Contaminant of concern (COPC) concentration deposited on edible produce and pasture
  - COPC concentration via root translocation
  - Total concentration in edible crop or pasture
  - Estimation of chronic daily intakes via inhalation by cattle
  - Total concentration in animal product (beef or milk)
  
- Receptor estimation of chronic intakes of COPCs associated with:
  - incidental soil ingestion
  - consumption of local crops
  - ingestion locally raised cattle products (beef & dairy milk)
  - inhalation of respirable particulates



- **Uncertainty assessment**

- Toxicity reference values generally based on NOAEL, include safety factors.
- Chemical composition of the COPC relevant to site.
- Uptake factors and transfer factors.
- Exposure assumptions
  - ie assumes exposed to same air concentration for 8 hours/day, 365 days/year for over a 20–30 year period.
- Maximum COPC concentrations modelled.

- **Risk characterisation**

- Potential health risks to receptor populations are considered to be low and acceptable where:
  - chronic exposures to individual contaminants are via multiple exposure pathways.
  - chronic exposures are via multiple exposure pathways and multiple COPCs.