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 Kilometres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56

**O**

**LEGEND**

- HMAS Creswell / JBRF Boundary
- Major Waterways
- Water Bodies
- Drainage Areas
- Contours
- Groundwater sample
- Surface Water sample

**DRAFT**



Department of Defence  
 HMAS Creswell and Jervis Bay Range Facility

Job Number 21-26171  
 Revision A  
 Date 18 Jul 2017

Concentration plan for 6:2 Fluorotelomer Sulfonate (6:2 FTS)  
 - Surface Water and Groundwater

Figure D

G:\UT0817\GIS\Maps\Deliverables\21\_26171\_2013\_Concentrations\_62FTS\_Water.mxd  
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**LEGEND**

- HMAS Creswell / JBRF Boundary
- Contours
- Water Bodies
- Concrete sample
- Drainage Areas
- Soil sample
- Major Waterways
- Sediment sample

0 50 100 200 300 400 500 600 700 800  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1984  
Grid: GDA 1994 MGA Zone 56

**GHD DRAFT**

Department of Defence  
HMAS Creswell and Jervis Bay Range Facility  
Concentration contour plan for Perfluorooctanoic acid (PFOA)  
- Soil and Sediment

Job Number | 21-26171  
Revision | A  
Date | 07 Aug 2017

Figure E

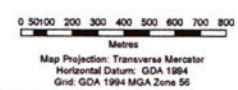
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Date source: Imagery - Land and Property Information (2017); Streets, Waterways, Contours - NSW LPI 2015 DTDB; Contours - NSW LPI 2016; Created by:mwebster



- LEGEND**
- HMAS Creswell / JBRF Boundary
  - 403 AREA
  - Water Bodies
  - Drainage Areas
  - Major Waterways
  - Contours
  - A Groundwater sample
  - + Surface Water sample



Department of Defence  
 HMAS Creswell and Jervis Bay Range Facility  
 Concentration plan for PFOA -  
 Surface Water and Groundwater

Job Number 21-26171  
 Revision A  
 Date 07 Aug 2017

Figure F

G:\110617\NSR\Map\Deliverables\21\_26171\_2015\_Concentrations\_PFOA\_Water\_PORTRAIT.mxd  
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 Data source: Imagery - Land and Property Information (2017); Streets, Waterways, Contours - NSW LPI 2015 DTDB; Contours - NSW LPI 2016. Created by mweber  
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**Appendix B – Preliminary human health exposure parameters**

Human Health Exposure Parameters - Adult Resident Jervis Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	4	29	The mean and 95th percentile duration of residence are 10 years and 35 years, respectively. It is assumed that residence times begin at birth and first 6 years based on child exposure scenario.	enHealth (2012)
Averaging time (non-carcinogens)	year	4	29	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	365	365	Indicated from the Water Use Survey	Professional Judgement
Surface water intake rate	L/day	0.5	1	The lifetime average daily intake of water by most Australians is 2 litres per day, while a reasonable intake of water for individuals undertaking moderate activity in temperate climates is 5 litres per day (enHealth, 2012). The results of the water use survey supplied to the community indicated that individuals drink or used to drink from creeks and streams in the area. It is assumed that 20% of total daily drinking water is consumed from surface water (rounded up to half a litre for the typical estimate).	enHealth (2012); Professional judgement
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	60	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per enHealth (2012).	enHealth (2012)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface area of exposed skin	cm <sup>2</sup>	--	--	Not an applicable pathway	
Sediment to skin adherence factor	mg/cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	21	19	Due to the temperate climate in the area, it is anticipated that more time will be spent outdoors by residents at this location than the general population. As such, indoor values represent the remaining amount of time in a day after outdoor hours have been subtracted.	Professional judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	3	5	enHealth recommends 3 hours/day as the average time spent outdoors for Australians, based upon the 2006 Time Use Survey by the Australian Bureau of Statistics. The upper estimate was selected from USEPA (2011), which reports a mean of 281 minutes/day (4.7 hours/day) spent outdoors for individuals aged 18-64. This value has been rounded up to 5 hours/day.	enHealth (2012), USEPA (2011), Professional Judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.90E+10	2.90E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. Value for low density dwellings selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Domestic food and drink preparation and clean up</b>					
Exposure frequency	days/year	6	12	Based on water use survey results. Most survey results indicate that this practice no longer occurs (i.e., occurred historically), however some individuals identified water features being utilized for making tea or cooking (mostly around Lake McKenzie). Most results indicate water is used from these sources occasionally (i.e. less than once per month). Therefore, the typical estimate assumes usage bi-monthly, while the upper estimate assumes usage once per month.	Water Use Survey, Professional judgement
Activity Duration	hours/day	0.8	1.12	Typical value based upon the average time for all persons (48 minutes). The upper estimate is the average participant time spent (67 minutes).	enHealth (2012)
Water ingestion rate	L/hour	0.005	0.24	Potable water intake value includes water used in food preparation, however an allowance has been made for incidental ingestion of water during cooking activities. The upper estimate assumes individuals prepare and drink one cup of tea (240 mL).	Professional Judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2880	2400	Based upon hands and forearms.	enHealth; Professional judgement

Human Health Exposure Parameters - Adult Resident Jervis Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	212	365	Per the Australian Bureau of Statistics (2014), 58.1% of persons over 19 years of age consumed fruit the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that fruit may not be consumed every day, and as such, the typical value adopted represents 58% of days in a year, while the upper estimate assumes fruit is eaten daily.	ABS (2014), Professional judgement
Exposure frequency - vegetables	days/year	282	365	Per the Australian Bureau of Statistics (2014), 77.2% of persons over 19 years of age consumed vegetables the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that vegetables may not be consumed every day, and as such, the typical value represents 77.2% of days in a year, while the upper estimate assumes vegetables are eaten daily.	ABS (2014), Professional judgement
Consumption rate - green vegetables	g/day	16.9	153.4	Typical value is the mean daily food intake for cabbage and leaf and stalk vegetables, combined. The upper estimate is the recommended value per NEPM (2013).	ABS (2014), NEPM (2013)
Consumption rate - root vegetables	g/day	14.7	50.4	Typical value is the mean daily food intake for carrots and root vegetables by individuals >19 years of age. The upper estimate is the median daily food intake for carrots and root vegetables by individuals >19 years of age.	ABS (2014)
Consumption rate - tuber vegetables	g/day	46.3	122.1	Typical value is the mean daily food intake for potatoes by individuals >19 years of age. The upper estimate is the median daily food intake for potatoes by individuals >19 years of age.	ABS (2014)
Consumption rate - fruit	g/day	140	190.6	The typical value is the recommended fruit consumption value per enHealth (2012), and is less than the mean value reported by ABS (2014). The median value for consumers >19 years of age is used as the upper estimate.	enHealth (2012), ABS (2014)
<b>Percentage of total fruit and vegetable ingestion for subgroups</b>					
Green vegetables	percent	59	59	Table 7, Schedule B7	NEPM 2013
Root vegetables	percent	18	18	Table 7, Schedule B7	NEPM 2013
Tuber vegetables	percent	23	23	Table 7, Schedule B7	NEPM 2013
Tree fruit	percent	100	100	Table 7, Schedule B7	NEPM 2013
Fraction of home grown produce - fruit	unitless	0.1	0.5	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
Fraction of home grown produce - vegetables	unitless	0.3	0.75	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Child Resident Jervis Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	17	15	The typical estimate is based upon the 95th percentile value for 2-3 year old males and females combined. The upper estimate is the average weight of 2-3 year old male and females combined.	enHealth (2012)
Exposure duration	year	6	6	The mean and 95th percentile duration of residence are 10 years and 35 years, respectively. It is assumed that residence times begin at birth.	enHealth (2012)
Averaging time (non-carcinogens)	year	6	6	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	7000	6100	Total skin surface area for males and females combined (based on 2-3 year old).	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	994	866.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	2695	2348.5	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	826	719.8	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	371	323.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	1624	1415.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	497	433.1	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	2100	1800	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	365	365	Professional Judgement	Professional Judgement
Surface water intake rate	L/day	0.1	0.2	The recommended mean and 95th percentile drinking water ingestion rates for children aged 2-3 are 0.36 and 0.91 L/day, respectively (enHealth, 2012). Ingestion of surface water by children may occur, however it is assumed that surface water will account for less than 20% of total drinking water intake.	enHealth (2012); Professional judgement
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	100	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per enHealth (2012).	enHealth (2012)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface area of exposed skin	cm <sup>2</sup>	--	--	Not an applicable pathway	
Sediment to skin adherence factor	mg/cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	22	20	Due to the temperate climate in the area, it is anticipated that more time will be spent outdoors by residents at this location than the general population. As such, indoor values represent the remaining amount of time in a day after outdoor hours have been subtracted.	Professional judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	4	enHealth recommends 2 hours/day as the average time spent outdoors for children aged 2-3. The upper estimate is based on professional judgement.	enHealth (2012), USEPA (2011), Professional Judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.90E+10	2.90E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. Value for low density dwellings selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Domestic food and drink preparation and clean up</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway for children < 6 years of age.	
Activity Duration	hours/day	--	--	Not an applicable pathway for children < 6 years of age.	
Water ingestion rate	L/hour	--	--	Not an applicable pathway for children < 6 years of age.	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway for children < 6 years of age.	
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Child Resident Jervis Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	307	365	Per the Australian Bureau of Statistics (2014), 84% of children between 2 and 3 years old consumed fruit the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that fruit may not be consumed every day. As such, the typical value represents 84% of days in a year, while the upper estimate assumes fruit is eaten daily.	ABS (2014), Professional judgement
Exposure frequency - vegetables	days/year	246	365	Per the Australian Bureau of Statistics (2014), 67.4% of children between 2 and 3 years old consumed vegetables the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that vegetables may not be consumed every day. As such, the typical value represents 67.4% of days in a year, while the upper estimate assumes vegetables are eaten daily.	ABS (2014), Professional judgement
Consumption rate - green vegetables	g/day	25.1	55	Due to uncertainty surrounding the mean and median values provided by ABS (2014) for green vegetables, the average of the mean (5.9 g/day) and median (44.3 g/day) values for cabbage and leaf and stalk values is used as the typical estimate. The upper estimate is the recommended value per NEPM (2013).	ABS (2014), NEPM (2013)
Consumption rate - root vegetables	g/day	8.7	37.2	Typical value is the mean daily food intake for carrots and root vegetables for children aged 2-3. The upper estimate is the median daily food intake for carrots and root vegetables by children aged 2-3.	ABS (2014)
Consumption rate - tuber vegetables	g/day	20.6	122.1	Typical value is the mean daily food intake for potatoes by children aged 2-3. The upper estimate is the recommended value per NEPM (2013).	ABS (2014), NEPM (2013)
Consumption rate - fruit	g/day	172.4	180	The typical value is the mean value reported by ABS (2014). The upper estimate is the recommended fruit consumption value per NEPM (2013).	enHealth (2012), ABS (2014)
<b>Percentage of total fruit and vegetable ingestion for subgr</b>					
Green vegetables	percent	55	55	Table 7, Schedule B7	NEPM 2013
Root vegetables	percent	17	17	Table 7, Schedule B7	NEPM 2013
Tuber vegetables	percent	28	28	Table 7, Schedule B7	NEPM 2013
Tree fruit	percent	100	100	Table 7, Schedule B7	NEPM 2013
Fraction of home grown produce - fruit	unitless	0.1	0.5	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
Fraction of home grown produce - vegetables	unitless	0.3	0.75	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	



Human Health Exposure Parameters - Adult Resident Wreck Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	4	72	Per enHealth (2012), the mean and 95th percentile duration of residence are 10 years and 35 years, respectively. However, in the case of the Indigenous Wreck Bay community, it is conservatively assumed that individuals may spend their entire lives in the region. This is reflected in the upper estimate value. It is assumed that residence times begin at birth. However, regardless of this assumption, number of years does not affect calculations in non-carcinogenic risk calculations.	enHealth (2012); Professional judgement
Averaging time (non-carcinogens)	year	4	72	Same as exposure duration.	enHealth (2012); Professional judgement
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	365	365	Indicated from the Water Use Survey	Professional Judgement
Surface water intake rate	L/day	0.5	1	The lifetime average daily intake of water by most Australians is 2 litres per day, while a reasonable intake of water for individuals undertaking moderate activity in temperate climates is 5 litres per day (enHealth, 2012). The results of the water use survey supplied to the community indicated that individuals drink or used to drink from creeks and streams in the area. It is assumed that 20% of total daily drinking water is consumed from surface water (rounded up to half a litre for the typical estimate).	enHealth (2012); Professional judgement
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	60	180	Typical estimate assumes pregnant woman consumes clay/sediment over two months of her pregnancy. Upper estimate determined by assuming pregnant women consume clay/sediment each day for six months of their pregnancies.	Ogallo (2008); Professional judgement
Years (number of pregnancies)	years	2	4	Average number of children per family in the Jervis Bay area is 1.9 (rounded up to two).	ABS 2016 Census; Professional judgement
Daily sediment ingestion rate	mg/day	50000	80000	50 grams/day is estimated by US EPA and adopted by enHealth for individuals with soil-pica or geophagic behaviour. The upper estimate of 80 grams is the upper end of the mean daily soil intake for pregnant Kenyan women, reported per Luoba et al. 2004, and referenced in enHealth (2012).	enHealth (2012); Luoba et al. 2004; Professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Based upon the community survey and to provide a conservative estimate, all clay ingested is expected to come from affected sources.	Professional judgement
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	60	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per enHealth (2012).	enHealth (2012)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	14	27	Assumed to be equal to the number of days using clay and sediments as sunscreens or during cultural ceremonies.	Professional judgement
Daily sediment ingestion rate	mg/day	50	60	Assumed to be equal to incidental soil ingestion values	enHealth (2012); Professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Based upon the community survey and to provide a conservative estimate, all clay is expected to come from affected sources.	Professional judgement
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	14	27	Upper estimate assumes sunscreen is used when temperature exceeds 28°C (15 days/year), and used for traditional ceremonies once per month. Typical estimate is half this value.	Bureau of Meteorology, Jervis Bay (Point Perpendicular AWS, data from 2001-2017; accessed 21 Sept 2017); Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	4313	16488	Typical estimate assumes sunscreen is applied to forearms, lower legs, and face (assumed to be 25% of head surface area). Upper estimate assumes sunscreen is applied to lower legs, trunk, arms, and face (25% of head surface area). Surface area averaged for males and females.	enHealth (2012)
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)

Human Health Exposure Parameters - Adult Resident Wreck Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	21	19	Due to the temperate climate in the area, it is anticipated that more time will be spent outdoors by residents at this location than the general population. As such, indoor values represent the remaining amount of time in a day after outdoor hours have been subtracted.	Professional judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m3/kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	3	5	enHealth recommends 3 hours/day as the average time spent outdoors for Australians, based upon the 2006 Time Use Survey by the Australian Bureau of Statistics. The upper estimate was selected from USEPA (2011), which reports a mean of 281 minutes/day (4.7 hours/day) spent outdoors for individuals aged 18-64. This value has been rounded up to 5 hours/day.	enHealth (2012), USEPA (2011), Professional Judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m3/kg	2.90E+10	2.90E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. Value for low density dwellings selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Domestic food and drink preparation and clean up</b>					
Exposure frequency	days/year	6	12	Based on water use survey results. Most survey results indicate that this practice no longer occurs (i.e., occurred historically), however some individuals identified water features being utilized for making tea or cooking (mostly around Lake McKenzie). Most results indicate water is used from these sources occasionally (i.e. less than once per month). Therefore, the typical estimate assumes usage bi-monthly, while the upper estimate assumes usage once per month.	Water Use Survey, Professional judgement
Activity Duration	hours/day	0.8	1.12	Typical value based upon the average time for all persons (48 minutes). The upper estimate is the average participant time spent (67 minutes).	enHealth (2012)
Water ingestion rate	L/hour	0.005	0.24	Potable water intake value includes water used in food preparation, however an allowance has been made for incidental ingestion of water during cooking activities. The upper estimate assumes individuals prepare and drink one cup of tea (240 mL).	Professional judgement enHealth; Professional judgement
Exposed skin surface for water contact	cm2	2880	2400	Based upon hands and forearms.	Professional judgement
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm2	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm2	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm2	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm2	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	4	7	Exposure frequencies assumed to be half those for children. Upper estimate based upon the number of days with greater than 10 mm of rainfall during months where the temperature is above 22° C (November - March; 14 days). Typical estimate is based upon half that value (7 days), assuming activity does not occur after each rainfall, and assuming that not all rainfall events result in enough pooled water for wading.	Bureau of Meteorology, Jervis Bay (Point Perpendicular AWS, data from 2001-2017; accessed 21 Sept 2017); Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Recommended incidental water ingestion value for swimming halved as sitting in pooled water is not expected to be a fully immersive activity.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm2	10450	8550	Exposed skin assumed to be lower extremities and hands, averaged for males and females.	Professional judgement; enHealth (2012)

Human Health Exposure Parameters - Adult Resident Wreck Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	212	365	Per the Australian Bureau of Statistics (2014), 58.1% of persons over 19 years of age consumed fruit the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that fruit may not be consumed every day. As such, the typical value represents 58% of days in a year, while the upper estimate assumes fruit is eaten daily.	ABS (2014), Professional judgement
Exposure frequency - vegetables	days/year	282	365	Per the Australian Bureau of Statistics (2014), 77.2% of persons over 19 years of age consumed vegetables the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that vegetables may not be consumed every day. As such, the typical value represents 77.2% of days in a year, while the upper estimate assumes vegetables are eaten daily.	ABS (2014), Professional judgement
Consumption rate - green vegetables	g/day	16.9	153.4	Typical value is the mean daily food intake for cabbage and leaf and stalk vegetables, combined. The upper estimate is the recommended value per NEPM (2013).	ABS (2014), NEPM (2013)
Consumption rate - root vegetables	g/day	14.7	50.4	Typical value is the mean daily food intake for carrots and root vegetables by individuals >19 years of age. The upper estimate is the median daily food intake for carrots and root vegetables by individuals >19 years of age.	ABS (2014)
Consumption rate - tuber vegetables	g/day	46.3	122.1	Typical value is the mean daily food intake for potatoes by individuals >19 years of age. The upper estimate is the median daily food intake for potatoes by individuals >19 years of age.	ABS (2014)
Consumption rate - fruit	g/day	140	190.6	The typical value is the recommended fruit consumption value per enHealth (2012), and is less than the mean value reported by ABS (2014). The median value for consumers >19 years of age is used as the upper estimate.	enHealth (2012), ABS (2014)
<b>Percentage of total fruit and vegetable ingestion for subgroups</b>					
Green vegetables	percent	59	59	Table 7, Schedule B7	NEPM 2013
Root vegetables	percent	18	18	Table 7, Schedule B7	NEPM 2013
Tuber vegetables	percent	23	23	Table 7, Schedule B7	NEPM 2013
Tree fruit	percent	100	100	Table 7, Schedule B7	NEPM 2013
Fraction of home grown produce - fruit	unitless	0.1	0.5	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
Fraction of home grown produce - vegetables	unitless	0.3	0.75	Based on water use survey results for individuals identifying home grown produce.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Child Resident Wreck Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	17	15	The typical estimate is based upon the 95th percentile value for 2-3 year old males and females combined. The upper estimate is the average weight of 2-3 year old male and females combined.	enHealth (2012)
Exposure duration	year	6	6	The mean and 95th percentile duration of residence are 10 years and 35 years, respectively. It is assumed that residence times begin at birth.	enHealth (2012)
Averaging time (non-carcinogens)	year	6	6	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	7000	6100	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	994	866.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	2695	2348.5	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	826	719.8	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	371	323.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	1624	1415.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	497	433.1	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	2100	1800	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	365	365	Professional Judgement	Professional Judgement
Surface water intake rate	L/day	0.1	0.2	The recommended mean and 95th percentile drinking water ingestion rates for children aged 2-3 are 0.36 and 0.91 L/day, respectively (enHealth, 2012). Ingestion of surface water by children may occur, however it is assumed that surface water will account for less than 20% of total drinking water intake.	enHealth (2012); Professional judgement
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	100	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per enHealth (2012).	enHealth (2012)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	39	77	Assumed to be equal to the number of days using clay and sediments as sunscreens or during cultural ceremonies.	Professional judgement enHealth (2012); Professional judgement
Daily sediment ingestion rate	mg/day	50	60	Assumed to be equal to incidental soil ingestion values	Professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Based upon the community survey and to provide a conservative estimate, all clay is expected to come from affected sources.	Professional judgement
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year				
Years (number of pregnancies)	years				
Daily sediment ingestion rate	mg/day				
Fraction of sediment intake from contaminated source	unitless				
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	39	77	Upper estimate assumes sunscreen is used when temperature exceeds 25°C (65 days/year), and used for traditional ceremonies once per month. Typical estimate is half this value. This activity is not expected to occur in children aged 2-3, however will provide a conservative estimate of exposure to children up to age 6.	Bureau of Meteorology, Jervis Bay (Point Perpendicular AWS, data from 2001-2017; accessed 21 Sept 2017); Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	1375	4025	Typical estimate assumes sunscreen is applied to forearms and lower legs (assumed to be 50% of arm and leg surface area), and face (assumed to be 25% of head surface area). Upper estimate assumes sunscreen is applied to lower legs, trunk, arms, and face (25% of head surface area).	enHealth (2012)
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	22	20	Due to the temperate climate in the area, it is anticipated that more time will be spent outdoors by residents at this location than the general population. As such, indoor values represent the remaining amount of time in a day after outdoor hours have been subtracted.	Professional judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	4	enHealth recommends 2 hours/day as the average time spent outdoors for children aged 2-3. The upper estimate is based on professional judgement.	enHealth (2012), USEPA (2011), Professional Judgement
Exposure frequency	days/year	365	365	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.90E+10	2.90E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. Value for low density dwellings selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Domestic food and drink preparation and clean up</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway for children < 6 years of age.	
Activity Duration	hours/day	--	--	Not an applicable pathway for children < 6 years of age.	
Water ingestion rate	L/hour	--	--	Not an applicable pathway for children < 6 years of age.	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway for children < 6 years of age.	

Human Health Exposure Parameters - Child Resident Wreck Bay Village					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Sitting/splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year		7	14	Bureau of Meteorology, Jervis Bay (Point Perpendicular AWS, data from 2001-2017; accessed 21 Sept 2017); Professional judgement
Activity duration	hours/day		1	2	Professional judgement
Incidental water ingestion rate	L/hour	0.025		0.075	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>		3390	2954	Exposed skin assumed to be legs, feet, hands, and lower third of trunk. Professional judgement; enHealth (2012)
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year		307	365	Per the Australian Bureau of Statistics (2014), 84% of children between 2 and 3 years old consumed fruit the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that fruit may not be consumed every day. As such, the typical value represents 84% of days in a year, while the upper estimate assumes fruit is eaten daily. ABS (2014), Professional judgement
Exposure frequency - vegetables	days/year		246	365	Per the Australian Bureau of Statistics (2014), 67.4% of children between 2 and 3 years old consumed vegetables the day prior to the survey. These statistics come from a 24-hour dietary recall, and are only based on a single day's intake. These results indicate that vegetables may not be consumed every day. As such, the typical value represents 67.4% of days in a year, while the upper estimate assumes vegetables are eaten daily. ABS (2014), Professional judgement
Consumption rate - green vegetables	g/day		25.1	55	Due to uncertainty surrounding the mean and median values provided by ABS (2014) for green vegetables, the average of the mean (5.9 g/day) and median (44.3 g/day) values for cabbage and leaf and stalk values is used as the typical estimate. The upper estimate is the recommended value per NEPM (2013). ABS (2014), NEPM (2013)
Consumption rate - root vegetables	g/day		8.7	37.2	Typical value is the mean daily food intake for carrots and root vegetables for children aged 2-3. The upper estimate is the median daily food intake for carrots and root vegetables by children aged 2-3. ABS (2014)
Consumption rate - tuber vegetables	g/day		20.6	122.1	Typical value is the mean daily food intake for potatoes by children aged 2-3. The upper estimate is the recommended value per NEPM (2013). ABS (2014), NEPM (2013)
Consumption rate - fruit	g/day		172.4	180	The typical value is the mean value reported by ABS (2014). The upper estimate is the recommended fruit consumption value per NEPM (2013). enHealth (2012), ABS (2014)
<b>Percentage of total fruit and vegetable ingestion for subgroups</b>					
Green vegetables	percent		55	55	Table 7, Schedule B7
Root vegetables	percent		17	17	Table 7, Schedule B7
Tuber vegetables	percent		28	28	Table 7, Schedule B7
Tree fruit	percent		100	100	Table 7, Schedule B7
Fraction of home grown produce - fruit	unitless		0.1	0.5	Based on water use survey results for individuals identifying home grown produce. Professional judgement
Fraction of home grown produce - vegetables	unitless		0.3	0.75	Based on water use survey results for individuals identifying home grown produce. Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	--	Not an applicable pathway
Exposure frequency for fish ingestion	days/year	--	--	--	Not an applicable pathway
Fraction of daily fish intake from site	unitless	--	--	--	Not an applicable pathway
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	--	Not an applicable pathway
Exposure frequency for fish ingestion	days/year	--	--	--	Not an applicable pathway
Fraction of daily fish intake from site	unitless	--	--	--	Not an applicable pathway
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	--	Not an applicable pathway
Exposure frequency for shellfish ingestion	days/year	--	--	--	Not an applicable pathway
Fraction of daily shellfish intake from site	unitless	--	--	--	Not an applicable pathway
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	--	Not an applicable pathway
Exposure frequency for shellfish ingestion	days/year	--	--	--	Not an applicable pathway
Fraction of daily shellfish intake from site	unitless	--	--	--	Not an applicable pathway
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	--	Not an applicable pathway
Exposure frequency for mammalian meat ingestion	days/year	--	--	--	Not an applicable pathway
Fraction of daily mammalian meat intake from site	unitless	--	--	--	Not an applicable pathway

Human Health Exposure Parameters - Booderee National Park Worker					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
				The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Body weight	kg	78	70		
Exposure duration	year	30	30	Commercial working life per NEPM Schedule B7.	NEPM (2013)
Averaging time (non-carcinogens)	year	30	30	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	240	240	Assumes 5 days per week for 48 weeks a year.	NEPM (2013)
				The lifetime average daily intake of water by most Australians is 2 litres per day, while a reasonable intake of water for individuals undertaking moderate activity in temperate climates is 5 litres per day (enHealth, 2012). The results of the water use survey supplied to the community indicated that individuals drink or used to drink from creeks and streams in the area. It is not expected that individuals will drink all of their daily water from onsite water features however, and as such, these recommended averages have been halved (and rounded up to three litres per day for the upper estimate).	enHealth (2012); Professional judgement
Surface water intake rate	L/day	1	3		
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	25	50	Soil ingestion values based upon the HIL C open space scenario.	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	skin	0.02	0.1	Recommended value for commercial/industrial adult groundskeepers.	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface area of exposed skin	cm <sup>2</sup>	--	--	Not an applicable pathway	
Sediment to skin adherence factor	mg/cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Inhalation of dust - indoors</b>					
				Based upon daily operating hours at the Booderee National Park Visitor Centre. Outdoor selected as the primary location and therefore, values selected for indoor exposure time are secondary to equal a total of 8 hours spent at work per day.	Parks Australia
Exposure time (indoor air)	hours/day	6	2		
Exposure frequency	days/year	240	240	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	6	Estimated time spent outdoors in natural resource management or botanic garden positions.	Professional judgement
Exposure frequency	days/year	240	240	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Booderee National Park Worker					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	48	240	Upper estimate assumes some flora consumed daily by park workers. Typical estimate assumes flora consumed once per week for 48 weeks.	Professional judgement
Exposure frequency - vegetables	days/year	--	--	Only fruit assumed to be consumed by park workers.	Community survey, professional judgement
Consumption rate - green vegetables	g/day	--	--	Only fruit assumed to be consumed by park workers.	Community survey, professional judgement
Consumption rate - root vegetables	g/day	--	--	Only fruit assumed to be consumed by park workers.	Community survey, professional judgement
Consumption rate - tuber vegetables	g/day	--	--	Only fruit assumed to be consumed by park workers.	Community survey, professional judgement
Consumption rate - fruit	g/day	75	150	Assumed to be a half serve or full serve of fruit per NHMRC nutritional guidelines for typical and upper estimates, respectively.	NHMRC (2013), professional judgement
Fraction of flora found in affected areas	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - JBRF Personnel					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	30	30	Commercial working life per NEPM Schedule B7.	NEPM (2013)
Averaging time (non-carcinogens)	year	30	30	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	60	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.1	0.3	Recommended value for commercial/industrial adult constructed workers (moderate values of soil to skin adherence factors).	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface area of exposed skin	cm <sup>2</sup>	--	--	Not an applicable pathway	
Sediment to skin adherence factor	mg/cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	4	8	Assumed half of working day spent indoors, with a reasonable maximum of total work time spent indoors.	Professional judgement
Exposure frequency	days/year	240	240	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	4	8	Assumed half of working day is spent outdoors, with a reasonable maximum of total work time spent outdoors.	Professional judgement
Exposure frequency	days/year	240	240	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	3.70E+10	3.70E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL D (commercial/industrial) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	--	--	Not an applicable pathway	
Exposure frequency - vegetables	days/year	--	--	Not an applicable pathway	
Consumption rate - green vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - root vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - tuber vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - fruit	g/day	--	--	Not an applicable pathway	
Fraction of flora found in affected areas	unitless	--	--	Not an applicable pathway	



Human Health Exposure Parameters - JBRF Personnel					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - HMAS Creswell Maintenance Workers					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	30	30	Commercial working life per NEPM Schedule B7.	NEPM (2013)
Averaging time (non-carcinogens)	year	30	30	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	60	Soil ingestion values for outside soil plus indoor dust.	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	skin	0.08	0.3	Recommended value for commercial/industrial adult irrigation installers.	enHealth (2012)
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of water spray/mist during maintenance activities</b>					
Exposure frequency	days/year	240	240	Recommendation value for commercial workers per NEPM (2013).	NEPM (2013)
Activity duration	hours/day	2	6	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Recommended incidental water ingestion value for swimming halved as activities not expected to be fully immersive.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2500	3200	Workers assumed to be wearing long pants and closed toed shoes. Exposed skin assumed to be forearms and hands. Values averaged for males and females.	
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface area of exposed skin	cm <sup>2</sup>	--	--	Not an applicable pathway	
Sediment to skin adherence factor	mg/cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	4	0	Outdoor selected as the primary working location and therefore, values selected for indoor exposure time are secondary to equal a total of 8 hours spent at work per day.	Professional judgement
Exposure frequency	days/year	240	240	Recommended value per NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Equation 21 in Appendix B of Schedule B7.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	4	8	Assumed half of working day is spent outdoors, with a reasonable maximum of total work time spent outdoors.	Professional judgement
Exposure frequency	days/year	240	240		
Particulate emission factor	m <sup>3</sup> /kg	3.70E+10	3.70E+10	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL D (commercial/industrial) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational fishing</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity Duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Recreational boating</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (freshwater)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Swimming in creeks and other surface water bodies (marine)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	

Human Health Exposure Parameters - HMAS Creswell Maintenance Workers					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	--	--	Not an applicable pathway	
Exposure frequency - vegetables	days/year	--	--	Not an applicable pathway	
Consumption rate - green vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - root vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - tuber vegetables	g/day	--	--	Not an applicable pathway	
Consumption rate - fruit	g/day	--	--	Not an applicable pathway	
Fraction of flora found in affected areas	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for shellfish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily shellfish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Adult Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	4	29	The recreational exposure duration defined by NEPM (2013) is 29 years (35 years minus 6 years of childhood). This has been used as the upper estimate, while 10 years has been adopted as the typical estimate (minus 6 years of childhood).	NEPM (2013); enHealth (2012)
Averaging time (non-carcinogens)	year	4	29	Same as exposure duration.	NEPM (2013)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	50	Estimated value for outdoor soil.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user participates in at least one aquatic activity per week, with an upper estimate of one aquatic activity per day.	Professional judgement
Daily sediment ingestion rate	mg/day	50	50	As no values for sediment ingestion are available, values are considered to be equal to values derived for incidental ingestion of soil.	enHealth (2012); professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user participates in at least one aquatic activity per week, with an upper estimate of one aquatic activity per day.	Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	4600	3800	Mean and 95th percentile estimates for surface area of lower legs and feet averaged for men and women.	enHealth (2012); professional judgement
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	--	--	Not an applicable pathway	
Exposure frequency	days/year	--	--	Not an applicable pathway	
Particulate emission factor	m <sup>3</sup> /kg	--	--	Not an applicable pathway	
Lung retention factor	unitless	--	--	Not an applicable pathway	
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	6	As per recreational scenario in NEPM (2013). Upper estimate is based on professional judgement.	NEPM (2013); professional judgement
Exposure frequency	days/year	365	365	As per recreational scenario in NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational ocean fishing</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user fishes the marine environment once per week. Upper estimate assumes recreational user fishes the marine environment daily.	Professional judgement
Activity Duration	hours/day	1	2	Professional judgement.	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)
<b>Recreational freshwater fishing/gathering of yabbies</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational user collects crustaceans from the freshwater environment once per month. Upper estimate assumes recreational user collects crustaceans from the freshwater environment once per week.	Professional judgement
Activity Duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)

Human Health Exposure Parameters - Adult Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Recreational boating</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational boating occurs once per month. Upper estimate assumes recreational boating occurs once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)
<b>Swimming in creeks and other freshwater surface water bodies</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational user swims in freshwater once per month. Upper estimate assumes recreational user swims in freshwater once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.125	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	24000	20000	Entire body	enHealth (2012)
<b>Swimming in the ocean</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user swims once per week. Upper estimate assumes recreational user swims every day.	Professional judgement
Activity duration	hours/day	0.5	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.125	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	24000	20000	Entire body	enHealth (2012)
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	52	208	Upper estimate assumes some flora consumed four times per week by recreational users. Typical estimate assumes flora consumed once per week.	Professional judgement
Exposure frequency - vegetables	days/year	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - green vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - root vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - tuber vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - fruit	g/day	75	150	Assumed to be a half serve or full serve of fruit per NHMRC nutritional guidelines for typical and upper estimates, respectively.	NHMRC (2013), professional judgement
Fraction of flora found in affected areas	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	7.6	110	Typical value is the mean daily food intake finfish for adults. The upper estimate is the median daily food intake finfish for adults. It is conservatively assumed that all finfish consumed are marine.	ABS (2014)
Exposure frequency for fish ingestion	days/year	52	365	Typical value assumes one meal of fish per week. Upper estimate assumes one meal of fish per day.	Professional judgement
Fraction of daily fish intake from site	unitless	0.5	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	0.4	17	Typical and upper values derived from the mean and median daily food intake for crustacean and molluscs for adults. It is assumed that 1/4 of the shellfish consumed are freshwater organisms, while 3/4 are marine based upon assumptions regarding shellfish collection (i.e., once per month for freshwater, and once per week for marine).	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	52	365	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	1.2	50.9	Typical and upper values derived from the mean and median daily food intake for crustacean and molluscs for adults. It is assumed that 1/4 of the shellfish consumed are freshwater organisms, while 3/4 are marine based upon assumptions regarding shellfish collection (i.e., once per month for freshwater, and once per week for marine).	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	52	365	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Child Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	17	15	The typical estimate is based upon the 95th percentile value for 2-3 year old males and females combined. The upper estimate is the average weight of 23 year old male and females combined.	enHealth (2012)
Exposure duration	year	6	6	The mean and 95th percentile duration of residence are 10 years and 35 years, respectively. It is assumed that residence times begin at birth.	enHealth (2012)
Averaging time (non-carcinogens)	year	6	6	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	7000	6100	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	994	866.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	2695	2348.5	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	826	719.8	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	371	323.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	1624	1415.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	497	433.1	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	2100	1800	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	50	Estimated value for outdoor soil only for children aged 1-5 years old.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	26	104	Typical value assumes children participate with adults in recreational activities fortnightly. Upper value assumes children participate with adults in recreational activities twice per week.	Professional judgement
Daily sediment ingestion rate	mg/day	50	50	As no values for sediment ingestion are available, values are considered to be equal to values derived for incidental ingestion of soil.	enHealth (2012); Professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	26	104	Typical value assumes children participate with adults in recreational activities fortnightly. Upper value assumes children participate with adults in recreational activities twice per week.	Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	--	--	Not an applicable pathway	
Exposure frequency	days/year	--	--	Not an applicable pathway	
Particulate emission factor	m <sup>3</sup> /kg	--	--	Not an applicable pathway	
Lung retention factor	unitless	--	--	Not an applicable pathway	
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	6	As per recreational scenario in NEPM (2013). Upper estimate is based on professional judgement.	NEPM (2013); professional judgement
Exposure frequency	days/year	365	365	As per recreational scenario in NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational ocean fishing</b>					
Exposure frequency	days/year	12	52	Typical value assumes children participate with adults in recreational activities once per month. Upper value assumes children participate with adults in recreational activities once per week.	Professional judgement
Activity Duration	hours/day	0.5	1	Activity duration halved from adult values.	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Recreational freshwater fishing/gathering of yabbies</b>					
Exposure frequency	days/year	6	26	Exposure frequency values for children halved from estimated adult exposure frequency values assuming adult recreational user collects crustaceans from the freshwater environment once per month and once per week.	Professional judgement
Activity Duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Recreational boating</b>					
Exposure frequency	days/year	6	26	Exposure frequency values for children halved from estimated adult exposure frequency values assuming adult recreational user boats once per month and once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Swimming in creeks and other freshwater surface water bodies</b>					
Exposure frequency	days/year	12	26	Children anticipated to swim in freshwater once per month or fortnightly.	Professional judgement
Activity duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.05	0.15	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	7000	6100	Entire body	enHealth (2012)

Human Health Exposure Parameters - Child Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Swimming in the ocean</b>					
Exposure frequency	days/year	12	26	Children anticipated to swim with adults in the ocean once per month or fortnightly.	Professional judgement
Activity duration	hours/day	0.5	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.05	0.15	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	7000	6100	Entire body	enHealth (2012)
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	12	52	Typical estimate assumes flora consumed once per month. Upper estimate assumes flora consumed once per week.	Professional judgement
Exposure frequency - vegetables	days/year	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - green vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - root vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - tuber vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - fruit	g/day	75	150	Assumed to be a half serve or full serve of fruit per NHMRC nutritional guidelines for typical and upper estimates, respectively.	NHMRC (2013), professional judgement
Fraction of flora found in affected areas	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	3.6	83.2	Typical value is the mean daily food intake of finfish for children aged 2-3. The upper estimate is the median daily food intake of finfish for children aged 2-3. It is conservatively assumed that all finfish consumed are marine.	ABS (2014)
Exposure frequency for fish ingestion	days/year	52	365	Typical value assumes one meal of fish per week. Upper estimate assumes one meal of fish per day.	Professional judgement
Fraction of daily fish intake from site	unitless	0.5	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	0.4	5	The mean and median values for shellfish consumption by children aged 2-3 are unreliable and are not recommended for use by enHealth (2012). Therefore, the typical value for adults has been carried through for children. The upper estimate is based upon consumption rates of all shellfish for Native American children (Table 10-107 in USEPA (2011)). The 95th percentile value is 1.337 g/kg-day, assuming the average 15 kg child, the upper estimate of shellfish consumption is 20.1 g/day. It is assumed that 1/4 of the shellfish consumed is freshwater, and 3/4 is marine.	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	26	183	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day. It is assumed half of the shellfish consumed comes from freshwater and half is marine.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	1.2	15.1	The mean and median values for shellfish consumption by children aged 2-3 are unreliable and are not recommended for use by enHealth (2012). Therefore, the typical value for adults has been carried through for children. The upper estimate is based upon consumption rates of all shellfish for Native American children (Table 10-107 in USEPA (2011)). The 95th percentile value is 1.337 g/kg-day, assuming the average 15 kg child, the upper estimate of shellfish consumption is 20.1 g/day. It is assumed that half of the shellfish consumed is freshwater, and half is marine.	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	26	183	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	--	--	Not an applicable pathway	
Exposure frequency for mammalian meat ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily mammalian meat intake from site	unitless	--	--	Not an applicable pathway	

Human Health Exposure Parameters - Adult Recreational User of Wreck Bay Area (Wreck Bay, Mary Creek, Summercloud Creek)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	78	70	The upper estimate is based upon the lifetime average value for males and females combined. The typical estimate is the average weight of male and female adults, combined.	enHealth (2012)
Exposure duration	year	4	72	The recreational exposure duration defined by NEPM (2013) is 29 years (35 years minus 6 years of childhood), however, in the case of the indigenous Wreck Bay community, it is conservatively assumed that individuals may spend their entire lives in the region. This is reflected in the upper estimate value. It is assumed that residence times begin at birth. Four years (10 year residence minus 6 years of childhood) was selected as the typical exposure value. However, regardless of this assumption, number of years does not affect calculations in non-carcinogenic risk calculations.	NEPM (2013); enHealth (2012)
Averaging time (non-carcinogens)	year	4	72	Same as exposure duration.	NEPM (2013)
Total skin surface area	cm <sup>2</sup>	24000	20000	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	1350	1250	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	9750	7400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	3350	2750	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	1200	1000	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	8050	6400	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	1550	1300	Surface area by body part, averaged for males and females.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	7900	6300	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	50	Estimated value for outdoor soil.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user participates in at least one aquatic activity per week, with an upper estimate of one aquatic activity per day.	Professional judgement
Daily sediment ingestion rate	mg/day	50	50	As no values for sediment ingestion are available, values are considered to be equal to values derived for incidental ingestion of soil.	enHealth (2012); professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user participates in at least one aquatic activity per week, with an upper estimate of one aquatic activity per day.	Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	4600	3800	Mean and 95th percentile estimates for surface area of lower legs and feet averaged for men and women.	enHealth (2012); professional judgement
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	--	--	Not an applicable pathway	
Exposure frequency	days/year	--	--	Not an applicable pathway	
Particulate emission factor	m <sup>3</sup> /kg	--	--	Not an applicable pathway	
Lung retention factor	unitless	--	--	Not an applicable pathway	
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	6	As per recreational scenario in NEPM (2013). Upper estimate is based on professional judgement.	NEPM (2013); professional judgement
Exposure frequency	days/year	365	365	As per recreational scenario in NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational ocean fishing</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user fishes the marine environment once per week. Upper estimate assumes recreational user fishes the marine environment daily.	Professional judgement
Activity Duration	hours/day	1	2	Professional judgement.	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)
<b>Recreational freshwater fishing/gathering of yabbies</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational user collects crustaceans from the freshwater environment once per month. Upper estimate assumes recreational user collects crustaceans from the freshwater environment once per week.	Professional judgement
Activity Duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)
<b>Recreational boating</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational boating occurs once per month. Upper estimate assumes recreational boating occurs once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.0125	0.0625	Half the values for incidental ingestion while swimming.	Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	7900	6300	Recommended value for exposed lower legs, feet, hands and forearms.	enHealth (2012)
<b>Swimming in creeks and other freshwater surface water bodies</b>					
Exposure frequency	days/year	12	52	Typical value assumes recreational user swims in freshwater once per month. Upper estimate assumes recreational user swims in freshwater once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.125	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	24000	20000	Entire body	enHealth (2012)



Human Health Exposure Parameters - Adult Recreational User of Wreck Bay Area (Wreck Bay, Mary Creek, Summercloud Creek)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Swimming in the ocean</b>					
Exposure frequency	days/year	52	365	Typical value assumes recreational user swims once per week. Upper estimate assumes recreational user swims every day.	Professional judgement
Activity duration	hours/day	0.5	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.125	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	24000	20000	Entire body	enHealth (2012)
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	52	208	Upper estimate assumes some flora consumed four times per week by recreational users. Typical estimate assumes flora consumed once per week.	Professional judgement
Exposure frequency - vegetables	days/year	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - green vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - root vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - tuber vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - fruit	g/day	75	150	Assumed to be a half serve or full serve of fruit per NHMRC nutritional guidelines for typical and upper estimates, respectively.	NHMRC (2013), professional judgement
Fraction of flora found in affected areas	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	7.6	110	Typical value is the mean daily food intake finfish for adults. The upper estimate is the median daily food intake finfish for adults. It is conservatively assumed that all finfish consumed are marine.	ABS (2014)
Exposure frequency for fish ingestion	days/year	52	365	Typical value assumes one meal of fish per week. Upper estimate assumes one meal of fish per day.	Professional judgement
Fraction of daily fish intake from site	unitless	0.5	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	0.4	17	Typical and upper values derived from the mean and median daily food intake for crustacean and molluscs for adults. It is assumed that 1/4 of the shellfish consumed are freshwater organisms, while 3/4 are marine based upon assumptions regarding shellfish collection (i.e., once per month for freshwater, and once per week for marine).	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	52	365	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	1.2	50.9	Typical and upper values derived from the mean and median daily food intake for crustacean and molluscs for adults. It is assumed that 1/4 of the shellfish consumed are freshwater organisms, while 3/4 are marine based upon assumptions regarding shellfish collection (i.e., once per month for freshwater, and once per week for marine).	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	52	365	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	35.8	150	Due to an unreliable mean for consumption of mammalian game meat, the mean value for beef, sheep and pork ingestion by adults has been selected as the typical value. The upper value is the median daily food intake for mammalian game meat by adults. It is noted that consumption of game meat does not currently occur, however this is a culturally significant pathway and as such, has been included for consideration in the risk assessment.	ABS (2014); professional judgement
Exposure frequency for mammalian meat ingestion	days/year	12	52	Typical value assumes one meal of mammalian game per month. Upper estimate assumes one meal of mammalian game per week.	Professional judgement
Fraction of daily mammalian meat intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement

Human Health Exposure Parameters - Child Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>General</b>					
Body weight	kg	17	15	The typical estimate is based upon the 95th percentile value for 2-3 year old males and females combined. The upper estimate is the average weight of 2-3 year old male and females combined.	enHealth (2012)
Exposure duration	year	6	6	The mean and 95th percentile duration of residence are 10 years and 35 years, respectively. It is assumed that residence times begin at birth.	enHealth (2012)
Averaging time (non-carcinogens)	year	6	6	Same as exposure duration.	enHealth (2012)
Total skin surface area	cm <sup>2</sup>	7000	6100	Total skin surface area for males and females combined.	enHealth (2012)
Skin surface area - head	cm <sup>2</sup>	994	866.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - trunk	cm <sup>2</sup>	2695	2348.5	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - arms	cm <sup>2</sup>	826	719.8	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - hands	cm <sup>2</sup>	371	323.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - legs	cm <sup>2</sup>	1624	1415.2	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - feet	cm <sup>2</sup>	497	433.1	Calculated surface area based upon the mean percentage of total surface area for children.	enHealth (2012)
Skin surface area - exposed (feet, legs, hands, arms)	cm <sup>2</sup>	2100	1800	Recommended value per enHealth (2012; Section 3.2.4).	enHealth (2012)
<b>Ingestion of surface water</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Surface water intake rate	L/day	--	--	Not an applicable pathway	
<b>Deliberate ingestion of sediment (geophagy)</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Years (number of pregnancies)	years	--	--	Not an applicable pathway	
Daily sediment ingestion rate	mg/day	--	--	Not an applicable pathway	
Fraction of sediment intake from contaminated source	unitless	--	--	Not an applicable pathway	
<b>Incidental ingestion of soil</b>					
Daily incidental soil ingestion rate	mg/day	50	50	Estimated value for outdoor soil only for children aged 1-5 years old.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Dermal contact with soil</b>					
Soil to skin adherence factor	mg soil/cm <sup>2</sup> skin	0.5	1.7	Recommended value for outdoor and indoor residential child and adult exposures.	enHealth (2012)
Exposure frequency	days/year	365	365	Recommendation value per NEPM (2013).	NEPM (2013)
<b>Incidental ingestion of sediment</b>					
Exposure frequency	days/year	26	104	Typical value assumes children participate with adults in recreational activities fortnightly. Upper value assumes children participate with adults in recreational activities twice per week.	Professional judgement
Daily sediment ingestion rate	mg/day	50	50	As no values for sediment ingestion are available, values are considered to be equal to values derived for incidental ingestion of soil.	enHealth (2012); Professional judgement
Fraction of sediment intake from contaminated source	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Dermal Contact with Sediment</b>					
Exposure frequency	days/year	26	104	Typical value assumes children participate with adults in recreational activities fortnightly. Upper value assumes children participate with adults in recreational activities twice per week.	Professional judgement
Surface area of exposed skin	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
Sediment to skin adherence factor	mg/cm <sup>2</sup>	1	1	In agreement with Massachusetts Department of Environmental Protection, 1 mg/cm <sup>2</sup> has been adopted as the default value for sediment. This assumes that only the monolayer against the skin has implications in dermal absorption.	DEP (2002)
<b>Inhalation of dust - indoors</b>					
Exposure time (indoor air)	hours/day	--	--	Not an applicable pathway	
Exposure frequency	days/year	--	--	Not an applicable pathway	
Particulate emission factor	m <sup>3</sup> /kg	--	--	Not an applicable pathway	
Lung retention factor	unitless	--	--	Not an applicable pathway	
<b>Inhalation of dust - outdoors</b>					
Exposure time (outdoor air)	hours/day	2	6	As per recreational scenario in NEPM (2013). Upper estimate is based on professional judgement.	NEPM (2013); Professional judgement
Exposure frequency	days/year	365	365	As per recreational scenario in NEPM (2013).	NEPM (2013)
Particulate emission factor	m <sup>3</sup> /kg	2.60E+07	2.60E+07	Refer to Appendix B and Section 5.3.3.1 of Schedule B7. HIL C (recreational) value selected.	NEPM (2013)
Lung retention factor	unitless	0.375	0.375	Value adopted per Schedule B7, Table 5.	NEPM (2013)
<b>Recreational ocean fishing</b>					
Exposure frequency	days/year	12	52	Typical value assumes children participate with adults in recreational activities once per month. Upper value assumes children participate with adults in recreational activities once per week.	Professional judgement
Activity Duration	hours/day	0.5	1	Activity duration halved from adult values.	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Recreational freshwater fishing/gathering of yabbies</b>					
Exposure frequency	days/year	6	26	Exposure frequency values for children halved from estimated adult exposure frequency values assuming adult recreational user collects crustaceans from the freshwater environment once per month and once per week.	Professional judgement
Activity Duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Recreational boating</b>					
Exposure frequency	days/year	6	26	Exposure frequency values for children halved from estimated adult exposure frequency values assuming adult recreational user boats once per month and once per week.	Professional judgement
Activity duration	hours/day	1	2	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.025	0.075	Half the values for incidental ingestion while swimming.	enHealth (2012); Professional judgement
Exposed skin surface for water contact	cm <sup>2</sup>	2100	1800	Recommended exposed surface area value for children aged 2-3.	enHealth (2012)
<b>Swimming in creeks and other freshwater surface water bodies</b>					
Exposure frequency	days/year	12	26	Children anticipated to swim in freshwater once per month or fortnightly.	Professional judgement
Activity duration	hours/day	1	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.05	0.15	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	7000	6100	Entire body	enHealth (2012)

Human Health Exposure Parameters - Child Recreational User of Jervis Bay Area (Jervis Bay, Flat Rock Creek, Captains Lagoon)					
Parameter	Units	Typical Estimate	Upper Estimate	Notes	Reference
<b>Swimming in the ocean</b>					
Exposure frequency	days/year	12	26	Children anticipated to swim with adults in the ocean once per month or fortnightly.	Professional judgement
Activity duration	hours/day	0.5	1	Professional judgement	Professional judgement
Incidental water ingestion rate	L/hour	0.05	0.15	Recommended values per enHealth (2012).	enHealth (2012)
Exposed skin surface for water contact	cm <sup>2</sup>	7000	6100	Entire body	enHealth (2012)
<b>Splashing in pooled/flooded groundwater after heavy rain events</b>					
Exposure frequency	days/year	--	--	Not an applicable pathway	
Activity duration	hours/day	--	--	Not an applicable pathway	
Incidental water ingestion rate	L/hour	--	--	Not an applicable pathway	
Exposed skin surface for water contact	cm <sup>2</sup>	--	--	Not an applicable pathway	
<b>Ingestion of plant produce</b>					
Exposure frequency - fruit	days/year	12	52	Typical estimate assumes flora consumed once per month. Upper estimate assumes flora consumed once per week.	Professional judgement
Exposure frequency - vegetables	days/year	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - green vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - root vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - tuber vegetables	g/day	--	--	Only fruit assumed to be consumed by recreational users.	Professional judgement
Consumption rate - fruit	g/day	75	150	Assumed to be a half serve or full serve of fruit per NHMRC nutritional guidelines for typical and upper estimates, respectively.	NHMRC (2013), professional judgement
Fraction of flora found in affected areas	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater fish</b>					
Daily fish ingestion rate (finfish only)	g/day	--	--	Not an applicable pathway	
Exposure frequency for fish ingestion	days/year	--	--	Not an applicable pathway	
Fraction of daily fish intake from site	unitless	--	--	Not an applicable pathway	
<b>Ingestion of marine fish</b>					
Daily fish ingestion rate (finfish only)	g/day	3.6	83.2	Typical value is the mean daily food intake of finfish for children aged 2-3. The upper estimate is the median daily food intake of finfish for children aged 2-3. It is conservatively assumed that all finfish consumed are marine.	ABS (2014)
Exposure frequency for fish ingestion	days/year	52	365	Typical value assumes one meal of fish per week. Upper estimate assumes one meal of fish per day.	Professional judgement
Fraction of daily fish intake from site	unitless	0.5	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of freshwater crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	0.4	5	The mean and median values for shellfish consumption by children aged 2-3 are unreliable and are not recommended for use by enHealth (2012). Therefore, the typical value for adults has been carried through for children. The upper estimate is based upon consumption rates of all shellfish for Native American children (Table 10-107 in USEPA (2011)). The 95th percentile value is 1.337 g/kg-day, assuming the average 15 kg child, the upper estimate of shellfish consumption is 20.1 g/day. It is assumed that 1/4 of the shellfish consumed is freshwater, and 3/4 is marine.	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	26	183	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day. It is assumed half of the shellfish consumed comes from freshwater and half is marine.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of marine crustaceans and molluscs</b>					
Daily shellfish ingestion rate	g/day	1.2	15.1	The mean and median values for shellfish consumption by children aged 2-3 are unreliable and are not recommended for use by enHealth (2012). Therefore, the typical value for adults has been carried through for children. The upper estimate is based upon consumption rates of all shellfish for Native American children (Table 10-107 in USEPA (2011)). The 95th percentile value is 1.337 g/kg-day, assuming the average 15 kg child, the upper estimate of shellfish consumption is 20.1 g/day. It is assumed that 1/4 of the shellfish consumed is freshwater, and 3/4 is marine.	ABS (2014); professional judgement
Exposure frequency for shellfish ingestion	days/year	26	183	Typical value assumes one meal of shellfish per week. Upper estimate assumes one meal of shellfish per day.	Professional judgement
Fraction of daily shellfish intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement
<b>Ingestion of terrestrial mammals</b>					
Daily game meat ingestion rate	g/day	47	108	Typical and upper estimate values were selected based upon the Food Consumption values per the 2011-12 NNPAS data presented in Table 7 of Supporting Document 2 of FSANZ (2016). The values are based upon consumer only values for all mammalian meat. It is noted that consumption of game meat does not currently occur, however this is a culturally significant pathway and as such, has been included for consideration in the risk assessment.	FSANZ (2016)
Exposure frequency for mammalian meat ingestion	days/year	12	52	Typical value assumes one meal of mammalian game per month. Upper estimate assumes one meal of mammalian game per week.	Professional judgement
Fraction of daily mammalian meat intake from site	unitless	1	1	Conservative estimate of exposure.	Professional judgement

**Appendix C – Community Survey Results**



**Department of Defence**  
Water Use and Biota Survey Jervis Bay Range Facility and  
HMAS Creswell – Jervis Bay Territory  
Commonwealth of Australia  
**DRAFT** Report of Findings

August 2017

## Table of Contents

1.	Introduction.....	3
1.1	Background.....	3
1.2	Purpose.....	3
1.3	Methodology.....	3
2.	Summary of key findings.....	4
3.	Water use.....	5
3.1	Property type.....	5
3.2	Type of supplied water.....	5
3.3	Surface water on property.....	5
3.4	Drinking water from creeks/ivers.....	6
3.5	Swimming in the ocean.....	7
3.6	Swimming in creeks/ivers.....	8
3.7	Fishing from the ocean.....	9
3.8	Fishing from creeks/ivers.....	10
3.9	Eating flora.....	11
3.10	Eating fauna.....	12
3.11	Using water collected from creeks for cooking.....	12
3.12	Using water collected from creeks for washing.....	12
3.13	Eating or using clay.....	13
3.14	Additional comments.....	14
4.	Conclusion.....	17

## Figure Index

Figure 1	Locations and popularity of water consumed from creeks/river.....	6
Figure 2	Locations where respondents swim in the ocean.....	7
Figure 3	Locations where respondents swim in the creeks/ivers.....	8
Figure 4	Locations where respondents fish from the ocean.....	9
Figure 5	Types of seafood collected.....	9
Figure 6	Locations where respondents fish from creeks/ivers.....	10
Figure 7	Types of fish collected from creeks/ivers.....	10
Figure 8	Locations where respondents collect flora.....	11
Figure 9	Types of flora collected and consumed.....	11
Figure 10	Where water has been or is collected for cooking.....	12
Figure 11	Where clay is collected.....	13
Figure 12	Use of clay.....	13

Figure 13 Collated Map Responses ..... 14

## Appendices

Appendix A – Map and legend used at community barbeque

Appendix B – Water Use Survey

# 1. Introduction

## 1.1 Background

The Department of Defence (Defence) has commenced a detailed investigation program at Jervis Bay Range Facility (JBRF) and HMAS Creswell (the base) and surrounding areas of Jervis Bay Territory, Commonwealth of Australia.

The investigation is part of Defence's review of a number of its sites around Australia that used fire-fighting foams containing perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA). PFOS and PFOA are two of a number of compounds that are collectively known as PFAS and are emerging as an international concern due to their persistence in the environment.

GHD consulted with residents of Jervis Bay and Wreck Bay villages to understand how they use locally sourced food and water within the field investigation area surrounding JBRF and the base. This information will help inform the off-site investigation program.

This report summarises the findings from surveys that comprised 23 interviews of people who live and/or use water (including animals or plants that are consumed – biota) in the investigation area. The survey was conducted over two weeks, from 19 June to 29 June 2017 with additional information collected during two community barbeque events held on Sunday 9 and Tuesday 11 July, 2017.

## 1.2 Purpose

The purpose of this survey was to obtain information from local residents about water and land use at their properties and within the investigation area. The results presented in this report will assist Defence in recommending appropriate management strategies throughout the JBRF and HMAS Creswell Investigation.

## 1.3 Methodology

The chosen survey method was a questionnaire developed to act as a guide when interviewing community members through the collation of both qualitative and quantitative responses. For seven days between 19 and 26 June team members were located at Jervis Bay Territory Administration (JBTA) office (located in Jervis Bay village) or Wreck Bay Aboriginal Community Council (WBACC) office (located in Wreck Bay village). Dates and locations were arranged in collaboration with the WBACC and promoted to the community through notices via letterbox drops. Residents were invited to drop in or make an appointment to complete a survey. Fourteen surveys were completed during the period.

On 9 and 11 July, community barbeques were held with the assistance of members of the Wreck Bay Community, outside the WBACC office in Wreck Bay village. The barbeques were promoted by WBACC through a mailout to their registered members (roughly 300). Attendees spoke to GHD team members to complete a survey. A second method used to capture data at this time was using large coloured aerial maps of the investigation area to allow residents to place coloured coded dots to visually demonstrate how and where they have interacted with land and water in this area. There were 14 attendees at the two barbeques, with nine new surveys being completed (four attendees had previously completed a survey). This is discussed in more detail in section 3.14. and illustrated in Figure 13.

The original map used at the barbeque showing the investigation area and coloured dot legend is attached as **Appendix A – Map and legend used at community barbeque**. A blank copy of the water use survey is attached to this report as **Appendix B – Water Use Survey**.



## 2. Summary of key findings

There are a number of findings from the water use and biota survey responses that provide an insight into how residents of Jervis Bay Territory use land and water.

The key findings include:

- The majority of respondents (86%) indicated they are private renters. The remaining respondents were the Jervis Bay Village School, shop and police station.
- No respondents had bores located on their properties.
- One respondent, the Jervis Bay Primary School, has rainwater tanks that are used to flush some of the toilets, and to water the school vegetable garden. Town water is used for all other purposes.
- Seven respondents (30%) reported that after wet weather events, water pooled on their property and did not quickly drain away.
- Eighteen respondents (78%) regularly swim (or used to swim, when younger) in the oceans in Jervis Bay Territory.
- Thirteen respondents (57%) regularly swim (or used to swim, when younger) in the rivers or creeks in Jervis Bay Territory.
- Sixteen respondents (70%) regularly fish (or used to fish, or used to fish when younger) from the oceans in Jervis Bay Territory.
- Eight respondents (35%) regularly fish (or used to fish, when younger) from the rivers or creeks in Jervis Bay Territory.
- Nineteen respondents (83%) have consumed or continue to consume flora/vegetation collected from within the investigation area.
- Seventeen of the respondents (74%) have, at some point, used or consumed clay collected from within the investigation area on a regular basis.

## 3. Water use

The findings of the survey showed that all people surveyed use mains water as their primary water source.

The results also indicate that respondents regularly use land and water around Jervis Bay Territory. All respondents reported using land or water in some way including swimming, fishing, consuming flora or using clay.

All respondents had, at one point lived within the investigation area, with the majority currently living in Wreck Bay village.

### 3.1 Property type

Nineteen responses (83%) indicated that they rented a private residence. The remaining 13% of respondents (three) were the Jervis Bay Village Primary School, the local takeaway shop/general store and the Australian Federal Police station located in Jervis Bay Village. 57% of respondents (13) currently live in Wreck Bay Village and 26% of respondents (six) live in Jervis Bay Village. Of the 13% of respondents (three) who did not live in either village, two had previously lived in Wreck Bay village and one had lived in Jervis Bay village.

### 3.2 Type of supplied water

The majority of respondents indicated that there were no bores or water tanks on their property. Survey respondents are all supplied with mains water. The one respondent with water tanks was the Jervis Bay Primary School and water from rainwater tanks is used only to flush some of the toilets and to water the school vegetable garden.

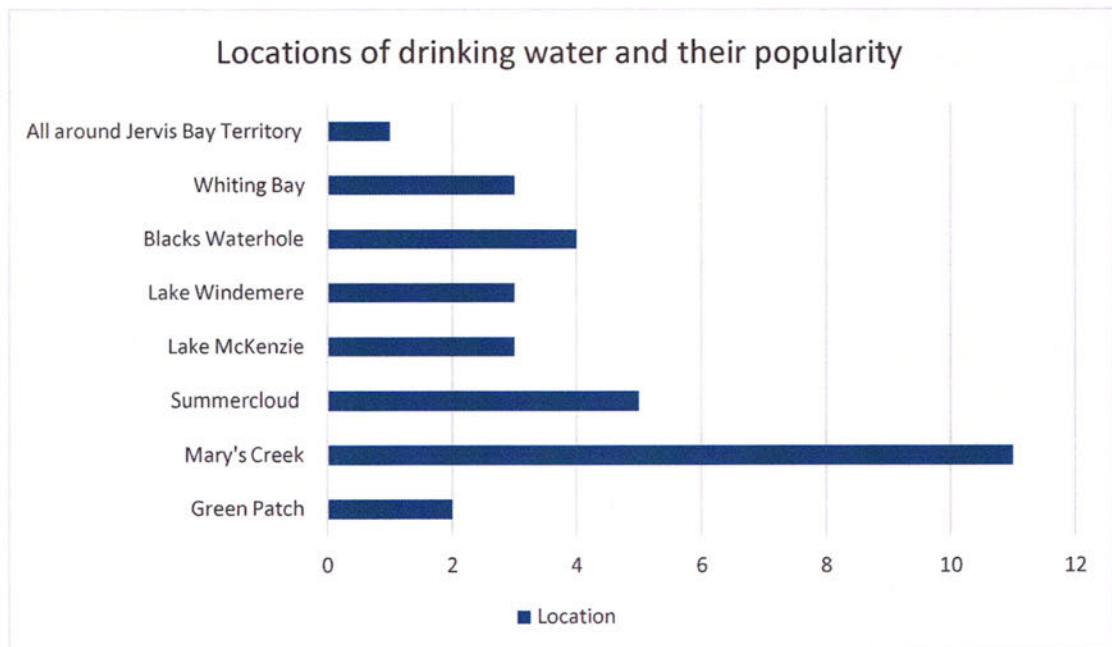
### 3.3 Surface water on property

Respondents were asked if there was any surface water on the property, including; dam, wetland, creek, surface drain, pond or other. One respondent reported that they had a pond on their property, which was filled by a tap (mains water). 30% of respondents (seven) indicated that after wet weather, water pooled in their front or back yards and did not drain away quickly. Respondents did not indicate that this water was used in any way other than eventually draining away.

### 3.4 Drinking water from creeks/ivers

The survey asked respondents if they drank water from the creeks and rivers around the Territory. 74% of respondents (seventeen) indicated that they drank (or used to drink) from a number of creeks and rivers around the Territory, while 22% of respondents (five) said they did not. Locations were primarily Mary's Creek and Blacks Waterhole, but also included Summercloud Creek, Whiting Bay and Green Patch. Figure 2 below shows the breakdown of drinking water locations, and the most popular locations for drinking water.

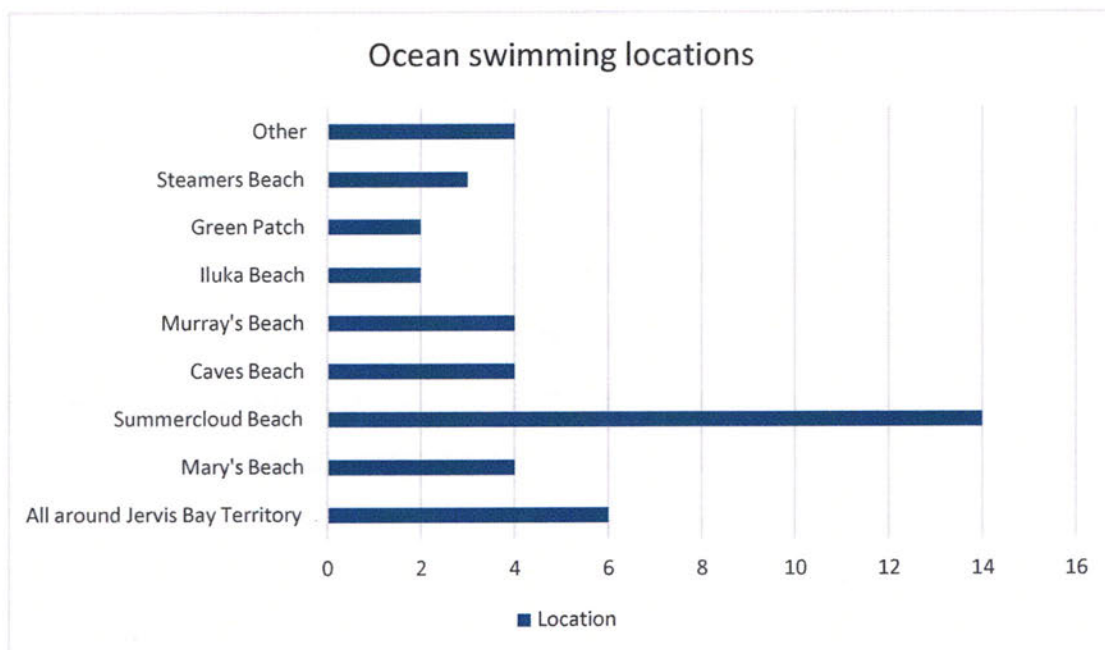
Respondents have been drinking from these creeks and rivers for a range of 12 to 60+ years. Four respondents no longer drink creek or river water; one stopped drinking water from Mary's Creek 20-30 years ago. One stopped drinking from Whiting Bay 16 years ago and one stopped drinking at the Falls (Mary's Creek) about 40 years ago. Both of these respondents were not specific about why they had stopped drinking the water. One respondent stopped drinking around five years ago as they were concerned about potential contamination.



**Figure 1 Locations and popularity of water consumed from creeks/river**

### 3.5 Swimming in the ocean

The survey asked respondents if and where they swim in the ocean. 83% of respondents (nineteen) indicated that they swim in oceans around the investigation area regularly, while 13% of respondents (three) said they did not. Locations were primarily Mary's Beach and Summercloud Beach (also known as "Front Beach"). Figure 2 shows the breakdown of where respondents indicated that they swim in the ocean, and the number of people who swim at those spots. Respondents have been swimming in these locations for a range of 12 to 60+ years.

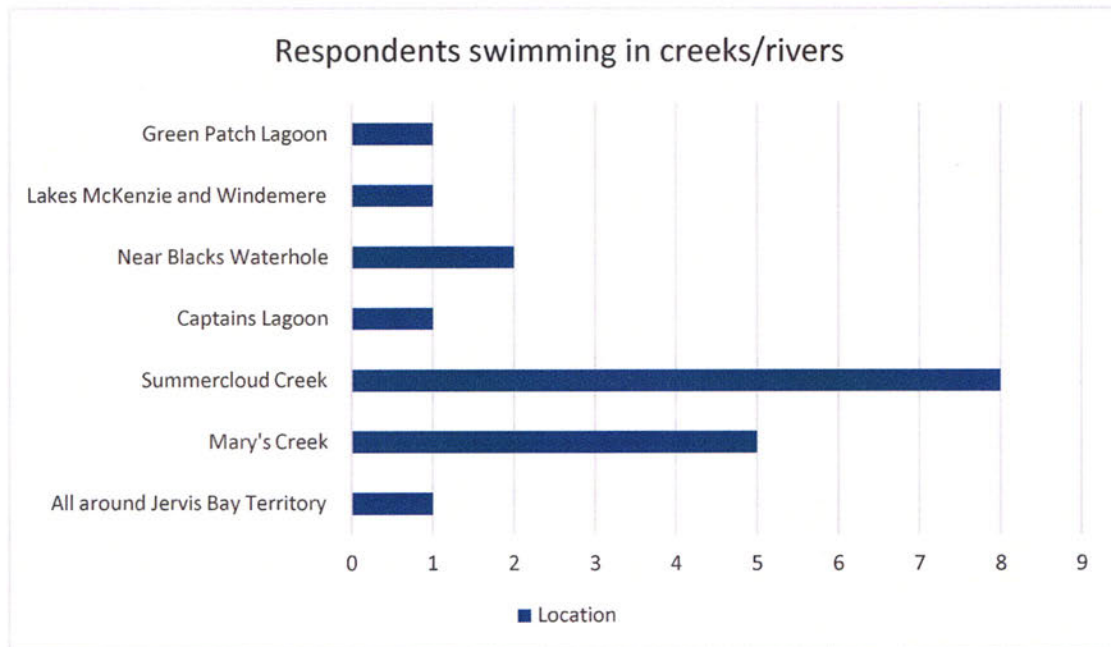


**Figure 2 Locations where respondents swim in the ocean**

### 3.6 Swimming in creeks/rivers

The survey asked respondents if and where they swim in creeks or rivers within the investigation area. 65% of respondents (fifteen) indicated that they swim (or in two cases used to swim) in creeks or rivers, while 30% of respondents (seven) said they did not.

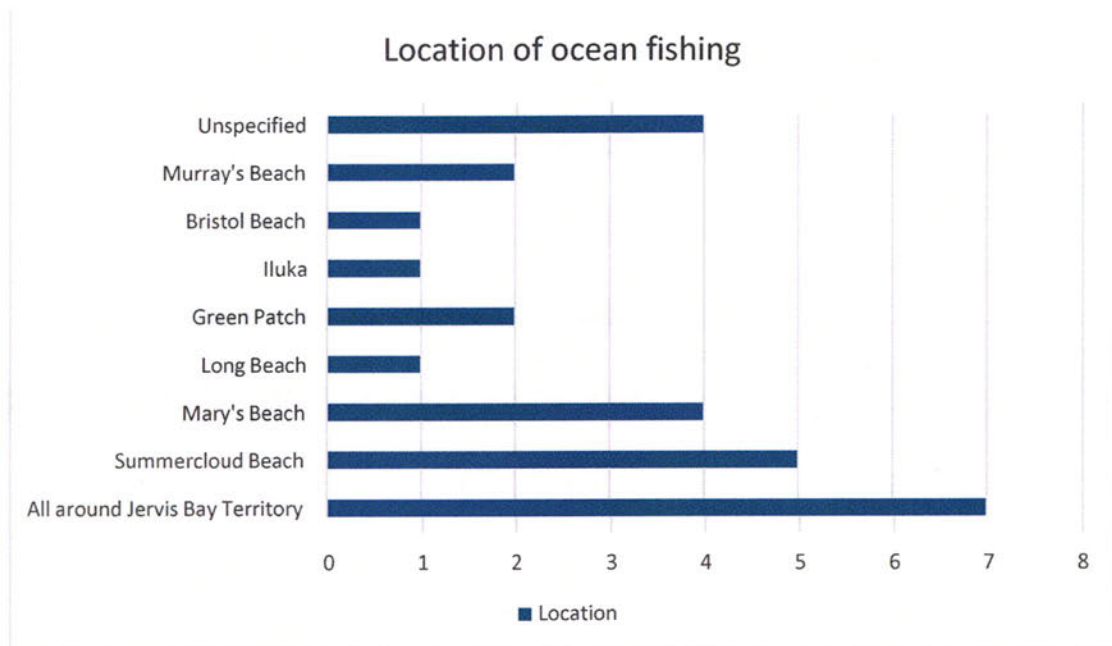
Locations were primarily Mary's Beach (also known as 'Front Beach') and Summercloud Beach. Figure 3 below indicates where respondents swim in creeks or rivers. Respondents have been swimming in these locations for a range of 12 to 60+ years. Some older respondents no longer swim, or swim rarely.



**Figure 3 Locations where respondents swim in the creeks/rivers**

### 3.7 Fishing from the ocean

The survey asked respondents if they fished from the ocean, the location of where they fished in the ocean and what they mostly caught. 83% of respondents (nineteen) indicated that they fished at beaches within the investigation area, while 13% of respondents (three) said they did not. The majority of respondents reported that they fished all around Jervis Bay Territory. Figure 4 shows where respondents indicated they fish from the ocean.



**Figure 4 Locations where respondents fish from the ocean**

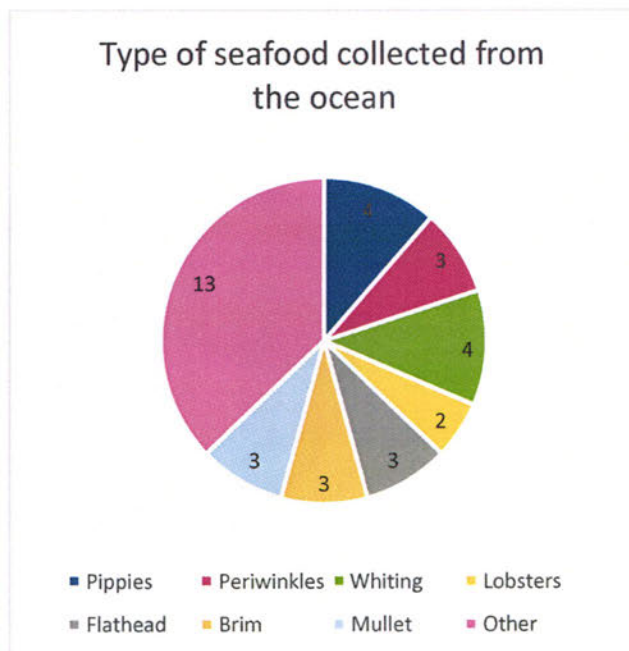
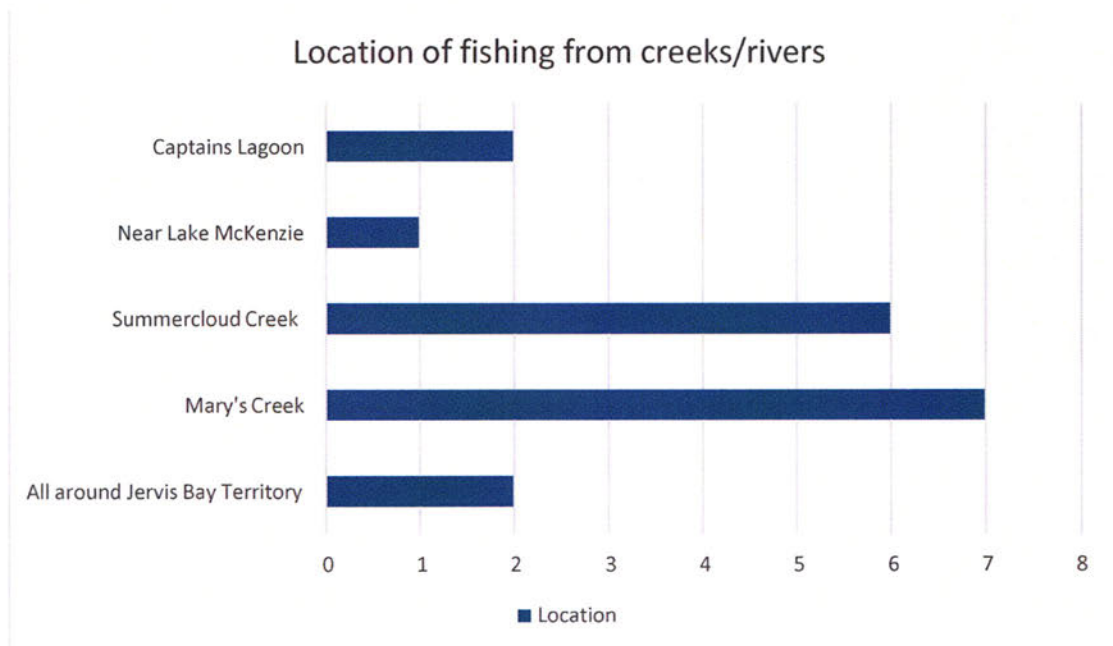


Figure 5 shows the types of seafood caught or collected. Respondents have been fishing at these locations for a range of 12 to 60+ years. One respondent said that they had stopped fishing in the area in the last six months due to concerns about potential contamination.

**Figure 5 Types of seafood collected**

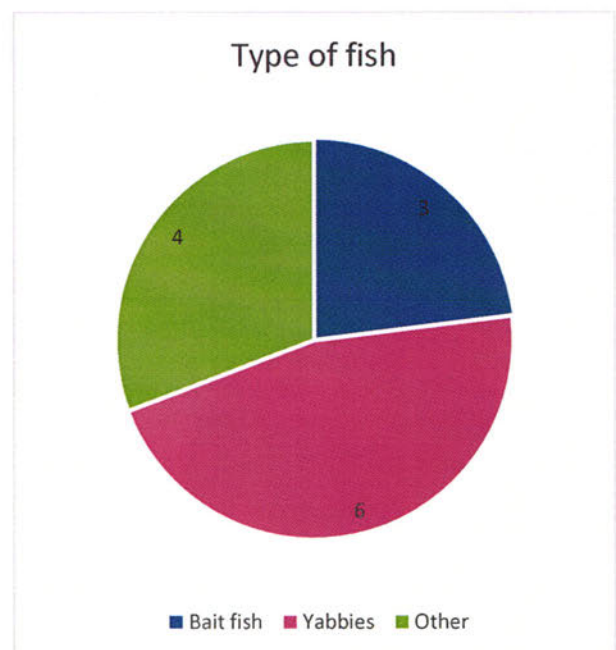
### 3.8 Fishing from creeks/ivers

The survey asked respondents if they fished from creeks or rivers, the location of freshwater fishing and what they caught. 61% of respondents (fourteen) indicated that they fished in creeks or rivers within the investigation area, while 35% of respondents (eight) said they did not. The majority of respondents reported that they fished from Mary's Creek and Summercloud Creek (or the surrounding areas). Figure 6 shows which creeks and rivers respondents use for fishing.



**Figure 6 Locations where respondents fish from creeks/ivers**

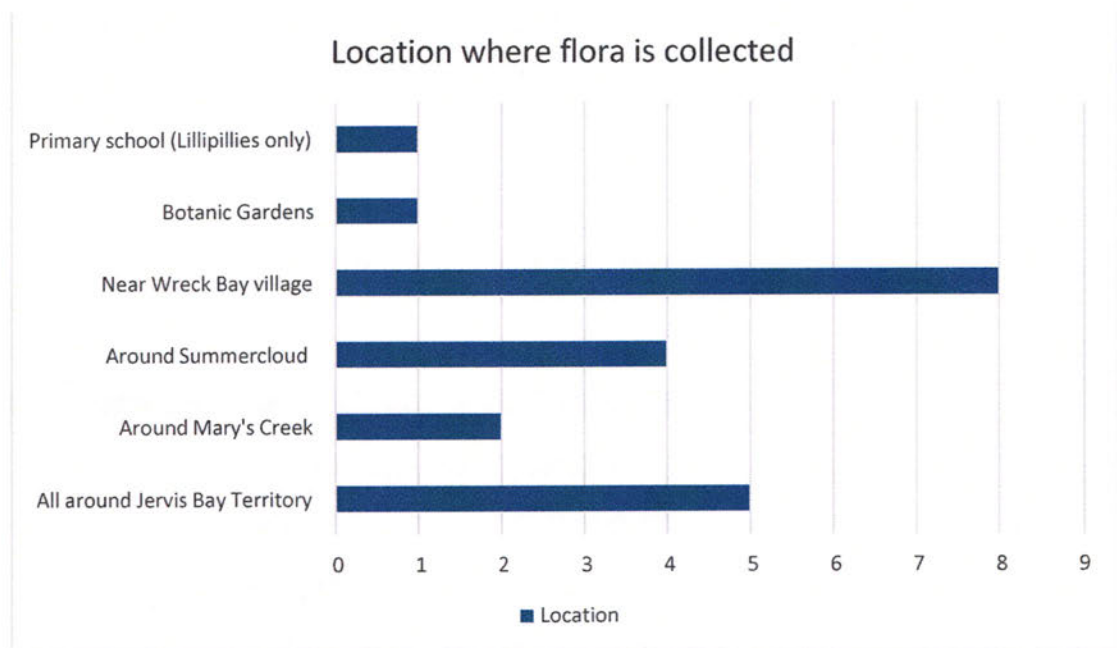
Figure 7 shows the types of fish collected from creeks and rivers. Respondents have been fishing at these locations for a range of 12 to 60+ years. One respondent reported that they fished for yabbies from Mary's and Summercloud Creeks 40 years ago, but doesn't any longer. They stopped collecting yabbies due to contamination concerns.



**Figure 7 Types of fish collected from creeks/ivers**

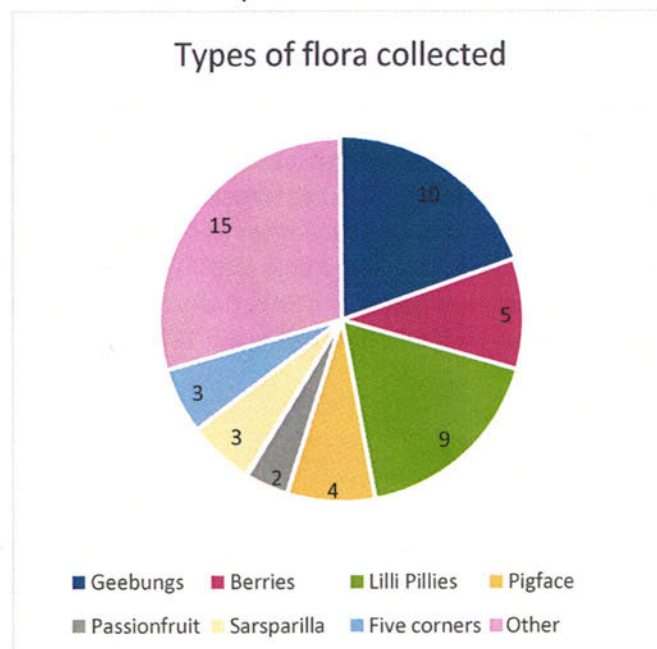
### 3.9 Eating flora

The survey asked respondents if they consumed flora/vegetation collected within the investigation area. 78% of respondents (eighteen) indicated that they collected and consumed flora, while 13% of respondents (three) said they did not. The majority of respondents reported that they collected flora from all over Jervis Bay Territory. Figure 8 indicates where respondents collect flora.



**Figure 8 Locations where respondents collect flora**

Figure 9 illustrates the type of flora that respondents collect. Respondents have been collecting and consuming flora from these locations for a range of 12 to 60+ years. Two respondents reported that they no longer collected flora but did not specify why. All of these plants are collected for consumption.



**Figure 9 Types of flora collected and consumed**

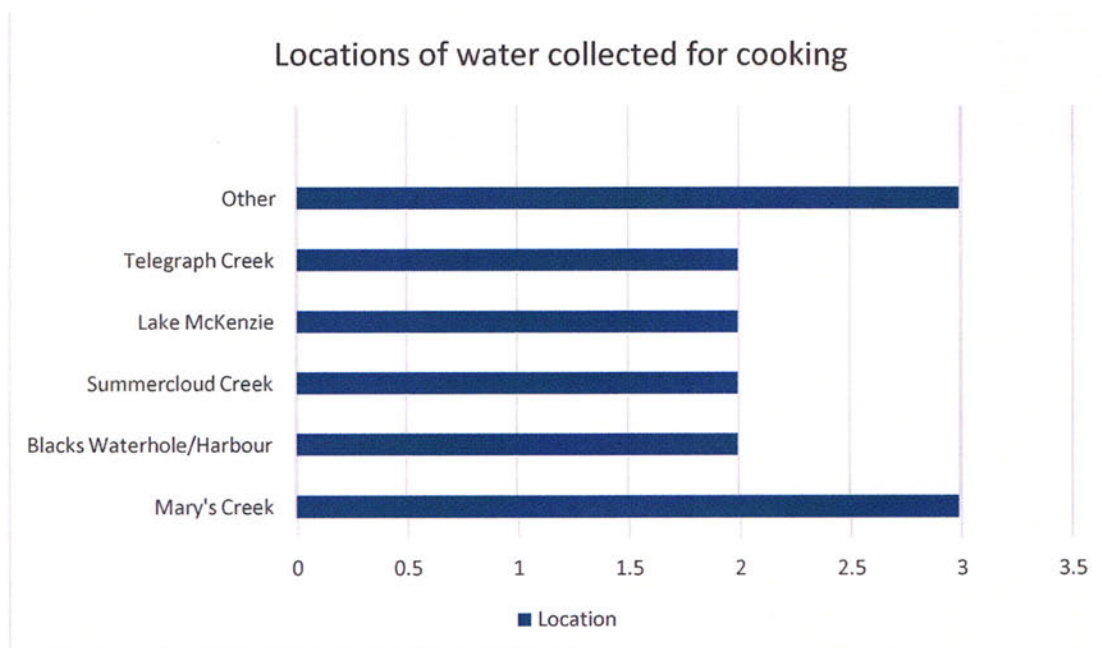


### 3.10 Eating fauna

No respondents indicated that they ate fauna found in Jervis Bay Territory. Two people reported that they knew that historically, people did eat fauna such as, kangaroo, possum, rabbit and birds in the area but this no longer occurs.

### 3.11 Using water collected from creeks for cooking

Respondents were asked if they used water collected from creeks or rivers for cooking. 30% of respondents (seven) indicated that they have cooked with water collected from creeks and rivers, while 65% of respondents (fifteen) said they did not. Figure 10 describes where respondents collected water.



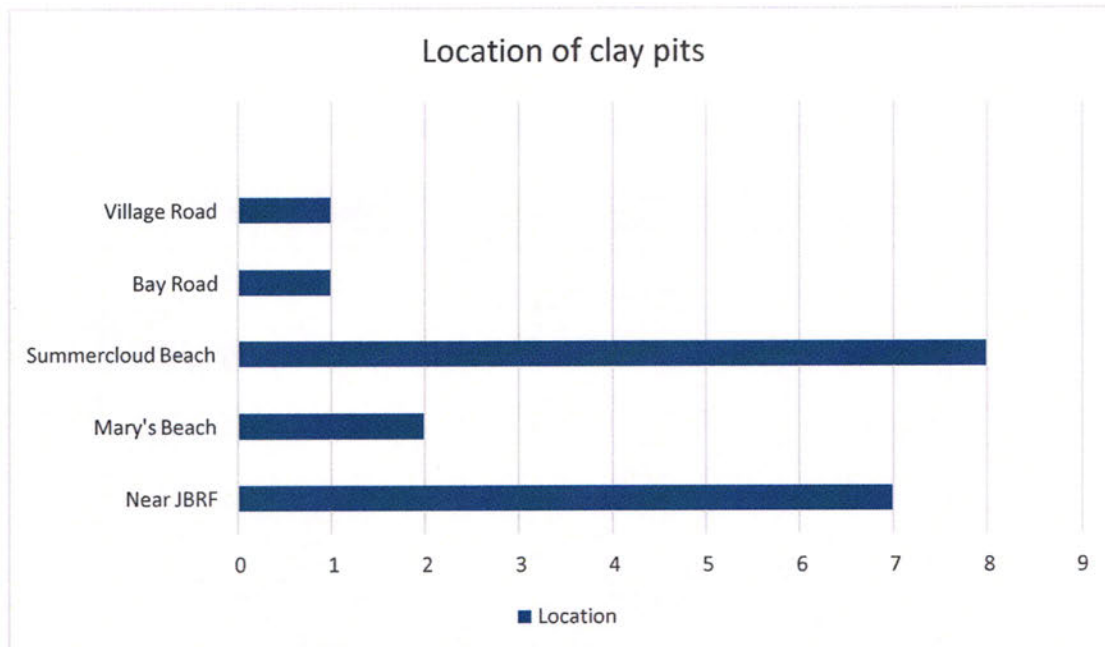
**Figure 10** Where water has been or is collected for cooking

### 3.12 Using water collected from creeks for washing

Respondents were asked if they used water collected from creeks or rivers for washing. 87% of respondents (twenty) said that they did not collect water from creeks or rivers for washing, while 9% of respondents (two) indicated that they had. One respondent said that they have occasionally used water from the creek west of the aerodrome (JBRF) for washing. Another respondent said that they had occasionally washed at The Falls (Mary's Creek) as a child. The two respondents washed in the creeks as children in the 1950s and 1970s.

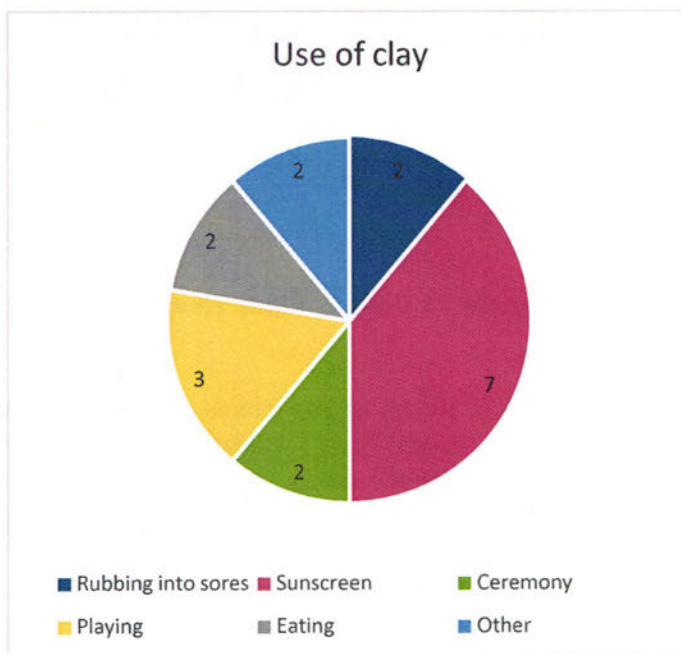
### 3.13 Eating or using clay

Respondents were asked if they consumed or used locally sourced clay. Clay can be applied to the skin for sun protection or ceremony, may be consumed for mineral benefits or may be played with by children. 70% of respondents (sixteen) indicated that they used clay from within the investigation area, while 26% respondents (six) said they did not. The majority of respondents reported that they used it as a topical application, usually as a sunscreen. 13% respondents (three) said they knew that in the past pregnant women consumed the clay when they had cravings. Figure 11 indicates the areas where respondents collected clay.



**Figure 11** Where clay is collected

Figure 12 illustrates the reason respondents used clay. Respondents have been collecting and consuming clay from these locations for a range of 12 to 60+ years. 17% respondents (four) said that they had only used the clay as children.



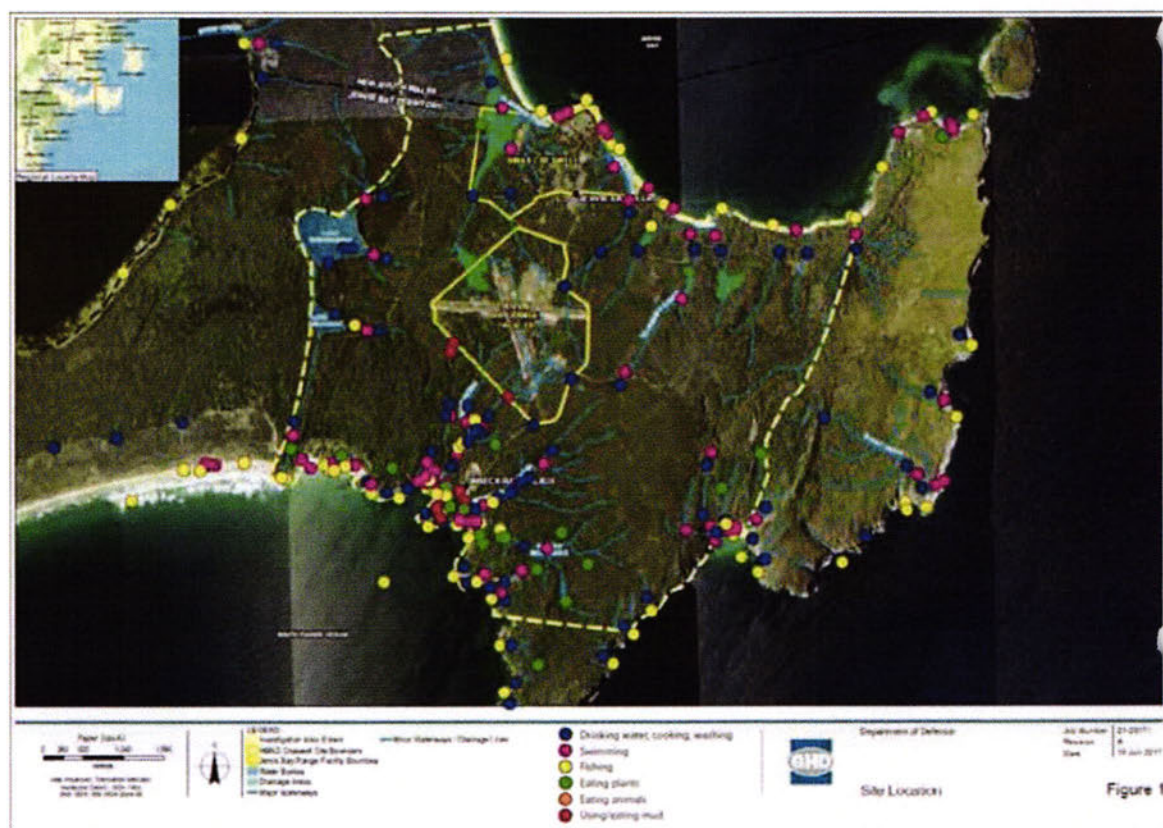
**Figure 12** Use of clay

### 3.14 Additional comments

On 9 and 11 July, community barbecues were held and surveys taken. A second method used to capture data from the community members who attended the barbecues was using large coloured aerial maps of the investigation area to allow residents to place coloured coded dots to visually demonstrate how and where they have interacted with land and water in this area. There were 14 attendees at the two barbecues, with nine new surveys being completed (four attendees had previously completed a survey).

The data collected visually indicates the ongoing activities occurring between the Wreck Bay and Jervis Bay Communities and the environment within and close to the investigation area.

The map with collated responses which also shows the investigation area, and colour dot legend is shown below as Figure 13 - Collated Map Responses.



**Figure 13 Collated Map Responses**

A small number of respondents provided some additional comments that may be relevant to the investigations. Table 1, below summarises the comments and the number of respondents who raised the same issues.

**Table 1 Additional comments**

Number of respondents	Comments
Three	"There are a lot of community members who have died because of cancer or heart disease. We are dealing with different exposures over different generations."
Three	There are historical stories of people born in the 1930s and 1940s eating fauna. This included possums, birds, kangaroo, rabbits and porcupine [we assume this is echidna].
Three	<p>References to the Coffey report:</p> <ul style="list-style-type: none"> <li>• Contamination in firefighting area which is referenced in the Report.</li> <li>• "Level of contamination was to be monitored (at border [on WB] of JBRF) but Defence hasn't done anything. Remediation Action Plan from the Coffey Report laid out actions to be taken by Defence in partnership with the community but nothing has happened. This has caused the lack of trust."</li> <li>• "Health risks (Coffey Report) around carcinogens haven't been communicated."</li> </ul>
Two	How do you quantify the loss of cultural knowledge, through not being able to forage, etc. We lived off land, it was our whole life.
Two	Defence used to do burn offs on JBRF using rubber tyres. In North Easterly winds, black smoke used to come towards community. It would go for hours on a daily basis.
Two	<p>Buried drums with unknown contents:</p> <ul style="list-style-type: none"> <li>• "There was talk of Defence burying drums down the back of the JBRF, on the south western side."</li> <li>• "There were 44 gallon drums buried [outside the testing area], near Bherwerre Track. Pippi's are collected in the area on a regular basis."</li> </ul>
Two	<p>Wells:</p> <ul style="list-style-type: none"> <li>• There was an old well used for water (30 years ago) - near Summercloud Beach.</li> <li>• There were wells in mission days.</li> </ul>
Two	Since awareness of contamination, kids have been banned from eating yabbies (which are deformed), bush food, etc.
Two	In 1964 Lake McKenzie was overflowing and running into Lake Windemere.
One	Information about Booderee National Park and worker practices.
One	Request for blood tests.
One	"At the moment [June 2017] there is a white substance on the bottom of Mary's Creek, we don't know what it is."

Number of respondents	Comments
One	Kids sit in the water laying around the village after wet weather.
One	There is no link between health providers monitoring the area and the community.
One	"Flight patterns and high usage (of planes and helicopters) in the area affects plants. The fuel goes over the land, but no one has captured environmental impacts or impacts on people. They look at impacts that are visible but miss the invisible impacts."
One	"Lack of consultation/communication from the WBACC board about this investigation/project (amongst other issues) is frustrating for the community."
One	Used to be a firefighter and did drills at JBRF. I thought foam was going into a holding.
One	Foams used to run into Lake Windemere.

## 4. Conclusion

Residents of Jervis Bay Territory are connected to mains water; no respondents who lived in a private residence reported that they had bores or water tanks.

The survey results indicate that the residents of Jervis Bay Territory regularly use the land and water within the investigation area.

Given the number of people who regularly consume seafood, flora, clay or water it is recommended that investigation includes sampling in the areas indicated on the maps. A number of testing sites and different types of media (e.g. biota, surface water, soils, sediment) may need to be sampled and tested for PFAS and other chemicals.

**Appendices**





## **Appendix B** – Water Use Survey

## Water Use Survey – Jervis Bay Territory

The Department of Defence is seeking to understand how water is used in the local area and requests your help to answer survey questions about water and land use on your property, and the quantity and type of local foods you and your family eat (such as meat, fruit and vegetables). This survey is an important part of the investigation and will assist in developing the detailed sampling program.

This investigation will determine the extent and levels of per- and poly-fluoroalkyl substances (PFAS) on, and around some of its bases around Australia. For more information regarding this investigation you can contact us on 1800 987 618 or at [JervisBay@ghd.com](mailto:JervisBay@ghd.com)

Your participation in this survey is voluntary and you do not have to provide an answer to each question if you choose not to. The privacy statement below explains how the information you provide will be used.

---

### Privacy Statement

This information is being collected by GHD on behalf of the Department of Defence.

Your response will inform Defence's investigation of the environmental conditions in the Jervis Bay Range Facility investigation area. Supply of this information is voluntary. If you choose not to provide this information, Defence will not be able to take into account your specific circumstances. For more information about the investigation go to <http://www.defence.gov.au/JervisBay> or contact us through the telephone or email address provided (1800 987 618 or [JervisBay@ghd.com](mailto:JervisBay@ghd.com))

The information you provide may be shared with Defence's technical advisors, relevant government agencies and organisations, and business entities directly involved in the environmental assessment program. Such organisations may include but are not limited to: Wreck Bay Aboriginal Community Council, Parks Australia, NSW Environmental Protection Agency, ACT Health, NSW Health, Jervis Bay Territory Administration.

The Defence Privacy Policy is available at: <http://www.defence.gov.au/Privacy.asp> The Defence Privacy Policy contains information on how an individual may apply for access to their personal information and how an individual may apply to have their personal information amended. The Defence Privacy Policy also contains information for individuals on how to make a privacy complaint to Defence if they consider Defence may have breached the Australian Privacy Principles. The Defence Privacy Officer can be contacted by email at: [defence.privacy@defence.gov.au](mailto:defence.privacy@defence.gov.au).



6. How many water tanks are on your property and what material they are made from? (e.g. concrete, iron, poly, fibreglass)

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7. Are your water tanks above or below ground?

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8. Have your water tanks contained bore water either currently or in the past? Please select more than one answer if required.

- No
- Yes – my water tank/s are **currently** mixed with bore water
- Yes – **in the past** my household rain water tank/s were mixed with bore water
- I use / have used bore water to clean my rain water tanks

How often do you clean your tanks with bore water? \_\_\_\_\_

9. Are your water tanks plumbed directly into the house and used for household purposes?

- Yes – the water tanks are plumbed directly to the house to supply household water
- No - the water tanks are not connected to the house but water is sometimes used for household purposes
- No - water is used for outdoor purposes only

10. Is there any surface water on your property?

- dam                       creek                       pond
- wetland                       surface drain                       other
- none

If yes – please specify and outline any uses of surface water that you may be aware of

*If there is no bore on your property, please go to Question 15.*

**11. How many bores do you have on your property?**

Active bores \_\_\_\_\_

Inactive bores \_\_\_\_\_

**12. Please provide further details about your bore(s) if known.**What is / are the depth(s) of your bore(s)?  
\_\_\_\_\_When were the bores installed?  
\_\_\_\_\_Has the water quality of your bore ever been tested? If yes, would you be able to provide the results?  
\_\_\_\_\_How much water do you take from the bore in a year?  
\_\_\_\_\_

Do you take water from your bore and store it on site (in dams, tanks etc.)?

 Yes NoIf yes - please specify how many dams / tanks and their capacity  
\_\_\_\_\_  
\_\_\_\_\_**If you extract bore water and store on site in a dam, what is that water generally used for?**  
\_\_\_\_\_  
\_\_\_\_\_**13. Is, or has your bore/s ever been, plumbed directly into the house and used for household purposes?** Yes – the bore is / was plumbed directly to the house to supply household water No – the bore is not directly connected to the house

**14. How often do you or your family use water (other than mains water) on your property for the activities listed below? Please tick all that apply.**

	Daily	Weekly	Monthly	Occasionally	Never	Years of use
Drinking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Cooking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other indoor use (e.g. showering, washing up)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Outdoor use (e.g. swimming pool, sprinkler play, washing vehicles)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Watering fruit / vegetable garden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Lawn watering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Watering for livestock (drinking or irrigation of feed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Watering for poultry (drinking or irrigation of feed)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Irrigation of commercial horticulture / crops	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Dust suppression (commercial sites)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Fire fighting water (commercial sites)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Aquaculture (growing fish) (private or commercial)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other uses (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

15. How often do you, or your family do the following activities? Please tick all that apply. Feel free to use the supplied maps to show locations.

	Daily	Weekly	Monthly	Occasionally	Never	For how many years?
Drinking water from creeks/rivers/etc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Swimming in ocean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Swimming in creeks/rivers/etc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Fishing from ocean	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Fishing from creeks/rivers/etc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Eating flora (vegetables/leaves/etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Eating fauna	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Using water collected from creeks for cooking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Using water collected from creeks for washing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						
Eating clay/mud	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
If so, whereabouts?						

	Daily	Weekly	Monthly	Occasionally	Never	For how many years?
--	-------	--------	---------	--------------	-------	---------------------

---

Other uses (please specify)

---

Whereabouts?

---

16. If you answered yes to fruit / vegetable gardens, please indicate below what type of fruit and /or vegetables you currently grow or previously used to grow and who consumes it.

17. If you answered yes to watering of livestock or poultry, please indicate below what types of animals you currently have or previously had on your property, what produce is consumed (e.g. meat / milk / eggs) and who consumes it.

18. Please provide any additional comments here.

*Thank you for completing this questionnaire. If you have any questions, please contact the GHD*

*Team:*

*email: [JervisBay@ghd.com](mailto:JervisBay@ghd.com) or phone 1800 876 618.*



GHD

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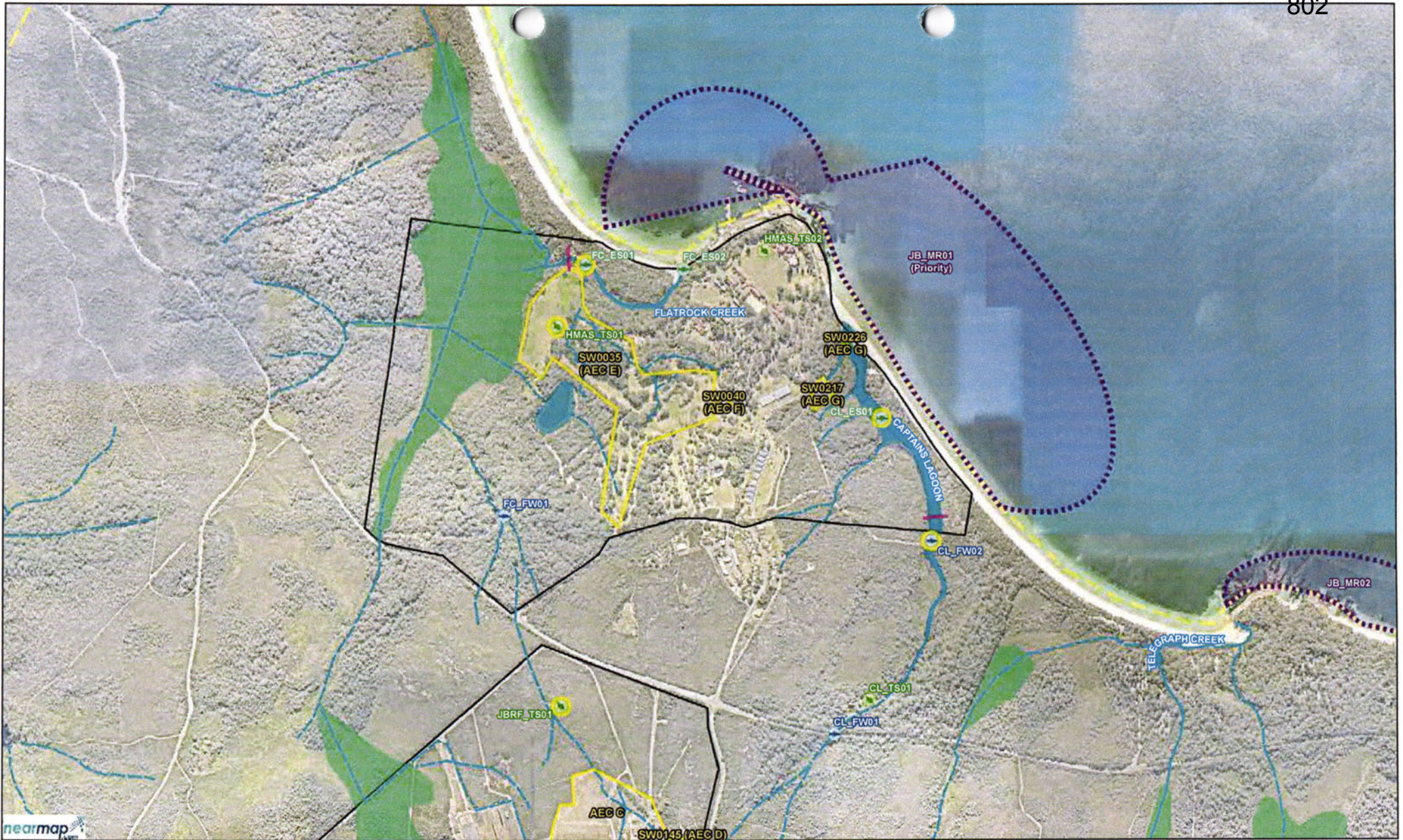
Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	[REDACTED]	[REDACTED]		[REDACTED]		25/07/2017
B	[REDACTED]	[REDACTED]		[REDACTED]		2/08/2017

\*Approved saved on file

[www.ghd.com](http://www.ghd.com)



**Appendix D – Proposed biota sampling locations**



nearmap

Paper Size A3  
 0 80 160 320 480  
 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 56



- LEGEND**
- Investigation Area Extent
  - Jervis Bay Range Facility
  - HMAS Creswell
  - Areas of Environmental Concern - JBRF
  - Areas of Environmental Concern - Creswell
  - Water Bodies
  - Drainage Areas
  - Major Waterways
  - - - Minor Waterways / Drainage Lines
  - - - Minor Waterways / Drainage Lines (Defence)
  - Approximate Saltwater/Freshwater Boundary
  - Marine Species Sampling Area (Approximate)
  - Estuarine Species Sampling Location
  - Freshwater Species Sampling Location
  - Terrestrial Species Sampling Location
  - Priority Sampling Location



Department of Defence  
 Job Number 21-26171  
 Revision A  
 Date 26 Sep 2017

**Terrestrial, Freshwater and Estuarine Biota Sample Locations** Figure D1

G:\2126171\06\Map\Deliverables\21\_26171\_2016\_Ecology.mxd  
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 Data source: Imagery - Nearmap (Imagery Date: 2016/09/14); Streets, Waterways - NSW LPI 2015 DTDB; Contours - NSW LPI 2016. Created by mwesber  
 Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au



Paper Size A3

Metres

Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
CRS: GDA 1994 MGA Zone 56

**LEGEND**

- Investigation Area Extent
- Jervis Bay Range Facility
- Areas of Environmental Concern - JBRF
- HATS Site Area
- Water Bodies
- Major Waterways
- Minor Waterways / Drainage Lines
- Terrestrial Species Sampling Location
- Estimated Approximate Saltwater/Freshwater Boundary
- Marine Species Sampling Area (Approximate)
- Estuarine Species Sampling Location
- Freshwater Species Sampling Location
- Priority Sampling Location

Department of Defence

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Job Number | 21-26171  
Revision | A  
Date | 26 Sep 2017

**Terrestrial, Freshwater and Estuarine  
Biota Sample Locations**

**Figure D2**

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